April, 25th, 2016

To: Michael Rothman, Commissioner
Minnesota Dept. of Commerce

From: Craig Sterle

Subject: Comment on the Scoping of Sandpiper and Line 3 Replacement

I want to reference a comment previously submitted by former DNR employee, Paul Stolen, in his Aug. 29th letter regarding the Sandpiper/Line 3 projects (see attached). Specifically, see page 3, 1st paragraph, where Paul mentions that "The Keystone 1 pipeline in Missouri, built in 2009, *suffered extreme and unexpected corrosion only three years after installation.* An internal report commissioned by the pipeline company found that this was caused by stray voltage."

Because the preferred route for this pipeline project follows electrical utility corridors for much of its length across Minnesota, it would seem prudent to closely examine this potential risk, and determine if this practice is indeed a wise location for any pipeline, regardless of which route is ultimately selected for this proposal.

Minnesota has historically tried to cluster utilities into other existing utility corridors. But in light of these findings, it seems clear that not all utilities are compatible in the same corridor. The DOC should thoroughly study this finding, and possibly determine whether the co-location of pipelines and electrical transmission lines is a risk over the 50-60 year lifetime of the project.

Thank you for your consideration of this matter.

Craig Sterle
2676 County Road 104
Barnum, MN 55707
218-384-4054

August 29, 2015
Paul Stolen
37603 370th Av. SE
Fosston, MN 56542
218-435-1138

Michael Rothman, Commissioner
Minnesota Department of Commerce
85 7th Pl E, #500,
St Paul, MN 55101

Tamara Cameron,
Chief, Regulatory Branch
St. Paul District
U.S. Army Corps of Engineers
180 5th St. East, Ste. 700
St. Paul, MN 55101-1678

Ken Westlake
Regional NEPA Contact
US EPA, Region 5, 77 West Jackson Blvd.
Chicago, IL 60604-3507

Re: Proposed Enbridge Sandpiper and Line 3 Enlargement/Relocation/Abandonment projects in Minnesota: *Policy and technical reasons for independent, scientifically sound analysis of the risk and environmental, cultural, and human consequences of oil releases for the 50 + years of the projects*

Dear Commissioner Rothman, Ms. Cameron, and Mr. Westlake:

I am writing this letter because two large industrial oil facilities are planned for a Minnesota landscape highly susceptible to oil releases. This landscape contains highly valuable natural and cultural resources, many of which are in inaccessible locations. . But even more concerning, they are being planned, to-date, *without adequate independent review by any government entity.* The topic of this letter is the portion of the independent review I refer to in the topic line of this memo: *independent, scientifically sound analysis of the risk and environmental, cultural, and human consequences of oil releases for the 50 + years of the projects.*

I am writing you at this time because crucial and as-yet unmade policy decisions are sorely needed on these two pipeline projects. Such decisions are past due. As I describe below, Minnesota agencies are currently not yet taking the proper approach to this subject. *I am thus urging that you collectively implement a coordinated state-federal policy that results in the proper science-based review of the two Enbridge pipelines with respect to the risks and impacts of oil releases.* And it is simply bad government to not coordinate federal and state reviews. The federal government, especially the Environmental Protection Agency, has more experience supervising the type of studies I am recommending. The model for such studies are contained in the three studies in Item 3 of Attachment 1 of this letter. I note that all of them were instigated by federal agencies.

Attachment 1 provides the technical reasons why the studies I am recommending must be accomplished for these two projects. For example, in recent weeks, the new Nexen pipeline in Canada recently ruptured and apparently leaked for weeks in spite of sophisticated new automated control systems. The Keystone 1 pipeline in Missouri, built in 2009, *suffered extreme and unexpected corrosion only three years after installation*. An internal report commissioned by the pipeline company found that this was caused by stray voltages. The result was deep corrosion pits that nearly ate through the pipeline wall. And time and time again, pipeline management failures have caused serious spills or explosions that caused loss of life.

Furthermore, there are even some indications that new technologies, new engineering complexities, and sophisticated control systems may even introduce new risks and causes of pipeline failures. These two Enbridge projects, costing billions of dollars, are technically complex industrial facilities, and will be remotely monitored and controlled from a high-tech, satellite-connected control center 1,000 miles away in Canada. Such control centers are the subject of a 2014 Department of Homeland Security warning that they can fail or result in false pipeline pressure readings from the effects of solar storms.

Attachment 2 contains descriptions of two specific areas extremely vulnerable to very damaging oil releases. These are: 1. The LaSalle Creek Valley, with its lakes north of Itasca Park, and the short distance to the Mississippi river; and 2. Upper and Lower Rice Lakes in southern Clearwater County. Both areas have very extensive and important wetlands, as well as highly valued public and cultural natural resources. *Should a significant release occur at the pipeline river crossings at these sites under certain normal conditions, oil recovery would likely be very difficult or impossible, recovery efforts would add to the damages, and human and natural resource impacts could occur for generations into the future.*

I am not claiming the Enbridge pipelines will certainly rupture and severely damage Minnesota's human and natural environment. But they will be in place for 50 or more years. I am *merely* saying an independent, appropriate, and thorough analysis be done of the risk and consequences of such events. *This is an eminently reasonable request, based in law, regulations, and common sense.* And I expect that route alternatives be included in the study that cross landscapes inherently less prone to damage from oil releases and more prone to easier clean-up. In fact, in my 30 year career doing environmental review—sometimes of complex projects—I have never encountered a situation where such large projects are not thoroughly and independently reviewed in this manner. *Ever.*

Of course, I am not a lawyer, but I have lots of policy experience, including interpreting the policy implications of court opinions and providing direction to other staff. I am reminded of a project I was deeply involved in where a federal judge made a statement quite appropriate to the current Enbridge situation. It was a proposal from the state of North Dakota to move Missouri River water into the Hudson Bay drainage, and was one of two such projects under consideration. Such proposals have lots of potential problems, including policy problems. The Bureau of Reclamation had only done an Environmental Assessment on one of the projects, known as "NAWS." They had dismissed adverse effects from introducing damaging biota across the Continental Divide into the Hudson Bay basin during the transfer. They were hoping to do the same with the other project. Manitoba sued, asking for an Environmental Impact Statement.

In an opinion admonishing the error of the Bureau of Reclamation, one could almost replace Judge Collyer's reference to "biota" with "risk and consequences of oil releases":

Topic for Scoping
Sandpiper/Line 3 Pipeline Project

Use of Eminent Domain for Pipeline ROW Acquisition

- America may now have sufficient domestic crude production to offset much of our oil imports.
- Many years ago pipeline companies were declared to be "public service corporations" and with that they were granted the right of eminent domain.
- In the early 1970's there was the "Arab Oil Embargo" and a law was passed that prohibited the export of all crude oil.
- Domestic oil production has collapsed in the last 24 months (mid-2014 to early 2016) and cheaper foreign imports have replaced domestic crude, driving down pump prices and flooding the world with cheap crude, and forcing many domestic productions out-of-business.
- In December, 2015 President Obama signed into law the Federal Budget, and with that signing the federal oil export ban disappeared.

What do these different pieces of information lead to, and how do they impact the Scoping? As public service corporations, pipeline companies are required to serve the public need, and provide a benefit to the citizens of Minnesota. The US (and world) is awash in oil, both from domestic supplies, but also from Canadian tar sands and cheap Saudi imports, so there was pressure to allow shippers, pipeline companies and refiners to exports their crude oil. The export of crude oil wasn't allowed until December. But now with exportation allowed, crude passing through Minnesota could easily be destined for export docks along the Gulf, or on our east and west coasts.

So, if this oil is being exported, is there any longer a value and service to Minnesota citizens? Or is this just another opportunity for oil industry corporations to make a profit? And how do we quantify and accurately account for any benefits to Minnesota?

The Scoping must look at the current and expected oil needs for Minnesota, and it must determine if oil passing through Minnesota is indeed going to provide a service and benefit to our citizens. Will the technological advances in EV (electric vehicle) design, along with improved storage batteries, prove to cut the demand for gasoline in Minnesota, and further reduce on need for crude? If analysis cannot positively show that a new pipeline will through Minnesota will benefit citizens, than the question needs to be examined of whether the authorization of eminent domain to pipeline companies is justifiable now and in the future.

Topic for Scoping
Sandpiper/Line 3 Pipeline Project

Thermal Impacts on Coldwater Trout Streams

During the summer months many trout streams reach or exceed thermal thresholds for survival of trout and other coldwater species. Insertion of these two pipelines will have an impact on the temperature of any coldwater streams that the pipeline corridor crosses.

All pipelines produce heat. This is easily observed when snow blankets the region, and pipelines lay bare due to the heat they are releasing. This will be particularly acute with Line 3, because it will be transporting tar sands crude, which must be heated to keep it fluid during the transport.

Of course these coldwater streams will be under even more stress as climate change pushes the survival envelope, with hotter summer weather and more sporadic rainfall. Will the release of heat into coldwater environments, during times when streams have reached their thermal threshold, have an enhanced negative impact on coldwater organisms? Specifically, the Straight and Blackhoof Rivers, two of the state's primer trout streams could be negatively impacted long-term by the heat from these pipes.

In addition, the proposed route passes very close to the MN DNR's Spire Valley Coldwater Fish Hatchery. The Hatchery is dependent on spring-fed waters for the hatchery operation. Questions about the impacts to spring-flow, and of course possible heating of the spring water must also be examined. Negative impacts on the spring's flow volume or temperature could have serious negative impacts on the hatchery operation.

These issues needs to be thoroughly examined, and the impacts considered when looking at the route options available.

Craig Sterle
2676 Co. Rd. 104
Barnum, MN 565707
218-384-4054
csterle777@gmail.com

The INGAA Foundation, Inc.

Criteria for Pipelines Co-Existing with Electric Power Lines

Prepared For:
The INGAA Foundation

Prepared By:
DNV GL

October 2015

The INGAA Foundation
FINAL Report No. 2015-04

Report name:	Criteria for Pipelines Co-Existing with Electric Power Lines
Customer:	The INGAA Foundation, Inc.
Contact person:	Richard Hoffmann
Date of issue:	October 5, 2015
Project No.:	PP105012
Organization unit:	OAPUS310 / OAPUS312
Report No.:	2015-04, Rev. 0
Document No.:	1E02G9N-4

Det Norske Veritas (U.S.A.), Inc. Oil & Gas
Computational Modeling
5777 Frantz Road
43017-1386 Dublin
OH
United States
Tel: +1 614 761 1214

Objective:

The primary objective of this report is to present the technical background, and provide best practice guidelines and summary criteria for pipelines collocated with high voltage AC power lines. The report addresses interference effects with respect to corrosion and safety hazards, and fault threats.

Prepared by:	Verified by:	Approved by:
Shane Finneran Senior Engineer	Barry Krebs Principal Engineer	Lynsay Bensman Head of Section, Materials Advisory Service

Rev. No.	Date	Reason for Issue	Prepared by	Verified by	Approved by
Draft	2015-06-18	First Issue	SF	BK	LB
0	2015-10-05	Final Issue	SF	BK	LB

EXECUTIVE SUMMARY

The primary objective of this report is to present the technical background, and provide best practice guidelines and summary criteria for pipelines collocated with high voltage AC power lines. The report addresses interference effects with respect to corrosion and safety hazards, and fault threats. The guidelines presented address mitigation and monitoring, encroachment and construction, risk severity classification, and recommendations for further industry development.

This report addresses the technical background to high voltage interference with respect to collocated and crossing pipelines, and presents basic procedures for dealing with interference scenarios. The provisions of this document are recommended to be used under the direction of competent persons, who are qualified in the practice of corrosion control on metallic structures, with specific suitable experience related to AC and/or DC interference and mitigation. This document is intended for use in conjunction with the reference materials cited herein.

Collocated pipelines, sharing, paralleling, or crossing high voltage power line rights-of-way (ROW), may be subject to electrical interference from electrostatic coupling, electromagnetic inductive, and conductive effects. If the interference effects are high enough, they may pose a safety hazard to personnel or the public, or may compromise the integrity of the pipeline. Because of increased opposition to pipeline and power line siting, many future projects propose collocating high voltage alternating current (HVAC) and high voltage direct current (HVDC) power lines and pipelines in shared corridors, worsening the threat.

Predicting HVAC interference on pipelines is a complex problem, with multiple interacting variables affecting the influence and consequences. In some cases, detailed modeling and field monitoring is used to estimate a collocated pipeline's susceptibility to HVAC interference, identify locations of possible AC current discharge, and design appropriate mitigation systems to reduce the effects of AC interference. This detailed computer modeling generally requires extensive data collection, field work, and subject-matter expertise. Basic industry guidelines are needed to help determine when more detailed analysis is warranted, or when detailed analysis can be ruled out based on the known collocation and loading parameters. A consistent technical guidance document will benefit the pipeline industry by increasing public safety and allowing for an efficient approach in assessment and mitigation of threats related to high voltage interference.

The INGAA Foundation contracted Det Norske Veritas (U.S.A), Inc. (DNV GL) to develop this guidance document. The project included a detailed industry literature review to identify applicable technical reports, international standards, existing guidance and operator procedures. In addition to the literature review, numerical modeling was performed to determine the effects of key parameters on the interference levels. The document addresses interference effects with respect to corrosion and safety hazards, mitigation, monitoring, encroachment and construction, prioritization and modeling. It also includes recommendations for further development.

The following severity ranking tables were developed for key variables and their impact on the severity of AC interference. Further background for the development of these rankings is provided throughout the report. Guidelines for determining the need for detailed analysis and applying these severity rankings are provided in Section 6.2.

Separation Distance

Table 3-Severity Ranking of Separation Distance

Separation Distance - *D* (Feet)	Severity Ranking of HVAC Interference
$D < 100$	High
$100 < D < 500$	Medium
$500 < D < 1,000$	Low
$1,000 < D \leq 2,500$	Very Low

HVAC Power Line Current

Table 4-Relative Ranking of HVAC Phase Current

HVAC Current - *I* (amps)	Relative Severity of HVAC Interference
$I \geq 1,000$	Very High
$500 < I > 1,000$	High
$250 < I < 500$	Med-High
$100 < I < 250$	Medium
$I < 100$	Low

Soil Resistivity

Table 5-Relative Ranking of Soil Resistivity

Soil Resistivity - ρ (ohm-cm)	Relative Severity of HVAC Corrosion
$\rho < 2,500$	Very High
$2,500 < \rho < 10,000$	High
$10,000 < \rho < 30,000$	Medium
$\rho > 30,000$	Low

Collocation Length

Table 6-Relative Ranking of Collocation Length

Collocation Length: *L* (feet)	Relative Severity
$L > 5,000$	High
$1,000 < L < 5,000$	Medium
$L < 1,000$	Low

Collocation / Crossing Angle

Table 7-Relative Ranking of Crossing Angle

Collocation/Crossing Angle - θ (°)	Relative Severity
$\theta < 30$	High
$30 < \theta < 60$	Med
$\theta > 60$	Low

The research and analytical studies accentuated the need for accurate power line current load data when assessing the susceptibility of a steel transmission line to high voltage interference. For this reason, collaboration between the respective pipeline and power line operators is advised to accurately determine where detailed assessment is required, and develop efficient mitigation where necessary.

The general safety recommendations and guidelines for interference analysis presented in Section 6 provide guidance on the relative susceptibility of AC interference associated with the selected variables. They primarily address the likelihood or susceptibility of AC interference, and do not address the consequence aspect of an overall risk assessment, as these details are specific to each individual assessment.

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Acronyms

AC	Alternating Current
CAPP	Canadian Association of Petroleum Producers
CFR	Code of Federal Regulation
CP	Cathodic Protection
CSA	Canadian Standards Association
CTS	Coupon Test Station
DC	Direct Current
DCD	DC Decoupler
DOC	Depth of Cover
DOT	Department of Transportation
EMI	Electromagnetic Interference
ER	Electrical Resistance
FBE	Fusion Bonded Epoxy
GPR	Ground Potential Rise
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
IEEE	Institute of Electrical and Electronics Engineers
IF	Isolation Flange
INGAA	Interstate Natural Gas Association of America
LEF	Longitudinal Electric Field
MPY	Mils per year
OSHA	Occupational Safety and Health Administration
PRCI	Pipeline Research Council International
ROW	Right(s) of Way
TLM	Transmission Line Model

1 INTRODUCTION

Trends within both the electric power and pipeline industries have increased the number of projects that co-locate high voltage alternating current (HVAC) and high voltage direct current (HVDC) power lines with steel transmission pipelines in shared rights-of-way (ROW). The primary objective of this report is to provide technical guidance and present best practice guidelines and summary criteria for steel transmission pipelines collocated with high voltage AC power lines.

Topography, permitting requirements, land access, increasingly vocal public opposition to infrastructure projects, and environmental concerns, including protected regions, all have led to an increase in sharing of common utility corridors. While there are numerous benefits to common utility corridors, there are also many concerns. Collocated steel transmission pipelines that share, parallel, or cross high voltage power line ROW may be subject to electrical interference from electrostatic coupling, electromagnetic inductive, and conductive effects. If these interference effects are high enough, they may pose a safety hazard to personnel or compromise the integrity of the pipeline.

Pipelines collocated with overhead HVAC lines account for a significant portion of the high voltage interference conditions encountered in the transmission pipeline industry. However, interference effects due to buried power lines and HVDC are also of concern to pipeline operators where close collocations exist. As aboveground HVAC is still the primary concern for pipeline interference, it is the primary focus of this report. However, comparison background and technical discussion is included related to HVDC and buried power line interference as well, and the effects of both should be considered on a case-by-case basis when steel transmission pipelines are closely collocated with these systems.

Numerous methodologies exist to analyze alternating current (AC) interference for specific collocations and crossings, but the analysis generally requires extensive data collection and detailed computational modeling. The accuracy of these models is sensitive to the HVAC power line operating parameters, which can often be difficult or costly for pipeline operators to obtain from electric power companies. Basic guidelines and prioritization criteria have been established in this report to provide guidance for pipeline operators to aid in a risk-based decision-making process and help prioritize regions for detailed modeling and mitigation design, or exclude further modeling analysis for a given region.

This report addresses interference effects related to encroachment and construction, corrosion and safety hazards, mitigation, and monitoring. This project included a detailed industry literature review to identify applicable technical reports, international standards and, guidance documents. Several INGAA members provided procedures. In addition to the literature review, numerical models were developed and trends presented detailing the effects of critical variables on interference levels under the conditions defined.

2 INDUSTRY LITERATURE REVIEW

There has been extensive research performed to understand the risks of high voltage interference and to develop efficient mitigation techniques. The effects of HVAC interference from a personnel safety and corrosion standpoint are a risk identified in much of the literature. Case studies in North America, the UK, and continental Europe have identified and documented AC corrosion concerns. Through-wall defects have been reported with corrosion rates greater than 50 mils/year (mpy) observed.[1]

In development of this guidance document a literature review identified and reviewed more than fifty technical references, US and International standards, existing guidance documents, research theses, journal manuscripts, and technical symposia papers. Additionally, INGAA collected operating procedures and guidelines from 10 member companies for review and comparison.

Where published, historically identified corrosion defects and pipeline failures associated with AC corrosion degradation have been reviewed and a selection are presented as case studies in Appendix A, demonstrating the magnitudes and variability in corrosion rates possible with AC accelerated corrosion.

The primary finding from this review is that there is significant variation in operating procedures and technical literature with respect to AC interference. Various companies' procedures were compared with published industry guidance, historical project data, and project experience to determine a best practice approach. Details and cross references are presented in each of the subsections of this document with a detailed review of the technical literature, case studies, and company procedures provided in Appendix A.

3 HIGH VOLTAGE INTERFERENCE ON ADJACENT PIPELINES

3.1 HVAC Interference Modes

Electrical interference from capacitive, electromagnetic inductive, and conductive coupling can affect pipelines collocated in close proximity to HVAC power lines. The subject of AC interference has been a growing concern across multiple industries in recent decades as improved pipeline coatings and utility ROW congestion has contributed to an increase in identified AC corrosion incidents. Recent trends in the high voltage electric power transmission industry are leading to increased power capacity and higher operating currents in certain systems, in part to overcome long distance transmission line losses.[2] This increase in operating current has a direct effect on the level of electromagnetic interference (EMI) and the corresponding magnitude of AC interference on affected pipelines. This trend toward elevated operating currents may present a significant challenge for achieving adequate mitigation on pipelines crossing or collocated with the high voltage power lines.

The three primary physical phenomena by which AC can interfere or "couple" with pipelines are through capacitive, resistive, or inductive coupling as detailed in Sections 3.1.1 through 3.1.3. High voltage interference can occur during normal operation, generally referred to as steady state, or during a power line fault. HVAC power line faults are any abnormal current flow from the standard intended operating conditions, and discussed further in Section 3.1.4.

3.1.1 Capacitive Coupling

Capacitive coupling, or electrostatic interference, occurs due to the electromagnetic field produced by AC current flowing in the conductors of a high voltage power line, which can induce a charge on an above ground steel pipeline that is electrically isolated from the ground. Capacitive effects are primarily a concern during construction when sections of the pipeline are aboveground on insulating supports, as indicated in Figure 1. The pipeline can build up charge as a capacitor with the surrounding air acting as the dielectric, which can maintain the electric field with a minimum loss in power, resulting in a potential difference with surrounding earth.

The magnitude of potential is primarily dependent on the pipeline proximity to the HVAC conductors, the magnitude of power line current, and the individual phase arrangement. If the potential buildup due to capacitive coupling is significant, electrostatic interference may present a risk of electric shock or arcing. While elevated capacitive voltages may exist, the corresponding current is generally low, resulting in low shocking consequence[3,4].

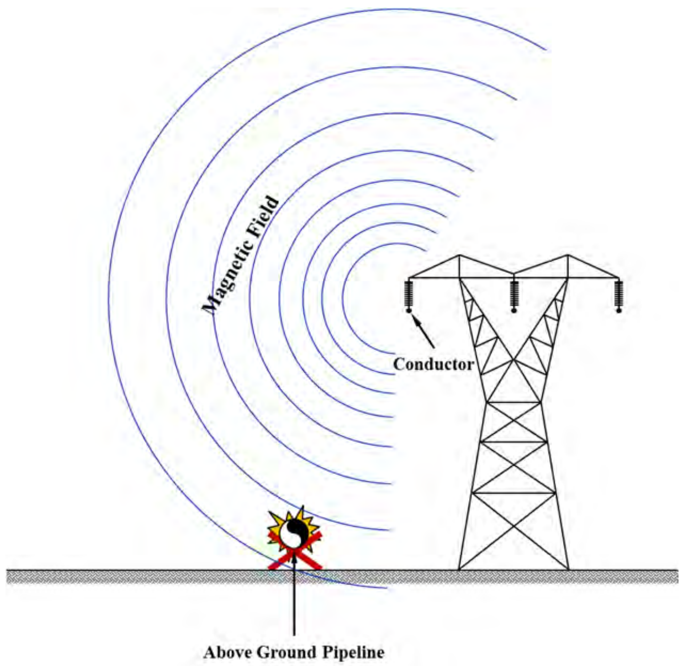


Figure 1. Illustration of Capacitive Coupling

3.1.2 Inductive Coupling

Electromagnetic induction is the primary interference effect of an HVAC power line on a buried steel pipeline during normal steady state operation. EMI occurs when AC flowing along power line conductors generates an electromagnetic field around the conductor, which can couple with adjacent buried pipelines, inducing an AC voltage, and corresponding current, on the structure as depicted in Figure 2. This induced AC potential may present a safety hazard to personnel, and can contribute to AC corrosion of the pipeline, as discussed in Section 3.3.1.

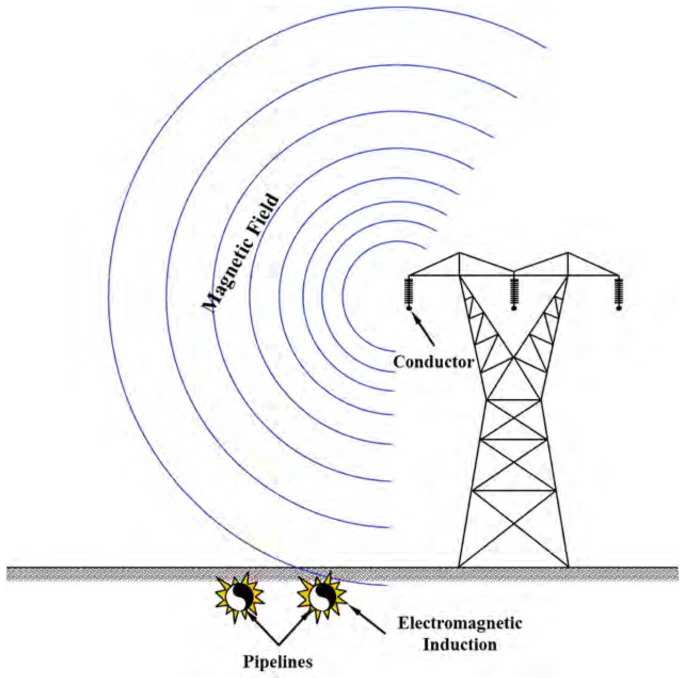


Figure 2. Illustration of Steady State HVAC Inductive Interference

The inductive effects of the HVAC power line on an adjacent pipeline are a function of geometry, soil resistivity, coating resistance, and the power line operating parameters. The geometry characteristics include separation distance between the pipeline and the towers, depth of cover (DOC), pipe diameter, angle between pipeline and power line, tower footing design, and phase conductor configuration. These parameters remain relatively constant over the life of the installation. The coating resistance, power system resistance, and soil resistivity may vary with the seasonal changes and as the installations age, but they are considered constants for most analyses. However, the operating parameters of the power line – such as phase conductor load, phase balance, voltage, and available fault current – all have an influence on the effects of AC interference, and can vary significantly. The individual conductor current load and phase balance is dynamic and changes with load requirements and switching surges. These variations in operating parameters contribute to variations in levels of AC interference. During normal HVAC operation, the current load varies as the load demand changes both daily and seasonally.[3,5] While normal operating conditions are often referred to as "steady state" throughout the industry, the term is somewhat misleading as the current loads and corresponding induced AC potentials can be continuously varying, adding further complexity to quantifying interference magnitude.

For a straight, parallel, homogenous collocation, induced potentials are highest at the ends of the collocated segment, and fall exponentially with distance past the point of divergence.[6] For more complex collocations, voltage peaks may occur at geometric or electrical discontinuities, where there is an abrupt change in the collocation geometry or electromagnetic field. Specifically, voltage peaks commonly occur where the pipeline converges or diverges with the HVAC power line, separation distance or soil resistivity changes significantly, isolation joints are present on the pipeline, or where the electromagnetic field varies such as at phase transpositions.[3,7,8,9]

3.1.3 Resistive Coupling

Current traveling through the soil to a pipeline can cause resistive or conductive coupling. As the grounded tower of an HVAC power system shares an electrolytic path with adjacent buried pipelines through the soil, fault currents may transfer to adjacent steel pipelines if the pipeline presents a lower resistance electrical path. Resistive interference is primarily a concern when a phase-to-ground fault occurs in an area where a pipeline is in close proximity to an HVAC power line, and magnitudes of fault currents in the ground are high. However, a phase imbalance on an HVAC system with a grounded neutral can contribute to resistive interference as return currents will travel through the ground and may transfer to a nearby pipeline.

During a fault condition (see Section 3.1.4), the primary concern is the resistive interference transferred through the soil. However, inductive interference can also be a concern as the phase current, and corresponding EMI, of at least one conductor can be high, as depicted in Figure 3. In other words, during a fault, the inductive effects during normal operation as described in Section 3.1.2 increase due the elevated EMI during the fault period.

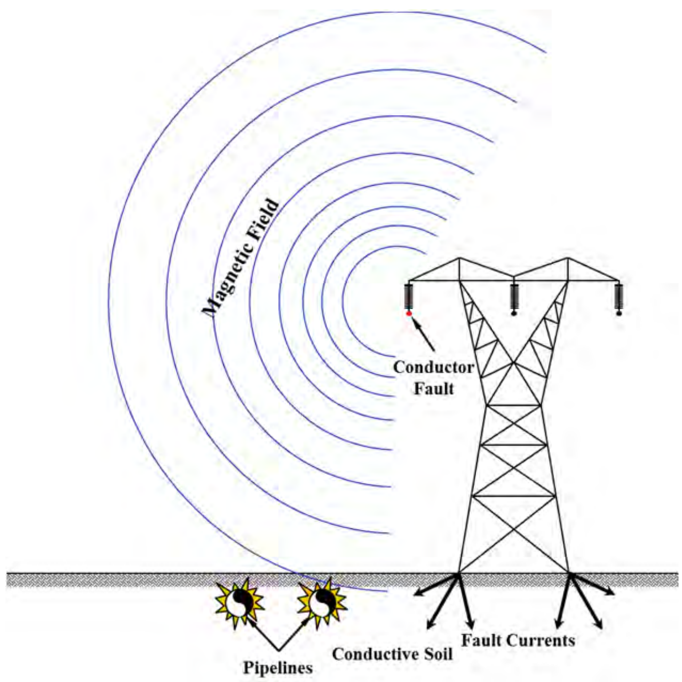


Figure 3. Illustration of HVAC Fault Condition – Inductive and Conductive Interference

If any of these electrical effects are high enough during operation, a possible shock hazard exists for anyone that touches an exposed part of the pipeline such as a valve, cathodic protection (CP) test station, or other aboveground appurtenance. During steady state normal power line operation, AC current density at a coating holiday (flaw) above a certain threshold may cause accelerated external corrosion damage to the pipeline. In addition, damage to the pipeline or its coating can occur if the voltage between the pipeline and surrounding soil becomes excessive during a fault condition.

3.1.4 AC Faults

For HVAC power lines, a fault is any abnormal current flow from the standard intended operating conditions. A fault can occur between one or more phase wires and the ground, or simply between adjacent phase wires. Faults can occur when one or more of the conductors are grounded or come in contact with each other, or due to other unforeseen events. This may be due to vegetation contacting the conductors, conductors contacting the towers or each other during high winds, physical damage to a tower, conductor, or insulator, flashover due to lightning strikes, or other abnormal operating condition. A phase-to-ground fault on a power line causes large currents in the soil at the location of the fault and large return currents on the phase conductor and ground return.

Faults are generally short duration transient events. Typical clearing times for faults range from approximately 5 to 60 cycles (0.08 to 1.0 seconds for 60-hertz transmission) depending on the location of the fault, breakers and type of communications. While the fault effects are transient, high-induced potentials or resistive coupled voltages along the ROW present a possible shocking hazard for personnel or anyone who may be in contact with above grade pipeline or appurtenances.

3.2 HVAC – Personnel Safety Hazards

An evaluation of the possible safety hazards for those working on a pipeline should take place whenever a pipeline is operating or constructed in close proximity to a HVAC power line. Personnel safety hazards are present during both pipeline construction and maintenance, and during normal steady state operation.

3.2.1 Hazards During Operation

Touch and Step Potential Limits

Personnel safety is of concern when a person is touching or standing near a pipeline when high voltages are present. The "touch potential" is defined as the voltage between an exposed feature of the pipeline, such as a CP test station or valve, and the surrounding soil or a nearby isolated metal object, such as a fence that can be touched at the same time. The touch potential is the voltage a person may be exposed to when contacting a pipe or electrically continuous appurtenance. The "step potential" is the voltage across a person's two feet and defined as the difference in the earth's surface potential between two spots one meter apart. The touch potential can be a concern during both normal steady state inductive and fault conductive/inductive conditions. Typically, the step potential is a concern during conductive fault conditions due to high currents and voltage gradients in the soil.

The Canadian Standards Association (CSA) and NACE International (NACE) have published standards addressing HVAC interference hazards. Both NACE and CSA standards[10,12] recommend reducing the steady state touch and step potential below 15 volts at any location where a person could contact the pipeline or any electrically continuous appurtenance. The 15-volt threshold is designed to limit the available maximum current through a typical human body to less than 10 mA. An 8 to 15 mA current results in a painful shock but is still in the maximum "let go" current range, for which a person can release an object or withdraw from contact.[10] The Institute of Electrical and Electronics Engineers (IEEE) Guide for Safety in AC Substation Grounding, indicates that a current in the range of 9 to 25 mA range may produce painful shock and involuntary muscular contraction, making it difficult to release an energized object.[13] Elevated body current in the range of 60 to 100 mA may cause severe injury or death as it can induce ventricular fibrillation, or inhibition of respiration. Current lower than nine (9) mA will generally result in a mild shock, but involuntary movement could still cause an accident.[10]

The touch potential is equal to the difference in voltage between an object and a contact point some distance away, and may be nearly the full voltage across the grounded object if that object is grounded at a point remote from where the person is in contact with it. For example, a crane that was grounded to the system neutral and that contacted an energized line would expose any person in contact with the crane or its un-insulated load line to a touch potential nearly equal to the full fault voltage.

The step potential may pose a risk during a fault simply by standing near the grounding point due to large potential gradients present in the soil, typically during a short duration fault condition.

A risk evaluation of the possible hazards to personnel for those working on the pipeline and possible pipeline coating damage should take place whenever a pipeline is in close proximity to a HVAC power line. This assessment should consider the possible likelihood and consequence of HVAC interference hazards to determine if further analytical assessment or mitigation is necessary. NACE International Standard Practice SP0177-2014 (Mitigation of Alternating Current and Lightning Effects on Metallic Structures and Corrosion Control Systems) indicates mitigation is necessary in those cases where step or touch potentials are in excess of 15 volts. Mitigation is further discussed in Section 5.

3.2.2 Encroachment and Construction Hazards

There are multiple safety hazards to consider associated with pipeline construction near a high voltage power line, the most obvious of which is the possibly lethal hazard of equipment directly contacting an energized overhead conductor.[3] The Occupational Safety and Health Administration (OSHA) has multiple regulations for safety requirements and limitations for working near power lines that must be considered in addition to pertinent company standards, and industry best practice guidelines. These include, but are not limited to the following:

- 29 CFR 1910.269: Electric power generation, transmission, and distribution
- 29 CFR 1910.333: Selection and use of work practices
- 29 CFR 1926, SUBPART V: Power Transmission and Distribution

The OSHA standards address requirements for working near energized equipment, overhead power lines, underground power lines, and construction nearby.

Elevated capacitive potentials generated on pipeline sections isolated from the ground on insulating skids as described in Section 3.1.1 can pose a safety hazard. Pipeline segments that are supported aboveground during pipeline construction near an HVAC power line are subject to EMI and electrical capacitance can build up between the pipeline segments and earth. If no electrical path to ground is present, even a relatively short section of piping may experience elevated AC potential, presenting a shock hazard to personnel near the pipeline.

Cases presented in published literature indicate scenarios of measured potentials greater than 1,000 volts on a pipeline segment exposed to an HVAC corridor.[4] In general, while the capacitive coupled voltages can exceed the NACE 15 volt touch potential safety threshold, the corresponding current is low reducing shocking hazard. However, arcing due to capacitive coupling may present a possible safety hazard, as an arc may be a possible ignition source for construction vehicles refueling along the ROW. Grounding pipelines in HVAC ROW will reduce the possibility of shocking or arcing.

Capacitive coupling is generally mitigated by connecting temporary grounding or bonding during construction to provide a low resistance path to ground for any electrostatic interference. Section 6 addresses further mitigation techniques and guidance for construction practices.

3.3 HVAC Threat to Pipeline Integrity

High voltage interference poses multiple threats to pipeline integrity for collocated and crossing pipelines under both steady state and fault conditions. During normal steady state HVAC power line operation, the inductive interference can contribute to accelerated external corrosion damage to the pipeline. Under faulted conditions, elevated potentials can lead to coating damage or a direct arcing to the pipeline.

The steady state 15 VAC threshold presented in NACE and CSA standards[10,12] considers personnel safety and does not necessarily address corrosion issues. Research and experience has shown that AC accelerated corrosion can occur in low resistivity soils at AC voltages well below this threshold.[3,6,14]

3.3.1 AC Corrosion

External corrosion, whether controlled by AC or DC, may pose a threat to the integrity of an operating pipeline. DC corrosion protection utilizes a system of corrosion resistant coatings and a CP system to provide electrochemical protection at coating holidays to reduce corrosion rate. However, AC corrosion is possible even in the presence of cathodically protected DC potentials due to high AC current density at coating holidays.

The concept of AC corrosion has been around since the early 1900s with only minor effects expected for many years.[3,10] AC accelerated corrosion has been recognized as a legitimate threat for collocated steel since the early 1990s, after several occurrences of accelerated pitting and leaks, ultimately associated with HVAC interference, were reported on cathodically protected pipelines.

Historically, there has been little consensus on specific mechanisms driving AC corrosion, and the severity of degradation attributed. However, several recent publications show tentative agreement in a plausible mechanism.[6,15,17] The explanation presented by Buchler, Tribollet, et al, suggests that AC corrosion on cathodically protected pipelines may be attributed to destabilization of pseudo-passive film that can normally form on exposed steel at a coating holiday under DC cathodic protection polarization. Due to the cyclic nature of AC current, the charge at the steel surface is continuously varying between anodic and cathodic polarization, which acts to reduce the passive film at the steel surface as shown in Figure 4. It is not the intention of this report to identify the specific mechanism driving material degradation due to AC corrosion, but rather to summarize a previously proposed mechanism and clarify the risks and contributing factors associated with AC corrosion.

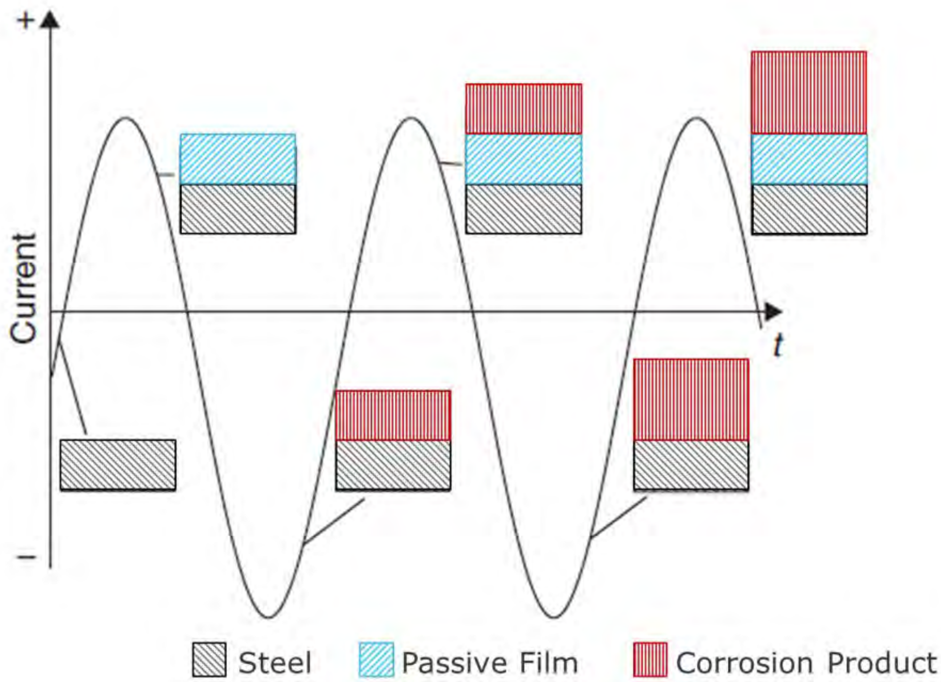


Figure 4. Graphical representation of proposed processes occurring during AC corrosion. Reproduced from Tribollet.[6]

3.3.1.1 AC Current Density

While there may be disagreement regarding the specific mechanism driving AC corrosion, AC current density is generally recognized as being an indicator of the likelihood of AC corrosion for a given location. In January of 2010, NACE International prepared and published a report entitled "AC Corrosion State-of-the-Art: Corrosion Rate, Mechanism, and Mitigation Requirements," which provides the following insight on AC corrosion current density.

> *"In 1986, a corrosion failure on a high-pressure gas pipeline in Germany was attributed to AC corrosion. This failure initiated field and laboratory investigations that indicated induced AC-enhanced corrosion can occur on coated steel pipelines, even when protection criteria are met. In addition, the investigations ascertained that above a minimum AC density, typically accepted levels of CP would not control AC-enhanced corrosion. The German AC corrosion investigators' conclusions can be summarized as follows:*
>
> - *AC-induced corrosion does not occur at AC densities less than 20 A/m² (1.9 A/ft²).*
> - *AC corrosion is unpredictable for AC densities between 20 to 100 A/m² (1.9 to 9.3 A/ft²).*
> - *AC corrosion occurs at current densities greater than 100 A/m² (9.3 A/ft²)."*3[1]

The AC density for a given location is dependent on soil resistivity, induced voltage, and the size of a coating holiday. Research has indicated that the highest corrosion rates occur at holidays with surface areas of 1 to 3 cm² (0.16 to 0.47 in²).[1] AC current density is best obtained through direct measurement of a correctly sized coupon or probe. However, the theoretical AC current density can be calculated, utilizing the soil resistivity and AC potential on a pipeline, in conjunction with Equation 1, presented in the State of the Art Report.[1]

$$I_{AC} = \frac{8V_{AC}}{\rho \pi d} \qquad \text{Equation (1)}$$

Where:

I_{AC}	=	Theoretical AC Current Density (A/m^2)
V_{ac}	=	Pipe AC Voltage to Remote Earth (V)
ρ	=	Soil Resistivity (ohm-m) (*1 ohm-m = 100 ohm-cm*)
d	=	Diameter of a circular holiday having an area equal to that of the actual holiday (m)

Multiple industry references discuss a current density threshold below which AC corrosion is not a significant factor; however, there is still disagreement on the magnitude of this threshold. While the majority of technical literature indicates AC corrosion is possible at current densities between 20 to 30 A/m^2, there is experimental evidence presented by Goidanich, et al[14] indicating that AC current densities as low as 10 A/m^2 can contribute to a measureable increase in corrosion rate[14]. A significant conclusion of study published by Yunovich and Thompson in 2004[9], reiterated in the NACE AC Corrosion State of the Art Report in 2010, indicated that there might not be a theoretical threshold below which AC corrosion is active. The focus should rather be on a practical limit, below which the contribution of AC interference to the overall corrosion rate is low, or rate of corrosion due to AC is not appreciably greater than the free corrosion rate for the particular conditions.[3,9] The results of the experimental study showed that a current density of approximately 20 A/m^2 produced a 90% or greater increase in the corrosion rate versus the control, in the absence of CP.[9] Experimental studies performed by Goidanich, Lazzari, et al in 2010 and 2014, in the presence of CP, concluded that while it was apparent AC current density greater than 30 A/m^2 showed a considerable increase in the corrosion rate, a current density as low as 10 A/m^2 resulted in a corrosion rate nearly double that of the specimens without AC.[14, 18]

For reference, the European Standard EN 15280:2013, "Evaluation of AC corrosion Likelihood of Buried Pipelines Applicable to Cathodically Protected Pipelines" adopted the 30 A/m^2 current density magnitude as a lower threshold, below which the likelihood of AC corrosion likelihood is low. In an effort to address the practical application seen in operation, considering interaction effects of CP current and AC interference, recent research has assessed the likelihood of AC corrosion in terms of the ratio between AC and DC current density (I_{AC}/I_{DC}).

3.3.1.2 Current Density Ratio

Recent research has shown that the likelihood of AC corrosion on pipelines is dependent on both the level of AC interference and the level of cathodic current from either CP or other stray current sources.[3, 15, 18] In general, AC current density values below the previously cited 20 A/m^2 recommended limits were shown to accelerate corrosion rates in the presence of elevated DC current density due to excessive CP overprotection.

The latest revision of EN 15280:2013 was revised to present criteria based upon the AC interference and DC current due to CP. Alternative acceptance criteria are presented in terms of limiting cathodic current density, or limiting the AC to DC current density ratio (I_{AC}/I_{DC}) below a specified level.

Current density obtained by use of coupons or electrical resistance (ER) probes will provide this ratio. However, both AC and DC current density data required to utilize these limits are often not available or easily obtained along the pipeline in practice. Therefore, the current density ratio limits provided within the EN 15280 standard are not widely used or easily applicable criteria. This reference demonstrates the recognized interaction of AC interference and CP systems, presenting an alternative approach that may be valuable for specific scenarios where data is available.

As mentioned previously, the measurement or calculation of AC current density has been the primary indicator to determine the likelihood of AC corrosion across industry in North America. It is possible to measure AC current density on a representative holiday through the installation and use of metallic coupons. A coupon representative of the pipe material, with a defined bare surface area, buried near the pipeline and connected to the pipeline routed through a test station will allow the measurement of current. These current measurements along with the known surface area of the coupon, allow for calculation of a representative current density. In many cases, the coupons are supplemented with additional instrumentation such as ER probes and reference electrodes to provide additional pertinent information. The ER probes provide a time based corrosion rate while the reference electrodes provide both and AC and DC pipe-to-soil potentials.

Section 6 provides further details related to mitigation and monitoring methods for to AC corrosion. Appendix A includes additional details related to literature review, historical AC corrosion rates, and industry case studies.

3.3.2 Faults

During a phase-to-ground fault on a power line, an adjacent or crossing pipeline may be subject to both resistive and inductive interference. Although these faults are normally of short duration (generally less than one second), pipeline damage can occur from high potential breakdown of the coating and conductive arcing across the coating near the fault. Further, the fault current is typically carried by a single conductor, resulting in short term elevated induced voltages that can reach thousands of volts or greater. This presents a significant risk to personnel in contact with the pipeline or electrically continuous appurtenance during a fault.

A phase-to-ground fault, or a lightning strike, on an HVAC power line can result in large potential differences with respect to the adjacent or crossing pipelines. If the potential gradient through the soil is sufficient, a direct arc to a collocated or crossing pipeline is possible, which can result in coating damage, or arc damage to the pipe wall up to the point of burn-through. Even if an arc is not sustained long enough to cause burn through, a short duration elevated current can cause molten pits on the pipe surface that may lead to crack development as the pipe cools. Fault arcing is generally a concern where fault potentials are greater than the dielectric strength of the coating, or at coating holidays within the possible arcing distance. Section 7.3 provides guidance limits for both issues. Where necessary, installation of grounding and shield wires can be used to mitigate the fault hazards as discussed in Section 6.

3.3.2.1 Coating Stress Voltage

During fault conditions, damage to the pipeline or its coating can occur if the voltage between the pipeline and surrounding soil becomes excessive. Fault conditions that produce excess coating stress voltages across the coating are of concern for dielectric coatings. The main factors to consider are the magnitude of the voltage gradient and the dielectric strength of the coating type. It should be noted that there are several parameters that are utilized to assess these issues: magnitude of the fault current, distance between the pipeline and fault, soil resistivity, coating age/quality, duration of the fault and coating thickness.

Guidance on allowable coating stress voltage varies across references. NACE SP0177-2014 indicates, "Limiting the coating stress voltage should be a mitigation objective." Multiple references offer varying coating stress limits and are generally considered to be in the range of 1 to 1.2 kV for bitumen, as low as 3 kV for coal tar and asphalt, and 3 to 5 kV for fusion-bonded epoxy (FBE) and polyethylene, for a short-duration fault."[10]

For reference, NACE SP0490-2007 "Holiday Detection of Fusion-Bonded Epoxy External Pipeline Coating of 250 to 760 μm (10 to 30 mil)" uses an equation for calculating test voltages which recommends a 15 mil (14 to 16 mils is a common specification for FBE coatings) fusion bonded coating (FBE) be tested at 2,050 volts.

NACE SP0188 2006 "Discontinuity (Holiday) Testing of New Protective Coatings" also uses an equation for calculating test voltages for coatings in general.

$$TV=1{,}250\sqrt{T} \quad \text{Equation (2)}$$

Where:

TV = Test Voltage (V)

T = Average coating thickness in mils

This results in a test voltage of 8,840 volts +/- 20% for a pipeline coated with a 50-mil coal tar coating.

The first standard above is the subject of AC mitigation and the following two standards are the recommendations for holiday testing; however, there appear to be inconsistences as to what voltage will actually damage the various pipeline coatings. The inconsistences appear to be due to the unidentified coating thickness in SP0177-2014 and actual duration of the fault resulting in conservative values.

Gummow et al. in their paper "Pipeline AC Mitigation Misconceptions"[19] present data that include the duration and coating thickness in the analysis resulting in values that are more practical. They conclude that FBE coatings with a 16 mil thickness should conservatively use a voltage gradient limit of 5,000 volts and that the 3kv to 5 kV range indicated in NACE SP0177-2014 would be more applicable in the range of 7.5 kV to 12.5 kV.

3.4 HVDC / Underground HVAC

High voltage power interference is primarily a concern for pipelines collocated with HVAC overhead power lines, due to the widespread sharing of common ROW, and the interference effects associated. However, there are associated concerns across industry regarding interference effects of aboveground HVDC transmission and underground AC power lines. Presently, the U.S. transmission grid consists of approximately 200,000 miles of 230 kV or greater high voltage transmission lines, with an estimate that underground transmission lines account for less than 1% of this total.[20] Industry trends indicate that due to significant disparity in overall installation costs, it is expected that while buried transmission lines will continue to be developed and implemented, overhead transmission will remain the primary means for electric transmission for the foreseeable future.[2]

In general, the level of interference from buried HVAC power lines is typically lower as the proximity between the individual phase conductors acts to balance electromagnetic fields, reducing EMI on foreign structures. Depending on the type of construction, sheathing or conduit may offer some level of electromagnetic shielding, further reducing inductive interference effects.

As aboveground HVAC is still the primary concern for pipeline interference, it is the primary focus of this report. However, the effects of both aboveground HVDC and buried transmission cables require review on a case-by-case basis when pipelines are closely collocated. There are currently less than 30 identified high voltage direct current (HVDC) transmission lines operating in the United States[21]. Although there are few relative to overhead HVAC, and the interference effects on a pipeline are different from HVAC transmission lines, they do warrant a brief discussion so that pipeline operators are aware of potential issues. The Canadian Association of Petroleum Producers (CAPP)[22] have produced a technical document that addresses in detail the issues associated with HVDC transmission lines influence on metallic pipelines. Due to the technical differences, the detailed extent of HVDC transmission line interference on steel pipelines necessitates its own study, beyond the scope of this document, however a summary overview of design and interference comparisons follows.

HVDC transmission systems in operation today are typically of monopole or bipole design. In each case, the systems consist of a transmission line between stations with the major components being DC-AC convertors and large ground electrodes. In monopole systems, a single conductor transports the power with an earth return, as depicted in Figure 5. It should be noted that where HVDC systems use a ground return, the interference concerns are similar to typical DC stray current interference, which is addressed in NACE SP0169 and is outside the scope of this document.

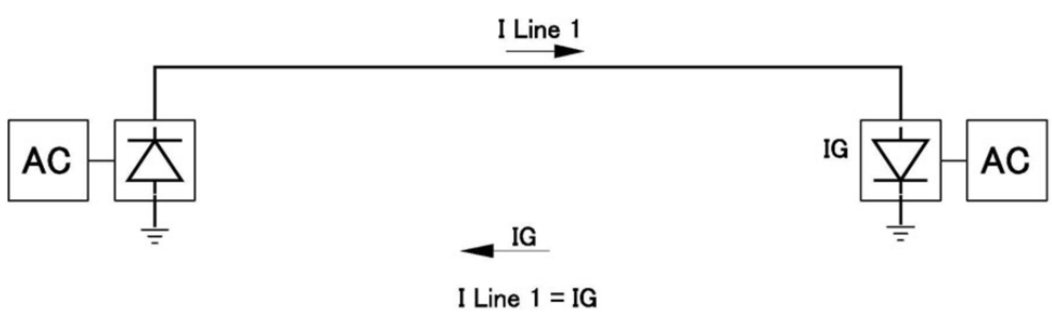


Figure 5. Monopole **System** (34)

In bipole systems, two conductors between stations allow the system to transport power through both conductors, one conductor and an earth return, or a combination of both, as depicted in Figure 6. The most common use of monopole systems is in submarine applications using the seawater as the earth return. The most common use of bipole systems consist of onshore overhead transmission towers to transport the power.

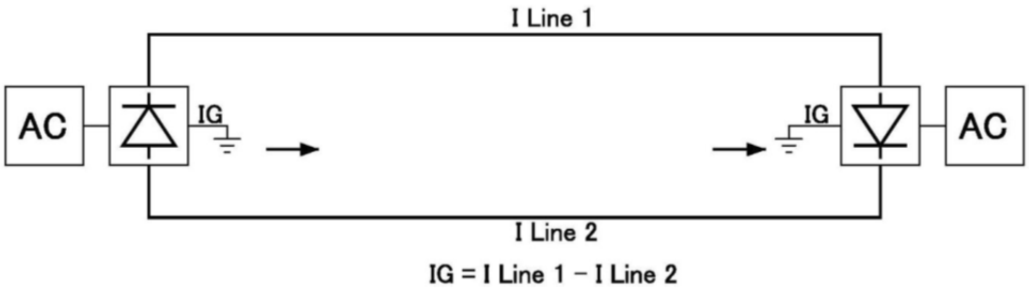


Figure 6. Bipole System (34)

Tripole configurations have been considered and reviewed in research, but have not seen widespread use in practice. There are several types of designs and operation modes within the broad parameters of the monopole and bipole systems. During emergencies and in maintenance of the bipole system, an earth return is used. In an earth return mode there is a potential gradient generated and metallic objects, such as pipelines, can be subject to varying potentials and become a conductor of the return current if they provide a low resistance path. Where current is collected or received by the pipeline generally no damage occurs, unless the current is high enough to damage the coating. However, corrosion will occur at current discharge locations. The amount of corrosion is dependent on the amount of current and duration of discharge. In the case of large discharge current, significant corrosion damage can occur in relatively short time periods. The effects are similar to the interference currents caused by other DC power sources such as traction systems, cathodic protection systems or welding with an improper ground.

HVDC transmission lines also have the same coupling modes with pipelines that occur with HVAC transmission lines capacitive, inductive, and resistive. Although under typical circumstances these effects may be negligible. However, interference levels under faulted conditions can be significant.

3.4.1.1 Capacitive coupling

The results of research presented by Koshcheev indicate the electrical field below HVDC transmission lines does not generally require significant safety measures during construction when the pipe is isolated on skids, as the electric field influence associated with HVDC transmission is limited compared to HVAC.[21]

3.4.1.2 Inductive coupling

CAPP indicates the voltages induced due to HVDC, under steady state conditions tend to be negligible. The magnitude of induction may contribute to minor interference problems with telephone lines, and possibly other communications systems, but is typically low enough that neither pipeline integrity nor safety hazards are considered likely under steady state conditions. However, during fault conditions, there is a possibility for short duration of elevated inductive coupling.

3.4.1.3 Resistive coupling

During faulting both HVAC and HVDC transmission systems can present personnel safety issues and compromise pipeline integrity, with possible damage to the pipeline, coating, and associated equipment. A faulted HVDC power line presents a possible integrity concern for nearby pipelines. CAPP indicates that the fault current discharged to ground at the power line tower causes a ground potential rise (GPR) near the ground electrode. A voltage gradient exists relative to remote earth. A pipeline within the voltage gradient will experience a coating stress voltage as discussed in Section 3.3.2.1. If high enough, the voltage stress could puncture the insulating coating possibly damaging the pipeline.

3.5 Industry Procedure Summary

The lack of industry consensus on the subject of AC corrosion guidelines has led to varied practices among pipeline operators in regards to mitigating AC interference on pipelines. As part of this study, The INGAA Foundation requested a review of industry practices and procedures related to AC interference. Based upon this review, all of the procedures address a safety concern and define a maximum allowable AC pipe-to-soil potential limit for above-grade appurtenances. For pipelines in close proximity to HVAC power lines, faults are identified as a hazard in almost all of the procedures. However, few addressed coating stress limit above which mitigation is required. For current density criteria, several procedures had clearly defined limits, while others addressed it as a concern for AC corrosion but did not specify a targeted limit of AC current density or define limits for mitigation. Table 1 provides a summary comparison of the industry procedures reviewed.

Table 1-Industry Procedure Summary

Induced AC Potential Limit Requiring Mitigation	***Fault Protection/Coating Stress Voltage Limit Requiring Mitigation***	***Current Density Criteria Requiring Mitigation***
In accordance with NACE: 15 V	Not specified	Not Specified
15 V	2500 V	Not Specified
15 V	Mentions damage possible from faults but no limit	Not Specified
15 V or higher - No work unless approved by area supervisor	Not specified	Not Specified
Modeling Required > 2 V	Consider with Modeling	30 A/m^2
15 V	5000 V	75 A/m^2 requires mitigation, 50 A/m^2 requires further evaluation
10-15 V	150-2000 V depending on fault duration	30 A/m^2
15 V	Faults to be considered along with a minimum separation distance, but no limit specified	20 A/m^2
15 V	Faults to be considered during mitigation analysis, but no limit specified	50 A/m^2
15 V	Faults to be considered during mitigation analysis, but no limit specified	50 A/m^2

4 NUMERICAL MODELING

Predicting high voltage interference is a complex problem, with multiple interacting variables affecting the influence and impact. In recent decades, development of advanced calculation methods and computer-based tools for simulation of interference effects, analysis of faults, and development of mitigation methods has been significant.2[3,5,9,10] Computer based numerical modeling can be utilized to examine the collocated pipeline's susceptibility to HVAC interference, help identify locations of possible AC current discharge, and where necessary design appropriate mitigation systems to reduce the effects of AC voltage, fault currents, and AC current density to meet accepted industry standards. These numerical models are capable of analyzing the interacting contribution of multiple variables to the overall magnitude of AC interference.

Computer modeling is used to analyze the interactions and sensitivity of the variables that affect the magnitude of AC induction on pipelines. This section provides a brief review of numerical modeling software in general, as well as the results of the individual variable analyses.

4.1 Modeling Software

Previous research has compared the benefits of specific industry standard software; literature is available for each of the common software packages.[3,9,2023] This review addresses the generalizations concerning the present industry standard software, but does not aim to address or endorse specific software packages.

For the majority of simple collocations considering a single pipeline and single HVAC power line numerous industry-accepted models have shown to be consistent in the assessment of HVAC interference. Often, for these simple cases, the benefit of a more complex model is not gained due to uncertainty in the analysis inputs. That is to say that for a majority of simple collocations, any of several industry accepted models are capable of providing an accurate analysis. The applicability is limited by the accuracy of the input data, and expertise of the analyst in utilizing the specific model. Often the uncertainty in critical input variables, such as the HVAC load current and phasing, outweighs the benefits gained from a more complex model. However, as the collocation complexity increases, both in terms of the number of structures and geometric routing, the limitations of some basic models support the benefits of the more detailed modeling software.

Typical industry standard software packages that were reviewed use a transmission line model (TLM) to calculate longitudinal electrical field (LEF), based on established fundamental Carson or Maxwell equations for electromagnetic fields. The geometry and routing of the complete pipeline and transmission line network incorporated in the model considers multiple pipelines, transmission lines, tower sections, and other collocation parameters. Collocations are simplified as a connected series of finite sections and nodes, with appropriate parameters applied simulating the pipeline, soil, and transmission load-ins. The modeling software can then calculate the LEF for each section and solve the fundamental equations to calculate the potential, current, and theoretical current density along a given collocation.

Calculation of the EMI and corresponding effects on buried pipelines requires a thorough understanding of the variables involved. Detailed modeling requires knowledge of electric field interactions, transmission current, tower design, bulk and local soil resistivity, and pipeline parameters such as geometry, coating, depth, diameter, electrical connections or isolations, and existing CP. All of these variables may significantly affect the AC interference model, and similarly the analogous real world interference. Likewise, the assumptions and simplifications made during the model setup can have significant impact on the accuracy and applicability of the outputs.

While most of the available models are able to analyze each of these variables, either directly or indirectly, the accuracy of the analysis is dependent on the expertise and understanding of the analyst to assess the given variables. Similarly, the accuracy of the models can only be as good as the input data. Multiple sources are required for the collection of data, i.e. measured in field, provided by power line or pipeline operators, or based off published nominal data. For that reason, the accuracy of the results is ultimately dependent on the expertise of analyst and the reliability of the data input to ensure technically appropriate setup, despite the presence of multiple models that have been shown to be capable of providing accurate analysis when used within their applicable limitations.

4.2 Variable Analyses

Due to the number of interacting variables affecting the overall levels of AC interference, it is difficult to isolate the effects of a single variable for all collocations scenarios encountered. Consequently, it is difficult to determine distinct limits for individual variables outside of which interference becomes negligible. Considering several key interacting variables is a more viable approach. For example, reported recommendations cite a distance of 1,000 feet as considered 'far' and assumed low risk for HVAC interference. However, in cases where power line current loads are greater than 1,000 amps and in regions of low soil resistivity, elevated induced AC potentials and corresponding current density exceeding recommended thresholds have resulted at even greater distances. Therefore, separation distance alone may not provide sufficient justification to exclude a collocation from further assessment. Conversely, considering the interacting effect of the key variables identified is necessary when determining the need for detailed analysis for a collocation.

DNV GL developed a series of computer models to illustrate the influence of key variables affecting induced AC on pipelines from nearby HVAC power lines. The software used is a graphical simulation platform developed to predict the steady state interference and resistive fault effects of HVAC power lines on buried pipelines in shared right-of-ways (ROWs). Using a TLM and appropriate input data, the software calculated the LEF, which then calculated the magnitude of induced AC potential, and current along the modeled collocated pipelines.

The models created for these studies are simplistic in terms of geometry and serve as a demonstration of the variables' influence on AC induction on adjacent pipelines. Based upon the number of variables and their interactions with respect to AC interference on pipelines, these studies determine the relevancy of the various parameters. The studies offer guidance demonstrating the trends associated with each parameter on the overall level of interference, and were used along with existing industry guidance and literature findings to develop the recommended guidelines presented in Section 6.

The primary variables analyzed as part of this study are as follows:

- HVAC Power Line Current
- Soil Resistivity
- Separation Distance Between Pipeline and Power Line
- Collocation Length of Pipeline and Transmission Line
- Angle Between Pipeline and Transmission Line
- Coating Resistance
- Pipeline Diameter and Depth of Cover

The results of these studies are presented and summarized in the following sub-sections.

4.2.1 HVAC Power Line Current

A primary variable influencing the magnitude of induced AC potential on a pipeline collocated with HVAC power lines is the magnitude of the phase conductor current. The current load of the nearby power lines has a direct influence on the LEF generated by the HVAC power line circuit(s). The intensity of the LEF varies with the current loads affecting both magnitude of induced AC potential on the nearby pipeline, as well as the area of influence. The area of influence affects the separation distance at which a collocated pipeline experiences significant interference and is further discussed in Section 4.2.3.1.

To demonstrate the sensitivity of power line current on pipeline interference, DNV GL created a computer model simulating a single circuit vertical transmission line, parallel to a 10-inch diameter pipeline for 5,000 feet at a horizontal separation distance of 100 feet. The pipeline approaches the transmission line at a 90-degree angle and parallels the transmission line for 5,000 feet before receding from the transmission line at a 90-degree angle, as depicted in Figure 7. The HVAC load current was varied while all other model inputs remained constant, to analyze the influence of current alone. A uniform soil resistivity of 10,000 ohm-cm was applied and constant throughout the analyses. The transmission line current loads analyzed were 250, 500, 1,000, 2,500, and 5,000 amps based on ranges of operating and emergency loading conditions reported in literature and previously provided from power transmission operator's design conditions. Figure 8 shows the maximum induced AC potential as a function of transmission line current load.

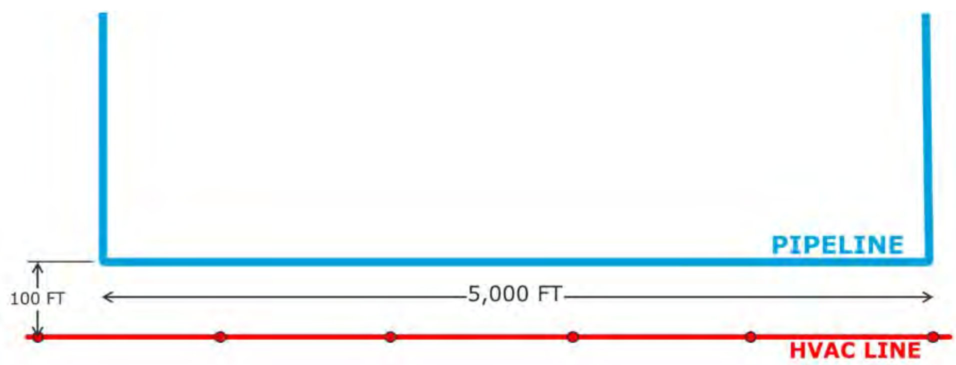


Figure 7. Simplified ROW Model Geometry

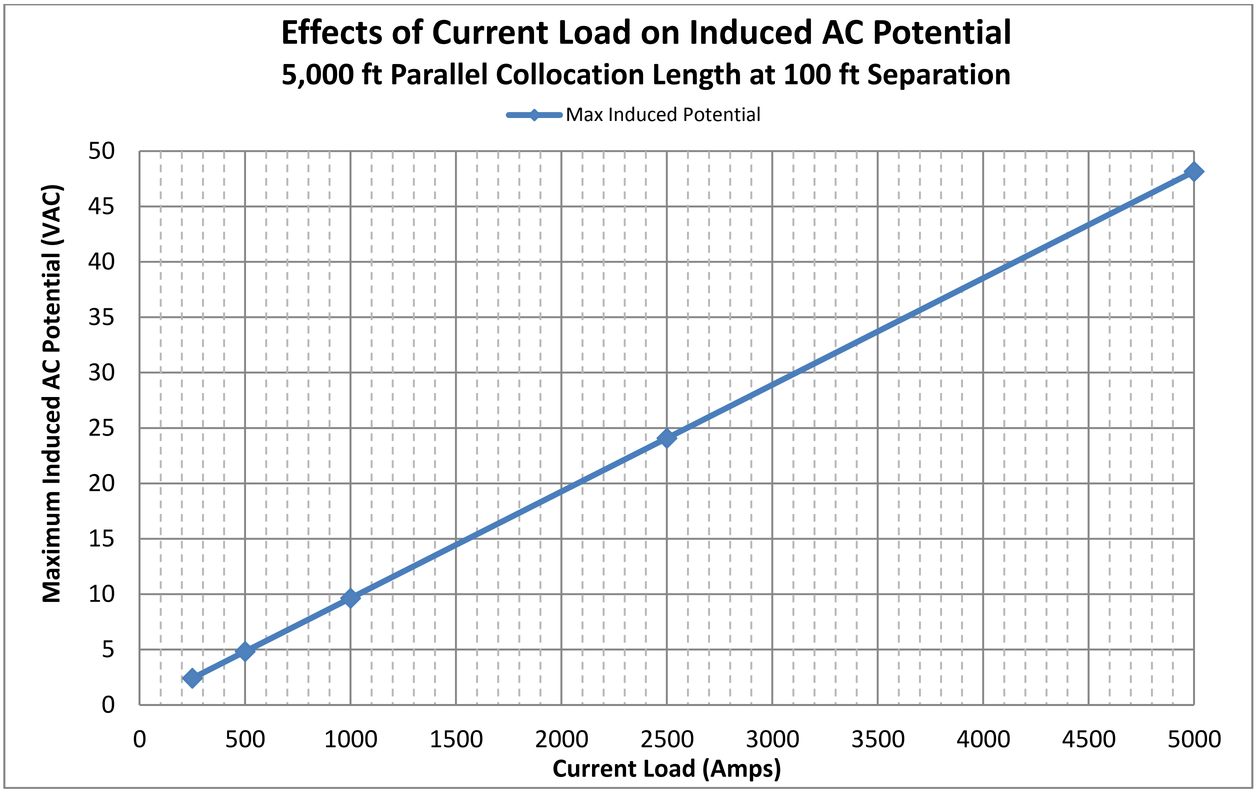


Figure 8. Maximum Induced AC Potential as a Function of HVAC Transmission Line Current

The results of this analysis show that the relationship between transmission line current and maximum induced AC potential on the pipeline is linear for a parallel collocation, considering a single interfering power line. When all other variables remain constant, the HVAC operating current load has a direct linear effect on the magnitude of the induced AC potential. This relationship allows for estimating influence of elevated current loads based on field measured AC pipe-to-soil potentials. For the specific case, with a pipeline collocated with a single HVAC circuit, if sufficient measurements of AC pipe-to-soil potential are taken, and corresponding transmission line current loads are provided for the specific time of measurement, the values can be scaled linearly to estimate the induced AC potential likely at the correspondingly scaled transmission current. This may be applicable, for example, for estimating the effects associated with a power line upgrade with a new current load. However, this method of approximation is only applicable for pipelines collocated with a single transmission line where sufficient data is available. As the number of transmission line circuits increases, the multiple interference sources and interaction the complexity of the interference increases such that the simply linear relationship is no longer valid. As the number of influencing HVAC circuits and pipelines within the area of influence are increased, the complexity of the interaction necessitates analysis that is more detailed.

It is known that while the higher current loads presented represent the high end of typical reported design loads, recent trends in the power transmission industry have shown development and installation of higher capacity HVAC transmission systems capable of carrying significantly greater current loads. For example, previous references indicate a typical load for 345kV to 500kV systems to be approximately 500 to 1,000 amps per circuit.3[24] Recent research indicates increased capacity for 345kV lines carrying up to 5,000 amps per circuit, and over 6,000 amps for 500kV systems.[2,24] While these magnitudes are not considered typical, numerous projects have developed recently that require mitigation for circuits operating at these elevated loads, indicating a need to consider actual current ratings for certain collocations. For this reason, loads are presented in terms of current rather than line voltage rating, as current is the driving load to control the level of EMI. It is noted that line ratings are typically given in terms of voltage ratings such as 138 kV, 345 kV, etc. however, the current load is the more relevant variable when determining the level of HVAC interference. Voltage rating alone can be misleading as the associated loads can be significantly higher or lower than the 'typical' current loads for that kV rating. For this reason, it is recommended to obtain current load data from the power utility company when assessing risk of interference.

4.2.2 Soil Resistivity

The soil resistivity along the collocation affects the magnitude of induced AC potential distribution as well as the theoretical AC current density along a given pipeline. It is necessary to consider both the bulk and specific layer resistivity when assessing likelihood and severity of interference. The bulk resistivity to the pipeline depth is one of the controlling factors in the analysis of induced AC potential. The bulk resistivity is the average soil resistivity measured in a half-hemisphere to the depth of the pipe, as shown in Figure 9 below. However, the specific resistivity of the soil layer directly next to the pipe surface, shown as Layer 2 in Figure 9, is a primary factor affecting the corrosion activity at a coating holiday, considering both conventional galvanic and AC assisted corrosion. The bulk soil resistivity combined with the coating resistance of the pipeline affect the level of induced AC potential expected along the pipeline.

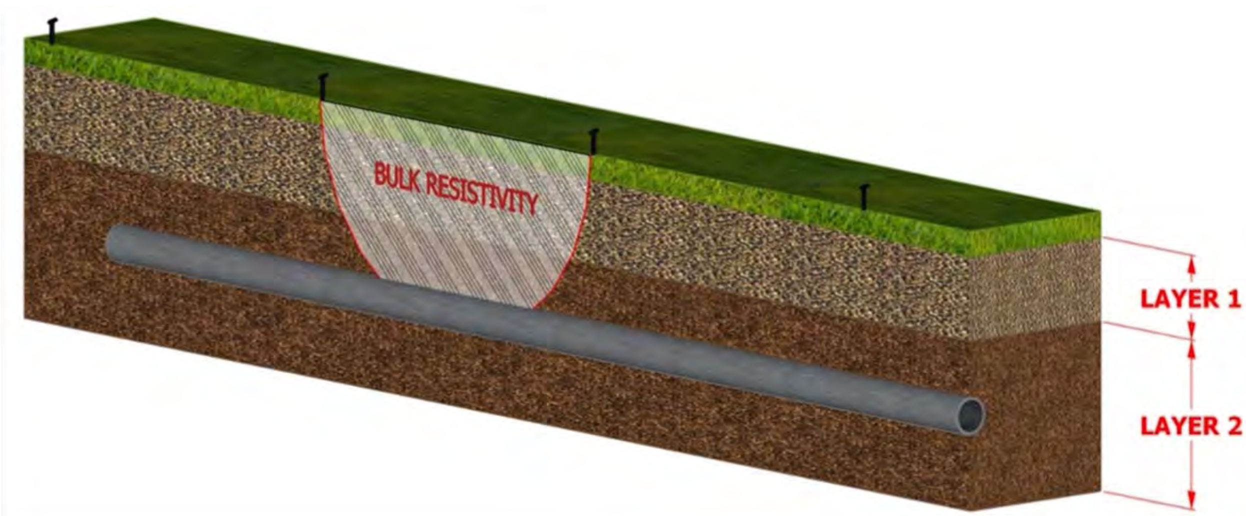


Figure 9. Graphical representation of soil resistivity measurements, showing bulk and layer zones

To demonstrate the sensitivity of soil resistivity on pipeline interference and current density, DNV GL created a computer model simulating a single circuit vertical transmission line, parallel to a 10-inch diameter pipeline with a configuration similar to the model setup described in Section 4.2.1. The soil resistivity was varied along the pipeline while all other model inputs remained constant, to analyze the influence of resistivity alone. The soil resistivity was uniform along the entire modeled collocation, considering 100, 1,000, 10,000, and 100,000 ohm-cm. Figure 10 shows the maximum induced AC potential corresponding to varying current loads.

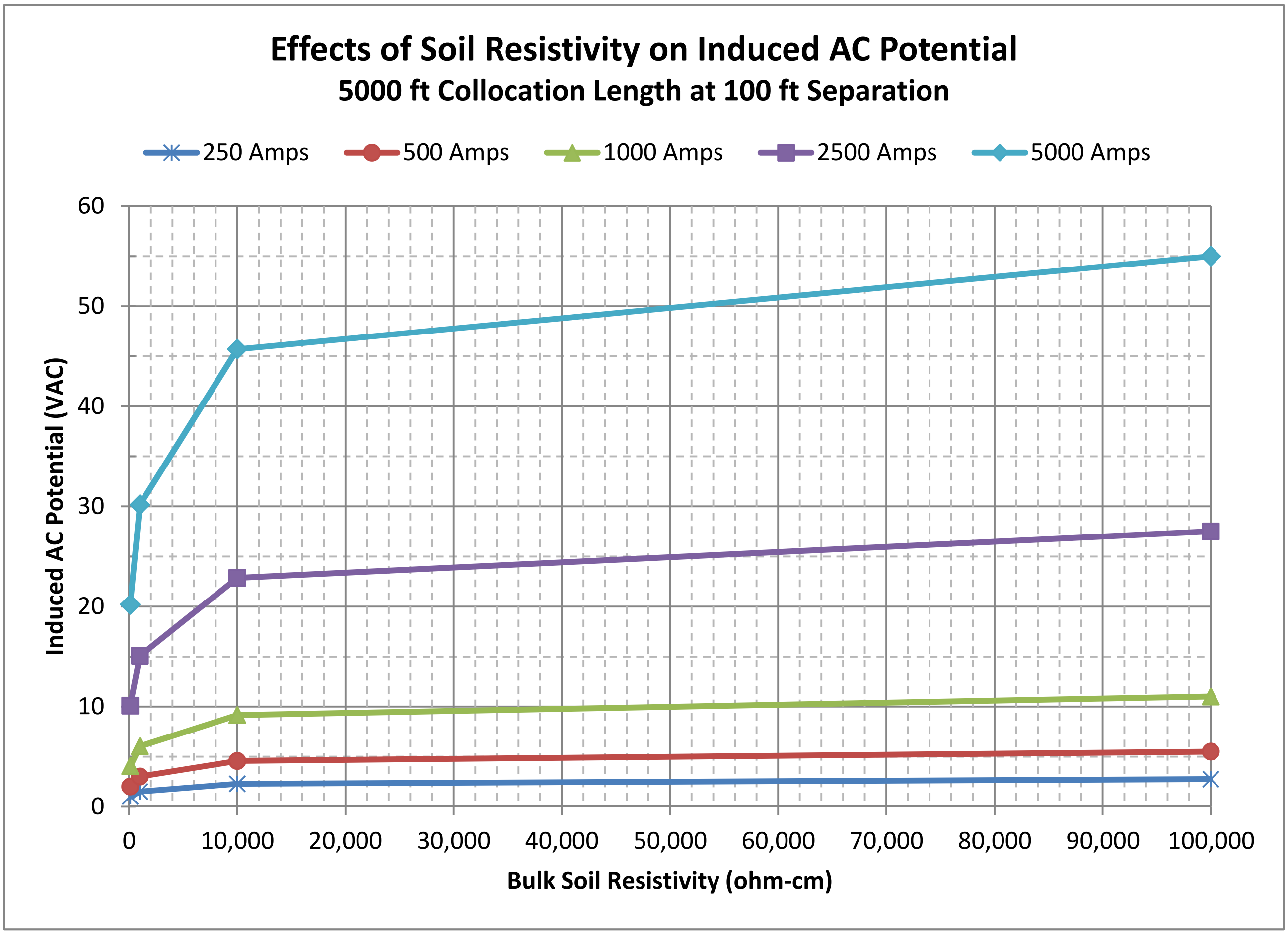


Figure 10. Maximum Induced AC Potential as a Function of Soil Resistivity

The results of the analyses show that the induced AC potential increases logarithmically with increasing soil resistivity. This increase in induced AC potential changes significantly between 100 and 10,000 ohm-cm but approaches asymptotical limit at soil resistivity values greater than 10,000 ohm-cm.

The effects of soil resistivity have greater influence however on the current density. While an increase in soil resistivity can result in a slight increase in the magnitude of induced AC voltage for a given collocation, the theoretical current density and associated risk of AC corrosion decreases linearly with the increased resistivity. The layer resistivity of the soil directly next to the pipe surface is a primary factor in the corrosion activity at a coating holiday. The specific resistivity near the pipe at a holiday is inversely related to theoretical AC current density, as shown by the calculation for theoretical AC current density in Equation 1. Thus, an increase in soil resistivity results in a decrease in theoretical AC current density.

Considering the 250 amp current load case from Figure 10, the theoretical current density was calculated from the induced AC potential for each magnitude of soil resistivity, considering a 1 cm^2 holiday, shown in Figure 11 and Table 2. While the soil resistivity values increase several orders of magnitude across the range, the theoretical current density decreases on similar order, with minimal change in the overall induced AC potential, as shown in Figure 11 and 0 Table 2. The red dashed line represents the lower bound 20 $amps/m^2$ threshold for current density as discussed in Section 3.3.1.1. It can be seen that based on the calculations provided by Equation 1, a very high theoretical AC current density is possible for relatively low AC potential, if soil resistivity values are below 10,000 ohm-cm. This results in elevated risk for AC corrosion for soil resistivity ranges below 10,000 ohm-cm.

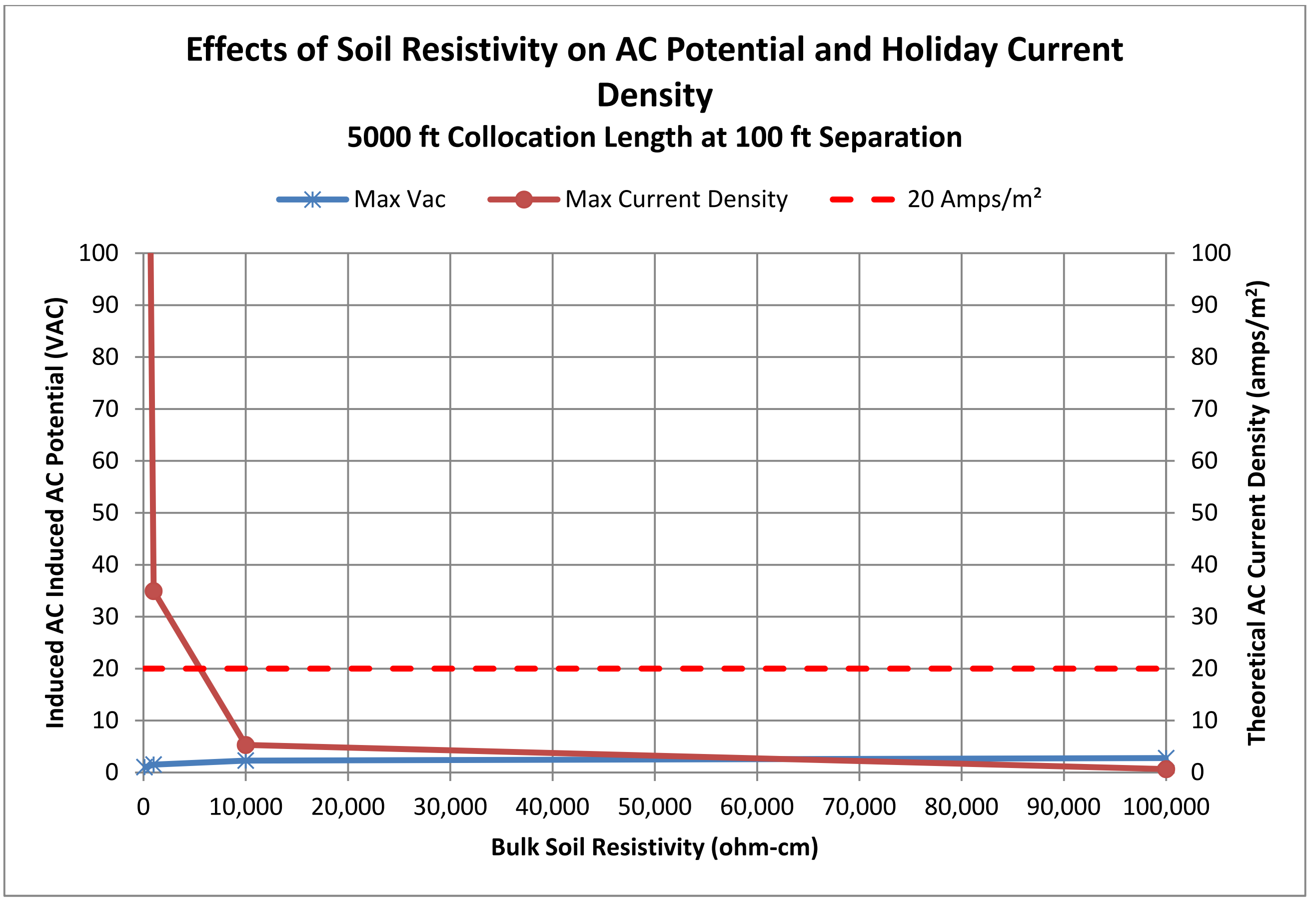


Figure 11. Effects of Soil Resistivity on Induced AC Potential and Corresponding Holiday Current Density. Current density presented for a theoretical 1cm^2 holiday

Table 2-Calculated current density and induced AC potential

ρ (ohm-cm)	Calculated Current Density (A/m^2)	Induced Potential (V_{ac})
100	234	1.0
1,000	35	1.5
10,000	5	2.3
100,000	0.6	2.8
Based on 5,000ft parallel collocation with a power line operating at 250 A load, 100-ft separation distance		

4.2.3 Collocation Geometry

The geometry of the pipeline relative to the transmission line is critical in determining the magnitude and distribution of induced AC potential along the pipeline. The level of AC interference for a given collocation or crossing, with respect to collocation geometry, is dependent on the relative distance between the phase conductors and pipeline, the locations of convergence or divergence, and angle of approach or crossing. Each of these variables affects the overall level of induction or susceptibility to fault hazards, and their influence is dependent on all other configuration variables. When assessing susceptibility to AC interference all of these variables are considered. However, for the sake of this assessment, the following studies analyzed each independently in order to provide a simplified assessment of the influence of each parameter.

The figures presented in Section 4.2.3.1 to 4.2.3.3 incorporate a dashed line similar to the current density threshold indicator in Figure 11. The limit lines provide reference to the AC potential limit that may result in a theoretical AC current density of 20 amps/m^2 for a hypothetical 1 cm^2 holiday, at soil resistivity of 1,000 and 10,000 ohm-cm. The limit lines are included to provide guidance illustrating the levels that may pose an elevated risk of AC corrosion at potentials below the NACE specified 15 volt limit for personnel safety.

4.2.3.1 Separation Distance Between Pipeline and Power Line

The separation distance between the pipeline and transmission line is a significant variable controlling the level of induced AC potential influencing a given pipeline. The proximity of the pipeline to the phase wires limits the strength of the LEF to which the pipeline is exposed.

To demonstrate the sensitivity of separation distance on pipeline interference, DNV GL created a computer model simulating a single 10-inch pipeline, and single circuit vertical transmission line, with similar configuration as described in Section 4.2.1. The separation distance was varied between the models while all other model inputs remained constant, to analyze the influence of separation alone. Induced AC potential results are plotted for separation distances of 50, 100, 500, 1,000, and 2,500 feet in Figure 12. The results indicate that for the higher load currents, the 20 A/m^2 recommended current density threshold is exceeded for separation distances greater than 500 feet is exceeded.

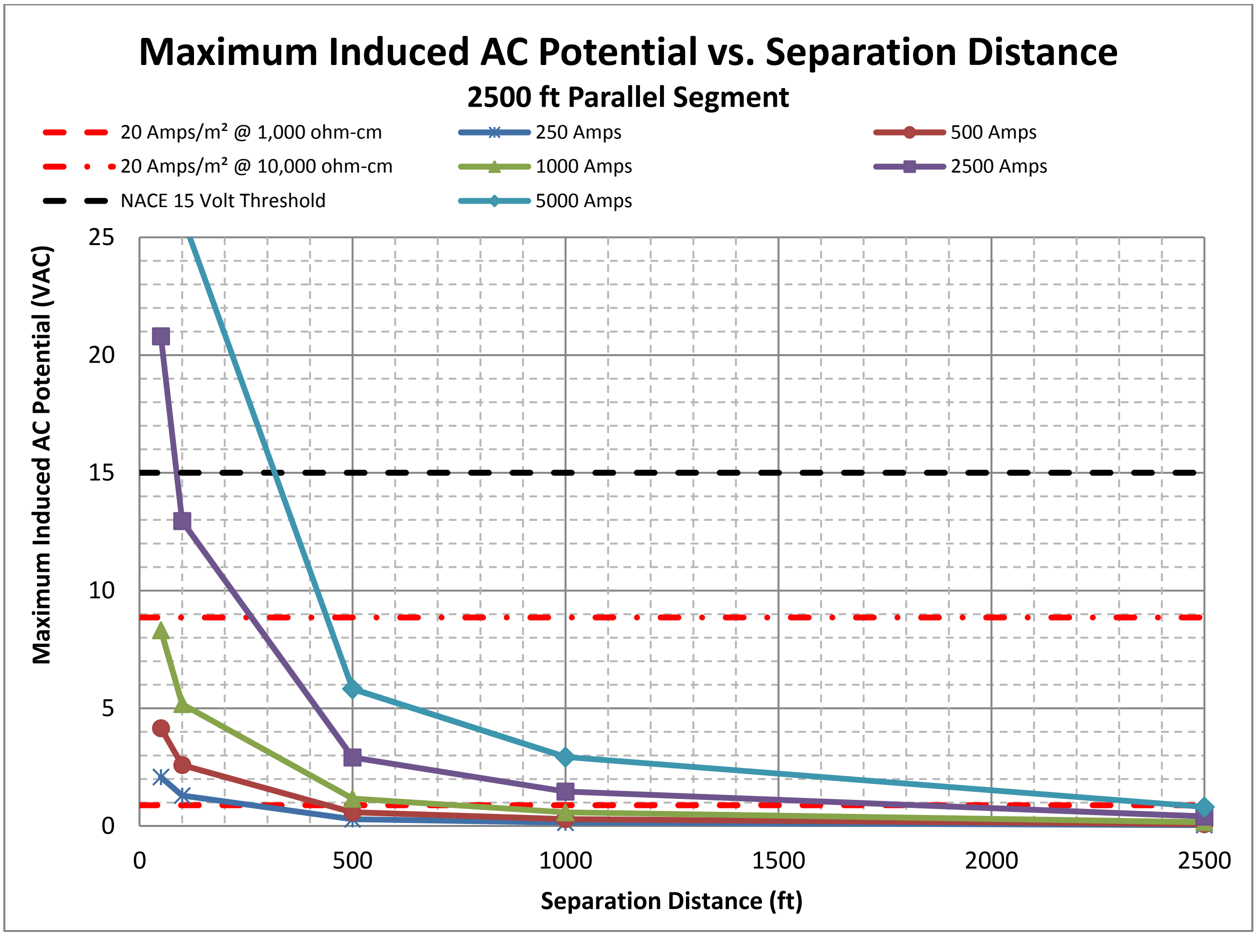


Figure 12. Effects of separation distance on induced AC potential. Current density limits presented for a theoretical 1cm^2 holiday.

As the distance between the pipeline and transmission line increases, the induction on the pipeline decreases. This is expected as where the distance between the pipeline and phase conductors increase the distance from the LEF origin increases, decreasing the coupling effects. The results of this study as presented in Figure 12 illustrate an important effect of the load current as well. The area of influence or separation distance at which a collocated pipeline experiences significant interference increases accordingly.

The figure also depicts potential levels corresponding to a 20 amp/m^2 current density for both 1,000 and 10,000 ohm-cm soil resistivity for reference. For the given parameters analyzed, a current load of 250 amps results in an induced potential of approximately 2 volts at a 50 foot separation distance which quickly decreases to less than 0.5 volts at a distance of 500 feet. However, a load of 2,500 amps results in an induced AC potential of approximately 21 volts at a separation distance of 50 feet, and approximately 1.5 volts at a separation distance of 1,000 feet. This is important when determining which pipeline collocations require detailed analysis, as there is variation among industry guidance documents for the limiting distance. A limiting distance of 1,000 feet is common practice, however, for HVAC current loads greater than 1,000 amps, significant interference might be possible at distances exceeding 1,000 feet. While the induced AC potentials magnitudes may appear relatively low in Figure 12, for separation greater than 2,000 feet, it should be noted this example is considering a single HVAC circuit, and only an approximately 0.5 mile collocation length. In practice additional interfering circuits collocated for longer distances would result in higher induced AC potentials. Further, as discussed in Section 4.2.2, it is possible to have an elevated AC current density under relatively low soil resistivity conditions, such that AC corrosion is a concern at relatively low induced potential.

It is necessary to consider separation distance in conjunction with the other factors to exclude a collocation from further analysis for separation distances within 2,500 feet. At a minimum, operating current, or an estimate of it, is also necessary when determining if further analysis is required.

4.2.3.2 Collocation Length of Pipeline and Transmission Line

Just as separation distance affects the magnitude and distribution of induced AC potential along the pipeline, so does the length of collocation. The collocation length is the distance along the ROW that a pipeline parallels or crosses the transmission line within a separation distance and angle that allow for inductive coupling. The collocation length affects the magnitude of induced AC potential that accumulates on the pipeline as it defines the length of the pipeline exposed to the LEF of the phase wires.

To demonstrate the sensitivity of collocation length on pipeline interference, DNV GL created a computer model simulating a single 10-inch pipeline, parallel to a single circuit vertical transmission line at a 50 foot offset. The collocation length was varied between the models while all other model inputs remained constant, to analyze the influence of collocation length alone. Collocation lengths of 500, 1,000, 2,500, 5,000, and 10,000 feet of the pipeline and transmission line compare the maximum induced AC potential in Figure 13.

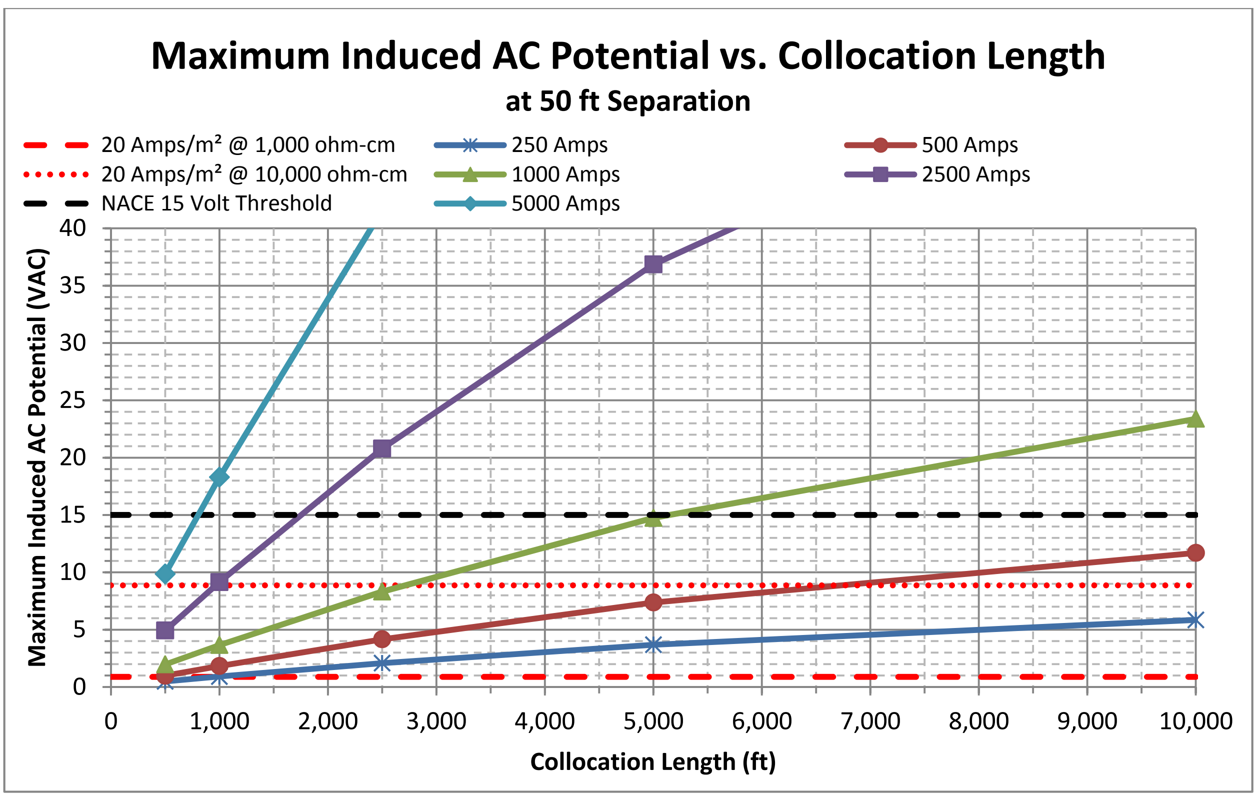


Figure 13. Maximum Induced AC Potential as a Function of Collocation Length

As the collocation length increases, the magnitude of induced AC potential on the pipeline increases, as the length of pipeline exposed to the LEF is increased. Collocation lengths as short as 500 feet are capable of inducing 2 – 10 VAC or greater considering a single collocated power line operating at 1,000 amps or greater.

The potential levels corresponding to a 20 amp/m^2 current density for both 1,000 and 10,000 ohm-cm soil resistivity have been included for reference. Considering a relatively low soil resistivity of 1,000 ohm-cm, the 20 amps/m^2 current density criteria is exceeded at a 2,500 foot collocation length for all load currents analyzed.

The results of the collocation length study also accentuate the sensitivity to HVAC load current as previously discussed in Section 4.2.1. The collocation length required prior to exceeding the 15 volt safety threshold for the 2,500 and 5,000 amp load conditions is approximately 1,750 and 800 feet respectively. These conditions are further increased in complex collocations where multiple lines exist.

It is necessary to consider collocation length in conjunction with the other factors to exclude a collocation from further analysis for separation distances within 2,500 feet. At a minimum, operating current, or an estimate of it, is also necessary when determining if further analysis is necessary.

4.2.3.3 Angle Between Pipeline and Transmission Line

The angle at which the pipeline and HVAC transmission line cross has an effect on the magnitude of induction on the pipeline at the crossing. As the angle increases between the pipeline and transmission line, the magnitude of the induction decreases as the component of the pipeline exposed to induction decreases. For a perpendicular crossing, with the pipeline crossing at or near 90° to the power line, the induction on the pipeline is minimized as the effective parallel length is minimized. The magnitude of the current on the transmission line also has a significant impact on the induced AC potential at crossing locations. Previous ‘rule-of-thumb’ practices throughout industry may have indicated crossings greater than 60° resulted in negligible induction on adjacent pipelines.[2] However, recent studies have resulted in HVAC installations with significantly greater current capacity, which acts to increase the corresponding interference resulting in cases with induced AC voltage at relatively high angle crossings.

To demonstrate the sensitivity of collocation angle on pipeline interference, DNV GL created a computer model simulating a single 10-inch pipeline, and single circuit vertical transmission line, with similar configuration as described in Section 4.2.1. The pipeline was approximately 2 miles long and the angle between the pipeline and transmission line varied between models while all other model inputs remained constant, in order to analyze the influence of crossing angle alone. Figure 14 shows the results of an analysis of crossing angles between 15 and 90 degrees and the calculated maximum induced AC potential for each case.

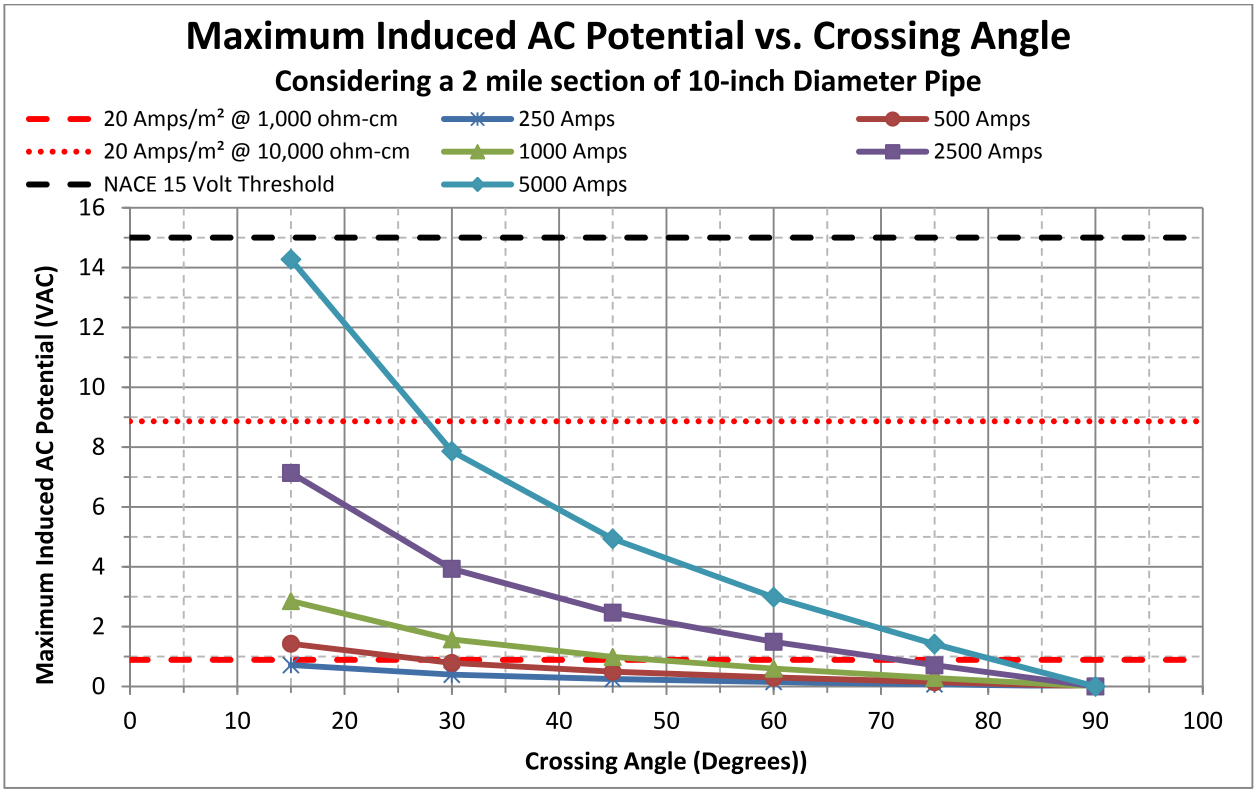


Figure 14. Maximum calculated induced voltage at various HVAC line crossing angles

Considering a typical 345kV circuit, and current loads of up to 1,000 amps, a crossing angle of greater than 45° degrees resulted in an induced potential of less than two (2) VAC for the study presented. A crossing angle of greater than 60° induces minimal potential such that the corresponding current density is less than 20 amps/m^2 even in a relatively low soil resistivity at 1,000 ohm-cm. Previous industry experience and general guidance practices across industry appear consistent with this understanding that crossings of greater than 60° are typically low-severity with respect to induction.

However, as the transmission line load increases to greater than 1,000 amps, it can be shown that crossing angles up to 60° may induce potentials such that corresponding current density exceeds 100 amps/m^2, in low resistivity soil conditions. Depending on target limits for current density, models show that crossing angles of 80° can cause high current density in relatively low soil resistivity locations.

The crossing angles discussed above are with respect to induced AC interference specifically. Assessment for susceptibility to faults, and coating breakdown due to fault voltage, is required for all crossings where pipelines pass in close proximity to a tower ground.

4.2.4 Coating Resistance

The resistance of the pipeline coating to ground is a significant factor controlling the level of induced potential that may build up on a pipeline. However, in practice the coating resistance is typically not known with great certainty and is generally inconsistent along the pipeline length. The coating resistance to ground is a function of the coating type, condition, thickness, and local soil resistivity, all of which may vary along a typical collocation length.

In general, a poorly coated pipeline, or deteriorated coating with low resistance to ground allows multiple paths to ground for AC potential to dissipate. This reduces the buildup of induction, resulting in lower AC potential and lower current density discharge at any individual holiday. Conversely, considering a well coated line with high dielectric strength and excellent coating condition, the resistance to earth along the length of the pipeline is relatively high allowing for greater induction build up over longer distances. For example, this case may exist with a newly FBE coated pipeline, with minimal holidays, in proximity to a collocated HVAC power line. Due to the high resistance to ground, and relatively few ground paths, the induced AC potential can build along the collocation length. This can generate elevated AC potentials, which may be hazardous from a safety standpoint, but also create a possible corrosion risk, as the AC current can discharge from a relatively few holidays after a physical or electromagnetic discontinuity, such as the pipeline diverging from the collocation.

Relative estimates of coating resistance are provided by Dabkoski in the report for Pipeline Research Council International (PRCI) and Parker[24,25], and summarized in Appendix B for reference, to be utilized in detailed modeling analysis based on coating quality, and soil resistivity, however specific guidance is not provided for a relative risk associated with the various coating resistance values.

4.2.5 Pipeline Diameter and Depth of Cover

The diameter of the pipeline collocated with or crossing an HVAC power line affects the level of induced AC potential on the pipeline. However, historical experience has indicated that the effect is relatively minor compared with the influence of other variables.

To demonstrate the sensitivity of pipe diameter on pipeline interference, DNV GL created a computer model simulating a single pipeline, parallel to a single circuit vertical transmission line for 5,000 feet at a horizontal separation distance of 100 feet. The pipeline approaches the transmission line at a 90-degree angle and parallels the transmission line for 5,000 feet before receding from the transmission line at a 90-degree angle. The pipeline model considered diameters of 6, 10, 18, 24, 36, and 48 inches, while all other model inputs remained constant, to analyze the influence of diameter alone. The model used a uniform soil resistivity of 10,000 ohms-cm. The results of this study indicate that the magnitude of induced AC potential decreases with an increase in pipeline diameter, as shown in Figure 15.

As the diameter of the pipeline decreases, the surface area exposed to the LEF also decreases. However, the magnitude of LEF generated by the transmission line remains unchanged. For a smaller diameter pipeline, the LEF influences a smaller surface area resulting in greater induced AC potential compared to a larger diameter line, considering all other variables equal. Further, the pipeline characteristic impedance varies inversely with pipeline diameter, as presented in previous work by PRCI3[24]. Considering all other parameters equal, a larger diameter pipeline will have a generally lower effective resistance to ground, and therefore a lower tendency of HVAC interference. For relative comparison, an increase in diameter from 6 to 48 inches resulted in a 20% decrease in induced AC potential on the pipeline, regardless of the interfering current level.

In the previous analysis, the models used 10-inch diameter pipeline, which will provide a conservative estimate relative to typical larger diameter transmission lines. This was chosen to clearly demonstrate the effects of the individual variables.

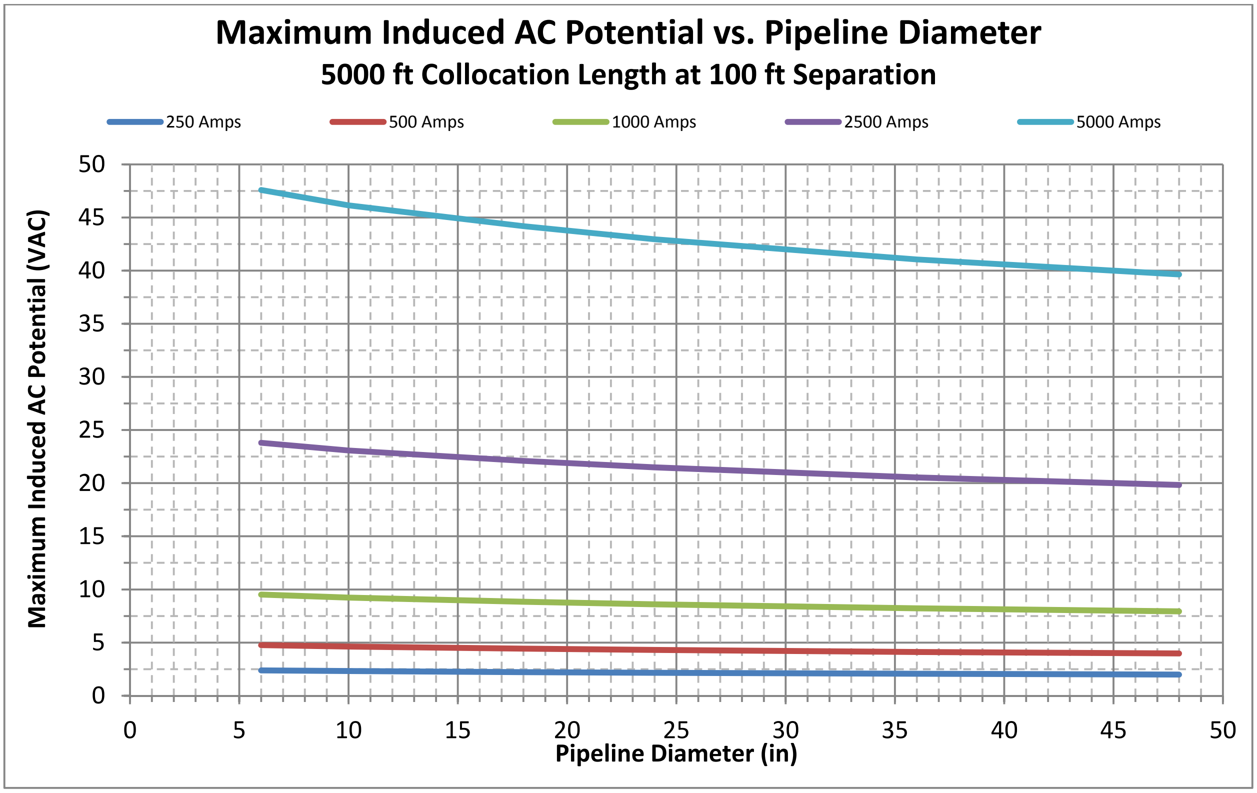


Figure 15. Maximum Induced AC Potential as a Function of Pipeline Diameter

Similar to pipeline diameter, the pipeline depth of cover has a relatively minor influence on the induced AC potential on the pipeline. In general, the level of AC interference decreases with increasing depth of cover as the distance from the individual phase conductors and total resistance to the LEF is increased, though the effect is relatively minor for typical burial depths. A fixed depth of cover of approximately 5 feet was used in the sensitivity studies above.

5 MITIGATION

NACE International Standard Practice SP0177-2014 requires a mitigation system designed for pipelines where HVAC interference is present.[10] Mitigation system design varies across the industry, but in general all involve a low resistance grounding system to pass interfering AC to ground. Typical mitigation system designs can be either surface or deep grounding designs. Both designs have benefits and detriments considering performance, cost, and constructability.

Liquid and gas transmission pipelines are regulated under the Department of Transportation (DOT) Pipeline and Hazardous Materials Safety Administration (PHMSA) Regulations §49 CFR Part 195 Subpart H Corrosion Control (195.551 – 195.589)[26] and §49 CFR Part 192 Subpart I Requirements for Corrosion Control (192.451 – 192.491)[27], respectively. The regulations have various requirements for corrosion control of which CP and electrical isolation are major factors in compliance. CP systems apply a DC to the pipeline, and electrical isolation quantifies the surface area or limits of the system. CP systems designed for transmission pipelines must meet federally regulated criteria.

5.1.1 DC Decouplers

When designing mitigation systems for induced AC and faults on transmission pipelines, detrimental effects to the CP system must be considered. It is essential to ensure they do not compromise the operation of the CP systems. Additional structures such as grounding and shield wires used in mitigating induced AC attached directly to the pipeline change the operating characteristics of the CP system, changing the surface area intended for the CP compromising its effectiveness. Direct current decouplers (DCD) alleviate this situation. However, there are some cases where the design of CP accounts for the mitigation. The decouplers, designed into the circuit, allow AC current to pass to ground, while blocking the DC CP current, maintaining the pipeline surface area. There are various types, sizes and ratings of decouplers used depending on the predicted faults or induced AC and mitigation design. DCDs are also used to block DC current at grounded above grade appurtenances, such as block valves, metering stations, and launcher/receiver stations.

Decouplers installed across electrical isolation flanges (IF) prevent "burn over" which can occur when an AC fault current or lightening surge is large enough in magnitude to arc over the gap between flange faces or exceeds the rating of the IF.

5.2 Surface Grounding

Surface grounding generally refers to one of several types of mitigation grounding installed at or near the surface or pipe depth. Typical designs may consist of bare copper cable, zinc ribbon, or engineered systems buried generally parallel to the pipe path and connected to the pipeline through a DCD. During new construction, surface grounding can be installed directly in the pipe trench, or laid parallel to the pipe in an adjacent trench or bore. This approach allows for cost-effective installation of a significant length of mitigation at a lower cost relative to alternative forms of mitigation, but is dependent on construction access along the ROW.[16]

If necessary, connecting additional mitigation ribbon in parallel and even adding shallow vertical anodes to the circuit will further reduce grounding resistance up to a certain extent. Installing this type of mitigation system at distributed, targeted locations, optimized from the interference model, reduces the induction along the pipeline. Additionally, when laid parallel to the pipeline in regions where transmission line towers are in close proximity, the mitigation ribbon also acts to protect and shield the pipeline from damage resulting from fault and arcing scenarios.

Analysis of the reduction in ground resistance possible with various installation approaches included a calculation of the resistance of 1,000 foot long mitigation ribbon in varying soil resistivity, using the modified Dwight's Equation for multiple anodes installed horizontally[28]. Figure 16 illustrates how this calculated grounding resistance varies with the number of ribbons connected in parallel at multiple levels of soil resistivity. While numerous sizes of ribbon cables exist, the length is a much more significant factor in determining total resistance than diameter, when considering typical ribbon diameters, therefore this analysis considers a constant diameter ribbon.

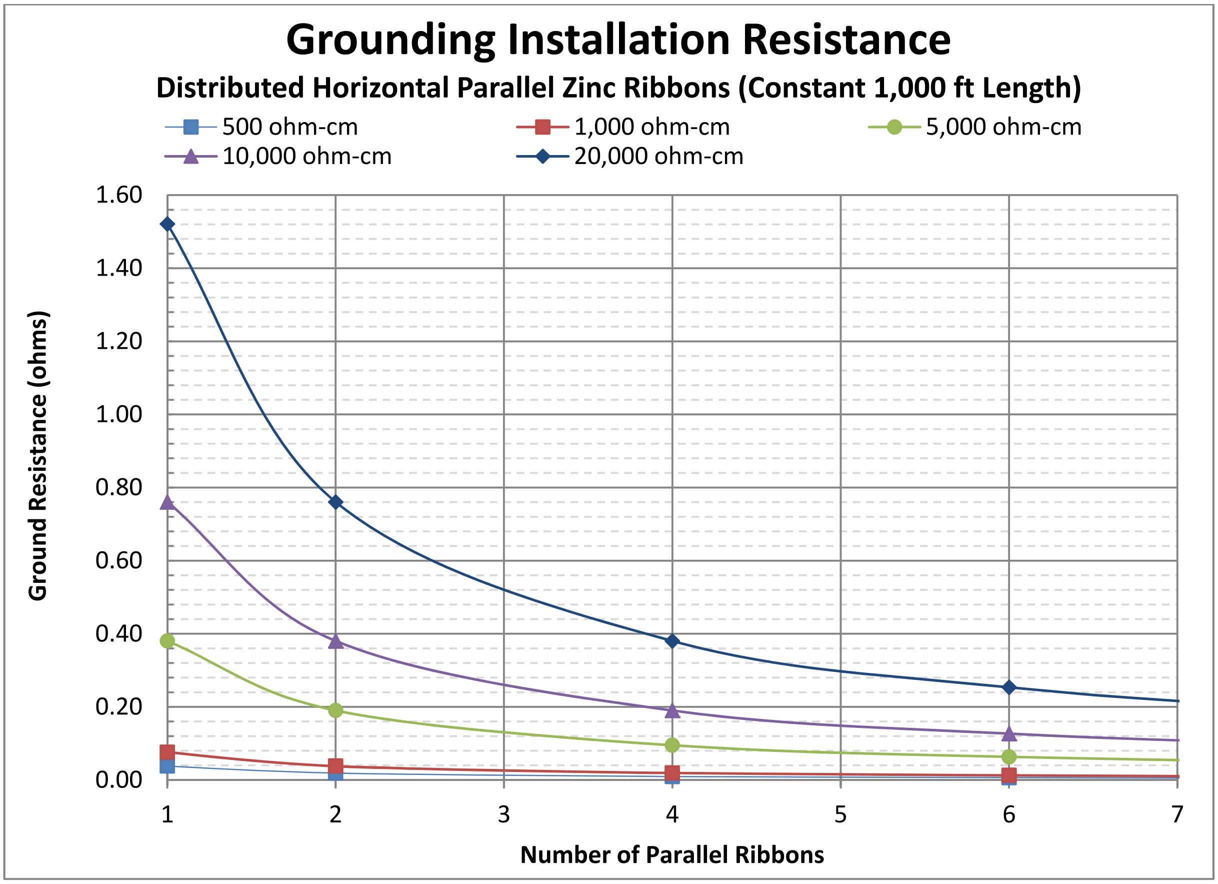


Figure 16. **Grounding Resistance of Horizontal Parallel Zinc Ribbons at Varying Soil Resistivities**

As shown in Figure 17, at low soil resistivities, very low grounding resistance results with a single, relatively short ribbon length. As the soil resistivity increases, so does the achievable grounding resistance. The data is presented considering multiple parallel mitigation ribbons to demonstrate that further reduction in ground resistance is possible by adding additional grounding at a particular installation. However, diminishing returns exist such that further increasing the extent of grounding at a specific site, beyond a certain threshold, results in minimal additional reduction, as shown in Figure 16.

The length of vertical grounding installations requires review of economics, construction, and practical design considerations. Multiple shorter grounding rods can be incorporated to achieve a low resistance to ground without requiring deep drilling, where parallel surface grounding does not sufficiently reduce the ground resistance. Vertical ground rods should be separated horizontally by the length of the ground rods at minimum for optimum efficiency.[23]

For locations of high surface resistivity, one drawback for horizontal surface grounding is the length of mitigation ribbon wire required to achieve a low resistance. Where multiple parallel ribbons are required to achieve sufficient grounding resistance significant ROW access may be required. As discussed, the shared utility ROW may limit construction access for mitigation parallel to a collocated pipeline. Additionally, as pipelines cross physical obstructions, such as roadways, railroads, access may limit the extent of parallel mitigation systems. However, surface grounding still continues to be the preferred mitigation technique and can efficiently provide adequate mitigation grounding for a majority of collocations.

5.3 Deep Grounding

Deep drilled ground wells (deep wells) offer another form of mitigation grounding, and may be considered for select applications. Deep wells generally consist of one or more anodes drilled vertically into the ground in order to achieve low ground resistance. Actual deep well depths can vary based on needs, but they generally range greater than 100 feet in depth.

In general, construction costs are generally higher for deep well grounding than for comparable surface mitigation. However, deep well grounding can be a viable option in specific applications where one or both of the following criteria are satisfied.

1 The soil resistivity at the surface is significantly greater than (>20 x) the soil resistivity at lower depths.

2 Horizontal surface grounding is not feasible due to construction obstacles (roads, railways, right-of-way access, etc.)

For typical mitigation systems, where parallel ribbon and deep grounding are both options, parallel ribbon proves to be more efficient and economical because it can achieve a lower resistance to ground for lower overall cost. For comparison, ground resistance calculations were analyzed to determine the approximate equivalency in effective ground resistance between parallel zinc ribbon, and an individual deep well anode.

Figure 17 below shows a comparison of parallel horizontal grounding configurations compared to a single 6-inch diameter deep well anode approximately 200 feet deep. The soil resistivity ratio, plotted on the x-axis, is the ratio between the bulk soil resistivity to a depth of 10 feet for surface ribbon and the bulk soil resistivity to a 200 foot depth for a deep well. Along the y-axis is the equivalent length of horizontal surface grounding required to meet the same level of grounding resistance as the deep well anode. The two curves in the figure below display this trend for single and double surface ribbon installations.

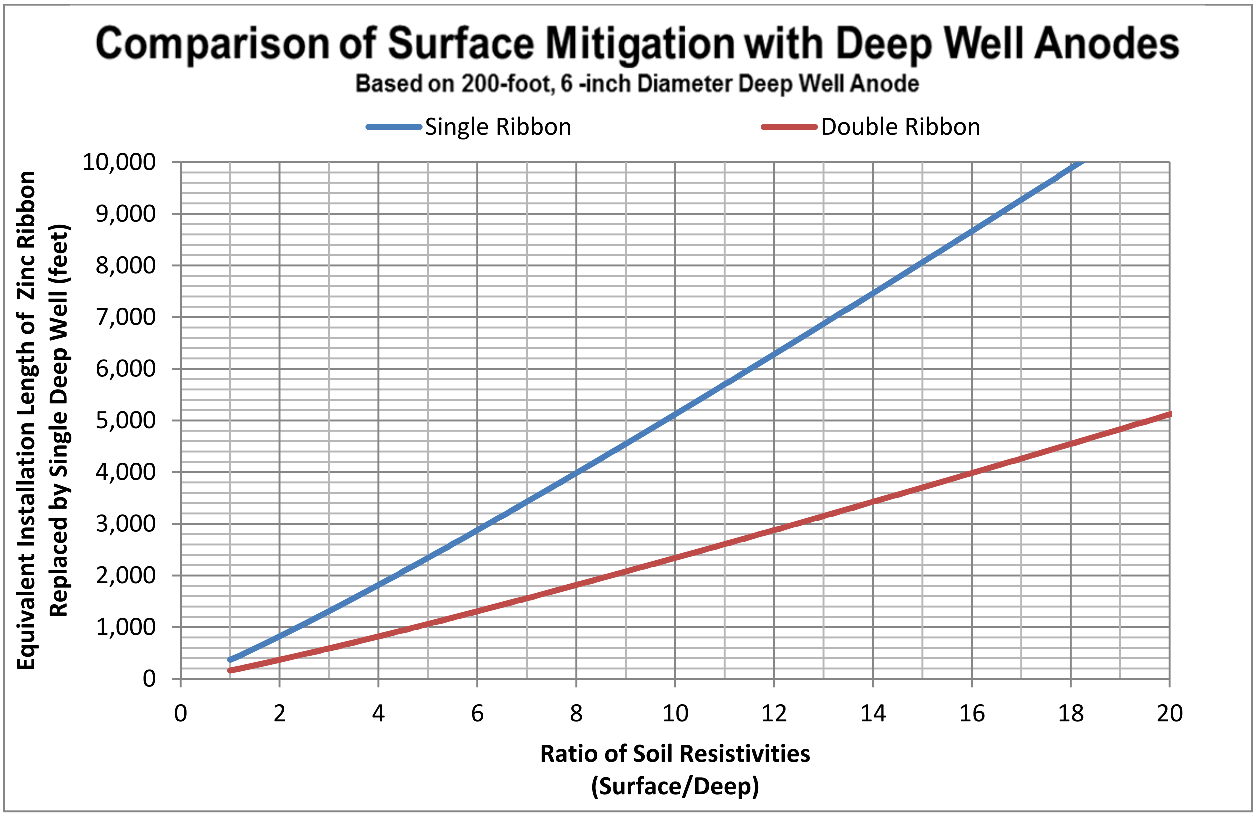


Figure 17. **Comparison of Surface Mitigation to Deep Well Anodes**

Considering a typical scenario where deep soil resistivity values are of similar order to the surface resistivity, a single deep well grounding installation would be necessary for approximately every 1,000 to 2,000 feet of individual parallel ribbon. However, considering a hypothetical location where the deep soil resistivity is an order of magnitude lower than at the surface (soil ratio of 10), it can be shown that a single deep well installation could provide a similar ground resistance as approximately 5,000 feet of individual parallel ribbon. Under certain scenarios, where the ratio between the surface and deep soil resistivity is high, deep well anodes may become a viable solution to obtain a low grounding resistance. Previous case studies and project experience have rarely shown soil resistivity ratios of this magnitude, such that deep well grounding was a preferred option. However, where construction access is limited, not allowing for installing longer lengths of surface grounding to achieve the required mitigation deep well grounding may be beneficial. In scenarios where grounding is only necessary at a single specific location on the pipeline, deep well grounding may be an option.

5.4 Mitigation Comparison

Deep well anodes may provide a viable mitigation option under specific circumstances, but industry practice, historical assessments, and construction practice have generally shown that surface mitigation provides more economical and efficient mitigation for the majority of collocations. In cases where arc shielding protection is required to guard against fault scenarios, deep well anodes do not provide such protection, thus necessitating the installation of surface ribbon in addition to primary mitigation. Surface mitigation can also serve as fault shielding, protecting against damage to the pipeline and its coating when properly placed between the pipeline and power transmission ground.

A primary benefit for surface mitigation is ease of installation and a lower associated cost. Mitigation installed in the same trench beside the pipe during pipeline construction further reduces installation costs. Typical industry construction estimates indicate that the cost of a single drilled deep well anode installation may be ten times the cost of a 1,000-foot surface installation, if installed during pipe construction. This would indicate that each deep well anode would need to replace approximately 10,000 feet of surface mitigation before it is economically viable from a ground resistance standpoint alone. That said, the decision between surface and deep grounding installation methods most often comes down to a number of other considerations, including construction access, grounding distribution, and contractor preference in addition to cost alone. [Appendix C contains a simplified summary, presents the pros and cons for various mitigation materials and methods for reference.] The comparison information provides guidance and demonstrates the comparative benefits of each approach based on various soil resistivity layers.

5.5 Additional Mitigation Methodologies

The AC mitigation techniques discussed utilize low-resistance grounding to transmit induced AC voltage to ground. While grounding can be an effective mitigation technique for many interference cases, recent industry experience has identified collocations where induced potentials or current density reduction to adequate levels cannot be achieved by grounding alone. This is generally due to a combination of elevated transmission currents and unfavorable soil resistivity conditions. Trends in the power transmission industry have led to increased power capacity and corresponding operating currents, for some long distance transmission systems as shown. This increase in operating current has a direct effect on the level of EMI. In many cases, this has presented a significant challenge for achieving adequate mitigation on pipelines crossing or collocated with the power transmission lines. In these cases, additional mitigation techniques should be considered.

In terms of risk reduction or prevention, the approach to AC interference mitigation can be categorized on a primary, secondary, or tertiary level. Primary prevention targets controlling or reducing the source of the risk, through elimination or control. Secondary prevention targets reducing exposure to a risk factor, and tertiary prevention targets treating the response or consequences of the risk factor, generally after exposure to the risk. By these terms, a standard practice of mitigating AC induction by grounding alone is considered a tertiary form of mitigation. That is to say, the treatment targets only the consequence of the interference by reducing the detrimental AC effects at the pipeline level, after allowing the pipeline to be exposed to the interference risks. While not currently in widespread application, further research of primary and secondary risk controls should be considered in future development, to reduce overall interference and risks associated with AC interference, especially considering cases that cannot be effectively mitigated by traditional means. While the concepts presented may not be readily employed by pipeline operators without further research, they are presented to address the need for continued research and development of more robust high voltage interference mitigation methodologies, and pursue improved collaboration between the power line and pipeline operators.

5.5.1 Primary Threat Control of AC Interference

Although mitigation grounding is a common industry practice, cases exist where grounding alone is insufficient to reduce interference levels on collocated pipelines. For such cases, additional techniques should be considered. From an engineering risk basis, with respect to overall risk reduction, a preferred approach is to reduce the source of interference. Specifically, this means reducing the interference prior to it reaching the pipeline, generally through design controls during the development phase prior to construction, where modifications to the pipeline or transmission line are possible. The level of interference experienced at the pipeline is dependent on the magnitude of EMI generated at the source, and the collocation parameters that limit the EMI levels reaching the pipeline. Specifically, revising collocation routing, and tower and circuit configuration modifications can reduce or optimize the level of EMI produced. Conductor arrangements can be designed to balance individual phases producing the lowest levels of EMI for a given circuit configuration.

For a given circuit configuration (single circuit horizontal/vertical, double circuit horizontal/vertical/delta, etc.) there exists an ideal phase sequence which minimizes the LEF at the pipeline location and thus results in lower magnitudes of AC interference. Dabkowski studied the magnitudes of the LEF for varying circuit types and phase sequence. The results demonstrated that for a single horizontal circuit a reduction of up to 9 percent of the LEF may be achieved, by choosing the proper phase sequence.[24] With the single circuit vertical case, the LEF at the pipeline location could be reduced by as much as 15% with the proper phase sequence.

The double circuit vertical tower configuration presents a unique scenario for phase sequencing. There are 36 possible phase sequences, classified into five sets of phase combinations: center point symmetric, full roll, partial roll upper, partial roll lower, and center line symmetric. The LEF magnitude between the various phasing configurations can vary significantly.[29] Generally, the ideal phase sequence for a double vertical circuit is the center point symmetric phase configuration, which generates an LEF approximately 65% to 90% less than the center line symmetric phase configuration.[29] This is significant when considering this is simply the result of the physical interaction between conductors, and primary mitigation reduction at the source reduces the interference levels that ever reach the collocated pipeline. Additionally, optimization of the phase configuration does not require unconventional installation methods to obtain this reduction in LEF magnitude.[29] It is recognized that for existing installations, pipeline operators generally may not be able to influence HVAC power design; however, for new construction and power system expansions where interference is a concern, communication between pipeline operators and transmission owners of possible effects is recommended in order to review possible interference hazards prior to construction. Where possible, pipeline and HVAC power line design controls can limit EMI and interference on adjacent pipelines.

The addition of phase transpositions along a given collocation can also act to reduce the overall EMI influencing a collocated pipeline. However, phase transpositions should only considered as part of a detailed analysis, as the discontinuity presented by a phase transposition can create a localized point of elevated interference, and may have further impact on the power transmission design.[24] However, where appropriate, phase transpositions can create discontinuities and effectively break up long line interference built up on long collocations. Further, in areas where construction access may be limited, phase transpositions can be located strategically to reduce interference at the source.

5.5.2 Secondary Threat Control of AC Interference

With respect to overall threat reduction, a secondary control works by means of isolating a threat from a structure. In the case of AC interference, this specifically means intercepting and grounding the EMI prior to reaching the pipeline.

One proposed example is overhead shielding, which is used to mitigate AC interference in other industries including rail transport systems, but is notably less common in mitigating AC interference on pipelines. An overhead shielding technique works by placing a conductor, grounded at regular intervals, within a targeted region between the pipeline and the adjacent transmission line. This shielding conductor, located in the same LEF generated by the conductor circuit, induces a current and an accompanying LEF 180 degrees out of phase with the field generated by the transmission line. In so doing the conductor acts to cancel part of the LEF generated by the transmission line, resulting in lower levels of induction on the pipeline. Dabkowski studied the effectiveness of this technique for the same tower configurations discussed in Section 5.5.1.[29] The results indicated a substantial reduction in the induced potential on the pipeline was possible; however, the mitigating effectiveness was highly sensitive to loading conditions, and the precise location of the shielding conductor. For the single circuit horizontal circuit, an auxiliary overhead ground wire resulted in a reduction of approximately 25% in the LEF, and thus the corresponding induction on the pipeline. The ideal placement of this overhead auxiliary shield wire was approximately the same height as the phase wires, which for single circuit horizontal circuits may make this solution impractical. For the single circuit vertical tower configuration, Dabkowski found a maximum LEF reduction of approximately 60% to 75% by mounting the overhead shield wire at an optimum height on the tower centerline. Reductions in the LEF generated by the double circuit vertical configuration were found to be range from 50%-95%. However, when examining slight imbalances of +/-5 to 15% between phase wires, the benefits realized by this auxiliary shield wire quickly diminished to 20% or less when compared to uniform current across all phase wires of the circuit.29[23] While this is generally not a common practice in mitigation of pipeline interference, overhead shielding has been considered and studied in the past, and is used within other industries. Specific overhead shielding installations require detailed design, and precise locating but this approach may present an alternative means of mitigation where ineffective through more traditional means. Further research and testing is required on a case-specific basis to determine if this is a viable technique.

Fault and arc shielding, which are used to reduce the risk of damage to the pipeline and the coating near tower grounds during fault conditions are another form of secondary risk control. Fault protection typically takes the form of a parallel shield wire, similar to mitigation ribbon discussed in Section 5.2. However, the primary function of fault and arc shielding protection acts to intercept transmission line fault current and transfer to ground prior to reaching the pipeline. For this reason, the location and placement of the arc shielding mitigation is far more critical when protecting against conductive (fault) interference than for inductive interference.

5.5.3 Tertiary Threat Control of AC Interference

With respect to overall risk reduction, tertiary controls rely on reducing the consequences of the threat after exposure to the structure. Per this definition, typical grounding mitigation can be considered a tertiary control. Mitigation grounding works by transmitting the AC potential to ground, only after it has already reached the pipeline. While grounding has proven to be an effective means of mitigation for many historical installations, and installation is generally within the capabilities and access of the pipeline operators, scenarios occur where grounding alone is not sufficient to reduce interference to acceptable levels.

Ideally, a combination of primary, secondary, and tertiary mitigation techniques would provide the highest level of threat reduction and protection for the pipeline. However, addressing a threat at the lowest level possible will provide reduction in severity, increasing the likelihood that mitigation will be effective. That is to say, reducing AC interference at its source or shielding EMI from reaching an adjacent pipeline can provide greater risk reduction than simply allowing the interference to pass to the structure and dissipating to ground via tertiary mitigation methods. In practice however, it may not always be possible or practical to address interference at a primary or even secondary level. Tertiary mitigation through low resistance grounding techniques may provide adequate risk reduction for a majority of interference collocations. However, further research and continued development into additional mitigation techniques would benefit the industry.

5.6 MONITORING

As mentioned previously, the measurement or calculation of AC current density has been the primary indicator to determine the likelihood of AC corrosion across industry in North America. It is possible to measure AC current density on a representative holiday through the installation and use of metallic coupons or ER probes. A test wire connected to the coupon, routed to the surface and connected to the pipeline through a test station is an example of a simple installation. By inserting an ammeter into the circuit, an AC and DC current can be measured which when can be used to calculate the current density at that location. In many cases, test stations with coupons also include additional instrumentation such as ER probes and reference electrodes. The ER probes provide a time based corrosion rate while the reference electrodes provide both and AC and DC pipe-to-soil potentials for comparison.

Using coupon test stations (CTS), and ER probes, real-time monitoring can provide a better understanding of the interference effects acting on a collocated pipeline. However, as previously discussed, the magnitude of interference depends on the magnitude of current loads on the associated power lines. Correlation of the CTS and ER probe data with power line loads provides a thorough understanding of the system performance. While it has historically been difficult to obtain this information from power line operators, there is a recognized need to have good understanding of the operating power line loads to determine relevance of coupon test station or ER probe data. Additionally, best practices dictate obtaining data over a representative period (days or weeks as relevant) in order to assess the interference response during high load conditions. A measurement for AC potential or AC current density at a single point in time with unknown operating current loads may not be representative of the actual risk for interference on the pipeline.

6 GUIDELINES FOR INTERFERENCE ANALYSIS

The following steps are provided as best practice procedures for determining where detailed analysis is recommended based on the results of this study, industry standards, historical technical publications, and previous industry experience.

Pipeline operators are faced with many existing and new construction pipelines collocated and crossing power line ROW. Little guidance exists to assist in selecting and prioritizing collocations for detailed analysis and modeling. Under certain conditions, it may be possible to justify the low likelihood of AC interference, and exclude specific locations from further detailed modeling with detailed monitoring, or justification that the risk due to interference is low.

It is recommended to collect the following information, where possible, to determine if a detailed AC analysis is required. Appendix D is a sample of data to collect from the powerline company. Use the corresponding severity limits in Sections 6.1.1 through 6.1.5 to assist with this methodology:

- Peak and Emergency load rating (amps) for collocated power lines
- Line rating (kV) for collocated power lines
- Soil resistivity along the collocation at multiple depths
- Collocation and / or crossing routing geometry for the pipeline and power line
- AC pipe-to-soil (P/S) measurements (for existing pipelines)
- AC Current density using coupons or probes where previously installed
- Maximum fault potential and fault clearing time

Detailed “analysis” in the context of this document refers either to data collection using detailed monitoring or to specific application of numerical calculation of interference magnitudes. This analysis is done using detailed computer modeling or similar application of interference calculation methods.

6.1 Severity Ranking Guidelines

This section provides general guidance with respect to the relative severity ranking for the identified variables with respect to their impact on the severity of AC interference.

6.1.1 Separation Distance

Separation distance and load current are key factors in determining whether a collocation will experience significant AC interference. Generally, the separation distance is readily available or easily determined, so it is often a primary screening variable. However, it has been shown that significant interference is possible for distances greater than 1,000 feet when considering collocations with load capacity greater than 1,000 amps.[2] It is therefore recommended to consider collocations within 2,500 feet, and the decision for further analysis should also incorporate estimate of the power line current.

Severity ranking for separation distance is provided in Table 3.The following generalized rankings have been determined through review of industry data, parametric studies, and historical experience.

Table 3-Severity Ranking of Separation Distance

Separation Distance - D (Feet)	Severity Ranking of HVAC Interference
$D < 100$	High
$100 < D < 500$	Medium
$500 < D < 1{,}000$	Low
$1{,}000 < D \leq 2{,}500$	Very Low

6.1.2 HVAC Power Line Current

The magnitude of transmission line currents is one of the most influential parameters determining the likelihood and severity of AC interference. However, there is often debate as to which load rating to consider for interference analysis and mitigation design. HVAC power lines generally have multiple ratings that specify the operating loads allowable during normal operation and peak or emergency load ratings allowable during short duration scenarios. Ultimately, the load rating considered should be a risk-based decision made by the pipeline operator, considering the frequency of occurrence for the load level, typical duration throughout operation, and the consequence associated.

From a personnel safety standpoint, it is recommended to consider the maximum load that a power line can carry for any duration. The terminology for this varies among transmission operators, but it is commonly referred to as "Emergency Load", defined as the maximum load a transmission circuit is capable of carrying for a short duration such as during an emergency or maintenance condition. Considering personnel safety, elevated step or touch potential could pose an instantaneous threat as a shocking hazard, regardless of duration of the elevated power line current. As the pipeline operator is generally unaware of an emergency load condition on the power line, it may not be feasible to reduce or prevent exposure during even a short-duration elevated current load. It is therefore generally best practice to consider the maximum capacity or emergency loading conditions when assessing the risk of personnel safety threats such as shocking, unless other provisions can be made to prevent exposure.

However, AC corrosion is a time-dependent threat. The magnitude of AC current density possible on a pipeline under AC interference will be sensitive to the current load on the adjacent HVAC conductor. While emergency loads, or other spikes in power line current may cause an elevated current density, the associated corrosion damage may be low as the duration is limited.

The power line current is often the most controlling parameter influencing the magnitude of AC interference. For this reason, we recommend obtaining the power line load limits from the relevant power transmission operator when assessing the risk of AC interference on a given pipeline. These limits should include the various operating ratings (generally 'Normal', 'Peak', and 'Emergency'), the allowable duration for each, and expected frequency of occurrence.

Transmission operating parameters are not always readily available to pipeline operators, and this information may be difficult to obtain. However, the power line current is a primary factor, and the relevance and accuracy of an AC analysis may vary greatly with the accuracy of the operating current. Where actual load data is unavailable, published reference currents for various HVAC power line ratings are available in literature[24]. However, these guidelines are for reference only, and may provide over or under conservative results. In practice, there are cases where the operating currents provided for a specific power line significantly exceeded these estimates. Additionally, as discussed in Section 4.2.1, increase load capacity on new and upgraded systems may result in load ratings above the provided reference levels.

Severity rankings associated with HVAC load current for a collocated power line is provided in Table 4.

The following generalized rankings have been determined through review of published technical literature, industry data, parametric studies, and historical experience.

Section 5.2.1 contains further background and detailed information for effects of power line phase current.

Table 4-Relative Ranking of HVAC Phase Current

HVAC Current - I (amps)	Relative Severity of HVAC Interference
$I \geq 1,000$	Very High
$500 < I > 1,000$	High
$250 < I < 500$	Med-High
$100 < I < 250$	Medium
$I < 100$	Low

6.1.3 Soil Resistivity

Soil resistivity affects both the magnitude of induced AC and the susceptibility to AC corrosion. The AC corrosion process, as presented in Section 3.3.1 is a function of the AC current density at a coating holiday, which in turn is dependent on the level of AC voltage on the pipeline and the local spread resistance. The bulk soil resistivity is a primary factor controlling overall level of induction, while the local soil resistivity near a holiday is a primary factor in the corrosion activity, as discussed in Section 4.2.2. The following generalized severity rankings have been determined based on industry experience and guidance provided in EN 15280:2013, with respect to AC corrosion.[15]

Table 5-Relative Ranking of Soil Resistivity

Soil Resistivity - ρ (ohm-cm)	Relative Severity of HVAC Corrosion
$\rho < 2,500$	Very High
$2,500 < \rho < 10,000$	High
$10,000 < \rho < 30,000$	Medium
$\rho > 30,000$	Low

6.1.4 Collocation Length

The collocation length of the pipeline and transmission line affects the magnitude of induced AC potential accumulating on the pipeline as it defines the length of the pipeline exposed to the LEF of the phase wires. The following generalized rankings have been determined through parametric studies, and historical experience.

Table 6-Relative Ranking of Collocation Length

Collocation Length: L (feet)	Relative Severity
$L > 5,000$	High
$1,000 < L < 5,000$	Medium
$L < 1,000$	Low

6.1.5 Collocation / Crossing Angle

The angle of collocation or crossing of the pipeline and power line limits the influence of induction. The following generalized rankings have been determined through parametric studies, and historical experience.

Table 7-Relative Ranking of Crossing Angle

Collocation/Crossing Angle - θ (°)	Relative Severity
$\theta < 30$	High
$30 < \theta < 60$	Med
$\theta > 60$	Low

6.2 Recommendations for Detailed Analysis

The guidance parameters presented are based on industry literature and standards where available. Where guidance has not previously been provided, qualitative classifications have been provided to aid in severity ranking and prioritization. The qualitative guidance parameters have been determined based on published industry guidance, numerical modeling parametric studies, previous analytical experience, laboratory studies, and failure investigations for AC corrosion related damage. The intention is not to replace or remove detailed analysis from the design decisions, but rather to aid in severity ranking and prioritization when determining where additional detailed analysis and mitigation design is required.

The guidelines within should be used by the operators as part of an overall risk-based decision. The details within this report and this section can only provide guidance regarding the severity of HVAC interference or AC corrosion. When determining whether to perform further detailed analysis, add location specific monitoring, or where no further action is required, possible consequences must be a part of the decision process and reviewed on a case-specific basis.

As discussed in Section 4.2, collocations with power lines operating at greater than 1,000 amps are subject to interference under conditions where likelihood would otherwise be low. Special consideration required for collocations where the power line loads are greater than or equal to 1,000 amps. For this reason, an understanding of the power line load current is necessary for evaluating the need for further analysis. The two cases below provide an assessment of collocations and crossings encountered, based on:

Case 1 – Current Load greater than or equal to 1,000 amps, pipeline crossing or collocated within 2,500 feet

Case 2 – Current Load less than 1,000 amps, pipeline crossing or collocated within 1,000 feet

6.2.1 Case 1

For scenarios where power line current is known or can be estimated to operate at or above 1,000 amps, and a steel pipeline is crossing or collocated within 2,500 feet of the power line, a detailed analysis is recommended when one or more of the following conditions are met:

- Collocation Length severity is characterized as “High”
- Soil resistivity severity is characterized as “High” or worse
- Three or more of the variables identified in Section 6.1 are categorized as “Medium” or worse

6.2.2 Case 2

For scenarios where power line current is known or estimated to operate below 1,000 amps, and a steel pipeline is crossing or collocated within 1,000 feet of the power line, a detailed analysis is recommended when one or more of the following conditions are met:

- Phase current severity is characterized as “High” or worse
- Collocation length severity is characterized as “High”
- Soil resistivity severity is characterized as “High” or worse
- Three or more of the variables of severity rankings identified in Section 6.1 are categorized as “Medium” or worse

High angle crossings, with crossing angles of greater than 60°, while considered low-risk for inductive interference, are susceptible to fault or lightning arcing, as well as coating breakdown due to fault voltage. Crossings with an angle greater than 60° may still be susceptible to inductive interference if subject to very high current load, or multiple HVAC power lines.

6.2.3 Faults

As fault conditions are generally infrequent and of short duration, it is not practical to obtain measurements of AC potential during a fault condition. Analysis of fault voltages generally requires numerical modeling. Fault current levels or estimates of possible magnitudes, are generally obtained by HVAC power line operators and can vary significantly depending on tower design, power capacity, and location relative to substation and generation source.

Whenever a pipeline crosses or is collocated in close proximity within 500 feet an HVAC tower, it is susceptible to faults. Detailed calculations or modeling is required to determine the possibility of fault arcing and possible coating damage due to GPR.

6.2.4 Fault Arcing Distance

When a pipeline crosses or is collocated in close proximity to an HVAC tower ground, a theoretical fault arcing radius can be calculated. The fault arcing radius is the distance from a HVAC tower ground that a sustained lighting or fault arc may reach an adjacent metallic structure. The arcing radius is primarily a function of the fault or lightning current and the local soil resistivity magnitude, and is estimated using equations 2 and 3 based on Sunde's equations for lightning arc distance.[30] The equations presented were developed to predict a safe separation distance considering an elevated current due to lightning strike, and can be utilized to provide an estimate of possible fault arcing distance from a faulted high voltage tower ground as well.

$$r_a = 0.08\sqrt{I_{ac} x \frac{\rho}{100}} \qquad \text{If } \rho \leq 100{,}000\ \Omega\cdot\text{cm} \qquad (2)$$

$$r_a = 0.047\sqrt{I_{ac} x \frac{\rho}{100}} \qquad \text{if } \rho > 100{,}000\ \Omega\cdot\text{cm} \qquad (3)$$

Where: r_a= arc distance in m

ρ= soil resistivity in Ω·cm

I_{ac} = the fault current in kA

6.3 Data and Documentation Requirements

Where the Severity Rankings Guidelines criteria indicated a more detailed analysis is necessary, collect the following information where possible, to facilitate development of an AC interference model. Appendix D contains a sample data log provided for reference:

Pipeline Parameters:

- Routing geometry
- Depth of cover
- Diameter
- Coating details
- Coating resistance
- Existing CP installations
- Location of bonds
- Soil resistivity at multiple depths and locations along the ROW
- Location of insulating joints

Power line Parameters:

- Routing geometry
- Number of circuits
- Conductor configuration (dimensions, orientation, phasing)
- Conductor loading (Peak and Emergency current)

- Tower ground resistance
- Maximum fault voltage
- Fault clearing time
- Shield wire configuration

6.4 General Recommendations

As the operating current is a controlling parameter influencing AC interference, it is recommended to obtain the power line load current from the relevant electrical utility operator when assessing a collocation for the threat of AC interference. Historically, lack of collaboration between pipeline and power line operators has led to projects being assessed without accurate understanding of the power line data. This can lead to either an overly conservative and costly design or an under-designed system not adequately reducing the interference. Collaboration between the respective pipeline and power line operators is critical to accurate assessment and efficient mitigation of any possible interference effects.

In addition to the assessment described in previous sections, the following general recommendations apply for collocations and crossings where AC interference is a concern:

- Install coupon test stations or ER probes to monitor AC Current density, a coupon surface area of 1.0 cm^2 is recommended.
- During pipeline construction near HVAC transmission lines, confirm that the contractor safety program complies with the recommended 15 VAC limit for shock hazards, and applicable OSHA construction standards as referenced in Section 3.2.2.
- Record AC pipe-to-soil potentials along with the DC pipe-to-soil potentials during the annual cathodic protection survey on sections where AC interference threats may exist. This can provide information, should the power transmission company change its operating parameters, or unexpected changes occur between the pipeline and transmission line.
- Request power line loads corresponding to the time of AC pipe-to-soil potential measurement to provide thorough understanding of the interference measurements
- Measure soil resistivity at locations where AC interference threats may exist. This data can be used with the measured AC potentials to estimate theoretical AC current density for specific locations in the absence of coupons or ER probes.
- Operating personnel should be trained in the hazards and safe practices associated with working on pipelines subject to HVAC interference
- Suspend work (when possible) along the collocated or crossing section of pipeline during weather conditions that may lead to a transmission line fault.

Safety precautions are required when making electrical measurements:

- Only knowledgeable and qualified personnel trained in electrical safety precautions install, adjust, repair, remove, or test impressed current cathodic protection and AC mitigation equipment.
- Properly insulated test lead clips and terminals should be used to prevent direct contact with the high voltage source.
- Attach test clips one at a time using a single-hand technique for each connection when possible.

- Extended test leads require caution near overhead HVAC power lines, which can induce hazardous voltages onto the test leads, or present a source of data error.

7 REFERENCES

1. NACE TG 327, “AC Corrosion State-of-the-Art: Corrosion Rate, Mechanism, and Mitigation Requirements, NACE Report 35110, 2010
2. S. Finneran, B. Krebs, “Advances in HVAC Transmission Industry and its Effects on Induced AC Corrosion”, CORROSION 2014, Paper No. 2014-4421
3. P. Simon, “Overview of HVAC Transmission Line Interference Issues on Buried Pipelines”, NACE 2010
4. R. Gummow, S. Segall, “AC Interference Guidelines,” CEPA 2014
5. E. Kirkpatrick, “Basic Concepts of Induced AC Voltages on Pipelines,” Materials Performance, July, 1995
6. B. Tribollet, “AC-Induced Corrosion of Underground Pipelines,” Underground Pipeline Corrosion, 2014, p. 35-61
7. Prinz, W. “AC Induced Corrosion on Cathodically Protected Pipelines”, UK Corrosion 1992, vol. 1, Proceedings of NACE, Nashville, USA, 26 April-1
8. H. Hanson, J. Smart, “AC Corrosion on a Pipeline Located in an HVAC Utility Corridor” CORROSION 2004, Paper No. 04209
9. M. Yunovich, N.G. Thompson, “AC Corrosion: Corrosion Rate and Mitigation Requirements,” CORROSION 2004, Paper No. 206, 2004
10. M. Yunovich, N. Thompson, “AC Corrosion: Mechanism and Proposed Model,” Proceedings of International Pipeline Conference 2004, paper no. IPC04-0574
11. NACE SP0177-2014 “Mitigation of Alternating Current and Lightning Effects on Metallic Structures and Corrosion Control Systems,” 2014
12. CAN/CSA-C22.3 No.6-M91 “Principles and Practices of Electrical Coordination Between Pipelines and Electric Supply Lines,” 2003
13. IEEE Std 80-2000 “Guide for Safety in AC Substation Grounding,” 2000
14. S. Goidanich, L Lazzari, M. Ormallese, “AC Corrosion. Part 1: Effects on Overpotentials of Anodic and Cathodic Processes,” Corrosion Science 52, 2010
15. EN15280, “Evaluation of AC Corrosion Likelihood of Buried Pipelines Applicable to Cathodically Protected Pipelines,” 2013
16. R. Southey, F. Dawalibi, “Computer Modelling of AC Interference for the Most Cost Effective Solutions, ”CORROSION 98, Paper No. 564
17. M. Büchler and H-G. Schöneich (2009), “Investigation of Alternating Current Corrosion of Cathodically Protected Pipelines: Development of a Detection Method, Mitigation Measures, and a Model for the Mechanism,” Corrosion 65, 578–586, 2009.
18. M. Ormellese, L. Lazzari, et al, “Proposal of CP Criterion in the Presence of AC Interference”, NACE 2010, C2010-10032
19. R. Gummow, S. Segall, “Pipeline AC Mitigation 19Misconceptions” NACE Northern Area Western Conference, February 2010
20. “Underground Electric Transmission Lines”, Public Service Commission of Wisconsin, 2011

21. L. Koshcheev, “Environmental Characteristics of HVDC Overhead Transmission Lines,” HVDC Transmission Institute, St. Petersburg, for Third International Workshop on Grid interconnection in North Eastern Asia
22. Canadian Association of Petroleum Producers (CAPP), GUIDE, “Influence of High Voltage DC Power Lines on Metallic Pipelines,” June 2014
23. J. Dabkowski, “Methodologies for AC Mitigation,” CORROSION 2003, Paper No. 03703
24. J. Dabkowski, “AC Predictive and Mitigation Techniques”, Pipeline Research Council International Catalog No. L51835e, 1999
25. M. Parker, E. Peattie, Pipeline Corrosion and Cathodic Protection, 1988
26. DOT PHMSA Regulations §49 CFR Part 195 Subpart H Corrosion Control (195.551 – 195.589)
27. DOT PHMSA Regulations §49 CFR Part 192 Subpart I Requirements for Corrosion Control (192.451 – 192.491)
28. H, Dwight, “Calculation of Resistances to Ground,” Transactions of the American Institute of Electrical Engineers, Vol. 55, No. 12, (December 1936), pp. 1319-1328.
29. J. Dabkowski, “Mitigation of Buried Pipeline Voltages Due to 60 Hz AC Inductive Coupling, Pt. I Design of Joint Rights-of-Way,” IEEE Transactions on Power Apparatus and Systems Vol. PAS-98, No. 5 (Sept/Oct, 1979): 1806-1813
30. E. Sunde, “Earth Conduction Effects in Transmission Systems”, New York, 1968
31. I. Ragualt, “AC corrosion induced by VHV electrical lines on polyethylene coated steel gas pipelines,” CORROSION 98, Paper No. 557
32. R. Wakelin, R. Gummow and S. Segall, “AC Corrosion - Case Histories, Test Procedures and Mitigation,” CORROSION 98, Paper No. 565, 1998
33. S. Goidanich, “Influence of Alternating Current on Metals Corrosion,” PhD thesis, Politecnico di Milano, 2005.
34. P. Nicholson, “High Voltage Direct Current Interference With Underground/Underwater Pipelines,” CORROSION 2010, NACE Paper No. 10102

APPENDIX A LITERATURE REVIEW

Where published, historically identified corrosion defects and pipeline failures associated with AC corrosion degradation were reviewed and are presented to demonstrate the magnitudes and variability in corrosion rates possible with AC accelerated corrosion. The general findings, discussion, technical details, and results are utilized and summarized throughout this document.

This lack of industry consensus on the subject of AC corrosion guidelines has led to varied practices among pipeline operators in regards to mitigating AC interference on pipelines. As part of this study, The INGAA Foundation requested a review of industry practices and procedures related to AC interference. The INGAA Foundation provided DNV GL with the procedures related to AC interference or mitigation for 10 pipeline operators who are members of the Foundation. The primary finding from this review is that there is significant variation in company procedures with respect to AC interference. Based upon this review, all of the procedures provided address a safety concern and define a maximum allowable AC pipe-to-soil potential limit for above grade appurtenances. Faults were included as a concern/risk for pipelines in close proximity to HVAC power lines in almost all of the procedures. However, few addressed coating stress limit above which mitigation is required. For current density criteria, several procedures had clearly defined limits, while others addressed it as a concern for AC corrosion but did not specify a targeted limit of AC current density or define limits for mitigation.

Case Studies

Numerous studies, both laboratory and field based, have been performed that attempt to determine magnitudes of corrosion rates associated with AC interference. However, reviewing available technical literature confirms a wide range of experimental rates, and a scarcity of controlled field measured rates.

Where published, historically identified corrosion defects and pipeline failures associated with AC corrosion degradation have been reviewed and are presented to demonstrate the magnitudes and variability in corrosion rates possible with AC accelerated corrosion.

Field investigations reported by Ragault[31] considering a coated cathodically protected pipeline, identified corrosion rates between 12 and 54 mpy (0.3 and 1.4 mm/yr), for AC current densities ranging between 84 and 1,100 A/m^2.

Wakelin, Gummow, et al[32] provided three case studies where field inspections identified defects as AC corrosion-related degradation. Based on inspection intervals and corrosion degradation, corrosion rates were identified ranging from 17 to 54 mpy (0.4 to 1.4 mm/yr) for AC current densities between 75 and 200 A/m^2.

A German field coupon study, published by Prinz, and Shoneich,[7] indicated general AC corrosion rates between 2 to 4 mpy (0.015 to 0.1 mm/yr) for a current density of 100 A/m^2, and 12 mpy (0.3 mm/yr) at 400 A/m^2. However, pitting rates were considerably greater and showed a wider range between 8 and 56 mpy (0.2 to 1.4 mm/yr), with considerably less dependence on AC density.[6]

A doctoral thesis study by Goidanich presents similar findings concluding that AC current density as low as 10 A/m^2 may be considered hazardous as the experimental studies showed it nearly doubled the free corrosion rate of the experimental samples in simulated soil tests.[33]

A 1998 report by Wakelin, Gummow, et al published by NACE reviewed several case studies dating back to the 1960's where AC corrosion was identified or suspected to be the primary mechanism of degradation. The report summarized recorded details on multiple case studies with specific focus on comparison of corrosion rates and AC current density where known. In 1991, a failure investigated on a 12-inch diameter pipeline concluded AC accelerated corrosion after only four (4) years of service. Induced AC potentials measured as high as 28 volts. Based on the nominal wall thickness and time to leak, an average pitting rate for the through wall pit was estimated to be greater than 55 mpy. Two other case studies indicated the average AC induced corrosion rates for the identified sites between 11 and 24 mpy.

A 2004 paper by Hanson and Smart, published by NACE, presents a case study for a gas pipeline installed in the summer of 2000.[8] The pipeline was collocated in a shared ROW with a 230 kV transmission line for approximately 9 miles, and then entered a shared power corridor with six power transmission lines, two of which were rated at 500 kV, all within sufficient proximity of the pipeline to cause interference. A leak occurred within 5 months of installation, before the line was in operation. Several other leaks were identified shortly after, with four leaks within close proximity. Induced AC potential measurements found AC voltages as high as 90 volts on the pipeline. The failure assessment indicated the corrosion was due to induced AC corrosion, and estimated rates in excess of 400 mpy.

The majority of literature reviewed indicates AC corrosion rates in the range of 5 to 60 mpy.[3, 9, 10] However, cases have been identified with localized corrosion rates significantly greater, in excess of 400 mpy. There is general agreement that higher AC current density leads to greater risk of AC corrosion. While higher current density may lead to accelerated corrosion rates, the correlation is not simple or direct.

International Standards

Review and comparison of multiple international standards identified the consistencies and variations across accepted industry standards.

Recent laboratory and field work has focused on the interaction between AC and DC current density in determining overall risk of AC corrosion, and the latest European standards reflect this as discussed in Section 3.3.1.1.[15] However, there is no generally accepted method of correlating current density or any other measurable indicator to an expected corrosion rate. A direct method of approximating the AC corrosion rate using a buried coupon or probe would provide accurate information.

The Canadian Standards Association (CSA), NACE International (NACE), and the European Committee for Standardization (CEN) have developed published standards addressing HVAC interference issues, as below:

- CAN/CSA-C22.3 No. 6-13 "Principles and Practices of Electrical Coordination Between Pipelines and Electric Supply Lines
- NACE SP0177-2014 "Mitigation of Alternating Current and Lightning Effects on Metallic Structures and Corrosion Control Systems
- CEN EN 50443:2012 "Effects of Electromagnetic Interference on Pipelines Caused by High Voltage AC Electric Traction Systems and/or High Voltage AC Power Supply Systems"
- CEN EN 15280:2013 "Evaluation of AC Corrosion likelihood of buried pipelines applicable to cathodically protected pipelines"

Of these standards, the first three primarily discuss safety issues, interference effects, and mitigation systems but do not explicitly address criteria for AC corrosion control. The European Standard EN15280:2013 deals specifically with corrosion due to AC interference, and establishing criteria or tolerable limits for interference effects, as presented in Section 3.3.1.1.

NACE Standard Practice SP0177-2014, *Mitigation of Alternating Current and Lightning Effects on Metallic Structures and Corrosion Control Systems*, addresses problems caused primarily by the proximity of metallic structures to AC power transmission systems. In this standard practice document, SP0177-2014 defines a steady state touch voltage of 15 volts or more with respect to local earth at above-grade or exposed sections and appurtenances to constitute a shock hazard. Findings presented in the standard indicate the average hand-to-hand or hand-to-foot resistance for adult male ranges from 600 ohms to 10,000 ohms. NACE uses "a reasonable safe value" of 1,500 ohms (hand-to-hand or hand-to-foot) for estimating body currents. Based upon work by C.F. Dalziel regarding muscular contraction, SP0177-2014 indicates the inability to release contact occurs between 6 mA and 20 mA for adult males.[10] Ten milliamps (hand-to-hand or hand-to-foot) is recognized as the maximum safe let-go current. This 15-volt safety threshold is therefore determined based upon 1,500 ohms hand-to-hand or hand-to-foot resistance and an absolute maximum let-go current of 10 mA. However, under certain circumstances, an even lower value is required. One such circumstance specifically identified where a lower touch potential safety threshold should be considered is "areas (such as urban residential zones or school zones) in which a high probability exists that children (who are more sensitive to shock hazard than are adults) can come in contact with a structure under the influence of induced AC voltage."[10] This standard practice document requires remedial measures to reduce the touch potential on the pipeline where shock hazards exist.

During construction of metallic structures in regions of AC interference, SP0177-2014 requires minimum protective requirements of the following:

- "On long metallic structures paralleling AC power systems, temporary electrical grounds shall be used at intervals not greater than 300 m (1,000 feet), with the first ground installed at the beginning of the section. Under certain conditions, a ground may be required on individual structure joints or sections before handling."
- "All temporary grounding connections shall be left in place until immediately prior to backfilling. Sufficient temporary grounds shall be maintained on each portion of the structure until adequate permanent grounding connections have been made."

The intent of the temporary grounds is to reduce AC potentials on the structure, and thus the shock hazard to personnel during construction. SP0177-2014 advises against direct connections to the electrical utility's grounding system during construction as this could actually increase the probability of a shock hazard to personnel.

Regarding AC corrosion, there are no established criteria for AC corrosion control provided in SP0177-2014. Further, this standard states that the subject of AC corrosion is "not quite fully understood, nor is there an industry consensus on this subject. There are reported incidents of AC corrosion on buried pipelines under specific conditions, and there are also many case histories of pipelines operating under the influence of induced AC for many years without any reports of AC corrosion."

While not a Standard Practice document, NACE published "AC Corrosion State-of-the-Art: Corrosion Rate, Mechanism, and Mitigation Requirements"[1] in 2010, providing guidance for evaluating AC current density, and providing recommended limits as discussed in Section 3.3.1.1.

The State-of-the-Art report also cites European Standard CEN/TS 15280:2006[15], which previously offered the following guidelines related to the likelihood of AC corrosion:

> *"The pipeline is considered protected from AC corrosion if the root mean square (RMS) AC density is lower than 30 A/m^2 (2.8 A/ft^2).*

In practice, the evaluation of AC corrosion likelihood is done on a broader basis:

- *Current density lower than 30 A/m^2 (2.8 A/ft^2): no or low likelihood;*
- *Current density between 30 and 100 A/m^2 (2.8 and 9.3 A/ft^2): medium likelihood; and*
- *Current density higher than 100 A/m^2 (9.3 A/ft^2): very high likelihood"*

EN 15280:2013

The latest revision of EN 15280:2013 was revised to present criteria based upon the AC interference and DC current due to CP. EN 15280:2013 presents using the cathodic protection system of the pipeline to ensure the levels of induced AC potential do not cause AC corrosion under the following conditions:

1. AC voltage on the pipeline should be decreased to a target value, which should be less than 15 V (measured over a representative time period, i.e. 24 hr)
2. Effective AC corrosion mitigation can be achieved while maintaining cathodic protection criteria as defined in EN 12954:2001
3. One of the following conditions is satisfied in addition to items 1 and 2:
   - Maintain AC current density (RMS) over a representative period of time (i.e. 24 hr) less than 30 A/m^2 (2.8 A/ft^2) on a 1cm^2 coupon or probe
   - If AC current density is greater than 30 A/m^2 (2.8 A/ft^2), maintain the average cathodic (DC) current density over a representative period of time (i.e. 24 hr) less than 1 A/m^2 on a 1cm^2 coupon or probe
   - Maintain a ratio between AC current density and DC current density (J_{AC}/J_{DC}) less than 5 over a representative period of time (i.e. 24 hr)

The NACE State-of-the-Art report also references experimental studies by Yunovich and Thompson that concluded

> *"AC density discharge on the order of 20 A/m^2 (1.9 A/ft^2) can produce significantly enhanced corrosion (higher rates of penetration and general attack without applied CP). Further, the authors stated that there likely was not a theoretical 'safe' AC density (i.e., a threshold below which AC does not enhance corrosion); however, a practical one for which the increase in corrosion because AC is not appreciably greater than the free-corrosion rate for a particular soil condition may exist."*[1]

APPENDIX B COATING RESISTANCE ESTIMATES

Pipe Coating Conductance/Resistance

Pipe Line Corrosion and Cathodic Protection, Marshall E. Parker & Edward G. Peattie

No.	**Coating Quality**	**Soil Resistivity**	**Conductance Range**		**Resistance Range**					
			µmhos/ft2		**ohm-m^2**		**ohm-ft^2**		**Kohm-ft^2**	
1	Excellent	High	1	10	92,903	9,290	1,000,000	100,000	1,000	100
2	Good	High	10	50	9,290	1,858	100,000	20,000	100	20
3	Excellent	Low	50	100	1,858	929	20,000	10,000	20	10
4	Good	Low	100	250	929	372	10,000	4,000	10	4
5	Average	Low	250	500	372	186	4,000	2,000	4	2
6	Poor	Low	500	1,000	186	93	2,000	1,000	2	1

PRCI

No.	**Coating Quality**	**Soil Resistivity (ohm-m)**	**Coating Resistance (Kohm-ft2)**		
1	Excellent	25	Multiply Soil Resistivity (ohm-m) by 5	5	125
	Excellent	50	Multiply Soil Resistivity (ohm-m) by 5	5	250
	Excellent	200	Multiply Soil Resistivity (ohm-m) by 5	5	1,000
	Excellent	600	Multiply Soil Resistivity (ohm-m) by 5	5	3,000
2	Good	25	Multiply Soil Resistivity (ohm-m) by 2	2	50
	Good	50	Multiply Soil Resistivity (ohm-m) by 2	2	100
	Good	200	Multiply Soil Resistivity (ohm-m) by 2	2	400
	Good	600	Multiply Soil Resistivity (ohm-m) by 2	2	1,200
3	Fair	25	Multiply Soil Resistivity (ohm-m) by 0.5	0.5	13
	Fair	50	Multiply Soil Resistivity (ohm-m) by 0.5	0.5	25
	Fair	200	Multiply Soil Resistivity (ohm-m) by 0.5	0.5	100
	Fair	600	Multiply Soil Resistivity (ohm-m) by 0.5	0.5	300

APPENDIX C MITIGATION COMPARISON SUMMARY

Zinc Ribbon

Advantages
- Can typically be installed during pipeline construction minimizing installation costs
- Cost of raw material is typically one third the cost of copper
- Can be trenched or plowed in relatively inexpensively after pipeline installation
- Typically results in very low resistances
- Historically has performed as intended
- Surface mitigation ribbon can double as shielding for fault mitigation

Disadvantages
- Zinc clad ribbon is more difficult to work with compared to copper
- Life expectancy is generally less than comparable copper installation

Copper Cable

Advantages
- Can typically be installed during pipeline construction minimizing installation costs
- Can be trenched or plowed in relatively inexpensively after pipeline installation
- Typically results in very low resistances
- Historically has performed as intended
- Surface mitigation cable can double as shielding for fault mitigation
- Depending on the size cable the material cost of a copper installation can be lower than a zinc installation

Disadvantages
- Cost of raw material is typically higher than the cost of zinc
- Risk of having a more noble metal (cathodic) near or connected to pipeline even if through a decoupler

Deep Grounding (anodes used as the ground)

Advantages
- May be advantageous when surface resistivity is extremely high

Disadvantages
- Typically high cost for both installation and materials
- Generally not suitable for mitigating ground potential rises (GPR) or arcing issues associated with faults

Shallow Grounding (driven ground rods or bored ribbon or cable)

Advantages
- Can be used to supplement horizontal ribbon or cable installation if required
- Magnitude of the surface resistivity affects the resistance

Disadvantages
- Generally not suitable for mitigating ground potential rises (GPR) or arcing issues associated with faults

Engineered mitigation and/or Additives (no specific product identified)

Advantages
- Could increase design life

Disadvantages
- Typically increases the material costs

Notes:
1) These are typical statements and there are instances where they do not apply.
2) All mitigation installations are considered connected through a decoupling device such that there is no direct passage of DC current to or from the mitigation.

APPENDIX D DATA REQUEST TEMPLATE

Company: ____
Project: ____
Project Number: ______________________________________

High Voltage Alternating Current (HVAC) Power Transmission Parameters

No.	Information Requested	T-Line 1	T-Line 2	T-Line 3
	General			
1	Owner:			
2	Power transmission voltage (kV):			
3	Average Tower Span (feet)			
4	Substation ground grid impedance (ohms):			
	Phase Wires			
5	No. of circuits:			
6	Circuit type:			
	Conductors:			
7	No. 1 average height (ft):			
8	No. 1 average horizontal distance (ft):			
9	No. 1 phasing (degrees):			
10	No. 2 average height (ft):			
11	No. 2 average horizontal distance. (ft):			
12	No. 2 phasing (degrees):			
13	No. 3 average height (ft):			
14	No. 3 average horizontal distance (ft):			
15	No. 3 phasing (degrees):			
16	Other: Cable Sag, Lowest point (feet):			
	Circuit Loading			
17	Peak loading (amps):			
18	Emergency loading (amps):			
19	Emergency loading time (hours):			
	Shield Wires			
20	No. of conductors:			
21	No. 1 type:			
22	No. 1 conductor GMR (ft):			
23	No. 1 conductor resistance (ohms/mil):			
24	No. 1 average height (ft):			
25	No. 1 average horizontal distance (ft):			
26	No.2 type:			
27	No. 2 conductor GMR (ft):			
28	No. 2 conductor resistance (ohms/mil):			
29	No. 2 average height (ft):			
30	No. 2 average horizontal distance (ft):			
	Fault Current Parameters			
31	Fault clearing time (cycles):			
32	Average tower resistance (ohms):			
33	Beginning of Collocation: Total______from left substation ___________ from right substation			
34	Middle of Collocation: Total______from left substation ___________ from right substation			
35	End of Collocation: Total______from left substation ___________ from right substation			

Company: ____

Project: ____

Project Number: ______________________________________

Pipeline Parameters

No.	Information Requested	Pipeline 1	Pipeline 2	Pipeline 3
	General			
1	Pipeline number:			
2	Pipeline owner:			
3	Pipeline name:			
4	Product transported:			
5	Diameter (in.):			
6	Burial depth (ft.):			
7	Wall Thickness (inch):			
8	Length of Collocation (feet/miles):			
	Coatings			
9	Coating type (majority):			
10	Coating resistance (kohm-ft2):			
11	Coating thickness (mils):			
	Cathodic Protection			
12	Location of cathodic protection:			
13	Resistance of cathodic protection groundbed(s):			
14	Bonding to foreign pipelines? (Y/N):			
15	Existing AC mitigation measures? (Y/N):			
16	Describe existing AC mitigation:			

May 5, 2016

Jamie MacAlister, Environmental Review Manager
Energy Environment Review and Analysis
MN Department of Commerce
85 7th Place East
Suite 500
St. Paul, MN 55101

RE: Proposed Sandpiper: 13-473 & 13-474 and Line 3 Rebuild: 14-916 & 15-137

Dear Ms. MacAlister:

This letter is written to highlight what I believe is important points and including previous letters I have written that will be referenced for further discussion that will be attached. In general, I have been involved in this process as a landowner originally barraged with paperwork and phone calls by Enbridge (before renamed to NDPC) who pushed for us to sign saying it was a "done deal" even before they even submitted their application. I stood at my property line with a camera when a surveyor showed intent to come onto our property anyway (by watching him stamp away in a huff). Then was sent a letter threatening "formal proceedings" using legal language the attorney identified they could not use as reason for access, etc. I have found this company whether called Enbridge or NDPC to use omission and power plays to push for what they want. To Carlton County they promised more tax dollars while at the same time they were in Tax Court to reduce their taxes to a Western County in Minnesota. When I asked a DOC employee whether they looked at how much other pipelines are in use, she responded "No", they only look at the shipper contracts and went on to explain the threat of suing by Enbridge/NDPC or North Dakota if the pipeline was not approved, yet I contacted FERC by email and they wrote it was up to the State to decide not just the contracts. Therefore, whether through Enbridge/NDPC, adjoining States or Legislators what I am saying to you is *threats and power plays should* ***not*** *dictate the conclusions of this EIS.* It needs to be scientifically based looking transparently at all the impacts. If you find them power playing you, please do not back down, but recognize you are on to something and need to look further.

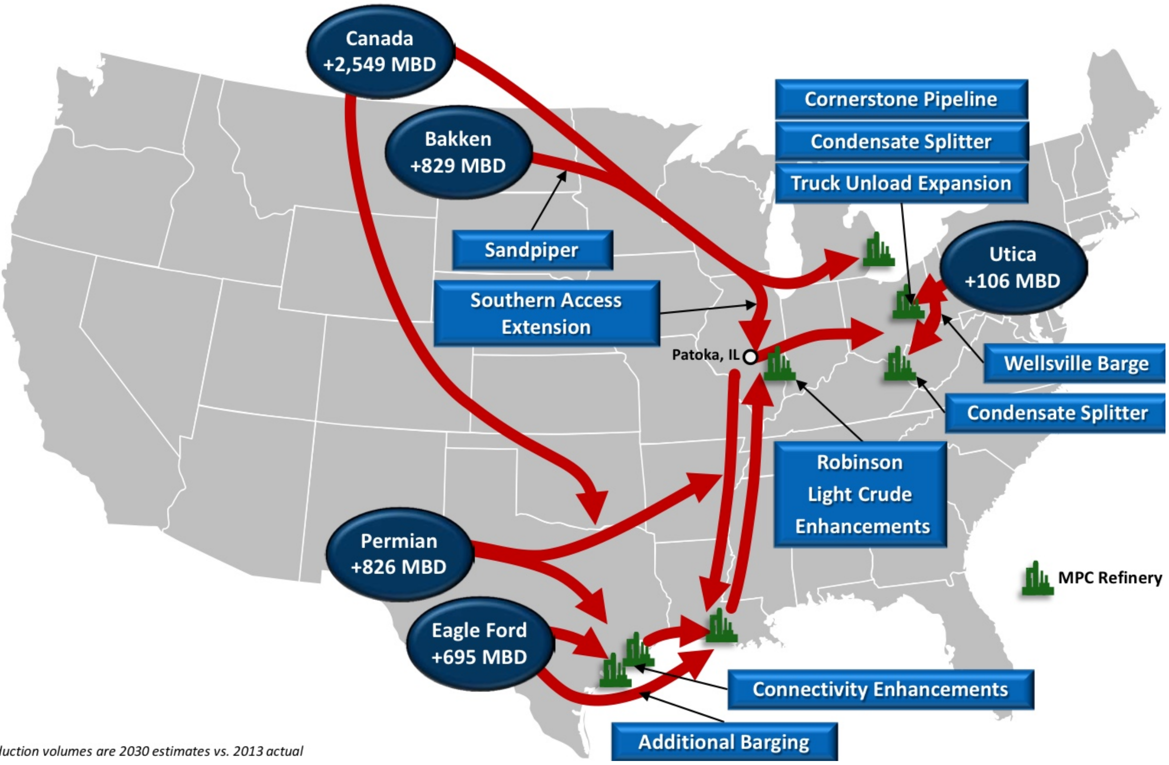
1. I would like to recognize that this EIS process is very important, because Minnesota has not done an EIS for pipelines before. As a Minnesota citizen, I expect that the intent behind preparing these EIS is… ***in the public trust***. In other words, it is **not** to be a document **to market pipelines** by: emphasizing a shorter route to enable higher profits, but ignoring the quality of the water put at risk; or counting jobs as 1 per year (2nd year as the 2nd), but not including the risk to the tourism industry; or by focusing on population, but ignoring topography and lack of accessibility for response to spill cleanup; or simply counting features like making a ditch equal to a shallow lake that produces wild rice. Each of these is a numerical way to hide and lessen the importance of the social, cultural and environmental impacts as compared to corporate financial interests. Please do not allow this EIS to be manipulated to put profit first! The EIS must transparently weigh the impact of different routes on the **health and well being of the environment** on which native people, private landowners, and rural communities along each route so dearly depend.

2. In the project description, it seems that you have already limited the routes to study as going through Clearbrook, MN and on to Superior, WI. That is what NDPC, Enbridge and Marathon want. I heard the executive from Marathon last year in front of the Judge justify going through Clearbrook, MN by stating it was his "right" to sell their product to the Twin Cities. But, what is the proposed Sandpiper really for? NDPC claimed it was for transporting North Dakota oil through Minnesota to Superior, WI. Calumet Refinery in Superior, WI is small and consumes heavy crude not ND sweet crude. So, unless the sweet crude is shipped over the Great Lakes, it must move through WI to a Midwest hub and on to refineries capable of refining sweet crude. *The EIS needs to recognize where the crude oil is going by widening its scope of routes from Tioga, ND to the hub in Patoka, IL and/or seriously study the impact of crude oil transport over Lake Superior on Duluth and the North Shore*. The only reason to limit the scope of the EIS is to allow NDPC and Marathon to dictate that their financial interests have precedence over the environmental impacts to Minnesota.

3. Marathon's shipper contracts with NDPC require the Southern Access Extension (SAX) to be completed. In the slide below from the Illinois Commerce Commission's (ICC) contested SAX case 07-0446, Marathon quantifies shipping **more crude** over Sandpiper **from Canada to Patoka, IL** than from ND. The crude will go to refineries or the Gulf. Marathon may desire to sell to Minnesota Refineries, but their interest is to *pass crude oil through Minnesota from Canada to their refineries and sell overseas*. If you look at the 2nd slide, you can see that Marathon has Inland Water Terminals on the Great Lakes. Is the use of eminent domain justified for the profit of corporations when the product will pass through Minnesota from Canada to overseas? Does this justify the risk of spills? **The EIS needs to identify where the crude oil is going and do a cost/benefit analysis to Minnesota on the use of eminent domain discussing how can this be a public purpose?**

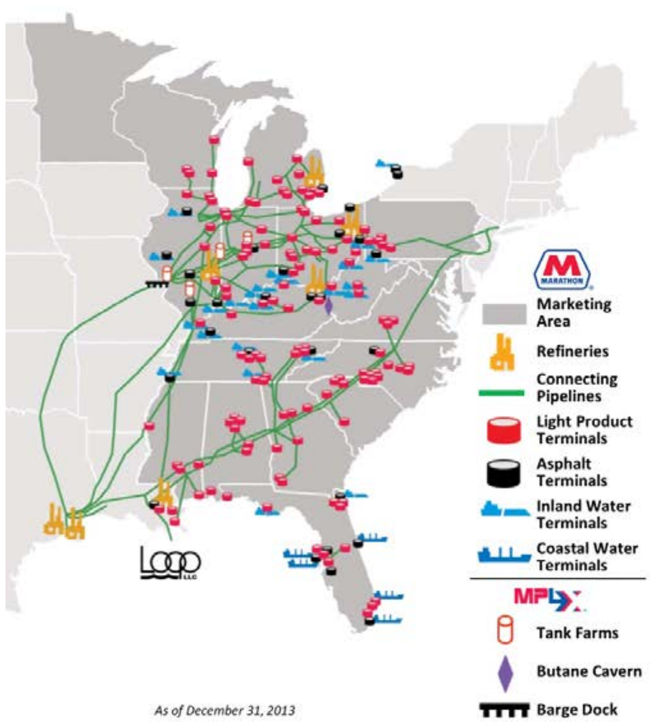
4. In my first letter to the PUC, I wrote on how the proposed Sandpiper was not just about one pipeline, but a means to open us a new corridor for expansion of their pipeline system to the Gulf and through the Great Lakes. A short time later, Calumet Refinery in Superior, WI was trying to get licensing to upgrade a section of the Port in Wisconsin to restart shipping of crude oil over Lake Superior. Please note that Marathon, their major shipper has already barge capability for shipping over the Great Lakes. Calumet Refinery wanted to reopen the use of a 30 years old pipe under the City of Superior. The WI DNR at first said this was a done deal, but had a local meeting to satisfy the public, but later said an EIS needed to be completed. I believe this was simply put on hold by Calumet Refinery because Enbridge at the time did not want this to be used as a way to stop their expansion. It is still a possibility! So this EIS must consider, especially since both the Sandpiper and Line 3 are expansions, where is the oil going? The EIS needs to address the possibility of shipping over Lake Superior and the effect of both light and tars sands crude oil spills in Lake Superior to the cities that depend on water from Lake Superior, people who live next to the lake, Isle Royal National Park, aquatic life, tourism businesses in the region, etc.

MPC Creating Crude/Condensate Advantage

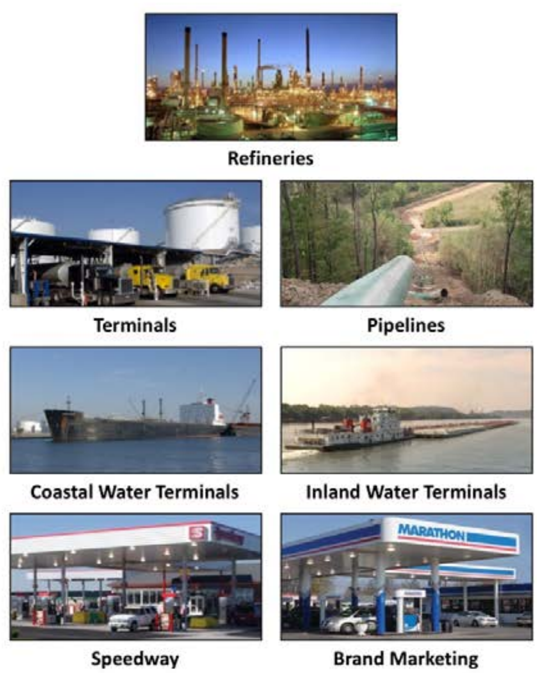


Production volumes are 2030 estimates vs. 2013 actual

MPC Integrated System



As of December 31, 2013



5. This EIS must seriously consider the effect of the routes on the cultural and financial vitality of the Native American Tribes by including the impact on their hunting and gathering rights – especially - Wild Rice. And, there should be representation from the Tribes in direct consult for preparation of this EIS. I was appalled by testimony showing NDPC's own environmental employee did not even know the pipeline's policy; and went to historical records instead of contact with the tribes for data as input to NDPC's Environmental Report. *The lands of several Minnesota Tribes have been greatly impacted by Enbridge pipelines.* ***It is time to honor the knowledge and culture of the Tribes.*** A way must be found to quantify not just in comparison of dollars, but to look at the cultural livelihood as a whole to the Tribes of the impact of losing wild rice and other rights granted through their Treaty Lands from building, operating and eventual spills from a new crude oil pipeline corridor along the preferred route by the corporation. Even more reasonably, ***the Tribes need direct representation in this EIS.***

6. Routes: EIS needs to consider in understanding the crude will just pass through Minnesota that a higher standard needs to be met for routing to protect Minnesota's natural resources.

The Mainline needs serious study as a route in both EIS. In the Alberta Clipper application, Enbridge wrote there is one more slot available after the Alberta Clipper is built. The impact of adding the proposed Sandpiper to an already existing route makes sense environmentally because the ***impacts already exist.*** This is non-proliferation and an important part of the law to avoid unnecessary degradation of Minnesota's forests, waters and environment by requiring efficient use of existing pipeline routes.

Just like the Mainline, other system alternative routes that follow existing gas and oil pipelines need to be included even if they are not NDPC/Enbridge's preference. The EIS needs to consider whether locating a new corridor along electrical power lines adds to spill risk from unexpected corrosion. See comments previously submitted by former DNR employee, Paul Stolen, in his Aug. 29th letter - page 3, 1st paragraph, where Paul mentions that "The Keystone 1 pipeline in Missouri, built in 2009, *suffered extreme and unexpected corrosion only three years after installation.* An internal report commissioned by the pipeline company found that this was caused by stray voltage."

And, the study of the Mainline should include the environmental advantage of replacing Line 3 in place instead of abandoning it. I understand pipeline companies do not identify any size of leaks as spills. Line 3 has a history of significant spills, but what about leaks underground? **A cost/benefit analysis must be completed on abandonment/rebuild in different corridor vs. clean up/replace Line 3 in Mainline** when considering (a) there are pipelines on the Mainline exposed to the elements; (b) how many more jobs would be created by direct replacement of Line 3 in the Mainline; and (C) once a pipeline is abandoned then who is responsible to pay for clean up of underground leaks, degraded pipe, etc? In this cost/benefit analysis the following questions need to be addressed from Enbridge's plan for abandonment of Line 3.

(1) *How do they plan to safely dispose of the discharge from within Line 3* that is called "transported liquid and vapor with an inert material"? In reality this contains crude oil with hazardous chemicals from the oil and whatever liquid, plus cleaning

agents. Enbridge should not be allowed to simply dump these contents into a waterway or upon the ground somewhere along the route. It is not enough for Enbridge to say they will follow Federal or State regulations. Enbridge needs to clearly state the composition of these chemicals and how they plan to protect the environment and properly dispose of these contents.

(2) *How do they plan to support the existing Line 3 where it is exposed to the elements by design or erosion?* It is not enough to seal the ends. When the pipeline is exposed it can also be a hazard to emergency personnel, children and the public. It is not enough to say they will follow Federal or State regulations. Enbridge needs to clarify a long-term safety plan for exposed sections of Line 3. In the attached article by Dan Gunderson, he describes an example of where Enbridge pipelines are suspended across a river and along the channel. These portions of the pipe risk being damaged by the elements, flood and debris. The pipe inspector quoted in the article said he is "aware of several locations across the state where exposed pipelines crosses rivers or ditches". And, what about the old pipeline collapse? *The EIS needs to address each of the sites where line 3 is exposed and describe their long-term plan for keeping each portion sealed, supported and safe for the public.*

(3) It is not enough to seal the ends. *How do they plan to seal the portions of Line 3 in which they already admit in section 1 page 1-7, that "Enbridge's pipeline maintenance program has revealed corrosion growth and other pipe material flaws that have impacted the operating capabilities of the pipeline"?*

These problems will multiply with Enbridge's plan to abandon more pipelines on the Mainline. In a news article attached written by Dan Gunderson from MPR.org , http://www.mprnews.org/story/2014/07/29/enbridge-pipelines-exposed he writes an Enbridge spokesperson admitted they have plans for more than just Line 3. The spokesperson said they plan to "reroute two of the lines next year." Line 3 is one of these 2 lines. And the spokesperson continued, "A third line is slated for replacement in 2017." These are existing lines in the Northern Mainline Route, which Enbridge plans to replace. The EIS needs to consider the impact of abandoning several pipelines in the Mainline.

The EIS needs to seriously look at the No-Build option for the Sandpiper and simple replacement of Line 3 in the Mainline because:

a. A series of two Bakken pipelines are proposed (Dakota Access Pipeline to deliver up to 570,000 bpd from ND to Patoka, IL near Enbridge's pipeline hub and Energy Transfer Crude Oil Pipeline to deliver up to 570,000 bpd from Patoka, IL to Nederland, TX) which would not pass through Minnesota and would go to pipeline hubs in PADD II and PADD III. These pipelines would have capacity to provide shipment for the same source of oil to similar markets ***with more direct routes***. Therefore, should be included in the EIS in the No-Build option.
b. Rail may be a better option for ND sweet crude because pipelines do not go to the East and West Coasts of the U.S. where refineries of sweet crude are located. For a further discussion on Rail, see my attached comments send from another email that are on record for the proposed Sandpiper.

c. The oil industry downturn may be a long-term trend with the growing interest in Tesla and other manufacturer's electric vehicles and more efficient use of fuel in hybrid vehicles. Building new and larger pipelines with the intention of 50-60 years of use may more likely become *stranded assets* as crude oil use lessens. Winona LaDuke from Honor the Earth wrote clearly about this and it is on record.

d. With the signing of the Paris Climate Initiative, Minnesota must step up and question the impact of decisions like more and larger pipelines as being counter productive to stopping Climate change.

7. The EIS needs to study the impact of a new corridor on private landowners vulnerable to the threats and power plays of Enbridge/NDPC. The fact that landowners have already signed is more of a reason to see the effect of this behavior than a reason to support the Enbridge/NDPC's preferred route. As stated above, I have first hand experience of this and luckily by having been a Chemical Dependency Counselor, I know how to address power plays whether they are puffing you up or pushing you down. But, most people do not have this experience and would be intimidated - thus signing to the pressure. See my letter in separate email on the social and financial effects of this process. This needs to be included in the EIS because if you look at the preferred route, private landowners were targeted. Direct lands of the Tribes, Counties, and State were avoided. I have read a copy of the initial contract presented to a landowner. In it they want "perpetual use of temporary areas", access to "any path, road" on their property, no protection of ground water is addressed and they are presented with a so-called "Bonus" if they sign early. The irony is when you add the "Bonus" and the other amount is the real value of the 30 foot easement, but does not pay for the full 120 foot easement they want perpetual use of. In our case, it was worst-case scenario with much larger temporary staging areas because of how much wetlands we have. Effectively, the bonus is only a power play in some cases people were given 24 hours, which does not allow them to find an experienced lawyer. In the initial Carlton meeting, landowners who complained were quickly ushered out to talk to a representative. Please consider the individuals and families who would directly affected by Enbridge/NDPC's plans.

I understand that you want to limit what you have to review, but there is some important documentation on the record for both the CON and Routing dockets: MNPCA and MNDNR; Paul Stolen; MN350; Friends of Headwaters; Carlton County Land Stewards; Honor the Earth; and the Tribes (White Earth, Fond du Lac, Mille Lacs, Leach Lake, Red Lake, etc.), Lake Associations and others. Please consider reviewing these.

Thank you for your consideration.

Sandy Sterle
2676 County Road 104
Barnum, MN 55707
218-384-4054

1 attachment – my previous letters still applicable will be sent under a separate email.

Erosion exposes Enbridge oil pipelines near river in NW Minn.

Environment

Dan Gunderson · Moorhead, Minn. · Jul 29, 2014

An Enbridge crude oil pipeline is exposed by erosion where it crosses the Tamarac River in northwestern Minnesota. *Dan Gunderson/MPR News*

. LISTEN Story audio 4min 18sec

Like many streams in the Red River Valley, the Tamarac River twists and winds its way across the northwest Minnesota landscape.

Constantly changing shape as floodwater erodes the soil, the Tamarac flows into the Red River about two hours north of Moorhead.

But in a grassy swath carved out of trees that flank the river, the channel's normally placid brown water is broken by pipelines spanning the Tamarac.

Flooding has uncovered three of seven Enbridge Corporation pipelines that cross the river, pipes that largely carry crude oil from Canada across Minnesota.

Although the pipelines generally are buried three to four feet below ground, in some places erosion has exposed them to the elements.

Pipelines are visible in this image from Google Maps:

Chad Jerome, a local farmer, said he has seen an exposed pipe in the spot for the 14 years that he has planted and harvested fields along the river. But until recently he didn't realize how many pipelines were uncovered.

"I guess I have faith that Enbridge knows what they're doing and that safety measures are in place and it's not an issue," Jerome said.

The three exposed lines include a 24-inch pipe, constructed in the early 1960s, a 34-inch line built about 1968, and a 20-inch pipe laid in 2010, Enbridge spokesperson Becky Haase said the lines flow across Minnesota to Superior, Wis.

Some pipes are suspended across the river channel, which is about 30 feet wide. In one case, a pipe is exposed along the river channel for about 100 feet. Enbridge has installed steel legs to stabilize that pipe.

The exposed pipes run the risk of pipelines being damaged, but no law requires Enbridge to rebury them, said Jon Wolfgram, chief engineer for the Minnesota Office of Pipeline Safety. The agency enforces federal rules for pipelines in the state, which require companies to check exposed pipes for corrosion every three years.

"There are certainly risks," he said. "If you had log jams, and things like that could put a pipeline at risk, yes."

Wolfgram said the risks increase the longer a line is exposed. But determining the level of risk is up to Enbridge, not the Office of Pipeline Safety, he said.

It's unclear how long the pipes have been exposed, but Wolfgram said they were during the only time a state inspector visited the site, in 2007.

Although federal regulations specify how deep pipelines must be buried, Wolfgram said the rules only apply during initial construction.

"If it does become exposed, it more or less becomes a requirement for the operator to monitor that and inspect it," he said. "But there isn't necessarily any requirement making them bury the pipeline again."

An Enbridge crude oil pipeline is exposed by erosion where it crosses the Tamarac River in rural Marshall County. *Dan Gunderson/MPR News*

Wolfgram said he is aware of several locations across the state where exposed pipelines cross rivers or ditches. Enbridge has detected exposed pipes at a handful of Minnesota river crossings.

Enbridge, which began inspecting exposed pipes at the northwest Minnesota site in 2009, has determined the lines are safe and do not pose any risk said Haase, the company spokesperson. Initially, she said the company conducts risk assessments at the site and did not plan to rebury the pipes.

"We have Enbridge crews out there every couple of weeks just monitoring that river crossing and making sure that those pipelines that are exposed are operating safely," she said.

Haase later said Enbridge is finalizing plans to stabilize one of the pipes this fall and reroute two of the lines next year. A third line is slated for replacement in 2017, she said.

The company has not yet filed any plans with the Minnesota Department of Natural Resources, which issues permits to build utilities across a river.

Such exposed lines have caught the attention of members of Congress. Some questioned if federal river crossing regulations were adequate after a pipeline crossing the Yellowstone River in Montana ruptured in 2011.

A study last year by the Pipeline and Hazardous Materials Safety Administration found "depletion of cover" was a factor in 16 significant pipeline spills at river crossings since 1991.

But the agency later told Congress no additional rules were needed.

May 7, 2015

Minnesota Public Utilities Commission
121 – 7th Place East, Suite 350
St. Paul, MN 55101-2147

RE: PL-9/CN-14-916 (Certificate of Need)
PL-9/PPL-15-137 (Pipeline Route)

Dear Honorable Commissioners,

This letter is commenting on issues with respect to the representations made in the Certificate of Need and Routing application for Enbridge Energy, Limited Partnership (Enbridge) for the proposed Line 3 Pipeline Project in Minnesota.

In Section 2, page 2-4 of the Line 3 application, Enbridge describes where they propose to relocate Line 3, which is along side of a section of the proposed Sandpiper pipeline in a new corridor from Clearbrook, MN to Superior, WI. This CON application does not acknowledge the proposed Sandpiper project nor that it is a currently unresolved contested case. The Line 3 CON application in section 2 and section 10 avoids the fact that there are several other system alternative routes currently being reviewed in the contested case. The Line 3 CON application is incomplete by not addressing the contested case and these system alternative routes. *Please deem the Line 3 CON application incomplete until the Commission has made its decision regarding the CON of the proposed Sandpiper due to Enbridge's insistence that Line 3 be laid along side of the proposed Sandpiper in a new corridor*.

If the Commission decides that the proposed Sandpiper Preferred Route (where Line 3 is described to follow on page 2-4) in the contested case will not be used or will be located instead along another system alternative route, then both the Line 3 CON and route application should not only be considered incomplete, but the whole application as written - denied. *If the Commission decides the route as described in this Line 3 application will not be used for the proposed Sandpiper, then by default Line 3 should not be allowed to use the route either.* The DNR, MPCA and Parties should not have to duplicate their efforts on the proposed Sandpiper here for the Line 3 Application. The DNR, MPCA and Parties should not have to continue to contest a route that the applicant has not done a comparative environmental impact analysis. *Therefore, please deem this Line 3 route application as incomplete until the Commission has decided upon both the CON and the route for the proposed Sandpiper.*

Under MEPA, the proposed Sandpiper and Line 3 are connected actions, which require an EIS. Neither an EIS nor a compliant EAS has been completed and has not been submitted with this application; thus, *please deem both the Line 3 CON and Route applications as incomplete until this requirement of a compliant EAS has been fulfilled.*

On page 2-8 of the Line 3 CON application in Table 2.2-1, Enbridge states the U.S. Army Corps of Engineers application will be submitted in July 2015. This is of concern. Enbridge/NDPC stated in the proposed Sandpiper CON application that they applied in

February 2014, but the application had been returned incomplete and has not been resubmitted. This application initiates Federal and State Agencies working together on Environmental Review. By promising to apply in the future, Enbridge and NDPC are continuing to stall and avoid initiating the federal environmental review (EIS). *Please require the Applicant to follow through on submitting a compliant application to the USACE and required proof of the status of a completed application from the USACE before accepting completion of the Line 3 CON and route application.*

The CON application Section 9, J. State Designated Areas is incomplete. Enbridge writes that the Project will not cross any state critical areas…etc. but does not acknowledge the DNR and MPCA concerns over risks to critical state resources downstream from oil spills. This application is incomplete without recognizing DNR and MPCA expressed concerns in letters filed on the record of the proposed Sandpiper pipeline.

The CON application Section 9, K. Historic, Cultural, & Archaeological Resources is incomplete. Culture is not only historic, but also a living and existing part of people's lives now. What is missing in this application is direct contact with the Native American communities. In the evidentiary hearing for the proposed Sandpiper, it was clear that websites with datasets on Native Cultural Resources were available that Enbridge/NDPC did not even inquire about. This application shows the continued avoidance of the responsibility to directly contact the tribes within the ceded territories, who have wild rice and other significant cultural resources that will be impacted. *We are asking the Commission to please require Enbridge to follow through on this responsibility to make contact with, specifically identify, report potential impacts to, and plans to address these impacts on cultural resources like wild rice before you consider this application complete.*

Under CON Section 9, Subpart 5, pages 9-25 called "Estimate of the number of people that would have to relocate if the pipeline were constructed." What is incomplete is the actual data: number, description, location, etc. And, the wording needs to be changed to reflect what Enbridge has already done on their Preferred Route to the people in these homes where they have already been forced to relocate ***long before*** this project, and the proposed Sandpiper's CON and route have been resolved.

In the Line 3 CON application, Enbridge says they have no other projects planned. In a news article dated July 29, 2014 written by Dan Gunderson from MPR.org , http://www.mprnews.org/story/2014/07/29/enbridge-pipelines-exposed he writes an Enbridge spokesperson admitted they have plans for more than just Line 3. The spokesperson said they plan to "reroute two of the lines next year." Line 3 is one of these 2 lines. And the spokesperson continued, "A third line is slated for replacement in 2017." These are existing lines in the Northern Mainline Route, which Enbridge plans to replace. *This CON application is incomplete without including these plans, and considering the cumulative impacts.*

On page 10-25 in section 10-4 of the Line 3 CON application, Enbridge states it cannot expand the capacity of one or more of the existing pipelines on the existing Mainline System. When in fact, the project can be fulfilled by replacing Line 3 in place on the Northern Mainline Route by removing the current Line 3 pipe and putting the new pipe back in the same place in the ground. This is considered non-proliferation and an important part of the law to avoid unnecessary degradation of Minnesota's forests, waters and environment by requiring efficient use of existing pipeline routes.

This application is incomplete without discussing the environmental vs. economic considerations for removal of Line 3 with replacement within the current Northern Mainline Route. There is some mention in 11.1.4 with a reference to section 6 in the route application of why Enbridge does not want to do this, but what is incomplete is a clarification of costs, which Enbridge may not want to pay to protect Minnesota's precious environmental resources by more efficiently using the corridor they already have. Abandoning a pipeline on the existing route and adding to a new corridor has increasing cumulative impacts when considering Enbridge's plans to replace and move at least 2 more pipelines in addition to Line 3. For the Commission to have clarity, the application needs to include: in part C of Section 4, how many more jobs (FTE's) for removal with replacement would add and compare this to the total economic benefit of the Project; the cost of removal with replacement; what savings Enbridge would receive with @50 miles less of clearing right-of-way, pipe and installation; what savings Enbridge would receive from not having to seal and monitor the old pipe indefinitely, and the benefit of less impact to the environment. One area to show benefit to the environment could be summarized by adding to Table 9-1.2.E-1 to compare in Land Cover Impacts by County for removal with replacement vs. the cumulative impact of adding another pipeline to a new corridor. The cost of removal and cleanup of previously leaked crude oil still in the ground surrounding the pipe are costs Enbridge should bear instead of future tribes, federal, state or individual landowners. Other petroleum companies, i.e. gas stations, are required to remove and clean up their sites at the end of operation. The Line 3 CON and route applications are not complete without this analysis.

The following are not detailed in Section 11.1.2-3 under the list of what they plan to do with the current Line 3 and need further detail before the application is complete:

> (1) *How do they plan to safely dispose of the discharge from within Line 3* that is called "transported liquid and vapor with an inert material"? In reality this contains crude oil with hazardous chemicals from the oil and whatever liquid, plus cleaning agents. Enbridge should not be allowed to simply dump these contents into a waterway or upon the ground somewhere along the route. It is not enough for Enbridge to say they will follow Federal or State regulations. Enbridge needs to clearly state the composition of these chemicals and how they plan to protect the environment and properly dispose of these contents.
>
> (2) How do they plan to support the existing Line 3 where it is exposed to the elements by design or erosion? It is not enough to seal the ends. When the pipeline is exposed it can also be a hazard to emergency personnel, children and the public. It is not enough to say they will follow Federal or State regulations. Enbridge needs to clarify a long-term safety plan for exposed sections of Line 3. In the attached article by Dan Gunderson, he describes an example of where Enbridge pipelines are suspended across a river and along the channel. These portions of the pipe risk being damaged by the elements, flood and debris. The pipe inspector quoted in the

article said he is “aware of several locations across the state where exposed pipelines crosses rivers or ditches”. *The application needs to specifically identify each of the sites where line 3 is exposed and describe their long-term plan for keeping each portion sealed, supported and safe for the public.*

(3) Again, it is not enough to seal the ends. *How do they plan to seal the portions of Line 3 in which they already admit in section 1 page 1-7, that “Enbridge’s pipeline maintenance program has revealed corrosion growth and other pipe material flaws that have impacted the operating capabilities of the pipeline”?* These areas need to be identified in the application and clarified on how they plan to seal and maintain the seals long-term in these areas.

Enbridge continues to avoid identifying how much capacity is available for barge or shipping over the Great Lakes. Calumet Refinery in Superior, WI initiated upgrade to a site in the harbor for loading crude oil for shipment over the Great Lakes. This project is waiting on full environmental review, but is serious enough that the Great Lakes Commission is in a process of a year-long study. *Enbridge is proposing additional volume of crude to be transported over Line 3 and is the supplier of crude oil to Calumet Refinery. This application is incomplete without addressing this concern.*

Overall, we ask that both the Line 3 CON and route applications be considered incomplete. The application lacks a compliant EAS and lacks a detailed environmental vs. economic analysis for Line 3 removal with replacement option on the existing Northern Mainline route. We ask that Enbridge be held accountable to complete a compliant application to USACE ***before*** accepting completion of the Line 3 CON and route application. Please also hold Enbridge accountable to its responsibility to the Native American tribes before the application is considered complete. And, *because Enbridge insists on placing this Line 3 upgrade along side of the proposed Sandpiper, it is critical the decisions made by the Commission for the contested case on the CON and route permit of the proposed Sandpiper are* ***determined before*** *this Line 3 application is allowed to go forward as being considered complete.* **And, a denial of the proposed Sandpiper route needs to be a denial of the Line 3 route; and changes to the proposed Sandpiper’s route needs to be changes to the route in this Line 3 application before it is considered complete.**

Transparency, collaboration and cooperation are key skills lacking in this company. We wish that Enbridge could be directed before the decisions are made on their proposed Sandpiper and Line 3 applications, to work as a partner in a group, including: other energy providers, the tribal communities, federal/state/county agencies, landowners and the public to create a long-term and sustainable plan for Minnesota’s energy needs with the least impact to our environment.

Sincerely,

Sandy and Craig Sterle
2676 County Road 104
Barnum, MN 55707
218-384-4054

Erosion exposes Enbridge oil pipelines near river in NW Minn.

Environment

Dan Gunderson · Moorhead, Minn. · Jul 29, 2014

An Enbridge crude oil pipeline is exposed by erosion where it crosses the Tamarac River in northwestern Minnesota. *Dan Gunderson/MPR News*

. LISTEN Story audio 4min 18sec

Like many streams in the Red River Valley, the Tamarac River twists and winds its way across the northwest Minnesota landscape.

Constantly changing shape as floodwater erodes the soil, the Tamarac flows into the Red River about two hours north of Moorhead.

But in a grassy swath carved out of trees that flank the river, the channel's normally placid brown water is broken by pipelines spanning the Tamarac.

Flooding has uncovered three of seven Enbridge

Corporation pipelines that cross the river, pipes that largely carry crude oil from Canada across Minnesota. Although the pipelines generally are buried three to four feet below ground, in some places erosion has exposed them to the elements.

Pipelines are visible in this image from Google Maps:

Chad Jerome, a local farmer, said he has seen an exposed pipe in the spot for the 14 years that he has planted and harvested fields along the river. But until recently he didn't realize how many pipelines were uncovered.

"I guess I have faith that Enbridge knows what they're doing and that safety measures are in place and it's not an issue," Jerome said.

The three exposed lines include a 24-inch pipe, constructed in the early 1960s, a 34-inch line built about 1968, and a 20-inch pipe laid in 2010, Enbridge spokesperson Becky Haase said the lines flow across Minnesota to Superior, Wis.

Some pipes are suspended across the river channel, which is about 30 feet wide. In one case, a pipe is exposed along the river channel for about 100 feet. Enbridge has installed steel legs to stabilize that pipe.

The exposed pipes run the risk of pipelines being damaged, but no law requires Enbridge to rebury them, said Jon Wolfgram, chief engineer for the Minnesota Office of Pipeline Safety. The agency enforces federal rules for pipelines in the state, which require companies to check exposed pipes for corrosion every three years.

"There are certainly risks," he said. "If you had log jams, and things like that could put a pipeline at risk, yes."

Wolfgram said the risks increase the longer a line is exposed. But determining the level of risk is up to Enbridge, not the Office of Pipeline Safety, he said.

It's unclear how long the pipes have been exposed, but Wolfgram said they were during the only time a state inspector visited the site, in 2007.

Although federal regulations specify how deep pipelines must be buried, Wolfgram said the rules only apply during initial construction.

"If it does become exposed, it more or less becomes a requirement for the operator to monitor that and inspect it," he said. "But there isn't necessarily any requirement making them bury the pipeline again."

An Enbridge crude oil pipeline is exposed by erosion where it crosses the Tamarac River in rural Marshall County. *Dan Gunderson/MPR News*

Wolfgram said he is aware of several locations across the state where exposed pipelines cross rivers or ditches. Enbridge has detected exposed pipes at a handful of Minnesota river crossings.

Enbridge, which began inspecting exposed pipes at the northwest Minnesota site in 2009, has determined the lines are safe and do not pose any risk said Haase, the company spokesperson. Initially, she said the company conducts risk assessments at the site and did not plan to rebury the pipes.

"We have Enbridge crews out there every couple of weeks just monitoring that river crossing and making sure that those pipelines that are exposed are operating safely," she said.

Haase later said Enbridge is finalizing plans to stabilize one of the pipes this fall and reroute two of the lines next year. A third line is slated for replacement in 2017, she said.

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Such exposed lines have caught the attention of members of Congress. Some questioned if federal river crossing regulations were adequate after a pipeline crossing the Yellowstone River in Montana ruptured in 2011.

A study last year by the Pipeline and Hazardous Materials Safety Administration found "depletion of cover" was a factor in 16 significant pipeline spills at river crossings since 1991.

But the agency later told Congress no additional rules were needed.

December 5, 2013

Minnesota Public Utilities Commission
121 – 7th Place East, Suite 350
St. Paul, MN 55101-2147

Sent VIA Email: PublicComments.PUC@state.mn.us

RE: PL-6668/CN-13-473 (Certificate of Need)
PL-6668/PPL-13-474 (Pipeline Route)

Dear Honorable Commissioners,

This letter is commenting on issues of fact with respect to the representations made in the Certificate of Need application for Enbridge Pipeline (North Dakota) LLC for the proposed Sandpiper Pipeline Project in Minnesota. This application seems to propose a new *single* pipeline across Minnesota. Yet, the preferred pipeline route would open a new corridor for a single pipeline. This application proposes to enlarge the Sandpiper pipeline as it leaves Clearbrook, MN allowing it to add a significant portion of Line 81 capacity from North Dakota. And, this application does not *specifically* mention the expansion plans of Enbridge's affiliate, Calumet Refinery in Superior, WI, who is actively seeking permits to ship crude oil over Lake Superior. I am asking you to consider that the proposed Sandpiper Pipeline Project in this current Certificate of Need application seems to *lack* details and transparency to identify Enbridge's wider scope of expansion; and thus, minimizes the accumulated impact of the criteria for route selection of a new corridor and the impact on our Great Lake Superior.

On page 14 of section 7853.20 of Certificate of Need, Enbridge states "EPND has no other expansion projects being developed other than the Project described herein." First of all, they do have a current expansion project before the PUC of adding capacity through the Alberta Clipper. In the letter to landowners dated October 8, 2013, Enbridge did not specifically include their "ultimate design capacity" of 711,000 bpd from Clearbrook, MN to Superior, WI now shown in this application. Instead, the proposed Sandpiper was presented in the letter as "the initial capacity" of 375,000 bpd from Clearbrook, MN to Superior, WI. As a landowner, I was surprised to find in the Certificate of Need application that Enbridge proposes a much greater capacity than was represented in the letter to us. By not giving full disclosure in the letter, Enbridge minimized the extent of the proposed Sandpiper pipeline to landowners. I am concerned in this application that Enbridge may be minimizing the number of pipelines they are planning for a preferred new pipeline corridor. So can the question be asked of why does Enbridge propose a new corridor for just one pipeline?

Enbridge's Line 81 pipeline transports Bakken crude oil into Clearbrook, MN. On page 2 of Section 7853.0240, Enbridge does not discuss where the Line 81 capacity is *currently* being transported through their pipeline(s) on the Northern Route from Clearbrook, MN to Superior, WI. It appears that Enbridge is planning to disconnect the Bakken oil from the

Northern Route of the Mainline System by redirecting 150,000 bpd into the proposed Sandpiper to Superior, and 60,000 bpd to the Twin Cities; and then terminating the current Line 81 connection to the Mainline System. Does Enbridge plan to decommission one of their pipelines on the Northern Route? Would Enbridge be able to expand pipeline capacity of Canadian tar sands crude oil *by default* on the Northern route? By asking Enbridge these questions, it could identify any more expansion plans in this Certificate of Need application, and identify additional pipeline construction space available on the Northern Route following decommissioning an existing pipeline. In Canada, Enbridge Pipelines Inc. proposes to decommission segments of Line 3, which also goes through Minnesota on the Northern route of the Mainline System to Superior, WI.
https://camrosecounty.civicweb.net/Documents/DocumentDisplay.aspx?Id=35465
If Enbridge plans to abandon segments of a pipeline in Minnesota and the proposed Sandpiper is the means for them to do this, then this application is the place for the public to give comment and for the PUC to have the details to be able to make a determination.

On page 10 of Section 7853.0240, Enbridge writes "Minnesota's refinery capacity somewhat exceeds demand for refined products within the state". In a Minnesota House of Representative report dated June 2013, on page 4 it states "Minnesota's refineries cannot absorb additional crude supplies at this time". In the Superior Telegram news article dated February 24, 2013, Enbridge's affiliate, Calumet Refinery, announced it is seeking permits to ship crude oil across Lake Superior. The article goes on to say: "The transfer from pipeline to water-based transportation makes sense because Enbridge can bring 500,000 more barrels a day into Superior than it can send out, Podratz said".
http://www.superiortelegram.com/event/article/id/259640/publisher_ID/36/
So where will the oil go from the proposed Sandpiper? It appears the majority of the proposed Sandpiper crude oil is not for local refining, but may be planned to ship over Lake Superior, or directed farther down the pipeline system, as a replacement for Canadian tar sands crude oil, which could be planned to ship across the Great Lakes.

Is the proposed Sandpiper driven entirely by what Enbridge states on page 7 of Section 7853.0240 "to meet the transportation requirements of the Bakken oil producers and refineries"? Thus, more detail in this section is critical to determine where the crude oil is proposed to go beyond Minnesota, and to understand how much of this application is just for the oil industry to expand. For example, an additional column could be added to the table on pages 7-10 on what kind of oil each facility refines and their current ability for accepting additional capacity. And, detail is needed in page 5-7 on how much oil capacity can be absorbed now in Enbridge's pipeline system where the Sandpiper ends in Superior, WI vs. how much capacity is planned to be shipped over the Great Lakes. Since the proposed Sandpiper potentially adds capacity to both Bakken and tar sands oil (see previous paragraph) this should include both types of crude oil. Once crude oil is shipped over the Great Lakes, its destination can be significantly farther, more market driven, and more about expansion of the crude oil transportation system than about a Minnesota need.

What I am suggesting is that the proposed Sandpiper Certificate of Need application lacks transparency necessary for full and accurate review of Enbridge's proposed expansion(s). I am asking that more detail be required in this application so that significant questions can be answered; such as: why a new pipeline corridor is necessary for just one pipeline; is a pipeline in the Northern route planned to be decommissioned; is there an implied expansion of Canadian oil in the Northern route; and how much of this application is simply for the oil industry to expand crude oil transportation into the Great Lakes? By answering these questions, it gives our state the opportunity to take a step back, and to consider the impact of expansion of shipping crude oil over Lake Superior, and the accumulated impact of a new proposed pipeline corridor on our people, lands and water. I wish that Enbridge could be directed to work as a partner in a group including: other energy providers, the tribal communities, federal/state/county agencies, landowners and the public to create a long-term and sustainable plan for Minnesota's energy needs with the least impact to our environment.

We greatly appreciate your consideration in this matter.

Sincerely,

Sandy and Craig Sterle
2676 County Road 104
Barnum, MN 55707
218-384-4054

April 4, 2014

Dr. Burl Haar
Minnesota Public Utilities Commission
121 – 7th Place East, Suite 350
St. Paul, MN 55101-2147

RE: PL-6668/PPL-13-474 (Pipeline Route)

Dear Dr. Haar:

This letter is commenting on human social impacts with respect to the Application for Pipeline Routing Permit by North Dakota Pipeline Company LLC (NDPC/Enbridge) for the proposed Sandpiper Pipeline Project in Minnesota.

The human social impacts of this proposed pipeline began when Enbridge approached hundreds of landowners through their contracted right-of-way agents pushing landowners to sign survey contracts and giving the impression that landowners had no choice - that it was a "done deal" – otherwise, their property in part or in whole would be taken through eminent domain. This was in the summer of 2013 long before Enbridge's application for a Certificate of Need and Routing Permit had been filed.

As my father would say, "The problem is…" We are good people, who have lived peacefully and privately in rural Minnesota. But, we are being ***burdened*** by the use of power plays upon us and not having our landowner rights respected. It was reported in the Pine Journal on November 1, 2013 by Wendy Johnson, "Carlton County Sheriff Kelly Lake stated that dispatch records show at least one formal complaint from a landowner about Enbridge survey crews coming on their land without permission". Two days after sitting in open view of surveyors, we received a letter, in which Enbridge's lawyer claimed rights that still now have not been granted by the state, yet the letter attempted to pressure us into signing survey contracts with warnings of "formal proceedings", if we did not comply at that time. Enbridge claimed publicly that landowners were supporting the proposed pipeline because they were signing survey contracts, but in reality, landowners were being pressured into compliance.

I have a Masters degree in Educational Psychology and have had a decade of experience working in the Chemical Dependency field. I experienced and confronted power plays on a daily basis. What is a power play? It is the use of power to gain a sense of control over the other in a relationship by using "manipulative or controlling behaviors directed at keeping the relationship partners in a "one-up, one-down" melodrama". This is straight out of a pamphlet from Hazelden Educational Materials. The manipulation is directed to force the other person into an emotional state, so they have difficulty using their reasoning ability. Power plays are destructive behavior to a relationship. It prohibits building trust and circumvents honest and open communication. The concern is NDPC is pursuing landowners to sign easement contracts now even before the certificate of need is proven or the route decided, so all the facts are not available to them. And, by using power plays and offering a time-limited signing bonus, this effectively limits landowners' choices to relieving their stress, instead of having the time and state of mind to make choices in their own best interest.

There is an interview of a federal Pipeline and Hazardous Materials Safety Administration inspector, he said about building a home, "I wouldn't build it on a pipeline, because they're all industrial facilities. That's just the reality." In response to the question, but what if people are forced to have a pipeline through there property? He says, "that is unfortunate, and (pauses)…it's unfair."

http://www.truth-out.org/opinion/item/20443-just-the-reality-pipeline-safety-official-admits-hed-avoid-buying-a-home-near-pipelines-like-keystone-xl

When deciding on a route through Minnesota, please consider the social impact on how a whole new set of landowners are being treated. The Southern Preferred Route with the majority of the proposed route on private lands (76.6%) seems too great a sacrifice when the people are not given a fair opportunity to make choices with all the facts and time to assess what is best for their family.

I appreciate your consideration in this matter.

Sandy Sterle
2676 County Road 104
Barnum, MN 55707

March 31, 2014

Dr. Burl Haar, Executive Secretary
Minnesota Public Utilities Commission
121 – 7th Place East, Suite 350
St. Paul, MN 55101-2147

Sent VIA Email: PublicComments.PUC@state.mn.us

RE: PUC Docket Number PL-6668/PPL-13-474

Dear Dr. Haar:

This letter is commenting on the human impacts as to be applied on route selection for Pipeline Route Permit by North Dakota Pipeline Company LLC (NDPC/Enbridge) for the proposed Sandpiper Pipeline Project in Minnesota (EIR – 11/8/2013 and Revised EIR – 1/31/14).

In the Revised EIR in section 4.2.1 on Land Use, there is a table showing land ownership on the Preferred Southern Route as 9.2% State, 15.4% County and 75.5% Private lands. The alternative route comparison tables show state lands, but there are no statistics for comparing the County and private land ownership to different alternative routes. Figures including private and County lands may be partially included in other categories in the route alternative tables, but ***there is no transparent comparison of County and Private land ownership across route alternatives***. Land ownership patterns in north central Minnesota need to be analyzed as distributed into county, state, federal and tribal lands vs. private property owners. It seems the proposed Southern route does not match these ownership patterns. Instead, 75.5% of the route is private land where NDPC can use eminent domain to quickly acquire a right-of-way. These are lands where private citizens would not likely have the expertise to identify or authority to enforce the best construction, safety, and management practices for pipelines carrying hazardous materials. The private landowner's only recourse in disputes is through litigation afterwards. ***The Southern route should not be preferred just to meet NDPC's desire for a quick-take, to avoid expert scrutiny, and to choose landowners who have the least legal recourse.***

My husband did a search in the Duluth area (largest city in the Northland) for lawyers with experience to represent landowners in negotiations. He found very few, who were not working for the pipeline industry already. This results in private landowners having very limited access to local legal resources, and then, private landowners will most likely be under-represented in negotiations. Because of this shortage of available experienced local counsel, this would leave private landowners vulnerable to being overpowered in negotiations. There is a concern that route selection has been based in part on legal disadvantage, which would result in less compensation to the private landowner and cheaper ROW acquisition for NDPC. ***The Southern Route should not be preferred based on cheaper ROW acquisition, but instead this legal disparity should be considered a financial burden and impact to private landowners***.

For most families, their home and land are their ***largest lifetime investment,*** one that takes the better part of their lifetime to establish, or one that has been handed down through generations. The economic impact of a new pipeline corridor, especially on land, which has no utility corridor, would have a significant negative impact on the value of both their home and land as a whole. A local resident in Blackhoof Township, who has worked as a realtor, reported it has been harder recently to sell homes and property on or near a pipeline. ***For NDPC to request to develop a route through 75.5% private land, where owners have spent a lifetime or possibly generations to acquire, just so NDPC can save on the cost of ROW acquisition, seems like an unjustifiable burden on private landowners rights.*** Especially, when NDPC would in only a few short years get a return in profits from the development of this proposed pipeline. A one-time payment to the private landowner for only the 50-foot easement does not adequately compensate for the physical and emotional investment of a lifetime of work.

The human impact of a new ROW is not only economic, but it also has health and social impacts from adding a hazardous industrial site across their property. In the Revised EIR in Table 4.3.5-1, it shows there will be 168 residences within 500 feet and 21 within 50 feet (if not removed) from the new proposed pipeline corridor. These families will be left with this burden for as long as they own their land, each wondering: is their drinking water is safe; will their pets or farm animals be safe; will they be able to afford insurance for their home with a pipeline of explosive Bakken crude nearby; as organic farmers or resort owners, will they lose their livelihood; who is motoring around their land unannounced; how will they stop ATV and snowmobile trespass; how do they limit the spread of invasive species; how can they protect their family if there is a spill; could they afford to sell at a loss; and will they develop health consequences from stress or pollution from an oil release or ROW maintenance chemicals? These health and social human impacts need to be included in the EIR, especially since the greatest land-use is private ownership.

On many private lands without existing ROW's, NDPC locates the proposed route through the middle of the property. This creates an artificial border that will limit or eliminate further development of their property. Because most people build their home and structures closer to the middle of their property, this leads to the greatest impact on the private landowner's safety, greatest impact on the value of their home, greatest sacrifice to their land's aesthetics, and greatest limits to managing and developing their property. These are impacts that must be included in the EIR, and instead, ***the least impact route should be found and chosen.***

When reading the EIR, what strikes me most is how concealed is the impact on the landowner. In the media and at meetings, it is like ***the landowner is considered collateral damage to NDPC –*** an object of nuisance, which can just be paid off or politically disempowered. When I say landowner, I am not only talking just about private landowners, but also anyone who is responsible to protect the waters and land on to which NDPC is proposing the Sandpiper route.

How you bring to awareness and quantify what is concealed is through transparent, detailed and cumulative impacts documented in the EIR. But, the EIR is only the plan, and there is little evidence that this will be followed without randomly examining ROW easement contracts, considering previous construction inspection reports and citations, and considering other plans announced, but not included in the application. For example, in the Revised EIR in 4.3.1 in the last paragraph, it states "Forested areas on the temporary right-of-way and in additional temporary workspaces will be restored to allow the natural reestablishment of forest cover". In a recent contract, NDPC has a clause of "the perpetual right to use and occupy such of Grantor's land adjacent to the Right-of-Way"... The whole, or a significant portion of the temporary space effectively will become permanent right-of-way, not as the Revised EIR states of allowing the temporary workspace to be restored to forest cover. And, Enbridge announced on March 5, 2014 as written in the Duluth News Tribune that the Line 3 upgrade could follow the Sandpiper line, so they clearly have plans to expand this new proposed corridor. These give us clues to what is concealed on how ***the real impact on the landowner will be much greater than is described in the current Revised EIR***. The EIR must give a transparent, detailed and cumulative analysis of the human economic, social and health impacts from proliferating a new pipeline corridor through Minnesota.

Please recognize that all of us who are giving you comments in opposition to the Preferred Southern Route are trying to protect Minnesota's pristine environment, to protect a sustainable livelihood, and to protect the health of our families by drawing attention to the ongoing and real threat of a second continuous hazardous industrial site through rural Minnesota. We are not collateral damage. In this letter, I am trying to reveal how the Preferred Southern Route is (by hiding the detail of how it impacts the landowner) crafted more in the interests of NDPC expansion, rather than considering the criteria of what route has least impact and is best for the people who live in our state.

With all these human impacts, it seems clear that the existing Northern Mainline corridor needs to be more clearly analyzed and seriously considered in the Revised EIR.

And, NDPC needs to clearly justify by analyzing least impact criteria as compared to the existing Northern Mainline corridor, why the private landowner should have the greatest burden with 75.5% of the Preferred Southern Route being located on their lands. Without this, the Preferred Southern Route should be rejected.

I greatly appreciate your consideration in this matter.

Sandy Sterle
2676 County Road 104
Barnum, MN 55707

MINNESOTA DEPARTMENT OF COMMERCE

Comment Form: Scoping

Energy Environmental Review and Analysis

Please provide your contact information. This information and your comments will be publicly available.

Name: Hilary Stoltz Phone: 218 652 3970

Street Address: 22334 Glacial Ridge Trail

City: Nevis State: MN ZIP: 56467

Email:

My comments pertain to:

- ☐ Sandpiper Pipeline Project
- ☐ Line 3 Replacement Project
- ☒ Both Projects

Perhaps Enbridge assumed they could forge ahead and install the Sandpiper Pipeline wherever they desired but this assumption was not proven to be correct when the courts ordered an EIS prior to approvals.
It is fortunate that through the vigilence & diligence of a few educated volunteers, the public & residents of Hubbard County have been allowed to give reasonable input on the proposed route. My personal fear is that it is not possible to compete on a level playing field with a billion dollar foreign corporation that is throwing millions of dollars at our governing entities & representatives, using professional lobbyists & professional spinmeisters.
Avoiding the pristine areas of Hubbard & adjacent counties where very sensitive sandy soils cannot contain small or large leaks or ruptures. Please consider the recommendations + warnings of DNR + MPCA.
My educated decision considering all facts I have been given leads me to endorse only SA05 or SA04; pending expert

If including additional pages please number them and tell us how many you are providing: ______ pages

unbiased evaluations of 3rd party scientists. & an honest EIS by agents with no conflicts.

Jerry Striegel

Last November 39 supertanker queued off the Texas coast with some 28 million barrel of crude. Their hope was to leave the ranks of the floating oil armada and find land based refinery or storage capacity. Meanwhile, land based crude transporters were feverishly trying to establish pipeline routes to both North American coastlines and inland based refineries or storage. We seem to be witness to a game of stranded asset hot potato. In early December a reported 100 million barrels of crude was afloat at sea. Last week Reuters reported 59 oil and gas company bankruptcies and the Saudis are planning 2017 IPO of Aramco. The world is awash in crude and the glut continues today.

This is relevant to the draft EIS scoping because combustion of fossil fuel does impact our environment. If there is to be any hope of maintaining a human friendly world, a minimum of 80% of today's carbon reserves must remain in the ground. If you place any stock in the scientific method and have tracked the climate change discussion, you know that 350 ppm of atmospheric carbon correlates to a world ~2°C above preindustrial temperatures. Today the atmosphere contains above 400 ppm. We have already passed 1°C of warming and at current rates the world is expected to reach the 2°C threshold by 2040. To take this a step further, the 350 ppm of atmospheric carbon correlates to roughly a trillion tons of atmospheric carbon. We have used all but 40% the allotted trillion tons.

So how does this apply to the Line 3 or the Sandpiper? In the case of Line 3, the crude supply varies from 17 and 22 percent higher atmospheric carbon loading potential than conventional crude supplies. As to the Sandpiper, in mid March the International Business Times reported the "biggest surprise for us was the lack of transparency in oil data from the Bakken." That is to say, the data is not publicly available. What can be said is that Bakken bankruptcies are rampant. Suggesting higher production energy input per barrel which correlates to higher wellhead to wheel atmospheric carbon loading. In either case, these two crude supplies expend the remainder of the trillion tons quicker than conventional crude.

Clearly, we need as much time as possible to mitigate, adapt and make the transition from our current energy supplies to sustainable replacements. So it falls to the EIS, by way of the scope, by way of our trustee, the Department of Commerce, to demand a comparison of the environmental impacts of convention oil supplies with those supplies from the Bakken and Tar Sands. It does matter. It buys us time.

From: Dennis Sutliff
To: *COMM_Pipeline Comments
Subject: Sandpiper and Line 3 Route
Date: Tuesday, April 26, 2016 1:33:20 PM

Dear Madam or Sir,

As long-time property owners and seasonal residents in the Aitkin County; McGregor area, my family and I are extraordinarily concerned with the route selection for the Sandpiper and Line 3 pipelines. Both are located in the very sensitive Big Sandy Lake Watershed, a district comprised of nearly 260,000 acres and 49 lakes. About 1/3 of the Big Sandy Watershed is wetland. While they are mosquito havens, it is precisely these wetlands that are key to the region's economy.

As you know, Aitkin and Carton Counties are poor counties with little industry. Tourism is their lifeblood. Tourism is of critical importance to the economy of the area and its residents. And it goes without saying that the tourist industry, the local businesses that it supports and the property values within the district are completely reliant on maintaining a healthy and thriving environment.

The recreational lakes, lakeshore properties and wild rice beds that lie within the Big Sandy Watershed are a product of the wetlands. The wetlands sustain the lakes and in turn, the lakes sustain the tourist industry. The diverse wildlife, fish populations, the rice beds and the waterfowl that depend on those beds require clean lands and clean waters to survive, to thrive and to provide economic opportunities to the area residents. Contamination by an oil spill would do severe harm to all of this.

While we resign ourselves to the fact that oil pipelines are - at least for a while - a necessary evil, they should be pursued with the greatest of care. They should be accomplished in manners that will reduce the potential for harm. That IS NOT the case when the routes cross major wetlands or watersheds. Those wetlands enable entire communities to exist. An oil spill anywhere within these wetlands or watershed would migrate directly to these sensitive waters and their underlying aquafers, potentially causing great harm for generations; harm that would reverberate through the entire local economy. It would have severe repercussions on the community, its people and their livelihoods.

If these pipelines are truly necessary, please, please, let's locate them where they can do the least harm. Let's not place them where an accident will have such widespread impacts.

Dennis J. Sutliff, AIA, AICP
Principal
Elness Swenson Graham Architects, Inc.
612.373.4624
www.esgarchitects.com

20571 480th Lnae
McGregor, MN
55760
Aitkin County, Shamrock
Township

From:	Dave Sutton
To:	*COMM_Pipeline Comments
Subject:	Scoping EIS comment for Sandpiper (13-473 & 13-474) and Line 3 Replacement (14-916 & 15-137)
Date:	Thursday, May 05, 2016 4:40:07 PM

Dear Ms. MacAlister,

These projects are not only good for the economy short and long term they also insure safe reliable transportation of products for many years to come. Most people want to see these built so we can feel confident our infrastructure is up to date. Please keep oil off TRAINS!!!

Sincerely,

Dave Sutton
8032 Kidd Ave
Clarksburg, WV 26301

Ingrid Kimball

From: Ryan Swanson <ryan@ulland.com>
Sent: Thursday, May 26, 2016 2:02 PM
To: MacAlister, Jamie (COMM)
Subject: Emailing: 20160526154032415
Attachments: 20160526154032415.pdf

Follow Up Flag: Follow up
Flag Status: Flagged

Categories: Purple Category

Jamie,
Hello! My name is Ryan Swanson and my mom is Betty Swanson-Peterson. She had asked me to send this information to you regarding the proposed Sandpiper Pipeline route near her house. I am trying to help her out on this pipeline issue. She does not want this pipeline on the proposed route for the Sandpiper line. It will be very close to her house.

I have attached her proposed "Alternate Route" for the pipeline that we feel is a better choice. It follows high ground for most of the route and we tried to keep it out of any swamps. It is mostly on Don Bremer, Greg Reed, Joel Reed, and Carlton County land. It will also help to move the line away from Joel Reed's house which is favorable to them. I have also attached a few letters from my mom that she had sent in on March of 2014 to your office.

Please let us know if you have any questions. We would be happy to discuss any other items you might need to know about.

Thank you for your time.

Ryan T. Swanson
218-384-5007
218-966-9822

Betty Swanson-Peterson
2211 County Road 5
Carlton, MN 55718

March 28, 2014

Larry B. Hartman, EERA Staff
Department of Commerce
85 – 7th Place East, Suite 500
St. Paul, MN 55101-2198

Re: Docket PL9 / PPL-13-474

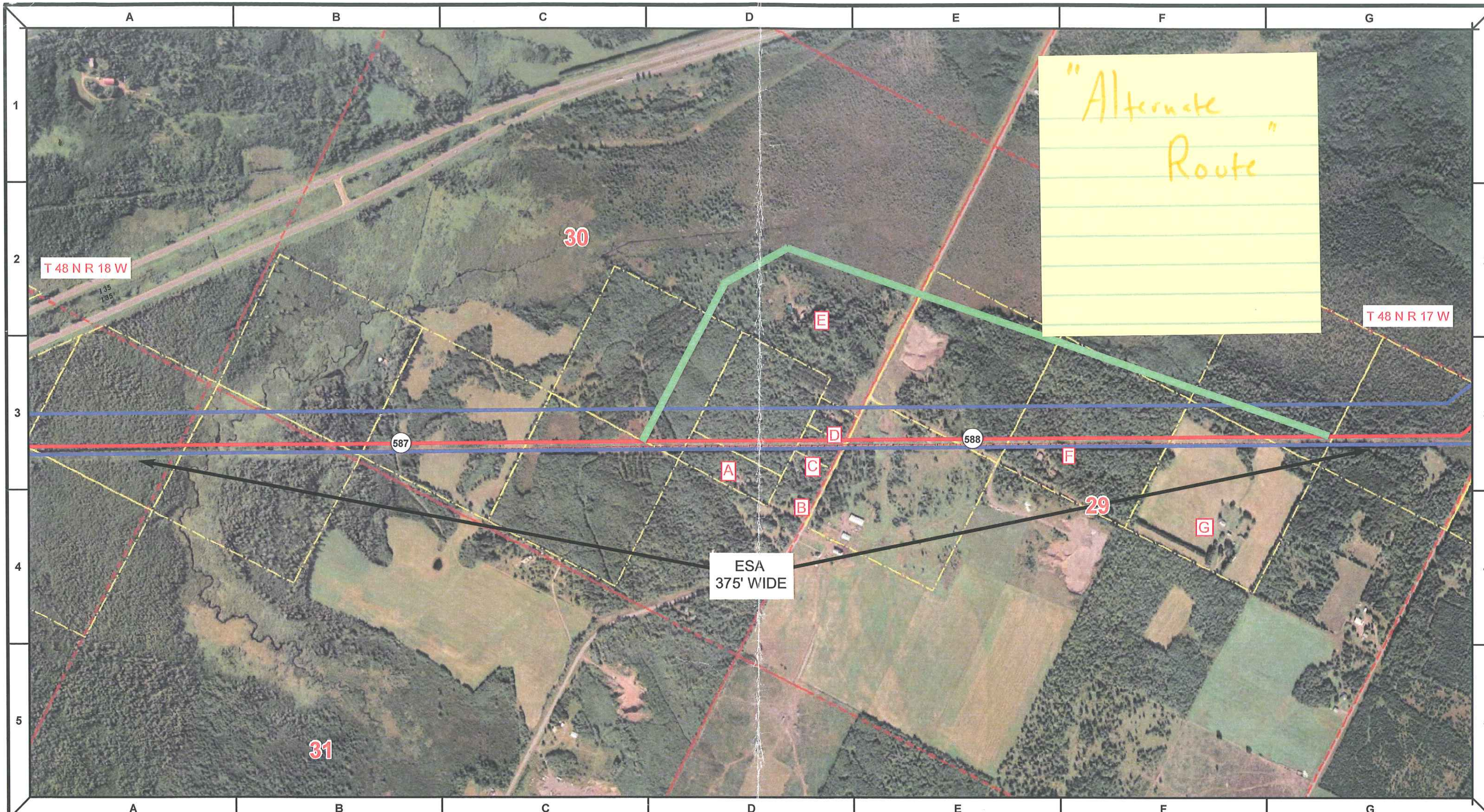
Honorable Commissioners:

This proposed pipeline will be within 215 feet of my house. I am very concerned for my safety with this oil pipeline being that close. I have heard a lot in the news about how volatile this light crude oil is and how explosive it can be. I will always have to be worried about that with this line being that close to my home. I also heard that future lines are coming, which would be even closer to my house. That is also a concern for me. I have lived here for 40 years and do not want to lose my house due to future pipelines along this proposed route. Also I feel that my house and property value will be greatly reduced with the initial pipeline and future pipelines. Please consider the alternate routes that we have provided. Thank you for your time.

Sincerely,

Betty Swanson-Peterson


5
BOUNDARY OF THE TEMPORARY WORK SPACE
THIS IS HOW CLOSE THIS PROJECT WILL BE
TO OUR HOUSE,
THIS AREA WILL BE CLEAR CUT
PLEASE USE THE ALTERNATE ROUTE
THAT IS SUBMITTED
© 2013 Google
©2010
46°36'42.43" N 92°32'03.02" W elev 1183 ft



- Proposed Pipeline - Sandpiper
- Existing Enbridge Pipelines
- Foreign Pipes
- Transmission Lines
- SPREAD BREAK
- Milepost - Sandpiper
- Potential Block Valve
- Environmental Survey Area (ESA)
- Tract Boundary
- Facility Boundary
- Previously Sited Facility Boundary
- Section Lines

500 250 0 500 1,000 Feet

DRAWN	CHECKED	APPROVED	DATE	REV NO.	DESCRIPTION
MLB			1/29/14	2	PUC Update - Revision D-2 Alignment
MLB			12/19/13	1	PUC Update - Revision D Alignment
MLB			10/10/13	0	PUC Submittal

ENBRIDGE
NORTH DAKOTA PIPELINE COMPANY LLC

PROPOSED SANDPIPER PIPELINE PROJECT
ROUTE MAP
Carlton County, MN

DRAWN: MLB CHECKED: –
DATE: Jan 30, 2014 SCALE: AS SHOWN

Spread:8 Map: 118 of 123

List of Landowners:

B) Susan Karp
2241 County Road 5
Carlton, Mn. 55718

C) ~~Stuart Swanson~~ Samuel Anderson
2231 County Road 5
Carlton, Mn. 55718

F) Joel and Debbie Reed
2237 Nendick Road
Carlton, Mn. 55718

D) Betty Swanson-Peterson
2211 County Road 5
Carlton, Mn. 55718

A) Calvin and Kristi Lindstrom
2245 County Road 5
Carlton, Mn. 55718

E) Greg and Sherry Reed
2183 County Road 5
Carlton, Mn. 55718

Betty Swanson-Peterson
2211 Co. Rd. 5
Carlton, Minn. 55718

March 25, 2014

Dear Ms. Hartman,

I am writing to you with concern in hearing that a pipeline route is planned so close to my home.

Forty-two years ago my husband-to-be took me down a beautiful wooded path and said "this is where we will build our home. Little by little we cleared the trees and started building our home. It took a few years as we would complete things as we could pay for them.

We raised a family of three surrounded by birch trees, deer, bear, chipmunks and birds. We had a wonderful view on our hill and wonderful memories.

When it came time to retire my husband enjoyed about nine months and then he was diagnosed with a brain tumor. We lost him about seven months later. This is why I treasure our home and property in memory of all he did here, and I dont want to lose it. I want his children and grand-children to be able to enjoy this also. This is the main reason I do not want a pipeline coming close to my home.

Another reason I am against the pipeline is that we have beautiful trails my brother-in-law has made which we use for walking, 4-wheeling and snowmobiling.

I have also been told of the danger of explosions and leaks in the pipeline. A danger to my home and family. The pipeline would be very close, within 225 feet of my front door. The value of my home would decrease with a pipeline so close.

I have read in the paper that once one pipeline is built, they will eventually build another. That might even take my home.

My neighbors and I are proposing a new route to get this route away from our homes. This proposal will be sent seperately from this letter. Please consider rerouting around our homes or take the northern route. Thank you.

Sincerely,
Betty Swanson-Peterson

From: malcolm Sweeney
To: *COMM_Pipeline Comments
Subject: Scoping EIS comment for Sandpiper (13-473 & 13-474) and Line 3 Replacement (14-916 & 15-137)
Date: Friday, May 06, 2016 10:00:06 AM

Dear Ms. MacAlister,

I am a father of three kids and a husband. I am also a member of local 798. This pipeline and ones like he me and other middle class hard working Americans put food on the table and some money in the bank for me and my family. The pipelines today are safer and eco friendly. I want America to stay strong and clean. None of us pipeliners want to see America polluted, all we want is a good job and a job done right the first time by American workers.

Sincerely,

malcolm Sweeney
309 W May St
Henryetta, OK 74437

MINNESOTA DEPARTMENT OF COMMERCE

Comment Form: Scoping

Energy Environmental Review and Analysis

Please provide your contact information. This information and your comments will be publicly available.

Name: DEAN SWENSON Phone: 218-435-6221

Street Address: 30503 360TH AVE SE

City: FOSSTON MN State: MN ZIP: 56542

Email: Don't Have E Mail

My comments pertain to:

- ☐ **Sandpiper Pipeline Project**
- ☐ **Line 3 Replacement Project**
- ☒ **Both Projects**

I wood START THE SANdpipEr proJect ASAP. I Live Along THE North Dakota line in the FOSSTON Area I Drive Truck FOR A living and i See A lots of Rail cars moving oil ALL 48 States they Are Dangerous it don't make Any sense to move oil by Rail when you can Ship oil by pipeline by the way North Dakota Aproved it if you look up on the computer you will see lots of Rail Road tanker tipped over like west virgina or canada or North Dakota, this project wood be good for Nathern Minn and North dakota ps Start ASAP

Dean Swenson

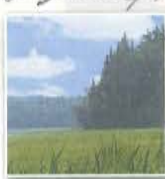
If including additional pages please number them and tell us how many you are providing: ________ pages

Mississippi River Headwaters
Itasca State Park
Minnesota
Photo © D.J. Nordgren

MINNEAPOLIS MN
23 MAY 2016 PM

Greetings from Elk Rapids

At the recent hearings of Sandpiper/Line 3 pipelines the vast majority of lake country residents voted NO to allowing it to be routed through the lakes, rivers, streams and aquifer of the PR area. Your EIS must include alternate routes that would move the pipeline corridor out of MN pristine waters. Do your job and protect our economy and our water resources. Nancy Terhart - 8181 Woodland Rd



8-U

Pub.# © NMN, Inc. 88889 South Lanning, Crosslake, MN 56442

POST CARD

Address

Jamie MacAllister
MN DOC
85 7th Place East
Suite 500
St. Paul, MN
55101

SPACE BELOW RESERVED FOR U.S. POSTAL SERVICE

MINNESOTA DEPARTMENT OF COMMERCE

Comment Form: Scoping

Energy Environmental Review and Analysis

Please provide your contact information. This information and your comments will be publicly available.

Name: Nancy Terhark Phone:

Street Address: 818 Woodland Ave

City: Park Rapids State: MN ZIP: 56470

Email: nancyterhark@gmail.com

My comments pertain to:

- ☐ **Sandpiper Pipeline Project**
- ☐ **Line 3 Replacement Project**
- ☒ **Both Projects**

- The Straight River Aquifer that provides water to the city of Park Rapids. It has been compromised by nitrates from neighboring farms and businesses already. As you do your scoping please give it a complete scientific and honest evaluation.
  Also consider what plans & who would pay for a clean up if a spill should happen.

- Everyone involved in the EIS should read the dilbit study.

Spills of Diluted Bitumen from Pipelines (2016)
A comparative study of Environmental Fate, Effects & Response
National Academies Press

If including additional pages please number them and tell us how many you are providing: ________ pages

MINNESOTA DEPARTMENT OF COMMERCE

Comment Form: Scoping

Energy Environmental Review and Analysis

Please provide your contact information. This information and your comments will be publicly available.

Name: Chris Thacker Phone: 218-728-5151

Street Address: 8 Sunnyside ST

City: Duluth, State: MN ZIP: 55808

Email: Chris@Local1091.com

My comments pertain to:

- ☐ Sandpiper Pipeline Project
- ☐ Line 3 Replacement Project
- ☒ Both Projects

I have helped build many Pipelines Throughout MN + WI. Every pipeline was built safely and effiently! The pipelines are the Safest way to move oil. The Lands and field are restored to better than what they were to begin with

In 2009-2010 My house was Close to going into foreclosure. Luckily I was able to work on Line 67. My Self + my family were able to Save our house.

1) Pipelines move oil Safely and efficiently
2) Pipelines create Jobs
3) Pipelines free up the rail System to move other goods
4) Pipelines increase tax base for areas

Please aprove these pipelines

Thanks, Chris Thacker

If including additional pages please number them and tell us how many you are providing: ______ pages

From:	Ashley Nerhus
To:	*COMM_Pipeline Comments
Subject:	Line3 Replacement and Sandpiper Projects
Date:	Tuesday, May 24, 2016 1:37:37 PM
Attachments:	Support of the Pipelines - TRF Chamber.docx

Jamie,

Please find attached a letter from Thief River Falls Chamber of Commerce that contains our thoughts on the Line3 Replacement and Sandpiper Pipeline Projects.

Sincerely,

Ashley Nerhus, Executive Director
Thief River Falls Chamber of Commerce
102 Main Ave N
Thief River Falls, MN 56701
218-681-3720

To Jamie MacAlister and the Department of Commerce,

The development of the Line 3 and Sandpiper Pipeline are major and important projects for the state of Minnesota. As director of the Thief River Falls Chamber of Commerce, I can verify that the benefits will be felt statewide – not simply along the route. Sandpiper and Line 3 will ensure the safe delivery of abundant, dependable energy that is vital to Minnesotans' homes, fueling cars and airplanes, and generating electricity for residential and industrial use.

A fair, timely, and final evaluation of this project has been delayed for far too long. Any entity attempting to do business in Minnesota relies on a predictable and timely regulatory process. I ask that the Department of Commerce adhere to the 280-day time limit to prepare the EIS to keep the project on track.

The scope of the EIS is vital. It needs to serve the public and private purpose of the Sandpiper project. It should not be so narrow that it would be inadequate, but it should also not be too broad. This balance must be met.

The economic benefit, safety of shipping oil through pipelines, and public support for this project should emphasize the importance of seeing this process through, in a timely and effective manner.
Thank you for the work you do for the state of Minnesota and thank you for your dedication in moving this project forward.

Sincerely,
Ashley Nerhus
Executive Director
Thief River Falls Chamber of Commerce

MINNESOTA DEPARTMENT OF COMMERCE

Comment Form: Scoping

Energy Environmental Review and Analysis

Please provide your contact information. This information and your comments will be publicly available.

Name: Linda Thompson Phone: 218 768 2846

Street Address: 20692 St Hwy 210

City: McGregor State: MN ZIP: 55760

Email:

My comments pertain to:

- ☐ **Sandpiper Pipeline Project**
- ☐ **Line 3 Replacement Project**
- ☒ **Both Projects**

I am very much FOR the Enbridge Projects. The pipeline going through Aitkin County will be beneficial to the taxpayers here.

I believe the pipeline will be much safer than transporting oil by rail or truck. And in the long run be SAFER and MORE Environmentally preferred than the rail or trucks on the highway.

After seeing how the pipeline is in Alaska I more understand the safety checks that can be employed to keep the pipeline safe.

I am a township supervisor & feel this project will be an asset to our area.

The biggest disappointment regarding this project is the LONG DELAY in getting it going!!!

Linda Thompson

If including additional pages please number them and tell us how many you are providing: 1 pages

From:	Sue Tomte
To:	*COMM_Pipeline Comments
Subject:	Public comment Sandpiper & L3
Date:	Tuesday, May 24, 2016 10:07:28 AM

Ms MacAlister --

In regards to the following PUC docket numbers
PL:6668/CN-13-473; PPL-13-474
PL-9/CN-14-916; PPL-15-137

Every single contractor, sub-contractor and consultant doing business with Enbridge must go through significant Safety training annually – even those who may never set foot on any construction site.

Doing business with Enbridge demands a higher level of safety awareness and standards on all aspects of conduct. This isn't just a 'check the box' activity, there is a culture of safety within this organization --***every person***, ***every day***. With conscious and consistent efforts to stress personnel (and personal) safety, environmental safety, sound procedural processes, plus detailed accountability and reporting, the Company is demonstrating the seriousness of doing business the right way.

Enbridge's people [employees and contractors] are trained, prepared, aware and concerned about all aspects of safety. The proposed routes are selected because they represent paths of least disturbance on a human, environment and economic impact, based on tens-of-thousands of man-hours of study and evaluation. As you proceed with the EIS please take into consideration Enbridge's significant emphasis on safety and the amount of work that has been done to carefully study route options. Please keep the EIS scope focused and complete the review in a timely manner.

Thank you for the opportunity to comment.

Susan Tomte
Park Rapids Community Ambassador for Sandpiper & Line 3
218-255-5776
stomte@gmail.com

MN Public Utilities Commission - Sandpiper/Line 3 EIS Comment

Name Dan Trepanier Email

Street Address 2352 radar Road

City Bemidji State MN Zip 56601

Jobs / Tax Revenue

Comment Ideas:

✓ - No pipeline has ever been studied more, stop the delays

✓ - The environmental review plan is good enough, let's get it going

✓ - Look at jobs and other benefits to communities, not just natural resources

✓ - Pipelines are safe, just ask people who build and live next to them

✓ - Don't forget to look at the danger of moving oil by rail

(Please print legibly)

Our staff will electronically file your comments on the MN PUC website. Thank you for your time!

MN Public Utilities Commission - Sandpiper/Line 3 EIS Comment

Name Joe Trepanier Email

Street Address 5810 Blueberry Ln. N.W

City Bemidji State MN Zip 56601

Hundreds of Jobs!

Comment Ideas:

✓ - No pipeline has ever been studied more, stop the delays

✓ - The environmental review plan is good enough, let's get it going

✓ - Look at jobs and other benefits to communities, not just natural resources

✓ - Pipelines are safe, just ask people who build and live next to them

✓ - Don't forget to look at the danger of moving oil by rail

(Please print legibly)

Our staff will electronically file your comments on the MN PUC website. Thank you for your time!

MN Public Utilities Commission - Sandpiper/Line 3 EIS Comment

Name Steve Trepanier Email Treps@paulbunyan.net

Street Address 5810 Blueberry Lane N.W

City Bemidji State MN Zip 56601

Jobs, Jobs, Jobs, Tax Revenue, Huge economic impact,

Comment Ideas:

- No pipeline has ever been studied more, stop the delays
- The environmental review plan is good enough, let's get it going
- Look at jobs and other benefits to communities, not just natural resources
- Pipelines are safe, just ask people who build and live next to them
- Don't forget to look at the danger of moving oil by rail

(Please print legibly)

Our staff will electronically file your comments on the MN PUC website. Thank you for your time!

From:	Audrey Tsinnie
To:	*COMM_Pipeline Comments
Subject:	Scoping EIS comment for Sandpiper (13-473 & 13-474) and Line 3 Replacement (14-916 & 15-137)
Date:	Saturday, May 07, 2016 3:40:05 PM

Dear Ms. MacAlister,

Dear Ms. Jamie MacAlister,

I am in support of the pipeline but would like to see old abandoned pipe be totally unearthed and removed to avoid any accidental fatalities in the future. I believe newer pipelines are the most efficient and cost effective way to transport much needed fuels. In my personal professional experience I have been a part of projects in which soils that were contaminated decades ago from other non-related situations were hauled out and replaced with cleaner more appropriate fill dirt. There are many many years combined of experienced engineers and field managers that deal with best practices in leaving areas crossed while installing pipeline or rehabbing worn pipe with a much better workable tact of land. We need these fuels and are more self sufficient freeing us from importing from other countries.

Thank you for your time,
Audrey A. Tsinnie
Minnesota Resident

Sincerely,

Audrey A. Tsinnie
807 SE 14th St
Brainerd, MN 56401

From:	F.H. Tucker
To:	*COMM_Pipeline Comments
Subject:	Scoping EIS comment for Sandpiper (13-473 & 13-474) and Line 3 Replacement (14-916 & 15-137)
Date:	Friday, May 06, 2016 10:50:05 PM

Dear Ms. MacAlister,

In the 40 years that I have been in the arena of pipeline work as a welder , I do strongly feel that most of the work that all the larger gas companies plan , they plan extensively , using a good deal of time & money researching all the aspects beforehand ..... on a large scale , thoroughly researched years before approaching any governing body with a request to build a pipeline . The industries & economies that help to employ so many of the families in the local areas of construction as well as maintaining fuel supplies and employing people in other places as well , quite possibly out of state . Americans all need clean safe utilities at reasonable prices and for daily use . I can remember in the 70's the waiting lines created due to shortages of gas and oil . In some areas gas is still not an option for homes - fuel oils & coal burning power plants for electricity are used . Hurry up 280 days left to build that pipeline & help us all . Thank you

Sincerely,

F.H.Tucker
907 Oakhollow Rd
Eastland, TX 76448
f_tucker13@yahoo.com

From:	Alex Ugalde
To:	*COMM_Pipeline Comments
Subject:	Scoping EIS comment for Sandpiper (13-473 & 13-474) and Line 3 Replacement (14-916 & 15-137)
Date:	Thursday, May 12, 2016 8:40:58 AM

Dear Ms. MacAlister,

Ms. Jamie MacAlister
Environment Review Manager
Minnesota Department of Commerce
87 7th Place East, Suite 500
St. Paul, MN 55101-2198

Ms. MacAlister,

We are writing another letter in regard to Sandpiper (13-473 & 13-474) and Line 3 Replacement (14-916 & 15-137). We as a company are in support of this line and after attending another public meeting this past week, we felt compelled as a group of proud Minnesotans, to comment on additional impacts. We understand that there are good people in our great state that are concerned about the slight chance that there would be a failure to the new line (environmental impact), but I think these same people fail to understand how low these percentages are with a new line. Especially when compared to a line that was built in the 1960's. A new line to replace Line 3 would be much more cost effective and safer for Minnesotans in the long run.

We at Innovative are a diverse group of people and personalities. We and our extended families primarily live all across western and eastern portions of northern Minnesota. Many here are Veterans or reserve military. We have many outdoor enthusiasts from hunters to marathon runners. We are a proud group of Minnesotans that live near or have family that live near the proposed line, we are passionate about our outdoor recreation and have no environmental concerns about this pipeline.

Personally speaking, my wife and I spend a good amount of time in northwestern Minnesota visiting family. For many years, we have seen the local businesses in these areas and understand their day to day struggles to keep their doors open. The economic benefits of pipeline construction and operation are so impactful to the creation of jobs, increase in tax revenue, and increase to local economic activity for local businesses. We fully support a company like Enbridge, who has proven over many years, that they will incorporate the best in materials and latest in technology to build the safest product for the people of this great state.

Thank you,

Alex Ugalde
Commercial Account Specialist
Foundation Supportworks
1100 Holstein Drive NE
Pine City, MN 55063

Sincerely,

Alex Ugalde
1100 Holstein Dr NE
Pine City, MN 55063
alex@innovativefsw.com

My name is Thor Underdahl with Minnesota Power and I am here to speak in favor of the Sandpiper and Line 3 projects proposed by Enbridge.

To ensure regional communities continue to thrive throughout Minnesota, it is essential that we invest in infrastructure for transportation of goods and services. It is incumbent upon both the public and private sector to contribute to these investments.

Sandpiper and Line 3 are projects that demonstrate responsible investment in transportation infrastructure and Minnesota Power supports these two vitally important projects.

Minnesota Power aligns with Enbridge's demonstrated commitment to the environment. Our company understands and embodies a philosophy that industrial projects can be accomplished safely while preserving the local environment. We also recognize the benefits of transporting ~~heavy crude~~ oil by pipeline rather than by rail or truck, as pipeline transportation not only requires less energy and emits much less carbon, but also relieves road and rail congestion, improving public safety.

We support and have confidence in the regulatory process and our regulators' ability to make informed decisions. Minnesota policymakers have demonstrated a history of providing appropriate oversight and regulation to ensure protection and preservation of the environment, while supporting responsible private sector growth. Minnesota Power trusts that Enbridge's commitment to the regional communities it impacts and environmental stewardship prove the company is a responsible corporate citizen and that the ~~expansion~~ projects should ~~receive approval.~~ move forward in a timely manner

Our region, state and nation depend on Enbridge's ability to deliver energy resources in a safe, environmentally responsible and cost-effective manner in order meet consumer demand and to move our country closer toward energy independence. Enbridge's responsible approach will provide a substantial return on investment to both the communities that are impacted by the projects and the State of Minnesota. I urge your support of the Sandpiper and Line 3 projects. Thank you.

MINNESOTA DEPARTMENT OF COMMERCE

Comment Form: Scoping

Energy Environmental Review and Analysis

Please provide your contact information. This information and your comments will be publicly available.

Name: Robert Walker Phone: 651-233-7584

Street Address: 6109 9th St. No.

City: Oakdale State: MN ZIP: 55128

Email: breezly@hotmail.com

5/09/16

My comments pertain to:

- ☐ **Sandpiper Pipeline Project**
- ☐ **Line 3 Replacement Project**
- ☑ **Both Projects**

My comments with regard to these 2 projects pertain to the risks to the water, in particular to the headwater area of the Mississippi & the lakes of the area. This area is cuturally & economically significant to the Ojibway people for very healthy production of wild rice & fish. These are of perpetual value. These risks are geographically greatest along the preferred routes.

The line 3 project, which would introduce more capacity for tar sands, which inherently are less free flowing & corrosive have already shown that they are very hard to impossible to clean up once they start to solidify. There is a larger question of if we want to facilitate more use of this dirtier and riskier form of oil.

All of the increasing transport & production will also bring risks to Lake Superior, which may well have greater value for water in this century than as a conduit for oil transport.

As these issues are considered I study the results of hasty extractive industries and their supporting systems. The real question here is the long term human & non economic costs. As we look into the future how much & what kind of world do we want? I oppose these projects in general but particularly the tar sands oil transport.

If including additional pages please number them and tell us how many you are providing: ______ pages

Robert Walker

Walker
City on the Bay

City Administration
205 Minnesota Ave
PO Box 207
Walker, MN 56484
Phone: (218) 547-5501 Fax: (218) 547-5513

May 25, 2016

Department of Commerce Staff,

As you know, the Sandpiper and Line 3 Replacement projects are both vital to the state of Minnesota. The development of these projects will create thousands of jobs, will ensure critical crude oil is distributed safely underground, and will provide a boost for our local economy.

As the Mayor of Walker, and a member of our local business community, I personally understand how important these projects are to the state of Minnesota. Our economy will benefit on a state-wide basis, not simply along the line. There are critical jobs in the balance, and property tax dollars needed by local governments all across the state.

A fair, timely, and final evaluation of these two projects has been delayed for far too long. The State of Minnesota needs to maintain a predictable and timely regulatory process in order to keep attracting job creators to our state. We ask that the Department of Commerce adhere to the 280-day time limit to prepare the EIS in order to keep these projects on track.

The scope of the EIS should not be overly broad, but it should also not be too narrow as to be inadequate. The scope should serve both the public and private purpose of the two projects. This important balance must be met.

Thank you for the work you do for the state of Minnesota and for your dedication to moving these projects forward.

Sincerely,

Jed Shaw
Mayor – Walker MN

From:	Justin Wallace
To:	*COMM_Pipeline Comments
Subject:	Scoping EIS comment for Sandpiper (13-473 & 13-474) and Line 3 Replacement (14-916 & 15-137)
Date:	Thursday, May 05, 2016 10:20:09 AM

Dear Ms. MacAlister,

Please consider the economic benefits that this project will bring to the local communities. Pipelines are, by far, the safest mode of transporting crude oil. Please do not delay in approving this project. Thank you

Sincerely,

Justin Wallace
16150 E Pueblo Rd
Claremore, OK 74017

Sandpiper Pipeline
PPL-13-473
CN-13-474

Line 3 Pipeline Replacement Project
PPL-15-137
CN-14-916

Phillip Wallace, business Agent for Pipeliners Local Union 798. I represent the pipeline welders, welder helpers, and pipefitters in the state of Minnesota that will help build the Enbridge Sandpiper Pipeline and the Line 3 Replacement if the permits are issued.

Enbridge's environmental program is second to none in the pipeline industry. The state of Minnesota, is what I call their home base in the United States. Enbridge spares no expense in choosing the contractors to do their work in Minnesota with trained workers from all the 4 union crafts. My craft of Pipeline Welders do all the welding with the latest technology in the welding field. While the Operating Engineers, International Laborers, And the

Teamsters do the dirt work and all the environmental work from the very start of the job to the final restoration where they leave the land and streams as good as or better than when they started. These workers have extensive training in the environmental field where they specialize in that type of work.

The environment and public safety is at risk when this Crude Oil is transported by rail or truck. The safest way to transport any liquid product in by a new state of the art pipeline built with the best materials, best craftsmanship, and a maintenance program to monitor its performance 7-24. Enbridge's pipelines are engineered and designed with emergency shutdown systems and back up emergency plans. Put the liquid product in a steel pipe and take it out hundreds of miles away without any exposure to the environment or the public. The Sandpiper Pipeline will bring American Crude from the Bakkun oil Field of North Dakota to be marketed in Superior Wisconsin.

Enbridge is also wanting to replace an old out dated pipeline, the Line 3 Replacement Project that runs across Minnesota. This pipeline will be taken out of service and replaced with a new pipeline to move Crude to market so the US can keep prices cheaper at the pump for us all.

The issue here is what can be done to help the Minnesota Department of Commerce have new ideas to draft an ESI.

I think the best idea for the Environment and public safety, is to put it in a pipeline and keep it off the rail and road.

I ask for the decision to be made within The 280 day Clock.

Phillip Wallace

MINNESOTA DEPARTMENT OF COMMERCE

Comment Form: Scoping

Energy Environmental Review and Analysis

Please provide your contact information. This information and your comments will be publicly available.

Name: Phillip Wallace Phone: 918-606-9459

Street Address: 724 Honeysuckle Rd.

City: Bald Knob State: Arkansas ZIP: 72010

Email: phillip@local798.org

My comments pertain to:

- ☐ **Sandpiper Pipeline Project**
- ☐ **Line 3 Replacement Project**
- ☑ **Both Projects**

I support Both Projects for many reasons.

1. This Country can't Survive without Energy. Crude Oil is a product in every human being's every day Needs from Gasoline for our Cars To diesel fuel to move products such as food To medical supply's. Our farmers have to have fuel to feed This Country.
2. Generate electricity, heat our homes, build homes.
3. Public Safety and Protect the enviroment by putting this Crude in a Pipeline and get it off The railroads and our hiways. Railroad derailments hauling crude has killed many citizens that live on ~~the~~ or close to Railroads.

If including additional pages please number them and tell us how many you are providing: 1 of 2 pages

MINNESOTA DEPARTMENT OF COMMERCE

Comment Form: Scoping

Energy Environmental Review and Analysis

Please provide your contact information. This information and your comments will be publicly available.

Name: Phillip Wallace Phone: 918-606-9459

Street Address: 726 Honeysackle Rd

City: Bald Knob State: Arkansas ZIP: 72012

Email: phillip@local798.org

My comments pertain to:

- ☐ **Sandpiper Pipeline Project**
- ☐ **Line 3 Replacement Project**
- ☑ **Both Projects**

One Small Town in ~~Quebec~~ Canada was burned to the grown and 47 Life's were lost in One Runaway Train wreck.

That Should be enough to stop this Madness of Crude ~~and~~ Truck and Trains hauling This Liqaid product.

It has been 2 ½ years of Trying to Permit These pipelines. Today sounds Like it will be another year and a half.

Thats To Long to Let Warren Buffett get richer hauling crude on his Railroad. with many Train wreck's To Come

Phillip Wallace

If including additional pages please number them and tell us how many you are providing: 2 of 2 pages

MINNESOTA DEPARTMENT OF COMMERCE

Comment Form: Scoping

Energy Environmental Review and Analysis

Please provide your contact information. This information and your comments will be publicly available.

Name: Mike Warner Phone: 612-840-4552

Street Address: 40589 Golden Ave.

City: North Branch State: MN ZIP: 55056

Email: mwarner@Liunagroc.com

My comments pertain to:

- ☐ **Sandpiper Pipeline Project**
- ☐ **Line 3 Replacement Project**
- ☒ **Both Projects**

I think the proposed route is fine. Most of the route already has pipe in the ground.

The oil is going to move one way or another. this pipe line will be placed by skilled trades men & women and be the safest way to move it.

Don't forget the damage and congestion transport by truck will further do to our already in need of repair roads & bridges.

Thank you to the MPCA, MN DNR and all other agencies involved. This project has been studied enough already let's move it forward.

If including additional pages please number them and tell us how many you are providing: ________ pages

- looking at carbon emissions from whole process, not just the construction
  - from creation to when it is burned
- expanding the possible oil spill scenarios to all major rivers and lakes that would be impacted. All of these should be looked at and the effects of spills on all of them should be analyzed. What impact will they have on our water and how will they financially impact the communities surrounding them

Isabel Watson.

* I am concerned about pipelines because of their effects on water and the communities that surround them. I am currently in 11th grade, and this is especially concerning to me because I know that if these pipelines are put in place it will be my generation that will feel the impacts most and have to clean them up.

robust + scientifically accurate

I think when doing the EIS for the Sandpiper and Line 3 we need to expand the possible oil spill scenarios to study all the major rivers, lakes, + watersheds that will be impacted, not just seven. These should all be analyzed to see the effects a spill will have on our water and how they will financially impact the communities living around them.

Additionally, it is good climate change is included, but it must be included in a robust and scientifically accurate way. Specifically, when looking at carbon emissions, we must look at the whole process from extraction to when it is burned. Just looking at the emissions from construction is not enough and would not be an accurate representation of the oil pipelines effect on climate change. These should be compared to the effects of the no build option.

TOM WATSON [redacted]

The ABC's of
The Environmental Review Process

A Fact Sheet for Citizens with Instructions for Filing a Citizens' Petition

The Minnesota Environmental Policy Act of 1973 established a formal process for reviewing the environmental impacts of major developmental projects. The purpose of the review is to provide information to units of government on the environmental impacts of a project before approvals or necessary permits are issued. After projects are completed, unanticipated environmental consequences can be very costly to undo, and environmentally sensitive areas can be impossible to restore. Environmental review creates the opportunity to anticipate and correct these problems before projects are built. The process operates according to rules (legally binding regulations) adopted by the Environmental Quality Board, but it is carried out by a local governmental unit or state agency (which is termed the RGU, for Responsible Governmental Unit). The primary role of the EQB is to advise local units and state agencies on the proper procedures for environmental review and to monitor the effectiveness of the process in general.

SHOULD BE A "WIN-WIN"

The EIS and EAW

Prior to any governmental approval of a project with potential for significant environmental effects, an Environmental Impact Statement (EIS) must be prepared. An EIS identifies the likely environmental impacts of the project along with ways to lessen or avoid significant impacts either through alternative means of accomplishing the project or by redesigning aspects of the project.

There are two routes to an EIS -- it may be mandatory or it may be ordered by a unit of government upon the determination that a project has potential for significant environmental effects EISs are mandatory for projects whose nature, size, or location makes it inevitable that there is the potential for significant environmental effects. When not mandatory, case-by-case decisions on the need for an EIS are based on a six-page questionnaire about the project and its potential environmental effects called an Environmental Assessment Worksheet (EAW).

An Environmental Assessment Worksheet may be prepared for two reasons. Most are required by mandatory categories in the rules, which cover projects of a nature, size, or location which may have the potential for significant environmental effects Other EAWs are ordered by governmental units either on their own initiative or as a result of a citizen petition when the facts indicate the project may have the potential for significant environmental effects.

The EAW process contains the following steps. The process typically requires 3-4 months to complete.

1. The RGU determines if an EAW is needed.
2. The RGU obtains data needed for the completion of the EAW form from the projects proposer.
3. The RGU completes the EAW form and distributes it to reviewing agencies. The member agencies of the EQB receive and review all EAWs as do other local, state, and federal agencies.
4. Notice of the EAW is published in the EQB Monitor and a press release is given to a local newspaper.
5. Any interested person can review the EAW and submit written comments to the RGU for 30 days following the Monitor notice. Comments may address the accuracy and completeness of information, additional environmental effects or corrective actions that should be considered and the potential for significant environmental effects due to the project.
6. The RGU considers the EAW information and the comments received and officially decides if the project has the potential for significant environmental effects. If not, the environmental review process is over. (Any appeal of this decision must be made in district court within 30 days.)

The EIS process contains the following steps.

1. The RGU determines if an EIS is needed.
2. An EAW form is completed by the RGU and the projects proposer as an aid in scoping the EIS. The EAW is distributed to reviewing agencies and noticed in the EQB Monitor. A press release is provided to a local newspaper.
3. A 30-day scoping period follows the notice allowing for public review of the EAW and input into a decision on the issues to be analyzed. A public meeting is held during this period to receive verbal comments. The purpose of the scoping is to focus the EIS analysis on the pertinent issues and to determine what reasonable alternatives will be compared to the project.
4. The RGU makes an official scoping decision which outlines the contents of the EIS.
5. A summary of the scoping decision is published in the EQB Monitor and a press release is supplied to a local newspaper. (The Monitor notice is termed an EIS Preparation Notice.)
6. The scoped issues are analyzed with economic and sociological impacts being considered in addition to environmental impacts. The results of the analysis are compiled into a draft EIS document. Frequently, a consulting firm is hired to assist the RGU with the analysis and the document.
7. Any person can review and comment on the draft EIS for a period of at least 25 working days after a notice of the draft EIS is published in the EQB Monitor. A press release is sent to a local newspaper. A public meeting

RECEIVED
MAY 19 2016
MAILROOM

Philips and Audrey Watt
24755 Co. 2
Shevlin, MN 56676
May 13, 2016

Jamie MacAlister
Environmental Review Manager
Minesota Department of Commerce
85 7th Place East, Suite 500
St. Paul, MN 55101

Dear Mr. MacAlister:

The following are our comments regarding the Sandpiper and Line 3 pipeline projects proposed by Enbridge energy.

These proposed lines will pass through our property in Clearwater County, amounting to about ½ mile of right of way. We have already been paid for this easment, so we have no vested interest in completion of these projects.

What we do have is a strong opinion that these pipeline are the best and safest means of transporting crude oil across Minnesota. It seems from recent news reports that Governor Dayton believes rail transport is safer, despite the fact it can be proven there is much less potential risk to the environment from pipelines than any of the alternatives. Witness the number of derailments in Minnesota which resulted in spills of hazardous materials

Including propane and ethyl alcohol. Since the Governor visited the propane fire site at Calloway, we would think it is obvious that rail transport is not all that safe.

Our farm home is within 200 yards of 4 existing Koch pipelines, alongside which the proposed Enbridge lines will run. We have been very much impressed with the safety measures taken by Koch, including weekly patrol flights and periodic tests by running electronic sensors, called "pigs" through the pipes to detect any weakness or other potential problems.

We are confident Enbridge would be every bit as diligent as Koch, plus there would be at least twice as much surveillance of the combined area of 6 separate pipelines. Any departure from this existing corridor would create new risks and much more costly surveillance.

In a better world, perhaps the United States would not be dependent upon foreign oil, including some from the barbarians guilty of horrible atrocities and crimes against humanity, such as beheading captives and destroying innocent villages and their inhabitants.

We truly believe these proposed pipeline projects are the best means of meeting the petroleum needs of this country at the least risk to the environment.

Virtually no enterprise is without risk. In this case, we believe it is minimal and justified.

Thank you for your consideration.

Sincerely,

Philip G Watt
Philip G. WATT

Audrey A. Watt
Audrey Watt

P.S. I inadvertently omitted any mention of the tremendous benefits of large scale employment, taxes paid to the County, and payments to land owners for easements.

RECEIVED

MAY 26 2016

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May 24, 2016

Jamie MacAlister
Minnesota Department of Commerce
85 7th Place East, Suite 500
St. Paul, MN 55101

Jamie MacAlister:

Please add the following to the comments received for DSDD Sandpiper/Line 3 Replacement as the process moves from draft to final scoping for EIS:

o Pipe dimensions and pipe metal thickness: Contrary to section 3.6 they should be evaluated such as double-hulling both 1) for during operational life and 2) for the far-longer abandoned death.

o 4.3: Troubling that "no field-level data collection will be performed for any of the route alternatives." What proof can or will be provided that the deck has not been unfairly stacked in favor the the Applicant's preferred route?

Applicant-provided data and analysis should be identified. Then substitute independent data and analysis.

Again, independent sources should be used to determine "general pipeline construction and pump station spacing" for system and major route alternatives rather than Applicant's preferred route configuration. Is this another example of the deck unduly stacked in favor of Applicant's preferred route rather than letting alternatives stand or fall on their own merits/demerits?

o Determine how many additional pipelines could be squeezed in the proposed 750-foot corridor. Would additional pipelines ever be removed or be abandoned in place? And what is the expected fate of Sandpiper/Line 3R, if built, a) removal or b) abandoned in place?

o EIS should examine "public good" vs. "private greed" of the Applicants.

O Invasive species: With such massive earth-moving during construction, how can introduction of aquatic and terresterial invasive plants and animals be avoided? What will be the "cost" if they can not?

o Impact on pollinators: existing pipelines in the area utilize extensive, excessive spraying and mowing in these corridors that "at best" create a no-man's land for pollinators; at worst a death trap. How will proposed pipeline corridors be any different?

o Impact of abandoning, rather than removing existing L3.

o Cultural/socioeconomic:
oo Impact on tourism in Itasca S.P./Park Rapids areas if preferred route chosen both during construction, operational phase and post-operational.

oo Impact on Native American cultural sites.

o Straight River Groundwater Mgnt. Area Plan and recently-adopted Hubbard County Local Water Plan did not address pipelines, but should have. How will an EIS handle this void?

O A few economic considerations:
oo Tax court: Already Enbridge establishing a track record of seeking and obtaining property tax relief. Negative impact of future efforts (why stop now!) should be addressed.

ooBakken: Production already reduced. What is long-term sustainability of fracking shale there (water availability, etc.)? Has the Dakota Access pipeline, which circumvents Minnesota entirely, already trumped the need for Sandpiper?

ooFactor in lesser overall demand for petroleum.

ooConseqences of a "carbon tax" should be addressed.

ooLikewise, consequences of a sooner, rather than later shift to renewable energy sources.

oo Bankrupties and subsequent contraction of petroleum companies that's already happening now that the bubble of "cheap borrowing" is bursting.

ooNDPC LLC: will it be around 1) if there's a major spill or leak or 2) to decommission Sandpiper? What sort of bond or other protection should be put in place to reduce individual or taxpayer exposure over the long haul?

oo "Domestic vs. export" end-purposes for both of these pipelines. Why is Superior, WI so critical for Applicants, if not as a jumping off point for a water route via Great Lakes?

o Ambititious EIS timeline: To have a final EIS issued in May 2017 for two massive projects suggests that a number of shortcuts, etc. will be taken. What assurances do 1) the public of Minnesota and 2) its environment have that the rush to completion will not steam-roll over important elements that should be considered?

o Expert panel: To date, it seems that Applicant Enbridge has had a heavy-handed influence on the application process. Regardless, the scoping process could greatly benefit from an independent, expert panel consisting of energy economist, hydrologist, dilbit (for L3R), cultural (including Native American point of view, for example.

Sincerely,

John Weber

John Weber
22382 Glacial Ridge Trl.
Nevis, MN 56467-4018

May 25, 2016
Regarding PUC docket items:
SANDPIPER PIPELINE
PPL-13-473
CN-13-474
Line 3 Pipeline Replacement Project
PPL-15-137
CN-14-916

Comments submitted by:
Darril Wegscheid
20231 Roosevelt Ridge – PO 251
Emily, MN 56447

Point Covered: **Cited preference for using a Power Line ROW for a new Oil Pipeline ROW.**

In the documents reviewed on these Enbridge pipelines, much seems to be made of the Enbridge 'preference' for using an existing Power Line ROW. That is (quite bluntly) a silly position for the PUC or anyone to accept – on face value, or with any thoughtful reflection.

By contrast, if I had a ROW for fiber cable, would that have been routed with concerns for anything BUT the process of installing, operation, repairing and other aspects of a fiber cable?

The environmental considerations for a power line may include some of the same issues, but MAJOR additional concerns need to be evaluated (EIS) for any other commodity using that ROW.

Consider a "leak" of oil, versus a "leak" of an electric line? Or consider restoring a power line to operation versus fixing an oil pipeline back to its operational levels. Imagine the amount of soil disrupted when digging pole / anchors for a power line tower, versus trenching deep and wide (and setting aside the soils) when creating an oil pipeline. If one looks at power towers going OVER a stream, versus a pipeline dug in or suspended over a stream there is very little similarity in construction, risks or damage. Therefore, that aspect needs to be dismissed as an innate preference.

While an existing ROW might simplify 'gaining control' to proceed with the owner of the ROW, and likely there is little existing construction of anything else in that ROW, there is virtually NO logic nor environmental 'free ride' that should be granted for any subsequent consideration for ANY other commodity to be moved in that ROW.

Submitted,
/ /
Darril Wegscheid

May 25, 2016
Regarding PUC docket items:

SANDPIPER PIPELINE

PPL-13-473

CN-13-474

Line 3 Pipeline Replacement Project

PPL-15-137

CN-14-916

Comments submitted by:

Darril Wegscheid

20231 Roosevelt Ridge – PO 251

Emily, MN 56447

Point Covered: **The correct and only defensible Scope needs to be from the commodities' "Source" in the oil fields to their "Sink" at the refineries in Chicago, IL; Gary, IN; Detroit, MI, or more broadly to OK, and to the primary USA refining areas along, in and around the gulf of Mexico.**

There is no current, nor forecasted, excess refinery **capacity** in Superior WI, nor any where in the north of the Great Lakes states of MN, WI, and MI. In fact, the Superior WI capacity (which is presently fulfilled) is at most about 5% of this pipeline's delivery capacity.

The various Enbridge corporate and industry-coalition stations along various 'routes' are either corporate relay / switching stations or simply store-and-forward positions built to control their share of the market distribution – those locations are not necessary to MN in order to provide the most direct path nor safest route from Source to Sink.

As a professional logistical modeler, and career student of distribution, I point-out that the "in-between" points that various industry investors choose / have chosen are to their relative advantage to control the market place. The USA needs to be served by siting the best route (now and through their economic life) from Western North Dakota and/or northern Alberta Canada to the refineries that are virtually ALL south of the Wisconsin border. Since these sources are expected to reduce the dependence on suppliers from outside of North America, then this must get to the refinery infrastructure that currently exists. No new refineries are anticipated in that process – just getting this oil to the existing refineries.

Therefore, since this effort by the PUC is meant to be a 'go back and get it right' directive from the Supreme Court, then the SYSTEM alternatives (that were shredded and disrespected under the erroneous Enbridge-directed false start) must now be included in the scope for the combined EIS. Many of those routes to Chicago and other refineries were discarded without the proper EIS-caliber scrutiny.

Therefore, they need to be included now.

Those early route considerations were NOT in the proper scoping. The studies' scoping now needs to be corrected, since the flows of Line 3 (sourced in Alberta) were never included - as the Sandpiper (coming our of Western N Dakota) was the 'stalking horse' to get a new corridor 'considered' and hopefully authorized.

These are TWO dramatically different flows, of drastically different commodities (Alberta tar sands versus Bakken-shale oils), from those two widely separate sources (Western Dakota and Northern Albert) and flowing to different refineries (whose capabilities differ) in terms of which products they can handle.

Thus, the scope has to include the entirety of BOTH system flows, since the impacts are cumulative, the projects are staged, they are both intrastate and quite simply part of one system.

That early 'assessment' of the Sandpiper route not only failed to consider that this was in fact an effort to open an entirely NEW CORRIDOR (not just simply to route a new single pipeline), but failed to establish / recognize the correct understanding that this is / was / will be PHASED, INTERSTATE, CONNECTED and SEQUENTIAL stages of ONE strategy to flow oils to refineries.

In addition, initially there was no focus on the true origin of the commodities, nor the true destinations at the refineries - but rather the focus was on Enbridge's conjured / contrived corporate "intermediate" points. The arguments tried vigorously to "demand" that their contracted oil shipments MUST be considered ONLY from Clearbrooke, MN (since they had it contracted to that point), and ONLY to Superior, WI (with no unsatisfied product demand there). Those are failures that cannot be repeated.

A reflection, that if they (Enbridge) had promoted their business to potential clients, and then signed contracts to deliver oil to a location at which (at the time of the contract) they had no capability to forward or process it, that seems to be a business practice that sounds like fraud and / or felonious mis-representation. Folks whom are more knowledgeable than I need to address that practice.

The State of MN should be paying no attention to that demand, as any definition of a key point from which oil needs to be moved. The oil is out in Dakota and up in Alberta – NOT in Clearbrooke, MN.

As a further reflection, how do those contracts stand today, since they are not being honored under the present configuration at a time point that was advocated by Enbridge as 'cannot wait'?

Clearly, under any reasonable view of the flows, the interconnectedness of the stages and projects as well as the cumulative effects of these diverse flows, the PUC study scope HAS to be recognized as the entire span from the SOURCES (the oil fields themselves) to the SINKS (the refineries) in Chicago, Detroit, Oklahoma, and the Gulf region.

This must be done, since this is truly a new and fresh corridor for oil transport, that is intended to allow Enbridge to leave leaked oil under and around Line 3, while using more geography for their corporate good as they strive to lock-in their distribution options, at the potential environmental expense of the lakes region of MN, WI, and MI.

Submitted,
/ /
Darril Wegscheid

May 25, 2016
Regarding PUC docket items:
SANDPIPER PIPELINE
PPL-13-473
CN-13-474
Line 3 Pipeline Replacement Project
PPL-15-137
CN-14-916

Comments submitted by:
Darril Wegscheid
20231 Roosevelt Ridge – PO 251
Emily, MN 56447

Point Covered: **The proposed environmental assessment and proposed environmental modeling must consider many things, including:**

- **a) The real (not hoped-for) frequency of leaks, spills, ruptures, and similar flow interruptions;**
- **b) The size / quantity of the specific commodity spilled (tar sands versus shale oil) and the configuration of the site where the spill occurs;**
- **c) The location of the spill, in terms of 'underground', in wetlands, in a river, in a / the lake shed, in a farm field, over or near farm wells, over or near city water sources, etc.**
- **d) The cleanup / mitigation duration, costs of all aspects of the breach, quantity and costs of all damaged materials, and the final "end-state" of the spill site over time;**
- **e) "Routine" leaks – frequency and consequence of the kind that have impacted the current Line 3 to the point that the land under and around it are impaired - as well as have led to reducing the capacity of the line (what is that process timeline for each of these pipes);**
- **f) Impact of High Power Electrical lines on the structure of the pipeline and its operational performance;**
- **g) The construction impacts, and post-construction restoration of the flora and fauna of key areas of the route;**
- **h) Intervention process timelines, timeliness and impacts of responses to any pipeline or related failures, or to any electric power line failures (if sited with Power Lines).**

The spill in the Kalamzoo River has reportedly left serious deposits of tar sands in the affected areas – to the point that the EPA indicates that we (society) do NOT have a protocol for certain tar sands cleanups.

If that be the case, then extra caution must be exercised in the siting process, and the specifications for all aspects of the system when near water – standing, running, saturated, or underground.

Submitted,
/ /
Darril Wegscheid

May 25, 2016
Regarding PUC docket items:
SANDPIPER PIPELINE
PPL-13-473
CN-13-474
Line 3 Pipeline Replacement Project
PPL-15-137
CN-14-916

Comments submitted by:
Darril Wegscheid
20231 Roosevelt Ridge – PO 251
Emily, MN 56447

Point Covered: **Spire Valley, in SE Cass County, MN is an environmentally significant site for the state of MN, the MN DNR, the trout streams of MN and elsewhere, and the fishermen whom enjoy trout fishing – this routing process must pose zero additional threats to the trout hatchery there. That hatchery relies on significant natural springs of clear, fresh, flowing water to enable trout (fish) eggs to hatch (as they would in a stream). If the aquifer pressure, flow, or the quality of its water is damaged then the hatchery is lost – period. If any part of any of these pipelines come in any proximity to these critical dimensions of the hatchery, the State of MN via the PUC and DOC must require a multi-billion dollar bond and an additional cash reserve of at least half of that amount as assurances that they will never impact the site. Even that presumes a comparable site might be found somewhere else – which is currently not a known option.**

Submitted,
/ /
Darril Wegscheid

From: Tami Wenthold
To: *COMM_Pipeline Comments
Subject: Sandpiper Pipeline and Line 3 Pipeline Projects
Date: Wednesday, May 25, 2016 4:40:01 PM

Re: Sandpiper Pipeline Project
Docket Nos. PL-6668/CN-13-473,PPL-13-474
Line 3 Pipeline Replacement Project
Docket Nos. PL-9/CN-14-916, PPL-14-137

Public Comment regarding both of these projects. We have attended the meetings in our area and are well aware of the maneuvers that have been made by Enbridge regarding the certificate of need and now the EIS. It is in the public best interest, the State of Minnesota and our waters that flow from the Headwaters of the Mississippi down through the United States to the Gulf of Mexico that you being charged with to ensure that the Environmental Impact Statement is honest, independent, and competent. There are alternative routes that have been suggested that would serve the purpose and avoid the Headwaters and the northern Minnesota lake country. We advocate for alternative route SA-04 as a top consideration. The MPCA alternative route SA-03 would be a viable second option. There are millions of people counting on the right decision to be made.

Regards,
Tami & Randy Wenthold
Menahga, MN

Ingrid Kimball

From: mccoop@invisimax.com
Sent: Thursday, May 26, 2016 1:03 PM
To: *COMM_Pipeline Comments
Subject: Gordon Wetterlund

Dear Sirs,

I am writing in favor of the ruling for the Line 3 that crosses Minnesota I have three pieces of land in Foldahl Township of Marshalll County that the pipeline goes across. They put a new line in 2009. They did what they said they would so and went the extra mile to be safe. They make every attempt to work with the landowners. I am in favor of the pipeline both for moving oil in a Economical way and a safe way to get oil from our neighbors in Canada, rather than buy crude from the Arab Countries that aren't friends to us.

Thank you for your consideration,

Gordon Wetterlund Jr.
23819-280th Ave NW
Warren, Mn 56762

MINNESOTA DEPARTMENT OF COMMERCE

Comment Form: Scoping

Energy Environmental Review and Analysis

Please provide your contact information. This information and your comments will be publicly available.

Name: ROGER WIEBESICK Phone: 218-652-3090

Street Address: 24164 200th St

City: Nevis State: MN ZIP: 56467

Email: bwiebesick@gmail.com

My comments pertain to:

- ☐ **Sandpiper Pipeline Project**
- ☐ **Line 3 Replacement Project**
- ☒ **Both Projects**

Enbridge should not be allowed to put this pipeline through our most valuable MN assets! Clean water is much more valuable to MN than oil! The land they want is drinking water through the whole middle of the country. They have a terrible environmental record and there is a 99% chance over the life of this pipeline that it will leak. Put it through a less environmentally vulnerable area! Don't ruin the best part of our state! Don't let big business buy their way through this! Find an alternative! We prefer the route that Friends of the Headwaters suggests - far away from the headwaters. We must be good stewards for our state.

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MAY 17 2016

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If including additional pages please number them and tell us how many you are providing: _________ pages

From:	Ken Warner
To:	*COMM_Pipeline Comments
Subject:	Scoping EIS comment for Sandpiper (13-473 & 13-474) and Line 3 Replacement (14-916 & 15-137)
Date:	Monday, May 23, 2016 10:50:06 AM

Dear Ms. MacAlister,

Members of the Public Utilities Commission and Department staff,

As you know, the development of the Sandpiper Pipeline is a major and important project for the state of Minnesota. As President of the Willmar Lakes Area Chamber of Commerce, I can verify that the benefits will be felt statewide – not simply along the route. Whether in direct jobs for folks in our community or reduced competition for scarce rail capacity – the benefits are clear, obvious and should be delayed no further.

A fair, timely, and final evaluation of this project has been delayed for far too long. Any entity attempting to do business in Minnesota relies on a predictable and timely regulatory process. I ask that the Department of Commerce adhere to the 280-day time limit to prepare the EIS to keep the project on track.

The scope of the EIS is vital. It needs to serve the public and private purpose of the Sandpiper project. It should not be so narrow that it would be inadequate, but it should also not be too broad. This balance must be met.

The economic benefit, safety of shipping oil through pipelines, and public support for this project should emphasize the importance of seeing this process through, in a timely and effective manner.

Thank you for the work you do for the state of Minnesota and thank you for your dedication in moving this project forward.

Sincerely,

Ken Warner

President

Willmar Lakes Area Chamber of Commerce

Sincerely,

Ken Warner
2104 Highway 12 E
Willmar, MN 56201
kwarner@willmarareachamber.com

From:	Mark Witt
To:	*COMM_Pipeline Comments
Subject:	Scoping EIS comment for Sandpiper (13-473 & 13-474) and Line 3 Replacement (14-916 & 15-137)
Date:	Thursday, May 12, 2016 4:00:07 PM

Dear Ms. MacAlister,

Approve pipeline project!

Sincerely,

Mark A. Witt
1500 Lipan Rd
Roswell, NM 88203
welder.mark@yahoo.com

From:	Dan Wolpert
To:	*COMM_Pipeline Comments
Subject:	Sandpiper EIS
Date:	Tuesday, May 24, 2016 12:17:33 PM

To whom it may concern, I have founded and run a retreat center in NWMN, just outside of Crookston. I write to you to strongly encourage that you reject the Sandpiper pipeline proposal. As I write to you I am teaching in West Virginia where they are fracking for gas and wreaking similar devastation on the environment that the ND fracking fields have done there. With the earth warming at an alarming, and so far out of control rate, we should not be encouraging further fossil fuel development. Rather it should be the opposite: we should be discouraging the drilling of any new wells and we should be putting our money towards conservation of energy and renewable energy sources. This is the only intelligent, sustainable, and faithful way forward for humanity. I hope that you have the courage to reject this unneeded development.

Peace,
Rev. Daniel Wolpert

www.micahprays.org

From: Mr. & Mrs. James Wyatt, Jr
To: *COMM_Pipeline Comments
Subject: Scoping EIS comment for Sandpiper (13-473 & 13-474) and Line 3 Replacement (14-916 & 15-137)
Date: Thursday, May 05, 2016 4:20:10 PM

Dear Ms. MacAlister,

I support the Sandpiper and line 3 replacement. This will continue our country's effort to become energy independent. It will also provide jobs both to construction workers but will infuse money to the local economy. Pipelines have be time tested to be the safest way to transport products.

Thank you

Sincerely,

James Wyatt Jr.
192 Leggett Rd
Mount Olive, MS 39119

MINNESOTA DEPARTMENT OF COMMERCE

Comment Form: Scoping

Energy Environmental Review and Analysis

Please provide your contact information. This information and your comments will be publicly available.

Name: June Wynne Phone: 218-243-2848

Street Address: 29440 Haggerty Dr NW

City: Puposky State: MN ZIP: 56667

Email: jbug52@gmail.com

My comments pertain to:

- ☐ Sandpiper Pipeline Project
- ☐ Line 3 Replacement Project
- ☒ Both Projects

Eminent Domain.

The power to take private property for public use by a state, municipality, or private person or corporation authorized to excercize character, following the payment of just compensation to the owner of that property.

How can Enbridge justify using eminent domain to take public and private property when these oil pipe lines are not for the benefit of the public or for public use as an art gallery, Hospital, highway would be for public use. The oil pipeline is for the benefit of the oil company, and its owners. This oil will cross our state without benefit to the people who live near the line. The potential of toxic spills affecting the public are too great to ignore. This is NOT for public use.

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