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BEFORE THE TENNESSEE REGULATORY AUTHORITY
NASHVILLE, TENNESSEE

IN RE:

IN THE MATTER OF THE PETITION	)	
OF PLAINS AND EASTERN CLEAN	)	
LINE LLC FOR A CERTIFICATE OF	)	
CONVENIENCE AND NECESSITY	)	Docket No. 14-00036
APPROVING A PLAN TO	)	
CONSTRUCT A TRANSMISSION LINE	)	
AND TO OPERATE AS AN ELECTRIC	)	
TRANSMISSION PUBLIC UTILITY	)	

TESTIMONY OF DR. ANTHONY WAYNE GALLI, P.E.
EXECUTIVE VICE PRESIDENT – TRANSMISSION AND TECHNICAL SERVICES
CLEAN LINE ENERGY PARTNERS LLC

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Exhibits

I. INTRODUCTION

Q. Please state your name and business address.

A. My name is Anthony Wayne Galli. My business address is 1001 McKinney Street, Suite 700, Houston, Texas 77002.

Q. By whom are you employed and in what capacity?

A. I am employed by Clean Line Energy Partners LLC ("Clean Line") as Executive Vice President – Transmission and Technical Services. Clean Line is the ultimate parent company of Plains and Eastern Clean Line LLC ("Plains and Eastern"), the Applicant in this proceeding.

Q. What are your duties and responsibilities as Executive Vice President – Transmission and Technical Services of Clean Line?

A. I oversee and am responsible for the planning, engineering, design, construction and other technical activities of Clean Line and its subsidiaries with respect to their transmission projects. I also play a role in long-term strategic planning for the company.

Q. Please describe your educational and professional background.

A. I received Bachelor of Science and Master of Science degrees from Louisiana Tech University and a Doctor of Philosophy degree from Purdue University, all in electrical engineering. I am a Senior Member of the Institute of Electrical and Electronics Engineers, a member of the International Council on Large Electric Systems, and a registered Professional Engineer in the Commonwealth of Virginia.

I have over 15 years of experience in the electric transmission industry, in both technical and managerial roles, ranging from power system planning and operations to regulatory matters and project development. Prior to my tenure at Clean Line, I served as

Director of Transmission Development for NextEra Energy Resources, a subsidiary of NextEra Energy, Inc. (formerly FPL Group, Inc.), where I developed transmission projects under the Competitive Renewable Energy Zones ("CREZ") initiative in Texas. In this position, I focused on, among other issues, the development of high voltage direct current ("HVDC") transmission solutions in the CREZ, and I led all efforts in routing, siting and engineering transmission lines in the CREZ. The LoneStar CREZ projects, as well as the 214 mile Horse Hollow Generation Tie project, began operations in 2013 and 2009, respectively. Previously, I spent six years at the Southwest Power Pool ("SPP"), where I led the implementation of several components of the SPP market and oversaw the expansion of the SPP Operations Engineering Group over fourfold to help ensure reliable operations of the SPP grid. As the Supervisor of Operations Engineering at SPP, my group was responsible for the real-time engineering support of the SPP's Regional Transmission Organization ("RTO") functions. These duties included activities primarily directed toward maintaining real-time system reliability through engineering support for the SPP Reliability Coordinator and Market Operations, performing short-term tariff studies, operational planning activities (e.g. processing outage requests), and engineering analysis support of the SPP Energy Imbalance Services Market. Additionally, my group led the implementation of several facets of the SPP market system and performed acceptance testing of various software systems.

My background also includes system-planning experience with Southern Company Services, a subsidiary of Southern Company, where I analyzed expansion plans for 500 kV transmission facilities, and commercial power systems experience with Siemens Westinghouse Technical Services. Additionally, I have held academic positions

at the university level and have helped design shipboard power systems for the U.S. Department of Defense.

Q. Have you testified previously before any utility regulatory commissions?

A. Yes, I have provided testimony in proceedings before the Federal Energy Regulatory Commission ("FERC"), the Public Utility Commission of Texas, the Kansas Corporation Commission, the Oklahoma Corporation Commission, the Arkansas Public Service Commission, the Indiana Utility Regulatory Commission, the Illinois Commerce Commission and the Missouri Public Service Commission.

Q. What is the purpose of your direct testimony?

A. I am testifying in support of Plains and Eastern's request to operate as a public utility in the State of Tennessee, including exercising all the rights and privileges of a public utility under Tennessee law. My testimony also supports Plains and Eastern's request that the Tennessee Regulatory Authority (the "Authority") approve Plains and Eastern's interstate transmission project pursuant to Tennessee Code Annotated § 65-4-208.

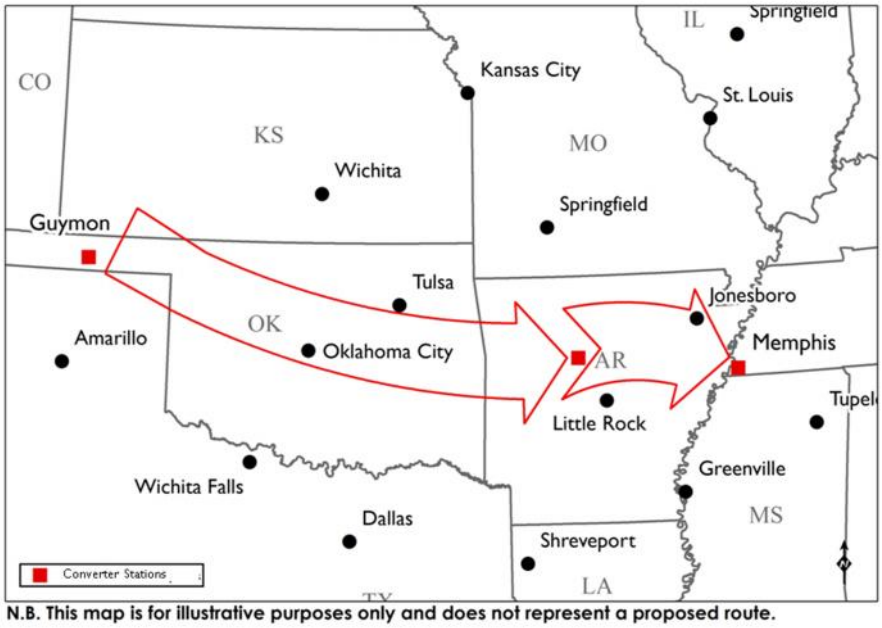
Specifically, in Section II, I will describe the status of the interconnection processes underway for the Plains & Eastern Clean Line transmission project ("Plains & Eastern Project" or "Project") with the appropriate Transmission Providers and Transmission Owners, including the Tennessee Valley Authority ("TVA"), the Southwest Power Pool, Inc. ("SPP"), and the Midcontinent Independent System Operator, Inc. ("MISO"). I also explain how the Project will connect with the bulk transmission systems of TVA, SPP, and MISO at such time as: (i) all appropriate and required interconnection studies have been completed with the relevant Transmission Providers and Transmission Owners, (ii) such studies demonstrate that reliability of the system will

be maintained, and (iii) Interconnection Service Agreements are executed. In Section III, I will supplement Mr. Michael Skelly's testimony and address Plains and Eastern's managerial and technical capabilities to be granted a certificate as a public utility and to construct, own, operate, and maintain the Project. My testimony will, along with other witnesses' testimony, demonstrate that Plains and Eastern is capable of efficiently managing and operating the Plains & Eastern Project. Finally, in Section IV, I will provide information on the proposed design and technical specifications for the Project and will explain the reasons for and benefits of Plains and Eastern's use of HVDC technology for the Project.

II. INTERCONNECTIONS WITH THE BULK TRANSMISSION SYSTEM

Q. Please describe how the proposed Plains & Eastern Project will interconnect with the bulk interstate electric transmission system.

A. The Plains & Eastern Project is comprised of an approximately 700-mile, +/-600 kilovolt ("kV") overhead, HVDC electric transmission line and associated facilities. These facilities will enable the delivery of up to 3,500 megawatts ("MW") from renewable energy generation facilities in the Oklahoma Panhandle region to the TVA in Tennessee and to other load serving entities in the Mid-South and southeastern United States via an interconnection with TVA in Tennessee and potentially via an interconnection with MISO in Arkansas. In addition to the HVDC line transmission line, the Project will include alternating current ("AC")/direct current ("DC") converter stations in Texas County, Oklahoma and in Shelby County, Tennessee, and potentially an intermediate converter station in Arkansas. A high level overview map of the transmission line and converter stations is below.



N.B. This map is for illustrative purposes only and does not represent a proposed route.

AC transmission lines and/or other interconnection facilities will be required at each converter station to connect the Project to the existing bulk transmission grid. At each point-of-interconnection, the Project has submitted an interconnection request with the Transmission Provider/Transmission Owner. The relevant Transmission Providers are SPP with respect to the proposed interconnection in Oklahoma, MISO with respect to the potential interconnection in Arkansas, and TVA with respect to the proposed interconnection in Tennessee. The relevant Transmission Owners are Southwestern Public Service Company ("SPS") in Oklahoma, Entergy Arkansas, Inc. ("EAI") in Arkansas, and TVA in Tennessee. TVA, SPP, and MISO each have interconnection procedures that require the analysis of the potential interconnection of new transmission facilities with their respective transmission systems. The studies are performed under the auspices of the relevant Transmission Provider's tariff and/or business practices manual or, in the case of TVA, its Large Generator Interconnection Procedures. These studies

determine the appropriate operating procedures and physical upgrades required for a reliable interconnection as requested by the Project.

Q. When can the Plains & Eastern Project interconnect with the respective transmission systems and begin operations?

A. The Project cannot interconnect and begin operation until all required studies with the appropriate Transmission Providers and Transmission Owners are completed, Interconnection Service Agreements with each system are executed, and any required mitigations have been implemented to ensure that the Bulk Electric System remains reliable. Therefore, the Project can only interconnect after completing the studies required by applicable law and the relevant Transmission Providers' studies show that reliability of the system will be maintained.

Q. What is the status of the proposed interconnection with TVA?

A. TVA is studying the Project's interconnection of up to 3,500 MW to the TVA system. On March 21, 2014, TVA delivered a final Interconnection System Impact Study report to Plains and Eastern. The System Impact Study identified certain upgrades that would be made to TVA's system to reliably interconnect the Project. As part of TVA's System Impact Study, Memphis, Light, Gas & Water Division ("MLGW") also performed an Affected System Impact Study and found that no upgrades were required for MLGW to maintain reliability on its system. MLGW is currently updating this study, and other affected parties like Entergy Arkansas may also update their studies, with the latest system models from TVA's System Impact Study results.

The Project will proceed to a Facilities Study. Plains and Eastern estimates that the Facilities Study will take 12 - 18 months to complete. After concluding the Facilities

Study, Plains and Eastern will sign an Interconnection Service Agreement with TVA. While TVA will construct all upgrades within its transmission system to accommodate Plains and Eastern's interconnection, Plains and Eastern will be responsible for funding such needed upgrades as set forth in the Interconnection Service Agreement.

Q. What is the status of the proposed interconnection with SPP?

A. On the western side of the Project, Plains and Eastern has worked with SPP, the RTO that operates the bulk electric transmission system in Oklahoma and other states in the region, to ensure that the Project can reliably interconnect with SPP's grid. In November 2012, SPP's Transmission Working Group unanimously confirmed that the Project's reliability studies are "…consistent with SPP planning processes and [have] met their coordinated planning requirements under SPP Criteria…"[1] These studies were performed in conjunction with SPP staff as well as affected parties, including TVA. The acceptance of these studies marked the successful conclusion of a study process that began in May 2010. As the Project progresses towards operation, additional studies will be conducted, which will be outlined as pre-requisites in the necessary Interconnection Service Agreements between Plains and Eastern, SPP, and SPS.

The Project was included as one of the projects considered in SPP's "ITP 20," which is the RTO's 20-year Integrated Transmission Plan that was published in July 2013.[2] The Project will also be analyzed as a sensitivity in SPP's "ITP 10," which is a value-based Integrated Transmission Plan that analyzes the transmission system out to a

[1] Southwest Power Pool Transmission Working Group Meeting minutes, posted November 19th, 2012. http://www.spp.org/publications/TWG%2011.7%20&%208.12%20Minutes%20&%20Attachments.pdf (last accessed April 3, 2014).

[2] 2013 Integrated Transmission Plan 20-Year Assessment Report. Southwest Power Pool, July 2013. http://www.spp.org/publications/ITP20_Report_01-26-11.pdf (last accessed April 3, 2014).

10-year horizon. SPP has scheduled completion of ITP 10 in 2015. The Project's consideration in these plans indicates that SPP is considering the Project in its medium and long term planning scenarios to consider coordination of impacts.

Q. What is the status of the proposed interconnection with MISO?

A. As discussed in the testimony of Mario Hurtado, the Project is separately under review by the Department of Energy ("DOE"), which is preparing an environmental impact statement ("EIS") on the Project pursuant to the National Environmental Policy Act ("NEPA"). During the scoping process for the EIS, several public commenters requested the study of a mid-point interconnection in Arkansas as an alternative for the Project. To inform DOE's consideration of this alternative under NEPA, Plains and Eastern submitted an interconnection request to MISO dated October 30, 2013. The Request is for a 500 MW injection at a tap of Entergy Arkansas' existing Arkansas Nuclear One to Pleasant Hill 500 kV transmission line. MISO has completed a Feasibility Study of this request and provided a Feasibility Study Report to Plains and Eastern dated February 10, 2014. MISO's Feasibility Study identified no transmission system constraints based on the Project's interconnection request. The next step in the interconnection process is to enter MISO's Definitive Planning Phase, at which time MISO, in conjunction with EAI and other affected parties, will perform additional studies of this request. After the MISO interconnection studies, Plains and Eastern will execute an Interconnection Service Agreement with MISO and EAI.

Q. In summary, will Plains and Eastern negatively affect the reliability of any of the existing electric systems to which it has requested interconnection?

A. No. The Plains & Eastern Project will only interconnect and operate the transmission line after signing an Interconnection Service Agreement with the Transmission Provider and Transmission Owner at the conclusion of all required interconnection studies. In SPP and MISO, the Interconnection Service Agreement will be three-party agreements between the Transmission Provider (SPP or MISO) and the Transmission Owner (SPS and EAI, respectively). The Interconnection Service Agreements will include any operating procedures or physical upgrades, identified through the study process, required to ensure the existing system will remain reliable after the interconnection of the Project. Through ongoing participation in these study processes, and ultimately by signing Interconnection Service Agreements, Plains and Eastern will ensure interconnection of the Project does not negatively affect system reliability. In addition, Project facilities must be operated in a manner consistent with NERC reliability criteria.

III. MANAGERIAL, TECHNICAL AND OPERATIONAL CAPABILITIES

Q. Does Plains and Eastern have the managerial and technical capabilities to develop, construct, own, operate and maintain the Plains & Eastern Project?

A. Yes. Clean Line, Plains and Eastern's parent company, has established a management and technical team with significant experience in the relevant developmental, technical and regulatory arenas that will support Clean Line's projects, including the Plains & Eastern Project. The testimony of Michael Skelly provides detailed information on the background and experience of the Clean Line management team.

The Clean Line management and technical teams will be directly involved with the Plains & Eastern Project and will supervise and oversee the contractors who will perform the detailed engineering and design, procurement, construction, and operating

and maintenance functions for the Project. Clean Line will contract with and utilize experienced, qualified companies to perform these functions. Clean Line has and will continue to select vendors, contractors and consultants with strong and suitable expertise in all areas relevant to the Project.

As indicated above, I have managed the interconnection study, facility design, siting and engineering work for NextEra's CREZ projects in Texas. NextEra's CREZ projects, developed under direction of NextEra subsidiary, LoneStar Transmission LLC, included approximately 330 miles of new 345 kV transmission lines in Central and North Texas. Also at NextEra, I managed the technical development of the Horse Hollow Generation Tie transmission project, a 214 mile, 345 kV transmission line that became the largest and longest privately permitted transmission line of its type in the country. The Horse Hollow project went from concept to completion in less than 18 months. The CREZ projects and Horse Hollow underwent interconnection studies conducted by the local transmission system operator, the Electric Reliability Council of Texas (ERCOT), and met all applicable state and Federal criteria to ensure reliability of the existing system once the projects were in operation.

In addition to my own technical management experience at NextEra and SPP, the Clean Line management team has successfully developed hundreds of miles of transmission lines and large energy projects across the country. Moreover, one of Clean Line's principal investors, National Grid, is one of the world's largest owners, builders and operators of transmission facilities, including HVDC facilities. National Grid will share its technical and management expertise and resources with Clean Line and Plains and Eastern during the development and construction of the Project.

Q. Have any other state utility commissions determined that Clean Line's subsidiaries have the managerial and technical capability to operate as a public utility in those states?

A. Yes. The Oklahoma Corporation Commission, in its order dated October 28, 2011, in Cause No. PUD 201000075 granting Plains and Eastern Clean Line LLC electric transmission-only public utility status in the State of Oklahoma, affirmed the Administrative Law Judge's recommendation that "Clean Line possesses the financial, managerial and technical experience to build, own and operate transmission in Oklahoma."[3] The Kansas Corporation Commission,[4] and the Indiana Utility Regulatory Commission[5] have found that Clean Line subsidiaries have the managerial and technical capability to operate as a public utility in those states.

Q. Has Plains and Eastern identified or contracted with any firms for the design of the proposed facilities?

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[3] Order No. 590530, Cause No. PUD 201000075, *In the Matter of the Application of Plains and Eastern Clean Line LLC, to Conduct Business as an Electric Utility in the State of Oklahoma*.

[4] Order Approving Stipulation & Agreement And Granting Certificate, Docket No: 11-GBEE-624-COC, *In the Matter of the Application of Grain Belt Express Clean Line LLC for a Limited Certificate of Public Convenience to Transact the Business of a Public Utility in the State of Kansas*.

[5] Order of the Commission, Cause No. 444264, *Petition of Grain Belt Express Clean Line LLC for: (1) a Determination of its Status as a "Public Utility" under Indiana Law; (2) a Determination that it has the Technical, Managerial, and Financial Capability to Operate as a Public Utility in Indiana; (3) Authority to Operate as a Public Utility in Indiana, including Authority to Exercise all Rights and Privileges of a Public Utility Accorded by Indiana Law; (4) Authority to Transfer Functional Control of Operation of its Transmission Facilities to be Constructed in Indiana to a Fully Functioning Regional Transmission Organization; (5) a Determination that the Commission should Decline to Exercise Certain Aspects of its Jurisdiction over Petitioner Clean Line LLC; (6) Authority to Locate its Books and Records Outside the State of Indiana; (7) Consent by the Commission to Boards of County Commissioners for Petitioner Clean Line LLC to Occupy Public Rights of Way, to the Extent it may be Necessary; and (8) all other Appropriate Relief*.

A. Yes. POWER Engineers, Inc. ("POWER") has performed the conceptual engineering for the transmission line design of the Project. POWER provides engineering/design, construction, asset management, and other services to the power generation and power delivery industries. POWER has successfully completed engineering designs and reviews on hundreds of transmission and substation projects across the country and the globe, including HVDC transmission projects. Conceptual engineering activities for the Project completed by POWER included conductor optimization studies, selection of a family of transmission structures, desktop geotechnical analysis of the study area, and conceptual foundation design, among others. POWER will provide structure designs and engineering support. Currently, POWER is reviewing all design criteria and optimizing designs for efficient procurement and construction.

Q. Has Plains and Eastern engaged any specialty firms to assist in the development of HVDC specifications?

A. Yes. We are currently working with TransGrid Solutions Inc. ("TGS"). TGS has specific expertise in developing performance and detailed specifications for HVDC projects. TGS has been involved in a majority of the global HVDC projects that are either currently in service or are under construction. TGS will finalize a performance specification for the Plains & Eastern Project. This performance specification will then be utilized, in part, to select a hardware vendor for the HVDC converter stations.

Q. Has Plains and Eastern contracted with any firms to advise on the construction of the proposed facilities?

A. Yes, Plains and Eastern has signed a Services Agreement with Fluor Enterprises, Inc. ("Fluor") for Fluor to supply construction advisory and development services for the

Project leading up to an Engineering, Procurement and Construction ("EPC") contract. As part of this arrangement, Fluor – with Pike Energy Solutions ("Pike") as a subcontractor to Fluor – has been providing initial permitting and EPC development support services for the Project. The Services Agreement also provides a framework for Fluor and Plains and Eastern to execute a full EPC contract for the HVDC transmission line. Fluor is a Fortune 500 engineering, procurement, construction maintenance and project management company. Founded in 1912 and employing over 41,000 people worldwide, Fluor has completed hundreds of energy, infrastructure, and industrial projects on six continents. Pike is part of Pike Corporation, which was founded in 1945. Pike provides engineering, construction and maintenance services for distribution and transmission power lines, substations, and renewable energy projects. The selection of Fluor for provision of EPC development services and potentially the EPC contract was the result of a competitive process with participation from multiple engineering and construction firms. Fluor was selected based on presenting the strongest combination of technical and financial qualifications, cost and pricing information, and the ability to understand local issues and utilize local services.

Q. Has Plains and Eastern identified or contracted with any firms for work on the routing and permitting of the proposed facilities?

A. Plains and Eastern has engaged Ecology and Environment ("E&E") as the principal consultant to assist with route development, permitting, environmental, land use, and public outreach activities for the Project. E&E offers engineering, architecture, and environmental planning services and has nearly 40 years of experience in providing such services worldwide.

Q. How will Plains and Eastern maintain the proposed facilities?

A. With respect to maintenance of the line, Plains and Eastern will contract with a firm or firms experienced in electric transmission maintenance and operations to provide maintenance services and also capital replacements and upgrades as necessary. This contract could be with a local utility or utilities, or a local contract with a firm that performs transmission line maintenance and construction services. There are numerous vendors recognized in the electric utility industry that are qualified to perform and are engaged in providing these services under contract, including Utility Lines Construction Services, Inc. (a subsidiary of Asplundh), Willbros companies, J.F. Electric, Incorporated, Pike Electric Corporation, MasTec, Inc., MYR Group Inc., a number of Quanta Services companies, and Highlines Construction Company Inc. Additionally, to ensure coordinated operations, Plains and Eastern will continue to work closely with the interconnected utilities, relevant RTOs and other entities in the region, so that appropriate agreements, per NERC reliability standards, are in place.

Q. How will Plains and Eastern ensure that competent and experienced firms are retained to design, construct, permit, operate, and maintain the Project facilities?

A. As I described above, and as is covered in Mr. Skelly's testimony, Clean Line has assembled a management team with the appropriate types of expertise for overseeing and selecting competent and experienced firms, and this team will be responsible for managing the Plains & Eastern Project. Additionally, Plains and Eastern will retain a qualified EPC firm to perform final engineering, procurement and construction and a qualified owner's engineer ("OE") to assist Plains and Eastern in overseeing the EPC firm. An OE is a third-party entity, experienced in the engineering and construction of large-scale infrastructure projects. The owner will retain the OE to assist the owner in project

management activities and oversee the activities of the other project contractors, including the EPC contractors, thereby supplementing the experience and expertise of the owner's internal team. As described above, during the development phase of the Project, Plains and Eastern retained POWER to assist in performing engineering and design work for the Project and has established a framework with Fluor for provision of the engineering, procurement and construction of the HVDC transmission line.

In regards to operations and maintenance, as discussed in more detail below, Plains and Eastern will be subject to mandatory and enforceable NERC and FERC rules. Entities that perform transmission operations on the Bulk Electric System (generally transmission facilities rated 100 kV and above) must meet applicable criteria and continual training requirements set forth by NERC. Clean Line will require entities selected to perform maintenance to have a proven record of safety and reliability in response times to emergencies.

Q. Has Plains and Eastern determined how the Project will be operated?

A. The Project's operations will be staffed 24/7 with NERC certified operators. The Project's actual injection levels will be physically controlled by Plains and Eastern employees or a qualified third party under Plains and Eastern supervision. Per the FERC requirements of its negotiated rate authority, Plains and Eastern expects to turn over operational control of the Project for scheduling and delivery of energy over its line to a regional transmission system operator. Under this transfer of operational control, the transmission system operator would administer Plains and Eastern's transmission tariff and new requests for service, assuring it is provided on a non-discriminatory basis.

Q. Will Plains and Eastern be prepared to comply with applicable NERC reliability standards in operating the Plains & Eastern Project?

A. Yes. NERC reliability standards became mandatory and enforceable (through the imposition of monetary penalties or other sanctions) in June 2007, pursuant to Section 215 of the Federal Power Act and regulations and orders of the FERC. Compliance with these standards is important to ensure the reliability of the bulk electric system. Plains and Eastern expects to be registered on the NERC Compliance Registry for the reliability functions of a "Transmission Owner," a "Transmission Operator," and a "Transmission Service Provider" (depending on the nature of its arrangements with a third party or parties to operate the Plains & Eastern Project, which could result in some or all of the Transmission Operator or Transmission Service Provider functions being assigned to the third party). Therefore, Plains and Eastern will be subject to applicable requirements of one or more NERC reliability standards in some or all of the following categories: Resource and Demand Balancing; Communications; Critical Infrastructure Protection; Emergency Preparedness and Operations Procedures; Facilities Design, Connections and Maintenance; Interchange Scheduling and Coordination; Interconnection Reliability Operations and Coordination; Modeling, Data, and Analysis; Personnel Performance, Training, and Qualifications; Protection and Control; Transmission Operations; Transmission Planning; and Voltage and Reactive. Plains and Eastern will be prepared to comply with the requirements of the reliability standards that are applicable to its activities.

IV. DESCRIPTION OF PROJECT FACILITIES

Q. Please provide the voltage rating (kV), operating voltage (kV), and normal peak operating current rating for the Project.

A. The Project will be rated at ±600 kV. The operating voltage also will be ±600 kV. In a bipolar HVDC project, as proposed for the Plains & Eastern Project, the positive electrical pole is at a potential of +600 kV relative to ground and the negative pole is at a potential of -600 kV relative to ground. Hence, we state that the voltage of the project is ±600 kV. As measured between the poles, the voltage would be 1,200 kV. Each pole will carry one-half of the power (1,750 MW delivered per pole) with a peak operating current of approximately 3,100 amperes.

Q. What types of facilities are anticipated to be located in Tennessee?

A. Plains and Eastern anticipates locating approximately 17 miles of HVDC transmission line within the state of Tennessee. Other facilities to be constructed in Tennessee will include a converter station and associated equipment to interconnect with the existing TVA Shelby 500 kV substation. The Project will also include communications and control and protection facilities, such as optical ground wire and fiber optic regeneration sites. Any required upgrades described in a future TVA Interconnection Service Agreement will be constructed by TVA.

Q. What type of structures will be utilized and what is a typical span between structures?

A. In the design work that has been performed by POWER and Pike for the HVDC line, two primary structure types have been identified: lattice structures and tubular steel "monopole" structures. Additionally, guyed structures may be used in very limited circumstances. Sketches of those structures are attached as **Exhibit WG-1**. Final structure selections cannot be made until after final engineering is completed, which will occur only after a final route is selected and approved. However, it is likely that a mix of

structures will be utilized depending on a number of factors, including soil types, span lengths, cost and other topological considerations. Based on the initial engineering, typical ruling spans are 1,500 feet for lattice and 1,200 feet for tubular steel structures.

Q. What width of right-of-way is planned for the Project within Tennessee?

A. The right-of-way width is estimated to be 150 to 200 feet. This width is necessary in order to encompass the maximum "blowout" distance (the horizontal swing of the pole conductors due to wind) under various wind loading conditions. Calculation of this distance is performed according to formulae and geographically specific parameters specified in the National Electrical Safety Code.[6]

Q. Please describe the converter station associated with the Project that is planned to be located in Tennessee.

A. The converter station will be similar to a typical AC substation, with additional equipment to convert between AC and DC. Ancillary facilities, such as communications equipment and cooling equipment, will be required. In addition, AC facilities will connect the converter station to the existing grid. The converter station will include the following components:

- DC switchyard;
- DC smoothing reactors;
- DC filters;
- Valve halls (which contain the power electronics for converting AC to DC and vice versa);
- AC switchyard;

[6] Rule 234A1-2. National Electrical Safety Code. Institute of Electrical and Electronics Engineers, 2012.

- AC filter banks;
- AC circuit breakers and disconnect switches; and
- Transformers.

The converter station will require an area encompassing approximately 40 to 60 fenced-in acres. The AC switchyard will be the largest portion of the electrical facility within the converter station footprint. There could be up to two buildings (valve halls) to house the power electronic equipment used in AC/DC conversion, each approximately 200 feet long by 75 feet wide. Additionally, smaller building(s) will house the control room, control and protection equipment, auxiliaries, and cooling equipment. Other electrical equipment such as synchronous condensers, static compensators, or static var compensators may be required within the AC portion of the switchyard. A typical HVDC converter station layout is provided in **Exhibit WG-2**.

Q. Please explain how DC technology differs from AC technology.

A. In AC systems, the voltage and current periodically change directions. In most of North America, this change in direction occurs 60 times every second (defined as a frequency of 60 Hertz). This, of course, is the same type of electricity that is typically supplied to our homes, offices, and commercial and industrial facilities. With DC systems, the voltage and current are not time-varying. That is, they hold a steady value over time. This is the type of electricity that is produced by, for example, a battery such as those used by automobiles, laptop computers, and cell phones.

Q. Why has Plains & Eastern decided to utilize HVDC technology for the Project?

A. HVDC is a more efficient technology for long-haul transmission of large amounts of electric power because substantially more energy can be transmitted with lower losses, narrower rights-of-way, and fewer conductors than with an equivalent high voltage AC

system. In general, over long distances, AC transmission lines require intermediate switching or substations approximately every 200 miles in order to segment the line to handle issues attendant with voltage support, transient over-voltages, and transient recovery voltages. Additionally, AC lines used for long-haul applications exhibit angular and voltage stability limitations, have a higher reactive power requirement dependent upon loading, and have higher charging currents at light load. At distances beyond about 300 miles, HVDC is generally the most efficient means to move large quantities of power. It should be emphasized, though, that HVDC and AC facilities are quite complementary when considering the integration of large amounts of renewable power into the electric transmission grid. A stronger AC network will reduce the cost of equipment needed to install HVDC converters, enable the collection of generation, and move power to load in the delivery system. The TVA system, with its extensive 500 kV AC backbone, is particularly well-suited to receive renewable power from an HVDC facility and distribute it throughout its own service territory and throughout the entire southeastern U.S. region. The TVA system is interconnected with a dozen other utilities and two RTOs, and the robustness of TVA's system allows for the transfer of power to these interfaces.

The use of HVDC technology is a particularly appropriate solution for the Plains & Eastern Project's goal of moving large amounts of power from variable generation sources (such as wind farms) over long distances, primarily or exclusively in one direction. In this application, DC lines result in a lower cost of transmission than AC lines. To summarize, the use of HVDC technology has a number of distinct benefits, including, but not limited to, the following:

(1) HVDC lines can transfer significantly more power with lower line losses over longer distances than comparable AC lines;

(2) HVDC lines complement AC networks without contribution to short circuit current power or additional reactive power requirements;

(3) HVDC lines can dampen power oscillations in an AC grid through fast modulation of the AC-to-DC converter stations, and thus improve system stability;

(4) HVDC technology gives the operators direct control of energy flows, which makes HVDC particularly well-suited to managing the injection of variable wind generation;

(5) HVDC lines, unlike AC lines, will not become overloaded by unrelated outages, because the amount of power delivered is strictly limited by the DC converters at each end of the HVDC line, thereby reducing the likelihood that outages will propagate from one region to another; and

(6) HVDC lines utilize narrower rights-of-way, and fewer conductors than comparable AC lines, thereby making more efficient use of transmission corridors and minimizing visual and land use impacts;

Q. Is the HVDC technology that Clean Line plans to use for the Project a recently-introduced technology for transmission systems?

A. Absolutely not. HVDC technology has been used and proven for several decades. In North America, there are over 30 HVDC installations, dating back as far as 1968. Of the more than 30 projects, there are 11 HVDC transmission lines in North America which have a combined capacity of approximately 14,000 MW. The remaining HVDC projects are back-to-back HVDC converters, which function the same as an HVDC transmission line project, but with no overhead or underground line connecting the rectifier and

inverter; rather, they are connected directly to each other within the same substation via a DC bus.

Worldwide, HVDC applications are commonplace and are continuing to increase in applications similar to that of the Plains & Eastern Project (and other Clean Line projects). For example, in India and China, there have been over 16 significant applications of the technology since the early 1990s. In China, alone, there are currently 11 operating HVDC projects with more than 35,000 MW of capacity, and there are plans to add an additional 33 HVDC projects totaling more than 217,000 MW of capacity over the next 20 years. India has over 10,000 MW of HVDC projects currently operational and over 6,000 MW in planning. Australia, New Zealand, Brazil, Japan and Europe have each installed large HVDC transmission projects since the late 1960s. Europe, in particular, has plans for multiple HVDC projects to support major off-shore wind applications in the North Sea as well as around the United Kingdom.

Q. Can you give some examples of significant HVDC transmission installations in North America?

A. Yes. The Pacific DC Intertie project is an 846 mile ±500 kV HVDC line, which transmits 3,100 MW of power from the Pacific Northwest, with its vast hydro resources, to the Los Angeles area. This intertie originally went into service in 1970 and was upgraded to its current capacity in 1989. This project is undergoing yet another upgrade, which will further increase its capability.

The Intermountain Power Project ("IPP") is an HVDC transmission system, operated by the Los Angeles Department of Water and Power, which moves 1,920 MW

of power from south of Salt Lake City, Utah into the Los Angeles Basin. In 2008, approval was obtained to upgrade the IPP HVDC line to a capacity of 2,400 MW.

Another example is in Canada where the Nelson River Bipole connects hydro resources in Northern Manitoba to the population centers in Southern Manitoba. The Nelson River projects have over 3,800 MW of capacity and cover over 550 miles. Currently, Manitoba Hydro is planning the addition of a third bi-pole to the Nelson River project. Finally, the Quebec-New England project, which delivers 2,000 MW over 932 miles from the southern Hudson Bay area in Quebec to near Boston, Massachusetts, was commissioned in 1990-1992. Quebec-New England was the first multi-terminal HVDC project in North America, and is partially owned and operated by National Grid USA, the primary investor in Clean Line.

The most recent additions in the United States include the Neptune project, which transmits 660 MW over 65 miles, with nearly 50 miles underwater, and connects Long Island and New Jersey; and the Trans Bay Cable, a 53-mile, 400 MW project, which brings power underneath the bay into the San Francisco area.

Other North American HVDC projects include the CU Powerline and Square Butte Projects which bring remote generating resources from North Dakota to Minneapolis, Minnesota and Duluth, Minnesota, respectively; and multiple back-to-back (no overhead line) HVDC projects between the various Interconnections.

Q. Does this conclude your prepared direct testimony?

A. Yes.

I swear that the foregoing testimony is true and correct to the best of my knowledge, information and belief.

Dr. Anthony Wayne Galli, P.E.
Executive Vice President – Transmission and Technical Services
Clean Line Energy Partners LLC

STATE OF TEXAS :

COUNTY OF HARRIS :

Sworn and subscribed before me this 4 day of April, 2014.

Notary Public

My Commission Expires: 1/6/2018

DORCAS RUTH O'QUINN
Notary Public, State of Texas
My Commission Expires
January 06, 2018

EXHIBIT WG-1: Sketches of Proposed Transmission Structures

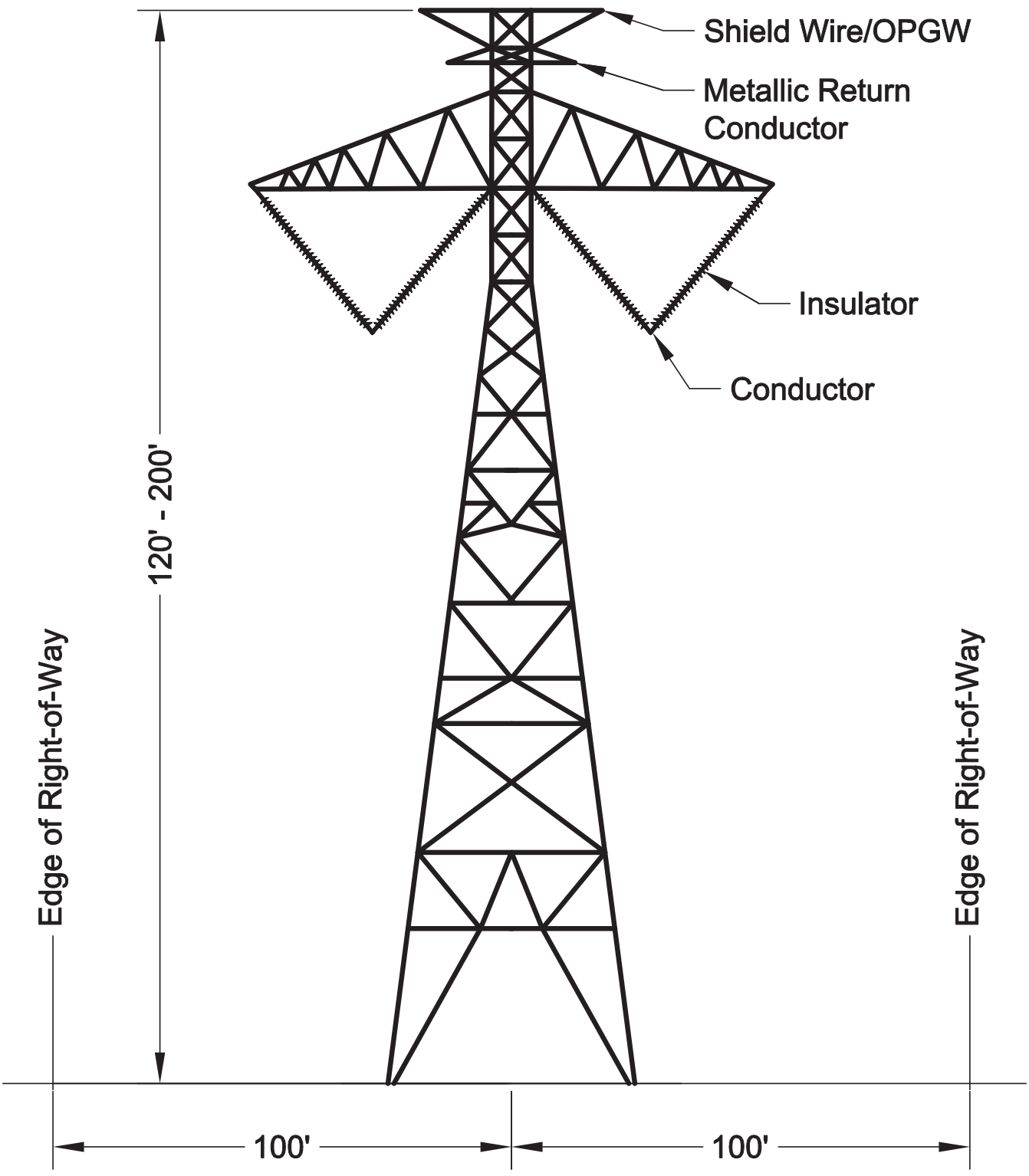


Figure 2-8c

600kV Lattice Tangent

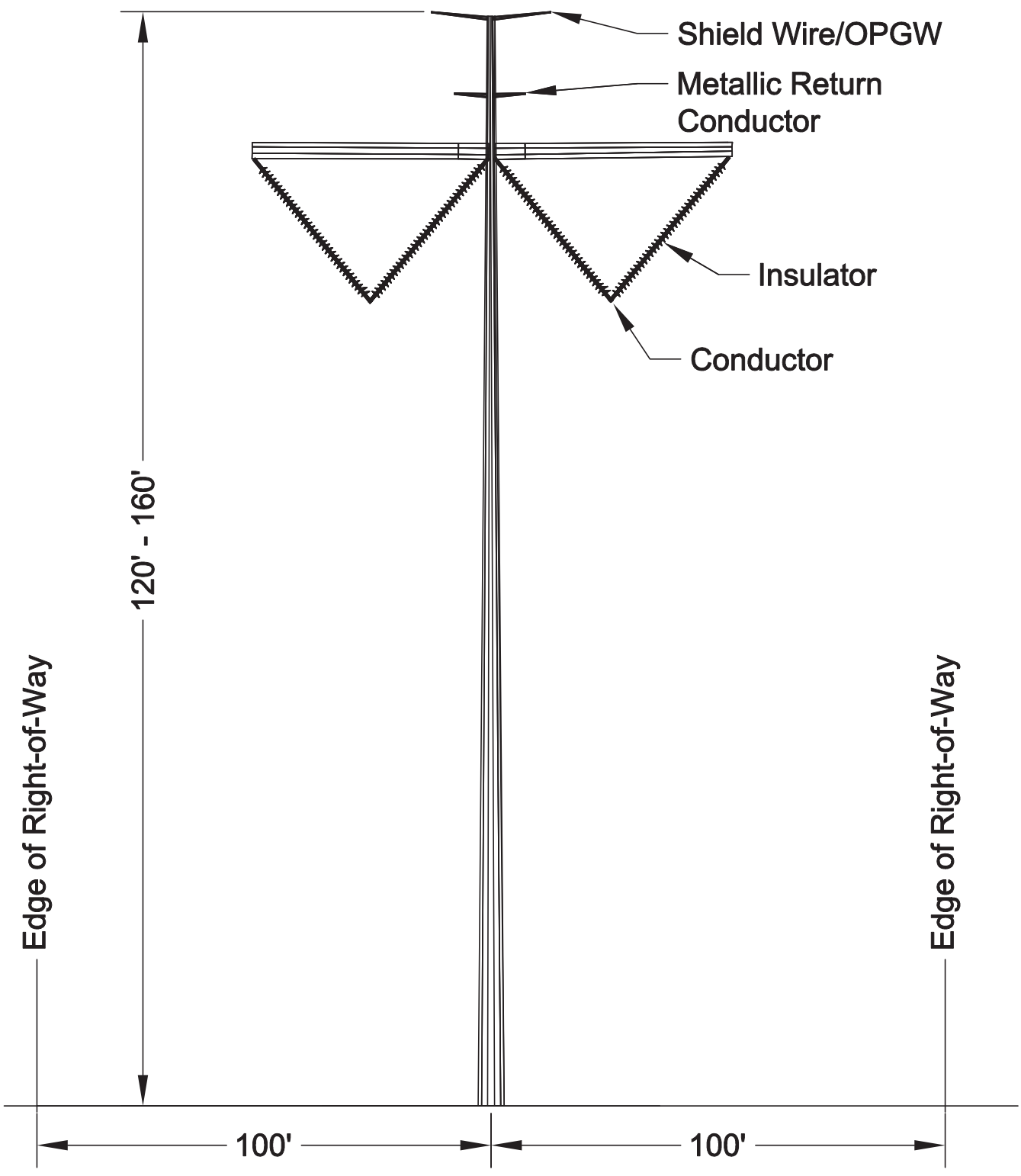
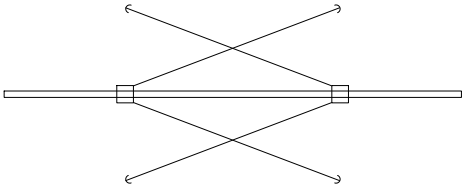
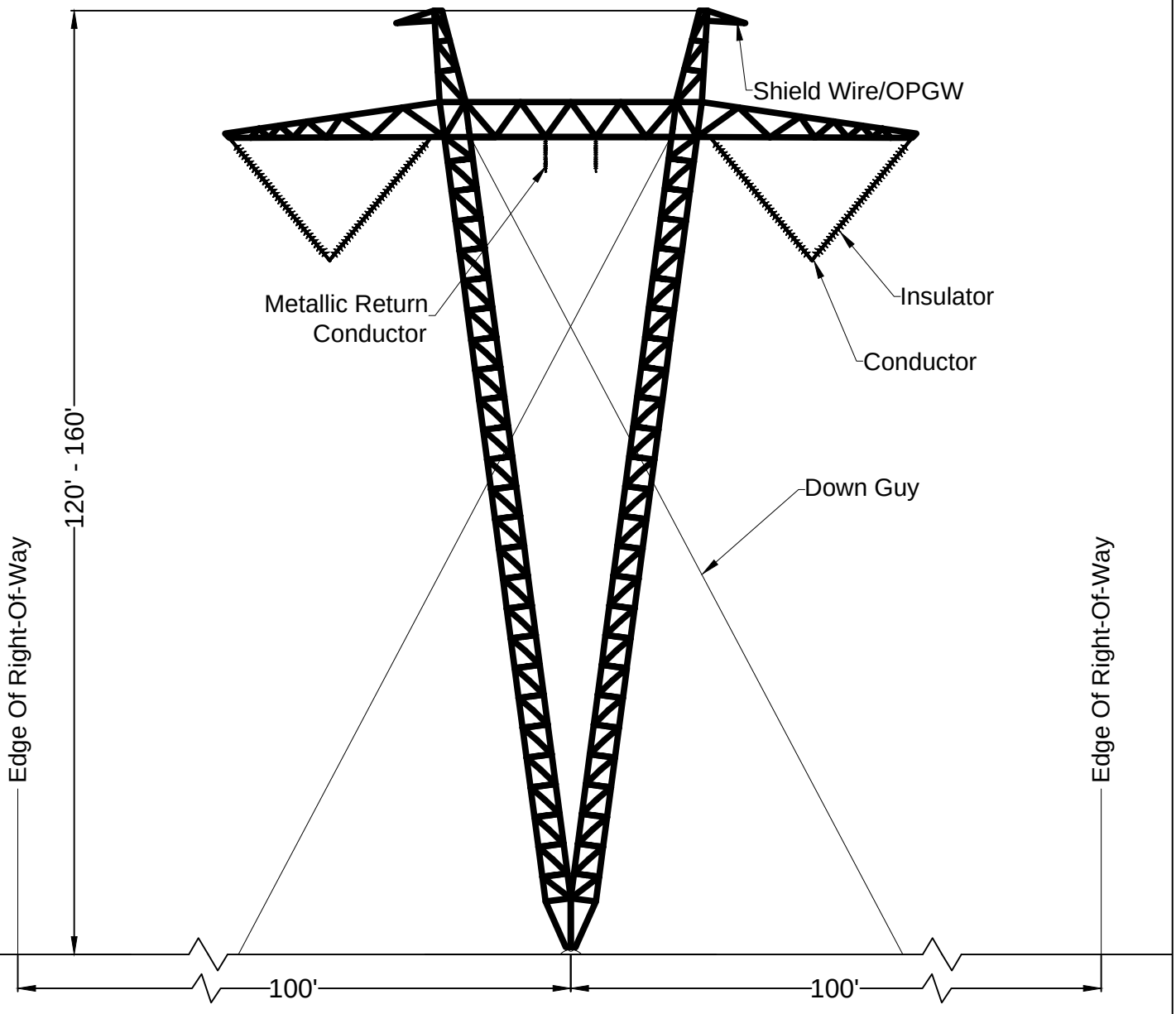


Figure 2-11c

600kV Monopole Tangent



PLAN VIEW



ELEVATION VIEW

NOTE:
DEPENDING ON STRUCTURE HEIGHT AND LINE ANGLE, GUY EASEMENTS MAY BE REQUIRED BEYOND THE PROJECT 200 FOOT RIGHT-OF-WAY.

NOT TO SCALE

600kV Guyed V-Lattice Tangent

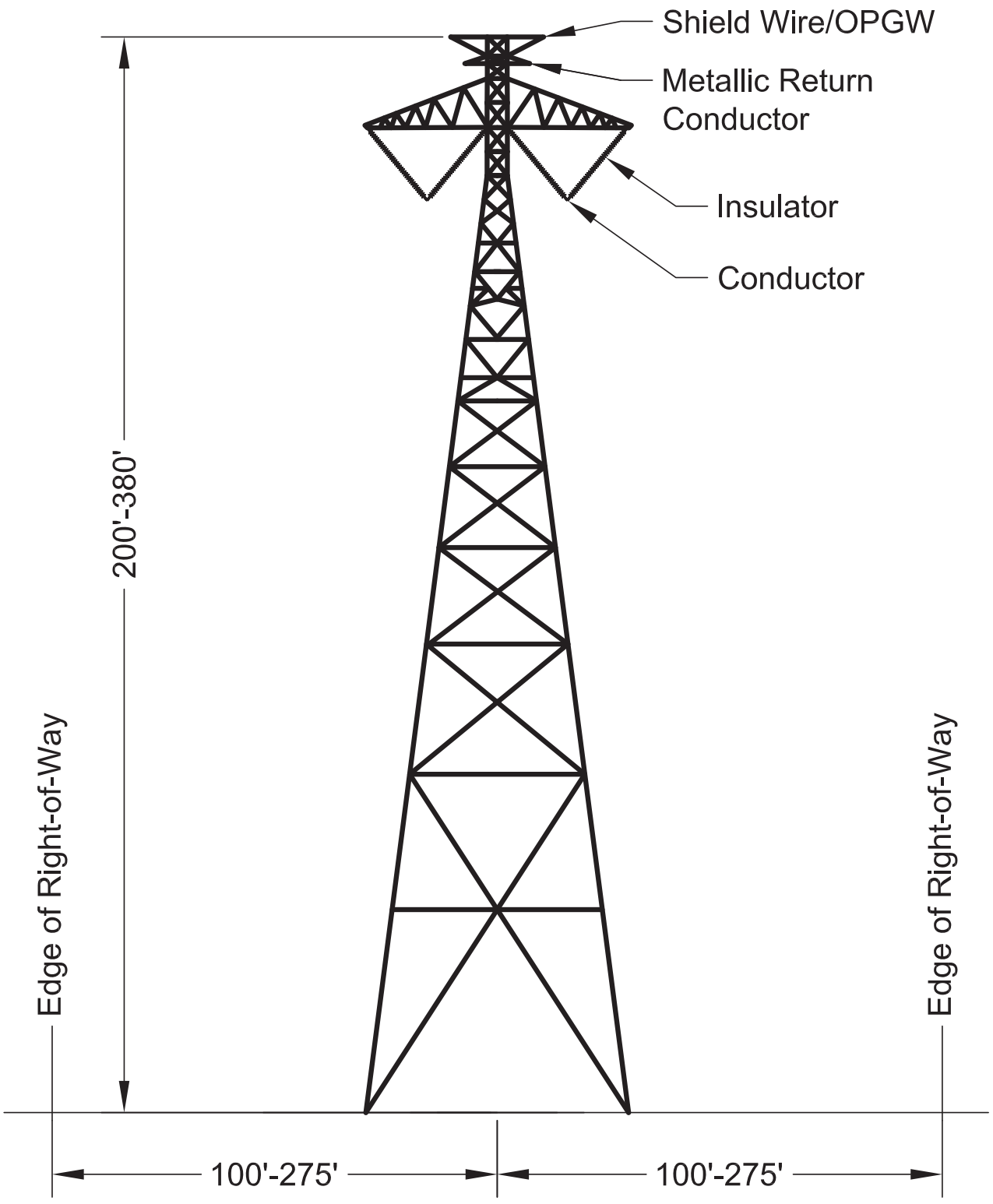
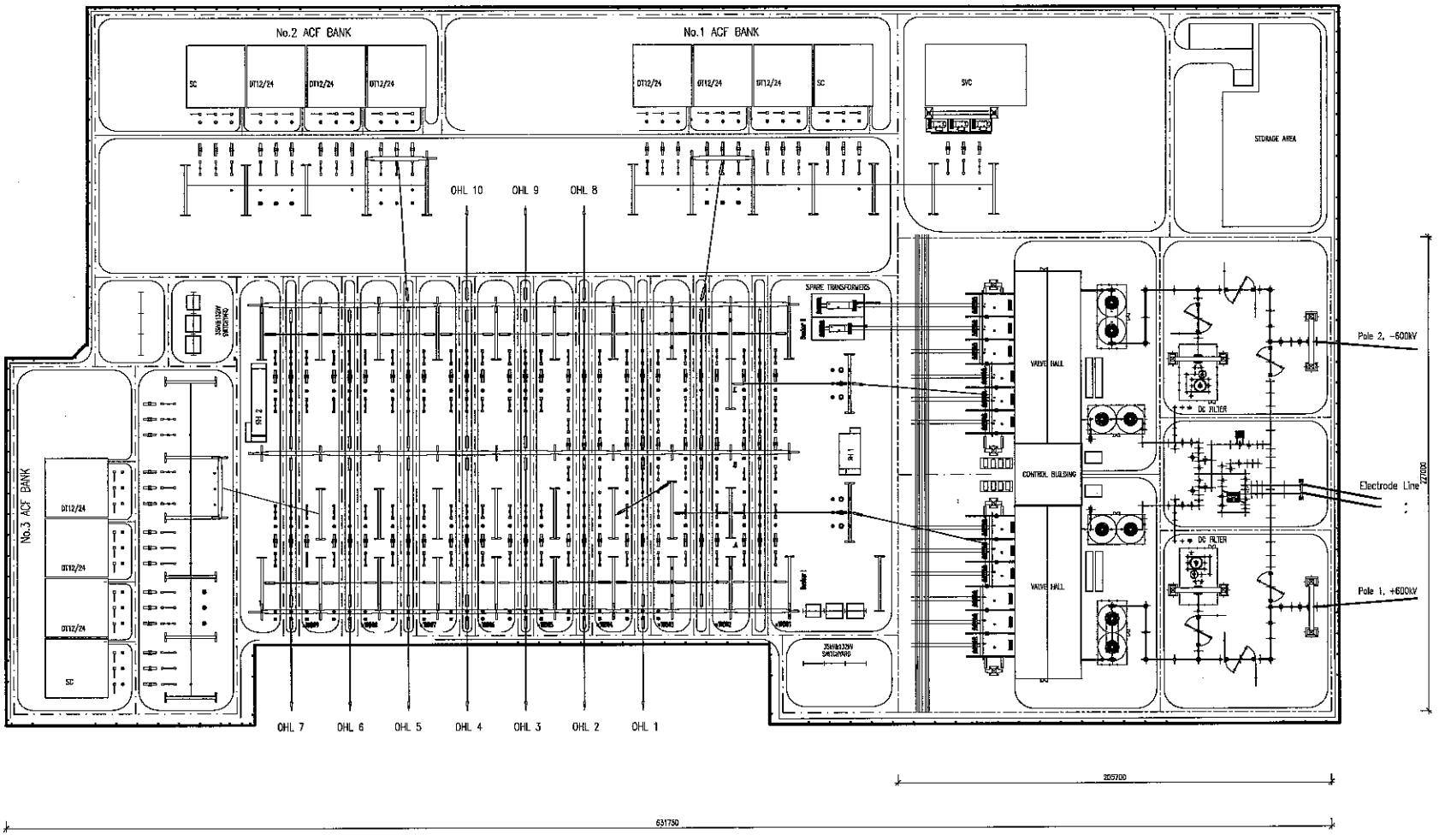


Figure 2-15

600kV Lattice Crossing Structure

EXHIBIT WG-2: Converter Station General Layout



CLEAN LINE HVDC CONVERTERS

CONVERTER STATION
GENRAL LAYOUT
ARRANGEMENT DRAWING

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