Kitty Hawk North Offshore Wind Project

Electric and Magnetic Field Study

Prepared for:

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TETRA TECH

Contents

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Introduction

Kitty Hawk Wind, LLC for the Kitty Hawk Wind Project (Kitty Hawk Project) proposes to construct, operate, and maintain subsea and onshore underground transmission cables between the wind lease area known as Kitty Hawk OCS-A-508 and connection to the local grid. The wind lease area has the potential to generate approximately 2500 MW of clean renewable energy. This report assumes the energy for a full project build out makes landfall at the parking lot south of the Sandbridge Seaside Market located at the intersection of Sandbridge Road and Sandpiper Road in the Sandbridge area of Virginia Beach, Virginia.

Landfall could include up to six 275-kV subsea cables to be installed by underground horizontal directional drill to avoid impacts to the beach and sand dunes. The HDD will reach depths of up to 60 feet. On land within the parking lot, each of the six subsea cables would terminate at a transition joint bay and connect to onshore cables. The onshore cables would connect from the subsea cable to three single-circuit cables making one full circuit and a total build out may consist of six circuits. Two of the six circuits will share one duct bank and the remaining four circuits will share another duct bank i.e six and 12 cables in each duct bank respectively. Typical configuration of the two duct banks are shown in *Figure 1*.

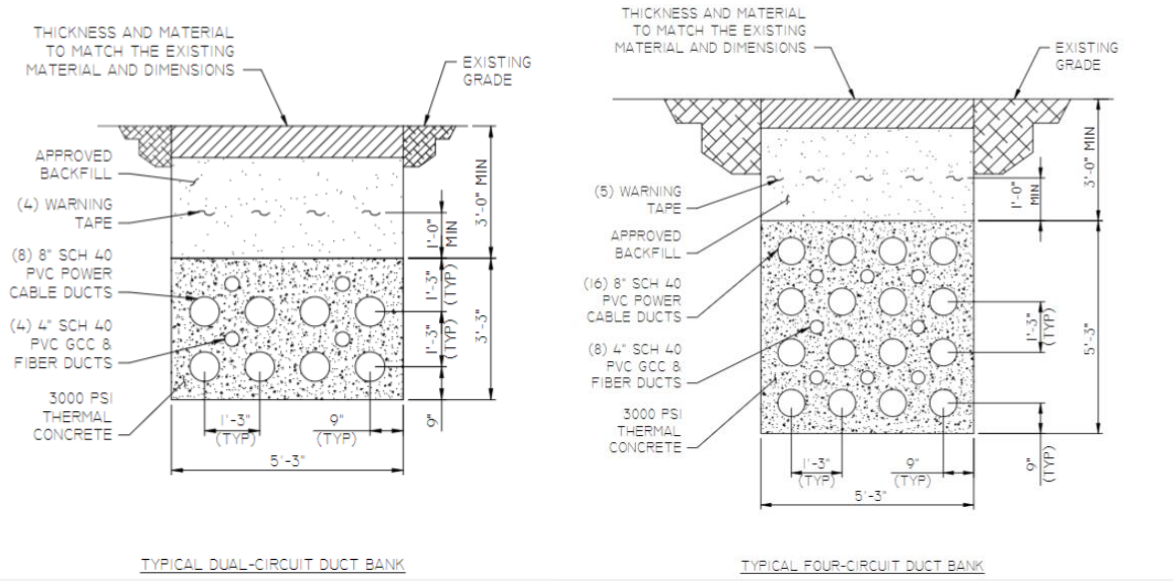

Figure 1: Indicative duct bank designs

The two sets of underground ducts banks modelled in this report parallel each other at a minimum separation of 10 feet from the intersection of Sandpiper Road and then following Sandbridge Road to where Sandbridge Road turns to the southwest and the duct banks continue to currently undeveloped City of Virginia Beach right of way. The cable will then follow Nimmo parkway and ultimately to substation that will provide an interconnection to the existing electric transmission grid.

The Kitty Hawk Wind Project requested that Tetra Tech, Inc. (Tetra Tech) conduct an independent assessment of the electric and magnetic field (EMF) modeling for Kitty Hawk Project to predict what types of EMF would be generated by both the undersea cables as they land onshore, as well as by the underground duct banks bringing power to the future onshore substations located within Virginia Beach.

EMF represents both electric and magnetic fields generated by electrical equipment, as all electrical devices, house wiring, and power lines and cables generate some amount of both electric and magnetic fields. When it comes to scientific studies about EMF, several thousand studies have been conducted by agencies around the world to investigate the potential health effects from power line EMF. No conclusive evidence from these studies has shown a health threat from public exposure to both EMF from power lines. Additionally, neither the Commonwealth of Virginia nor the Federal government have adopted maximum exposure standards for public exposure to power line EMF. Both the International Commission on Non-Ionizing Radiation Protection (ICNIRP) and the American Conference of Governmental Industrial Hygienists (ACGIH) have established voluntary guidelines for magnetic field exposure in an occupational setting (for workers in EMF environments for an eight-hour exposure), see below (Table 1):

Table 1: Occupational guidelines for Magnetic Field Exposure Limits

Organization	**Magnetic Field Exposure Limits**
International Commission on Non-Ionizing Radiation Protection (ICNIRP)	Occupational - 4.2 G (4,200 mG)[1] General Public - 0.833 G (833 mG)[1]
American Conference of Governmental Industrial Hygienists (ACGIH)	Occupational – 10 G (10,000 mG)[1] Workers with Pacemakers - 1 G (1,000 mG)[1]
[1] National Institute of Environmental Health Sciences and National Institutes of Health, *Electric and Magnetic Fields Associated with the Use of Electric Power,* 2002.	

Study

The study conducted for the Kitty Hawk Project focused only on magnetic fields as electrical fields generated by the underground cables or duct banks are grounded by the earth surrounding the cables, so electric fields are undetectable at the surface. Therefore, this study focuses strictly on magnetic fields (MF) generated by the undersea cables or the underground duct banks (depending on location) and their typical characteristics with power cables will:

1. Be greatest directly above the center of the cable/duct bank.
2. Decrease rapidly with distance down to levels which are immeasurable

The FIELDS computer program, designed by Southern California Edison, was utilized to calculate MF strengths from the proposed underground and submarine transmission line. This program operates using Maxwell's equations, which accurately apply the laws of physics as related to electricity and magnetism (EPRI, 1982, 1993). Modeled fields using this program are both precise and accurate for the input data utilized. Results of the model have been checked extensively against each other and against other software (*e.g.*, CORONA, from the Bonneville Power Administration, United States Department of Energy) to ensure that the implementation of the laws of physics are consistent. In these validation tests, program results for MF levels were found to be in very good agreement with each other (Mamishev and Russell, 1995).

The Kitty Hawk Project team and Tetra Tech decided on three locations to model magnetic fields (see Figure 2):

1. Underground duct banks near Atwoodtown Road/Artesia Way;
2. Underground duct banks near the intersection of Sandpiper Road and Sandbridge Road; and
3. Undersea cables at Sandbridge Beach east of the Sandbridge parking lot.

Magnetic fields are measured in units called Gauss, or in this case one thousandth of a Gauss or milligauss (mG). Typical household items and the magnetic fields they generate are as follows[1]:

- Fluorescent lights – 100 mG
- Hair dryer – 700 mG
- Power saw – 1,000 mG

[1] National Institute of Environmental Health Sciences and National Institutes of Health, *Electric and Magnetic Fields Associated with the Use of Electric Power,* 2002.

Figure 2: Figure showing the location of three magnetic field modeling studies

These locations (Figure 2) were selected based on the following criteria and used the following assumptions:

1. Locations 1 and 2 were selected as they were closest to nearby residential areas. Location 1 had residences approximately 90 feet away from the centerline of the cable duct bank, and Location 2 was closest to Sandbridge Dunes Condominiums.
2. Location 3 was selected to calculate EMF that beachgoers would experience at the beach.
3. All undersea cables or underground duct banks for full lease area electric output were modeled in the three locations.
4. Cables layouts used the locations and typical details provided by the electrical engineers on the Kitty Hawk Project.
5. Peak output from the lease area was used in all modeling situations.
6. Phasing of cables were determined by others, and do not incorporate phase optimization which could reduce overall EMF values.
7. All locations used FIELDS, a computer program developed by Southern California Edison.
8. All measured EMF fields were calculated at 3.28 feet (one meter) above the ground.

Results

Magnetic field modeling for Location 1, underground duct banks near Atwoodtown Road/Artesia Way, is shown below (Figure 3). The two underground duct banks are approximately 10 feet apart. The peak magnetic field generated at this location is less than a standard hair dryer and dissipates rapidly as one moves from the center of the two duct banks. The closest residence 90 feet away from the center results in minimal magnetic fields from the duct banks.

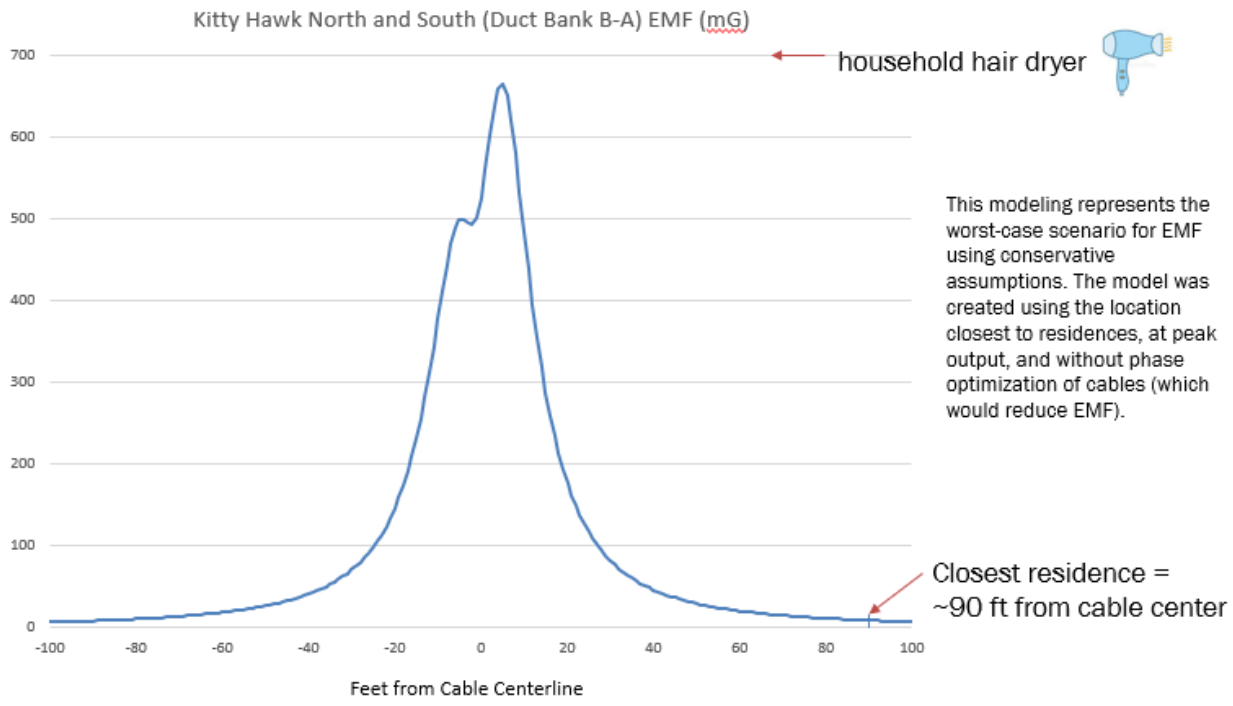

Figure 3: Location 1 Atwoodtown Road/Artesia Way

Magnetic field modeling for Location 2 (Figure 4), underground duct banks near the intersection of Sandpiper Road and Sandbridge Road, is shown below. The two duct banks are separated further from each other in this model (approximately 30 feet), so two separate peaks for the magnetic field show in the graph. Again, the peak over the center of the two duct banks is less than a common hair dryer and dissipates rapidly as one moves away from the center of the duct banks. The closest residences at Sandbridge Dunes Condominiums results in a magnetic field of around 74 mG.

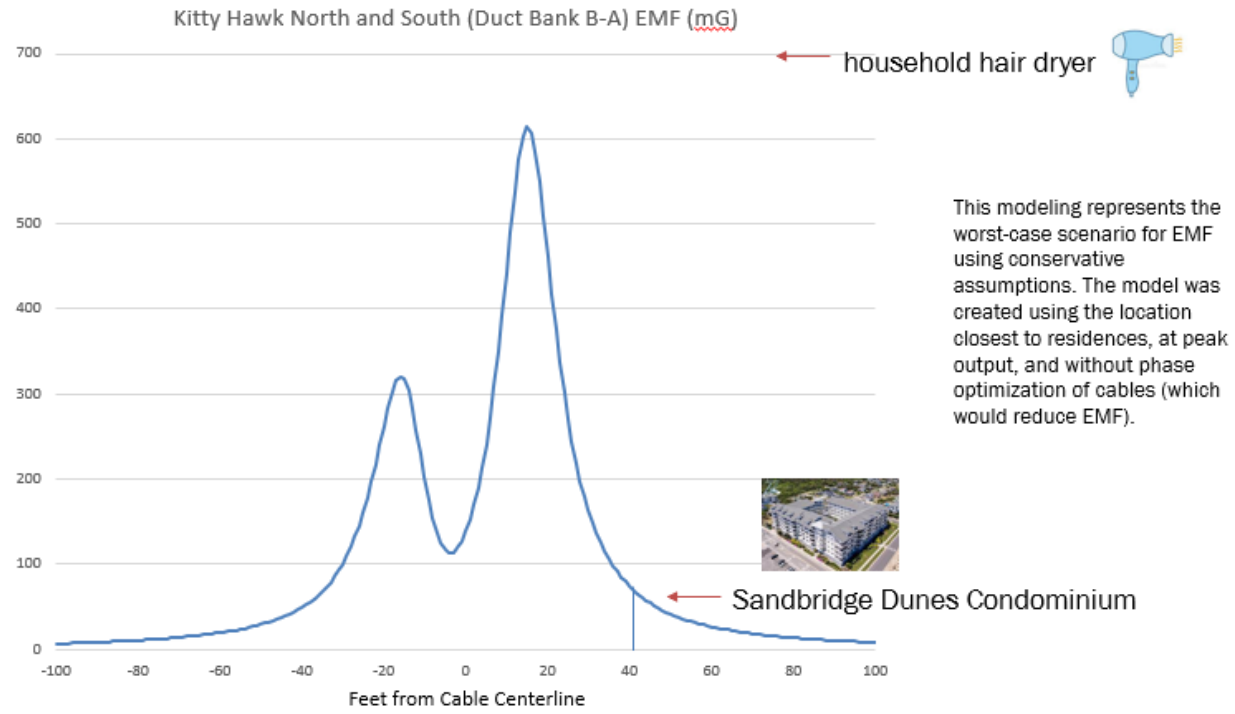

Figure 4: Location 2 Intersection of Sandpiper Road and Sandbridge Road

Magnetic field modeling for the third location (Figure 5), the undersea cables underneath Sandbridge Beach, is shown below. The cables create an extremely low amount of magnetic field due to the depth the cables are installed at 29 feet below the ground. Magnetic fields generated by the undersea cables are less than 1 mG at this location as a result.

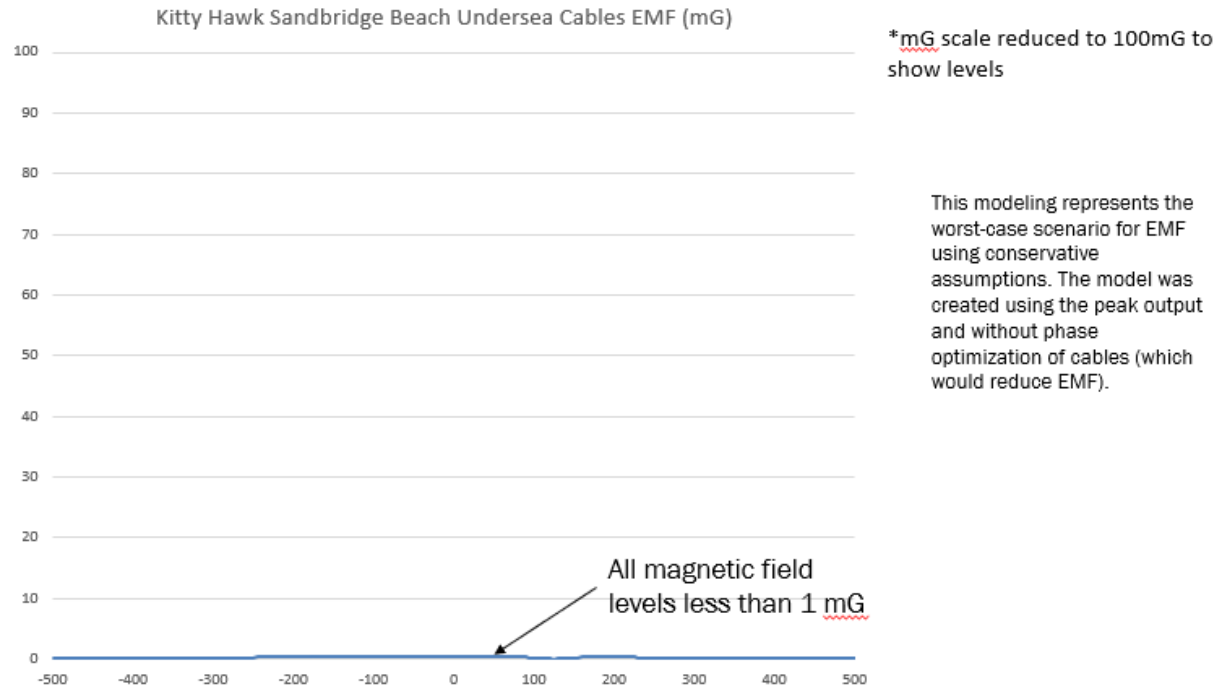

Figure 5: Location 3 Undersea cables at Sandbridge Beach

Summary

This study found that:

- Electric fields from the buried cables will not be detectable at the ground level due to the grounding effect of the earth.
- Project specific modeling at three locations show that the exposure to magnetic fields dissipates rapidly with distance from the cable and peak exposure levels is less than many household objects.

This report presents the EMF information presented to the to the Sandbridge Beach Civic League on June 20, 2022 by Andrew Lintz and Dr Bob Pearson of Tetra Tech. The Tetratech Team along with the Kitty Hawk Team can be available for questions and comments that may arise from this report.

Appendix A: Frequency Ask Questions

Q: What is EMF?

A: EMF is a shorthand term for electric and magnetic fields. EMF is produced by any device using or transmitting electricity. It is present near electric appliances and machinery, house electrical wiring, and electric power lines such as being proposed here.

Q: Will the underground power lines produce EMF?

A: Yes. Like all power lines, these lines will produce EMF. Electric fields will be produced by the 275-kilovolt voltage in the line. However, since the lines will be buried underground, the electric fields will be absorbed by the surrounding soil and will not be detectable at the surface of the ground. Magnetic fields will also be produced by the power lines. The strength of the magnetic fields will be directly proportional to the amount of power that is flowing through the power lines from the offshore wind farms. The strength of the magnetic fields will diminish rapidly with distance away from the cables.

Q: Will the magnetic fields be measurable at the surface?

A: Yes, the fields will be detectable at the surface using a magnetometer. However, magnetic fields cannot be felt by people.

Q: Can the strength of the magnetic fields that will be produced by the power lines be predicted?

A: Yes. Digital computer modeling of the fields has been done using the FIELDS model from the Southern California Edison Company. The model shows the strength and location of the fields produced by the lines. Modeling was done at several locations along the power lines to show representative results for different configurations of the power lines at different locations along the onshore export cable route from the landfall at Sandbridge Beach to the Corporate Landing onshore substation site.

Q: What do these computer models show?

A: Because the lines will be buried, the cables will be spaced close together in concrete ducts. This close spacing will result in narrow profiles of the fields that are reduced in their magnitude due to the electrical interaction of the fields between the various cables. In some locations the magnetic fields will peak at a value of about 600 milli Gauss (mG) and will drop by 95% of this value within 30 feet from the centerline of the cable duct bank. In other locations the peak field will be about 350 mG at the centerline with a drop by 95% within 30 feet.

Q: How does 600 mG compare to other exposures we frequently encounter?

A: We do experience these types of magnetic fields in everyday life. For instance, a fluorescent light can produce a magnetic field of 100 mG and an electric hair dryer can produce a magnetic field of 700 mG when held 6 inches from the head. Similar fields are produced by electric shavers, vacuum cleaners, and power saws.

Q: How do we know that exposure to these levels of magnetic fields from power lines is safe?

A: Several thousand scientific studies have been conducted around the world in the past 40 years looking at the issue of human health effects from exposure to magnetic fields. To date no study has demonstrated a definitive link between exposure to power line levels of magnetic fields and a human disease outcome such as cancer. In addition, neither the Commonwealth of Virginia nor the Federal government have adopted standards for the exposure of the public to magnetic fields from power lines.

Q: Have exposure standards been set for exposure to magnetic fields in industrial laboratories?

A: Yes. The International Commission on Non-ionizing Radiation Protection (ICNIRP) has set suggested magnetic field exposure guidelines of 4,200 mG for workers and 833 mG for the public. In addition, the American Conference of Governmental Industrial Hygienists (ACGIH) have set magnetic field exposure guidelines of 10,000 mG for workers and 1,000 mG for workers with cardiac pacemakers. All these guidelines are well above the maximum magnetic field levels that these power lines will produce.

Q: Have government studies been published that summarize what is known about the health effects of EMF and provide recommendations on setting standards for magnetic fields?

A: Yes. Congress in 1992 passed the Energy Policy Act (PL 102-486). That law set out the requirement for the federal government to assemble and disseminate information on health effects from EMF. The law authorized the EMF RAPID program which required the National Institute of Environmental Health Sciences of the National Institutes of Health and the National Academy of Sciences to prepare reports to Congress on the health effects of EMF. Both reports conclude that there was insufficient evidence to warrant the setting of public exposure standards for EMF from power lines.

Q: Are these reports available on the Internet?

A: Yes. The EMF RAPID program published a general information document on EMF titled *EMF Electric and Magnetic Fields Associated with the Use of Electric Power Questions and Answers*. It is available at https://www.niehs.nih.gov/health/materials/electric_and_magnetic_fields_associated_with_the_use_of_electric_power_questions_and_answers_english_508.pdf

The NIEHS report to Congress is titled *Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields.* It is available at:
https://www.niehs.nih.gov/health/assets/docs_p_z/report_powerline_electric_mg_predates_508.pdf

The National Academy of Sciences Report to Congress is titled: *Research on Power-Frequency Fields Completed Under the Energy Policy Act of 1992.* It is available at
https://nap.nationalacademies.org/read/9587/chapter/2

Q: Does the earth produce a magnetic field?

A: Yes. The earth does produce a magnetic field. However, it is a steady state field that does not oscillate at 60 Hz like power line magnetic fields. The earth's field is generally 500 mG in the vicinity of Virginia Beach. It is this natural magnetic field that causes compasses to point toward north.

Q: Will the power cables produce heat?

A: Yes. However, the cables will be buried at a minimum depth of three feet and will be encased in a special thermal dissipating concrete. Therefore, the heat will be absorbed by the concrete and the surrounding soil and will not be detectable at the surface.

Appendix B: Resumes

TETRA TECH

Robert Pearson, PhD, PE
Consultant

EXPERIENCE SUMMARY

Dr. Pearson is presently a Senior Project Manager with Tetra Tech Inc., a large engineering consulting company. He recently retired as a Vice President and Principal Technologist in the Environment and Nuclear Division of CH2M HILL in their Denver office. He had responsibility for developing programs to respond to clients in all areas of environmental services with a particular emphasis to clients in the electric utility industry. Previously, he was a Project Manager and Senior Staff Scientist on the Denver technical staff of Radian International LLC responsible for the technical conduct of research and analysis projects for these clients. He has over 33 years of experience in environmental and technical engineering, regulatory review and assessment, preparation of industrial compliance policy, and environmental consulting. He has proven ability to work with clients to assess regulatory programs, define needs, and develop programs to satisfy those needs. His program administrative experience includes projects in health effects of electric and magnetic fields, air pollution control and assessment, water quality control, environmental permitting, and environmental research and development. Prior to joining Radian, Dr. Pearson was a nationally recognized expert concerning environmental issues in the electric utility industry. He was also a state water quality regulatory commissioner and commission chairman appointed by the Governor of Colorado, as well as a member and chairman of a water quality operator certification board, also governor appointed.

RELEVANT EXPERIENCE

Wind and Solar Farm EMF Analysis for Transmission Lines, Substations and Switchyards

Managed and provided senior technical lead for the analysis of EMF for several terrestrial and offshore wind and solar farms:

- Transmission lines from Nolan Hills Wind farm Oregon
- Transmission lines and substations for two Rush Creek Wind Farms Colorado
- Transmission line and substation for Windtalker Wind Farm, Colorado
- Transmission line for Rock Creek Wind Farm Oregon
- Transmission line for Timber Road Wind Farm Ohio
- Transmission Line for Brush Canyon Wind farm Oregon
- Transmission Line and substation analysis for Shortgrass Wind farm Colorado
- Onshore transmission lines for Coastal Virginia Offshore Wind Project, Virginia
- Solar farm and transmission line, Paeahu Solar Farm, Maui Hawaii
- Solar farm and transmission line, Kahana Solar Farm Maui Hawaii

EDUCATION

PhD, Remote Sensing of Natural Resources, Colorado State University, 1973

MS, Remote Sensing of Natural Resources, Colorado State University, 1971

Professional Geophysical Engineer, Colorado School of Mines, 1968

AREA OF EXPERTISE

Project Management

Regulatory Review and Assessment

Industrial Compliance Policy

EMF

Air Quality

REGISTRATIONS/ CERTIFICATIONS

Registered Professional Engineer, CO No. 12582

OFFICE

Denver, CO

YEARS OF EXPERIENCE

52

- Switchyard and transmission lines for Spanish Peaks Solar Farm, Valent Switchyard, Las Animas County, Colorado

Electric and Magnetic Field Health Effects

Epidemiological Research Study Lead

Managed utility company participation in two state of the art epidemiological research studies on the relationship between electric power lines and the occurrence of childhood cancer. These studies were done in Denver by Wertheimer and Leeper in 1978 and Savitz et al. in 1985. Much of the data required for the studies were provided from company data files and the overall design and execution of both studies was critiqued for its correctness and appropriateness.

Expert Testimony, Electric and EMF Analysis

Provided electric and magnetic field (EMF) analysis and testimony for a 115 kV underground electric transmission project In Denver which had been stalled by community opposition. As a result, the concerns of the citizens were allayed, and the project was allowed to be constructed and placed into operation on schedule.

Expert Testimony, EMF Analysis

Provided EMF analysis and expert testimony to governmental bodies for an overhead electric transmission project being relocated due to construction of the new Denver International Airport. The EMF concerns raised by the governmental bodies were reduced to a level allowing them to approve the project to be built on schedule.

Chair, EMF Health Studies Task Force, EPRI

Chaired the EMF Health Studies Task Force of the Electric Power Research Institute. This industry advisory committee directs the EMF health studies research program of the Institute which is the largest such basic EMF research program in the world.

Vice Chair, EMF Task Force, Edison Electric Institute

Served as Vice Chairman of the Electric and Magnetic Fields Task Force of the Edison Electric Institute. This trade association industry committee of the investor-owned electric utilities in the United States provided policy preparation and issue management for this largest sector of the American electric utility industry.

EMF Scientific Meetings

Participated in the organization and conduct of annual EMF scientific meetings for the Electric Power Research Institute (EPRI). These annual meetings are the principle informational meetings for representatives of the electric utility industry.

Expert Opinion, EMF Effects

Provided analysis and expert opinion on the EMF effects of a proposed Regional Transportation District light rail transportation system. This system, which is electrically powered, runs through several residential neighborhoods as well as commercial and industrial districts in the Denver area.

Expert Opinion, Magnetic Fields Effects

Analyzed and provided expert opinion on a proposed university high energy physics facility. This facility proposed to be constructed on the campus of the University of California at Los Angeles (UCLA), will house state of the art high energy particle accelerators. The analysis provided information regarding the exposure to the surrounding neighborhood of magnetic fields from the facility as well as within the facility laboratories.

Expert Opinion, EMF Effects

Analyzed and provided expert opinion on a proposed electric cogeneration facility. This facility, also to be constructed on the campus of the UCLA, will provide electric power to the University. The analysis provided information regarding the potential interference with adjoining telephone switching equipment, as well as exposure to workers in nearby offices.

Co-Principal Investigator/Project Manager, Wire Code Paradox, EPRI

Served as co-principal investigator and Project Manager of a study to investigate the "wire code paradox", sponsored by the Electric Power Research Institute. The apparent paradox was revealed when earlier EMF epidemiological studies done in Denver and elsewhere demonstrated a relationship between a surrogate measure of magnetic fields exposure, the wire code, and the occurrence of childhood cancer. Actual measures of

magnetic fields showed no such relationship. The study investigated the nature of the wire code paradox and to determine if the wire code is related to other parameters of the neighborhood such as its layout or of the house such as its age where the child lived. Several papers on the design and status of this project were presented to the Annual DOE/EPRI Contractor's Review Meetings and Annual Meetings of the Bioelectromagnetics Society.

Co-Principal Investigator/Project Manager, Epidemiological Investigation, EPRI

Served as co-principal investigator and Project Manager of a study to investigate the feasibility of conducting an epidemiological investigation of children living in very high current configuration residences, sponsored by the Electric Power Research Institute. This study explored the feasibility of identifying children who live near larger power lines who could be surveyed for their incidence of contracting various forms of cancer including leukemia.

Study Team Member, Environmental Impacts, Seattle East Link Light Rail, WA

Served on the study team evaluating the environmental impacts of the proposed Seattle East Link Light Rail System segment from Seattle to Belleview WA, the Federal Way segment from the SeaTac Airport to Federal Way and the downtown Tacoma circulator. My role was to evaluate the exposure to EMF for both passengers on the train as well as members of the public long the right of way. I also reviewed the potential for interference with sensitive electronic equipment in buildings near the ROW as well as pipelines corrosion in underground utilities along the ROW.

Study Team Member, Environmental Impacts, Minneapolis Metro Southwest Light Rail Train Extension, MN

Served on the study team evaluating the environmental impacts of the proposed Minneapolis Metro Southwest Light Rail Train extension segment from downtown Minneapolis to Eden Prairie, MN. My role was to evaluate the exposure to EMF for both passengers on the train as well as members of the public long the right of way. I also reviewed the potential for interference with sensitive electronic equipment in buildings near the ROW as well as pipelines corrosion in underground utilities along the ROW.

Study Team Member, Environmental Impacts, California High Speed Train System Expansion, CA

Served on the study team evaluating the environmental impacts of the proposed California High Speed Train System segment from Modesto to Fresno CA, the segment from Modesto to Sacramento and from Fresno to Bakersfield. My role was to evaluate the exposure to EMF and electromagnetic interference for both passengers on the train as well as members of the public and communications systems along the right of way.

Project Director, Magnetic Fields Assessment, High Speed Electric Rail System, TX

Served as Project Director of an assessment of the magnetic fields to be generated by the proposed high speed electric rail system to be built in Texas. This project determined the background levels of magnetic fields and the field levels which will be generated by the transit system when it is placed into service. Areas which will be exposed to an elevated magnetic field as a result of the operation of the transit system were determined. These magnetic field levels were then screened to determine if existing occupational or environmental guidelines or standards will be exceeded and if so what health implications there may be given the current scientific knowledge on the subject. As a portion of this project, measurements were made of the magnetic fields produced by the Spanish high speed rail train, the AVE, which operates between Madrid and Seville. This rail system is identical to the system proposed to be constructed in Texas. Measurements were made both on the train as well as alongside the tracks and at a power substation which supplies electricity for the AVE rail system.

Survey Lead, Magnetic Fields Surveys, Electric Utility Distribution Lines, Granada, Spain

Conducted two surveys of magnetic fields produced by 25 kV distribution power lines for an electric utility in Granada, Spain. The utility had received two requests to relocate two primary voltage distribution power lines, one from the local government and one from a group of concerned neighbors. Measurements were made of the magnetic fields produced by each of these lines which demonstrated the magnetic fields to be very low. Reports were produced for the utility for presentation to the city government and the group of concerned neighbors.

Expert Opinion, Electric Transmission Line Development, CO

Representing two electric utilities in Colorado at public meetings on the construction of new 115 and 230 kV electric transmission lines to be built to serve eight separate areas in Colorado and New Mexico. Presented information on the expected magnetic field levels to be produced by the transmission lines and the broader issue of the status of scientific knowledge on human health effects of electric and magnetic fields. That information was

specifically requested by the public to be presented by a recognized expert in the field other than an employee of the utilities.

EMF Modeler, Protero Power Plant, CA

Modeled the magnetic fields in the transmission switchyard and in an underground power transmission cable at the Protrero Power plant in the Bay Area of California. The project is to add a seventh unit to the power plant. The California Energy Commission requested that the modeling be done as part of the environmental impact analysis for the plant.

Principal Investigator, EMF Research Project, EPRI, CO

Served as Principle Investigator of an EMF research project on the Denver area for the Electric Power Research Institute. The project measured the voltages induced in grounded water pipes and electric neutrals along with magnetic fields in the homes and wire codes from nearby power lines in 191 homes selected from the Denver metropolitan area.

EMF Expert Witness, Tri-State Generation and Transmission

Testified as an expert EMF witness for Tri State Generation and Transmission in the Eighth District Court in Raton, New Mexico, January 2006. The issue was a condemnation proceeding: Tri-State Generation and Transmission Association, Inc. v. Faver, King, Sierra Grande, and Spanish Trail Ranches, [consolidated] and the damages to the ranches from the construction and operation of the new power line.

Expert Testimony, Colorado Public Utility Commission Hearings

Testified as an EMF and corona noise expert in the Colorado Public Utility Commission hearings on the Xcel Energy Midway to Daniels Park transmission line.

Expert Testimony, Colorado PUC

Testifying as an EMF and corona noise expert in the Colorado PUC hearings on the San Luis Valley to Calumet to Comanche transmission line project in Southern Colorado and several transmission line projects in Eastern Colorado.

Expert Witness, Xcel Energy, Silverthorne Substation, CO

Participated as an expert in the Xcel Energy hearings for the Silverthorne Substation in central Colorado, the Chambers Transmission Line rebuild project in Aurora Colorado and the Brantner/Thornton Substation in Adams County, Colorado.

Taught master's level course titled Air Quality Planning and Policy, URP 6686-002, Department of Urban and Regional Planning, College of Architecture & Planning, University of Colorado at Denver, 1995 to 2003.

Participated as an expert in the Xcel Energy hearings for the Thornton Substation in the City of Thornton, Colorado

Participated as lead expert in offshore wind projects for Kitty Hawk, NC, and Coastal Virginia Offshore Wind Project VA.

Participated as lead EMF expert for the solar farm power lines for the Innergex solar projects of Preahu Solar and Maui Meadows Solar in Maui County, HI,

Participated as lead EMF expert for the switchyard interconnections for the following solar projects for Tri State Generation and Transmission Association for Spanish Peaks Solar in Las Animas County, CO and Milk Creek Solar in Moffat County, CO.

EMF PUBLICATIONS

Pearson, R.L., and H. Wachtel. An Examination of the Residential and Lifestyle Factors Which May Underlie the Wire Code Paradox. RP2964-22, Electric Power Research Institute, January, 1994.

Pearson, R.L., and H Wachtel. "An Examination of the Residential and Lifestyle Factors Which May Underlie the Wire Code Paradox." Presented at The Annual Review of Research on Biological Effects of Electric and Magnetic Fields From the Generation, Delivery and Use of Electricity, Savannah, Georgia, November, 1993.

Wachtel, H., and R.L. Pearson. "An Approach to Unraveling the Wire Code Paradox." Presented at The Annual Review of Research on Biological Effects of Electric and Magnetic Fields From the Generation, Delivery and Use of Electricity, Savannah, Georgia, November, 1993.

Pearson, R.L. and H. Wachtel, "An Approach to Automatically Computing Wiring Code Patterns for a City." Presented to the Annual Meeting of the Bioelectromagnetics Society, Copenhagen, Denmark, June 1994.

Wachtel, H and R.L. Pearson. "Associative Residential and Lifestyle Factors Which Appear to Underlie the Wiring Code Paradox." Presented to the Annual Meeting of the Bioelectromagnetics Society, Copenhagen, Denmark, June 1994.

Pearson, R.L. and H. Wachtel, "An Automatic Wire Coding System for Exploring Possible Control Selection Bias and Identifying Large Exposed Populations for Cohort Studies." Presented at The Annual Review of Research on Biological Effects of Electric and Magnetic Fields From the Generation, Delivery and Use of Electricity, Albuquerque, New Mexico, November, 1994.

Wachtel, H., R.L. Pearson and D.A. Savitz. "A Determination of Childhood Cancer Risk in Relation to Residential Environment and Lifestyle Factors Associated With Wire Codes." Presented at The Annual Review of Research on Biological Effects of Electric and Magnetic Fields From the Generation, Delivery and Use of Electricity, Albuquerque, New Mexico, November, 1994.

Pearson, R.L., H. Wachtel and K.L. Ebi, Childhood Cancer Risk in Relation to Residential Environment and Lifestyle Factors that are Associated with Wire Codes. Presented to the Annual Meeting of the Bioelectromagnetics Society, Boston Massachusetts, June 1995.

Wachtel, H., R.L. Pearson and K.L. Ebi, Could Air Pollution Be a n Alternative to or a Cofactor With Magnetic Fields as a Link Between Wire Codes and Childhood Cancer? Presented to the Annual Meeting of the Bioelectromagnetics Society, Boston Massachusetts, June 1995.

Pearson, R.L., H. Wachtel and K.L. Ebi, Automatic Wire Coding, A Method for Mapping Electric Power Lines and Identifying Potentially Exposed Populations for Epidemiologic Studies. Presented at The Annual Review of Research on Biological Effects of Electric and Magnetic Fields From the Generation, Delivery and Use of Electricity, Palm Springs, California, November, 1995.

Wachtel, H., R.L. Pearson and K.L. Ebi. Childhood cancer Risk in Relation to Wire Code Associated REL factors and Causal Links that are Implicated. Presented at The Annual Review of Research on Biological Effects of Electric and Magnetic Fields From the Generation, Delivery and Use of Electricity, Palm Springs, California, November, 1995.

Pearson, R.L., H. Wachtel and K.L. Ebi. Assessing Possible Control Selection Bias Using a Method for Automatic Wire Coding. Presented to the Annual Meeting of the Bioelectromagnetics Society, Victoria, B.C. Canada, June, 1996.

Wachtel, H., R.L. Pearson and K.L. Ebi. Rental Status and Wire Code Are Risk Factors for Childhood Cancer. Presented to the Annual Meeting of the Bioelectromagnetics Society, Victoria, B.C. Canada, June, 1996.

Pearson, R.L. "Transmission Lines, Electric and Magnetic Fields." Encyclopedia of Chemical Processing and Design, Volume 47, Marcel Decker, Inc., New York, July, 1996

Wachtel, H., R.L. Pearson and K.L. Ebi Distance Weighted Traffic Density Is Associated With Wire Code And Is A Risk Factor For Childhood Cancer. Presented at The Annual Review of Research on Biological Effects of Electric and Magnetic Fields From the Generation, Delivery and Use of Electricity, San Antonio, Texas, November, 1996.

Pearson, R.L., H. Wachtel and K.L. Ebi. A Retrospective Test Of Control Selection Bias Using Census Data And City Wide Automatic Wire Coding. Presented at The Annual Review of Research on Biological Effects of

Electric and Magnetic Fields From the Generation, Delivery and Use of Electricity, San Antonio, Texas, November, 1996

Zaffanella, L.E., S. Greenland, D.A. Savitz, R.L. Pearson, and R. Iryie. Application of the Case Specular Method to the Savitz Denver Study Residences. Technical Report 107751, Electric Power Research Institute, Palo Alto, California, 1997

Pearson, R.L., H. Wachtel, K.L. Ebi. Feasibility of a Study of VHCC Wire Code as a Risk Factor For Childhood Leukemia. Technical Report 107745, Electric Power Research Institute, Palo Alto, California, March, 1997 (in press).

Pearson, R.L., H. Wachtel, K.L. Ebi. The Use of Automatic Wire Coding to Evaluate Control Selection Bias in the Savitz et. al. Study. Technical Report TR-108044, Electric Power Research Institute, Palo Alto, California, August, 1998.

Pearson, R.L., H. Wachtel, K.L. Ebi. Feasibility of a Study of VHCC Wire Code as a Risk Factor for Childhood Leukemia. Technical Report TR-107745, Electric Power Research Institute, Palo Alto, California, December, 1997.

Pearson, R.L., H. Wachtel and K.L. Ebi. Residence Specific Air Pollution As A Possible Childhood Cancer Risk Factor And A Potential Link Between Wire Codes, Traffic Density And Childhood Cancer. Presented at the Second World Congress for Electricity and Magnetism in Biology and Medicine, Bologna, Italy, June, 1997.

Wachtel, H., R.L. Pearson and K.L. Ebi. Study Design For Evaluating VHCC Wire Code As A Risk Factor For Childhood Cancer. Presented at the Second World Congress for Electricity and Magnetism in Biology and Medicine, Bologna, Italy, June, 1997.

K. L. Ebi , H. Wachtel , R. L. Pearson and L. Kheifets. Assessment Of Control Selection Bias As A Possible Explanation Of The Association Between Wire Code And Childhood Cancer. Presented at the Second World Congress for Electricity and Magnetism in Biology and Medicine, Bologna, Italy, June, 1997.

R.L. Pearson. Residence Specific Air Pollution As A Possible Childhood Cancer Risk Factor And A Potential Link Between Wire Codes, Traffic Density And Childhood Cancer. Presented at the Second World Congress for Electricity and Magnetism in Biology and Medicine, Bologna, Italy, June, 1997.

Wachtel, H., R.L. Pearson and K.L. Ebi. Why Is Wire Code Associated With Childhood Leukemia Risk In Some Cities But Not In Others? Presented at the Annual Review of Research on Biological Effects of Electric and Magnetic Fields From the Generation, Delivery and Use of Electricity, San Diego California, November, 1997

Pearson, R.L., H. Wachtel and K.L. Ebi. Determining The Historical Stability Of Associations Between Traffic Density, Wire Codes And Cancer Risk. Presented at the Annual Review of Research on Biological Effects of Electric and Magnetic Fields From the Generation, Delivery and Use of Electricity, San Diego California, November, 1997

Wachtel, H., R.L. Pearson and K.L. Ebi. Control Selection Bias as A Possible Explanation For The Observed Associations Between Wire Codes And Childhood Cancer. Presented to the Annual Meeting of the Bioelectromagnetics Society, St Petersburg, Florida, June, 1998.

Pearson, R.L., H. Wachtel and K.L. Ebi. Wire Codes, Traffic, And Air Pollution, Citywide Associations. Presented to the Annual Meeting of the Bioelectromagnetics Society, St Petersburg, Florida, June, 1998.

Wachtel, H., R.L. Pearson and K.L. Ebi. What Might We Learn About Childhood Cancer Etiology From 20 Years Of “EMF Inspired” Research? Annual Review of Research on Biological Effects of Electric and Magnetic Fields From the Generation, Delivery and Use of Electricity, Tucson, Arizona, November, 1998

Wachtel, H., R.L. Pearson and K.L. Ebi. Traffic Density And Wire Codes May Be Risk Cofactors For Childhood Cancer. Presented to the Annual Meeting of the Bioelectromagnetics Society, Long Beach California, June, 1999.

Pearson, R.L., H. Wachtel, K.L. Ebi and J Crawford. Wire Codes And Traffic Density Are Associated On A Citywide Basis. Presented to the Annual Meeting of the Bioelectromagnetics Society, Long Beach California, June 1999.

K. L. Ebi , L. Kheifets, R. L. Pearson and H. Wachtel. Evaluation of Control Selection Bias in the Savitz et al. Childhood Cancer Study, 2000. Journal of the Bioelectromagnetics Society, vol 21, pp 346-53.

Pearson, R.L., H. Wachtel and K.L. Ebi. Distance Weighted Traffic Density in Proximity to a Home is a Risk factor for Childhood Cancer, Particularly Childhood Leukemia, 2000. Journal of the Air and Waste Management Association, vol. 50, pp175-80.

Pearson, R.L., H. Wachtel and K.L. Ebi. Traffic Density as a Risk Factor for Childhood Cancer in Denver and Los Angeles. Technical Report TR-114231. Electric Power Research Institute, Palo Alto, California, December 1999.

R. Pearson, H. Wachtel, K. Ebi, J. Crawford, Association Of Traffic Density With Wire Codes, Comparison Of Patterns Seen In Los Angeles And Denver. Presented to the Annual Meeting of the Bioelectromagnetics Society, Munich, Germany, June 2000.

H. Wachtel and R. Pearson. Interactions of traffic density and wire codes as cancer risk factors—a comparison of results in Los Angeles with those in Denver. Presented to the Annual Meeting of the Bioelectromagnetics Society, Munich, Germany, June 2000.

R.L. Pearson, H.Wachtel, and K.L. Ebi. Integrated Distance Weighted Traffic Density In Proximity To A Home Is A Risk Factor For Leukemia And Other Childhood Cancers. Presented to the Annual meeting of the Air and Waste Management Association, Salt Lake City Utah, June 2000.

H. Wachtel and R. Pearson. Combined Exposures to High Levels of Air Pollution and Electromagnetic Fields May Increase Leukemia and Other Cancer Risks in Children. Presented to the Annual meeting of the Air and Waste Management Association, Salt Lake City Utah, June 2000.

R. Kavet, L. Zaffanella, R. Pearson, and J. Dallapiazza. Association of Residential Magnetic Fields With Contact Voltage, 2004. Journal of the Bioelectromagnetics Society, in press.

TETRA TECH

Andrew Lintz, PE
Senior Engineer/Project Manager

EXPERIENCE SUMMARY

Mr. Lintz has is a licensed professional engineer with approximately 21 years of experience as a senior engineer and project manager for Tetra Tech with a variety of civil, environmental, process, electrical, and renewable energy project experience at the corporate office in Golden, Colorado. His responsibilities have included design and support roles for civil engineering projects including extensive experience using AutoCAD products (project layouts, civil designs, grading and excavation designs and plans, road layouts and vehicle tracking, specifications and assorted plans); renewable energy projects (project layouts, civil designs including grading, permit and construction document development, and plan and report development); and electrical projects (electrical and magnetic field modeling for substation/switchyards and transmission lines, report preparation). Mr. Lintz has acted as project manager on several civil and electrical design projects, as well as long-term reporting efforts.

RELEVANT EXPERIENCE

Electromagnetic Field and Noise Modeler
Xcel Energy, Denver Area Substation Updates

Electromagnetic frequency (EMF) modeler responsible for modeling EMF and other parameters for electrical substation updates and interconnects for the Greenwood, Denver, Arapahoe, Evraz, Pronghorn, and High Point substations. EMF modeler responsible for modeling 230-kV transmission line upgrades between Greenwood and Denver substations.

Electromagnetic Field and Noise Modeler
Xcel Energy, Shortgrass Transmission Line

EMF and noise modeler responsible for modeling the permitting application in Colorado.

Electromagnetic Field and Noise Modeler
Xcel Energy, Cloverly Transmission Line

EMF and noise modeler responsible for modeling EMF, noise, and other parameters for the permitting application in Colorado.

Electromagnetic Field and Noise Modeler
Xcel Energy, Graham Creek and Husky Substations

EMF and noise modeler responsible for modeling EMF and other parameters for the permitting applications in Colorado.

Electromagnetic Field and Noise Modeler
Tri-State Generation and Transmission Association, Inc., Milk Creek Substation

Task manager, EMF and noise modeler responsible for modeling EMF and other parameters for the permitting application in Colorado. Developed modeling result report for client review and inclusion into the permit application.

EDUCATION

BS, Chemical Engineering, University of Colorado – Boulder, 2000

AREA OF EXPERTISE

Civil, Environmental, and Chemical Engineering

Computer Aided Drafting and Design

Renewable Energy Technology

Engineering analysis/design for hazardous waste remediation

Electromagnetic frequency model development

Project and Task Management

REGISTRATIONS/ CERTIFICATIONS

Professional Engineer, Chemical, CO, PE.0043831, expiration 10/31/23

TRAINING

Hazardous Waste Operator and Emergency Response 40 Hour Training, Rocky Mountain Education Center; 2001

Hazardous Waste Operator and Emergency Response 8-Hour Refresher; 2019

OFFICE

Golden, CO

YEARS OF EXPERIENCE

21

Electromagnetic Field and Noise Modeler
Tri-State Generation and Transmission Association, Inc., Valent Switchyard

Task manager, EMF and noise modeler responsible for modeling EMF and other parameters for the permitting application in Colorado. Developed modeling result report for client review and inclusion into the permit application.

Electromagnetic Field and Noise Modeler
Tri-State Generation and Transmission Association, Inc., Jackson Fuller Substation

Task manager responsible for compiling noise model for the permitting application in Colorado. Developed modeling result report for client review and inclusion into the permit application.

Electromagnetic Field and Noise Modeler
Tri-State Generation and Transmission Association, Inc., Rattlesnake Ridge Substation

EMF and noise modeler responsible for modeling EMF and other parameters for the permitting application in Colorado.

Electromagnetic Field and Noise Modeler
Tri-State Generation and Transmission Association, Inc., Windtalker Substation

EMF and noise modeler responsible for modeling EMF and other parameters for the permitting application in Colorado.

Electromagnetic Field and Noise Modeler
Tri-State Generation and Transmission Association, Inc., Vollmer Substation

EMF and noise modeler responsible for modeling EMF and other parameters for the permitting application in Colorado.

Electromagnetic Field and Noise Modeler
PacifiCorp, Eugene to Medford Transmission Lines

EMF and noise modeler responsible for modeling multiple transmission lines for the permitting application in Oregon.

Electromagnetic Field and Noise Modeler
PacifiCorp, Wheatridge Solar

EMF and noise modeler responsible for modeling for the permitting application in Oregon.

Electromagnetic Field and Noise Modeler
PacifiCorp, Sam's Valley to Whetstone

EMF and noise modeler responsible for modeling three different transmission lines for the permitting application in Oregon.

Electromagnetic Field and Noise Modeler
Capital Power, Nolin Hills Wind

EMF and noise modeler responsible for modeling multiple transmission lines and interconnects for the permitting application in Oregon. Developed permit reports for application.

Electromagnetic Field and Noise Modeler
Dominion Energy, Coastal Virginal Offshore Wind Commercial

EMF modeler responsible for modeling multiple onshore aboveground transmission line configurations and underground collection lines for the permitting application in Virginia. Developed permit reports for application.