**MOJAVE PIPELINE COMPANY, L.L.C.**
P.O. Box 1087
Colorado Springs, CO 80944

Line No: 1901, 1905, 1903B
R/W Tract No: K1-164 (1901), K1-164 (1905), 1KE-277 (1903B)

**CROSSING STIPULATION LETTER**

MOJAVE PIPELINE COMPANY, L.L.C. (sometimes hereinafter referred to as MOJAVE or COMPANY) hereby acknowledges the receipt of that certain Crossing Company's Notification Document with the reference or subject line of "City of Los Angeles, Department of Water and Power (sometimes hereinafter referred to as APPLICANT) Barren Ridge Renewable Transmission Project (BRRTP)" from Nick L. Demos representing City of Los Angeles, Department of Water and Power dated 10th day of May, 2016 including the plan attached thereto entitled "Barren Ridge Renewable Transmission Project" which are together marked as Exhibit "A" and attached hereto and made a part hereof and hereinafter referred to as the "Crossing". Said plan shows, describes, details, and/or depicts the proposed methods and specifications for the installation/construction of a permanent 230 kV Transmission line over, and in close proximity to Company's pipeline and/or pipeline related facilities ("Company Facilities") on Company's easement or easements (whether one or more, "Company Easement") at the section line of Section 24, Township 11 North, Range 13 West, Kern County, CA.

**SPECIFICATIONS OF ALL CROSSINGS**

1. APPLICANT, or its agent, will give a representative of MOJAVE and MOJAVE'S Bakersfield Area **Maintenance Office,** telephone number 661-363-4035 (office) 48- hours' notice of the day on which the crossing(s) will be made, in order that arrangements can be made for necessary representatives of MOJAVE to be present. MOJAVE's representative will establish the width of the pipeline confinement strip and approximate depth of the pipeline(s).
2. APPLICANT shall investigate, defend, indemnify, and hold MOJAVE, its officers, employees, agents, and representatives, harmless from all claims, loss, liability, attorney fees, cost and expense, including death, personal injury, and property damage occurring to APPLICANT or its respective Contractor, or its subcontractors or MOJAVE, their respective officers, employees, agents, and representatives, or to third parties to the extent caused by APPLICANT in connection with, or by reason of, performance of the work herein contemplated or the existence of said installations, thereafter, but which arise out of, or in connection with, or by reasons of, performance of the work development herein contemplated or the existence of said installations thereafter, except to the extent that such liability results from MOJAVE's or its representative's negligence or willful misconduct.
3. MOJAVE shall investigate, defend, indemnify, and hold APPLICANT, its officers, employees, agents, and representatives, harmless from all claims, loss, liability, attorney fees, cost and expense, including death, personal injury, and property damage occurring to MOJAVE or its respective Contractor, or its subcontractors or APPLICANT, their respective officers, employees, agent, and representatives, or to third parties to the extent caused by MOJAVE in connection with, or by reason of, performance of the work herein contemplated or the existence of said installation, thereafter, but which arise out of, or in connection with, or by reasons of performance of the work development herein contemplated or the existence of said installations thereafter except to the extent that such liability results from APPLICANT's or its representative's negligence or willful misconduct..
4. It is further understood and agreed between APPLICANT and MOJAVE:

    a. That MOJAVE does not, by consenting to the proposed installation of this facility across its pipeline confinement strip and its facilities, assume any responsibility for the protection of its pipeline(s) during APPLICANT'S work contemplated by this agreement. Furthermore, all work performed in connection with these installations will be without expense, risk, or liability to MOJAVE or any of its directors, officers, agents, representatives, or employees.

b. That MOJAVE will make every reasonable effort to avoid damage to the APPLICANT's installations that may be permitted pursuant to this permit for the purpose of exercising its easement rights. MOJAVE will attempt to notify the APPLICANT, except in cases of an emergency nature, prior to interruption of service. MOJAVE will accept no liability for restoring the installation or for the interruption of service in the use of said installation unless such damage or interruption was caused by MOJAVE.
c. That except to the extent made necessary by the construction and maintenance of such permitted crossings and encroachments, and the reasonable use thereof, the exercise of any rights permitted to applicant shall not interfere with or supersede the rights of MOJAVE under its easement(s).

5. This agreement shall be binding upon the parties hereto and their respective successors and assigns. No assignment of this agreement shall be made without the prior written consent of the other parties.
6. Execution below by APPLICANT acknowledges agreement and acceptance of the conditions expressed herein both as to Specifications for all crossings and Specifications for APPLICANT's particular type crossing and APPLICANT agrees not to begin any work within the confines of the confinement strip until this permit has been executed by the Parties.

**SPECIFICATIONS FOR TRANSMISSION LINE CROSSINGS**

1. Only the APPLICANT Facilities shown on the drawings reviewed by MOJAVE will be approved for installation on the MOJAVE's Easement(s). All drawing revisions that affect the APPLICANT Facilities proposed to be placed on the MOJAVE's Easement(s) must be approved by MOJAVE in writing.
2. The transmission line crossing shall cross as nearly as possible at right angles to MOJAVE's line(s). APPLICANT shall not run parallel to MOJAVE Facilities within the MOJAVE'S Easement(s) without MOJAVE's prior written approval.
3. APPLICANT shall at all times conduct all of its activities on the MOJAVE's Easement(s) in such a manner as not to interfere with or impede the operation of the MOJAVE Facilities.
4. No poles or structures, including anchors or guy wires shall be placed or located within Easement(s) of MOJAVE.
5. No guy wires shall cross over any MOJAVE pipeline easement(s).
6. Conductors shall at all times be at thirty (30) feet above the top of the ground, i.e. ground clearance to the lowest conductor must be a minimum of thirty (30) feet.
7. Local One Call System or Underground Service Alert (811) shall be contacted forty-eight (48) hours before beginning any excavation work anywhere near or within MOJAVE's pipeline(s).
8. The electric power conductors shall be maintained at sufficient distances from MOJAVE pipeline(s) to minimize induced AC pipeline voltages and fault currents that can be potentially harmful to MOJAVE's pipeline(s) or personnel.
9. Within one year after APPLICANT's facilities are in-service, post construction AC monitoring shall be conducted by APPLICANT during the season of highest AC loading for a period of no less than two (2) weeks to verify that the modeled results in Exhibit "A" are not exceeded. APPLICANT shall contact MOJAVE corrosion personnel prior to conducting the follow up AC monitoring. If actual results exceed modeled results in Exhibit "A" APPLICANT shall coordinate with MOJAVE regarding any necessary AC Mitigation which might be required. All costs for any additional studies or mitigation shall be borne entirely by APPLICANT.
10. THE CONTINUED INTEGRITY OF Mojave Facilities and the safety of all individuals in the area of the proposed work near MOJAVE Facilities are of the utmost importance. Therefore, contractor(s) of APPLICANT must meet with MOJAVE's representatives prior to construction to provide and receive notification listings for appropriate area operations and emergency personnel. MOJAVE's on-site representative will require discontinuation of any work that, in his/her opinion endangers the operations or safety of personnel, pipeline(s) of facilities.
11. All MOJAVE's pipeline locations and elevations are approximate and must be field verified. A Mojave representative shall do all line locating. A MOJAVE representative shall be present for hydraulic excavation. The use of probing rods for pipeline locating shall be performed by an MOJAVE representative only to prevent unnecessary damage to the pipeline coating.

12. Heavy equipment will not be allowed to operate directly over MOJAVE Facilities or on the MOJAVE's Easement(s) unless prior written approval is obtained from MOJAVE. Heavy equipment shall only be allowed to cross MOJAVE Facilities at locations designated by MOJAVE. Contractor(s) of APPLICANT shall comply with all precautionary measures require by MOJAVE to protect the MOJAVE Facilities. When inclement weather exists, provisions must be made to compensate for soil displacement due to subsidence of tires.
13. Excavating or grading which might result in erosion or which could render the MOJAVE's Easement(s) inaccessible shall not be permitted unless APPLICANT agrees to restore the area to its original condition and provide protection to the MOJAVE's Facilities.
14. Any physical contact with any MOJAVE Facilities shall be reported immediately to MOJAVE. If repairs to MOJAVE's Facilities are necessary, they will be made and inspected before being back-filled.
15. Burning of trash, brush, etc. is not permitted within the MOJAVE'S Easement(s). If you have any questions, please contact me by telephone at 719-520-4734, or by e-mail at Patrick.McCarthy@kindermorgan.com.
16. A Company representative shall be on site to monitor any construction activities within twenty-five (25) feet of Company Facilities or within the Company Easement(s).

APPROVED:

ANDREW C. KENDALL
Executive Director – Power System
Construction, Maintenance, and Operations

Sincerely,

9/28/16

Patrick McCarthy
Project Manager
Mojave Pipeline Company, L.L.C.

Date

Approved as to Conditions
Provided by
Power System Right of Way Engineering

Right of Way Engineer
Power System

DEPARTMENT OF WATER AND POWER
OF THE CITY OF LOS ANGELES BY
BOARD OF WATER AND POWER COMMISSIONERS

By: _____
DAVID H. WRIGHT
General Manager

Date: _____

And: _____
BARBARA E. MOSCHOS
Secretary

APPROVED AS TO FORM AND LEGALITY
MICHAEL N. FEUER, CITY ATTORNEY

SEP 13 2017

BY _____
TIMOTHY J. CHUNG
DEPUTY CITY ATTORNEY

**Exhibit "A"**

**DESIGN DRAWINGS**
**Attached Hereto and Incorporated Herein**

Los Angeles Department of Water & Power

ERIC GARCETTI
*Mayor*

Commission
MEL LEVINE, *President*
WILLIAM W. FUNDERBURK JR., *Vice President*
JILL BANKS BARAD
MICHAEL F. FLEMING
CHRISTINA E. NOONAN
BARBARA E. MOSCHOS, *Secretary*

MARCIE L. EDWARDS
*General Manager*

May 10 , 2016

Melinda Risinger
Kinder Morgan
Land Department
2 North Nevada Avenue
Colorado Springs, CO 80903

Dear Mrs. Risinger:

RE: City of Los Angeles, Department of Water and Power (LADWP)
Barren Ridge Renewable Transmission Project (BRRTP)
Kinder Morgan Energy Partners, L. P. (Kinder Morgan) Pipeline Crossings

As part of the BRRTP, LADWP has acquired the fee property on which you hold certain easement interests. The BRRTP includes the construction of a transmission line between the Barren Ridge Switching Station, in Kern County, and the Haskell Switching Station, in Los Angeles County.

The proposed transmission line wires (no structures) will cross over All American Pipeline Company, Kern River Gas Transmission Company, and Mojave Pipeline Company easements located within a portion of Section 24, T. 11 N., R. 13 W., SBM. The LADWP also maintains an existing 230 kV transmission line over your easements in this area. The proposed BRRTP transmission line crossing and a portion of LADWP's right-of-way is shown on the enclosed drawing (11" x 17").

LADWP has conducted an AC Interference Analysis to examine the effects of LADWP's new BRRTP and existing 230kV Transmission Lines on the three existing pipelines operated and maintained by Kinder Morgan. The analysis prepared by Power Engineering concludes that the BRRTP and existing Transmission Lines will not impact the pipelines and no mitigation is needed along the pipeline for faults on LADWP's new and existing 230kV Transmission Lines. Attached you will find a copy of the study for your review and records.

The pipelines within a portion of Section 24, T. 11 N., R. 13W., SBM have recorded easements ranging from 25-foot to 50-foot wide granted for operating and maintaining the pipelines in question. The pipeline easements are now within LADWP's newly acquired 200-foot wide right-of-way granted in fee interest. LADWP is now the owner of the property under which said easements for pipelines are maintained and operated by Kinder Morgan.


111 N. Hope Street, Los Angeles, California 90012-2607 *Mailing address:* Box 51111, Los Angeles, CA 90051-5700
Telephone: (213) 367-4211 www.LADWP.com

LADWP will not be placing any towers or structures within your easement areas. Note, BRRTP conductor wires will not obstruct or impact the pipelines on said easements. Please review the information provided and let us knows if you have any questions.

We would appreciate it if you would return a copy of this letter with your acknowledgment, within 10 days, to the following address:

Los Angeles Department of Water and Power
Right-of-Way Engineering
Attention: David Nevarez
111 N. Hope Street, Room 1121
Los Angeles, CA 90012

Mr. David Nevarez of our staff has been assigned to provide you with any assistance you require and will be contacting you within 10 days. He may be contacted at 213-367-3621, or david.nevarez@ladwp.com.

Sincerely,

Nick L. Demos
Civil Engineer
Right-of-Way Engineering
Power Engineering Division

DN:mc
Enclosures
c: David Nevarez

ACKNOWLEDGMENT AND CONSENT:

The undersigned, on behalf of the easement holders, acknowledges that LADWP will NOT be constructing any structures within the easement areas shown on the enclosed drawings and that the LADWP will only be stringing transmission line conductors for the BRRTP over the areas shown on the enclosed drawings.

_____

By: _____
Its: _____

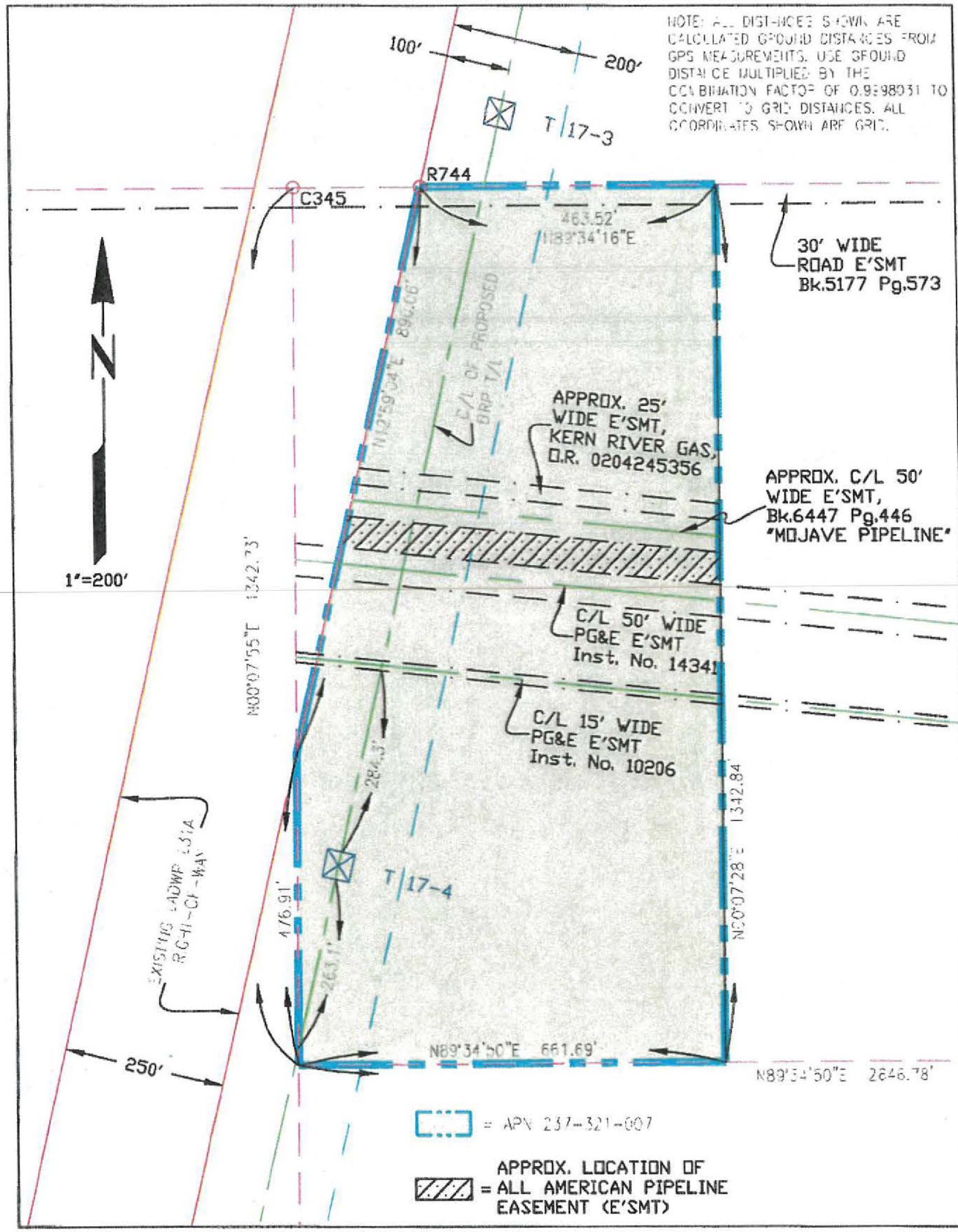
bc: Eric C. Hartman
Eric G. Montag
Angela Ung Petcharamuk
Reynan L. Ledesma
Timothy Chung
Patrick Scott (Kinder Morgan)
Anthony Offutt (El Paso Natural Gas Company)

Sheet 4 of 4

SURVEY OF PROPOSED BARREN RIDGE TOWER LINE | L86 FACILITY/WO | P 140030 RFS/FB | 220 PAGE

T.11N. R.13W. SECT. 24 (POR.), S.B.M.

SURVEYOR M.STEVENS DATE 8-24-15




Altus Ave
Altus Ave
Ruben St
Ruben St
24180' COMMON MAINLINE WEST SIDE LATERAL, BACCETT TO WHEELER RIDGE
M.P. 80
MP80

April 19, 2016

# BARNARD CONSTRUCTION COMPANY, INC.

## Barren Ridge Renewable Transmission Project

*Pipeline AC Interference Analysis*

*Revision 0*


***PROJECT NUMBER:***
*141463*

***PROJECT CONTACT:***
*KURT BELL, P.E.*
***EMAIL:***
*KBELL@POWERENG.COM*
***PHONE:***
*208-288-6343*

POWER ENGINEERS

# Pipeline AC Interference Analysis

***PREPARED FOR:***

*BARNARD CONSTRUCTION COMPANY, INC.*

***PREPARED BY:***

*JOSH BROWN – (503) 892-6714 – JOSH.BROWN@POWERENG.COM*
*ROB SCHAERER – (858) 810-5337 – ROBERT.SCHAERER@POWERENG.COM*
*SIVASIS PANIGRAHI – (503) 892-6742 – SPANIGRAHI@POWERENG.COM*

| REVISION HISTORY | | | | | | |
|---|---|---|---|---|---|---|
| REV. | ISSUE DATE | ISSUED FOR | PREP BY | CHKD BY | APPD BY | NOTES |
| A | 04/01/16 | Appvl | JAB | RES | SP | Issued for Client Review and Approval |
| 0 | 04/19/16 | Impl | JAB | RES | SP | Issued for Implementation |
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"Issued For" Definitions:

- "Prelim" means this document is issued for preliminary review, not for implementation
- "Appvl" means this document is issued for review and approval, not for implementation
- "Impl" means this document is issued for implementation
- "Record" means this document is issued after project completion for project file

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## LIST OF FIGURES

# 1.0 EXECUTIVE SUMMARY

At the request of Barnard Construction Company, Inc. (Barnard), POWER Engineers, Inc. (POWER) performed an AC interference analysis to examine the effects of Los Angeles Department of Water & Power's (LADWP) new and existing 230 kV transmission lines on three existing Kinder Morgan pipelines near Mojave, CA. This work is performed as part of the Barren Ridge Renewable Transmission Project. The project consists of the Barren Ridge to Haskell Lines 2 and 3 double circuit 230 kV transmission line (new line) and the existing single circuit 230 kV Barren Ridge to Haskell Line 1 (existing line) in the area of the Kinder Morgan pipelines.

The transmission lines all cross three Kinder Morgan pipelines in a single corridor at nearly 90 degrees. The pipelines are located near the center of the span for each of the lines and are approximately 500 feet away from the closest transmission structure.

The effect of ground faults were evaluated at the towers closest to the pipelines for each of the transmission lines. The worst case results occur for faults on the existing LADWP 230 kV line. A fault at Structure 192-5 on the existing LADWP 230 kV transmission line produces the maximum coating stress voltage of 130 volts and is below the 5,000 volt limit per Kinder Morgan standards (Document E-1300). The maximum pipeline voltage on the pipeline is 70 volts, and occurs for a fault at Structure 192-4. Both of these values are below the IEEE Std 80-2013 calculated touch voltage compliance limit of 184 volts. Section 4.0 provides results for each of the fault scenarios.

Based on these results, no mitigation is needed along the pipeline for faults on the new or existing 230 kV lines. Due to the nearly 90 degree crossing angle steady state values were not calculated. Magnetic fields do not transfer voltage for a 90 degree crossing and no significant increase in induced steady state 60 Hz voltages is expected for the Kinder Morgan pipelines.

# 2.0 ANALYSIS APPROACH

## 2.1 Software

Safe Engineering Services' (SES) Current Distribution, Electromagnetic interference, Grounding and Soil analysis (CDEGS) computer program (version 15.1.3950.0) was used to perform the analytical studies for this project. The analysis for this study involved creating a three dimensional model of the pertinent parts of the electrical and pipeline systems in the vicinity of the crossing. The HIFREQ module of the CDEGS software is capable of analyzing a three dimensional system at any given frequency (accurately up to the megahertz range), and calculating electromagnetic fields throughout the areas modeled. Inductive, capacitive, and conductive interference effects are computed simultaneously. Based on these effects, resulting voltages on and currents through each modeled conductor are calculated. These values can then be tabulated or plotted in color plots and/or presented as numerical values on a plot of any part of the pipeline system. Due to the model complexity and the varying functionalities of the HIFREQ package, there is no simple way to plot out a specific

summary. Therefore, a combination of plotting techniques is used to extract the results needed in this type of study.

### 2.2 Compliance Guidelines

The industry typical guidelines for this type of analysis are based on the National Association of Corrosion Engineers (NACE) Standard Recommended Practice SP0177-2014, "Mitigation of Alternating Current Lightning Effects on Metallic Structures and Corrosion Control Systems". The principal personnel safety guidelines used for this analysis are based on IEEE Std 80-2013, "IEEE Guide for Safety in AC Substation Grounding". While IEEE Std 80-2013 is primarily focused on substations, the theory can be applied to touch and step voltage locations as part of AC Interference analysis. Kinder Morgan Document E-1300 provides the following guidance for fault conditions:

- A coating stress voltage limit of 5,000 volts was used for this analysis. This is the short duration voltage limit that is expected to prevent damage to the coatings based on the pipeline voltage limit identified in the Kinder Morgan document E-1300.
- Touch voltages were analyzed utilizing IEEE Std 80-2013 assuming a 50 kg person, no insulating surfacing, native soil, and a 0.5 second backup transmission line clearing time. The touch voltage compliance limit is 184 volts under faulted conditions.

## 3.0 DATA AND MODELING DETAILS

Due to the complexity of the system, this section details the source data and modeling methods used for creating the model of the system. Since CDEGS performs calculations in three dimensions, the overhead transmission lines must be modeled in three dimensions surrounding the pipeline crossings. To accomplish this, a single overall model was constructed which contained the three pipelines and the new and existing 230 kV transmission lines. The model includes both the physical characteristics (such as the structures, conductors, and pipe locations) and the electrical characteristics (fault current, conductor impedances, etc.) of all objects under analysis.

### 3.1 Kinder Morgan Pipelines

The models created for this analysis consist of simplified transmission line structures and the Kinder Morgan pipeline system. Based on the system drawings provided, the transmission lines and pipeline system were physically modeled for a minimum of a mile and a half in all directions from the crossing location.

Three total pipelines were included in the analysis. These include the pipelines 1901, 1903, and 1905. The pipelines were all modeled with the following characteristics:

- Four foot burial depth
- Fusion bonded epoxy coating (FBE) (assumed for Pipeline 1903 as shown below)

Details for each of the individual pipelines are included below and their alignment drawings can be found in Appendix A.

**Pipeline 1901:**

- Middle pipeline in corridor
- 40 inch diameter pipeline
- Figure 1 in Appendix A

**Pipeline 1903:**

- Southernmost pipeline in corridor
- 32 inch diameter pipeline
- FBE coating assumed
- Marked as inactive/out of service
- Figure 2 in Appendix A

**Pipeline 1905:**

- Northernmost pipeline in corridor
- 40 inch diameter pipeline
- Figure 3 in Appendix A

The valve sites and path of the pipelines could be seen in Google Earth. This was used to trace the path of the pipeline corridor. The distances between the individual pipelines and the transmission structures were measured by Barnard at the crossing location and can be seen in Figure 4 of Appendix A. Using the traced path and measurements the pipelines were modeled both relative to one another and the transmission structures.

Appurtenances such as valves and test sites were not modeled as part of this analysis because the voltages on the pipelines did not exceed the touch voltage compliance limits. If the limits had been exceeded the appurtenances would have had to have been modeled to determine appropriate mitigation measures at the specific locations. No insulating joints or insulating flanges were identified on the drawings.

All pipelines were modeled as coated with fusion bonded epoxy. Based on this information, the pipeline coating was modeled at a thickness of 15 mils and an assumed resistivity of 200,000 ohm-ft$^2$. The coatings resistance value was derived based on the age and condition of the pipeline and information contained in a Safe Engineering Services (SES) paper titled "Pipeline Coating Resistance and Coating Stress Voltage Basics" from the 2009 SES Users Group Meeting Conference Proceedings. The upper limit of the resistance was chosen as it will result in slightly elevated induced voltages on the pipeline.

## 3.2 LADWP 230 kV Transmission Lines

The following sections detail the data used to model the geometry and the electrical characteristics of the new and existing LADWP 230 kV transmission lines.

### 3.2.1 Physical Geometry

The location of the structures for both the new and existing transmission 230 kV transmission lines were available via a Google Earth kmz file. Figure 5 in Appendix B shows the Google Earth overview of the pipeline crossing. Figure 6 shows the plan and profile drawings for the new line in the vicinity of the crossing.

The new line was modeled from Structure 14-1 to Structure 22-1. The existing line was modeled from Structure 189-2 to Structure 197-2. For each 230 kV line this is about eight miles in total length. Modeling the transmission lines to this length provides a path for the fault current to return to the sources other than the immediate tower grounds adjacent to the pipelines and reduces the overall ground potential rise to a more accurate value. Modeling the entire transmission line would have little additional benefit.

The physical locations of the shield wires with respect to the towers have very little impact on tower fault analysis for pipeline crossings that are at or near 90 degrees. For the existing line the shield wires were modeled at a height of 75 feet and horizontal separation distance of 40 feet based on the existing transmission line structures. The existing structure is shown in Figure 7 of Appendix B. The new structures were modeled at the same 40 foot horizontal separation and a height of 100 feet. Any deviations in the height or horizontal separation will not have a significant impact on the results.

The lattice tower footings were assumed to be 30 feet x 30 feet for the existing line and 40 x 40 feet for the new line based on Google Earth imagery and the kmz file provided. The size of the lattice tower footings does not have a significant impact on the analysis because of the distance between the pipeline and towers. If the distance were much smaller e.g. 100 foot separation, the actual geometry of the tower foundations and grounding may cause the results to change.

### 3.2.2 Electrical Details

POWER modeled the grounding systems and shield wires for both the new and existing transmission structures. Due to the angle of crossing, magnetic coupling to the pipeline is not expected to be significant and the phase conductors were not modeled for the electrical system.

The grounding for the structures was based on the new transmission line. This consisted of two 3/4 inch by 8 foot ground rods placed diagonally across from one another on opposite corners of the lattice structure. Figure 8 in Appendix B shows the tower grounding for the new line. The existing line grounding was modeled identically. The towers examined for fault conditions also had the legs extended to a depth of ten feet to increase the amount of current flowing in the faulted tower versus the adjacent structures.

The shield wires were modeled as follows:

- Existing Line:
    - Two 5/16 inch EHS shields, as identified by Barnard

- New Line :
  - One Baekert 7/16 inch shield wire, modeled as steel
  - One ZTT OPGW with a cable diameter of 0.6299 inches

The single-line-to-ground fault currents were provided for the each of the circuits at the location of the crossing. Each circuit of the new transmission line had identical fault current values. The existing transmission line had a slightly lower magnitude. The fault currents for each line are below:

- Existing Line - single-line-to-ground fault current magnitude of 5,214 A
- New Line - single-line-to-ground fault current magnitude of 5,350A

### 3.3 Soil Model

POWER performed two traverses of soil resistivity measurements at near the pipeline crossing on February 23, 2016. The soil traverses were located south of Structure 17-4. Figure 9 in Appendix C shows the measurement data for the two traverses. Soil models were created for each of the traverses as shown in Figure 10 and Figure 11 in Appendix C.

Both sets of measurements produced similar four layer soil models. Traverse 1 was utilized to produce an equivalent three layer soil model for the purposes of analysis which can be seen in Table 1. The reason this is necessary is because the pipeline cannot be modeled at the intersection of two soil layers, and therefore the top two layers were approximated as one.

TABLE 1: SOIL RESISTIVITY MODEL

| LAYER | RESISISTIVITY (OHM-M) | THICKNESS (FEET) |
|---|---|---|
| Top | 115 | 13.5 |
| Middle | 237 | 17.8 |
| Bottom | 84 | Infinite* |

*Measured to a depth of 200 feet.

## 4.0 RESULTS

Faults were placed at the four structures closest to the pipeline crossing. For each fault both the voltage on the pipelines and the voltage across the coating (coating stress voltage) were calculated. Table 2 shows the maximum voltage and coating stress voltages on any of the three Kinder Morgan pipelines in the area of analysis. Table 2 also identifies the results plots for each of the cases evaluated which can be seen in Appendix D.

TABLE 2: SUMMARY OF RESULTS

| CASE | MAX COATING STRESS (VOLTS) | MAX PIPELINE VOLTAGE (VOLTS) | REFERENCES |
|---|---|---|---|
| Fault at Structure 192-4 (existing) | 123 | 70 | Figure 12<br>Figure 13 |
| Fault at Structure 192-5 (existing) | 130 | 65 | Figure 14<br>Figure 15 |
| Fault at Structure 17-3 (new) | 75 | 59 | Figure 16<br>Figure 17 |
| Fault at 17-4 (new) | 78 | 52 | Figure 18<br>Figure 19 |

All of the calculated coating stresses are well below the compliance limit of 5,000 volts for faulted conditions. Touch voltages are normally evaluated only at above grade pipelines locations such as at valves or test station. Near the fault location coating stress voltages are nearly identical to touch voltages to any above grade objects in the area. Away from the fault location the pipeline voltage is representative of the touch voltages at appurtenances. For this analysis the touch voltage will not exceed either of these values and neither the coating stress of pipeline voltage exceeds the touch voltage compliance limit of 184 volts. The maximum of these two values is 130, which is about 70 percent of the touch voltage compliance limit.

## 5.0 CONCLUSION

The analysis and results presented indicate that the LADWP 230 kV transmission lines do not produce non-compliant voltages on the Kinder Morgan pipelines under fault conditions. More detailed analysis exploring individual above ground appurtenance evaluation does not appear to be required because of the low magnitude of the pipeline voltages. Voltages on the pipelines are not expected to be significantly affected by the energization of the new transmission line.

The effect of ground faults were evaluated at the towers closest to the pipelines for each of the transmission lines. The worst case results occur for faults on the existing line. A fault at Structure 192-5 on the existing 230 kV transmission line produces the maximum coating stress voltage of 130 volts and is below the 5,000 volt limit per Kinder Morgan standards. The maximum voltage on the pipeline is 70 volts, and occurs for a fault at 192-4. Both of these values are below the IEEE Std 80-2013 calculated touch voltage compliance limit of 184 volts.

# APPENDIX A – KINDER MORGAN PIPELINE DATA

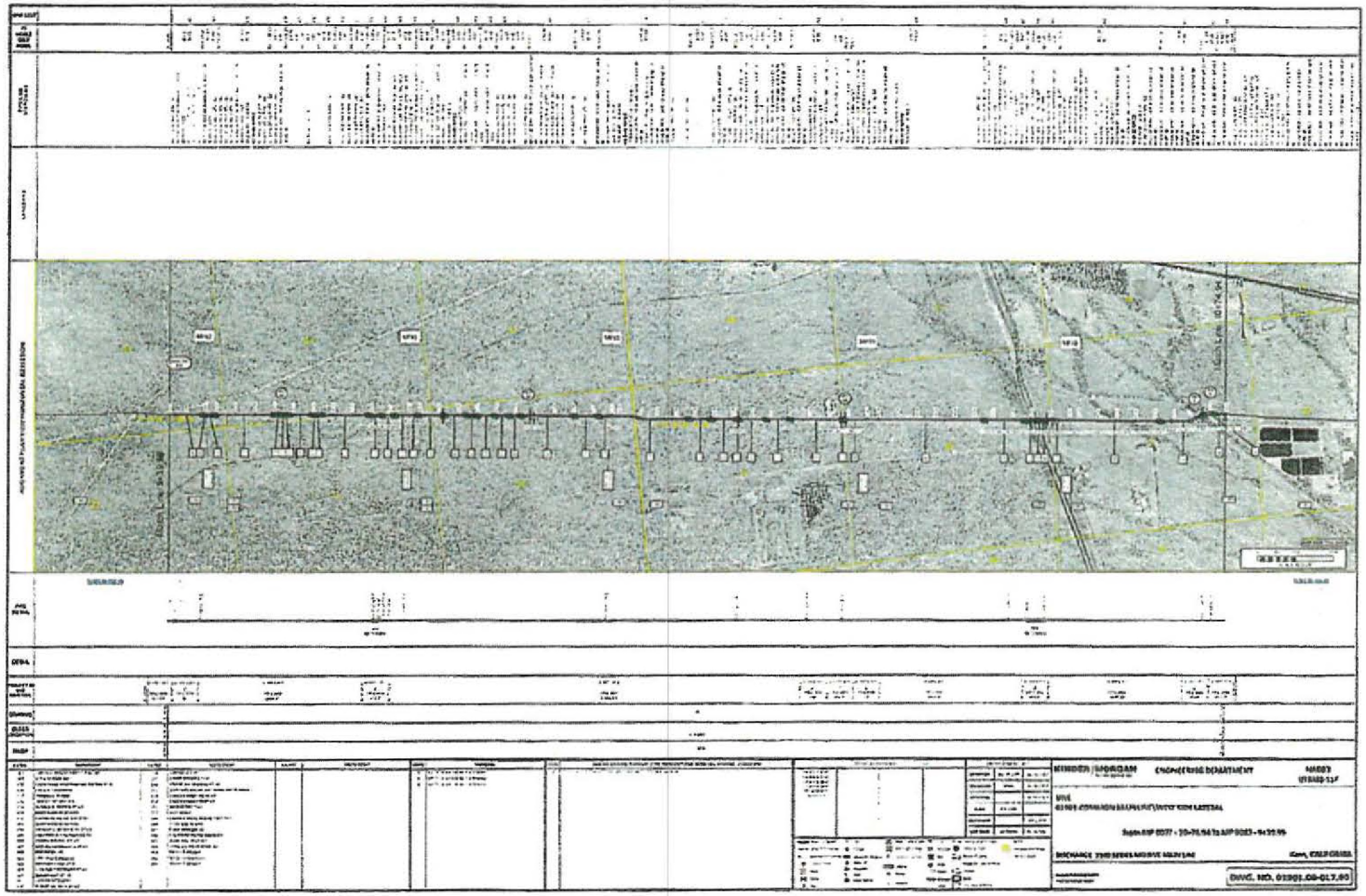


**Figure 1: Pipeline 1901 Alignment Drawing**

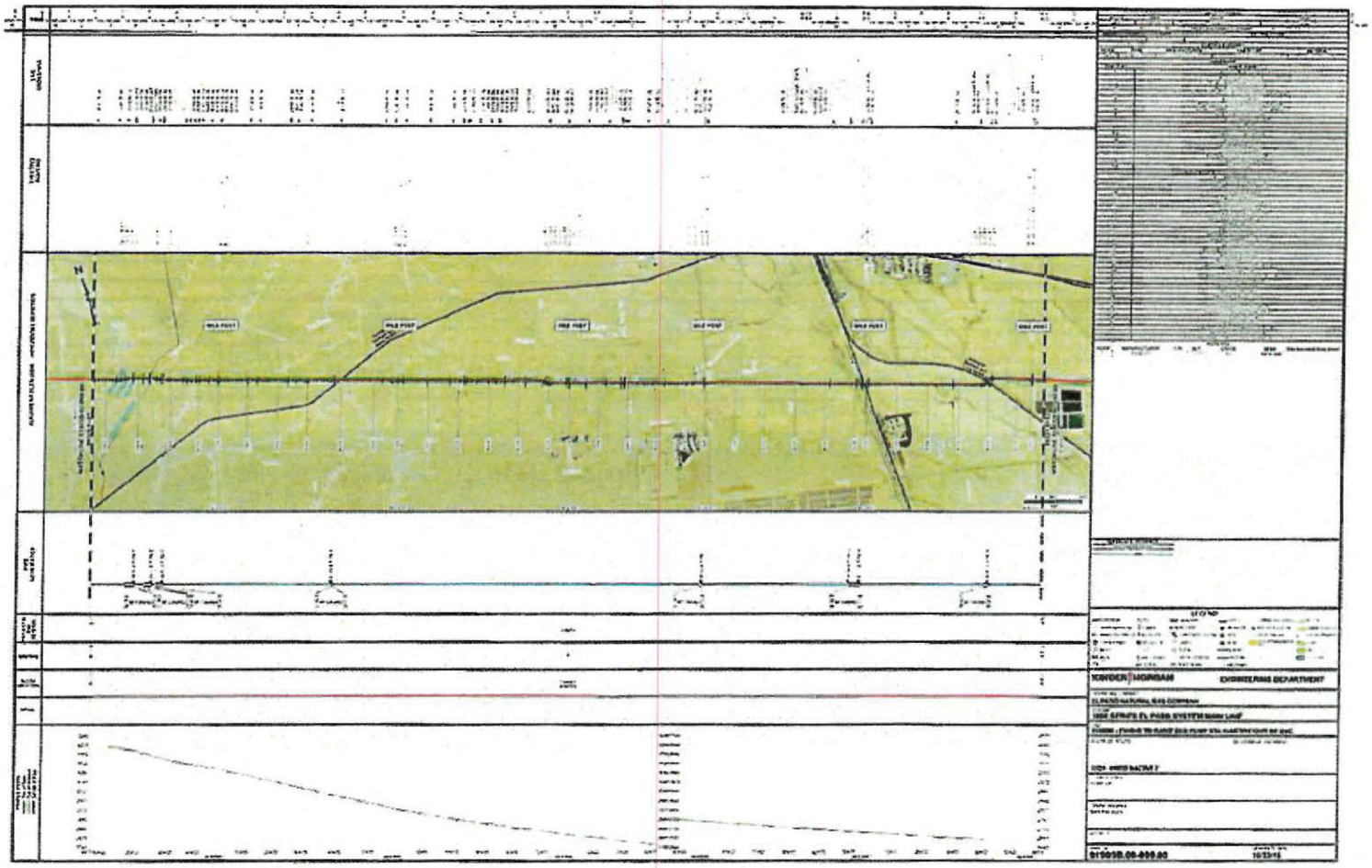


**Figure 2: Pipeline 1903 Alignment Drawing**

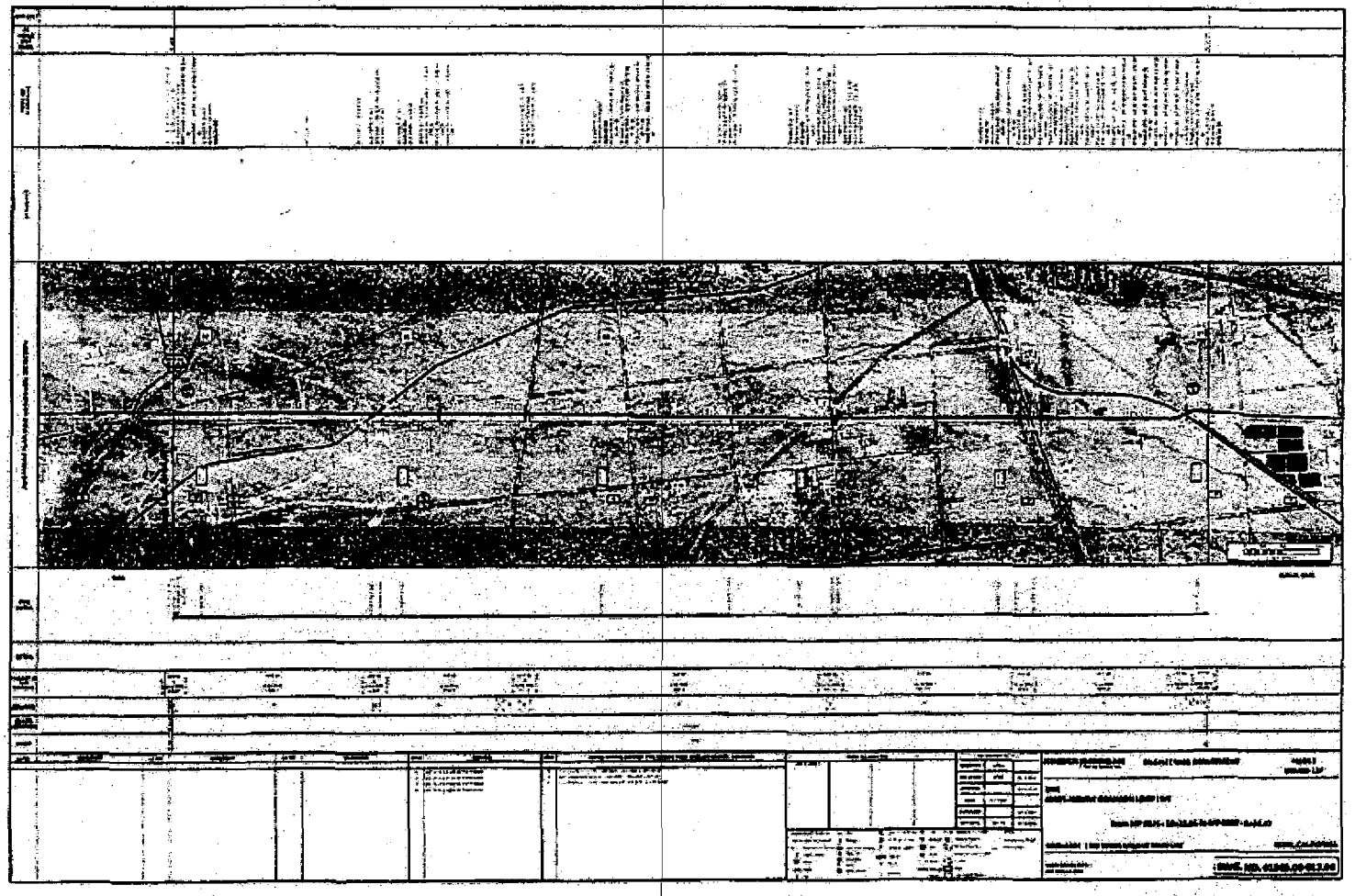


Figure 3: Pipeline 1905 Alignment Drawing

BARNARD

| Project Name: | By: | Date: |
|---|---|---|
| Description: | Detail: | Page of |

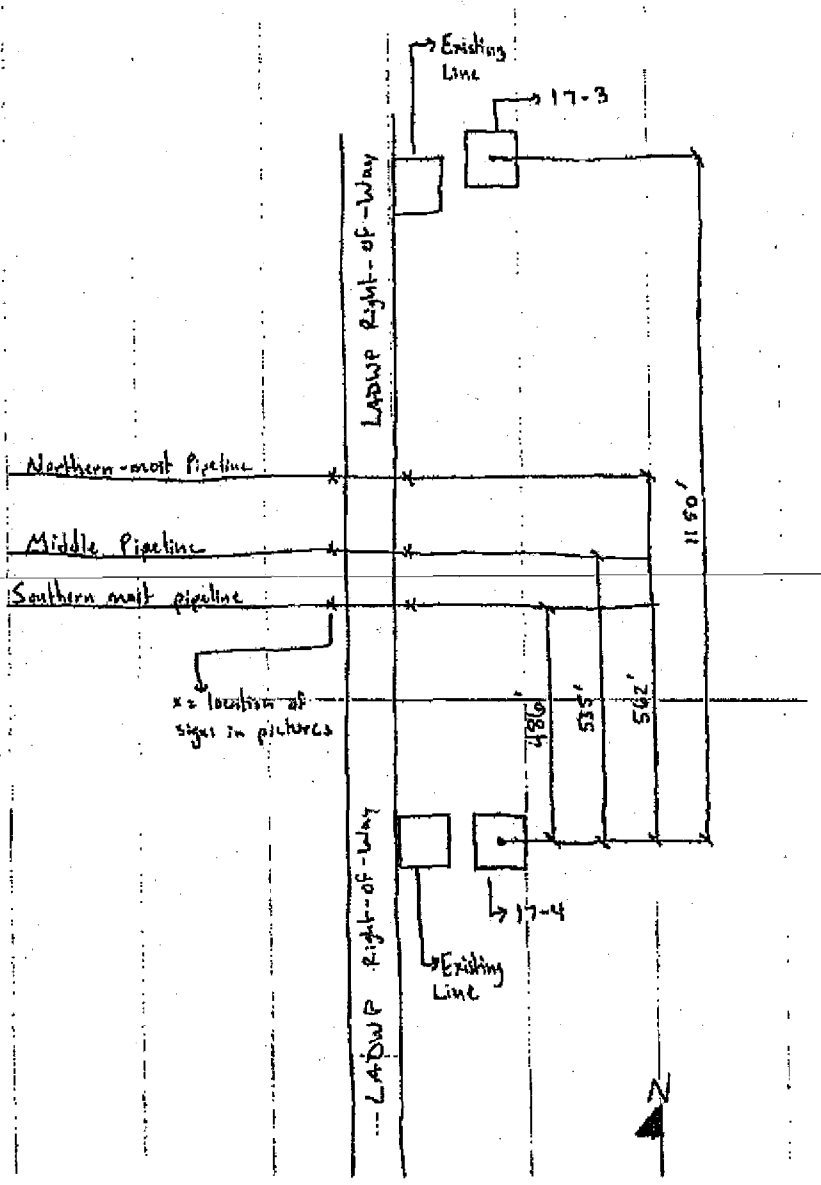



Figure 4: Co-location of Pipelines and Electrical Lines

# APPENDIX B – TRANSMISSION LINE DATA


**Figure 5: Google Earth Overview**

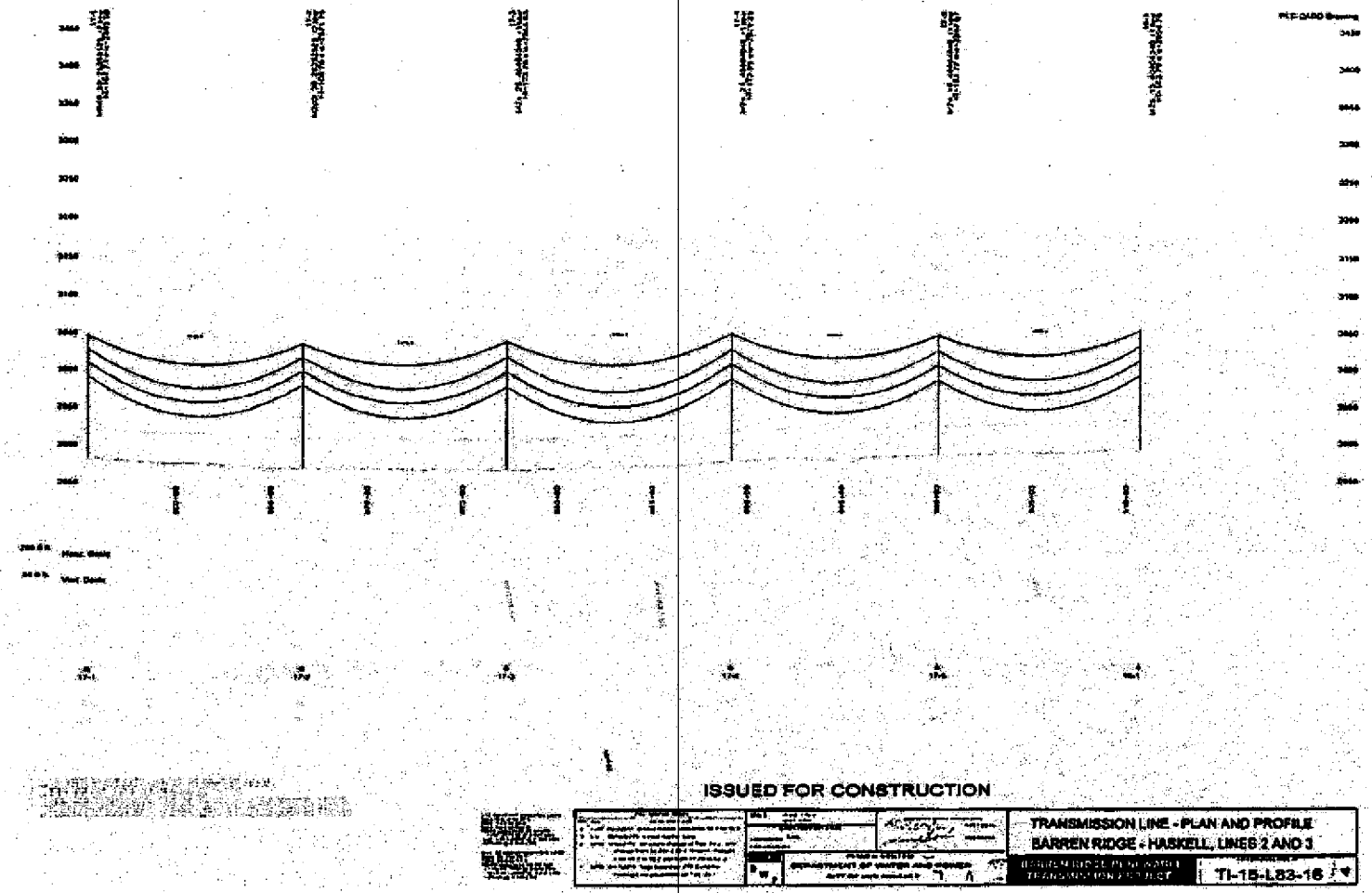



**Figure 6: Plan and Profile Barren Ridge to Haskell 2 and 3**

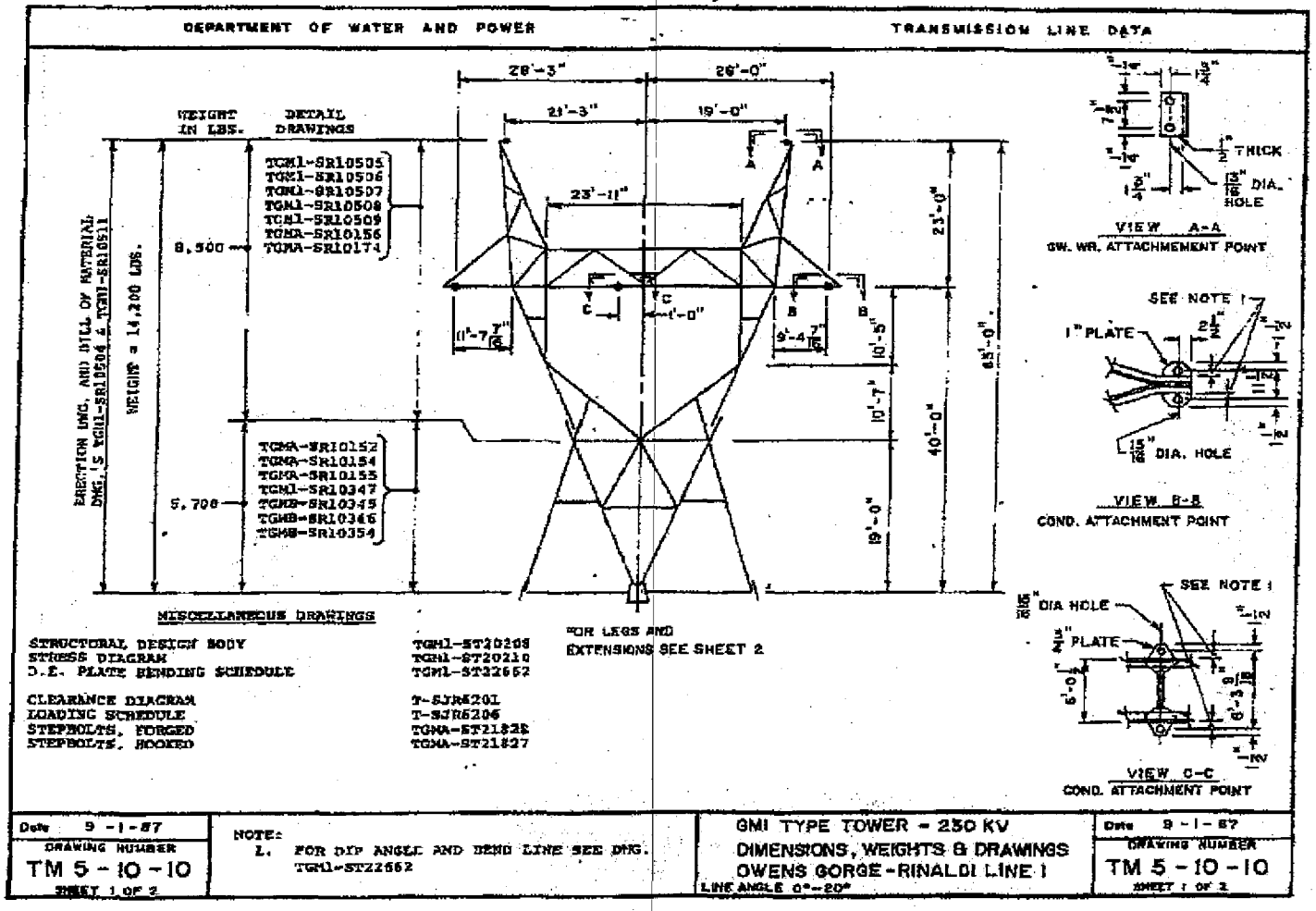



Figure 7: Existing Line Structure

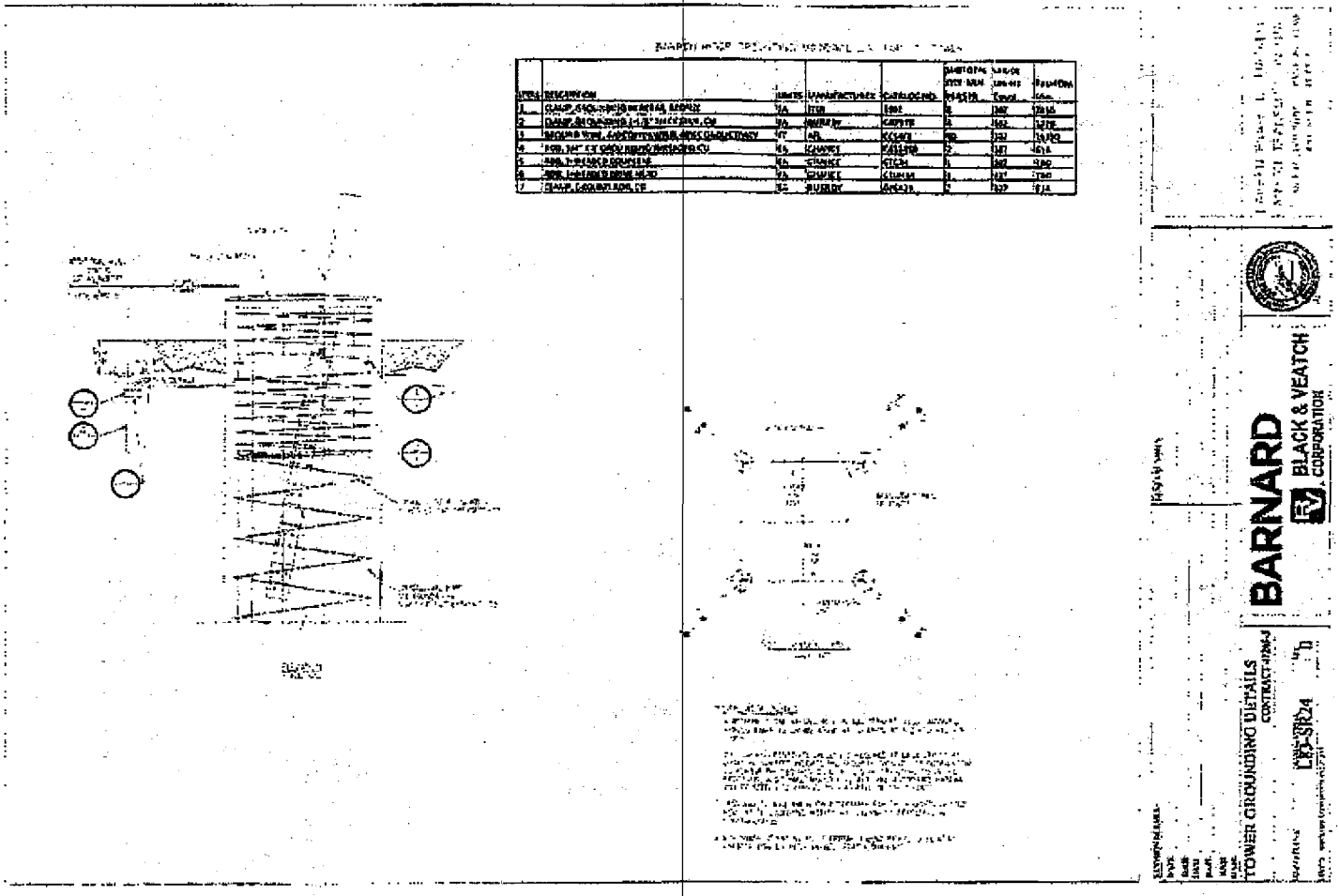



**Figure 8: New Line Tower Grounding Details**

# APPENDIX C – SOIL RESISTIVITY MEASUREMENTS AND MODEL

## SOIL RESISTIVITY DATA - WENNER METHOD

| | | | |
|---|---|---|---|
| CLIENT | Barnard Construction (for LADWP) | DATE | 2/23/2016 |
| LOCATION | Near BRRTP Structure 17-4 | TEST ENGINEER | Rob Schaerer, John Thole |
| SOIL TYPE | Sandy Clay | TEST EQUIPMENT | AGI MiniSting |
| WEATHER | Partly Cloudy, Dry Recently | SOIL CONDITION | Dry, soft |

| TEST POINT | PROBE SPACING (A FEET) | RESISTANCE READING (R OHMS) | RESISTIVITY (OHM-METERS) |
|---|---|---|---|
| 1 | 1.25 | 71.92 | 172.28 |
| 2 | 2.5 | 30.74 | 147.27 |
| 3 | 5 | 13.91 | 133.28 |
| 4 | 7.5 | 8.493 | 122.07 |
| 5 | 10 | 5.893 | 112.93 |
| 6 | 15 | 3.706 | 106.53 |
| 7 | 20 | 2.874 | 110.15 |
| 8 | 25 | 2.454 | 117.67 |
| 9 | 30 | 2.1 | 120.73 |
| 10 | 40 | 1.645 | 126.10 |
| 11 | 50 | 1.34 | 128.40 |
| 12 | 60 | 1.07 | 123.03 |
| 13 | 80 | 0.7519 | 115.27 |
| 14 | 100 | 0.5617 | 107.64 |
| 15 | 125 | 0.3975 | 95.22 |
| 16 | 150 | 0.3227 | 92.76 |
| 17 | 200 | 0.2454 | 94.06 |
| 18 | | | 0.00 |
| 19 | | | 0.00 |

SOIL RESISTIVITY p CALCULATION

p=2*0.305*(PI)AR (OHM-FEET)
A=PROBE SPACING, FEET
R=RESISTANCE, OHMS
METERS = 0.305 FEET
Therefore:
p=2*0.305*3.1416926*R*A

NOTES:
Traverse 1: NW to SE

Traverse 2: NE to SW

Center point 35°2.093'N 119°12.724'W

| TEST POINT | PROBE SPACING (A FEET) | RESISTANCE READING (R OHMS) | RESISTIVITY (OHM-METERS) |
|---|---|---|---|
| 1 | 1.25 | 67.01 | 160.62 |
| 2 | 2.5 | 31.45 | 150.67 |
| 3 | 5 | 13.57 | 130.03 |
| 4 | 7.5 | 7.982 | 114.72 |
| 5 | 10 | 5.787 | 110.90 |
| 6 | 15 | 3.685 | 105.96 |
| 7 | 20 | 2.925 | 112.11 |
| 8 | 25 | 2.471 | 118.38 |
| 9 | 30 | 2.078 | 119.47 |
| 10 | 40 | 1.696 | 130.01 |
| 11 | 50 | 1.38 | 132.23 |
| 12 | 60 | 1.177 | 135.33 |
| 13 | 80 | 0.7912 | 121.30 |
| 14 | 100 | 0.6053 | 116.00 |
| 15 | 125 | 0.4093 | 98.05 |
| 16 | 150 | 0.3538 | 101.70 |
| 17 | 200 | 0.2624 | 100.57 |
| 18 | | | 0.00 |
| 19 | | | 0.00 |

**Figure 9: Soil Measurement Data**

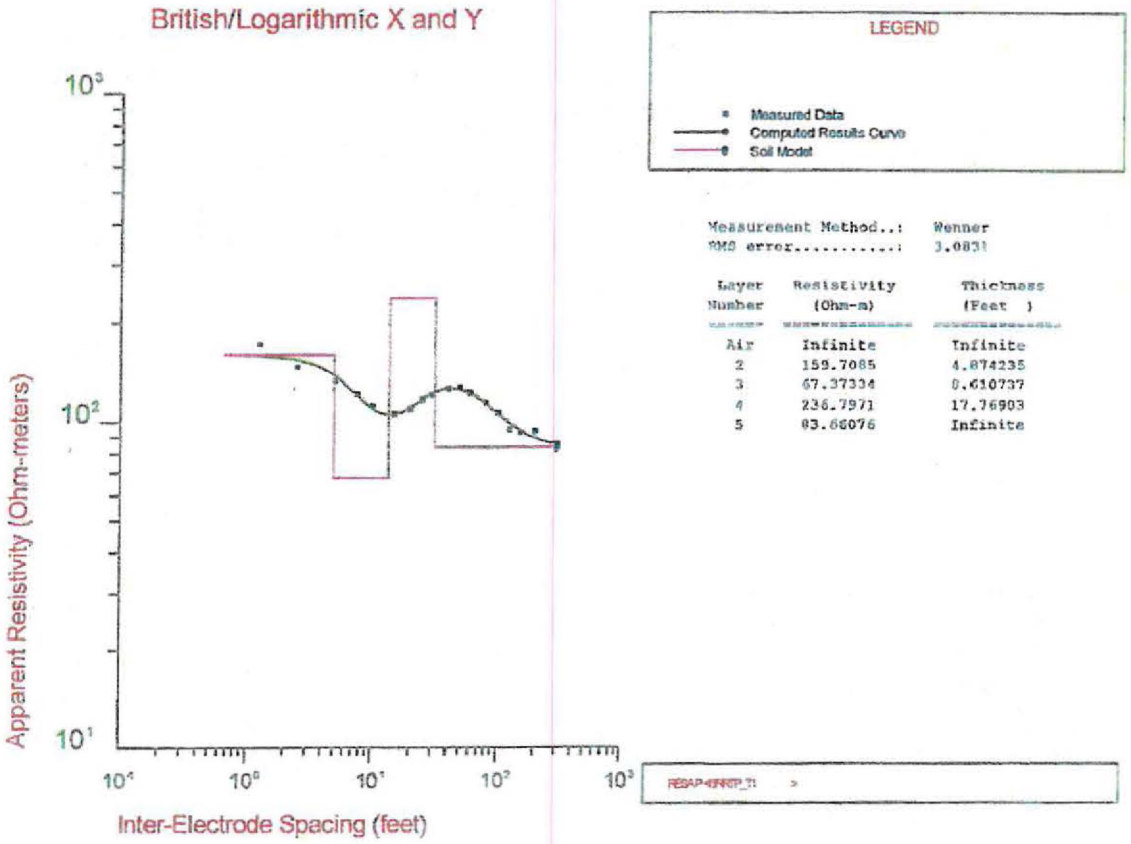



**Figure 10: Traverse 1 Soil Model**

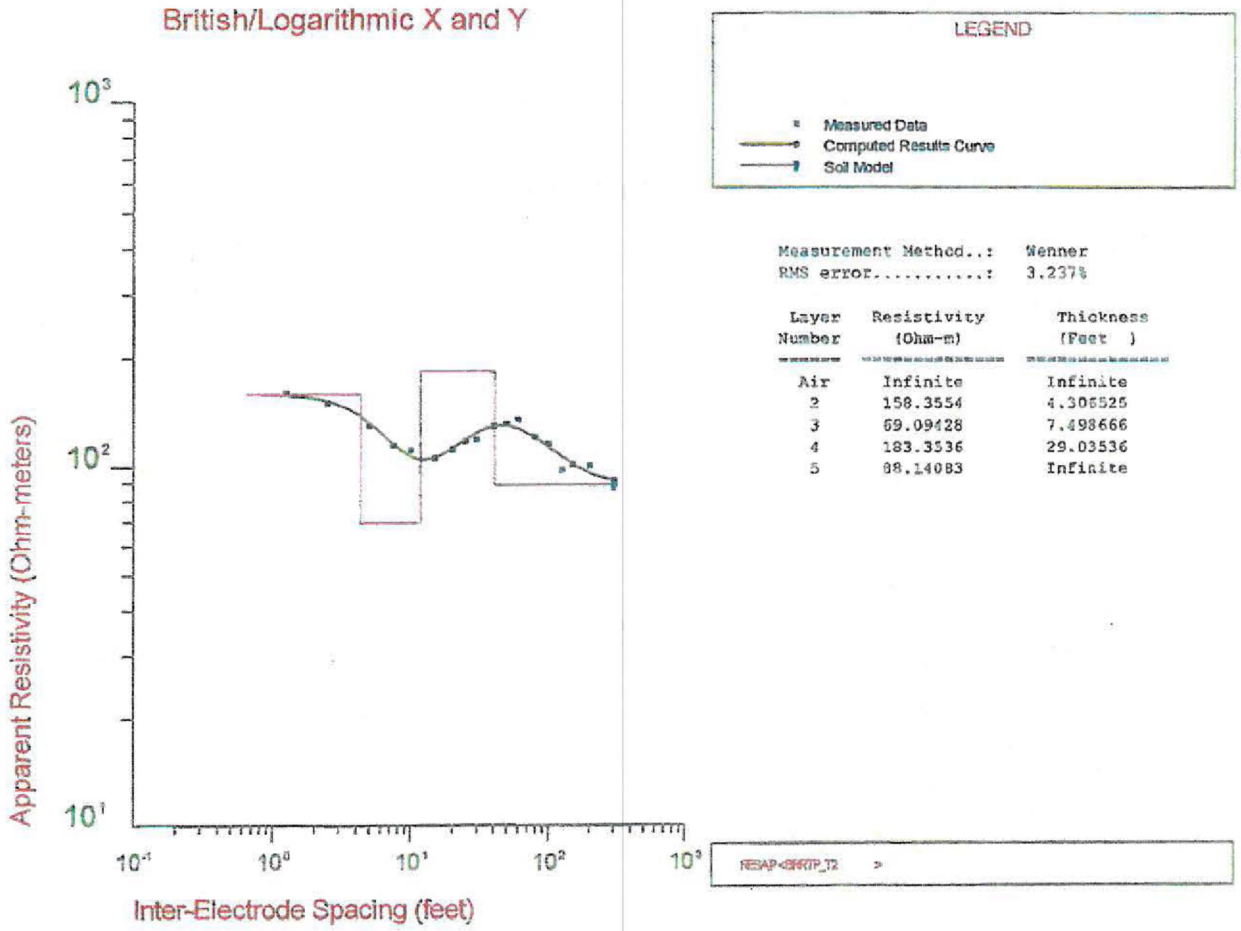



**Figure 11: Traverse 2 Soil Model**

# APPENDIX D –RESULTS

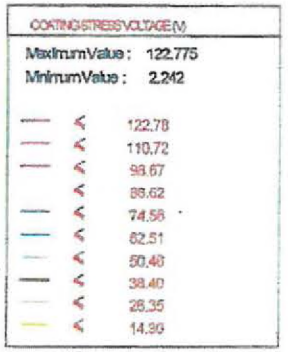




**Figure 12: Structure 192-4 Fault Pipeline Coating Stress**

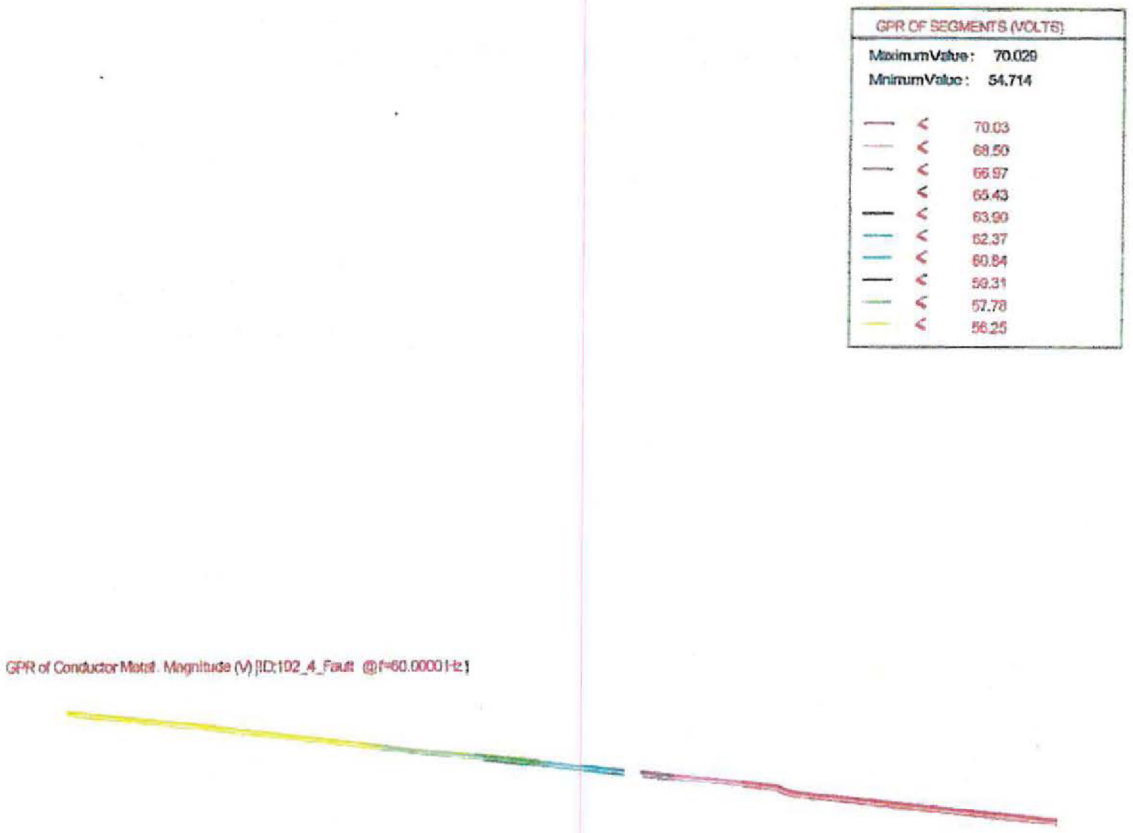



**Figure 13: Structure 192-4 Fault Pipeline Voltage**

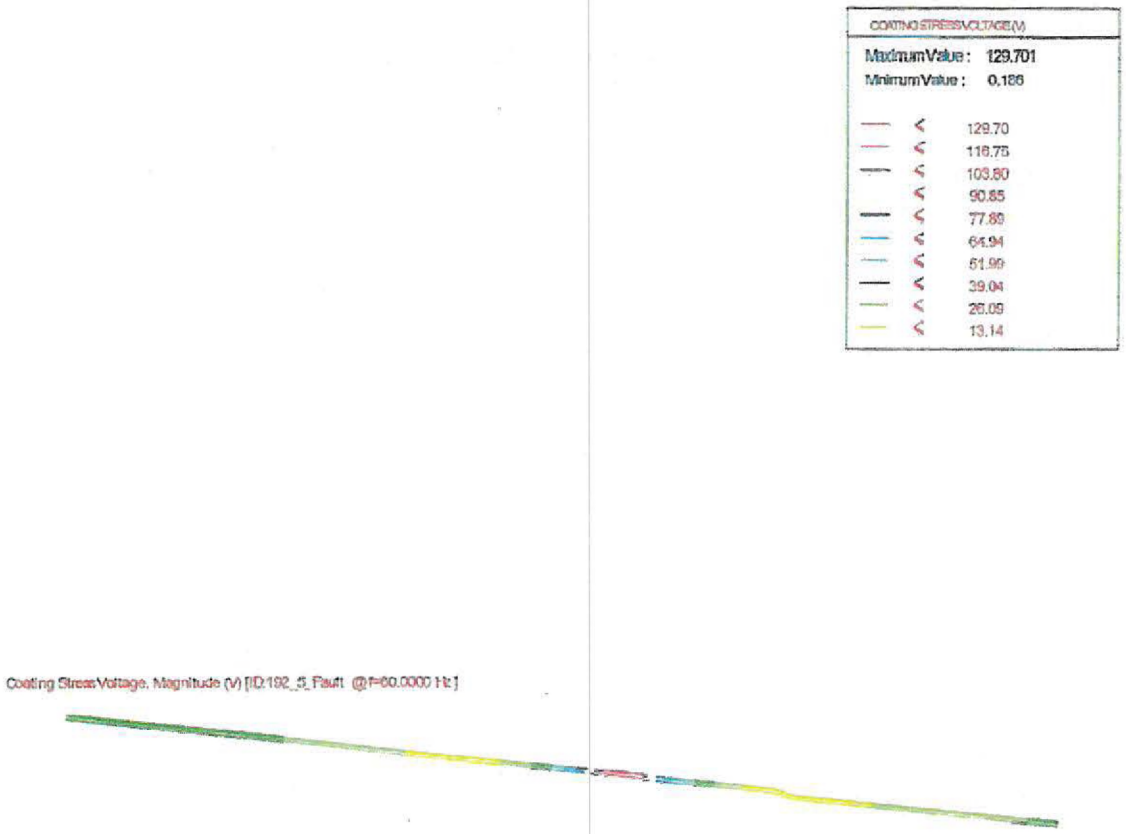



**Figure 14: Structure 192-5 Fault Pipeline Coating Stress**

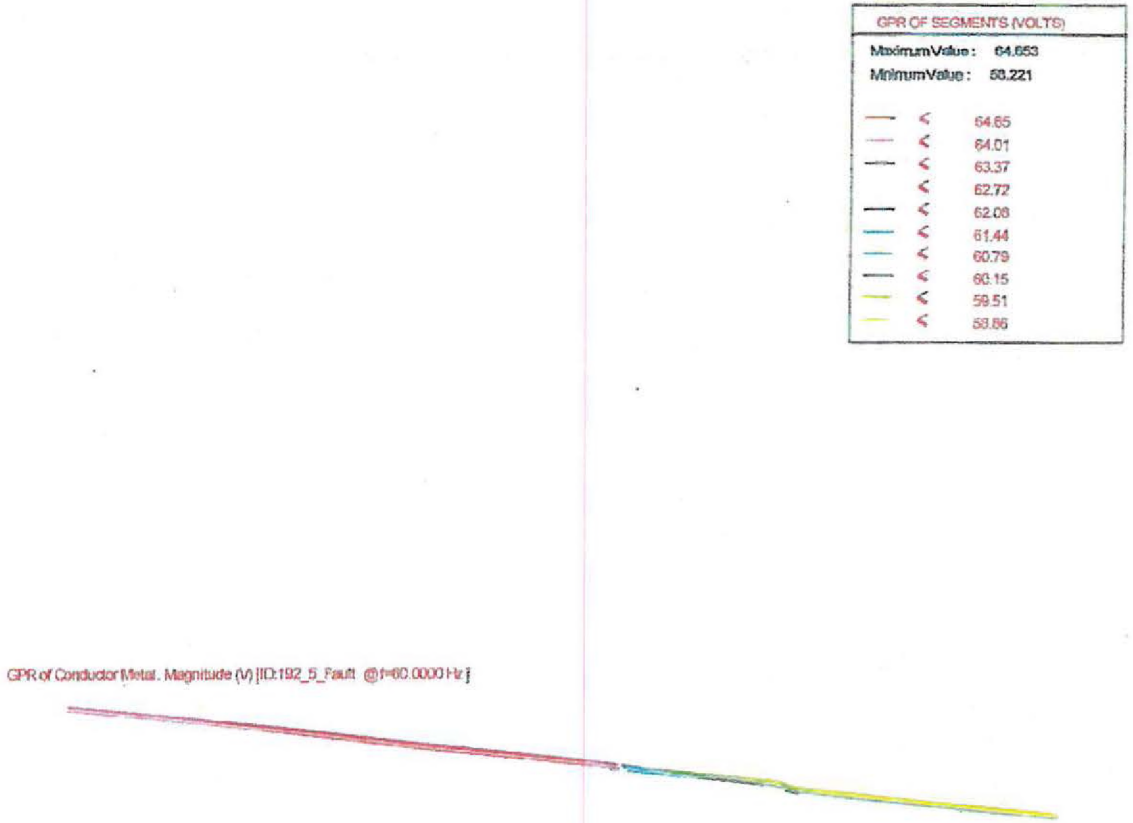



**Figure 15: Structure 192-5 Fault Pipeline Voltage**

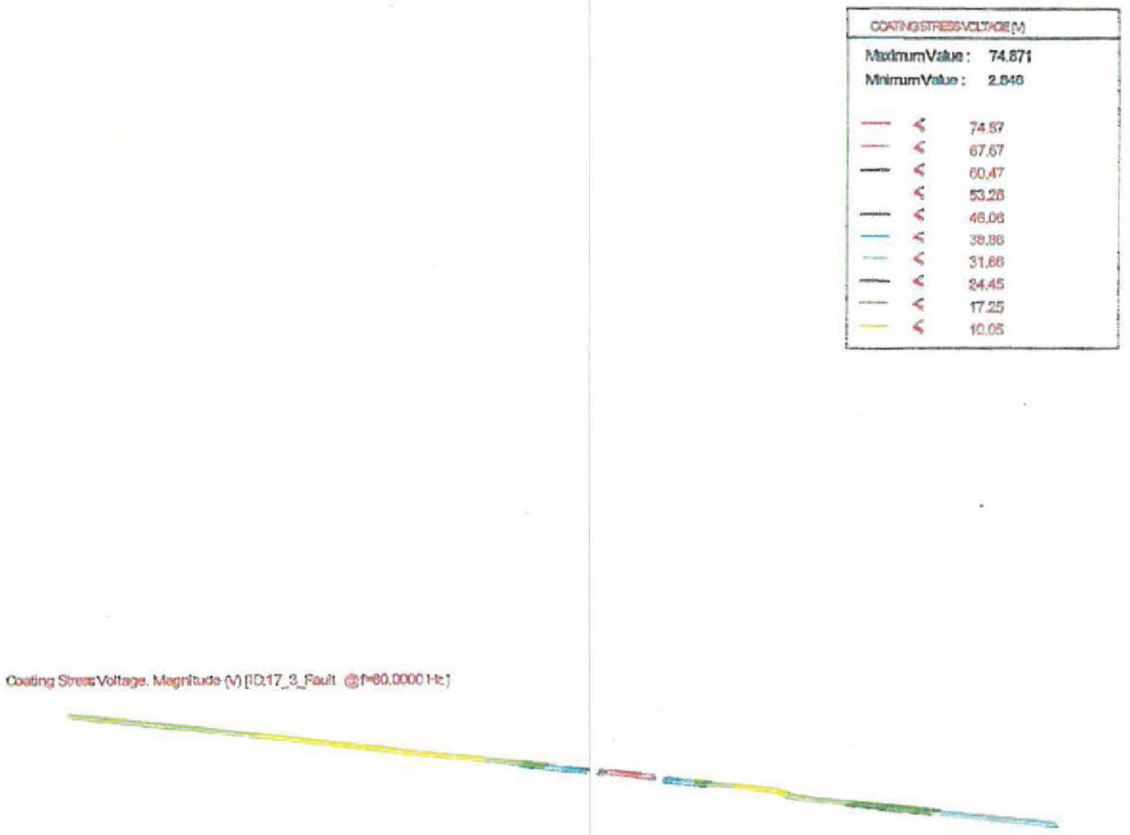



**Figure 16: Structure 17-3 Fault Pipeline Coating Stress**

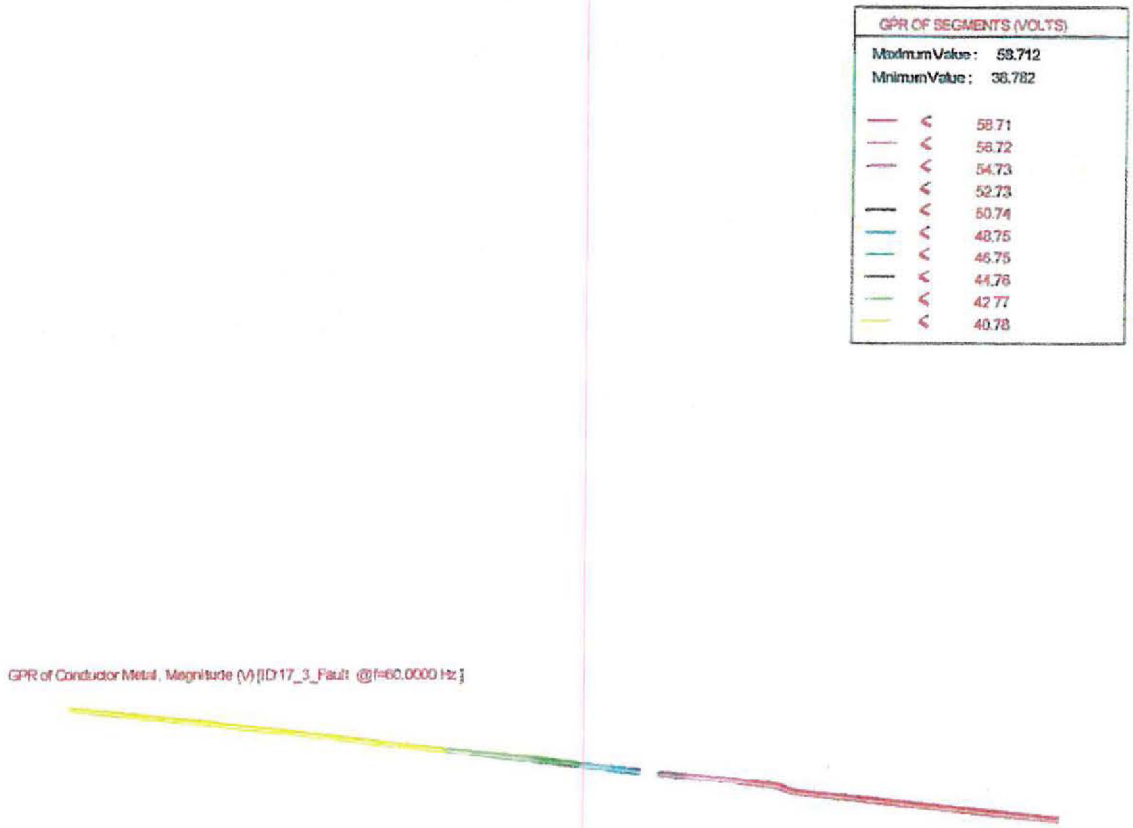



**Figure 17: Structure 17-3 Fault Pipeline Voltage**

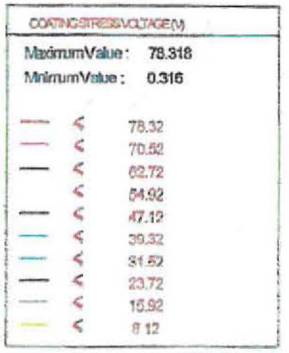
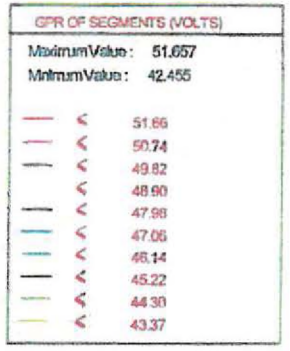




**Figure 18: Structure 17-4 Fault Pipeline Coating Stress**



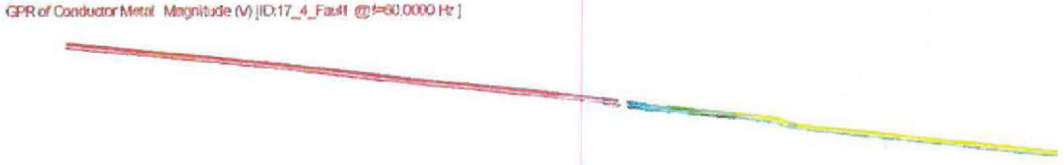




**Figure 19: Structure 17-4 Fault Pipeline Voltage**

**Exhibit "B"**

**O&M Procedure 204 OM200-29 &**
**O&M 204/C1005**
**"Guidelines for Design and Construction near CIG Operated Facilities, Attached Hereto and Incorporated Herein**

KINDER MORGAN

# Guidelines for Design and Construction near Kinder Morgan Operated Facilities

## Name of Company: CIG

The list of design, construction and contractor requirements, including but not limited to the following, for the design and installation of foreign utilities or improvements on **CIG** (Company) right-of-way (ROW) are not intended nor do they waive or modify any rights Company may have under existing easements or ROW agreements. Reference existing easements and amendments for additional requirements. This list of requirements is applicable for Company facilities on easements only. Encroachments on fee property should be referred to the Land and Right-of-Way Department.

**Design**

- Company shall be provided sufficient prior notice of planned activities involving excavation, blasting, or any type of construction on Company's ROW to determine and resolve any location, grade or encroachment problems and provide protection of our facilities and the public before the actual work is to take place.
- Encroaching entity shall provide Company with a set of drawings for review and a set of final construction drawings showing all aspects of the proposed facilities in the vicinity of Company's ROW. The encroaching entity shall also provide a set of as-built drawings showing the proposed facilities in the vicinity of Company's ROW.
- Only facilities shown on drawings reviewed by Company will be approved for installation on Company's ROW. All drawing revisions that effect facilities proposed to be placed on Company's ROW must be approved by Company in writing.
- Company shall approve the design of all permanent road crossings.
- Encroaching entity shall, at the discretion of the Company, incorporate Heath ATI "sniffer" Gas Detection Units in the design of paved areas or "Green Belt" areas of Company ROW. The units shall be installed per Company Standard TYP-V-0100-B010 – Gas Detection Unit for Pipelines Located under Asphalt or Concrete Parking Areas.
- Any repair to surface facilities following future pipeline maintenance or repair work by Company will be at the expense of the developer or landowner.
- The depth of cover over the Company pipelines shall not be reduced nor drainage altered without Company's written approval.
- Construction of any permanent structure, building(s) or obstructions within Company pipeline easement is not permitted.
- Planting of shrubs and trees is not permitted on Company pipeline easement.
- Irrigation equipment i.e. backflow prevent devices, meters, valves, valve boxes, etc. shall not be located on Company easement.
- Foreign line, gas, water, electric and sewer lines, etc., may cross perpendicular to Company's pipeline within the ROW, provided that a minimum of two (2) feet of vertical clearance is maintained between Company pipeline(s) and the foreign pipeline. Constant line elevations must be maintained across Company's entire ROW width, gravity drain lines are the only exception. Foreign line crossings below the Company pipeline must be evaluated by Company to ensure that a significant length of the Company line is not exposed and unsupported during construction. When installing underground utilities, the last line should be placed beneath all existing lines unless it is impractical or unreasonable to do so. Foreign line crossings above the Company pipeline with less than two (2) feet of clearance must be evaluated by Company to ensure that additional support is not necessary to prevent settling on top of the Company natural gas pipeline.
- A foreign pipeline shall cross Company facilities at as near a ninety-degree angle as possible. A foreign pipeline shall not run parallel to Company pipeline within Company easement without written permission of Company.
- The foreign utility should be advised that Company maintains cathodic protection on their pipelines. The foreign utility must coordinate their cathodic protection system with Company's. At the request of Company, foreign utilities shall install (or allow to be installed) cathodic protection test leads at all crossings for the purposes of monitoring cathodic protection. The Company Cathodic Protection (CP) technician and the foreign utility CP technician shall perform post construction CP interference testing. Interference issues shall be resolved by mutual agreement between foreign utility and Company. All costs associated with the correction of cathodic protection problems on Company pipeline as a result of the foreign utility crossing shall be borne by the foreign utility for a period of one year from date the foreign utility is put in service.

KINDER MORGAN

## Guidelines for Design and Construction near Kinder Morgan Operated Facilities

- The metallic foreign line shall be coated with a suitable pipe coating for a distance of at least 10-feet on either side of the crossing unless otherwise requested by the Company CP Technician.
- AC Electrical lines must be installed in conduit and properly insulated.
- DOT approved pipeline markers shall be installed so as to indicate the route of the foreign pipeline across the Company ROW.
- No power poles, light standards, etc. shall be installed on Company easement.

**Construction**

- Contractors shall be advised of Company's requirements and be contractually obligated to comply.
- The continued integrity of Company's pipelines and the safety of all individuals in the area of proposed work near Company's facilities are of the utmost importance. Therefore, contractor must meet with Company representatives prior to construction to provide and receive notification listings for appropriate area operations and emergency personnel. **Company's on-site representative will require discontinuation of any work that, in his opinion, endangers the operations or safety of personnel, pipelines or facilities.**
- The Contractor must expose all Company transmission and distribution lines prior to crossing to determine the exact alignment and depth of the lines. A Company representative must be present. In the event of parallel lines, only one pipeline can be exposed at a time.
- Company will not allow pipelines to remain exposed overnight without consent of Company designated representative. Contractor may be required to backfill pipelines at the end of each day.
- A Company representative shall do all line locating. A Company representative shall be present for hydraulic excavation. The use of probing rods for pipeline locating shall be performed by Company representatives only, to prevent unnecessary damage to the pipeline coating.
- Notification shall be given to Company at least 72 hours before start of construction. A schedule of activities for the duration of the project must be made available at that time to facilitate the scheduling of Company's work site representative. Any Contractor schedule changes shall be provided to Company immediately.
- Heavy equipment will not be allowed to operate directly over Company pipelines or in Company ROW unless written approval is obtained from Company. Heavy equipment shall only be allowed to cross Company pipelines at locations designated by Company. Contractor shall comply with all precautionary measures required by Company to protect its pipelines. When inclement weather exists, provisions must be made to compensate for soil displacement due to subsidence of tires.
- Excavating or grading which might result in erosion or which could render the Company ROW inaccessible shall not be permitted unless the contractor/developer/owner agrees to restore the area to its original condition and provide protection to Company's facility.
- A Company representative shall be on-site to monitor any construction activities within 25-feet of a Company pipeline or aboveground appurtenance. The contractor shall not work within this distance without a Company representative being on site. Only hand excavation shall be permitted within a minimum of 18-inches (refer to state specific rules/regulations regarding any additional clearance requirements) of Company pipelines, valves and fittings. However, proceed with extreme caution when within three (3) feet of the pipe.
- Ripping is only allowed when the position of the pipe is known and not within 10-feet of Company facility unless Company representative is present.
- Temporary support of any exposed Company pipeline by Contractor may be necessary if required by Company's on-site representative. Backfill below the exposed lines and 12-inches above the lines shall be replaced with sand or other selected material as approved by Company's on-site representative and thoroughly compacted in 12-inches lifts to 95% of standard proctor dry density minimum or as approved by Company's on-site representative. This is to adequately protect against stresses that may be caused by the settling of the pipeline.

KINDER MORGAN

## Guidelines for Design and Construction near Kinder Morgan Operated Facilities

- No blasting shall be allowed within 1000-feet of Company's facilities unless blasting notification is given to Company including complete Blasting Plan Data. A pre-blast meeting shall be conducted by the organization responsible for blasting.

  Company shall be indemnified and held harmless from any loss, cost of liability for personal injuries received, death caused or property damage suffered or sustained by any person resulting from any blasting operations undertaken within 500-feet of its facilities. The organization responsible for blasting shall be liable for any and all damages caused to Company's facilities as a result of their activities whether or not Company representatives are present. Company shall have a signed and executed Blasting Indemnification Agreement before authorized permission to blast can be given.

  No blasting shall be allowed within 300-feet of Company's facilities unless blasting notification is given to Company a minimum of one week before blasting. *(Note: covered above)* Company shall review and analyze the blasting methods. A written blasting plan shall be provided by the organization responsible for blasting and agreed to in writing by Company in addition to meeting requirements for 500-feet and 1000-feet being met above. A written emergency plan shall be provided by the organization responsible for blasting. *(Note: covered above)*

- Any contact with any Company facility, pipeline, valve set, etc. shall be reported immediately to Company. If repairs to the pipe are necessary, they will be made and inspected before the section is re-coated and the line is back-filled.
- Company personnel shall install all test leads on Company facilities.
- Burning of trash, brush, etc. is not permitted within the Company ROW.

## Exhibit "C"

### Daily Inspection Rates

| | |
|---|---|
| Inspector / Representative (Daily Rate): | $4,144.00 per Week |
| Expenses (Daily Rate): | $125.00 per day |
| Vehicle (Mileage Rate): | $0.56 per mile |