WIND BOT SCOPE BOOK

Revision 1

DATE 06/26/2024

REVISION RECORD

Revision No.	Approval Date	Section / Page Revised	Reason / Description of Change
0		All	Initial Issue
1		3.6,8.2	Updates to SCADA Fiber requirement and PEP submittal requirement.

WIND BOT SCOPE BOOK

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LIST OF APPENDICES

1 General Data[1]

This Appendix, including its attachments, is the Scope Book. This Scope Book is part an Acquisition Agreement between Seller and Buyer and is subject to the rules of interpretation set forth therein. Terms with initial capital letters used but not defined in this Scope Book shall have the meanings ascribed to such terms in the Agreement unless the context otherwise requires. For the avoidance of doubt, the rules of interpretation set forth in the main body of the Agreement shall apply to this Scope Book.

This Scope Book describes certain requirements with respect to the Work. In performing the Work, Seller shall comply with the requirements specified in this Scope Book, all requirements specified in the Agreement, Prudent Wind Industry Practices, the Turbine Supplier specification, all Laws, all applicable permits, the Applicable Standards and Organizations, and all requirements specified in the GIA and their respective Scope Books (collectively, the "Requirements").

This Scope Book provides the minimum functional specification (MFS) for the Project, including scope and design requirements for the Wind Turbine. In addition to the requirements set forth in this Scope Book, the Project (including the Collector Substation and the HV transmission lines) shall comply with all requirements specified in the GIA and their respective Scope Books.

This Scope Book includes elements that apply to the work contemplated by and the provisions set forth in the Collector Substation Attachment (Appendix 1) and the High Voltage Overhead Transmission Line Attachment (Appendix 2). These elements include, but are not limited to, project controls; cybersecurity; environmental requirements; site fire protection; site security; temporary site installation and laydown areas; tools, spare part, and consumables; project utilities, redundancy; and control system and communication requirements.

1.1 Project Description

The Project will include the following main systems and equipment:

- Wind Turbines
- Meteorological (Met) Tower(s)
- Civil works including Wind Turbine Foundations, hardstand areas, on-site roads with passing bays and turning circles (if required), fencing and site rehabilitation.
- Site electrical distribution system including Wind Turbine step up transformers, with distribution cables brought to central point of connection (MV Switchgear).
- High Voltage (HV) Collector Substation
- HV transmission line (if applicable)
- Control System (including charge controllers and battery energy management system)
- Backup Power Supply/Emergency Generator, if required for equipment protection or personnel safety (i.e., Container/Enclosure HVAC and emergency lighting)
- Buildings and other structures (if required), including temporary.
- Access and internal roads
- Water, fuel, power, and all other utilities, including temporary.

Seller shall provide all other ancillary equipment, systems, materials, and components necessary to deliver to Buyer a fully functional and operational Project. Among other things, the Project will be designed to comply with at least the following principles:

- allow safe, reliable, long-term operations

[1] The Scope Book remains subject in all respects to Buyer's continued due diligence and internal review (including by Buyer's subject matter experts). This draft may need to be revised to reflect certain matters included or not addressed in the Agreement or the RFP or that have been reconsidered. [Entity] reserves the right to issue an updated version of the Scope Book at a later date.

- provide maintenance access for all equipment (including OSHA requirements)
- achieve at least a thirty (30)-year design life, recognizing that the theoretical design life of the Wind Turbine is a minimum of 20 years as per IEC61400 or longer as per the specific Wind Turbine's approved Design Certificate.
- minimize operator surveillance (the intent being that the Project will be designed to operate autonomously with minimal interaction by operators such that a limited O&M staff is required).
- provide reliable, utility grade power to the interconnect.
- minimize adverse local community impacts while adhering to all project permits.
- minimize impact of fire and natural hazards on site

1.2 Site Description

1.2.1 General

The Project Site is located in _____________, as further identified on the Site map in Appendix 8.

All Work, including construction, materials storage, grading, landscaping, cut/fill, erosion control, and other similar or related activities, shall not extend beyond the designated disturbance limits shown in Appendix 8. Unnecessary disturbance of the existing Project Site conditions shall be minimized, and under no circumstance may Seller perform any Work or cause any disturbance beyond these corridors without explicit written confirmation from Buyer.

Seller shall inspect the Project Site prior to initiating the Work to obtain such additional or supplementary examinations, investigations, explorations, surveys, tests, studies, and/or data concerning conditions at or contiguous to the Project Site or otherwise, which may affect cost, progress, performance, or furnishing of the Work. All such inspections shall have been contemplated and included in the Contract Price, and Seller shall not be entitled to request or be granted any scope change claims based on the results of these investigations.

1.2.2 Climatic Conditions

Seller shall design all aspects of the Project based on verifiable criteria that are specific to the Project and the Project Site, including elevation, terrain, ground cover / vegetation, corrosivity, precipitation (rain, snow, ice), frost depth, seismic loads, and subsurface conditions. All such design criteria shall be clearly displayed on the design drawings. Refer to Appendix 3 for specific climatic conditions information.

Both the Preliminary Energy Yield Assessment Report and Detailed Long-Term Energy Yield Assessment Report should contain a 12x24 probabilistic generation profile outlined in the wind resource assessment report required in the Term Sheet.

Design wind speed for the Project and all components shall be per IEC as noted herein and ASCE 7, Risk Category III.

Seller shall furnish weather equipment at the Project Site capable of measuring rainfall, wind speed, and other conditions as necessary to determine the occurrence of wind days and abnormally severe weather conditions, respectively.

1.3 Codes and Standards

Seller shall design, procure, construct, commission, and test the Project, including all equipment, materials, components, and auxiliary facilities and systems, in accordance with the most recently established codes, standards, or guidelines, or the code agreed upon at the time of the Agreement.

There are additional requirements in Appendix 12: Risk.

Seller shall perform the Work and otherwise cause the Project to comply with the applicable standards set forth in Table 1 below. Note that this table is not exhaustive, and Seller will also be responsible to comply with any other standards listed in all Project permits.

Seller shall design the Project in accordance with all applicable federal, state and local laws and codes, regulations and standards provided by the organizations listed below. Where these codes do not govern specific features of the equipment or system, Seller and Original Equipment Manufacturer (OEM) standards shall be applied. Where local codes or ordinances will have an impact on the design (e.g. building height restrictions) or equipment selection, Seller shall jointly address these with the local authorities having jurisdiction (AHJ). Seller shall review all applicable laws, codes and standards throughout the project duration. Any change in requirements which become applicable to the Work prior to final turnover shall be identified and presented to Buyer with recommended implementation options for Buyer's consideration and final approval. Any general standard or organization listed below shall be understood to include all relevant codes, standards, and/or guidelines under that particular standard or organization. For example, ACI shall include ACI 301, ACI 305, ACI 306, ACI 318, etc. Unless otherwise specified herein, in the case of conflict between any Applicable Standards and Organizations, the more stringent requirement shall apply.

Table 1: Applicable Standards and Organizations

Applicable Standards and Organizations	
AA	Aluminum Association
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AISC	American Institute of Steel Construction
AISE	Association of Iron and Steel Engineers
ANSI	American National Standards Institute
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASNT	American Society of Nondestructive Testing
ASTM	American Society for Testing Materials
AWEA	American Wind Energy Association
AWWA	American Water Works Association
AWS	American Welding Society
APLIC	Avian Power Line Committee
CFR	Code of Federal Regulations
CRSI	Concrete Reinforcing Steel Institute
CMAA	Crane Manufacturer Association of America
EPA	United States Environmental Protection Agency
FAA	Federal Aviation Agency, Department of Transportation
FERC	Federal Energy Regulatory Commission
FHWA	Federal Highway Administration
IBC	International Building Code
ICE	Institution of Civil Engineers
ICEA	Insulated Cable Engineering Association
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
ISA	Instrumentation Society of America
ISO	International Standardization Organization
NEC	National Electrical Code
NECA	National Electrical Contractors Association
NEMA	National Electrical Manufacturers Association
NERC	North America Electric Reliability Corporation
NESC	National Electrical Safety Code

Applicable Standards and Organizations	
NETA	National Electrical Testing Association
NFPA	National Fire Protection Association
NSC	National Safety Council
OSHA	Occupational Health & Safety Administration
PTI	Post-Tensioning Institute
SAMA	Scientific Apparatus Makers Association
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SPC	Society for Protective Coatings
TIA/EIA	Telecommunications Industry Association/Electronic Industries Association
UL	Underwriters Laboratories

1.4 Project Sequence and Milestones

The Project Execution Plan shall include a Project Schedule for the engineering, procurement, construction, commissioning, and testing of the Project in accordance with the milestones for the Project, including, but not limited to, these milestones:

- Limited Notice to Proceed
- Full Notice to Proceed
- Begin Construction
- Wind Turbine Manufacturing
- Wind Turbine Delivery
- Access Road Completion
- Foundation Completion
- Mechanical Completion
- Collection System Circuit Completion
- O&M Building Completion
- Wind Turbine Commissioning
- Backfeed
- Energization
- Closing
- Performance Testing Completed
- Substantial Completion
- Final Completion

1.5 Project Controls

Refer to Appendix 11 for requirements related to Project Controls.

1.6 Units and Language

1.6.1 Units for Calculations

Unless otherwise indicated, English units will be used in all calculations, as specified in Table 2 below. When both metric and English units of measurement are presented, English dimensional units shall prevail.

All drawings and dimensions shall be to scale; not-to-scale (“**NTS**”) dimensions will not be permitted on scalable drawings. A scale bar shall be included to permit use following photo-reduction.

Table 2. Units for Calculation	
Measurement	**Units**
Area	Acre
Dimensions	Ft

Table 2. Units for Calculation	
Measurement	**Units**
Electrical Energy	kWh or MWh
Electrical Power	kW or MW
Mass	Lb or ton
Temperature	ºF
Velocity	Mph
Voltage	V or kV
Volume	ft^3
Mass Density	Lb/ft^3
Pressure	PSI
Torque	Lbf

1.6.2 Language

Seller shall provide all information, including all designs and submittals, in the English language.

2 Scope of Work

2.1 General

The Work shall include, but not be limited to, the following:

- Survey and assessment of the Project Site
- Development, design, engineering, permitting, procurement, manufacturing, factory acceptance testing (FAT), equipment and materials delivery, unloading, handling and storage at the Project Site, erection, construction, equipment and system integration, onsite quality control assurance and control, commissioning, and testing of the Project including but not limited to the Wind Turbines, Meteorological Towers, Collection System, the Collector substation, HV transmission line(s), Wind Turbine Foundations, Project Roads
- Onsite quality control system, description, and execution program
- Works and services related to preparation, civil, mechanical, electrical, instrumentation and control (I&C), and communication
- Security of the Project Site
- Utilities and interconnections needed for construction, commissioning, and testing such as potable/non-potable water, temporary power, telecommunications and internet, and fuel
- Site specific health, safety, and environment plan (“HSE Plan”) and implementation
- Project hand-off and training
- Environmental compliance and implementation
- Site restoration as required

2.2 Design and Engineering

Seller shall be responsible for all design and engineering of the Project and Project Site in accordance with this Scope Book. Seller shall cause all design and engineering Work to be performed in accordance with the Requirements. The design shall meet the interface requirements of the Transmission System, and the Independent System Operator (ISO) if applicable, including communications and battery limits.

All equipment incorporated into the Project or otherwise sold to Buyer under the Agreement shall be of proven design for the intended use of such equipment.

The Project shall include a well-established classification and identification (“tagging”) system in all phases. This includes identification of drawings, document deliverables, and physical labeling of devices as it relates to design documentation. Seller shall use a consistent tagging system across the Project and obtain Buyer approval prior to implementation of the tagging system.

Seller shall prepare and submit all deliverables and submittals necessary for the successful completion of the Work, including, but not limited to, Job Books, As-Built Drawings, completion certificates, design documents, and all other manuals, drawings, plans, studies, calculations, safety-related documentation, reports, checklists, completion procedures, and other similar items (collectively, the “Seller Deliverables”). All Seller Deliverables shall be coordinated and discussed with all pertinent parties prior to and during the construction phase of the Project; shall be subject to review and/or approval by Buyer, as applicable; and shall be submitted by the applicable dates in the submittal schedule, as further detailed in Section 88.4 of this Scope Book, to Buyer for Buyer’s design review of the Project at the following milestones:

- 30% completion of detailed design
- 60% completion of detailed design
- 90% completion of detailed design
- 100% completion of detailed design prior to issue for construction release.
- Issued for construction release
- As-built drawings after project completion

Seller may deliver documents for a given system as they reach each of the agreed milestones instead of delivering all documents in a single package. Seller shall incorporate all reasonable comments from Buyer on each such set of documents and any subsequent input from Buyer regarding such comments or Seller’s response thereto.

For Buyer comments provided to Seller following delivery of the proposed issued for construction (IFC) design documents, Seller shall promptly notify Buyer in writing of, document (for Buyer’s review), and describe any changes made thereto, as a result of Buyer’s comments or otherwise, and provide Buyer no less than five business days to review and comment on the modified design documents. Seller shall not construct any portion of the Work until the applicable IFC drawings have been approved by Buyer. Buyer and Seller shall follow RFI procedure and guidelines to achieve change management completion and acceptance.

The preliminary Project Site layout in Appendix 8 sets forth the preliminary layout of the Project, including certain project design parameters:

- Wind Turbine locations
- Major equipment used
- Electrical interconnection facilities voltage and substation location
- Access road specifications, including width, internal turning radii, and surfacing cross section
- Project Site ingress and egress including locations of gates
- Project generation tie lines and the electrical interconnection point in accordance with the GIA.

The detailed design of the Project shall be finalized in accordance with the Project Schedule.

2.3 Property Protection

2.3.1 Risk Identification Process

2.3.1.1 General Inputs

All Applicable Codes, Applicable Standards, stakeholder inputs, and other Requirements shall be reviewed for applicability.

2.3.1.2 Project Specific Inputs

Each facility will have its own special conditions that impact the nature of the installation. The Project-specific input utilized in the design basis process shall include but not be limited to the following:

- Assumed staffing levels for operation

- Plant layout and geographic location
- Equipment availability / redundancy
- Availability of water supply
- Capability of emergency services responding to the site
- Storage configuration (short and long term)
- Historical geographic loss information / industry lessons learned

2.3.2 Property Protection Design Basis Document

The Seller shall prepare a site-specific Design Basis Document (DBD) in accordance with the Scope Book and Appendix 12 to establish the fire protection design criteria for the facility. This document is to be maintained and revised for the life of the facility as it is key to the management of change process. This document outlines the design basis for achieving the objectives agreed upon by the stakeholders and the subsequent decision-making process, including:

- Identification of source documents and assumptions,
- Identification of hazards and which fire protection/prevention features are to be provided or omitted, and
- Where operational and administrative controls are assumed to be in place to mitigate operational or natural hazards.

This DBD has been developed specifically for the project description, design parameters, and hazards identified within this document. As each project has unique conditions, parameters, and hazards, this document and the analysis contained within shall not be applied to other projects.

The development of this document is an iterative process and will be revised as the design progresses based on dialogue among the stakeholders. Stakeholders establish goals and objectives and evaluate whether the design is adequate to meet those goals and objectives.

Appendix 12 of this document serves as the minimum considerations for the Property protection elements of the DBD. Seller shall input the requested information into the tables in Appendix 12 and should provide any additional information relevant to the parameters of this DBD, including consideration for Appendices 3 and 5.

2.3.2.1 Risk Considerations

Major hazards associated with wind generating plants are as follows:

- Adjacent Wind Turbine units consistent with land and wind topography constraints
- Adjacent structures or exposures, including transformers
- Adjacent properties (e.g., aboveground pipelines, tank farms, or natural gas facilities that could present a severe exposure)
- Risk of Flood and maximum depth of water inundation
- Risk of Hail and maximum survivable diameter
- Risk of seismic activity if applicable

Flood, hail, windstorms, and lightning are natural hazards that are not specifically mentioned in NFPA 850, but are hazards which must be addressed in the DBD.

2.4 Civil and Structural

The civil and structural Work is described in the following sections.

2.4.1 Infrastructure and Outdoor Works

Civil works, structures, and foundations for the Project Site, such as:

- Rerouting of existing underground services, such as piping, cabling, and ducts, if appropriate
- Civil works for discharging rainwater (grading provides positive drainage to rainwater to avoid ponding, as well as culverts and low water crossings)
- General site filling, leveling, and grading to the necessary lines and levels, and all other earthworks where required, including access areas
- Construction of new roads, parking areas, and pavement as a part of the required infrastructure. The following shall be included as a minimum:
    - Main access road(s)
    - Internal roads
    - Collector Substation access road(s)
    - Transmission line maintenance road(s)
- Security fence and surveillance system and lighting system (where applicable)
- Access gate (where applicable)
- All civil works for the Wind Turbine site including:
    - Trenches
    - Service roads
    - Onsite infrastructure
    - Foundations
- All civil and structural works for the Collector Substation (if substation is in Seller's scope of work)
- All civil and structural works for routing and installation of the transmission line (if in Seller's scope of work)
- Any other outdoor civil works required inside the Project Site or as needed for interconnection of the Project to the Transmission System.

2.4.2 Electrical and Instrumentation & Control (I&C) Systems

Civil works, structures, and foundations for the electrical and I&C systems, including:

- Construction of ducts, culverts, underground cable ducts, trenches, manholes, and other routing methods and access points for medium voltage (MV) and low voltage (LV) system cables, perimeter lighting, surveillance, I&C system, etc.
- For transformer, switchgear, and enclosures, including their corresponding foundations
- Within the Collector Substation area for power evacuation
- For the power transmission line from the Collector Substation to the Electrical Interconnection Point, including tower foundations, if required
- For the Electrical Interconnection Point, if required
- Underground cable for MV and data connections inside of the Wind Turbine field
- Connecting MV and I&C cables to the agreed interface points
- Power and control cabling
- Transformer foundation(s)
- Switchgear foundation(s)
- Enclosure foundation(s)
- Metering (operational meters not the revenue meter, see Collector Substation Attachment (Appendix 1))
- Any other civil and/or structural works related to the electrical and I&C systems.

2.4.3 Storage

A storage area on the Project Site that will be located, sized, and for the unloading, storing, accessing, handling, removal, and delivering of supplies, equipment, materials, consumables, and spare parts during all phases of the Project, including construction, commissioning, testing, and operation and maintenance.

2.5 Electrical

2.5.1 Auxiliary Supply System

The Work includes the supply, assembly, installation, and testing of the following components:

- Auxiliary transformer(s), including the station service transformer
- LV switchgear
- LV panel boards, including panel board grounding and disconnect switches
- Busducts and cables
- Conduits and cable trays
- Protective devices for transformers, MV and main LV switchgears
- Required protection systems
- Lighting System (including emergency lighting)
- Grounding
- Electrical workshop equipment
- Automatic transfer switch
- Fuses and fused disconnect switches
- Backup power supply/emergency generator (including UPS)
- Lightning protection system, where applicable
- Junction boxes

2.5.2 MV Distribution

The Work includes the supply, assembly, installation, and testing of the following components:

- MV Switchgear
- MV Transformers
- MV Cables and connections
- MV minor collection equipment necessary for Seller to achieve completion of the Collection System design, including those outlined herein (e.g. marker balls, warning tape, cable markers, fault indicators, etc.).

2.5.3 Instrumentation and Control

The Work with respect to the local control system (LCS)[2] includes the supply, assembly, and installation of the following components:

- Primary sensors, transmitters, actuators
- Plant control and monitoring system for the Plant including all necessary software licenses
- Local Workstation with Windows-based operating system and a local representation of the Ignition SCADA platform to operate and monitor the Project from the control house
- Meteorological Tower(s) as described in Section 3.4.2 below
- Revenue metering systems at the Collector Substation
- Plant monitoring system
- Communication systems (telephone, LAN/WAN system, etc.)
- GPS-based clock systems
- Data transfer to Buyer remote control center (e.g., via the internet)
- All works required for integration of the Project into the Collector Substation control system

[2] A distributed control system (DCS) providing equivalent or better controls or equipment is also acceptable. The term “LDC” shall be deemed to include such a DCS for purposes of this Scope Book.

- All works required for implementation and integration of the Project into MISO's systems, including all required equipment and software as well as testing, auditing, and all necessary documentation as required by MISO

2.6 Environmental Requirements

Seller shall design, build, and maintain the Project to meet all applicable Environmental Laws. Seller shall demonstrate during the design and construction phase and during the Performance Tests that the Project is able to (design) or does (construction) comply with all applicable Environmental Laws and standards. Applicable standards for environmental protection must be fulfilled without any restriction.

Seller shall conduct studies and necessary evaluations for activities commonly associated with new construction, including but not limited to:

- Conduct Environmental Assessments (EA) in compliance with Good Industry Practices and current requirements and Laws
- Conduct Wetlands Delineation and Threatened and Endangered Species Survey
- Develop National Pollutant Discharge Elimination System (NPDES) Construction Stormwater Permit
- Develop Stormwater Pollution Prevention Plan (SWPPP)
- Develop a Spill Prevention, Control, and Countermeasures (SPCC) Plan for project construction activities and O&M activities, respectively
- Hazard communication and chemical storage requirements found in 29 CFR 1910.1200
- Waste Management for non-hazardous, hazardous, and universal wastes.
- Waste management for broken, damaged, or waste solar panel modules
- Above ground storage tanks
- On-site sewage facilities (Septic Systems)
- Development of an environmental considerations report as required by State Public Utility Commissions

2.7 Site Security - Construction

The Site Security Plan shall include the following:

- Security fence around the Met Tower(s), including guy wires (if applicable)
- Project Site access gate with interface for remote operation from Operations Center.
- Locks on any building on the Project Site that contains microprocessor-based relays
- Locks and alarms on all Wind Turbine tower base doors
- Necessary cables (e.g., for power supply and sensors) and a fiber line that will permit Buyer to install (as, when, and if Buyer elects to do so) a PAC System (Physical Access Control System) for card reader access to all protected areas on the Project Site that contain cyber assets
- Pre-wiring of the main plant control room/enclosure entrance for, and procurement and installation of, professional grade security cameras that satisfy Buyer's NERC compliance requirements
- Door alarms on all electrical hardware enclosures/panels and any BOP security systems.

Seller shall ensure that the security systems comply with all Requirements, including requirements of Law and applicable Permits.

2.8 Temporary Site Installations and Laydown Areas

Seller shall obtain all necessary approvals and/or Permits for the installation of the temporary site installations and laydown areas.

Seller shall design, furnish, construct, install, and maintain one (1) temporary laydown yard.

The laydown yard shall be constructed at a location at the Project Site to be approved by Buyer.

The laydown yard shall be sufficient in size to allow for simultaneous (a) storage of equipment, including any Buyer-Supplied Equipment, that will not be stored at the Wind Turbine Pads; (b) storage of office trailers and other temporary facilities; (c) portable restrooms, including for Turbine Supplier; (d) parking for 20 Buyer vehicles; (e) regular construction traffic; and (f) Turbine Supplier requirements for storage area, parking, etc.; Seller shall incorporate this into the design and construction of the laydown yard.

The laydown yard shall be covered throughout with at least six (6) inches of aggregate over a compacted subgrade. The maximum aggregate size shall not exceed three (3) inches.

The laydown yard shall be graded to drain and shall not exceed two percent (2%) grade, or less if required for the safe storage of equipment or to meet manufacturer's requirements for storage of equipment.

Fencing shall be installed around the perimeter of the laydown yard, and vehicle gates shall be installed at all entrances to the laydown yard. This fencing may be re-used as permanent fencing for the O&M structure.

The laydown yard shall comply with the Turbine Supplier Project Site Requirements, as defined in the Agreement.

Seller shall maintain site cleanliness and perform housekeeping in accordance with Good Industry Practices.

Seller is responsible for the mobilization of field forces and all necessary construction facilities at the Project Site, including temporary office trailers as necessary or advisable for completion of the Work. Seller shall be solely responsible for furnishing their trailer(s), including any utility services.

Seller shall furnish and install one (1) 12-foot by 60-foot wide office trailer for Buyer's exclusive use. Each trailer shall be located at the laydown yard and shall be installed and ready-to-use no later than 10 days after the Seller mobilization date or on the same date when Buyer's trailers are installed, whichever occurs first. Buyer's trailer(s) shall be removed from the Project Site at Project Substantial Completion or when Seller's trailers are removed from the Project Site, whichever occurs last. After Substantial Completion, Buyer shall have an option to assume contractual obligations for this temporary office trailer.

Each trailer shall include two (2) furnished offices

Each trailer shall include at least one (1) furnished conference area

Each trailer shall include at least one (1) unisex restroom, each complete with potable water, one (1) flushable toilet, and one (1) sink.

Each trailer shall include at least one (1) full-size drawing table, one (1) full-size drawing rack, and two (2) 4-foot by 6-foot bookshelves, respectively.

Each trailer shall include one (1) full-size refrigerator with freezer and one (1) full-size microwave. All appliances shall be new and unused.

Each trailer shall be furnished with central HVAC.

Each trailer shall be furnished with at least one (1) first aid kit and one (1) fully-charged fire extinguisher, respectively. Seller shall maintain and recharge such fire extinguishers throughout the duration of the construction activities, as required.

Each trailer shall be furnished with a wifi-enabled printer that includes scanning capabilities, and with 8.5-inch by 11-inch and 11-inch by 17-inch print sizes.

Seller shall furnish and install broadband internet service, electric service, and running water for each Buyer trailer, including connection of all communications to the jobsite. Internet service shall include high-speed internet infrastructure wiring up to the wall jacks in each trailer and high-speed wireless internet service (wifi) throughout the trailer compound, respectively. All utility services shall include use and service charges to Seller's account, including for Buyer's trailers.

Seller shall furnish bottled water and ice in each Buyer trailer and for Buyer's exclusive use throughout the duration of the construction activities.

Seller shall provide weekly cleaning services within each Buyer trailer throughout the duration of the Work. This shall include cleaning restrooms and trash collection, pickup, and removal, respectively.

Seller shall furnish, install, and maintain portable chemical toilets for use by site construction personnel, including Buyer, Turbine Supplier, and subcontractors. This shall include cleaning (at least weekly), emptying, and disposal of such toilets through substantial completion of the Project or Seller demobilization, whichever occurs last. Following such date, Seller shall remove all such toilets from the Project Site.

Seller shall design, permit, furnish, construct, and maintain, as required, any temporary fuel containment facilities required to support ongoing construction activities. This shall include removal of all such facilities following substantial completion of the Project or Seller demobilization, whichever occurs last.

Seller shall design, permit, furnish, construct, and maintain (including disposal), as required, any hazardous materials/waste facilities required to support ongoing construction activities. This shall include removal of all such facilities following substantial completion of the Project or Seller demobilization, whichever occurs last. Seller shall provide Buyer with a copy of all hazardous material manifests.

As required to perform the Work, Seller shall procure, permit, install, construct, and maintain batch plant(s) at the Project Site, including all necessary labor and materials related to the operation of the batch plant, and removal of the batch plant at the conclusion of the Work. The batch plant shall be removed from the Project Site by Seller within 30 days of the final Project concrete pour utilizing the batch plant, not to occur after substantial completion of the Project. Power to operate the batch plant shall be the sole responsibility of Seller.

As required to perform the Work, Seller shall procure, permit, install, construct, and maintain fixed and/or mobile rock crusher(s) at the Project Site, including all necessary labor and materials related to the operation of the rock crusher(s), and removal of the rock crusher(s) at the conclusion of the Work. The location of any fixed rock crusher(s) shall be at the temporary facility areas, and the location of any mobile rock crusher(s) shall remain within the designated disturbance areas. Power to operate the rock crusher(s) shall be the sole responsibility of Seller.

Promptly after the Substantial Completion Payment Date, and as a condition to Final Completion, Seller shall remove all temporary installations and demobilize, leaving the Project Site clean and orderly, and clear of debris or pollution. Any laydown, construction parking, and/or work areas constructed on a temporary basis may be requested by the Buyer to remain for future use.

2.9 Tools, Spare Parts, and Consumables

Seller shall provide all equipment and tools, including cranes, lifting equipment, and Special Tools, necessary for operation and maintenance of the plant through the Substantial Completion Payment Date.

In addition to the Transferred Closing Inventory and any Transferred Post-Closing Inventory required to be supplied by Seller hereunder, Seller shall provide, no later than 16 weeks prior to Substantial Completion, a list of recommended spare parts and Consumables, including the recommended quantities, part / model numbers, and list price of each item. The recommended spare parts and Consumables should be classified as follows:

- Maintenance Spares and Consumables: Items that Seller reasonably anticipates may be required or appropriate for Buyer to have in stock during the first two (2) years of normal operation of the Project.
- Overhaul Spares and Consumables: Items that Seller reasonably anticipates may be required or appropriate for Buyer to have in stock during the programmed minor and major overhauls.

- Strategic/Breakdown Spares: Items that Seller reasonably anticipates may be required or appropriate for Buyer to have in stock after commissioning before extensive testing to refurbish the equipment.

Seller shall be responsible for supplying and fitting any spare parts required prior to Take Over, including during construction, commissioning, and testing, without charge to Buyer. Spare parts shall align with requirements set forth by Turbine Supplier.

All spare parts and Consumables shall be commercially available for the operational lifetime of the installation. For all categories of spare parts and Consumables, Seller shall recommend in accordance with Good Industry Practices proper storage procedures for all items.

Following receipt of such list, Buyer shall inform Seller of the spare parts and Consumables for operations that it is electing to maintain (whether that is the full list provided by Seller or a modified list). Seller will support Buyer's review and finalization of such list. Following finalization of the list of such spare parts and Consumables for operations that Buyer is electing to maintain, Seller shall, for Buyer's account and at Buyer's direction and cost, manage the procurement and delivery to the site designated by Buyer of such spare parts and Consumables.

2.10 Permits

Seller shall obtain, pay for, and maintain all permits required for its performance of the Work and Project Operational Permits from applicable Governmental Authorities. Seller shall provide copies to Buyer of all permit applications for Seller Permits promptly after such applications are submitted to the applicable authority.

2.11 Project Site Closeout and Restitution

Seller shall document and repair all drain tiles damaged during performance of the Work, including during road installation, Collection System Circuit installation, Wind Turbine Foundation installation, crane walks, or otherwise. Repairs shall be consistent with or better than the original tile installation.

Seller shall remove all tools, equipment, surplus materials (including unused or useless materials), waste materials, temporary work (including temporary erosion control features), temporary buildings, temporary facilities (including batch plants, rock crushers, and office trailers), and rubbish from the Project Site prior to final completion, and shall cause any facilities used by Seller during the performance of the Work to be restored to the same or better condition that such facilities and the Project Site were in on the date the Seller commenced work at the Project Site, ordinary wear and tear excepted.

Seller shall perform restitution, restoration, and/or reclamation of Work areas to include, but not limited to, the following. Notwithstanding anything that follows, all Work areas at the Project Site shall be restored, at a minimum, in accordance with the requirements set forth in the Applicable Permits, the SWPPP, and the other Requirements, as appropriate, and shall be fully restored to their pre-construction condition, at a minimum.

Clean all drains and ditches at completion of the construction Work, including removal of silt and debris from culverts, and leave the Project Site in a neat and presentable condition wherever construction operations have disturbed the conditions existing at the time of starting the Work.

Preserve and/or restore to their pre-construction condition all land and water resources adjacent to construction areas. Such work shall include restoration of all terraces to their pre-construction condition.

Wind Turbine Pads, laydown areas (including the laydown yard), roadway shoulders, and roadway turning radii shall be decompacted and reclaimed, including proper grading, aggregate touch-up, and seeding with an approved mixture. For the avoidance of doubt, such areas shall not be reclaimed until applicable Wind Turbine erection activities have been completed.

Crane pads shall be preserved in a suitable manner to support the use of cranes in ongoing Wind Turbine maintenance activities following construction (e.g., cranes required for gearbox removal and / or installation).

Re-dress all road surfaces within the Project Site such that the final cross section meets the specifications including the post-construction aggregate cap and such that all roadway surfaces are graded for draining and low spots are removed.

Seed all cut / fill slopes utilizing an approved seed mixture. Seeding shall occur during a time / season when the probability of successful seed germination is maximized; hydro-seeding is acceptable for slopes.

Areas inside and outside the fence line disturbed during construction or site remediation shall be reseeded prior to closure of the construction stormwater permit.

Fill all depressions and water pockets caused by construction operations and remove all obstructions within waterways.

Spread surplus fill on-Project Site in areas and depths approved by Buyer.

Spread recovered aggregate from laydown yard within approved disturbance limits at Buyer-approved locations including but not limited to on access roads, beauty rings, and/or the O&M Building yard.

Collect large rocks or boulders unearthed during excavation as part of the Work but not utilized in the construction of the Project and store at a Buyer-approved location at the Project Site.

3 Technical Requirements

3.1 General System Requirements

Seller shall perform and complete the Work in a thorough, professional manner utilizing personnel skilled, competent, and appropriately licensed in their various trades. All design, workmanship, equipment, materials, and components shall comply with the requirements of this Scope Book, including the Requirements.

Seller shall take necessary precautionary measures to ensure that there will be no interruption, damage, or danger to any equipment or system due to broadband, radiofrequency, or comparable interference. Seller shall ensure that there are no discharge sources from the Project that could cause interference with radio and television reception, wireless communication, telecommunication, or microwave communication systems. The Work shall include any mitigation necessary to ensure that such communication systems are not adversely affected.

No aspect of the operation of the Project shall produce electromagnetic interference (EMI) that will cause faulty operation of instrumentation, communication, or similar electronic equipment within the Project or elsewhere on the Transmission System. The Project shall be designed to suppress EMI effects and must meet the specifications of the latest revision of IEEE 519 and its referenced standards, as applicable.

If not supplied internal to the Wind Turbine, each Wind Turbine location shall include a medium-voltage, transformer. Such transformer shall be sufficiently sized to allow the full Wind Turbine capacity to be delivered.

3.2 Civil and Structural Requirements

3.2.1 General

The Project shall be designed, constructed, and installed with sufficient access aisles, equipment separation, and clearance to ensure the safe operation, maintenance, inspection, and repair, removal, and replacement of equipment and systems. The Project design shall include and allow for appropriate walkways, forklift/vehicle runs, access routes, means of access, and related safety protections, including doors, stairs, landings, ladders, and other access means.

All civil / structural works, including, but not limited to, access roads, Wind Turbine Foundations, Wind Turbine Pads, and the laydown yard, shall conform to Turbine Supplier Project Site Requirements, including for roads, crane pads, and hardstands.

3.2.2 Accessibility

3.2.2.1 Platform Access at the Project Site

Reasonable access shall be provided for systems components and equipment that require regular or anticipated maintenance activities or operator access for normal operations or repair of the Project. All platforms shall provide space for maintenance of equipment and pull-space.

3.2.3 Geotechnical Investigation

Seller shall conduct geotechnical investigations on the Project, foundation design requirements, as well as specific local geotechnical and hydrological parameters. The results of the investigation shall serve as a basis for the Project's civil, structural, and architectural design, including identifying the required foundations and earthworks, selection of materials and corrosion protection methods, trench and cable sizes, erosion potential, or any other aspect in which soil characteristics are relevant. For the avoidance of doubt, all such investigations shall be completed before commencing the applicable Work.

All Work concerning the geotechnical services shall be supervised and directed by a qualified, competent, practicing geotechnical engineer. A geotechnical engineer or engineering geologist shall observe, log borings, obtain soil samples, and record blow counts of the samples, drill rates, rock quality, depth to ground water, and other pertinent data under the direction of a licensed geotechnical engineer.

3.2.3.1 Submittals

Seller shall submit to Buyer, *prior* to initiating subsurface investigations, the name and qualification statement for proposed geotechnical engineer.

Seller shall submit to Buyer, *prior* to initiating subsurface investigations, the proposed scope of subsurface investigation, including number, location, and depths of borings; anticipated plan for laboratory testing; and detailed descriptions of additional site investigation techniques, including thermal and electrical resistivity or other necessary testing.

Seller shall submit a complete geotechnical engineering report (the "**Geotechnical Report**") containing the required information summarized below, at a minimum. The Geotechnical Report shall be utilized for the design and construction of all Project structures, including Wind Turbine Foundations.

- Subsurface and groundwater conditions encountered.
- Description of the geology, including areas of landslides, potential landslides, potential geologic hazards, past (historical) earth movements, and transitions between geologic units; special consideration shall be given to identify active and potential landslide zones.
- Description of the drilling and sampling program.
- Field photographs.
- Boring coordinates, boring location drawings, and final boring logs.
- Summary of results of field and laboratory tests performed.
- Specific design criteria for the Project, including (a) impacts of new construction on existing facilities; (b) factors of safety used in determining allowable foundation loads; (c) recommended foundation types for all structures; (d) discussion of the dynamic soil properties at the Project Site, including dynamic shear modulus, Poisson's ratio, Young's Modulus, and shear wave velocity; (e) recommendations for designing for seismic issues, including liquefaction potential and the identified building code site

coefficient/site classification for seismic design; and (f) recommendations for site dewatering and construction practices, including design water level.

- For shallow foundations, (a) allowable soil bearing values and minimum bearing depths; (b) anticipated total and differential settlements; (c) uplift resistance; (d) lateral resistance; (e) subgrade modulus; and (f) dynamic spring constants for foundations supporting vibrating machines, if applicable.
- For deep foundations, (a) type of deep foundation (e.g., drilled shaft, rock anchor); (b) diameter (or dimensions) and depth of foundation members; (c) minimum spacing and group reduction factors; (d) allowable compressive, uplift, and lateral capacities including allowable skin friction and end bearing capacities, anticipated settlements and lateral deflections; and (e) static and dynamic spring constants.
- Recommendations for slopes, including (a) temporary excavation slopes and OSHA soil types; (b) permanent slopes; and (c) temporary and permanent excavation support requirements.
- Corrosion potential and chemical attack to construction materials.
- Recommended cement type in concrete and corrosion protection for buried steel, based on chemical test results. Recommended cement type shall be based on soluble sulfate content in the soil and ACI recommendations.
- An evaluation of the expansive, dispersive, and collapsing nature of the on-Site soil materials and discussion of design features to resist these tendencies.
- Recommendations for earthwork including acceptable fill materials, moisture contents, compactive effort, lift thickness, proofrolling, equipment, and compaction testing, and recommended aggregate gradations for general fill, load bearing fill, granular road base, and granular surfacing.

3.2.3.2 Field Investigation

Geotechnical borings and material sampling, including boreholes, cone penetration tests, soil resistivity (electrical), soil physical properties, soil mechanical properties, soil chemical properties, and ground water (hydrological), shall be provided at the following minimum frequencies:

- Wind Turbines: each Wind Turbine location
- Meteorological towers: each free-standing meteorological tower location
- O&M Building: minimum of two (2) locations at the O&M Building.

Geotechnical borings and material sampling shall be provided to a minimum depth necessary to provide sufficient information for the data and recommendations required in the geotechnical engineering report. Boring depth at each Wind Turbine location shall be per the Turbine Supplier's recommendations.

Seller shall perform electrical resistivity measurements at the minimum frequencies set forth below, in each case using the Wenner Four-Electrode method (ASTM G57) or Buyer-approved equal, and in each case with final locations approved by Buyer prior to testing:

- Wind Turbines: ten percent (10%) of all Wind Turbine locations.
- Collection System Circuits: minimum of one (1) location per circuit.

Seller shall perform thermal resistivity testing in accordance with ASTM D5334. Laboratory testing shall include a measurement of the soil's moisture content, maximum dry density, and thermal dryout characteristics.

Seller shall obtain 24-hour water level readings in boreholes or install piezometers for long-term water level readings as required to determine prevailing groundwater levels.

Seller shall perform any additional geophysical or other site investigations, including, but not limited to, standard penetration tests, Shelby tube samples, deepened borings, additional borings, test pits, seismic refractions, cone penetrometer soundings, in situ testing, and other similar or related methods, as necessary to supplement the required geotechnical investigations summarized herein or to otherwise provide the data and recommendations required in the Geotechnical Report.

3.2.3.3 Lab Testing

Seller shall perform all laboratory testing necessary to classify the materials and to obtain physical characteristics of the subsurface materials. All testing shall be performed by an independent, experienced third party.

3.2.4 Site Clearing, Grading, Soil Improvement, and Fill

Seller shall provide all Project Site preparation as necessary to complete the Work, including, but not limited to, all clearing, grubbing, stripping, grading, compaction, demolition, blasting, excavation, soil stabilization, tree trimming, and drainage.

Topsoil shall be stockpiled for later use during landscape reclamation activities. Topsoil shall be stockpiled only in areas designated where it will not interfere with construction operations or existing facilities. Stockpiled topsoil shall be reasonably free of subsoil, stumps, roots, debris, and stones larger than two (2) inches in diameter. Topsoil shall not be used as structural fill. Appropriate erosion control measures shall be utilized on stockpiled topsoil.

Root mats and stumps shall be completely removed from the Project Site construction areas; holes refilled with select material and compacted adequately for the ultimate expected loading for the material used; and graded to drain.

Any waste generated from such activities, including tree trimmings or grubbed vegetation material, shall be Seller's responsibility to dispose of.

Seller shall provide and maintain throughout the duration of construction activities all necessary construction surveying and marking necessary to construct the Project and complete the Work, to include, but not limited to, (a) grading limits; (b) limits of disturbance; (c) laydown and storage areas; (d) culturally-, archeologically-, and/or environmentally-sensitive areas; (e) utilities, pipelines, and other buried facilities; (f) Wind Turbine locations; (g) access roads and crane paths; (h) Collection System Circuit routing; (i) including centerline and structure locations; (j) O&M Building, including pads, parking area, and property limits; and (k) easements.

Seller shall locate the Work from horizontal and vertical control monuments. Seller shall be solely responsible for locating any survey monuments at or near the Project Site and shall replace such monuments if they are disturbed during performance of the Work.

All structure foundations shall be surveyed and staked prior to excavation. The methods of staking and final alignment shall be designed such that the finished condition of the Work meets the requirements for alignment, position, elevation, and rotation.

All permanent Project facilities, including roads, Collection System Circuits (including feeder routing, junction boxes, and splices), shall be surveyed following their construction and included in the applicable As-Built Drawings. Surveyed locations shall be included in the drawings and a Seller-provided geospatial file (.SHP and/or .KMZ format) for each.

Seller shall design the general grading of the Project Site taking into account the needs of the general drainage system. Soft, shifting, or unstable subsoil areas may be excavated down to firm subsoil and replaced with well-compacted suitable selected or imported fill material as determined by the engineer of record. Compaction levels shall be to an acceptable standard as specified by the engineer of record. Seller shall ensure that all Project grading and drainage and access roads are designed to the requirements of all Laws and applicable Permits.

Earthwork (excavation, fill, backfill, slopes, etc.) associated with grading and drainage, including materials and installation, shall be conducted in accordance with the final geotechnical data and as reasonably determined by Seller's geotechnical engineer(s) for the Project. Testing and monitoring of soils for earthwork shall be performed by a qualified, experienced, properly licensed independent quality control inspection and testing firm hired by Seller. Construction damage to earthwork shall be remediated prior to Substantial Completion.

Materials suitable for use as fill at the Project Site shall include only materials that are free of debris, roots, stumps, organic matter, frozen matter, coal, ashes, cinders, stones larger than two (2) inches in diameter, slag, other deleterious materials, and as recommended by the Geotechnical Report. Surplus fill shall be spread on-Site and in areas and depths approved by Buyer; surplus materials shall not be exported off-Site without the approval of Buyer.

Permanent slope and rock stability measures shall be part of the Project design and shall incorporate the recommendations and requirements set forth in the Geotechnical Report. Safe stabilization for all slopes, regardless of the type of rock or soil conditions, shall be guaranteed including protection of all personnel and structures against any damage from cave-ins, heaving, or other earth movements.

Structural fill lifts shall not exceed a thickness of 8 inches. Other fill lifts shall not exceed a thickness of 12 inches.

Wind Turbine Foundation embedment depth shall consider final height requirements for the applicable Wind Turbine's FAA DNH letter.

Seller shall provide for the inspection and testing of all load-bearing surfaces (foundations, slabs, roadways, trench bottom, etc.) by qualified, experienced, properly licensed independent inspectors.

Adequate streamside vegetation buffers should be established based on project needs and site-specific conditions identified in the US Army Corps of Engineers Jurisdictional Determination of wetlands and waters of the US. If a streamside buffer cannot be feasibly established, adequate BMPs should be utilized for soil stabilization. Refer to Appendix 12 for additional requirements.

Seller shall protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations, soil conditions, or Environmental conditions. Seller shall provide erosion-control measures in accordance with the approved Storm Water Pollution Prevention Plan (SWPPP) for the Project to prevent or mitigate erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties, including roads, walkways, waterways, and wetlands.

3.2.5 Construction Materials

All materials shall be new, of good quality, and capable of withstanding the environmental and subsoil conditions they will be exposed to during the life span of the Project without any significant decrease in serviceability or strength. All construction materials shall be in accordance with the Requirements, including the latest version of the codes and standards, as per Section 1.3 of this Scope Book.

3.2.6 Drainage and Stormwater Management

Seller shall be responsible for developing, constructing, and maintaining through the Substantial Completion Date a Project Site stormwater management plan that meets all Requirements, including Laws and applicable Permits. Seller shall conduct a topographical survey to define the general drainage for the Project Site and shall use the survey as a basis for the design of the Project Site stormwater management plan. Seller shall complete and submit all necessary permitting applications, including stormwater discharge NPDES Permit applications, to the appropriate Governmental Authorities. The stormwater management plan, the Work, and the Project shall comply with all such Permits.

Seller shall develop, design, engineer, and construct an adequate drainage system, including any necessary inlets, pipes, culverts, channels, manholes, stormwater swales, surface flow, outlets, or other components for collecting, directing, and disposing of storm water from the Project Site. All permanent drainage facilities, including culverts, low-water crossings, ditches, and swales, shall be designed and constructed to withstand a 20-year, 24-hour storm event. A clear path for the collected stormwater out of the Project Site shall be provided, without flooding, while complying with all Laws (including codes and standards) and permits. All drainage shall be away from buildings and foundations.

Stormwater runoff shall replicate existing pre-development stormwater runoff to the greatest extent possible. Any contaminated runoff shall be segregated and detained separately in strict accordance with all Laws and applicable Permits. Permanent stormwater drainage systems shall be designed to carry the storm return period as required by all Laws.

Underground piping and culverts shall be corrugated metal pipe (CMP), reinforced concrete pipe (RCP) or corrugated, dual wall, high density polyethylene pipe (HDPE). The hydraulic grade line for the storm water pipeline system shall be as required by all Laws and applicable Permits. Ditches shall be lined with vegetation, rip-rap, and/or concrete, as applicable, based on the water velocity.

All areas not drained via a stormwater drainage system shall be drained via an open ditch system consisting of trapezoidal ditches with culverts or grating at road crossings or, where slope can be achieved, sheet flow.

Culverts or low-water crossings shall be installed / constructed where required to pass existing storm water concentrated flows. Culvert pipe ends, swales, and ditches shall be designed and constructed to control concentrated flow velocities and minimize erosion and siltation. Only culverts shall be used at entrances; low-water crossings are not allowed at entrances. When culverts are utilized, the culvert inlets and outlets shall be provided with end sections and permanent erosion protection.

Roadway cross sections shall be shaped to move water away from the road, such as crowning or cross-slopes, and roads shall be designed and constructed to prevent water ponding. Roads shall have no more than two percent (2%) crown / side slope, unless such roads will be utilized as crane paths, in which case the maximum crown / side slope shall be one percent (1%). All roadways, including shoulders, shall be graded to self-drain and must not allow water to puddle and all roadways shall have a minimum crown / side slope of one percent (1%) to promote drainage.

Storm water shall not channel flow across constructed roads and a self-draining ditch shall be construed on the high (cut) side of roadways. Sheet flows shall be collected and conveyed to culverts or channels to safely pass storm water flows.

Areas of the Project Site not included in or affected by the Project shall be left in their existing condition. Controls shall be provided to protect the water quality and shall be in accordance with all Requirements, including applicable laws, applicable permits, and the SWPPP. All storm water flows shall be returned to their original drainage patterns and the Project shall not increase flow rates from their historic levels.

Wetlands impacts shall be avoided to the maximum extent practicable and are subject to regulatory approval or other applicable Requirements.

3.2.7 Erosion Control

An erosion and sediment control plan shall be developed by Seller’s licensed professional engineer in conjunction with the SWPPP for the construction phase of the Project. During Project construction, erosion and sediment control measures shall be implemented to prevent sediment-laden runoff from leaving the Project Site and to control the erosion of embankments, temporary and final exposed slopes, and temporary stockpiles, as well to protect water quality as applicable. Construction runoff shall be directed to the erosion and sediment control systems prior to leaving the Project Site. The plan shall include, at minimum, the incorporation of silt fencing, silt bags, straw bale dikes, storm inlet protection, sediment basins, swales, piping, stream crossings, check dams, straw mulch, pre-manufactured geotextiles, geotubes, geogrids, cellular geoweb, and other measures as required or appropriate to promote sediment and erosion control as prescribed in the approved plan and/or by periodic inspection by the local soil conservation district. Silt bags or reasonable equivalent shall be included as necessary when dewatering excavations to prevent sediment from collecting in the storm water system (e.g., Seller shall not pump silt laden water through the storm water system without proper filtration).

Synthetic, toxic, or otherwise harmful erosion-control materials shall be made inaccessible to livestock on or adjacent to the Project Site during the construction period.

3.2.8 Miscellaneous Equipment Foundations

Foundations shall be designed, constructed, and completed to consider the site climatic conditions (heat, cold, rain, earthquake, ice, and wind), soil conditions, and thermal loads caused by expected fluctuations of materials and ambient temperatures.

Foundations shall be elevated from the ground to prevent any equipment or systems from contact with surface water or runoff. The minimum height (reveal) of the above-ground portion of any such foundation (measured from the top of ground level to top of concrete) shall be at least six (6) inches. However, if the hydrology study shows water levels above the top of concrete, then the top of concrete shall be raised to ensure that the minimum height exceeds the maximum anticipated water level.

3.2.9 Wind Turbine Foundations

Wind Turbine Foundations shall be constructed at each approved Wind Turbine location. The design working life of the Wind Turbine Foundations shall be a minimum of 30 years.

Wind Turbine Foundation design as per the Requirements and Turbine Supplier's provided parameters in accordance with local, national, and international standards. Wind Turbine Foundations shall be reinforced concrete designed in accordance with Turbine Supplier Project Site Requirements; ASCE/AWEA RP2011 "Recommended Practice for Compliance of Large Land-based Wind Turbine Support Structures"; ACI 318; and other relevant Applicable Standards and Requirements.

Wind Turbine Foundations shall be designed in accordance with Turbine Supplier design parameters by approved contractor and peer reviewed. Wind Turbine Foundations shall be conventional spread footing / gravity-type foundations. No alternate Wind Turbine Foundation type, including P&H or rock anchor, shall be utilized without Buyer approval.

Wind Turbine Foundations shall, at a minimum, be designed using the final geotechnical and hydrological engineering report, including allowable soil bearing pressure values determined by geotechnical investigation from soil borings at each specific Wind Turbine site and equipment loads provided by the Turbine Supplier. Seller shall furnish and install the subgrade improvements set forth in the Geotechnical Report, including overexcavations, geopiers, and subgrade densification as described therein.

Wind Turbine Foundations shall not be constructed until (a) the Wind Turbine Foundation drawings and calculations have been approved by Buyer, including its independent engineer; and (b) until pre-determined hold points have been approved by Buyer, including inspection of rebar placement prior to pouring concrete.

Wind Turbine Foundations shall include a grounding grid as per Turbine Supplier recommendation and local, national, and international standards, including NESC. The design and construction of the grounding system in such foundations shall meet or include the following requirements, at a minimum: (a) Turbine Supplier Project Site Requirements; (b) incorporate the recommendations, values, and minimum requirements set forth in the Geotechnical Report; (c) installation of adequate ground for personnel safety, including touch and step potentials (to be demonstrated by Seller via calculations in the grounding study); (d) incorporate local resistivity measurements; and (e) a ground resistance <= 10 ohms.

Wind Turbine Foundations shall be designed to have adequate stiffness to comply with the Turbine Supplier requirements.

Seller shall provide all necessary dewatering of the Wind Turbine Foundation excavation.

Each Wind Turbine Foundation shall include at least two (2) thermocouples for concrete temperature monitoring, including one at the center and one near the outer surface.

Wind Turbine Foundation gapping is prohibited without Buyer and Turbine Supplier approval.

Wind Turbine Foundation anchor bolts shall have a minimum projection as recommended by Turbine Supplier, or two (2) anchor bolt diameters beyond the tightened anchor nuts, whichever is greater. Anchor bolts not meeting this requirement may be rejected by Buyer.

The area surrounding the Wind Turbine Foundation shall be constructed with a grade of two percent (2%) sloping away from the Wind Turbine Foundation for the greater of (a) 25 feet from the edge of the pedestal or (b) the distance calculated as 1 foot from the bottom outer edge of the base plus the distance to the surface at a slope of 1H:2V from the bottom of the excavation.

Following Wind Turbine installation, a gravel ring (i.e., “beauty ring”) shall be installed around the perimeter of each Wind Turbine location, at a minimum distance of twenty (20) feet beyond the Wind Turbine tower wall and Wind Turbine tower stairs in all directions. Each beauty ring shall be installed after the applicable Wind Turbine is installed and after the removal (including decompaction) of the Wind Turbine Pad at such location.

Each beauty ring (a) shall have an identical cross section as the Wind Turbine access roads (i.e., same thickness, same surfacing material); (b) shall be shaped to move water away from the Wind Turbine and pad-mount transformer (if any); and (c) shall be constructed to prevent water ponding.

3.2.9.1 Wind Turbine Pads

A Wind Turbine Pad shall be constructed at every Wind Turbine Foundation location and in accordance with the Project design/layout drawings.

Wind Turbine Pads shall be sufficient in size to allow for simultaneous offloading, storage, and assembly of all Wind Turbine components, including, but not limited to, rotor, nacelle, blades, and tower sections.

Wind Turbine Pads shall comply with the Turbine Supplier Project Site Requirements.

Wind Turbine Pads shall be cleared of brush, boulders, and other debris around each Wind Turbine Foundation, up to the pad limits, and shall be continually maintained during construction and operational period to ensure a safe working environment.

The grade of each Wind Turbine Pad shall be as specified by the Turbine Supplier and crane contractor, not to exceed two percent (2%) grade.

Wind Turbine Pads shall have a graveled surface with sub-grade cleared and compacted to at least ninety-five percent (95%) of the maximum density within the moisture content of two percent (2%) below optimum to two percent (2%) above optimum, as determined by ASTM Standard D698, unless a higher level of compaction is required by the geotechnical engineering report.

Crane pads shall be designed and constructed to allow for use of cranes in ongoing Wind Turbine maintenance activities following construction (e.g., cranes required for gearbox removal and / or installation).

3.2.10 Corrosion Protection

Seller shall be aware of and take into account the corrosion potential to be encountered on the Project Site, especially with outdoor equipment. Seller shall provide corrosion protection for concrete and steel structures and components.

3.2.11 Roads

Seller shall design, furnish, construct, and install all roads, including access roads and spur roads, temporary turnarounds, intersection/radius improvements, crane paths, and transitions to/from existing roads in conformance with the minimum requirements set forth herein and in accordance with the requirements of Law and applicable Permits. The design conditions stated herein are minimums and any roadways that are planned to, or would reasonably be expected to, carry equipment and vehicle loads or traffic repetitions in excess of these minimum design conditions shall be designed to meet such planned or reasonably expected use. Roads shall be designed, constructed, and maintained adequately to support all anticipated construction loads, equipment delivery (including Wind Turbines and other Buyer-Supplied Equipment), crane crawling, construction traffic usage (including concrete trucks), and weather conditions to be expected. New roadway lanes shall be as per the Turbine Supplier, crane requirements, and transportation studies requirements in regard to camber, slope, curvature (radii), and load carrying capacity. This should include passing locations and turning points as per the layout drawings. Seller shall be responsible for checking any possible limitations on the transportation of sensitive material, heavy equipment, or other items to be delivered to the Project Site or use of vehicles or other modes of transportation due to the loading capacities and clearances of existing bridges and roads linking the roads, waterways, or other places to the Project Site.

Vertical clearances above roadways for transmission lines shall be at least twenty (20) feet unless additional clearances are required for special equipment access or other design requirements.

3.2.11.1 Site Roads

Access roads shall include a road to each Wind Turbine, permanent meteorological tower, Project Substation, O&M Building, and along the route of the Interconnection Line, at a minimum.

Wind Turbine spur roads shall have a minimum turning radius of 25 feet from other roads at final construction, or as determined by Turbine Supplier, whichever is greater.

Roads shall be a minimum of 16 feet wide (or wider if required by the Turbine Supplier Project Site Requirements), except for meteorological tower roads which shall only be 12 feet wide. Where crane walks are to be utilized, roads shall have a minimum 10-foot temporary compacted earthen shoulder on each side. Roads shall be widened through turns and curves, as necessary.

Roads shall be covered with at least six (6) inches of aggregate over a compacted subgrade, including geotextile fabric (or equivalent) as required. The maximum aggregate size shall not exceed two (2) inches, shall include appropriate fines, and shall conform to local department of transportation requirements. The subgrade shall be cleared and compacted to at least ninety-five percent (95%) of the maximum density within the moisture content of two percent (2%) below optimum to two percent (2%) above optimum, as determined by ASTM Standard D698.

Roads shall be designed and constructed with a maximum grade of eight percent (8%). Approaches to Wind Turbine Pads from access / spur roads shall be designed and constructed sufficiently level to allow transport vehicles, including Wind Turbine transport vehicles, to park on a flat surface during offloading.

Roads shall meet all required design elements at Substantial Completion (as defined in the Agreement). For the avoidance of doubt, this shall include replenishing road aggregate, repairing road damage, repairing subgrade damage, and other loss of strength or stability that may have occurred during the course of construction.

3.2.11.2 Road Crossings

All access road crossings, including public roads, railroad, pipeline, utilities, and property lines, shall be as close to ninety degrees (90°) as reasonably practicable. All access road crossings of buried facilities (e.g., pipeline, utility line) shall maintain at least 36 inches of cover.

All access road crossings of buried facilities (e.g., pipeline, utility line) shall be marked on each side with an above-ground cable marker, each meeting the requirements set forth herein.

Seller shall coordinate with local utilities and pipeline companies as set forth herein.

3.2.11.3 Public Roads

Seller shall design, furnish, construct, and install all public road improvements including upgrading and maintaining any public roads, bridges, and culverts as specified therein.

Seller shall maintain graveled public roads within the Site boundary throughout construction of the Project, including dust control, washboard removal, and pothole removal.

Seller shall, prior to mobilization to the Project Site, digitally video and document the condition of existing public roads to quantify the extent of any Seller-caused wear and tear.

3.2.12 Fencing and Gates

Seller shall furnish and install all required fencing for the Project, including perimeter fencing around any temporary equipment that will be left at Closing.

The Seller shall ensure there are no ground gaps greater than two inches and the fence is secure. If permits require specialty fencing for wildlife or species concerns, fencing shall comply with recommendations and/or requirements from permitting. All fence posts shall be anchored using concrete. All posts, rails, fabric, wire, and gates, including for the Project O&M Building, and meteorological towers (including guy wires, if applicable) shall be galvanized in accordance with ASTM A392. All permanent fencing shall be appropriately grounded.

Unless stated otherwise, permanent fencing shall be 8-foot-high (7-foot fence plus 1-foot barbed wire), anti-climb, chain link, perimeter fencing with 2-inch diamond mesh. Fencing fabric / slats are not required.

Seller shall design primary gate to collector substation and O&M building to include Buyer-approved gate operator including on-board power and local solar power cell with safety and loops (obstruction and exit) installed. Seller shall install conduit and wiring and fiber to support power of gate, external card reader (egress and ingress), pin pad access control, and camera installation. This is to include NEMA enclosure that includes a four-plex outlet and fiber. NEMA enclosure to measure.

All gates may be swing style excluding gates at the O&M structure. All other gates shall be secured with a high security chain and a high security padlock. Each permanent gate shall be a double-hung, prefabricated, finished metal gate; each such gate shall be a minimum 20-feet-wide with a pipe frame and manufacturer’s standard coating finish, complete with hinges and latching hardware, and lockable via lag bolt. Fencepost for gates and transitions/pull fencepost shall be steel and concrete poured (embedded). Fence posts may be pile driven.

Safe step and touch potential of the fencing shall be verified by an IEEE 80 compliant grounding study.

Seller shall furnish and install a gate or cattleguard as appropriate at every location where a roadway penetrates an existing fence line at the Project Site.

Gate widths shall be consistent with road widths, wherein all gate posts shall be set outside of the road width area. Sufficient space and graded area shall be provided near each gate to allow truck turning.

All gates shall adequately contain livestock without being pushed open, bending, or otherwise failing, and all gates shall adequately prevent opening due to wind conditions expected at the Project Site.

Cattle guards shall (a) cover the full road width; (b) be installed level; and (c) be provided with a stable base capable of sustaining heavy loads without shifting or settling.

Each temporary gate shall match the existing fence materials, and the existing fencing shall be reestablished at the end of construction activities.

3.2.13 Signage

All necessary safety signs and warnings described in ANSI Z535-2002 (entire series from Z535.1 through Z535.6) shall be included on Project Site fencing and each enclosure and any other buildings at the Project Site. All necessary signs and warnings for identification of Hazardous Substances as described in NFPA 704 shall be included on the fencing, each building, and any other enclosure at the Project Site.

Seller shall furnish, install, and maintain throughout the performance of the Work all signage required by the Applicable Permits, the Applicable Standards, and other applicable Requirements. All signage and equipment marking (including numbering and labeling) shall be approved by Buyer prior to installation.

Seller shall furnish and install (a) a permanent sign at each Wind Turbine listing the name of the Wind Turbine; (b) a permanent sign at each Wind Turbine string road listing the name(s) of all Wind Turbine(s) along that road; and (c) identification numbers and permanent, weatherproof labels on the base of all Wind Turbine towers, indicating Buyer tower number and Collection System Circuit number, respectively.

Seller shall furnish and install identification numbers and permanent, weatherproof labels on all Interconnection Line structures.

Seller shall furnish, install, and maintain above-ground "buried cable" marker signs (a) at all locations where an underground Collection System Circuit crosses a road, fence, or underground utility respectively; (b) at a minimum of every 1,000 feet of trench length; and (c) at all sharp turns in the Collection System Circuits.

Seller shall furnish and install "no trespassing" signs at access road entry points and permanent speed limit signs at intervals of no greater than two (2) miles along all Project access roads.

Seller shall, prior to the start of construction activities, measure the height of all overhead power lines or obstructions at the Project Site. Seller shall furnish, install, and maintain signage at each such crossing and incorporate any measures necessary to operate, move, and mobilize cranes and other equipment to ensure safe passage with adequate clearance.

Seller shall furnish, install, and maintain signage as needed for blind corners, dips, trucks entering roadways, restricted areas, and other potential hazards. Seller shall also furnish, install, and maintain danger signs, signals, lights, guard rails, reflectors on curves, and notices as may be necessary to adequately protect the Work and personnel of any company at the Project Site, including visitors, against injury or property damage. All such signage shall be installed prior to commencing construction activities.

Seller shall furnish, install, and maintain signage as needed to provide reasonable information and direction to Project Site personnel and to facilitate orderly entrance and egress from the Project Site. Seller shall also furnish, install, and maintain signage identifying personnel assembly locations for use during emergencies or Project Site evacuations.

Seller shall furnish and install emergency response (E-911) address signs in accordance with local authorities.

Seller shall uninstall, remove, and discard of all temporary signage at the completion of the Work, or as otherwise prescribed in the Applicable Permits. Temporary signage shall be legible and of sufficient durability to last the duration of construction activities.

3.2.14 Parking and Access at the Project Site

Seller shall be responsible for assuring that parking areas are included next to the O&M structure or as required for the Project based on Seller's final design. The quantity of parking spaces shall be sufficient for six vehicles plus one space per 20 Wind Turbines.

Seller shall be responsible for ensuring that adequate parking is available for Project construction and commissioning staff and parking and access areas are sufficient for all construction and commissioning activities, including lifting of heavy loads.

3.2.15 Buildings

Buildings on the Project Site shall be designed in accordance with the requirements of all Laws and applicable Permits. Construction materials used in Project buildings and enclosures shall meet the definition of non-combustible or limited combustible, except roof coverings, which shall be Class A in accordance with standard methods of fire tests of roof coverings. Metal roof deck construction, where used, shall be “Class 1” or “fire classified.” The local fire protection and NFPA rules and recommendations shall be followed for the fire safety design and fire protection systems. The Collector Substation Control House is specified in Appendix 1.

Seller shall provide an option to erect the Operations and Maintenance building for the project. The O&M structure and requirements are specified in Appendix 13.

Particular attention shall be focused on sloping floors and roofs and adding drains around equipment to preclude any pooling of water and flashing to preclude water penetration inside the building.

Seller shall ensure that fire-rated seals in all openings and penetrations in all rated barriers for the Project are supplied and incorporated into the Project and that the fire-rating of such seals are commensurate with the fire rating of the barrier.

Seller shall provide and incorporate noncombustible or fire-rated sealing materials for all cable penetrations entering from below a raised electrical structure at the Project Site (Power Distribution Center, MCC Enclosure, etc.).

An adequately designed HVAC system that considers the specific needs of every room and the climatic conditions set forth in Section 1.2.2 shall be installed.

3.2.16 Structures

All buildings, support structures, foundations (including Wind Turbine Foundations), and equipment pads shall be constructed on competent material. All loose materials shall be removed from excavation bottoms. Unsatisfactory foundation subgrade material shall be removed and replaced with compacted structural fill material or with suitable concrete.

Foundation designs shall neglect or degrade soil strength properties at the top of the foundation as a result of frost or disturbance during drilling per recommendations of the geotechnical engineer. All foundations shall be designed with consultation of a licensed geotechnical engineer.

All foundations and slabs-on-grade shall have a minimum projection (reveal) of 6 inches above ground level, except that concrete pier-type foundations shall have a minimum projection of 12 inches of concrete above ground level.

3.2.17 Concrete

Concrete for Wind Turbine Foundations shall have a minimum specified compressive strength of 5,000 psi and any other structural concrete shall have a minimum specified compressive strength of 4,500 psi. Non-structural concrete shall have a minimum specified compressive strength of 2,000 psi.

Concrete mix designs and concrete placement procedures shall be approved by Buyer prior to use; see herein for mix design requirements.

Concrete testing:

- Prepare concrete test cylinders conforming to ASTM C31 prior to the first pour of each day and at a rate of not less than one set of cylinders for each 100 cubic yards or fraction thereof and not less than one set for each foundation or structure.
- Field slump tests in accordance with ASTM C143 shall be performed, at a minimum, prior to the first batch of concrete placed each day and with each set of test cylinders. Adjustment or fixing of concrete in situ shall not be allowed.
- Air content, concrete temperature, and air temperature tests shall be performed for the first batch of each day and with each set of test cylinders. All testing shall be done in accordance with the requirements of ASTM C231 (air) and ASTM C1064 (temperature).
- Electronic copies of concrete test reports shall be provided to Buyer within 72 hours of testing but not less than 24 hours in advance of commencing Wind Turbine erection activities at the relevant Wind Turbine location. In the event of failure of any concrete test, Buyer shall be immediately notified, and a repair/remediation plan shall be provided.

3.2.18 Testing & Quality Control

Seller shall inspect and test each roadway, except for public roads, in accordance with the following minimum requirements. All testing shall be performed by an independent, experienced third party.

All roadways and compacted areas shall be tested to demonstrate they meet stated design criteria and are fit for purpose.

Testing standards: (a) maximum dry density and optimum moisture content per ASTM D698 or ASTM D1557; (b) in-place density by nuclear methods (shallow) per ASTM D2922; (c) aggregate sampling per ASTM D75; (d) sieve analysis of fine and coarse aggregates per ASTM C136; (e) sand equivalent value per ASTM D2419; and (f) liquid limit, plasticity limit, and plasticity index per ASTM D4318.

Fill material / embankments: (a) proof roll over entire length; (b) grain size analysis, moisture content, Atterberg limits on fines contents, and standard proctor test on each material type; (c) if proof roll fails, moisture density test at 4 per lift or every 1,000 feet of road, whichever is greater; and (d) DCP test at any location where moisture density testing fails. The civil engineer of record shall specify passing criteria for the DCP test (e.g., minimum blows per 6 inches).

Compacted subgrade: (a) proof roll over entire length prior to placement of aggregate base; (b) moisture density test every 1,000 feet or 3 per road, whichever is greater; and (c) DCP test (recorded to a minimum depth of 2 feet) at any location where moisture density testing fails. The civil engineer of record shall specify passing criteria for the DCP test (e.g., minimum blows per 6 inches).

Aggregate base: (a) proof roll over entire length; (b) DCP test (recorded to a minimum depth of 2 feet) every 1,000 feet or minimum 3 per road, whichever is greater; (c) sieve analysis, liquid limit, and plasticity index every 2,500 cubic yards; and (d) wet ball mill test every 5,000 cubic yards. The civil engineer of record shall specify passing criteria for the DCP test (e.g., minimum blows per 6 inches).

Crane paths (including shoulders): proof roll over entire length.

Seller shall complete a test run for Wind Turbine deliveries at the Project Site by use of non-loaded trucks to demonstrate that road dimensions will be appropriate for successfully delivering components from the Project Site entrance (to be defined by Buyer) to the Wind Turbine Pads in the most critical points in terms of access. Such trial run(s) shall be completed prior to commencing deliveries of Wind Turbine equipment to the Project Site, and shall be coordinated between Turbine Supplier, Buyer, and Buyer’s contractors.

Seller shall inspect and test each Wind Turbine Foundation in conformance with the following minimum requirements. All testing shall be performed by an independent, experienced third party.

All Wind Turbine Foundations shall be tested to demonstrate they meet stated design criteria and are fit for purpose.

Certification of integrity of Wind Turbine Foundation sub-base, including verification that conditions within excavation align with expected / design conditions and all information required in Foundation Inspection Report (as defined herein); the Foundation Inspection Report, including all accompanying documentation, shall be completed prior to placement of the mud mat.

Compacted subgrade (all performed prior to placement of mud mat): (a) proof roll over entire length; (b) soil probe or shallow hand auger probes to determine presence of unsuitable soils below the surface, to aid in classifying soils, and to make comparisons of exposed soils to those available in the Geotechnical Report; and (c) static cone penetrometer ("SCP") tests on cohesive soils and dynamic cone penetrometer ("DCP") tests on cohesionless soils to verify against requirements in the Geotechnical Report, including one test at the center at the Wind Turbine Foundation and one test in each quadrant (five total). The foundation engineer of record shall specify passing criteria for the SCP/DCP test (e.g., minimum blows per 6 inches).

Concrete / grout strength and properties, including break tests, grout cubes, slump, air, and temperature, each at the minimum frequencies specified herein.

Random tension test of at least 10 percent (10%) of anchor bolts on each Wind Turbine Foundation. If any bolts do not meet the required tension value, all bolts on such Wind Turbine shall be re-tensioned and the 10-percent check repeated until all tests pass.

Seller shall inspect and test each Wind Turbine Pad (including Wind Turbine Foundation backfill as applicable) in conformance with the following minimum requirements. All testing shall be performed by an independent, experienced third party.

All Wind Turbine Pads shall be tested to demonstrate they meet stated design criteria and are fit for purpose.

Structural fill below Wind Turbine Foundation: (a) two (2) unit weight tests per lift and (b) two (2) moisture density compaction tests per lift.

Common fill around Wind Turbines / Wind Turbine Pads (including backfill for Wind Turbine Foundations): (a) for every 2,500 cubic yards of fill placed and at least one set per Wind Turbine location, provide (i) grain size analysis per ASTM D422; (ii) moisture content per ASTM D2216; and (iii) standard proctor maximum dry density per ASTM D698; and (b) for each fill lift at each Wind Turbine Foundation backfill location, provide density test per ASTM D6938, including test location, dry density, and moisture content for each test.

All Wind Turbine Pads shall be proof-rolled over the entire length.

Wind Turbine Foundation concrete temperature monitoring results (to be furnished to Buyer within 72 hours of concrete placement).

Seller shall notify Buyer of all testing schedules at least 30 days in advance of testing activities and copies of testing reports (including a summary of testing procedures and acceptance criteria) shall be submitted to Buyer within 10 days of completing such test. Notwithstanding the preceding requirements, a copy of test results for each Wind Turbine Foundation shall be provided to Buyer prior to erection of the applicable Wind Turbine.

3.3 Collection System Circuits

3.3.1 General Requirements

Protective relaying, metering, and controls for all electrical equipment shall be according to industry standard metering and relaying, including North America Electric Reliability Corporation (NERC) compliance, applicable codes and standards, and other requirements of the performance standard. Dynamically operated reactive compensation devices may be used to meet the power factor at the Electric Interconnection Point according to the GIA.

All cables shall be halogen-free, fire-retardant, and self-extinguishing, with cross linked polyethylene (XLPE) insulation where required. For buried cable, anti-rodent additives shall be included for cable protection. In lieu of anti-rodent cabling, other rodent mitigations may be allowed pending Buyer approval.

All cable (regardless of voltage level and use) shall have a fire-retardant jacket and shall have successfully passed the appropriate (IEEE, American Society for Testing Materials [ASTM], or Underwriters Laboratories [UL]) flame-spread and smoke-generated test for the class, voltage rating, and size of the specific cable.

Transformers shall employ an environmentally friendly oil that has a higher flash point than regular oil (e.g., Cargill Envirotemp 360 fluid).

Seller shall relocate, drop and reterminate, or cross power lines as needed and as appropriate to complete the Work, with prior approval of the appropriate authority(ies). Seller shall be responsible for obtaining and maintaining any necessary permits and / or easements, equipment, and labor for such work.

Seller shall design and construct the Project such that the total annual energy losses for Project Site-specific wind distribution data, measured between the generator leads of each Wind Turbine and the Electric Interconnection Point shall not exceed 2.5 percent (2.5%) (the "Electrical Loss Limit"). For the avoidance of doubt, this shall include all medium-voltage transformers, Wind Turbine cabling, Collection System Circuit cabling, substation main power step-up transformer(s), and the Interconnection Line(s) up to the Electric Interconnection Point.

Seller shall design and construct the Collection System Circuits in accordance with the Collection System Electrical Studies, as defined herein.

All Collection System Circuits shall be installed underground.

Access to the Collection System Circuits shall be from existing roads or new access roads within the permitted area. Exact Collection System Circuit routing shall be determined, however, the preferred routing shall be to parallel the access roads and crane paths as much as possible, so long as such routing does not increase the required number of crane breakdowns. When not practical or efficient to parallel the access roads, the Collection System Circuit shall be routed in a straight line, shortest distance as much as possible.

All Collection System Circuit backfill, including splice pits (if used), shall be compacted to a minimum of 85 percent (85%) of standard proctor density, unless otherwise noted on the design drawings. For the avoidance of doubt, collection backfill at Wind Turbine Foundations, near junction boxes, and access road crossings shall be compacted to ninety-five percent (95%) as noted elsewhere herein.

3.3.2 Collection System Cabling

All Collection System Circuit power cabling shall be 34.5-kV AC, three (3)-phase, 60 Hertz.

Jacketed, single-conductor, appropriately-sized concentric neutral, insulated medium-voltage underground distribution power cable shall be used. All underground Collection System Circuit power cabling shall be supplied with a minimum of 100 percent (100%) insulation that meets or exceeds all requirements of applicable AEIC, IEEE, ICEA, NEMA, and UL standards. All Collection System Circuit cables shall be UL listed.

Collection System Circuits shall be of a discharge-free design and suitable for direct burial, installation in duct and exposure to sunlight on an alternating current, three-phase, 34.5-kV nominal, 60-Hertz power system.

All central conductors shall be Class B stranded. No more than one (1) conductor per cable shall be allowed. Conductor material shall be aluminum or copper. Allowable conductor sizes are 1/0 AWG through 1500 kcmil.

Cable ampacity shall not exceed 95 percent of the rated value, based on Project Site-specific thermal resistivity and in consideration of all external heat sources. Ampacity shall be calculated assuming the soil around the cable within the trench is dried out to zero percent (0%) moisture content and that soil above the cable within the trench is at two percent (2%) moisture content.

Notwithstanding the requirements for cable crossings in Section 3.3.4 herein, all underground Collection System Circuit cabling shall be direct buried at a depth of at least 42 inches below grade.

A sufficient amount of cable slack shall be provided to allow installation of elbows and termination of the cables to the appropriate junction box and/or Wind Turbine switchgear terminal and permit ready disconnection of the elbows and mounting on the parking stands. For the avoidance of doubt, such slack shall allow for the installation / service disconnection of connectors, dead breaks, and other similar devices.

Excess slack shall be provided to allow re-termination in the event of failure. The excess slack at each Wind Turbine location shall be in the form of a maintenance loop. At least 25 feet of excess cable shall be provided at each Wind Turbine such that the cables may be re-terminated if needed following installation.

All Collection System Circuit power cabling shall be provided with terminators and labels. Labels shall be permanently attached at both ends. Labels shall be sequentially numbered.

Collection System Circuits shall be designed to minimize the use of cable splices. Underground splices, if used, shall be protected by a splice box and identified using GPS-located marker balls, and splices shall only be performed by a skilled, qualified craft worker who shall receive training at the Project Site from the splice kit manufacturer prior to performing splices; the coordinates of each splice shall be recorded and noted within the As-Built Drawings. Splicing of different cable types, splices between Wind Turbines (except at directional boring locations), and “dutchman” cable splices are each strictly prohibited.

Excessive bending of cabling shall be avoided, and the manufacturer maximum recommended bending radius shall not be exceeded.

Minimum BIL voltage rating for 35 kV rated Collection System equipment: 200 kV.

Only Wind Turbines from the same manufacturer shall be installed on a circuit (i.e., all Siemens Gamesa Wind Turbines shall be on the same circuit(s) and all GE Turbines shall be on the same circuit(s); no GE Wind Turbines shall be on a Siemens Gamesa circuit or vice versa).

3.3.3 Trenches

All Collection System Circuits shall be installed via trenching; plowing is not permitted unless explicitly approved by Buyer and excavation by blasting for the Collection System Circuits is strictly prohibited. Trench widths shall be kept to a minimum to allow sufficient space for equipment installation. The trench bottom shall be firm for the entire length and width. Trenches shall be kept free from water. Conduit and cable shall not be placed on frozen ground.

Bedding and/or backfill material shall be installed around all buried Collection System Circuits to provide physical and/or thermal protection for buried cable. All trench bedding and/or backfill materials shall be screened and visually inspected for materials in excess of two (2) inches, with any backfill within 12 inches of cable being free of sharp objects, rocks, and other debris larger than 0.5 inches. All bedding and/or backfill material shall be composed of materials that are native to the Project Site. Such materials shall be free of debris, roots, organic matter, frozen matter, coal, ashes or cinders.

3.3.4 Cable Crossings

Seller shall perform directional boring at all Collection System Circuit crossings with a stream, wetland, public road, railroad, pipeline, or other buried facility.

All Collection System Circuit (a) railroad crossings shall be buried at a depth of at least 120 inches below the railroad; (b) public road crossings shall be buried at a depth of at least 60 inches below the road, including the ditch(es) on either side; (c) wetland and stream crossings shall be buried at a depth of at least 60 inches below the steam bottom; and (d) utility and pipeline crossings shall be buried at a depth of at least 48 inches below the existing utility or pipeline. All other Collection System Circuit crossings shall be buried at a depth of at least 48 inches below the applicable infrastructure. All Collection System Circuit crossings shall be installed in conduit as more particularly described in Section 3.3.16 below.

All crossings, including public road, railroad, pipeline, utility crossings, property lines, wetlands, and streams, shall be marked on each side with buried marker balls and above-ground cable markers, each meeting the requirements in Section 3.3.5 below.

Seller shall coordinate with local utilities and pipeline companies as set forth herein.

3.3.5 Markers

Cable marking tape shall be furnished and installed in all trenches. Such tape shall be red, metallic, and detectable. Marking tape shall be placed 12 to 18 inches above cable.

GPS-located marker balls shall be placed within all cable trench at the following: (a) each side of crossings / directional bore locations; (b) each above-ground cable marker location; (c) every splice location; (d) all 90-degree turns in a Collection System Circuit; and (e) minimum of every 1,000 feet of trench length.

Above-ground cable markers shall be a Curv-Flex marker or equivalent and shall include a decal warning of buried cable and other Buyer-approved details.

3.3.6 Fiber Optic Cabling

Fiber optic cable shall be installed in the same trench as the Collection System Circuit power cabling.

When fiber cables are installed in a trench, the fiber cable shall be placed in conduit or continuous innerduct; the fiber cable shall be rated for underground use; and there shall be a suitable locating cable installed in the innerduct/conduit. Innerduct shall have a minimum diameter of 1.25 inches. Fiber optic shall be separated from any power cables when co-located in a trench.

All fiber cables shall consist of a minimum of 12-strand multi/single mode fiber, except that the fiber run between the Project Substation and O&M Building shall be a minimum of 48-strand. All fiber runs greater than one (1) mile in length shall be single-mode fiber, or as otherwise required to maintain a minimum of at least one (1) gigabyte bandwidth throughout the backbone of the system.

If metallic armored fiber optic cable is used, protection from induced voltage shall be installed.

All fiber cables shall be designed with a minimum of fifty percent (50%) spare fiber.

Excess slack shall be provided to allow re-termination in the event of failure. At least 60 feet of excess cable shall be provided at each pull box such that the cables may be re-terminated if needed following installation. Terminations shall be completed with either an approved fiber optic pigtail kit or with approved mechanical connectors and an approved fanout kit.

All communications cables, including fiber cables, shall be appropriately labeled with a permanently-attached label at both ends. Labels shall be sequentially numbered.

The fiber system shall be designed for a minimum of five (5) dB system margin.

The fiber system design shall be a fiber ring topology or a “daisy-chained” system.

Conduits for fiber entry into the Wind Turbine areas shall include a pull string for pulling the cable.

Fiber cables may be routed through Project Substation control cable trenches with other control wiring provided that a high-visibility color innerduct is used for identification and protection of the fiber cables.

Seller shall complete all fiber optic terminations, including, but not limited to, those at the O&M Building, Project Substation, permanent meteorological towers, and in the base of each Wind Turbine at the fiber patch panels.

All splices shall be fusion splices. Other types of splices are subject to Buyer approval.

Maximum attenuation: (a) 0.35 dB/km at 1310 nm and (b) 0.25 dB/km at 1550 nm.

Data collection loops shall be designed so that a loss of a power circuit does not cause a loss of data collection from the Wind Turbines during the power outage.

3.3.7 Junction Boxes

Junction boxes shall meet the requirements of ANSI C57.12.28, including water resistance.

Junction boxes shall be stainless steel or fiberglass.

Junction boxes shall be lockable with a padlock.

Junctions boxes shall be installed level and plumb, and set on concrete with a rock base, with excavations filled with a minimum 2,000 psi slurry.

Junction boxes shall be clearly marked with an appropriate high-voltage sign identifying the junction box number and Collection System Circuit number.

The coordinates of each junction box shall be recorded and noted within the As-Built Drawings. Junction box locations shall be installed reasonably close to a roadway or Wind Turbine location to facilitate access. All junction box locations are subject to Buyer approval.

No medium-voltage cable run shall exceed 10,000 feet (or less if partial discharge testing is performed) without a sectionalizing junction box.

A flag shall be installed at each junction box location to make them visible in the event of high snow or crops.

3.3.8 Pad-mount Transformers

If not supplied internal to the Wind Turbine, each Wind Turbine location shall include a medium-voltage, pad-mount transformer. Such transformer shall be sufficiently sized to allow the full Wind Turbine capacity to be delivered. Pad-mount transformers (including spares) shall be in accordance with the requirements set forth in Table 3 (*Table 3. Summary of General Requirements for* Pad-Mount Transformers) herein, at a minimum.

Table 3. Summary of General Requirements for Pad-Mount Transformers

Description	Value
Quantity	1 per Wind Turbine plus spares noted herein
Type	Oil filled, hermetically sealed, outdoor installation
Voltage ratio	based on Wind Turbine model
Phases	3
Windings	based on Wind Turbine model
Steady state temperature rise	65°C above ambient
Frequency	60 Hz
Impulse levels	150 kV (General), 200 kV (Windings)
Winding Configuration	Delta (MV) / Grounded-wye (LV)

Description	Value
Cooling	ONAN
Tapping range	±5%, 2.5% steps, de-energized control
Guaranteed losses	Not used (see Electrical Loss Limit)
Temperature gauge	Required
Pressure level indicator	Required
Pressure relief device	Required
Oil sampling valve	Required (located on end of drain valve inside LV compartment)
Filling orifice	Required
Tank ground tag	Required
Oil level indicator	Required
Grounding	Solid (MV source, LV winding), un-grounded delta (MV winding)
Thermometer	Required
Liquid Level Gauge	Required

Pad-mount transformers shall be fitted with in-line, medium-voltage rated, current-limiting fuse protection per phase utilizing suitably-rated, oil-immersed, current-limiting fuses. The selection of these fuses shall be such as to ensure (a) compliance with the requirements of IEC 60787 or ANSI/IEEE equivalent; (b) short circuit protection of the MV transformer winding; (c) that degradation of the fuses does not occur as a result of the flow of repeated transformer magnetizing in-rush currents; and (d) ease of replacement following an in-service operation.

Pad-mount transformers shall be fitted with a low-side disconnect with means to take a Wind Turbine offline without taking an entire Collection System Circuit offline.

3.3.9 Enclosure

The pad-mount transformer shall include a fully-enclosed, transformer mounted, MV and LV termination, steel cabinet, suitable for outdoor installation, as per ANSI C57.12.28. The cabinet must be so designed as to fully enclose all cable tails, cable terminations, grounding tags and transformer fittings within a tamper and rodent resistant, secure enclosure.

The cabinet shall extend to floor level, fully shrouding all cable tails, having the facility for being directly bolted to the supporting pad. The cabinet depth shall be at least 24 inches.

The MV and LV compartments shall be partitioned such that access to each compartment is via a separate door. External access shall be available through the LV compartment door only, with access to the MV compartment door lock being available within the LV compartment. The doors shall be fitted with an all steel, robust, tamper proof, three point (i.e., top, mid, and bottom) integral locking system. Each door shall have the facility of being securely locked shut via the application of a dedicated pad lock.

The transformer name plate and all transformer indication fittings (e.g., oil level indicator, oil temperature indicator) shall be located within the LV compartment, while all transformer operational fittings (e.g., tap changer switch, isolation switch etc.) shall be located within the MV compartment.

The cabinet doors shall be fitted with anti-close stays designed such that both doors can be held open at right angles. The anti-close stay design shall be sufficiently strong enough to withstand the prevailing wind conditions.

3.3.10 Foundations / Vaults

Pad-mount transformers shall be installed with a fiberglass or concrete box pad.

Box pads shall be installed level and plumb, and set on concrete with a rock base. Excavations shall be filled with a minimum 2,000 psi slurry mix.

Transformer's design, testing, and installation shall be in compliance with ANSI C57.12.00, ANSI, ANSI C57.12.28, C57.12.34, ANSI C57.12.70, ANSI C57.12.80, ANSI C57.12.90, ANSI C59.131, IEEE 386 ,and IEEE 592 standards at a minimum.

3.3.11 Surge Arresters

Surge arresters shall be provided at the end of each string of Wind Turbines. Surge arresters shall be 35-kV class, 600A, 30kV/24.4kV MCOV (or greater if required by the Seller-provided insulation coordination and transient overvoltage studies) equipment meeting the requirements of ANSI C62.11 for Station Class installation in a 60-Hertz outdoor installation, IEEE C62.22, IEEE C62.91.1, unless greater ratings are required by the Seller-provided transient overvoltage study.

Surge arresters shall provide overvoltage system protection in an insulated, fully shielded, submersible, dead-front device. Surge arresters shall be provided in pre-molded rubber elbows.

3.3.12 Bollards

Seller shall install four (4) bollards around every junction box, above-ground splices, and pad-mount transformer (if any), respectively.

Bollards shall (a) be a minimum three (3)-inch diameter steel pipe or a minimum four (4)-inch diameter schedule 40 PVC; (b) be concrete filled for equipment protection (minimum 2,000 psi); (c) be painted safety yellow; (d) extend four (4) feet above grade with at least six (6) inches below the bollard for concrete; and (e) tie into the Wind Turbine ground grid.

3.3.13 AC Cables

AC cables shall be rated for the correct maximum voltage and sized according to the operating and short-circuit currents. All low voltage cables shall be copper and XHHW-2 insulated.

Conductors shall be sized to ensure peak losses are below the Electrical Loss Limit and to avoid excessive voltage drop.

Insulation shall be adequate for the climactic and environmental conditions of the Project as listed in Section 1.2.2 and Appendix 3.

AC cables shall adhere to local authorities having jurisdiction and applicable standards, including IEEE and UL, for the voltage class. Dual class rating is prohibited.

3.3.14 Medium Voltage AC Cables

SAC cables shall be rated for the correct maximum voltage and sized according to the operating and short-circuit currents. MV Cables are MV-90 or MV105, TR-XLPE or EPR, 100% or higher insulation, with concentric neutral to be sized for maximum ground fault. MV cables are UL listed and according to the standards below as minimum and in addition to any other applicable Requirements.

Specifications:

- ASTM B231 Standard Specification for Concentric-Lay-Stranded Aluminum 1350 Conductors
- ASTM B609 Standard Specification for Aluminum 1350 Round Wire, Annealed and Intermediate Tempers, for Electrical Purposes
- Insulated Cable Engineers Association S-94-649 Standard for Concentric Neutral Cables Rated 5 through 46 kV
- Association of Edison Illuminating Companies CS-8 Specification for extruded dielectric shielded power cables rated for 5 through 46 kV

Construction:

- Conductor: Moisture-blocked class B compressed aluminum ASTM B231 1350 .75 hard H16/H26
- Conductor shield: Conventional semi-conducting, cross-linked copolymer; supersmooth conductor shield optional; a conductor tape is used for cable size larger than or equal to 1500 kcmil
- Insulation: 345 mils tree-retardant, cross-linked polyethylene, 100% insulation level
- Insulation shield: Strippable semi-conducting, cross-linked copolymer
- Concentric neutral: Helically applied soft-drawn, bare copper one-third concentric neutral
- Overall jacket: Linear low density polyethylene (LLDPE) jacket, black with red extruded stripes

3.3.15 Cable Management

All above-ground power and communications cabling shall be installed in conduit. All below grade crossings, including road and utility crossings, shall be installed in conduit. Conduit shall be installed from each Wind Turbine to each pad-mount transformer (if any). All 600 V cables are to be installed in conduits. All conduits to be Schedule 40 PVC underground and Schedule 80 PVC UV-resistant above ground.

All direct-buried cables must be installed:

- In compliance with National Electrical Code (NEC) 300 requirements and guidelines, including NEC 300.5 and NEC 300.50.
- Buried at a minimum depth noted in Section 3.3.2 below the ground surface for MV.

3.3.16 DC and AC Circuit Conduit

All aboveground power and communications cabling shall be installed in conduit with threaded adapters. Add expansion joints for all risers and fixed terminations as required by code. All terminations at the bottom of cabinets to include appropriate sealing material.

All below grade crossings, including public road and utility crossings, shall be installed in conduit. Conduit shall be installed from each Wind Turbine to each pad-mount transformer (if any).

Conduit size / fill ratio shall be in accordance with ANSI / NFPA 70, at a minimum.

The location of all conduit shall be recorded within the As-Built Drawings.

Non-metallic conduit shall be protected from sunlight.

The interior surface of all conduits shall be smooth to prevent damage to the cables. When cable is pulled into a duct, a suitable pulling lubricant shall be used and bell housing shall be installed on all conduit ends.

HDPE conduit shall be SDR13.5 or heavier if needed to avoid damage when pulling into the bored hole. HDPE shall be one continuous length or connected together with fused joints.

Use suitable temporary plugs or caps to protect installed conduit against entrance of dirt, moisture, and debris.

All conduit materials required shall be furnished new and undamaged in accordance with the following requirements, at a minimum:

All below grade and concrete encased conduit: polyvinyl chloride, Schedule 40 PVC in accordance with NEMA TC-2.

Couplings: plastic, for use with duct previously specified and “Duct-to-steel” adapters as required, including joint cement.

Spacers: plastic high impact, interlocking, base and intermediate type

Factory bends and sweeps: Schedule 40 PVC, 3-foot minimum radius (or greater if required to not violate the minimum bending radius of the cable being installed in it).

End bells: plastic.

Plugs: plastic, high impact, tapered to fit end bell provided.

Duct binder: hemp or sisal twine coupling.

Plastic bushings with locking nuts shall be used for all exposed threads.

All sweeps and transitions from below ground to aboveground shall be rigid polyvinyl chloride (PVC) or HDPE conduit, schedule 80. All sections of conduit shall have an inside chamfer at both ends.

All above grade AC conduit shall be rigid galvanized steel conforming to the American National Standards Institute (ANSI) C80.1 and UL 6.

All below grade and concrete encased conduit (DC or AC) shall be rigid schedule 40 PVC or HDPE.

Seller shall provide pull boxes and conduit bodies to facilitate wire pulls and maintain compliance with NFPA 70.

3.3.17 Grounding

A comprehensive soil resistivity measurement shall be performed in accordance with IEEE Standard 81. All exposed equipment shall be fully grounded and bonded in accordance with Law, applicable Permits, the requirements of any Governmental Authority and the applicable standards listed in Section 1.3. Grounding measurements shall be taken prior to tying each Wind Turbine ground grid to the collection system. If each Wind Turbine ground grid's resistance is determine to be above or out of compliance with requirements outlined in this section or in the applicable standards listed in Section 1.3, the grounding system and the surrounding soil shall be modified as necessary to comply with grounding requirements.

Wind Turbine Foundations shall include a grounding grid, as further described herein. Wind Turbines shall be installed in accordance with the Turbine Supplier's recommendations for grounding and bonding.

Grounding connections at junction boxes and pad-mount transformers (if any) shall be bolted to facilitate separation of grounds for continuity testing and ground mat testing.

Ground rods shall be incorporated into the grounding system (a) if determined to be necessary by the results of the Seller-provided grounding study and/or (b) if required by Turbine Supplier. Ground rods shall be copper-clad, 5/8-inch diameter, 10-foot-long rods at a minimum.

All below-grade grounding connections shall be exothermic weld (e.g., Cadweld); mechanical / compression connections are not permitted.

All LV and MV electrical equipment bonding will be bonded to the grounding ring or mat and be designed in accordance with the applicable standards listed in Section 1.3.

Meteorological towers shall be independently grounded; meteorological tower grounding shall not be interconnected to the Wind Turbine grounding system. Meteorological towers shall be grounded as per manufacturer's recommendations.

Grounding for all equipment, including the equipment listed above, shall be in compliance with IEEE 80 and shall be conducive to safe touch potential, step potential, and ground potential rise levels for personnel and equipment.

3.3.18 Miscellaneous Material

Cable fault indicators shall be installed. The remote head shall be mounted in the cabinet wall to allow viewing from outside the cabinet. Directional fault indicators shall be installed at every junction box and at a frequency of no more than every third Wind Turbine location (i.e., such that any single fault indicator monitors no more than three (3) cable segments).

3.3.19 Testing and Quality Control

Seller shall test, commission, start-up, and place into successful operation each Collection System Circuit, including the electrical infrastructure and communications infrastructure. At a minimum, testing shall be in conformance with the following minimum requirements. All testing shall be performed by an independent, experienced third party.

All Collection System Circuits shall be tested to demonstrate they meet stated design criteria and are fit for purpose.

All testing specified in the Applicable Standards, including NETA.

All testing reasonably recommended or required by the applicable equipment suppliers.

All exposed cable sections (including Wind Turbine cabling) shall be visually inspected for physical damage or manufacturing defects. Such inspections shall be performed prior to and during installation.

Resistance testing on grounding grid at each Wind Turbine location and junction box.

Megger test of all 34.5-kV Wind Turbine cables.

Very low frequency ("VLF") test of all 34.5-kV power cabling prior to energizing. Testing shall be performed at 0.1 Hertz for at least 60 minutes and in accordance with IEEE 400.2. Testing shall include all terminations and splices.

Insulation resistance testing of all low-voltage cabling, including Wind Turbine down-tower cabling and 600-Volt class meteorological tower cabling.

Final continuity tests (including phase continuity of each phase) after completion of all system connections.

Partial discharge testing on each splice and Collection System Circuit. All partial discharge testing shall be performed at a minimum of 200 percent of the rated voltage of the cable and at 60 Hertz. All partial discharge testing shall be performed following installation of the cabling, including backfill, but prior to energization. VLF testing shall not be performed on the same cable segments where partial discharge testing was performed.

Compaction testing shall be verified at a minimum of every 2,000 feet and at every splice pit location. Compaction testing shall be performed at depths of approximately 12 inches and 24 inches, respectively, below grade.

Communications system testing per Section 3.7 herein.

OTDR reel test at 1550 nm for all Seller terminated fiber and results provided to Buyer in SOR format

Pad-mount transformers, minimum factory testing on all units unless expressly noted otherwise: (a) all tests identified as "Routine" in IEEE C57.12.00 Table 18 and performed in accordance with IEEE C57.12.90.00; (b) resistance measurements of all windings; (c) polarity and phase relation; (d) ratio at rated voltage on all taps; (e) no-load losses and excitation current; (f) load losses and impedance voltage; (g) lightning impulse test on first unit produced; (h) audible sound emissions on first unit produced; (i) dissolved gas analysis on all units prior to temperature rise test; (j) temperature rise test on first unit produced; (k) dissolved gas analysis on tested unit after temperature rise test; (l) dielectric tests; (m) oil testing on all units prior to energization; and (n) oil testing on all units within 30 days of energization.

Seller shall notify Buyer of all testing schedules at least 30 days in advance of testing activities and copies of testing reports (including a summary of testing procedures and acceptance criteria) shall be submitted to Buyer within 10 days of completing such test.

3.4 Wind Turbine Supply, Installation, and Commissioning Specifications

3.4.1 Procedures

Transportation, offloading, storage, and erection of Wind Turbines shall be performed in accordance with the applicable instructions provided by the Turbine Supplier, the specifications provided herein, and critical lift plans.

Mechanical completion of each Wind Turbine, including documentation of progress on Turbine Supplier-furnished forms, shall be successfully achieved in accordance with the instructions set forth in the installation manual and mechanical completion checklists provided by the Turbine Supplier. Seller shall provide a 72 hour notice of Mechanical Completion Certificate (MCC) walkdown to the Buyer representative to be present for MCC walkdown inspections, and subsequent MCC sign-off inspections from the Seller.

Seller shall furnish all containers, stands, frames, feet, racks, and any other items required to transport the Wind Turbine equipment (collectively, the "Delivery Devices") and all specialized lifting and rigging equipment necessary for Wind Turbine offloading or installation (collectively, the "Special Tools").

All rigging utilized for the transportation, offloading, or erection of Wind Turbines shall be rated; inspected daily and monthly; and load tested in accordance with Applicable Standards or other more rigorous requirements set forth in the HSE Plan in Appendix 11. Inspection reports shall be maintained at the Project Site and available for review by Buyer.

Copies of testing certificates and calibration records for all tooling shall be maintained at the Project Site and available for review by Buyer.

Seller shall utilize tooling in accordance with manufacturer recommendations, including any Turbine Supplier guidelines for use of special tools.

Seller shall cause Turbine Supplier to prepare and submit all deliverables and submittals necessary for the successful completion of the Work, including, but not limited to, all manuals, drawings, plans, studies, calculations, checklists, completion procedures, and other similar items (collectively, the "Turbine Supplier Deliverables"). All such materials shall be subject to review and/or approval by Purchaser, as applicable; shall be coordinated and discussed with all pertinent parties prior to and during the construction phase of the Project; shall be submitted by the applicable dates in the Submittal Schedule; and shall meet the minimum requirements for submittals as prescribed herein. The following list provides an indicative sample of Buyer requirements for specific Turbine Supplier Deliverables for the sole purpose of ensuring clarity of expectations for the referenced submittals; this list is not intended to be an exhaustive listing of all Turbine Supplier Deliverables or the requirements thereof.

3.4.2 Wind Turbine Delivery

Seller shall transport all Wind Turbine Equipment to the Project Site on or before the applicable milestone dates in the Agreement.

Wind Turbines shall be delivered to the Wind Turbine pad location nearest each Wind Turbine.

Wind Turbine SCADA System, service lifts (if any), the Spare Parts Inventory, parts shipped losses, and other equipment shall be delivered to the Project Site laydown yard or other location(s) at the Project Site as specified by Buyer.

Seller shall perform all off-Project Site clearing necessary for the transportation of Wind Turbine equipment to the Project Site, including, but not limited to, tree trimming / removal and clearing of overhead obstructions.

Seller shall upgrade and maintain public roads, bridges, and culverts as required for the transportation of Wind Turbine equipment to the Project Site and including obtaining any necessary permits.

Seller shall furnish and operate assist vehicles (i.e., prime movers) as necessary for delivery and movement of Wind Turbine equipment at and within the Project Site and as needed to traverse steep grades.

Seller shall inspect all delivery trucks upon arrival to the Project Site to ensure they are free of debris, mud, and vegetation, and to ensure they are in good mechanical condition. Seller shall also regularly inspect trucks and other equipment for oil leaks. Any vehicles that fail to pass this inspection shall be turned away, unless expressly permitted by Buyer.

Seller shall complete a test run for Wind Turbine deliveries at the Project Site by use of non-loaded trucks to demonstrate that road dimensions will be appropriate for successfully delivering components from the Project Site entrance to the Wind Turbine Pads in the most critical points in terms of access. Such trial run(s) shall be completed prior to commencing deliveries of Wind Turbine equipment to the Project Site, and shall be coordinated with Buyer and BOP Contractor.

Seller, Buyer, and Turbine Supplier shall meet (a) on a weekly basis before Wind Turbine deliveries begin and (b) daily after Wind Turbine deliveries begin; the purpose of such meetings shall be to coordinate schedule for delivery and commissioning of the Wind Turbines. On a weekly basis, a meeting shall be held to reconcile all demurrage and delays for all parties regarding deliveries and offloading of components.

3.4.3 Wind Turbine Erection

Seller shall meet with Buyer and Turbine Supplier prior to installation of the first Wind Turbine to participate in an in-person page turn of the Wind Turbine installation manual.

Wind Turbine erection shall follow a “reference” approach. Such initial Wind Turbine erection shall be reviewed and approved by Buyer and the Turbine Supplier before continuing Wind Turbine erection activities, and such approval shall not be unreasonably withheld or delayed. The “reference” Wind Turbine, once accepted, shall serve as a model finished product for all subsequent Wind Turbine erections.

Wind days shall be actively minimized by scheduling Wind Turbine erection activities at times of day when wind speeds are projected to be lowest, while adhering to ESIA consenting requirements regarding working hours and days.

Wind Turbines shall be erected such that the tower door orientation is downwind of the of the prevailing wind direction.

Each crane, including the main erection crane(s) and any base/mid crane(s), shall be equipped with redundant anemometers at the top of boom for measurement of wind speeds. Wind speeds shall be recorded from these instruments prior to the start of all lifting activities, and measurements shall be recorded on a Seller-furnished data logger. Handheld anemometers shall also be furnished to determine safe wind speeds for all other operations. All such wind data shall be shared with Buyer.

Prior to erection, all exterior Wind Turbine surfaces shall be cleaned via pressure washing; light brushing with mild, biodegradable detergent shall be performed as necessary. Following cleaning, all surfaces shall appear clean at a minimum distance of 50 feet. All washing, including runoff, shall be in accordance with the applicable permits and other requirements.

Prior to erection, any imperfections in paint should be repaired. Any imperfections in blades (incl vortex generators, serrated trailing edges, etc.) should also be fixed prior to erection. After erection, Seller shall identify and repair any paint imperfections or scratches that remain.

Seller shall assemble, install, construct, and erect all Wind Turbines, including all components, equipment, switchgear / down-tower assembly, stairs, climb assists / service lifts (as applicable), and other similar items, and including furnishing of the main crane(s) with suitable capacity for Wind Turbine erection.

Seller shall furnish all labor, equipment (including rigging, tooling, hoisting equipment, and lifting devices), and materials that are necessary to assemble and install the Wind Turbines.

Seller shall fabricate and furnish all anchor bolt template rings as required to support Wind Turbine installation.

Seller shall design, furnish, construct, and install concrete pads for the stair support columns and concrete stair landing (approximately 3-feet by 3-feet) for each Wind Turbine.

Seller shall grout, install, shim, and level all tower base sections, including providing all necessary grease, shim packs, leveling feet, and other necessary items or consumables.

Seller shall provide all crane breakdowns, both partial and full, necessary to complete the Work.

Seller shall install the electrical wiring and cabling in each Wind Turbine, including all necessary pulling, dressing, lugging, taping, splicing, and terminations, to interface to the Wind Turbine Foundation.

Seller shall furnish all labor, equipment, and materials that are necessary for the electrical connection of the Wind Turbine to the Collection System, including all down-tower cabling.

Seller shall complete all fiber optic communications system terminations in each Wind Turbine and at the Wind Turbine SCADA System server, respectively.

Seller shall install the grounding system in each Wind Turbine, including grounding of Wind Turbine stairs.

Seller shall furnish and install (a) all temporary Wind Turbine obstruction lights, including wiring and mounting brackets and (b) all permanent Wind Turbine obstruction lights, including wiring and mounting brackets. Obstruction lights shall be (i) FAA Type L-810 (red, steady burning), L-864 (red, flashing), or L-865 (white, flashing, medium intensity) as determined in Seller's *Determination of No Hazard to Air Navigation* letter from the FAA; (ii) in compliance with the Work Requirements, including US DOT-FAA Advisory Circular No. AC 70/7460-1K: Obstruction Marking and Lighting; (iii) provided with an uninterruptible power supply capable of supplying back-up power for at least one (1) hour; (iv) programmed to blink in unison, including with those aviation obstruction lights that are installed on meteorological towers; and (v) night vision goggle compliant. Seller shall remove all temporary FAA lights when no longer needed.

Seller shall provide any required Wind Turbine maintenance, including freewheeling, and including any necessary generators and fuel.

Seller shall provide a final broom cleaning of each Wind Turbine prior to handoff following mechanical completion. Further, each Wind Turbine should be reasonably clean and free from grease, oil, and other grime prior to mechanical completion.

Seller shall collect, repackage, and return all returnable items on loan from Turbine Supplier, including, but not limited to, shipping frames, delivery devices, brackets, lifting and rigging equipment, specialized tooling, and other returnable items.

Seller shall provide qualified personnel to perform lock-out / tag-out, switching, and other similar activities during the commissioning of the Wind Turbines by Turbine Supplier.

Seller shall provide technical advisors at the Project Site, subject to the terms of the TSA, for consultation during the offloading, assembly, erection, installation, and mechanical completion, and commissioning of the Wind Turbines. The technical advisors shall provide advice, consultation (including answering questions), and clarification to regarding the Turbine Supplier manuals, specifications, and other Wind Turbine-related technical documents.

3.4.4 Wind Turbine Offloading

Seller shall receive, visually inspect, and inventory all deliveries of Wind Turbine equipment, Wind Turbine SCADA System, Special Tools, shipping containers, and other similar items to the Project Site. Seller shall submit reports to Buyer within 5 days of delivery regarding receipt, inspection, and inventorying of all such deliveries, including any damage identified.

Seller shall offload all Wind Turbine equipment at the Project Site. Seller shall offload and stage all Wind Turbine deliveries at the Wind Turbine Pad location nearest each Wind Turbine.

Seller shall furnish and install adequate measures to prevent Wind Turbine equipment from being blown over or otherwise damaged while stored at the Project Site. This shall include tie down of blades and other similar measures.

Seller shall furnish protective tarps to eliminate unwanted materials from entering Wind Turbine equipment after removal of shrink wrapping.

Seller shall furnish all dehumidifiers, turning gears, and other similar equipment and tools that are necessary to properly store and maintain the Wind Turbine equipment prior to Wind Turbine erection in accordance with the storage instructions.

3.4.5 Wind Turbine Commissioning

Following mechanical completion of each Wind Turbine, Seller shall perform an inspection of each Wind Turbine. During inspection, if deficiencies or discrepancies in the requirements of the installation manual or any other Work Requirement are discovered, Seller shall inform Buyer of the discrepancy and such discrepancy shall be resolved prior to Wind Turbine commissioning.

Seller shall start-up, test, commission, and successfully achieve commissioning completion and substantial completion of all Wind Turbines and other Wind Turbine equipment, including the Wind Turbine SCADA System and service lifts (if any), and including achievement of SCADA completion and all reliability tests being successfully run, including all testing set forth herein.

3.4.6 Testing and Quality Control

All testing described herein shall be performed by the Turbine Supplier and Seller, and witnessed by an independent, experienced third party. Seller shall notify Buyer of all testing schedules at least 30 days in advance of testing activities.

All Wind Turbine electrical wiring and cabling shall be tested to demonstrate it meets stated design criteria and is fit for purpose.

Wind Turbine testing shall include the following, at a minimum:

- Mechanical Components (including torque levels)
- Hoses and ducts
- Motors and fans
- Testing of hoists and lifts
- All testing specified in the Applicable Standards, including NETA.
- All testing reasonably recommended or required by the applicable equipment suppliers.
- Structural works testing for grout properties, in accordance with requirements herein.
- All exposed cable sections shall be visually inspected for physical damage or manufacturing defects. Such inspections shall be performed prior to and during installation.
- Insulation resistance testing and continuity testing as described in Section 3.3.19.
- Megger test of all MV cables.

- Final continuity tests after completion of all system connections. Acceptable continuity tests shall include a Megger test or VLF test at 100 percent of rated voltage.

Seller shall notify Buyer of all onsite testing schedules as least 5 days in advance of testing activities and copies of onsite testing reports (including a summary of testing procedures and acceptance criteria) shall be submitted to Buyer within 5 days of Seller receiving report from contractor not to exceed 30 days of completing such test. Seller shall immediately notify Buyer upon becoming aware of any deviations between specified properties and tested properties.

3.4.7 Wind Turbine Supply

The Wind Turbine, including all components, shall be capable of operating at rated capacity in a safe, reliable, and continuous manner and without undue maintenance under the meteorological conditions (e.g., temperature, air density, wind speed, salinity) of the Project and Project Site.

All exterior surfaces of the Wind Turbine shall be white or light gray in color. RAL 9010 (pure white) or RAL 7035 (light gray) are acceptable colors. A non-glare finish shall be used. Touch-up paint shall be provided as reasonably necessary to repair any damage to Wind Turbine equipment that occurs during the transportation, offloading, erection, and/or commissioning of the Wind Turbines. All damages shall be repaired prior to acceptance.

The Wind Turbine (including the tower and nacelle) shall have no external markings unless explicitly listed herein.

Wind Turbines shall be supplied with the first fill of all grease, oil, and other lubricants and consumables in the Wind Turbine equipment (or filled at the Project Site following delivery). Gearbox oil shall be per Turbine Supplier design specification.

Turbine Supplier shall validate the Wind Turbine equipment incorporated into the Work is new, unused, of good quality, consistent for use in wind generation facilities, and complies with the Requirements.

The Turbine Supplier shall supply the Wind Turbines with same sub-components as per the Design Certificate. Each Wind Turbine shall include all of the parts, components, equipment, materials, apparatus, structures, tools, supplies, consumables, goods, and other items required or appropriate for a complete, fully-functional Wind Turbine, including, but not limited to, the rotor blade set; hub; pitch system; main shaft arrangement, including main bearing; generator; gearbox; mechanical brake; high-speed shaft coupling (if used); internal crane; power converter; medium-voltage transformer (if applicable); service lift; internal tower wiring and cabling; controller; auxiliary system; wind vane; anemometer; yaw system; cooling system; hydraulic system; tower section; switchgear; ground controller; uninterruptible power supply; door with lock and key; and Wind Turbine SCADA System.

The design working life of the Wind Turbine equipment shall be a minimum of 20 years or as per the accepted Design Certificate for the Wind Turbine utilized for the project.

Quality control and assurance programs, both Turbine Supplier and their component suppliers, shall meet ISO 9001 requirements. Environmental programs, both Turbine Supplier and their component suppliers, shall meet ISO 14001 requirements. Health and Safety programs, both Turbine Supplier and their component suppliers, shall meet ISO 18001 requirements.

Proposals shall include a listing of all potential component suppliers that will furnish the following components for the Project. Seller shall cause Turbine Supplier to represent that all components below shall be interchangeable, regardless of the suppliers or manufacturers of the component, including if such component are furnished by different suppliers or manufacturers.

- Rotor blades.
- Gearbox (if applicable).
- Generator.

- Main shaft arrangement, including main bearing.
- Hub.
- Controller.
- Power converter.
- Tower.
- Pitch system, including actuators and accumulators (as applicable).
- Yaw system, including motors.
- Mechanical brake.
- Transformer (if applicable). If Seller will provide medium-voltage transformers external to Wind Turbine, see additional information herein.
- High-speed shaft coupling.
- Internal crane.
- Internal tower wiring and cabling.
- Auxiliary system.
- Wind vane and anemometer.
- Cooling system.
- Hydraulic system.
- Switchgear.

3.4.7.1 Rotor and Blades

Blades shall have an integrated lightning protection system, in accordance with IEC 61400-24.

Rotor blades shall be manufactured by an experienced component supplier in an ISO 9001 certified facility.

3.4.7.2 Generator

The generator shall be of minimum protection class IP54.

The generator and its internal components shall be manufactured to NEMA Class H insulation.

Generators shall be manufactured by an experienced component supplier in an ISO 9001 certified facility.

3.4.7.3 Gearbox

Production testing of the gearbox shall have been performed prior to final acceptance.

The gearbox shall be manufactured by an experienced component supplier in an ISO 9001 certified facility.

3.4.7.4 Tower

The tower shall be accessible through a lockable door at the base of the tower. Doors shall be protected by an intrusion alarm integrated into the operator SCADA System. Permanent metal stairs, including concrete pads for the stair support columns and stair landing for each Wind Turbine, shall be provided if the access door is above grade level.

Tower lighting shall meet OSHA requirements for working environments. Lighting shall be installed at the base of the tower, at all platforms within the tower, and at appropriate height intervals in each section of the tower to allow inspection and work if required. Lighting shall incorporate an uninterruptible power supply capable of supplying back-up power for at least one (1) hour.

Service platforms, or other means to allow access to all components, shall be included within the tower. Duplex, interior, 120-volt alternating current, 20-amp GFI power receptacles shall be installed at the base of the tower, at all platforms within the tower, and at the top of the tower below the nacelle. Floors of all platforms shall have anti-slip surfaces.

A ladder shall be included in the tower for internal ascent. The tower ladder shall reach from the base of the tower to the nacelle. The tower ladder shall be made of aluminum or steel. The tower ladder shall meet all OSHA standard requirements for safety and construction. Lights shall be mounted along the ladder route inside the tower to provide adequate lighting of the tower interior. An OSHA-compliant fall arrest system shall be included that is compatible with the tower ladder. The fall arrest system shall be designed and manufactured according to the latest versions of the following standards, at a minimum: EN 353-1, EN 362, EN 363, CAN/CSA Z259 and ANSI Z359.1. The fall arrest system shall be understood to include rail, guide seat, and runner.

The tower shall be manufactured per requirements set forth in IEC 61400 and Design Certification.

3.4.7.5 Climb Assist

A climb assist system shall be provided for each Wind Turbine if a climb assist is standard equipment in the proposed Wind Turbine model. The following specifications shall apply to any climb assist that may be provided.

The climb assist shall be compatible with the standard tower ladder.

The climb assist shall provide a reduced carrying weight of at least 75 pounds (34 kg).

The climb assist shall meet all OSHA standard requirements for safety and construction.

3.4.7.6 Service Lift

A service lift system shall be included in the Proposal as an option. The following specifications shall apply to any service lift that may be provided.

- The service lift shall be an electrically driven person-lift capable of lifting two workers and light parts from the base of the tower to the nacelle.
- The service lift shall have a minimum lift capacity of 500 pounds (227 kg).
- The service lift shall meet, at a minimum, the requirements of ASME A17.1, ASME A17.8, ASME A120.1, and OSHA standard requirements for safety and construction.
- The service lift shall have interior lights.
- The service lift shall have an access door that can be secured from within the lift.
- The service lift shall include external controls at the base of the tower to enable movement of the lift without an operator inside.
- The service lift shall have controlled descent capability to enable descent at a controlled rate during power interruption.
- The tower ladder shall be accessible from the service lift in the event of power interruption during tower ascent or descent.

3.4.7.7 Service Hoist

A standard electrically powered service hoist shall be included in the nacelle, capable of lifting parts from ground level to the nacelle.

The service lift shall have a minimum lift capacity of 1,000 pounds (453 kg).

3.4.7.8 Power Converter

The Wind Turbine shall include a power convertor capable of supplying power at constant frequency and voltage from the generator to the step-up transformer.

Power converter shall comply with all applicable national and international electrical standards.

The power converter will be (self or forced) cooled to allow operation in all expected ambient temperatures as per the Design Certificate.

3.4.7.9 MV Transformer

See Section 3.3.8 for requirements of pad-mount transformers.

Transformers shall be either dry or liquid filled. The MV transformers shall be three-phase, 60 hertz, 149°F temperature rise, cooled, pad mounted, dead-front, compartmentalized distribution transformers, loop feed with disconnectable elbows and +/-5% de-energized tap.

The transformer will be cooled (self or forced) to allow operation in all expected ambient temperatures as per the Design Certificate.

Transformers shall be rated for inverter source operation of this type of generation and the Project Site climactic conditions.

Transformers shall be supplied with a lockable and visible fused disconnect switch on the transformer high voltage side to isolate the transformer in case of an internal fault of an oil-filled transformer.

Oil-filled transformers shall not be used inside the nacelle.

Transformers shall be equipped with dedicated relays for oil level, pressure, and temperature as per applicable design standard.

3.4.7.10 Conditioning Monitoring System

Critical Wind Turbine components shall be monitored by a condition monitoring system for the purpose of targeting predictive maintenance and proactively monitoring failures.

On-line vibration diagnostics shall be carried out, at a minimum, on the following: main bearing, gearbox, and generator.

A baseline for vibration data shall be established on every Wind Turbine using no less than three (3) months of data at the beginning of life on every Wind Turbine.

Limits shall be set in the SCADA monitoring system for warnings and alarms using these baseline vibration characteristics. These limits shall be actively monitored.

In the event that vibration limits are exceeded, the Wind Turbine shall be automatically shut down in a safe and reliable manner and left in a safe configuration so inspection may be performed.

Vibration data and statistics of the Wind Turbine shall be retrievable from the SCADA System interface.

3.4.7.11 Meteorological Equipment

Each nacelle shall have a meteorological station installed on the nacelle that measures all parameters for safe and optimal operation of the Wind Turbine as per the Design Certificate.

Each nacelle shall be supplied with primary and secondary wind vanes capable of measuring wind direction. Heaters should be included for anemometers. For additional requirements for meteorological equipment, see Section 3.5.

The supplied anemometers and wind vanes shall provide control and display data for the system.

The anemometers shall provide information for system shutdown in the event of excessive wind speeds.

The anemometers shall provide information for system start or restart when wind speeds are within an acceptable range.

The wind vanes shall provide information for yawing of Wind Turbines.

3.4.7.12 Switchgear

The Wind Turbine shall include all relaying and switchgear required to assure safe and proper connection and disconnection with the Collection System Circuits, including uninterruptible power supply for safe shutdown upon loss of grid power. The switchgear shall include all enclosures, fittings, disconnect switches, fuses, breakers, and other similar or related items as necessary to adequately protect and isolate the Wind Turbine equipment. This equipment shall be labeled as per Section3.3.5.

The switchgear shall consist primarily of a main circuit breaker, along with associated equipment.

All equipment and its installation shall meet, at a minimum, applicable NEMA, ANSI, and IEC standards. In the case of conflict between standards, the more stringent shall apply.

The switchgear shall be provided in a dedicated steel enclosure and be readily accessible for inspection and maintenance.

The circuit breaker compartment shall have a hinged door and dead front construction.

No exposed buswork or cable connection shall be present with the breaker door open.

3.4.7.13 Wind Turbine Obstruction Lighting

The Wind Farm shall be provided with aviation obstruction lights, including mounting assemblies, GPS controller, and photocell as required by the Federal Aviation Administration and all other Applicable Standards. Seller shall furnish all required obstruction light brackets and obstruction lights, including wiring.

Wind Turbine aviation obstruction lights shall be programmed to blink in unison, including with those aviation obstruction lights that are installed on the meteorological towers.

Aviation obstruction lighting equipment shall be designed for continuous operation.

Aviation obstruction lights shall be FAA Type L-864 (single, red, flashing configuration) or as otherwise required by Seller's *Determination of No Hazard to Air Navigation* letter from the FAA.

Obstruction lighting shall incorporate an uninterruptible power supply capable of supplying back- up power for at least one (1) hour.

3.4.7.14 Lightning Protection

The Wind Turbine shall be furnished with lightning protection designed in compliance with, at a minimum, the requirements of IEC 61400-24 and IEC 62305.

Lightning protection equipment should include, at a minimum, the following on every Wind Turbine:

- Franklin rods on nacelle.
- Lightning receptors on hub, nacelle, and each rotor blade.
- Internal steel mesh in nacelle to act as Faraday cage.
- Fire-retardant materials within nacelle composition.
- Earthing system, including down-conducting system with clear electrical path to ground.

All metallic components within the Wind Turbine shall be bonded to the Wind Turbine.

Rotor blades shall be designed to Lightning Protection Level ("LPL") I, in accordance with IEC 61400-24.

Unless demonstrated by a risk analysis that a lower level is adequate, the remaining components (other than rotor blades) shall be designed to at least LPL-II, in accordance with IEC 61400-24.

3.4.7.15 Corrosion Protection

All ferrous materials shall be supplied with coating systems adequate to protect it from corrosion for the design life of the Wind Turbines at the Project Site location, based on Climatic Conditions.

3.4.7.16 Extreme Weather Packages

The design temperature ranges for each Wind Turbine shall be in accordance with, at a minimum, the most recent edition of IEC 61400-1. The Wind Turbine shall employ hot weather and/or cold weather packages as necessary to maximize production opportunities at the project site.

3.4.7.17 Emergency Protection Systems

During power outages of any nature, the Wind Turbine shall have the ability to power or shut down, feather blades properly, and orient the Wind Turbine appropriately to prevent damage by high winds.

Tower, nacelle, and obstruction lighting back-up power of one hour (or as per FAA regulations in regard to obstruction lighting) shall be provided for personnel and equipment safety during power outages.

3.4.7.18 Fire Protection

Fire protection should be designed to the NFPA 850 (Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations) standard Chapter 13 and all referenced chapters.

Fire suppression equipment for the Wind Turbine should be included as an option in the Proposal. Buyer reserves the right to install third-party fire suppression equipment at a later date. Fire Suppression within the Nacelle shall be provided unless all oils used within the nacelle are UL Listed as fire retardant or "Less Flammable" Provisions shall be made for incorporating the fire suppression system monitoring into the local control system for each Wind Turbine generator.

3.4.7.19 Grid Compliance

The Wind Turbine shall provide a controlled and predictable power response from variations in wind and grid frequency.

The Wind Turbine shall be compliant with the following power quality and grid interconnection standards, at a minimum:

- Federal Energy Regulation Commission Order 661a Appendix G, "Interconnection Requirements for a Wind Generating Plant".
- IEEE Standard 519, "Harmonic Limits" and its referenced standards, as applicable.
- ANSI C84.1, "American National Standard for Electric Power Systems and Equipment - Voltage Ratings".
- The GIA and its applicable appendices.

The Wind Turbine shall be capable of providing active power control through the following, at a minimum:

Ramp rate control, permitting active power response up to ten percent (10%) of rated power per second.

Delta control, permitting Wind Turbine to be operated at specified output level (delta) below available output level.

Reactive power control shall be provided by the Wind Turbine to assist with regulating grid voltages. The Project (inclusive of all Wind Turbines) shall maintain a power factor within the range of 0.95 leading to 0.95 lagging, or more stringent if requirement by applicable agreements (e.g. GIA) as measured at the Electric Interconnection Point.

3.5 Meteorological Tower Specifications

References to "meteorological towers" herein shall be understood to include both permanent and temporary meteorological towers, unless explicitly stated otherwise. All civil and structural works shall comply with applicable specifications in Section 3.2.

Meteorological towers are to be installed for the following applications:

- To assess the wind resource prior to Substantial Completion. If at that time the actual Wind Turbine is not known yet, the top anemometer shall be installed as close to hub height as possible. From this tower, a minimum of one (1) year (two (2) years or more preferred) worth of data will be gathered for the Historical Climatological Data set. This data will be extrapolated, correlated and Energy Yield Assessment (EYA) will be calculated (including the 12x24 matrix) The towers shall be instrumented to match or exceed industry standards (e.g., redundant anemometers, and temperature, relative humidity, pressure sensors) as noted herein. If towers with heights below the anticipated hub height are used, at least one tower shall have a collocated LiDAR with at least one year of concurrent data collection.
- Seller shall decommission the existing, temporary, pre-construction meteorological tower(s) used for energy production estimates, if any. All equipment from these existing towers shall be removed from site.
- Long term permanent meteorological tower(s) will be installed as per IEC 61400-12 to provide reference data for Monthly and Annual Reports and to compare with Wind Turbine generation performance. Each tower shall be installed and instrumented in a manner that they can also be used for power curve verification for nearby Wind Turbines and/or Insurance issues. At minimum one permanent meteorological tower shall be installed on all project sites.
- Short term meteorological towers may be installed for power curve verifications. If site calibration according to IEC guidelines is required, one tower (calibration tower) will be installed on a Wind Turbine location prior to the installation of the Wind Turbine in enough time to fulfill site calibration needs; a second tower (reference tower) will be installed upstream from the Wind Turbine in accordance to the applicable IEC references to minimize power curve testing uncertainty.

Meteorological towers shall be sized and constructed appropriately to allow instrumentation to be placed at Wind Turbine hub height. A side-by-side (i.e., goalpost) anemometer orientation, as shown in IEC 61400-12-1, shall be utilized; such side-by-side anemometers will be mounted at Wind Turbine hub height on each permanent meteorological tower. Similarly, any height provided by a foundation for the temporary meteorological tower shall be taken into consideration relative to the final constructed hub height of the Wind Turbine.

Meteorological towers shall be designed and fabricated to the latest EIA/TIA-222-FS Structural Standards for Steel Antenna Towers and Antenna Supporting Structures and according to other Applicable Standards.

Meteorological towers shall be painted / marked in accordance with the Applicable Standards and applicable permits.

All meteorological tower designs, including foundation design, shall be approved by Buyer prior to procurement of such equipment or materials.

Permanent meteorological towers shall be hub height, self-supported (non-guyed), galvanized lattice structures, each designed and certified for maximum wind and ice loading per the Project Climatic Conditions.

All permanent meteorological tower locations shall be fenced. Fencing shall be placed to allow a minimum of ten (10) feet of free space around the tower base and shall have constructed dimensions of approximately

40 feet by 40 feet. Fencing shall be grounded. At least one (1) walk gate shall be installed at each permanent meteorological tower. The walk gate shall be a lockable, single-hung, 4-foot-wide, swing-gate for personnel access. The fenced area for the permanent meteorological tower shall be covered throughout with at least six (6) inches of aggregate over a compacted subgrade, with aggregate extending at least one (1) foot beyond the fence in all directions and using the same aggregate material as the access roads.

All meteorological towers shall incorporate a safety climb cable.

Sufficient grounding and lightning protection per IEC 61400-12 shall be installed on all meteorological towers, including lightning finials. Meteorological towers shall be independently grounded; meteorological tower grounding shall not be interconnected to the Wind Turbine grounding system.

All anemometers for permanent towers shall be type "first class", and one heated sensor installed per tower. All anemometers shall be calibrated in accordance with MEASNET's Anemometer Calibration Procedure and performed by a MEASNET-certified organization.

The design working life of the meteorological tower (minus instrumentation) shall be a minimum of 30 years.

Each permanent meteorological tower shall include, as a minimum, all instruments specified per IEC 61400-12 and as detailed below.

- Two (2) cup anemometers at Wind Turbine hub height in a goal-post configuration.

Seller shall include optional pricing for performance of an IEC-compliant power curve test. The following additional equipment and instrumentation is needed if a power curve test is to be performed:

- (*) One (1) cup anemometer at mid-blade height.
- One (1) cup anemometer at lower-blade height.
- (*) One (1) vertical anemometer near Wind Turbine hub height (below goal post).
- (* … only 1 vane needed) Two (2) wind direction sensors near Wind Turbine hub height (below goal post). Each shall be MetOne 020C and NRG #200P, respectively.
- (*) One (1) temperature / relative humidity sensor with radiation shields near Wind Turbine hub height (below goal post). Each shall be MetOne 597 or Vaisala HMP60A.
- (*) One (1) barometric pressure sensor near Wind Turbine hub height (below goal post). Each shall be MetOne 092 or Vaisala PTB 110.
- (*) One (1) wind direction sensor at lower-blade height. Each shall be MetOne 020C.
- One (1) temperature / relative humidity sensor with radiation shields at 10 meters above ground level. Each shall be MetOne 597 or Vaisala HMP60A.
- (*) One (1) precipitation sensor. Each shall be Campbell Scientific 237-L.

Each permanent meteorological tower shall include at a minimum the following other equipment:

- One (1) NEMA 4X fiberglass enclosure for data logger and auxiliary equipment.
- One (1) data logger. Each shall be Campbell Scientific, model CR1000.
- One (1) satellite or cellular (as appropriate for location) data modem.
- One (1) radio. Each shall be Campbell Scientific, model 401A.
- Signal surge protection terminals. Each shall be Phoenix Contact, type Termitrab 24V.
- Grounding and lightning protection, including lightning finial.
- Instrumentation booms. Instrumentation booms shall be oriented to minimize tower shading (e.g., perpendicular to prevailing wind direction).
- Cabling.
- H-frame equipment rack.
- Fiber patch panel.
- Safety climb cable.
- Temporary power supply for data logger and aviation lights (if a power performance test (i.e., power curve test) is performed).

Each temporary meteorological tower shall include the following equipment:

- Two (2) cup anemometers at Wind Turbine hub height in a goal post configuration.
- One (1) NEMA 4X fiberglass enclosure for data logger and auxiliary equipment.
- One (1) data logger. Each shall be Campbell Scientific, model CR1000.
- One (1) radio. Each shall be Campbell Scientific, model 401A.
- Signal surge protection terminals. Each shall be Phoenix Contact, type Termitrab 24V.
- Grounding and lightning protection, including lightning finial.
- Instrumentation booms. Instrumentation booms shall be oriented to minimize tower shading (e.g., perpendicular to prevailing wind direction).
- Cabling.
- H-frame equipment rack.
- Safety climb cable.
- Temporary power supply for data logger and aviation lights (if a power performance test (i.e., power curve test) is performed).

3.5.1 Lighting

All meteorological towers shall be provided with aviation obstruction lights, including top- and mid-level as required, and including all mounting assemblies, GPS controller, and photocell as required by the Federal Aviation Administration and all other Applicable Standards.

Meteorological tower aviation obstruction lights shall be programmed to blink in unison, including with those aviation obstruction lights that are installed on the Wind Turbines.

Aviation obstruction lighting equipment shall be designed for continuous operation.

Aviation obstruction lights shall be FAA Type L-864 (single, red, flashing configuration) or as otherwise determined in the *Determination of No Hazard to Air Navigation* letter from the FAA, and in compliance with the Work Requirements, including US DOT-FAA Advisory Circular No. AC 70/7460-1K: *Obstruction Marking and Lighting*.

Obstruction lighting shall incorporate an uninterruptible power supply capable of supplying back-up power for at least one (1) hour or in accordance with FAA requirements, whichever is greater.

Seller shall remove all temporary FAA lights when no longer needed.

3.5.2 Power

Permanent power supply for each permanent meteorological tower shall be taken from the nearest Wind Turbine or Collection System Circuit. Such permanent power supply path shall follow the same route as the Collection System Circuits in order to minimize disturbed area.

Backup power, in the form of uninterruptible power supply systems, shall be installed in nearest Wind Turbine of each meteorological tower. Each uninterruptible power supply system will have a minimum capacity of 48 hours backup power for each meteorological tower and communication (including fiber switch).

3.5.3 Communication

All permanent meteorological towers shall be connected to, and communicate with, the SCADA and Communications System and allow data recording and storage through the data archival features of the SCADA and Communications System.

Communication from each permanent meteorological tower to the SCADA and Communications System shall be via dedicated fiber optic circuit. Such communication path shall follow the same route as the Collection System in order to minimize disturbed area.

3.5.4 Testing and Quality Control

Seller shall test, commission, start-up, and place into successful operation the meteorological towers. At a minimum, testing shall include the minimum requirements below. All testing shall be performed by an independent, experienced third party.

All meteorological tower equipment shall be tested to demonstrate it meets stated design criteria and is fit for purpose.

All testing specified in the Applicable Standards.

All testing reasonably recommended or required by the applicable equipment suppliers.

Meteorological tower foundations shall be tested for concrete strength and properties, including break tests, grout cubes, slump, air, and temperature, each at the minimum frequencies specified herein.

All exposed cable sections shall be visually inspected for physical damage or manufacturing defects. Such inspections shall be performed prior to and during installation.

Resistance testing on grounding grid at each tower location.

Final continuity tests after completion of all system connections. Acceptable continuity tests shall include a Megger test or VLF test at 100 percent of rated voltage.

Verify all alarms, indications and analog quantities are communicated and received properly by the RTU and displayed correctly on the HMI.

Verify all communication channels operate as expected.

Seller shall notify Buyer of all testing schedules at least 30 days in advance of testing activities and copies of testing reports (including a summary of testing procedures and acceptance criteria) shall be submitted to Buyer within 10 days of completing such test.

3.6 SCADA

Seller/Developer to design, supply, and install a redundant fiber-based network connecting all the Wind Turbines, meteorological (met) stations, and step-up transformers.

Seller to design, supply, and install SCADA enclosures to integrate the Wind Turbines and Met Towers.

Seller to develop communication system single line and network block diagrams, which include all applicable Wind Turbines, Collection System Circuits, Project Substation, Interconnection Line, and O&M Building equipment.

Seller to design, supply, and install Collector Substation Control House communication rack layout, including BOM and elevation drawings. All projects are to have a redundant SCADA system with primary and secondary switches and connections on both generating asset and collector substation.

Seller to design, supply, and install appropriate SCADA, communications, wiring, fiber, splice details.

Seller to design, supply, and install field installed SCADA communication panels at each Wind Turbine with layer 2, 3 looped switch and fiber patch panel in a National Electrical Manufacturers Association (NEMA) 4X enclosure.

Seller supplies Seller controlled fiber to the site (i.e., ATT fiber which the Seller is the account owner of) – this is to support Commissioning activities.

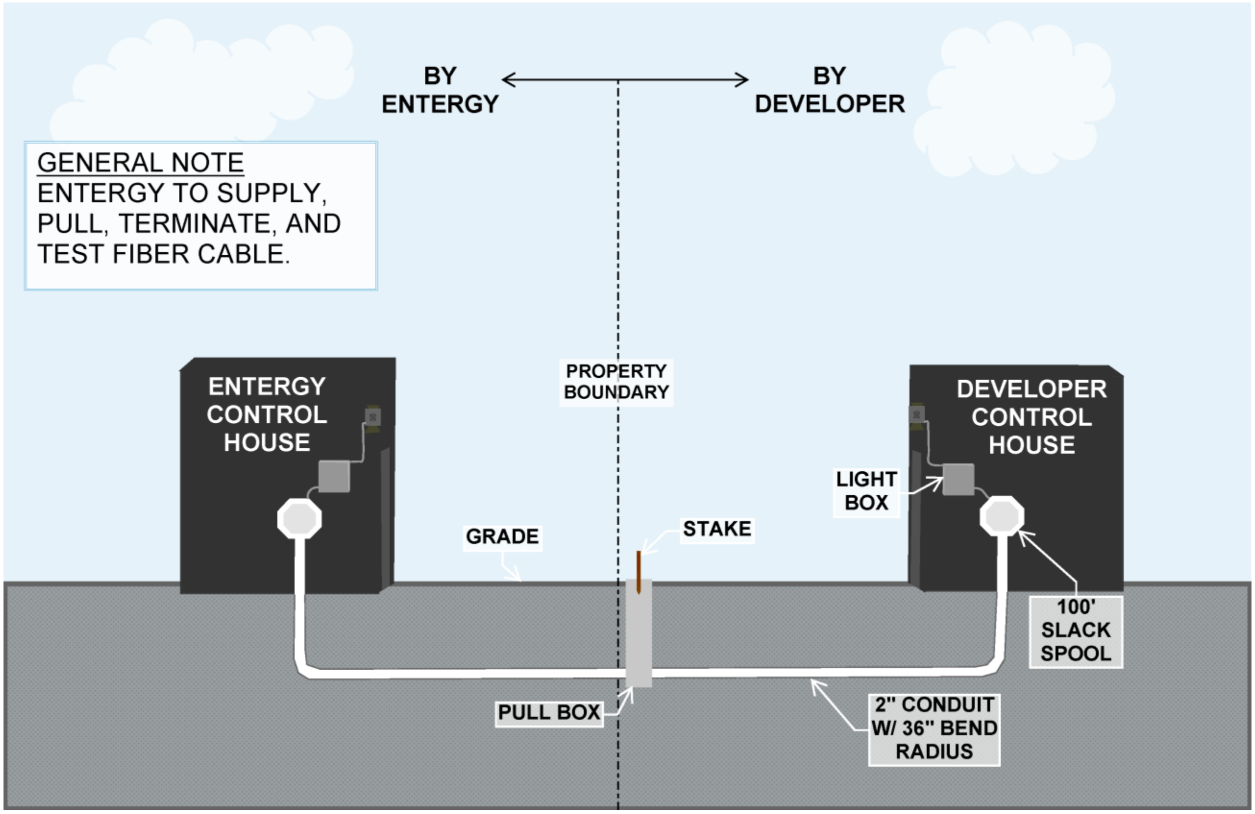
All fiber optic cable from the control house to the Electric Interconnection Point shall be 96-strand, single mode, meeting Telecommunications Industry Association (TIA) 568.3-E.

This site will have an additional fiber for the Buyer network from the interconnecting substation to the Collector Substation

If the distance from the Buyer substation to the Collector Substation is cost effectively short and Buyer owns property rights, then: (refer to Figure 1)

- Underground the fiber.
- Buyer supplied fiberoptic cable shall be underground rated.
- ADSS fiber to be pulled in microduct/conduit.
- Demarcation point between Seller/Developer installed microduct/conduit from Collector Substation and Buyer's installed innerduct/conduit is a Seller installed pull box or similar at a mutually agreed to point, typically at or the near the property boundary, between the interconnect substation and Collector Substation (often initially marked as a stake in the ground) – refer to Figure 1
- Innerduct/Conduit shall be conduit or microduct (e.g., 2" PEX) with a minimum 2" diameter and 36" bend radius.
- Seller to install lightbox and 100 ft slack spool and associated innerduct/conduit in the Collector Substation
- Buyer will supply and terminate fiber on both ends.

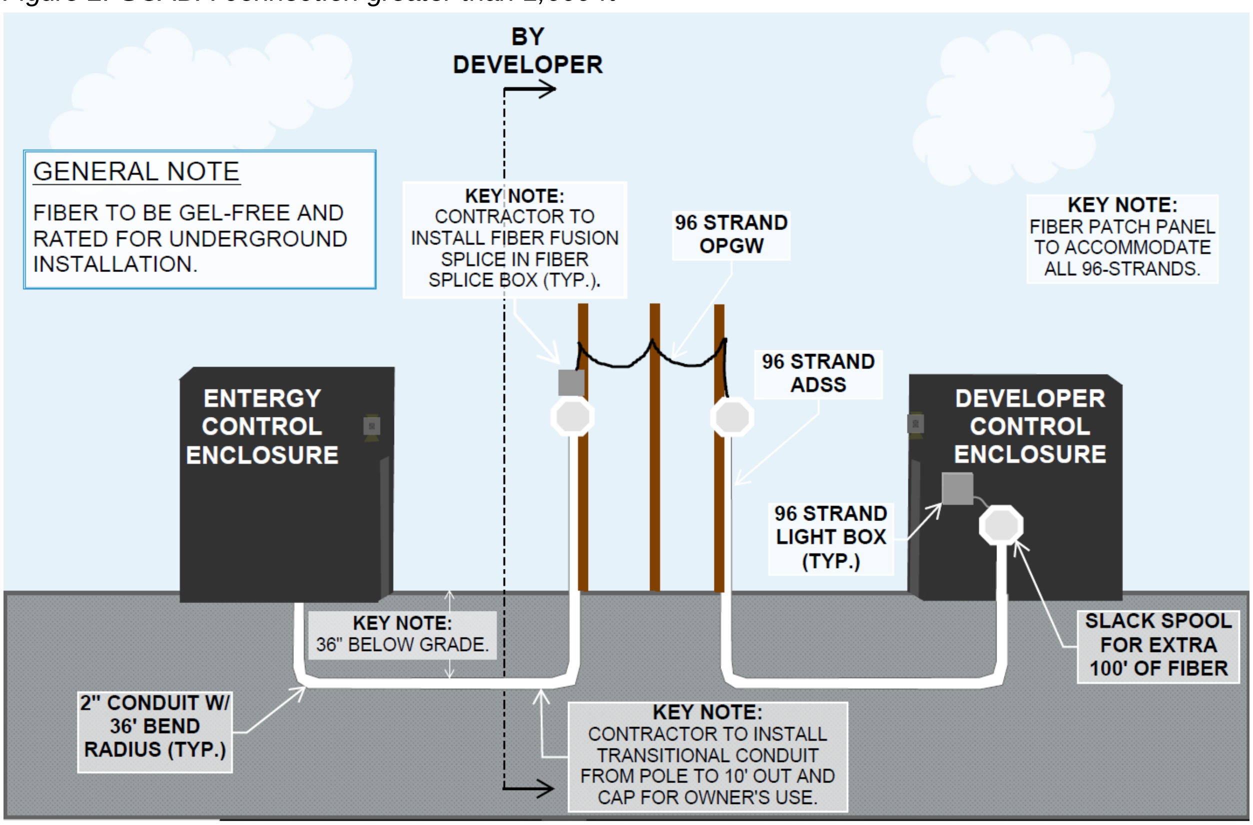
Figure 1: SCADA connection less than 1,000 ft



If the distance from the Buyer substation to the Collector Substation is not cost effective for underground fiber OR Buyer does not own property rights, then (refer to Figure 2):

- Seller/Developer to install 96-strand OPGW fiber and associated fiber splice box on pole to transition to underground to the collector substation, including all fiber fusions in the splice box as required.
- Seller furnished fiberoptic cable shall be underground rated (from existing control house to dead end pole)
- Seller fiber shall OTDR reel test at 1550 nm and results provided to Buyer in.SOR format.
- OPGW fiber shall be installed at a height >15' on structures.
- At all splice locations, a 100' plus height above ground level reel of fiber shall be installed on a Seller supplied and installed coil bracket.
- Between the final structure and the Collector Substation Control House lightbox, Seller to supply and install innerduct/conduit and associated ADSS fiber.
- Seller to terminate ADSS fiber with Collector Substation Control House
- Seller to leave 100' of fiber and slack spool on a Developer supplied and installed coil bracket within the Control House
- Microduct/Schedule 40 PVC conduit with a minimum 2" diameter with 36" bend radius
- For purpose of developing a project, the Seller can assume the following:
    - Demarcation point between Developer/Seller installed Innerduct/conduit from the first structure and Buyer's installed innerduct/conduit is a Seller installed pull box or similar at a mutually agreed to point, typically at or the near the property boundary, between the interconnect substation and first structure Collector Substation (often initially marked as a stake in the ground)
    - Seller to supply and install a splice box on the first structure.
    - Buyer will supply and terminate fiber on both ends.
    - Buyer to perform OTDR on all splices with no losses greater than 0.10 dB allowed.

Figure 2: SCADA connection greater than 1,000 ft



Seller to land the Seller controlled fiber (i.e., ATT) on a Seller supplied and installed firewall (Palo Alto or CheckPoint are acceptable firewalls).

Seller to supply and install a firewall managed Level II switch with 3 VLANs configured (Seller to supply subnet information)

The 3 VLANs consist of the following.

- Wind Turbines
- Collector Substation
- Control

Seller to work with Buyer's Information Technology group in configuring the firewall using allow by exemption principle and opening only ports and protocols necessary for required functionality.

Configure VLAN Access Control Lists to manage routing for only necessary functions.

Seller to supply and install redundant core switches (IE4010 switch or similar) and connect to upstream SM SFPs.

Seller to supply and install fiber patch panels.

Seller to supply and install 42U server rack.

Seller to supply and install 8hr UPS.

Seller to supply and install miscellaneous fiber, ethernet jumpers, and cable management.

For purposes of design, assume that the site will be a CIP Low site.

Seller shall configure the SCADA system for access credentials including Admin, Operator, and View Only credentials; SCADA shall be View Only upon launch with credentials required for operational changes.

Seller supplies and configures a Power Plant Controller.

- The Power Plant Controller can be two SEL 3555 – RTACs in redundant configuration or similar.
    - Power Plant Controller shall be configured with the with the following Control Aspects
        - Control Modes
        - Voltage
        - VAR
        - Power Factor
    - Setpoint Control
    - Local
    - Remote – Automatic Generation Control

A narrative of the control configuration shall be supplied.

Seller shall supply and configure Ignition as the plant's SCADA system.

Seller to supply and install redundant Type I virtualized servers hosting the Ignition (DEL PowerEdge Rackmount server or equivalent)

- Each Type I server shall be sized (hard drive, memory, etc.) to allow both Ignition servers to be running in either location if needed.

Seller to supply and install one KVM switch with 19" display, keyboard, mouse.

- Ignition shall be supplied with Historian and unlimited tag licenses.

- Historian shall be sized for 2 weeks of 1 second data
- Seller shall supply and install one Inductive Automation Ignition HMI package

Seller shall supply and install one SQL server license (or equivalent)

  - o Seller to configure web portal access

Within Ignition, the Seller shall buildout the Graphical interface to include the following screens at a minimum:

- Site overview
- Control
- Alarm management
- Trending management
- Wind Turbine details
- MET details
- SCADA health (i.e., communication detail)
- One-Line (to include Meter details and all other high level RTU-RTU datapoints)
- Reporting Functions

Install Ignition utilizing least functionality privilege and operating system utilizing CIS Benchmark

- Seller to work with Buyer to define Ignition security user groups credentials including Admin, Operator, and View Only credentials; Ignition shall be View Only upon launch with credentials required for operational changes

Within Ignition, Seller to configure the object alarm configuration based on the I/O List

Seller to configure Major Interfaces including the following:

- PI
- RTU-RTU (Collector Substation to interconnecting Buyer Substation) - Seller to provide Buyer the following Point List
- Overall Point List
- Abbreviated Point List focused on Seller's typical importance list

Seller supplies and installs an IT rack for Buyer's exclusive use in the Collector Substation

- 19" rack with 24"x36" footprint
- Front and back lockable mesh doors and cable entry slots in roof
- 36" front clearance and 24" rear clearance
- Dual 120 V_{ac} UPS backed power strip with UPS ethernet monitoring capability, with UPS capable of 12 hours of backup run-time

At Substantial Completion:

Seller to transfer all licenses procured on Buyer's behalf to Buyer

- During license procurement, Seller shall work with Buyer in establishing Terms and Conditions which will allow for seamless transfer
- Seller and its subsidiaries shall surrender all rights to software development work for this project to Buyer for use within this site at a minimum.

Seller transfers Seller owned fiber account ownership to Buyer (e.g. takes over ATT account)

- Buyer installs and interconnects Firewall (between Buyer's network fiber and the site's Seller supplied Palo Alto/CheckPoint firewall)

Seller to develop and supply system documentation consisting of the following:

- Hardware/software manuals
- Server setup and configuration details
- All username and passwords
- Drawings list and specifications
- Testing and commission documentation
- Tag list with tag name, units, description, and range as a minimum

3.7 Control System and Communication Requirements

Seller shall furnish a local control system (LCS). The LCS shall be an integrated system that interfaces with the Project to allow for monitoring and/or control of all Project equipment and systems from one common location at the Project Site. In addition, the LCS shall interface with Met Towers, field instrumentation, and other data acquisition sensors to perform complete data acquisition, storage, and transmission functions. Seller shall also provide a remote terminal unit (RTU) and the LCS to RTU interfaces to provide for remote (off the Project Site) monitoring and control of the Project (including as required by NERC and MISO requirements). The LCS control cabinet power shall be installed and configured to feed from the UPS.

The LCS shall perform all control and monitoring functions both automatically and manually. These functions shall include:

- Control of the site electrical output to the grid
- Centralized control of all Wind Turbine parameters
- Performance metrics
- Coordination and communication for all site meteorological data
- Monitoring of the UPS, batteries, and other power generation equipment
- Monitoring of Project Site switching equipment
- Alarm generation for equipment failure or abnormal operation
- Equipment status
- Sequence of event recording
- Historical storage, data retrieval, and report generation.

The LCS equipment shall include reasonable spare capacity for future expansion. Without limiting the foregoing, the installed system shall include at least 20% spare or extra discrete input/output points and at least 20% spare or extra cabinet space for future input/output points, and the capacity of the LCS controllers shall provide at least 20% more computing capacity than necessary for the LCS system as designed and transferred to Buyer.

The design, materials, manufacturing, construction, testing, cleaning, coating, and packaging of all equipment and components included in the scope of the LCS shall comply with the applicable standards listed in Section 1.3.

3.7.1 Operational Interface

The Project shall be operated using an LCS and will leverage DNP3 over IP communications protocols. As DNP3 is not inherently secure, Seller will provide to Buyer any security options offered by Seller or expected to be used by Seller and will include these in the cyber security plan, as discussed in Section 3.8.1.1 of this Scope Book.

Seller shall provide information regarding support and any plans/roadmaps for transition of the LCS to a DER Management System (DERMS), including adoption of IEEE 2030.5. This information is for future planning purposes only; the implementation of DERMS and IEEE 2030.5 is not a requirement of this Scope Book.

3.7.2 Remote Access

For operation and maintenance activities, the Project shall include access to the control and monitoring system to enable remote access to monitor, manipulate, and control the setpoints, gains, and droop curves of these functionalities.

The control system shall:

- Utilize an Ignition SCADA platform.
- Include real-time data in no longer than one (1) minute intervals at a minimum.
- Ensure time-stamped data will be obtained from a consistent time source using an internal time source synchronized to GPS time and provided by Seller with the Project
- Create alerts accessible to both internal and external operators when devices under its control are not performing as expected with the communications mechanism to be proposed by Seller for review and acceptance by Buyer.
- Provide remote access to all IEEE 2800 settable parameters and any additional parameters required based on the following:

Access to controllable parameters may be provided via remote access over the network, but such access must be highly secure.

The vendor will provide remote access security controls as a part of the cyber security plan, which will include user identity management, encryption standards, intrusion detection features, and any additional pertinent security controls.

In addition to system security features, Buyer will provide transport level security for these functions as they traverse the network.

- Provide a mechanism for updating system software for security patching.
- Seller shall provide Buyer “maps” to be utilized by Buyer SCADA and Historian systems 6 months prior to mechanical completion.

Seller shall comply with the list of eligible protocols in Table 4 below:

Table 4. List of Eligible Protocols

Protocol	Transport	Physical Layer
IEEE Std 2030.55 (SEP2)	TCP/IP	Ethernet
IEEE Std 1815 (DNP3)	TCP/IP	Ethernet
Modbus	TCP/IP	Ethernet
	N/A	RS-485

3.8 Control System and Communication Requirements

3.8.1 Control System Security

3.8.1.1 Cyber Security

Seller shall design, build, and deliver a cyber security system and plan for the Project that conforms to applicable NERC CIP rules, regulations, standards, and Laws. Buyer shall provide Security Controls that will be required to be tested prior to site acceptance. If Seller becomes the site operator there will be shared responsibility between the Construction and Operator divisions agreed to by all parties. Seller shall develop and provide to Buyer a cyber security plan that includes accommodations to test the defined security controls. (Buyer may elect in its discretion to provide a sample plan for Seller to consider and possibly utilize.). The plan must include and cover:

- Steps taken in software development to detect and correct security flaws, including plans for code scanning.
- Methods used to protect system user identities and logins, including methods of encryptions and use of certificates.
- Methods to assure reliable and confidential communications of inbound commands and outbound data
- A description of software maintenance processes, including the process to patch security vulnerabilities in the vendor's product
- Test planning to assure compliance with the cyber security plan.

Seller shall implement cybersecurity controls for low impact and non-CIP sites as applicable in development of the NERC CIP cyber security plan. Buyer expects to provide additional guidance or input in the development of the plan to ensure the Project's cyber systems are compatible with and provide the protection required or appropriate for Buyer's cyber systems. The plan is subject to Buyer's review and approval in advance of the FNTP date.

Buyer will contract for a third-party vulnerability assessment and penetration test during Project testing. Such testing shall be done, at Seller's expense, as a "type" test for the initial unit, with testing not required for subsequent units. Seller shall correct vulnerabilities identified in this testing and the completion of such corrections shall be a condition to substantial completion.

Seller shall:

- Undertake periodic reviews of emerging vulnerabilities that will potentially impact the Project
- Provide notice to Buyer of new vulnerabilities within a specified time frame from a new vulnerability becomes known.
- Develop corrections (patches) to address identified vulnerabilities.

Seller shall assure the above software support, including operations and maintenance, is provided through Substantial Completion. Buyer reserves the right to perform periodically independent, recurring security audits to assure compliance with the security maintenance requirements of this Scope Book during the performance of the Work.

Once the Project's cyber security system is in operation, Seller shall not provide communications directly to the system and must access the system via Buyer security controls. If Seller reasonably requires monitoring (read-only) information to perform the Work, Buyer will use commercially reasonable efforts to provide such information via internet solutions to Seller or the applicable vendor after Seller's request therefor. Any remote access to the cyber security system shall be covered in the cyber security plan, and Buyer agrees to use commercially reasonable efforts to cooperate with Seller to provide mutually agreeable solutions for gaining access to the system once in operation.

3.9 Metering Requirements

Project shall include a revenue grade meter(s) for performance testing.

Please see Appendix 1 - Collector Substation.

3.10 Interconnection of Utilities

Seller shall provide all utility interconnections needed for construction, commissioning, and testing of the Project or performance of the Work (in each case, or any portion thereof), e.g., potable and non-potable water, wastewater, sanitation (including sewage), temporary power, telecommunications, internet, and fuel.

3.10.1 Data Network Engineering and Data Network Operations (DNE/DNO)

3.10.1.1 DNE Design

Buyer will provide to Seller the DNE design including address space of the affected zones. Zones to include the collector substation, Wind Turbines, physical security (CCTV and ACCESS control), and Buyer corporate network. The DNE design will provide flexibility for future of division of responsibility for operations.

Allocation of devices in defined address space will be left up to respective parties network address space of networks will be provided by Buyer DNE and filtered by Buyer onsite firewall to ensure separation of separately managed network and in compliance with applicable Buyer and regulatory requirements.

Seller is responsible for ensuring address space provided by Buyer is adequate to support devices being installed and configured by Seller. Seller shall install Cisco network devices unless otherwise approved by Buyer.

Seller's design shall be subject to Buyer approval at Buyer's sole discretion. Seller shall be responsible for all engineering, construction, installation, and testing necessary to comply with physical security requirements.

Seller shall provide redundant Layer 2 network switches. Network segmentation of Seller-provided network shall meet the following requirements:

- Collector substation equipment (RTU, breaker relays, etc.) shall be on its own VLAN segment
- Wind Turbine equipment (Inverters, Metrology, PPC, etc.) shall be on its own VLAN segment
- Wind Turbine access control and camera system shall be on its own VLAN segment
- Prior to substantial completion, segments shall be filtered by a Seller-provided firewall. Logical segments shall be filtered by a Buyer onsite firewall after substantial completion Seller shall provide to Buyer reasonable and necessary requirements for firewall configuration between segments
- Prior to substantial completion, network connectivity shall be provided by Seller. After substantial completion, network connectivity shall be provided by Buyer
- Seller to use defined cable and connectors. User-defined color codes for low CIP sites are as follows: primary ethernet shall be blue, secondary ethernet shall be gray, back-up ethernet shall be green, iLO/KVM shall be yellow, and serial consoles shall be black

3.10.1.2 Procurement and Ownership

Seller shall procure equipment with a minimum five-year manufacturing and support warranty with service level agreement of next day replacement.

Any items that will reside on the Buyer's network (e.g., CCTV, firewall, access control), Buyer will be responsible for procuring, installing, operating, maintaining, and managing. Special cases may be considered but are subject to strict review of cyber asset protection and monitoring. As such a third-party operation of a facility may be allowed to purchase, configure, install, and maintain network equipment if the equipment will be protected or isolated from the Buyer network via firewall apparatus or diode and the third party will be establishing means to replace failed equipment through a five-year period of operation.

3.10.2 Desktop Equipment

As required by Buyer for the functionality of the site and in support of Buyer associates or vendors onsite, Buyer will specify desktop equipment to be utilized. Seller shall install fixtures and wiring terminated on appropriate breaker or patch panels to allow Buyer field services to install and configure equipment. Desktop equipment includes laptops, desktop computing boxes, printers, and peripheral devices.

3.11 Physical Security Installations

The physical security of the site shall comply with Buyer and regulatory requirements. Seller is responsible to implement as described in the following sections.

Location	Description	Equipment by Seller	Equipment by Buyer
Collector Substation	Minimum 2 cameras, located at opposite corners of substation area	Wiring (power and communications) and required hardware supports	Camera
	Electrically operated slide gate with keycard reader	Keypad, Slide gate, gate operator, and wiring (power and communications), grounding loop, and hardware for mounting keycard reader	Keycard reader
Collector Substation Control House	Keycard reader for lock on control house personnel door	Keypad, Wiring (power and communications) and required hardware supports for mounting keycard reader	Keycard reader

3.11.1 CCTV Installations

Seller shall supply the network video recorder (NVR), Genetec Streamvault SVR-500A or approved equal, and pan, tilt, zoom cameras for the project site.

Seller-supplied cabling for all cameras at the Project Site will be copper or fiber traveling and connect to identified network switches supplied by Buyer. An uplink cable will connect the NVR to the Buyer's network switch.

The location of NVR equipment shall be monitored via installed camera.

Seller shall design the system so that all cameras to be mounted at the Project Site will be mounted within a physically secure area within or enclosed by fencing installed and will have an unobstructed line of sight and the ability to obtain and record reasonably clear images, at minimum, at and around each location to be covered by the camera. The design and installation of the system will include proper conduit, ethernet, and fiber, and appropriately placed and connected power outlets/power supply for Buyer to contract and install.

Seller shall use the following camera design criteria for camera mounting locations.

- Exterior Open space cameras shall support panoramic with PTZ attachment below.
- Interior Cameras focused on doors shall be fixed dome providing a double ganged ceiling mounted junction box.
- Exterior Cameras focused on doors shall support panoramic, fixed dome, or fixed bullet style providing a double gang ceiling mounted junction box.
- Locations to be recorded:
- Collector Substation(s)
- Either side of any human passable door into or inside the Collector Station Control House.

Seller shall incorporate the agreed upon design into appropriate design drawings and receive approval from Buyer security team.

Seller shall install necessary mounting hardware, conduit and wiring to Buyer patch panels per drawings.

Buyer to contract with Buyer approved vendor to install NVR, cameras, and make final connection from patch panels to equipment to be installed.

3.11.2 Locks

The site will be a mix of Buyers access control system for control houses and battery storage. All equipment shall be lockable per NERC/CIP requirements. Seller shall be responsible for project until COD and provide all keys properly labeled at COD. Buyer will supply its own locks at COD.

All egress and ingress doors on building not on access control system shall utilize high security puck lock or a high security cylinder lock.

All NEMA enclosures shall utilize a high security padlock or a clasp lock for the following use equipment types:

- IT
- Telecom
- Met Towers

Seller shall coordinate with Buyer Security to intake and begin management of CyberLock equipment using the CyberLock system managed by Buyer.

3.11.3 High Security Chain

Seller shall provide high security chains on appropriate gates or other site access points. The chain will be of a 3/8" minimum heavy-duty construction, rated either "High Security" or Grade 100 or higher, with a through tempered alloy and square-sided construction to minimize cutting ability.

3.11.4 Lock Forms

The acceptable types of locks Seller to provide at the Project Site are:

- High Security Padlock – A padlock that meets certain levels, a minimum grade of F5/S6/K5/C4 per ASTM F883-13 in each of the areas of concern is desired.
- High Security Puck Lock – A padlock in the form of a hockey puck with the shackle hidden in a recess on the back side. This type of lock provides its high security by protecting the shackle itself from access, uses the same high security key as the padlock, and includes a special hasp that has a surround shield that protects the hasp tab and hole from cutting where the shackle enters the padlock.
- Clasp Lock or Cam lock that fits NEMA cabinets as required.

3.11.5 Lock Locations

Seller shall consider the location types described in Section 3.11.2 and 3.11.6 below for inclusion of the CyberLock product

3.11.6 Buildings

All egress and ingress doors on building not on Access Control System shall utilize High Security Puck Lock or a High Security Cylinder Locks

All NEMA enclosures shall utilize a High Security Padlock or a Clasp Lock for the following use equipment types;

- IT
- Telecom
- Met Towers

Standard Equipment List			
Part #	Description	Manufacturer	Equipment Type
920NTNNEK00000	R40	HID	Reader
ES4200-K3-T1	Door prop alarm	DSI	Sounder
S3 backbox	door prop alarm back box	DSI	Sounder
9600 630	Electric Rim Strike	HES	Lock
1500C	Electric Recessed Strike	HES	Lock
LD 22 EO SP28 3'	Electrified Crashbar	Von Duprin	Lock
LNL-X2220	Intelligent Door Controller	Lenel	Panel
LNL-1320	Door Controller	Lenel	Panel
4405-A	DPDT door contact	GRI	Contact
FPO150/250-3D8P2M8NL4E8M2 / P16-A	Enclosure Large-Life Safety-Networked 2220	Life Safety Power	Enclosure
FPO150/250-3D8P2M8NL4E8M2 / P16-C	Enclosure Large-Life Safety-Networked 1320's	Life Safety Power	Enclosure
FPO75 – B100M8PNL4E4M / T4-A	Enclosure Small-Life Safety-Networked 2220	Life Safety Power	Enclosure
FPO75 – B100M8PNL4E4M / T4-C	Enclosure Small-Life Safety-Networked 1320's	Life Safety Power	Enclosure
FPO150-Boxed	Power Supply	Life Safety Power	Panel
FPO250-Boxed	Power Supply	Life Safety Power	Panel
FPO75-Boxed	Power Supply	Life Safety Power	Panel
M8-Boxed	8 Managed Outputs	Life Safety Power	Panel
M8P-Boxed	8 Managed Outputs	Life Safety Power	Panel
NL4-Boxed	Network - 4 ports	Life Safety Power	Panel
NLX-Boxed	Network - 8 ports plus RS485	Life Safety Power	Panel
D8-Boxed	Aux Outputs	Life Safety Power	Panel
D8P-Boxed	Aux Outputs	Life Safety Power	Panel
SD-16	16 Managed Outputs	Life Safety Power	Panel
BT500-8	Midspan, 500W, 8 Port, 802.3bt	Life Safety Power	Panel
BT500-16	Midspan, 500W, 16 Port, 802.3bt	Life Safety Power	Panel
BX50-Boxed	PoE PS | 50W | FoE	Life Safety Power	Panel
BX75-Boxed	PoE PS | 75W | Local Fire	Life Safety Power	Panel
MSM25	Software	Life Safety Power	Panel
RS-Mod	RS485	Life Safety Power	Panel
VMA-AS3-16P09-NA	Video Appliance	Avigilon	Video
ACC7-ENT	Video License	Avigilon	Video
4461030	Composite - Yellow	Smartwire	Cable
775600-110DB	Cat6 Burial	Smartwire	Cable
Q3-15201806	18/6 Burial - Shielded	Houston Wire & Cable	Cable
RM-1008WBL1B	18/4 Burial	Remee Wire & Cable	Cable
Q3-15001802	18/2 Burial	Houston Wire & Cable	Cable
RM-725180L2W	18/2 Plenum	Remee Wire & Cable	Cable
RM-6BENHM3Y	Cat6 Plenum - Yellow	Remee Wire & Cable	Cable
DS160	Motion Detectors	Bosch	Motion Detector

4 Commissioning and Testing

Seller shall provide supervision, inspection, testing, and quality control of the Work to ensure it is completed safely, competently, and efficiently. Seller shall devote attention, skills, and expertise as is necessary to perform the Work in accordance with the Requirements. All materials shall be new, unused, of the highest quality, free of defects and irregularities, and consistent for use in wind generation facilities. Equipment shall be installed, assembled, and tested in strict compliance with the manufacturer's drawings, manuals, code markings, and instructions, and any proposed materials, structures, and/or assemblies shall be maintainable in the simplest and most cost-effective manner possible.

Seller shall develop a commissioning plan and process (Commissioning Plan) that ensures all Project components meet the requirements of the Agreement and this Scope Book including Wind Turbine Reliability, and Plant Capacity. The Commissioning Plan shall outline the tasks, processes, procedures, and deliverables required to commission the Project, conduct the Performance Tests, and prove the function and performance of the Project, including its components. The Commissioning Plan shall designate the tests and processes required to be completed and performed prior to Mechanical Completion and Substantial Completion in accordance with the Agreement, including completion of all quality assurance and quality control (QA/QC) tests prior to Mechanical Completion and completion of all Project Performance Tests prior to Substantial Completion.

Seller shall provide the Commissioning Plan to Buyer at least 60 days in advance of the planned Energization date prior to the commencement of Seller's commissioning activities. Buyer shall provide comments, if any, in good faith on such Commissioning Plan to Seller within ten (10) Business Days after Buyer's receipt of such Commissioning Plan. If Buyer provides such comments, Seller, within five (5) Business Days after Seller's receipt of Buyer's comments, shall revise the Commissioning Plan to address Buyer's comments and resubmit the revised Commissioning Plan to Buyer for review and approval. This procedure shall be repeated until the Commissioning Plan, as modified, is approved by Buyer. Buyer shall promptly notify Seller in writing if it has approved the Commissioning Plan.

Buyer shall be given reasonable advance notice of and a reasonable opportunity to review, monitor, and witness all commissioning and testing activities performed as part of the Work. Seller shall provide Buyer a schedule of all factory and Project Site tests, inspections, and performance tests within thirty (30) days after the FNTP Date and any update to such schedule promptly after such update is made.

Buyer and its contractors and Representatives shall be permitted access to the Project Site at all times and shall be permitted to visit factories during the manufacturing of equipment, materials, and components for the Project and to witness factory tests and inspections. Buyer may contract with one or more third parties to conduct individual inspections and tests at any time to confirm test results and to verify that the Project has been installed and constructed in accordance with the requirements of the Agreement and this Scope Book.

Where manufacturing or finishing is performed at the Project Site, reviews, inspections, studies, and tests shall be conducted as a replacement for an appropriate workshop test. The preliminary check-out and test runs, the reliability test run, and the Project Performance Tests shall be carried out by Seller under the witnessing of and review by Buyer and its contractors and Representatives.

These tests shall demonstrate, among other things:

- Completeness of the mechanical and electrical construction works
- Correctness of the assembly and installation
- Safety and reliability of the Project under all operating conditions
- Proper functioning of the components and system under all operating conditions

4.1 Commissioning Documentation and NERC Compliance

The minimum required information for commissioning shall be documented and checked, if appropriate, during the commissioning period, including as listed below:

- Basic system information
- Project location and installation date
- Rated system capacity
- Wind Turbines – manufacturer, model, and quantity
- Commissioning date
- System designers' information
- System installer/contractor information
- Detailed single-line diagram of the Project
- Cable type, size, and length
- Specification (current and voltage rating) of overvoltage protection device
- Project electrical characteristics
- Project junction box locations
- Project main cable specification
- Location, type, and rating of over voltage protective devices
- Earthing and over voltage protections
- Single-line diagram(s), showing the facility ratings of all series and shunt electrical devices from the generator to the Electric Interconnection Point.

- The details of all earthing, lightning protection, and surge protection systems
- A single-line diagram showing AC isolator location, type, and rating and similar information for AC over-current protection device
- Technical data sheet for all major components
- Warranty documentations for Wind Turbines with the information of starting date of warranty and period of warranty
- Documentation of all required Permits
- Documentation and stock of spare parts and Consumables
- Commissioning test reports
- Equipment calibration certificates
- Operation and maintenance information, including:

Procedures for verifying correct system operation and minimum guaranteed performance parameters

Preventive and corrective maintenance procedures

Scheduling of routine maintenance

A checklist of what to do in case of system failure

Emergency shutdown/isolation procedures

Seller shall be compliant with the applicable NERC Standards in effect as of the Effective Date including those set forth in Appendix 10 to the Scope Book. Seller shall be responsible complying with all active "Generator Owner" (GO) and "Generator Operator" (GO) obligations set forth by applicable NERC standards as written and referenced in Appendix 10 through Substantial Completion.

Seller's GO/GOP obligations shall transfer to Buyer at Substantial Completion.

Seller will provide to Buyer reasonable evidence of the Seller's compliance with, the NERC Standards and any other NERC-related documentation reasonably requested by Buyer or required by NERC as required by the due dates listed in appendix 10.

4.2 Factory Acceptance Tests

All equipment, materials, and components specified in Section 2 of this Scope Book shall be factory tested to ensure such items are suitable for use at the Project and will be able to satisfy the requirements of the Agreement, including this Scope Book. Quality check lists and test protocols for such equipment, materials, and individual components shall be submitted by Seller prior to and during the factory tests. Seller shall have the right to witness such testing as set forth therein.

All equipment, materials, and components shall be "routine" or "type"-tested in the factory in accordance with the applicable standards set forth in Section 1.3 of this Scope Book. The frequency of testing shall be as agreed between Seller and Buyer prior to the FNTP Date. Type tests shall not be repeated if type test certificates of identical equipment designed and fabricated to a specification identical to that of the Project are available. Any proposed type test certificates must be submitted to Buyer for review and approval.

The following sequence shall be included in Seller's QA/QC Plan provided as part of the PEP:

1. Seller shall keep a "Three-Month Look Ahead Inspection Schedule," which shall be updated on a regular basis as part of the monthly report to be delivered under Section 6.2 of the main body of the Agreement.
2. Seller shall provide Buyer notice of its intent to inspect prior to any inspection as detailed in the Agreement.
3. Prior to notifying Buyer of its intent to inspect, Seller shall have issued and obtained Buyer's approval of the relevant inspection test plan (ITP) and all other technical documentation relevant to the inspection.

4. Buyer will notify Seller of Buyer's intent to attend the inspection. Buyer may contract with third party inspectors to attend the inspection with, or on behalf of, Buyer.
5. Upon completion of the inspection, Seller shall issue an inspection test report summarizing the results of the inspection, including any reports generated by the manufacturer, for review and approval by Buyer.

Seller shall notify Buyer of all offsite testing schedules at least 30 days in advance of testing activities and copies of testing reports (including a summary of testing procedures and acceptance criteria) shall be submitted to Buyer within 30 days of completing such test. Seller shall immediately notify Buyer upon becoming aware of any deviations between specified properties and tested properties.

Seller should expect Buyer to attend the inspections of at least the following equipment:

- Rotor Blades
- Nacelle (including generator, yaw system, power converter, hub, pitch system, gearbox, and main bearings)
- Tower
- Controller/ LCS
- Switchgear
- Step-Up transformers

4.3 Project Performance Tests

Seller shall conduct all Project Performance Tests after the Closing and synchronization of the Project to the interconnected electric grid. Project Performance Tests may be run simultaneously when possible.

Requirements, standards, and procedures for the performance of the Project Performance Tests shall be conducted in accordance with the Commissioning Plan under Section 4 of this Scope Book.

The Project Performance Test Report shall include the following information with respect to the Project Performance Test Results:

- Summary
- Test Protocols
- Instrument Calibration Certificates
- Test Data (manual and data acquisition)
- Field Notes
- Calculations
- Conclusions

4.3.1 Wind Turbine Acceptance Test

Seller shall cause a Run Test to be performed to measure Wind Turbine reliability in accordance with the requirements, standards, and procedures set forth in Scope Book.

The Run Test shall consist of an operational trial test of a Wind Turbine for seventy-two (72) consecutive (plus, in the case of clause (b), the Interim Check (as defined in the Turbine Supply Agreement) hours with the following test criteria: (a) demonstrating ninety-five percent (95%) availability with no Wind Turbine Faults; (b) achieving twelve (12) cumulative hours of non-continuous production; and with respect to at least fifty percent (50%) of the Wind Turbines within the Project, the following additional test criteria shall apply: (c) achieving two (2) consecutive hours of continuous production at or above ninety percent (90%) of the Wind Turbine's rated power output for the wind speeds during such seventy-two (72) hour period.

With respect to each Wind Turbine that has completed a Run Test, Seller shall provide to Purchaser a written report stating, at a minimum, (a) start date, (b) start time, (c) start wind speed, (d) start kW reading, (e) stop date, (f) stop time, (g) stop wind speed, (h) end kW reading, (i) Wind Turbine faults, (j) Wind Turbine

Availability, and (k) total kW reading for the duration of each such Run Test (the "Run Test Completion Report"). The Run Test Completion Report shall attach relevant data in a report from the SCADA system as proof of successful completion of the Run Test. Such report may include more than one Wind Turbine so long as all data points for each Wind Turbine are reported on a per Wind Turbine basis.

5 Warranty

Seller shall procure warranties from original equipment manufacturers that satisfy the requirements set forth in this Section. Seller shall notify Buyer of any procedure, activity, or other Work that may void a manufacturer warranty or violate any Law or applicable Permit reasonably in advance of the performance of such procedure, activity, or Work. Seller shall provide to Buyer all original equipment manufacturer warranty documents.

5.1 Wind Turbine Warranty

The Project Wind Turbines shall be provided with an original equipment manufacturer's warranty that the Wind Turbines are free from defects in material, manufacture, workmanship, and design, which warranty may commence no sooner than delivery of the Wind Turbines to the Project Site and continue for a minimum of two (2) years from the warranty commencement date. The Turbine Supplier shall be required to repair or replace at its cost any Wind Turbine (or any component thereof) in breach of such warranty. The Wind Turbine warranty shall cover, to the extent applicable, the cost of removal from the Project Site, transportation to and from the repair facility, reinstallation after repairs, and any and all other "in and out" work.

Each Wind Turbine shall be furnished with the power curve and sound level warranties consistent with the terms set forth in the Turbine Supply Agreement. Seller shall cause the power curve test to be performed and successfully passed. Similarly, Seller shall cause pre- and post-construction noise monitoring to be performed to confirm sound levels are reasonable and acceptable.

5.2 Transformer Warranty

The Project transformers shall be provided with an original equipment manufacturer's warranty that the transformers are free from defects in material, manufacture, workmanship, and design, which warranty shall commence no sooner than the earlier of (i) energization thereof (in which case it shall continue through at least eighteen (18) months thereafter) or (ii) arrival at the Project Site (in which case it shall continue through at least thirty-six (36) months thereafter). The transformer manufacturer shall be required to repair or replace at its cost any transformer (or component thereof) in breach of such warranty. The transformer warranty shall cover the cost of removal from the Project Site, transportation to and from the repair facility, reinstallation after repairs, and any and all other "in and out" work.

5.3 Balance of Plant Warranties

Seller shall provide written confirmation to Buyer that all Balance of Plant equipment, including all parts spare parts, are free of defect. Balance of Plant equipment warranties shall be a minimum of 24 months from the date of arrival to the project site unless otherwise approved by Seller. Warranties shall cover any defects, malfunctions, faulty installation, or other conditions other than those introduced by improper maintenance, improper operation, or vandalism. Seller shall be responsible for all labor, procurement costs, mobilization of personnel, and any other expense which the Seller recognizes to repair or replace equipment during the period of the warranty.

Seller shall ensure that the provider of the LCS software commits to the following:

- Conduct reviews for emerging vulnerabilities that will potentially impact the LCS
- Notify Buyer of new vulnerabilities within a time frame acceptable to Buyer after those vulnerabilities become known
- Develop corrections (patches) to the product to address identified vulnerabilities

6 Training

Buyer will identify a project team to be trained by Seller during the design, construction, commissioning, and testing of the Project. Seller shall provide the required training to 8 to 12 people and through a 40-hour course. Scheduling of the training program shall be subject to mutual agreement between Seller and Buyer. The objective of the training program shall be to train Buyer's personnel to be qualified and self-sufficient in the overall operation, maintenance, and troubleshooting of each system included, so the Project is operated safely and efficiently.

Seller shall provide for Buyer's operation and maintenance staff a training program that includes training for all components and systems of the Project, including use of all related equipment and software. The training program shall include a training plan, training materials, and presentation schedule designed to ensure a successful training program. The training program shall consist of on-the-job training during different stages of the Project and shall be supplemented by classroom instruction and computer-assisted training.

All training shall be conducted at the Project Site prior to initial operation of the Project or the generation of power therefrom. All costs of training shall be borne by Seller. Expenses incurred by Buyer's project team to attend training at the Project Site will be borne by Buyer. Seller shall be responsible for any expenses incurred by Buyer's project team for any training that occurs at any alternative locations. Training shall be held only during normal working days and hours and shall not be held on holidays or weekends or require the need for overtime of Buyer's personnel.

All presented lectures shall be conducted by personnel having extensive experience both in Wind plant start-up, O&M, and training. All training shall include classroom and hands-on field instruction. Additional hard copies and one electronic equivalent of the training manual shall be provided to Buyer.

Training shall include:

- Plant overview
- Performance modeling basics and software operation, including control algorithms
- Introduction to Project equipment (Wind Turbines, LCS, Met Towers, transformers)
- SCADA
- Collector substation
- Control system basics
- Interconnection basics
- Operations and maintenance
- Lockout-tagout

Seller shall ensure the instructors have the knowledge and qualifications to participate in the training program. All instructors must be fluent in both written and spoken English.

The routine training program consists of assigning each individual a qualification goal and schedule for accomplishment. Each individual will receive position qualification requirements (PQRs) based on their specific qualification schedule, which shall outline the specific knowledge and demonstrated skill requirements for satisfactorily performing in the required position.

7 Health and Safety Requirements

7.1 General Requirements

Seller shall prepare and implement a comprehensive Project/Project Site-specific HSE Plan for the performance of the Work. The HSE Plan shall apply at all times during the design, preparation, construction, and operation of the Project and shall be prepared in accordance with, and require compliance with, all Laws (including codes and standards) and applicable Permits. The terms of the HSE Plan shall not conflict with the terms of the Project Custody Plan. For the period from and after the Closing, the terms of the HSE

Plan shall be no less stringent than the terms of Buyer's rules, policies, procedures, and programs applicable to sites similar to the Facility site and the performance of work similar to the Work for any of the health, safety, environmental, and other matters covered in the HSE Plan and will not eliminate, condition, or otherwise limit any rights granted to Buyer (or any member of the Buyer Group) under the Agreement or any Ancillary Agreement.

Seller shall submit to Buyer at least one hundred twenty (120) days prior to the Construction Commencement Date an initial HSE Plan that demonstrates Seller's commitment to the highest standards of health and occupational hygiene of the construction workforce during the development, construction, operation, maintenance, and repair of the Project. Buyer shall provide its comments to the initial proposed HSE Plan, if any, to Seller within forty-five (45) days after Buyer's receipt of the initial proposed HSE Plan from Seller and within ten (10) Business Days after Buyer's receipt of any modification to a proposed HSE Plan from Seller, and Seller shall, in each case, consider in good faith timely comments from Buyer on the proposed HSE Plan. Seller shall be responsible for implementing, complying with, and enforcing, and performing the Work in accordance with, the approved HSE Plan. Seller shall not commence Work at the Project Site until the HSE Plan has been approved by Buyer. Buyer shall not unreasonably withhold, condition, or delay its approval of an HSE Plan.

The HSE Plan shall address and include pertinent information regarding any known or reasonably anticipated safety issues arising out of the Work on the Project Site, including the equipment to be incorporated into the Project (such as, for example, how to properly handle generated and stored energy in emergencies) and operation of the Project prior to Substantial Completion. Without limiting the foregoing, the HSE Plan also shall set forth Seller's detailed plan for addressing Environmental risks and challenges that may arise during the construction, commissioning, testing, operation, maintenance, and repair phases of the Project.

The Project shall be designed and HSE Plan (and Site Security Plan) developed to minimize the risk of injury to personnel and to the public during performance of the Work, including during the use, operation, maintenance, repair, and replacement of the Project or components thereof.

Seller shall ensure that guidelines and policies for maintaining hygienic conditions and appropriate shelter or shading at eating, resting, drinking, washing facilities, and restrooms are established and adhered to by individuals at the Project Site.

The Project shall be designed to cease to energize and trip off in the event of a grid power outage. In such circumstance, the Project shall cease to energize, trip off, and physically isolate from the interconnected grid to prevent interaction with the grid (nominal auxiliary load contactors may continue to serve these loads). This shutdown/isolation mode includes both normal shutdown and system trips requiring reset.

Hazardous areas on or at the Project Site shall be identified and marked as such, and Seller shall select and install suitable equipment for use in such areas.

7.1.1 Safety Rules and Procedures

The Work shall be performed and completed in accordance with the HSE Plan and Site Security Plan. Any safety rules and procedures required for any specific activities of the Work shall be included in the HSE Plan.

7.2 Community Relations

Seller shall manage for community relations with respect to the Project through Substantial Completion (except as otherwise directed by Buyer after the Closing). Seller shall use best efforts to undertake such works and other activities as necessary or advisable to engender and maintain, and shall perform the Work and its other obligations under the Agreement in a manner that is intended to engender and maintain, a positive perception of the Project within, and a harmonious relationship with, the surrounding community, such that Buyer could reasonably be expected to inherit that perception and relationship at the Closing and thereafter preserves the same through Substantial Completion and, to the extent based on Seller's or the Seller Service Providers' acts or omissions, thereafter.

8 Submittals

8.1 Submittal Requirements

Without limiting the information summarized herein, the purpose of this attachment is to summarize the minimum requirements for Seller-provided submittals, including Seller Deliverables.

8.1.1 General Requirements

Seller shall name and label all submittals using a Buyer-approved naming convention. Such naming convention shall be used consistently for all submittals, and the only filename modification for revised submittals shall be a change in revision number. Unidentifiable submittals will be returned for proper identification.

Submittals shall be accompanied by copies of native, electronic design files (e.g., AutoCAD .dwg file, PLS-CADD .bak file, electrical model files (PSS/E, EasyPower, ETAP, CYME), etc.), including for interim design transmittals (e.g., 30%, 90%, IFC, etc. as applicable) and As-Built Drawings.

All design submittals shall be provided in a common and consistent coordinate system. Such coordinate system shall be subject to Buyer approval.

All design submittals (including product sheets, mix designs, verification procedures, installation procedures, testing procedures, etc.) shall be approved by the applicable engineer of record prior to submitting to Buyer.

Seller shall prepare and maintain a documentation list for the Project. This list shall include, at a minimum, a listing of all Seller Deliverables and the status (including responsible party) and revision number of each. The naming and labeling conventions for all Seller Deliverables shall be coordinated with and approved by Buyer. The documentation list shall be updated by Seller each time a new or revised drawing or document is issued, at a minimum, including identifying any open and/or pending submittals for review.

Seller shall prepare and maintain a complete log, including supporting documentation, of all requests for information (each, an "RFI") issued throughout performance of the Work. This log shall include, at a minimum, a listing of each RFI and the status (including responsible party) and revision number of each. The naming and labeling conventions for all RFIs shall be coordinated with and approved by Buyer. The documentation list shall be updated by Seller each time a new or revised RFI is issued, at a minimum.

Seller shall provide to Buyer periodic written reports as to the actual progress of the Work in comparison to the Project Schedule. These reports shall include, but are not limited to, the plan of the day report, the weekly progress report, and the monthly progress report.

8.1.2 Quality Requirements

Scanned submittals are not acceptable. All submittal text shall be electronically recognizable and searchable.

Submittals to Buyer shall be of suitable quality for legibility and reproduction purposes. Every line, character, and letter shall be clearly legible. Drawings shall be useable for further reproduction to yield legible hard copies.

Documents submitted to Buyer that do not conform to specified requirements shall be subject to rejection by Buyer, and upon request, Seller shall resubmit conforming documents. If conforming submittals cannot be obtained, such documents shall be retraced, redrawn, or photographically restored as may be necessary to meet such requirements. Seller's (or its subcontractor's) failure to initially satisfy the legibility quality requirements will not relieve Seller (or its subcontractors) from meeting the required schedule for submittals, as prescribed in the submittal schedule herein or elsewhere in the Agreement.

8.1.3 Submittal Completeness

Submittals shall be complete with respect to dimensions, design criteria, materials of construction, and other information specified to enable Buyer to review the information effectively.

Where standard drawings are furnished which cover a number of variations of the general class of equipment, each drawing shall be annotated to indicate exactly which parts of the drawing apply to the equipment being furnished. Use hatch marks to indicate variations which do not apply to the submittal. The use of "highlighting markers" will not be an acceptable means of annotating submittals. Such annotation shall also include proper identification of the submittal permanently attached to the drawing.

8.1.4 Transmittal of Submittals

Submittals and Project documents shall be transmitted in (a) nonproprietary, native electronic format, incorporating any necessary reference files; and/or (b) Adobe (*.pdf) files created directly from native electronic format.

All electronic submittals shall be uploaded to Buyer's web-based document management site.

All electronic submittals shall be clearly named and versioned (e.g., revision number, date appended to file name).

8.1.5 Buyer's Review

Buyer's review and approval of submittals will not relieve Seller of responsibility for any deviation from the Requirements unless Seller has in writing called Buyer's attention to such deviation at the time of submission, and Buyer has given written concurrence in and approval of the specific deviation. Approval by Buyer shall not relieve Seller from responsibility for errors or omissions in submittals.

Seller shall make all modifications noted or indicated by Buyer and return the required number of revised submittals until approved. Direct specific attention in writing, or on revised submittals, to changes other than the modifications called for by Buyer on previous submittals. After submittals have been approved, submit copies thereof for final distribution. Previously approved submittals transmitted for final distribution will not be further reviewed and are not to be revised. If errors are discovered during manufacture or fabrication, correct the submittal, and resubmit for review.

Seller shall submit equipment catalog cut sheets for Buyer review and approval prior to procurement.

8.1.6 Design Submittals

All design submittals shall bear the Project name, the status of the submittal (e.g., Preliminary, Issued for Bid, Issued for Construction, As Built), and shall be sequentially numbered with a unique identifier.

Issued-for-construction drawings shall not be changed or substantially deviated from without Buyer approval.

As-Built Drawings: As-Built Drawings shall be issued as the next sequential revision from previous releases. The revision block shall state "As Built". All clouds, revision diamonds, and other interim control markings shall be removed, and all information listed as "later" or "hold" shall be completed. The As-Built Drawings shall include a final bill of materials, and native copies of all drawings and layouts. As-Built Drawings shall be created in the latest version of AutoCAD, or in the version of AutoCAD utilized by Buyer, as applicable and reference files shall be merged into the final deliverable file.

All materials shall be fully identified by Seller, and each engineering package shall include a bill of materials, including all equipment and materials to be procured. Every item in the bill of materials shall have a unique identifier (typically numerical). Each bill of materials shall list product name, manufacturer, unique product / part number, and quantity.

All engineering shall be performed under the supervision of and stamped by the engineer(s) of record, who shall be a registered professional engineer with a current license in the State where the project is located. Such professional engineer(s) shall be registered in the applicable discipline for the drawings being signed and sealed.

8.2 Documentation to be Submitted (General)

Seller shall prepare and submit to Buyer the following documents during the Project. Refer to Table below for requirements.

Item	Description	Due
8.2.1	Weekly updates to Project Schedule	as per appendix 11
8.2.2	Document control plan per appendix 11	30 days after Execution Date
8.2.3	Project execution plan per	as per appendix 11
8.2.4	Quality assurance/control per appendix 11	30 days after Execution Date
8.2.5	Health and safety plan per appendix 11	30 days after Execution Date
8.2.6	Site environmental plan per appendix 11	30 days after Execution Date
8.2.7	Property Protection Design Basis Document (DBD) per appendix 12	90 days after Execution Date and updated as needed per design.
8.2.8	List of all Hazardous Material to be brought onto or generated at the Project Site by Seller or any Subcontractors	Prior to bringing or generating such Hazardous Material onto or at the Project Site
8.2.9	Hazardous waste management and control plan per appendix 14	Prior to Seller mobilization
8.2.10	Manufacturer's product sheets (material cut sheets) for all permanently-installed equipment and materials	14 days prior to installation of applicable equipment / material
8.2.11	Name and qualifications for proposed testing agencies (civil, structural, electrical, O&M building, etc.), as described herein	14 days prior to initiating investigations
8.2.12	RFI log, as described herein	Updated concurrent with each RFI
8.2.13	Preliminary schedule for all factory acceptance tests	45 days prior to the first occurrence of any such test or 60 days after the Execution Date, whichever occurs first
8.2.14	Copies of factory acceptance test reports, as described herein	Within 14 days of completion of any factory acceptance test
8.2.15	Milestone Certificates	As set forth in Agreement

8.3 Documentation to be Submitted (Turbine Supply)

Seller shall prepare and submit to Buyer the following documents via the Turbine Supplier during the Project. Refer to Table below for requirements.

Item	Description	Due
8.3.1	Tentative manufacturing and testing schedule specifying the date and where the Major Components are going to be manufactured and any special tests to be performed.	30 days after Notice to Proceed

Item	Description	Due
8.3.2	Turbine Supplier shall prepare a manufacturing and testing schedule for each Wind Turbine (the “Manufacturing Schedule”). The Manufacturing Schedule shall be updated on a weekly basis thereafter. The Manufacturing Schedule shall include the anticipated production / manufacturing dates locations for each major component.	60 days prior to start of manufacturing of first Wind Turbine major component
8.3.3	Tentative Work schedule, including anticipated production / manufacturing dates of Wind Turbine Nacelles, and anticipated Ex Works and delivery dates for Main Components.	As set forth in the Agreement
8.3.4	Detailed engineering drawings for the foundation bolt template for the Wind Turbine, sufficient in detail to allow independent fabrication of a within-tolerance Tower Foundation bolt template if necessary.	30 days after Effective Date
8.3.5	Factory acceptance test reports or final test reports, including all minimum required testing	As set forth in the Agreement
8.3.6	Manufacturing documentation for every Wind Turbine	As set forth in the Agreement
8.3.7	Site Suitability Report: Turbine Supplier shall prepare an assessment of suitability of the Wind Turbines at the Project Site. This assessment shall include a representation from Turbine Supplier confirming the suitability of the Wind Turbine for the Project Site and its ability to withstand the Project Site conditions for a period of at least 20 years. Turbine Supplier’s requirements for wake sector management (if any) shall be included in the suitability assessment. If an extended life beyond 20 years is required, supporting documentation from Turbine Supplier shall be provided to support the extended life.	As set forth in the Agreement
8.3.8	Design Certificate / Type Certificate: Turbine Supplier shall provide a current certification of compliance with IEC WT 01 / IEC 61400-1 / IEC 61400-22, either in the form of a Type Certificate or an A-Design statement of compliance, for the Wind Turbine, including the major components as listed in TBD. The Certificate shall be from an approved certifying entity, including Germanischer Lloyd, Det Norske Veritas, TÜV NORD Group, or a Buyer-approved equal.	As set forth in the Agreement
8.3.9	Delivery Certificate	As set forth in the Agreement
8.3.10	Wind Turbine installation manual in electronic format	90 days prior to delivery of first Wind Turbine component
8.3.11	Wind Turbine operations and maintenance manual in electronic format	90 days prior to commissioning of first Wind Turbine
8.3.12	Turbine Supplier shall provide information for the design of the Wind Turbine Foundations, including, but not limited to, loading information, Markov matrices, and tower alignment information.	Prior to initiating applicable BOP design
8.3.13	PSS/E model: A Wind Turbine model in PSS/E format shall be furnished and the model parameters shall be validated for both Wind Turbine and generator and automatic voltage regulator and frequency control.	Within 30 days of TSA effective date
8.3.14	Arc flash hazard analysis of the Wind Turbine equipment and ANSI-approved warning labels warning of the dangers of arc flash to be affixed to any Wind Turbine equipment that may require service or maintenance while energized.	60 days prior to commissioning of first Wind Turbine

8.4 Documentation to be Submitted During Project Design

Seller shall prepare and submit to Buyer the following documents during the design and engineering phase of the Project. Refer to Table 1 for requirements during design.

Table 1: Submittal requirements during project design

Item	Description	Due
8.4.1	Monthly progress reports in accordance Appendix 11 of the Scope Book	Monthly
8.4.2	Project Schedule showing, among other things, design and engineering work, procurement, and delivery of major equipment, FAT of major equipment, site surveys and studies, site preparation, construction activities, commissioning activities, and performance tests	30 days after FNTP, then with each monthly report
8.4.3	Drawings and documents provided with permit applications in accordance with Appendix 11 and copies of all correspondence exchanged prior to and after the closing date between or on behalf of Seller and any governmental authority with respect to the Project	As specified in Appendix 11
8.4.4	The initial, baseline Environmental Assessment (subject to the main body of the Agreement)	As specified in Appendix 11
8.4.5	Subject to Appendix 4 below, the final Energy Model, including all, inputs, parameters, and reports; 30-year estimates; and P50 and P90 estimates	As specified Appendix 4
8.4.6	Project Plot Plan with landscaping notes	Per design milestones in Scope Book Section 2.2
8.4.7	General arrangement drawings	Per design milestones in Scope Book Section 2.2
8.4.8	Plans, sections, and details for each system	Per design milestones in Scope Book Section 2.2
8.4.9	Underground arrangement drawings (mechanical, electrical, and civil)	Per design milestones in Scope Book Section 2.2
8.4.10	Terminal point list	Per design milestones in Scope Book Section 2.2
8.4.11	One-line diagrams	Per design milestones in Scope Book Section 2.2
8.4.12	Three-line diagrams	Per design milestones in Scope Book Section 2.2
8.4.13	Cable layouts	Per design milestones in Scope Book Section 2.2
8.4.14	Collection System Circuit Documents, as described herein: • 30% Design Documents • 60% Design Documents • 90% Design Documents • 100% Design Documents • Issued-for-construction Design Documents Seller shall prepare the Collection System Circuit design documents containing the following information, at a minimum: (a) design basis; (b) plan view of the overall system, including power and fiber; (c) one-line electrical diagram; (d) fiber optic loop diagram, including communication loop and connection / termination details for all Wind Turbines, permanent meteorological towers, and the O&M Building; (e) cable installation details, including cable specifications, trench details, splice details, and cable marker details; (f) cable crossing details and schedule, including road crossings, railroad crossings, utility crossings, pipeline crossings, existing subgrade equipment crossings, and directional boring; (g) grounding details, including trench grounds, junction box grounding, meteorological tower grounding, and Wind Turbine grounding; (h) termination details, including junction boxes and Wind Turbine switchgear; (i) junction box details; (j) meteorological tower power	[To be negotiated with successful bidder]

Item	Description	Due
	and physical details; (k) conduit and cable schedules; (l) civil works requirements (e.g., backfill, compaction, grading, drainage, etc.); (m) drawing index; (n) bill of materials; (o) inspection, testing, and quality control requirements; and (p) geospatial file (.SHP and/or .KMZ format) showing all Wind Turbines, cable routing, and junction box locations, at a minimum. Seller shall prepare equipment specifications to define the requirements and properties for the procurement of all permanently installed Collection System Circuit equipment and materials. The specifications shall be submitted to Buyer for review prior to the procurement of the applicable equipment. The following specifications shall be provided, each as applicable to the design: (a) construction specification; (b) pad-mounted transformers, including vaults (if any); (c) junction boxes; (d) power cable; (e) fiber optic cable; (f) handholes / enclosures; and (g) surge arresters.	
8.4.15	Project Electrical Studies, as defined herein: • Short circuit study • Annual energy loss report • Reactive compensation study • Harmonic analysis report • Concentric induced voltage report • Insulation coordination report • Transient overvoltage report • Wind Turbine ground grid report • Load flow studies • Substation grounding report • Effectively grounded report • Substation AC system study • Substation DC system study • Substation bus ampacity study • Substation bus structural analysis study • Substation bus design study • Substation lighting study • Substation lightning study • Arc flash study • Protection coordination study Cable Ampacity Study: load flow study with power flow analysis for the Collection System Circuits, including all medium-voltage cables within the Collection System and low-voltage cables (from the Wind Turbine to the pad-mounted transformer) (if any). Final report shall include a table showing cable ampacity and percent loading per cable section corresponding to the Project one-line diagram. Cable ampacity shall not exceed the limit set forth herein. All external heat sources and all possible project cable configurations (parallel trench, parallel bore, cable crossing, substation, Wind Turbine Foundation, etc) shall be considered. Thermal design shall account for actual field soil samples and backfill requirements (native or engineered). Short Circuit Study: short circuit analysis of Collection System Circuits, Project Substation, and Interconnection Line, including secondary voltage values on Wind Turbines. The short circuit analysis and study shall be utilized in Seller's electrical designs to	[To be negotiated with successful bidder]

Item	Description	Due
	support relay coordination study, arc flash study, and equipment specification. Annual Energy Loss Report: electrical losses evaluation, including estimate of annual energy losses for Project design. Such analysis shall be sufficient to demonstrate that the Electrical Loss Limit, as defined herein, is not being exceeded, and shall be based upon Project-specific cabling and transformer specifications, Project Site-specific soil conditions, Project Site-specific wind data, and other similar considerations. A pre-construction annual energy loss report and an as-built energy loss report, respectively, shall be submitted. Reactive Compensation Study: reactive power flow report, including power factor study at Electric Interconnection Point. The study shall identify reactive compensation required to meet the Requirements, including the Generator Interconnection Agreement requirements for power factor and voltage regulation, and including any capacitor bank and/or reactor requirements. The study shall include combinations of (a) active power (no load to full load at ten percent (10%) increments); (b) power factor (0.95 leading to 0.95 lagging); and (c) voltage (0.95 to 1.05 pu unless otherwise specified in the project's voltage schedule) at the Electric Interconnection Point, or more stringent as necessary to meet the Requirements, including the Generator Interconnection Agreement and compliance with FERC Order 827. Harmonic Analysis Report: power quality analysis at the Electric Interconnection Point to determine the harmonic resonance and flicker conditions within the Project, and demonstration that the Project design meets the harmonics distortion requirements in the Requirements (including IEEE 519 and its referenced standards, as applicable), including any necessary filtering or mitigation to be provided by Seller. A pre-construction harmonic analysis report (performed at 90 percent design) and an as-built harmonic analysis report (which analyzes , respectively, shall be submitted. Harmonics Metering Plan: plan to measure the harmonic voltage distortion and harmonic current distortion at the Project to compare with the limits of IEEE 519 and its referenced standards, as applicable. The plan shall include recommendations for harmonic metering equipment, equipment locations, and measured quantities where the resulting harmonic meter dataset collected will be used to determine whether there are any harmonics at the site which might damage equipment or be cause for concern. Concentric Induced Voltage Report: analysis to calculate the maximum induced voltage on the Collection System Circuit sheath. This study shall determine the maximum length for each unique cable size within the Collection System for which cables will exhibit an induced voltage of less than 25 V on cable sheaths.. Insulation Coordination Report: study to ensure the insulation coordination requirements of IEEE C62.22-2009 have been satisfied within the Project electrical design, including proper application of surge arresters to safeguard electric power equipment within the Collection System Circuits, Project Substation, and	

Item	Description	Due
	Interconnection Line against hazards of abnormally-high voltage surges of various origins. Transient Overvoltage Report: study to confirm any system modifications required to adequately limit transient overvoltage on the Collection System Circuits, including determination of the transient overvoltage levels on the Collection System Circuits after feeders have been isolated from the Project Substation due to a line-to-ground fault, and determination of the maximum energy required to be absorbed by each surge arrester on the Collection System Circuit feeders. Wind Turbine Ground Grid Report: analysis of Wind Turbine grounding design to verify the adequacy of the proposed design and the safety of personnel working in or around the Wind Turbine. The study shall confirm that the grounding system maintains touch and step voltages within tolerable limits, and shall be prepared in accordance with the procedures, data, and recommendations given in IEEE 80). The study shall determine the ground potential rise with respect to remote earth, and Wind Turbine Foundations shall be modeled as they are actually constructed (i.e., if not solidly bonded (e.g., using wire ties), they should be modeled accordingly). The study shall consider clearing time in the event of a breaker failure for the purpose of determining if the grounding design (e.g., ground potential rise) is acceptable. If construction of Wind Turbine grounding yields higher ground grid resistance values than this study assumed, this study shall be updated to confirm if touch and step potential are acceptable per IEEE 80.	
8.4.16	NERC Compliance Studies, per appendix 10	per appendix 10
8.4.17	Civil Works Design Documents, as described herein: • 30% Design Documents • 60% Design Documents • 90% Design Documents • 100% Design Documents • Issued-for-construction Design Documents The civil works design documents shall contain the following information, at a minimum: (a) design basis; (b) plan views of Project Site, including all access / site roads, crane paths, Wind Turbine locations, staging / laydown areas, Project Substation location, Interconnection Line route, Collection System Circuit routes, landowner names, parcel identification number, parcel statuses (participating, non-participating), easements, and public right-of-way; (c) Wind Turbine delivery flow plan; (d) profile views for all vertical curves; (e) grading and drainage plans; (f) details for erosion control, fencing, gates, compaction, road cross sections, road curves (horizontal and vertical), and Wind Turbine Pad cross sections; (g) properties for backfill / fill and road materials; (h) public road improvements; (i) drawing index; (j) inspection, testing, and quality control requirements; and (k) geospatial file (.SHP and/or .KMZ format) showing all Wind Turbines, meteorological towers, access roads, crane paths, and intersection improvements, at a minimum.	[To be negotiated with successful bidder]
8.4.18	Stormwater pollution prevention plan (SWPPP), as described herein	[To be negotiated with successful bidder]
8.4.19	Seller shall prepare an aggregate mix formula based on recommendations from the final Geotechnical Report	30 days prior to placing material

Item	Description	Due
	and complying with the requirements herein. Each formula shall be approved by Buyer prior to use and shall be accompanied by testing data for each aggregate source, including sieve analysis, moisture data, liquid limit, and plastic limit.	
8.4.20	Grading and drainage drawings	Per design milestones in Scope Book Section 2.2
8.4.21	Name and qualifications for proposed geotechnical engineer, as described herein	14 days prior to initiating subsurface investigations
8.4.22	Proposed scope of subsurface investigation, as described	14 days prior to initiating subsurface investigations
8.4.23	Geotechnical Investigation Report	Per design milestones in Scope Book Section 2.2
8.4.24	Wind Turbine Foundation Design Documents, as described herein: • Preliminary Design Documents • Issued-for-review (IFR) Design Documents • Issued-for-construction Design Documents Seller shall prepare the Wind Turbine Foundation design documents and containing the following information, at a minimum: (a) design basis; (b) plan and profile view of Wind Turbine Foundation design, including cross sections; (c) details for reinforcing steel, conduit, and grouting; (d) civil works requirements (e.g., backfill, compaction, grading, drainage, etc.); (e) tensioning sequencing and parameters, including post-installation re-tensioning; (f) structural calculations, to be provided with each set of Wind Turbine Foundation design drawings; (g) rebar and embedment ring shop drawings; (h) drawing index; (i) bill of materials; and (j) inspection, testing, and quality control requirements. For the avoidance of doubt, the approval of the Wind Turbine Foundation design documents by Buyer's independent engineer shall be received prior to constructing any portion of the Wind Turbine Foundation. Seller shall allocate adequate review time to the independent engineer for this purpose and shall coordinate with the independent engineer as reasonably required to address and incorporate any comments required to receive approval.	[To be negotiated with successful bidder]
8.4.25	Shop drawings, Wind Turbine Foundation rebar	30 days prior to installation of first rebar cage
8.4.26	Shop drawings, embedment ring	30 days prior to installation of first rebar cage
8.4.27	Concrete mix designs and concrete placement procedures, as described herein Seller shall prepare concrete mix designs; grout specifications; and concrete and grout placement procedures. All such submittals shall be approved by Buyer prior to use. Each mix design submitted by Seller shall be stamped by a professional engineer with an active license in the state where the Project is located and shall include, at a minimum, (a) documentation of achieving Project-specific compressive strength requirements per ACI procedures; (b) gradation, source, and type of aggregates; (c) mill reports for cement and fly ash; (d) product data for admixtures, including vendor certification of compliance with applicable ASTM standard; (e) ASR test results, including expansion results per ASTM C1567; (f) specified slump value; (g) specified water/cement ratio; (h) specified air entrainment; (i) water quality test per Table 2 of ASTM C1602 if non-potable; and (j) an approval stamp by the applicable engineer of record.	30 days prior to performing concrete work

Item	Description	Due
8.4.28	Grout specification sheets and grout placement procedures, as described herein	30 days prior to performing grouting work
8.4.29	Seller shall submit three (3) laboratory tension test reports for anchor bolts for each heat number furnished, complete with threads, and to be prepared by an independent third-party tester. This task shall be in accordance with ASTM A370 and the report shall include yield stress and tensile stress.	30 days prior to ordering anchor bolts
8.4.30	Seller shall provide copies of mill certificates for all steel reinforcement (rebar) and anchor bolts	Within 10 days of delivery of applicable materials
8.4.31	Foundation and structural steel drawings sealed by a PE licensed in the state where the project is located	Per design milestones in Scope Book Section 2.2
8.4.32	Structural calculations for Wind Turbine Foundations	With IFR Design Documents
8.4.33	Structural calculations for BOP foundations	Per design milestones in Scope Book Section 2.2
8.4.34	Structural calculations for substation structure and foundation calculations	Per design milestones in Scope Book Section 2.2
8.4.35	Specifications and datasheets for major and minor equipment	Per design milestones in Scope Book Section 2.2
8.4.36	Seller shall provide a hydrology study for the Project. Such study shall include a two-dimensional analysis of the Project area to determine specific flooding hazards (depth, velocity) at all locations within the Project Site boundary; such information shall be presented in a maximum 50-foot grid size and native (*.SHP) files shall be included. The hydrology study shall include an analysis of the following storm events: (a) 20-year, 24-hour; and (b) 100-year, 24-hour.	Per design milestones in Scope Book Section 2.2
8.4.37	Site Environmental Impact Assessment study	Per design milestones in Scope Book Section 2.2
8.4.38	System description of the main systems for the Project	Per design milestones in Scope Book Section 2.2
8.4.39	Start-up and shutdown diagrams	Per design milestones in Scope Book Section 2.2
8.4.40	Preliminary Commissioning Program with procedures for respective tests and activities	Per design milestones in Scope Book Section 2.2
8.4.41	Draft project performance test procedures	Per design milestones in Scope Book Section 2.2
8.4.42	Preliminary O&M philosophy	Per design milestones in Scope Book Section 2.2
8.4.43	O&M Building Design Documents, as described herein (if option is selected): • 30% Design Documents • 60% Design Documents • 90% Design Documents • 100% Design Documents • Issued-for-construction Design Documents	[To be negotiated with successful bidder]
8.4.44	Shop drawings, O&M Building foundation rebar	30 days prior to installation
8.4.45	Meteorological Tower Design Documents, as described herein: • Preliminary Design Documents • Issued-for-review Design Documents • Issued-for-construction Design Documents Seller shall prepare the meteorological tower design documents containing the following information, at a minimum: (a) design basis; (b) foundation plans and details, including all structural calculations, pier details, and footing details; (c) tower details, including boom elevations, boom directions, equipment mounting, guying details, and hardware details; (d) instrument details, including all equipment listed herein; (e) wiring	[To be negotiated with successful bidder]

Item	Description	Due
	schematics; (f) H-frame diagrams; (g) grounding details; (h) power supply details; (i) fiber termination diagrams; (j) drawing index; (k) bill of materials; and (l) inspection, testing, and quality control requirements.	
8.4.46	Property Protection Design Basis Document as described in Appendix 12	Per design milestones in Scope Book Section 2.2
8.4.47	Project Site Security Plan	120 days prior to construction commencement date
8.4.48	Initial Point list for SCADA system	Per design milestones in Scope Book Section 2.2
8.4.49	Project design basis (including design criteria) for all major works including Civil, Wind Turbine Foundations, Collection System, Substation, Meteorological Towers, O&M Building,	At 30% design
8.4.50	Equipment receiving, handling, storage, and installation instructions and manuals	120 days prior to construction commencement date
8.4.51	Corrosion engineering report	At 30% design
8.4.52	Field touch-up procedures of painted equipment	120 days prior to construction commencement date
8.4.53	Site finish grade	At 30% design
8.4.54	I&C drawings (instrument list, network diagram, control panel layout, architecture, alarm list))	Per design milestones in Scope Book Section 2.2
8.4.55	MSDS documentation	120 days prior to construction commencement date
8.4.56	Visual weld inspection procedures	120 days prior to construction commencement date
8.4.57	HVAC equipment	Per design milestones in Scope Book Section 2.2
8.4.58	Electrical package including cable schedule	Per design milestones in Scope Book Section 2.2
8.4.59	Transformer recommended assembly and filling procedure	Per design milestones in Scope Book Section 2.2
8.4.60	Copy of aerial / LiDAR survey data	Prior to 60% civil design

8.5 Documentation to be Submitted During Project Construction

Seller shall prepare and submit to Buyer the following documents from and after the construction commencement date through substantial completion. Refer to Table 2.

Table 2: Submittal requirements during project construction

Item	Description	Due
8.5.1	Monthly progress reports in accordance with Appendix 11	Monthly
8.5.2	Weekly construction status report in accordance with Scope Book Appendix 11	No later than 5 PM Tuesday
8.5.3	Plan of the Day Report	8 AM daily
8.5.4	Copy of all Project Work permits and Project operational permits when obtained	As obtained
8.5.5	Critical lift plans and procedures, as described herein	No less than 14 days prior to beginning critical lift
8.5.6	Seller shall prepare energization plans and procedures for each Collection System Circuit. Energization plans shall include both electrical and communications infrastructure as well as backfeed plans, soaking plans, testing plans, and lock out tag out procedures, at a minimum.	90 days prior to Project energization date
8.5.7	Receipt, inspection, and inventory reports for all Equipment deliveries (*including* Wind Turbine deliveries and main step-up transformer), as described herein	As set forth herein
8.5.8	Final Commissioning Program	30 days prior to mechanical completion

Item	Description	Due
8.5.9	Final performance test procedure	Prior to mechanical completion
8.5.10	Final O&M philosophy	Prior to mechanical completion
8.5.11	Construction Test Reports, including compaction test results and related documents for roads, substation pads, and at foundations and structures; in situ test results and related documents	Within 48 hours of completing applicable test
8.5.12	Recurring test reports: compaction, sieve, wet ball mill, concrete, grout, electrical	Copy to on-site job books within 48 hours of completing test
8.5.13	Project electrical testing and energization results, including results for all required testing (including that noted herein for the Project Substation, Collection System Circuits, SCADA System, Wind Turbines (tower wiring, Wind Turbine grounding grid resistance tests), Interconnection Line (if applicable), and other relevant systems.	Within 5 days of completing the applicable test
8.5.14	Mass concrete temperature control plan	14 days prior to first concrete placement
8.5.15	Hot / cold weather concreting plan	14 days prior to first concrete placement
8.5.16	Wind Turbine Foundation subgrade evaluation procedure	14 days prior to first concrete placement
8.5.17	Foundation Inspection Report, containing the following minimum information: • Date of excavation • Date of inspection • Ambient air temperature at time of inspection • Structure name / number and location • Structure type and foundation type • Soil conditions • Verification of subgrade against expected conditions, including test results • Depth to rock and depth to water • Information on deviations from the foundation design and actual installation. • Location of center of foundation • Cable trenches into foundation/excavation area and daisy chaining (or else) to neighboring foundations and including SCADA/communication cables • Location and orientation of Wind Turbine 'can' or 'cage' insert and/or cable pit/ground level component plinths (if available) – all as per OEM's design • Cube tests, on-site tests results • Temperature during curing, additives to concrete if used (approved additives)	30 days prior to commencing erection of the applicable Wind Turbine
8.5.18	Third-party certification of Foundation integrity, including test results, as described herein	30 days prior to commencing erection of the applicable Wind Turbine
8.5.18	Calibration and installation records for all permanently-installed meteorological tower equipment, as applicable	Within 14 days of installation of such equipment
8.5.19	System graphics	Prior to mechanical completion
8.5.20	Certificate of achievement of mechanical completion	Prior to mechanical completion
8.5.21	Final post-mechanical completion punchlist	Prior to mechanical completion
8.5.22	OEM FAT and shop test reports for equipment listed in Scope Book Section 5.2	Prior to initial energization
8.5.23	Environmental Assessment	No earlier than 180 days prior to closing
8.5.24	Environmental test reports, inspections, and records	Closing

Item	Description	Due
8.5.25	Proposed training schedule, training course outline, and training manuals for Seller-Provided Training	Prior to mechanical completion
8.5.26	Coating specifications	Prior to mechanical completion
8.5.27	Paint color samples	Prior to mechanical completion

8.6 Documentation to be Submitted at Substantial Completion Payment Date

Seller shall prepare and submit to Buyer the following documents as shown in Table 3 prior to Substantial Completion.

Table 3: Submittal requirements prior to Substantial Completion

Item	Description	Due
8.6.1	Punchlist in accordance with the Agreement, including the agreed punchlist holdback amount	Substantial completion
8.6.2	Draft Job Books (electronic format only)	Substantial completion
8.6.3	Draft as-builts for all drawings and documents submitted during the engineering and design phase and during project construction	Substantial completion
8.6.4	Power production estimates	Substantial completion
8.6.5	OEM performance field test reports	Substantial completion
8.6.6	Software licenses and Project intellectual property rights	Substantial completion
8.6.7	Instrument calibration list and certificates	Substantial completion
8.6.8	Protective relay settings list	Substantial completion
8.6.9	Equipment list	Substantial completion
8.6.10	Equipment O&M manuals	Substantial completion
8.6.11	Construction turnover documentation	Substantial completion
8.6.12	Commissioning turnover documentation	Substantial completion
8.6.13	Input and output list	Substantial completion
8.6.14	SCADA FAT results	Substantial completion
8.6.15	Commissioning test results, bills of material, and drawings to demonstrate compliance with NERC standards	Substantial completion
8.6.16	Project Site specific operating procedures	Substantial completion
8.6.17	Arc flash study	Substantial completion
8.6.18	NERC test reports and calibration records	Substantial completion
8.6.19	Project performance test results	Substantial completion
8.6.20	All permits	Substantial completion
8.6.21	All signed and approved design change requests	Substantial completion
8.6.22	Invoices	Substantial completion
8.6.23	Spare parts and consumables lists	16 weeks prior to substantial completion
8.6.24	Copies of all Subcontractor guarantees and warranties	As set forth in Agreement
8.6.25	Wind Turbine serial numbers	As set forth in Agreement

8.7 Documentation to be Submitted after Substantial Completion Payment Date

Seller shall prepare and submit to Buyer the following documents as shown in Table 4 after Substantial Completion.

Table 4: Submittal requirements after Substantial Completion

Item	Description	Due
8.7.1	Final as-builts for all drawings and documents submitted during the engineering and design phase and during project construction	Final completion
8.7.2	Final version of Job Books, in electronic format, as described herein	Final completion
8.7.3	Controlled red line drawings showing all Seller-approved changes made during construction	Final completion
8.7.4	Operator and maintenance personnel training records	Final completion
8.7.5	Final equipment O&M manuals	Final completion
8.7.6	Final system descriptions of as-built systems	Final completion

8.8 Supplemental Appendix Information

For each of Appendices 1 through 14 and in accordance with the other terms of this Agreement, Seller shall update all applicable cells left blank as of the effective date in the Appendix with accurate data and content. Seller shall provide to Buyer periodic updates to each Appendix at the intervals specified in the Agreement for Seller's updates to the schedules. However, no cells may be updated within 90 days of closing without the prior written agreement of Buyer and Seller.

***** END OF SCOPE BOOK MAIN BODY *****

Appendix 1
to BOT Scope Book

Collector Substation

Rev. 1

June 6, 2024

REVISION RECORD			
Revision No.	Approval Date	Section / Page Revised	Reason / Description of Change
0	9/14/2023	All	Initial Issue
1	6/6/24	5.3.14	Updated GSU/MPT Transformer Configurations
		9.1	Updated Gates

APPENDIX 1

TO BOT SCOPE BOOK

COLLECTOR SUBSTATION

TABLE OF CONTENTS

Appendix 1: Collector Substation

1 INTRODUCTION

1.1 Purpose

This Appendix 1 to the Scope Book (this "Appendix 1") provides design requirements and reference material for the design of renewable energy (solar, wind, battery storage) collector substations (the "Collector Substations") that will be built in or connected to the Project. This Appendix 1 is intended to provide to Seller and others acting at Seller's request requirements, recommendations, and guidance in the planning, design, construction, asset management, use, and operation of the Collector Substations.

1.2 Scope

This Appendix 1 applies to all new Collector Substations.

This Appendix 1 primarily describes technical requirements, both performance-based and prescriptive for the design and installation of Collector Substations. Refer to the Scope Book and other parts of the Agreement for information regarding project sequencing and milestones, the project execution plan, project schedule and schedule management, project controls reporting, health and safety information, factory acceptance tests, training, required submittals, design reviews, equipment records, specified deliverables, project documentation, and other relevant matters not covered by this Appendix 1.

1.3 General Data

This Appendix 1 addresses aspects of the Work relating to Collector Substations. It is not intended to be, and shall not be construed to be, a comprehensive list of each and every element or other requirement applicable to the Work and shall in no way limit Seller's obligations under the Agreement or any Ancillary Agreement. Seller shall comply with, any cause its Contractors and Subcontractors to comply with, the terms of this Appendix 1, the Scope Book, all Laws (including codes) and applicable Permits.

This Appendix 1 provides the minimum functional specification (MFS) for the Collector Substations, including scope and design requirements. In addition to the requirements set forth in the Agreement (including the Scope Book), the Collector Substations shall comply with all requirements specified in the GIA or any other Required Deliverability Arrangement.

This Appendix 1 is part of the Scope Book.

Article, Section, Table, Figure, and Attachment references in this Appendix are to this Appendix 1 unless otherwise provided or the context otherwise requires.

1.4 HV Collector Substation Work

The Work includes the supply, assembly, and installation of the following components:

- HV switchgear, if applicable
- MV switchgear, if applicable
- MV/HV transformer(s)
- Switchyard buses
- Revenue metering
- Circuit breakers
- Disconnect switches
- Overhead line
- Normal AC and DC Power Distribution
- Backup power supply/emergency generator
- UPS, if applicable
- HVAC
- Grounding (grid and conductors)
- Lightning protection system, if applicable
- Conduits and cable trays
- Cables
- Relay Protection
- Relay and Control Panels
- DC Control Power (including batteries, chargers, and motoring)
- Lighting systems (including emergency lighting)
- I&C system (including fire alarm system), if applicable
- Earthwork
- Structures
- Control enclosure
- Fencing

1.5 Deviations

Any deviations from the MFS for the Collector Substations or the terms of this Appendix 1 shall require Buyer's prior approval and will be subject to the terms of the Agreement.

2 DEFINITIONS, TERMINOLOGY AND ACRONYMS

Terms with initial capital letters used but not defined in this document shall have the meanings ascribed to such terms in the Agreement, unless the context manifestly requires otherwise. For the avoidance of doubt, the rules of interpretation set forth in the main body of the Agreement shall apply to this document.

Equipment support structures: Generally, refers to all structures within the Collector Substation other than the control house.

System Voltage: The root-mean-square (rms) phase-to-phase voltage of a portion of an alternating-current electric system. Each system voltage pertains to a portion of the system that is bounded by transformers or utilization equipment. (All voltages are rms phase to-phase or phase-to-neutral voltages.) (ANSI C84.1)

Nominal System Voltage: The voltage by which a portion of the system is designated, and to which certain operating characteristics of the system are related. Each nominal system voltage pertains to a portion of the system bounded by transformers or utilization equipment. (ANSI C84.1)

Maximum System Voltage: The highest system voltage that occurs under normal operating conditions, and the highest system voltage for which equipment and other components are designed for satisfactory continuous operation without derating of any kind. In defining maximum system voltage, voltage transients and temporary overvoltages caused by abnormal system conditions such as faults, load rejection, and the like are excluded. However, voltage transients and temporary overvoltages may affect equipment operating performance and are considered in equipment application. (ANSI C84.1)

Low Voltage (LV): Nominal system voltage less than 1000 volts. This term is also used as an adjective to designate the low voltage winding of a power transformer and for referring to the low voltage side of a distribution substation.

Medium Voltage (MV): Nominal system voltage above 1 kV and up to 38 kV. (Note that ANSI C84.1 defines medium voltage as nominal system voltage above 1 kV and below 100 kV).

High Voltage (HV): Nominal system voltages 69 kV and higher up to 230 kV. (Note that ANSI C84.1 defines high voltage as nominal system voltage between 100 kV and 230 kV). This term is also used as an adjective to designate the high voltage winding of a power transformer and for referring to the high voltage side of a distribution substation.

Extra High Voltage (EHV): Nominal system voltage 345 kV and above.

Ampacity: The current-carrying capacity, expressed in amperes, of an electric conductor under stated thermal conditions.

Distribution Substation: A substation whose combination of switching equipment and step- down power transformers are arranged to reduce incoming transmission and distribution voltages, from Transmission up to 230 kV, to Distribution at 34.5 kV and below, for distribution of power to rural, residential, commercial, and industrial loads. It may or may not contain transmission breakers. Distribution substations may also be a combination of switching equipment and step-down transformers arranged to reduce distribution voltages to lower distribution voltages.

Switching Station: A substation that connects three or more transmission lines 69 kV or above without power transformers. A switching station does not serve distribution load and does not include transformation.

Transmission Substation: A substation, 69 kV or above, containing switches, circuit

breakers, busses, and transformers for switching power circuits and to transform power from one voltage to another or from one system to another.

Note: the terms switching station and substation are commonly used as interchangeable.

Finished Grade (or Subgrade): Design site elevation, after site grading.

Substation Designer: For the purposes of this guide, any person, regardless of business unit or contractor or employment status, who makes decisions pertaining to the equipment to be used in a substation, or the manner in which it will be used. Generally, the term "Substation Designer" includes substation layout and relay designers.

Base flood means the flood level having a one percent chance of being equaled or exceeded in any given year. Base flood is also known as 100-year flood. Note that a 100 year flood does not mean that such a flood occurs once every 100 years; instead, it means that there is a one in one-hundred (or 1%) chance of such a flood occurring in a given year. There is approximately a 63.4% chance of one or more 100 year floods occurring in any 100 year period.

3 Applicable Codes and Standards

The Collector Substation shall be designed and constructed in accordance with all applicable and up to date codes, ordinances and standard industry practices including, without limitation, ANSI, IEEE, NEMA, standards and FERC, NERC and OSHA regulations. This includes, without limitation, the standards and guidelines for substation design established by the following sources:

Applicable Standards and Organizations	
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
APLIC	Avian Power Line Interaction Committee
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing Materials
AWS	American Welding Society
CRSI	Concrete Reinforcing Steel Institute
IBC	International Building Code
ICE	Institution of Civil Engineers
ICEA	Insulated Cable Engineers Association
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IESNA	Illuminating Engineering Society of North America
ISO	International Standardization Organization
NEC	National Electrical Code

Applicable Standards and Organizations	
NEMA	National Electrical Manufacturers Association
NERC	North America Electric Reliability Corporation
NESC	National Electrical Safety Code
NFPA	National Fire Protection Association
OSHA	Occupational Health & Safety Administration
SSPC	Steel Structures Painting Council
UL	Underwriters Laboratories
	ACI 318: Building Code Requirements for Structural Concrete
	AISC 360: Specification for Structural Steel Buildings
	ANSI/TIA-568-C.0-2009 Generic Telecommunications Cabling for Customer Premises
	ASCE 113: Design of Substation Structures
	ASCE 48: Design of Steel Transmission Pole Structures
	American Welding Society (AWS) D1.1
	IEEE Std 605-2008: IEEE Guide for Bus Design in Air Insulated Substations
	IEEE Std 693-2018: IEEE Recommended Practice for Seismic Design of Substations
	IEEE Std 1527-2018: IEEE Recommended Practice for the Design of Buswork Located in Seismically Active Areas
	NECA/FOA 301-2009 Installing and Testing Fiber Optics
	RUS Bulletin 1724-200 Rural Utilities Service Design Manual for High Voltage Transmission Lines Electrical System Requirements
	RUS Bulletin 1724-300 Rural Utilities Service Design Guide for Rural Substations

The latest issued Standards and Codes at the issuance of the effective date of the Agreement shall be used. Earlier editions are not allowed unless specifically identified in this Appendix 1.

If a revision to a standard or code is issued, it is not required to be implemented unless the Authority Have Jurisdiction (AHJ) has adopted it, in which case, Seller is obligated to any increased compliance above what is required by the Standards and Codes at the effective date of the Agreement. This risk is borne by Seller.

4 SAFETY

The Substation Designer shall incorporate safe work practices into the design of the collector substation. The Collector Substations design and construction shall allow safe operation and maintenance under all foreseeable operating conditions. The design shall ensure that maintenance can be carried out without a significant effect on the Collector Substations operation and will allow adequate working space to maintain minimum approach distances as specified in the Section 5.2.3, Table 3.

Other aspects such as fire hazard and fire suppression and environmental aspects, such as site drainage and oil containment, shall be considered and incorporated in the design. The Substation Designer is responsible for ensuring that the Collector Substations are designed in compliance with the National Electrical Safety Code, OSHA, and other regulations. See Section 6 for further details.

5 GENERAL REQUIREMENTS

5.1 Site Environmental Characteristics

Seller shall use the criteria and values set out in "Attachment 2 – Site Environmental Characteristics" and any other criteria and values reasonably determined by Buyer to be necessary or appropriate in the design of the Collector Substation.

5.2 Substation Current, Voltages and Clearances

5.2.1 Current Ratings

The Collector Substation bus systems, jumpers and equipment which is part of the bus shall be designed to serve the maximum equipment ratings. Equipment attached to buses, but not a part of the bus system, shall be designed to service the equipment maximum capabilities.

Any current calculation performed shall take into consideration ambient temperature, temperature rise, conductor maximum operating temperature and coefficient of emissivity. Typical and acceptable ambient temperature value for continuous ampacity shall be 40°C.

Size, variety, and types of conductors used in the Collector Substation shall be kept as minimal as practical.

5.2.2 Voltage Ratings

The Collector Substation equipment and bus systems shall be designed for the voltage ratings in accordance with Table 1. Any project-specific voltage requirements shall be considered, such as high voltage or contamination will dictate increased Basic Impulse levels ("BIL") for a specific design. This shall be coordinated and agreed upon by Seller and Buyer during project planning phases.

Table 1: Equipment Voltage Ratings

Nominal Voltage	Rated Voltage	BIL	BSL	Remarks
13.8 kV	15.5 kV	110 kV		Bus, and Disconnects shall be rated 34.5 kV, 200 kV BIL
24 kV	25.8 kV	150 kV		Bus, and Disconnects shall be rated 34.5 kV
200 kV BIL				
34.5 kV	38 kV	200 kV		
69 kV	72.5 kV	350 kV		
115 kV	121 kV	550 kV		Circuit breakers and instrument current transformers shall be

Nominal Voltage	Rated Voltage	BIL	BSL	Remarks
				rated 145 kV and 650 kV BIL.
138 kV	145 kV	650 kV		
161 kV	169 kV	750 kV		
230 kV	242 kV	900 kV		Instrument current transformers shall be rated 242 kV, and 1050 kV BIL
345 kV	362 kV	1300 kV	825 kV	
500 kV	550 kV	1800 kV	1175 kV	

5.2.3 Clearances and Spacing

All Collector Substation equipment shall be designed to maintain minimum substation clearances and spacing in Table 2, Table 3, Table 4, and Table 7. The below clearances are the minimum allowable clearances for common collector substation HV and MV voltages. Values listed are for altitudes of 1000 meters (3300 feet) or less. See IEEE 1427 for altitude adjustments (if required).

Table 2: Substation Minimum Clearances

Minimum electrical clearances between the conductors, and conductors to ground, shall be as tabulated below.

Nominal Voltage	BIL (BSL)	Minimum Clearance to Ground for Rigid Parts	Minimum Clearance Between Phases (or Live Parts) for Rigid Parts, Metal to Metal
7.5 kV	95 kV	7 inches	8 inches
15 kV	110 kV	8 inches	9 inches
25 kV	150 kV	11 inches	12 inches
34.5 kV	200 kV	15 inches	16 inches
69 kV	350 kV	26 inches	29 inches
115 kV	550 kV	41 inches	45 inches
138 kV	650 kV	49 inches	54 inches
161 kV	750 kV	56 inches	62 inches
230 kV	900 kV	67 inches	74 inches
345 kV	1300 (975) kV	97 (100) inches	105 (140) inches
500 kV	1800 (1300) kV	135 (150) inches	150 (215) inches

Table 3: Substation Minimum Safety Clearances

Minimum horizontal and vertical clearances to live parts for worker safety shall be as tabulated below. These clearances are intended to prevent unintentional encroachment by a worker into the guard zone.

Nominal Voltage	BIL (BSL)	Vertical Clearance	Horizontal Clearance
7.5 kV	95 kV	8 ft 10 in	3 ft 4 in
15 kV	110 kV	9 ft	3 ft 6 in
25 kV	150 kV	9 ft 3 in	3 ft 9 in
34.5 kV	200 kV	9 ft 6 in	4 ft
69 kV	350 kV	10 ft 5 in	4 ft 11 in
115 kV	550 kV	11 ft 7 in	6 ft 1 in
138 kV	650 kV	12 ft 2 in	6 ft 8 in
161 kV	750 kV	12 ft 10 in	7 ft 4 in
230 kV	900 kV	13 ft 9 in	8 ft 3 in
345 kV	1300 (828) kV	18 ft 11 in	13 ft 5 in
500 kV	1800 (1167) kV	27 ft	21 ft 6 in

Table 4: Substation Minimum Vertical Clearances above Ground

Maximum System Voltage	Pedestrian Traffic	Roadways
7.5 kV	14 ft 6 in	18 ft 6 in
15 kV	14 ft 6 in	18 ft 6 in
25 kV	14 ft 6 in	18 ft 6 in
38 kV	14 ft 6 in	18 ft 6 in
72.5 kV	15 ft 2 in	19 ft 2 in
121 kV	16 ft 1 in	20 ft 1 in
145 kV	16 ft 7 in	20 ft 7 in
169 kV	17 ft	21 ft
245 kV	18 ft 6 in	22 ft 6 in
362 kV	20 ft 9 in	24 ft 9 in
550 kV	24 ft 4 in	28 ft 4 in

Note: These clearances shall be maintained under the maximum conductor operating temperatures.

Table 5: Substation Minimum Horizontal Clearance to Fence

Nominal Voltage	BIL	Clearance to Fence
7.5 kV	95 kV	10 ft
15 kV	110 kV	10 ft 1 in
25 kV	150 kV	10 ft 4 in
34.5 kV	200 kV	10 ft 7 in
69 kV	350 kV	11 ft 7 in
115 kV	550 kV	13 ft
138 kV	650 kV	13 ft 8 in
161 kV	750 kV	14 ft 4 in
230 kV	900 kV	15 ft 5 in
345 kV	1300 kV	18 ft 4 in
500 kV	1800 kV	21 ft 6 in

5.3 Substation Equipment

5.3.1 Approved Manufacturers

An Approved Manufacturer List is included in Attachment 1. The Approved Manufacturer List includes a column with applicable Entergy purchase specifications. Approved Manufacturers should already be familiar with the applicable Entergy specifications and be able to provide equipment conforming to these specifications. Seller shall procure items from manufacturers listed in the Approved Manufacturer List in accordance with the applicable Entergy purchase specification and in accordance with this specification.

5.3.2 HV Cables

Seller shall comply with the requirements of the GIA for the design, manufacturing, installation, and testing of all HV cables.

5.3.3 Substation Bus/Conductors

Cable connections between the tube bus and equipment and between equipment shall be ACSR (aluminum conductor steel reinforced), AAAC (all aluminum alloy cable) or AAC (all aluminum cable). Bus connectors shall be aluminum alloy for aluminum-to-aluminum connections and tinned bronze for aluminum-to-copper connections. Hardware connectors shall be welded onto the cable or tube. Aeolian cable shall be installed in the switchyard tubing to limit bus vibration.

5.3.4 Insulators

All insulators for the rigid bus system and disconnect switches shall be porcelain station post and shall be ANSI 70 gray in color. High strength or extra-high strength insulators may be required based on detailed analysis. See Section 5.3.4.1. Polymer station post insulators shall be used for jumper standoff support.

Insulators shall conform to ANSI C29 standards. Insulators shall be specified to satisfy mechanical and electrical requirements including creepage based on the project contamination criteria. If contamination criteria is not available, medium (35mm/kV) shall be used.

5.3.5 Insulator Strength

The determination of the required cantilever strength of the insulator shall be performed in accordance with ANSI/IEEE Standard 605. The determination of the required effective bus span length due to insulator strength shall be determined for the insulator chosen and the external forces applied.

5.3.6 Load Combinations:

Case 1 – Extreme Wind:	2.5 D + 2.5 W IFW + 1.0 SC
Case 2 – Ice with Concurrent Wind:	2.5 D + 2.5 IWIFI + 2.5 WIIFI + 1.0 SC
Case 3 – Seismic:	2.5 D + 2.5 E (or EFS)IFE + 1.0 SC

Refer to ASCE 113 for definitions of the load components within the load cases above. Design values for these load cases shall be as defined in Section 7.1. IEEE 605-2008 recommends a safety factor of 0.4 be applied to insulator strengths for loads other than short circuit loading and 1.0 for short circuit loading. As detailed in IEEE 605-2008, Section 12.4.2, when different load types are combined, the loads must be calibrated by the appropriate safety factor. As such, the 2.5 Load Factors on loads other than short circuit loading shown above are used to account for the safety factor on the insulator strength.

5.3.7 Surge Arresters

The surge arresters shall be station class, metal-oxide (MOV) type. Surge arresters shall be in accordance with ANSI C62.11. The arrester housing shall be made of polymeric silicone and shall be gray in color. Arresters up to a rated duty cycle voltage of 60 kV shall be of single unit construction, and not more than 2 pieces up through 120 kV.

Arresters shall not be used as rigid bus supports. Arresters shall be installed on all incoming line terminals and at transformer terminals. Arresters shall be installed as close as possible to the equipment being protected. Ratings for surge arresters shall be as shown in Table 5 and dimensions shall be as shown in Table 6.

Table 6: Station Class Surge Arrester Ratings

Nominal System Voltage (kV)	System Type	Rated Duty-Cycle Voltage (kV)	Rated MCOV (kV)
2.4	Effectively Grounded, wye connected system	3	2.55
	Ungrounded or Impedance Grounded, Delta connected system	3	2.55
	Distribution Networks (Note)	3	2.55
4.16	Effectively Grounded, wye connected system	6	5.1
	Ungrounded or Impedance Grounded, Delta connected system	6	5.1
	Distribution Networks (Note)	9	7.65
12.47-14.4	Effectively Grounded, wye connected system	12	10.2
	Ungrounded or Impedance Grounded, Delta connected system	18	15.3
	Distribution Networks (Note)	21	17
23	Effectively Grounded, wye connected system	21	17
	Ungrounded or Impedance Grounded, Delta connected system	36	29
	Distribution Networks (Note)	36	29
34.5	Effectively Grounded, wye connected system	30	24.4
	Ungrounded or Impedance Grounded, Delta connected system	48	39
	Distribution Networks (Note)	48	39
69	Effectively Grounded, wye connected system	60	48
115	Effectively Grounded, wye connected system	96	76
138	Effectively Grounded, wye connected system	120	98
161	Effectively Grounded, wye connected system	132	106
230	Effectively Grounded, wye connected system	192	152
345	Effectively Grounded, wye connected system	276	220

Nominal System Voltage (kV)	System Type	Rated Duty-Cycle Voltage (kV)	Rated MCOV (kV)
500	Effectively Grounded, wye connected system	420	335

Note: Ungrounded Distribution Network and Systems where an accidental ground can exist for long periods of time.

Table 7: Arrester Housing Dimensions by Rating

Rated Duty-Cycle Voltage	Creepage Distance	Height
3 kV	15”	8”
6 kV	20”	10”
12 kV	25”	13”
18 kV	34”	14”
21 kV	38”	16”
30 kV	45”	19”
36 kV	55”	23”
48 kV	55”	23”
60 kV	69”	25”
96 kV	115”	45”
120 kV	138”	50”
132 kV	161”	65”
192 kV	230”	92”
276 kV	345”	110”
420 kV	500”	175”

5.3.8 Disconnect Switches

GSU high-side main disconnect switches are not required when there is only a single transformer configuration. The HV line disconnect shall provide isolation to HV circuit breaker and transformer without compromising safety or operations. When a dual transformer configuration is in place, the high side transformer circuit breaker shall include disconnect switches. The GSU shall include a low side disconnect switch to allow isolation of the entire transformer zone without the need of opening feeder circuit breaker hooksticks.

The disconnect switches shall be three-pole, group operated, single-throw complete with station post insulators, switch blades, contacts, operating mechanisms and include all necessary hardware for the assembly and mounting to steel structures. All disconnect switches shall conform to IEEE Standard C37.30.1 for HV switches. Ratings for disconnect switches shall be as shown in Table 7 and Table 8.

Standard practice is to orient the vertical and side break switches so that the blade shall be dead when the switch is in the open position, i.e., the hinge shall be towards the closest circuit breaker.

All disconnect switches shall be provided with arcing horns which will interrupt charging or magnetizing currents to prevent any arcing at the main switch contacts. Grounding switches will be required for HV line disconnect switches. The line disconnect switch and associated ground switch shall be mechanically interlocked to avoid mis-operation, i.e. closing the line disconnect switch when the ground switch is closed and vice versa.

Table 8: HV Disconnect Switch Ratings

Nominal Operating Voltage (phase-to-phase)	**230kV**	**161 kV**	**138kV**	**115kV**	**69kV**	**34.5 kV**
Maximum Voltage (phase-to-phase)	See Table 1					
Basic Impulse Level (BIL)						
Maximum Continuous Current (amperes)	To be determined after study results					
Short Time Withstand (symmetrical) Current	To be determined after study results					
Preferred Configuration Type	Vertical Break/Double End Break/Center Break					Vertical Break/ Center Break/ Hookstick

Table 9: EHV Disconnect Switch Ratings

Nominal Operating Voltage (phase-to- phase)	**345kV**	**500kV**
Rated Voltage	362 kV	550 kV
Lightning Impulse Withstand Voltage	1300 kV	1800 kV
Switching Impulse Withstand Voltage	885 kV to ground 1120 kV across open gap	1150 kV to ground 1450 kV across open gap
Rated Continuous Current:	2000 A, or 3000 A (To be determined after study results)	2000 A, or 3000 A (To be determined after study results)
Rated Short Time Withstand	63 kA rms, 164 kA peak	63 kA rms, 164 kA peak
Short-time Current Withstand Duration	3 seconds	3 seconds

Line switches shall be monitored by the RTU or SCADA system.

All disconnect switches whether motorized or not will have auxiliary contacts for system monitoring. Auxiliary contacts on motorized switches will not be actuated by the motor cam but will be triggered based on the physical switch position.

Electrical interlocks shall be installed to prevent opening of motor operated disconnects and/or grounding switches when the station main breaker is in the closed position.

The complete switch assembly shall have a rated ice breaking ability to open and close with a ¾" thick coating of ice.

Gradient control rings shall be provided for switches at 230kV and higher voltages on both the hinge end and the jaw end to fully shield the live mechanism parts including the terminal pads.

Flexible braids are not acceptable as by-pass shunts. Flexible laminated current carrying components are acceptable only when welded connections are made on each end. Bolted connections are not acceptable on laminated components. All moving contact surfaces for current transfer shall be silver or silver alloy. Aluminum or plated aluminum is not acceptable.

The switches shall be free of visible corona at 110% rated voltage. The Radio Influence Voltage (RIV) shall not exceed 300 microvolts.

All fastenings, nuts, bolts and washers utilized in the non-live parts area shall be of hot-dipped galvanized steel. Plated fastenings are not acceptable.

All bearings shall be heavy duty with stainless steel balls and races. Aluminum or its alloys are not acceptable as a material for bearing raceways or bushing surfaces.

Bearings shall be maintenance free and not located in the current carrying path. Switch bearings shall be lubricated and sealed and shall not require further field lubrication. Dry type, non-lubricated type bearings will be preferred. Lubricant shall be non-deteriorating with a projected shelf life in excess of ten years. All bearing assemblies shall be weatherproofed with corrosion-free seals.

All switches supplied with manual operating mechanism shall be readily convertible to motor operation.

Maintenance ground studs shall be supplied on both hinge and jaw sides of the switch for attachment of portable ground cables. Design of the ground stud attachment shall be such that presence or absence of the ground studs will not change the switch height from its base to the top of the switch terminal pads. Ground studs shall be capable of being added to a switch in the field without undue switch dismantling. The ground studs shall be corona-free and shall be fully shielded where necessary. The ground stud material shall be the same as that of the switch contacts. The ground stud length shall be at least 6" for attaching the portable ground cable clamps and have sufficient strength to support a 50 feet length of a 4/0 copper portable ground cable.

5.3.9 Operating Mechanism

Hookstick operated switches may be used for equipment or circuit isolation, and regulator bypass applications up to 34.5 kV. Hookstick operated disconnect shall be located to provide switch operator space to allow 45 degree switch stick angle, for opening or closing, without operator or switch stick bumping into adjacent equipment, structures or foundations. Escape paths shall be considered in layout to deal with arcing or equipment failure that might occur during switching any switch or local breaker operation.

Switches shall be supplied with a manual three-phase group operated mechanism. The operating mechanism shall be designed such that the complete three phase switch assembly can be operated to fully open and closed positions by one person with a force of not more than 35 lbs applied to the actuating handle.

The vertical operating pipe operation for switches up to and including 145 kV shall be torsion operated by a swing handle. The swing handle shall be galvanized steel pipe not less than 3 feet in length. The switch design, where operation with a swing handle would require a force greater than 35 lbs, shall utilize a worm gear operator.

The vertical operating pipe operation for 170 kV and 230 kV switches shall be torsional operated by a worm gear in lieu of swing handle.

For 363 kV and 550 kV switches, the switch shall be supplied preferably with a three-phase torsional gear drive mechanism with a gearbox for each pole. The operating mechanism shall be designed such that the complete three-phase switch assembly, can be operated to fully open and closed positions with a force of not more than 35 lbs. applied to a manual actuating handle. The worm gear operator, when supplied, shall be in a sealed housing, corrosion and maintenance free. The gear operator shall be self-locking and prevent back driving of the crank handle during operation. The operating crank handle shall be no more than 15 inches in length.

Status indication of operator position is not required for manually operated switches but is required for motor operated switches.

5.3.10 EHV Switches (345 kV & 500 kV) Additional Requirements

The mounting location for the switch operating handle and/or the motor operator shall be the center pole support column.

The switch shall use porcelain station post insulators ANSI TR number 368, rated 1300 kV BIL for 362 kV switches and ANSI TR number 391, rated 1800 kV BIL for 550 kV switches.

5.3.11 Line Tuners

Communication using carrier equipment (line traps and tuners) shall not be used.

5.3.12 Metering Devices

5.3.12.1 General

Metering systems for the Project shall be designed and installed to monitor and record all energy traveling to and from the Project and to permit the evaluation of the functionality and efficiency of the overall Project.

Shorting-type terminal blocks shall be provided for all current transformer circuits to allow meters to be removed without disrupting current transformer circuits.

A set of metering current transformers on the GSU secondary shall be provided. Potential transformers shall be provided on the medium voltage buses for input to the meters. Shorting-type terminal blocks shall be provided to allow meters to be removed without disturbing current transformer circuits.

All permanently installed electrical metering instrumentation, or a combination of temporary test and permanently installed instrumentation, that will be used for the Project Performance Tests shall comply with maximum allowable measurement uncertainties per ASME PTC 22.

Except where more restrictive requirements apply, relaying class accuracy voltage and current transformers are acceptable for panel indication meter applications.

ABB FT-1 type test switches shall be provided for the voltage and current inputs to each meter.

5.3.12.2 Revenue Metering

The revenue metering system shall be included in the Work except for installation of the revenue meters, which shall be performed by Buyer. Seller shall purchase the revenue meter(s) from [Entity] Transmission during the design phase of the Project. Notwithstanding anything herein to the contrary, all revenue meters, installation and purchases thereof, and revenue metering shall be in accordance with the GIA or other applicable Required Deliverability Arrangement (to the extent applicable).

All meters shall conform to ANSI Standards C12.20, C12.1, and C12.10.

Seller shall provide and install high accuracy 0.15B1.8 extended range CTs and 0.15Z accuracy PTs for GSU high-side revenue metering. Seller shall provide the revenue meter cabinet(s) to Buyer's specifications. Seller shall design and install all wiring needed for revenue metering. Buyer shall install the revenue meters and make the final connections to the meters. Seller's schedule for the Work shall allow a reasonable period of time for Buyer to undertake, complete, and test such installation and final connections, and Seller shall use commercially reasonable efforts to cooperate with Buyer in connection with such installation and final connections.

5.3.12.3 Metering Locations

Other than where included with standard equipment packages (e.g., inverters), indication metering shall be provided in the following locations:

- High side of each GSU (voltage, current, kW, and kVAR)
- Each medium voltage main breaker (voltage, current, kW, and kVAR)

5.3.13 CCVT's & PT's

Voltage transformers and/or CCVTs are required to provide a low voltage supply to protective relays and metering equipment.

Voltage transformers, CVTs and CCVTs are directly connected to the high voltage bus.

Fuses shall not be used on the high side of the Voltage Transformer.

Auxiliary transformers are not permitted.

Refer to Table 10 and Table 11 for required CCVT and PT ratings, respectively.

Table 10: CCVT Ratings

Nominal System Voltage	Maximum Line to Ground Voltage	BIL	Performance Reference Voltage	Nameplate Ratio	Nameplate Secondary Voltage	Accuracy
69 kV	42 kV	350 kV	40.25 kV	350 / 600:1	115 / 67.1 Volts	0.6 WXYZ
115 kV	70 kV	550 kV	69 kV	600 / 1000:1	115 / 69 Volts	0.6 WXYZ
138 kV	84 kV	650 kV	80.5 kV	700 / 1200:1	115 / 67.1 Volts	0.6 WXYZ
161 kV	98 kV	750 kV	92 kV	800 / 1400:1	115 / 65.7 Volts	0.6 WXYZ
230 kV	140 kV	1050 kV	138 kV	1200 / 2000:1	115 / 69 Volts	0.3 WXYZ, ZZ
345 kV	209 kV	1550 kV	209 kV	1800 / 3000:1	115 / 69 Volts	0.3 WXYZ, ZZ
500 kV	318 kV	1800 kV	287.5 kV	2500 / 4500:1	115 / 63.8 Volts	0.3 WXYZ, ZZ

Table 11: PT Ratings

System Voltage	BIL	Primary Voltage	Marked Ratio	Secondary Voltage (each winding)	Accuracy/ Burden	Minimum Thermal Burden
15 kV	110kV	7.2 kV/12.47 kV Y	60 : 1	120 V	0.3Z	1000 VA
15 kV	110kV	8.4 kV/14.4 kV Y	70 : 1	120 V	0.3 Z	1000 VA
25 kV	150kV	14.4 kV/24.9 kV Grd Y	120/200 :1:1	120 / 72 V	0.3 Z	1000 VA
34.5 kV	200kV	20.125 kV/34.5 kV Grd Y	175/300:1:1	115 / 67.08 V	0.3 Z	1000 VA
69 kV	350kV	40.25 kV/69 kV Grd Y	350/600:1:1	115 / 67.08 V	0.3 ZZ	2000 VA
115 kV	550kV	69 kV/115 kV Grd Y	600/1000:1:1	115 / 69 V	0.3 ZZ	2000 VA
138 kV	650kV	80.5 kV/138 kV Grd Y	700/1200:1:1	115 / 67.08 V	0.3 ZZ	2000 VA
161 kV	750kV	92 kV/161 kV Grd Y	800/1400:1:1	115 / 65.71 V	0.3 ZZ	2000 VA

230 kV	1050kV	138 kV/230 kV Grd Y	1200/2000:1:1	115 / 69 V	0.3 ZZ	2000 VA

5.3.13.1 Current Transformers (CT)

All current transformers shall be in accordance with ANSI-C57.13 and shall meet the following requirements.

Relaying: Bushing type, fully distributed winding, five lead multi-ratio, C800 or as specified. (X and Y positions on a breaker bushing 69kV and higher; X position on a breaker bushing 34.5kV only.)

Metering: Bushing type, fully distributed winding, single- or dual-ratio, 0.15% B-0.9 and 0.30% B-1.8 or as specified. To be installed at the Z position on a breaker bushing for 69kV and higher or on the Y position on a breaker bushing at 34.5kV. See Revenue Metering Requirements sections.

Free standing post type current transformers shall be designed to operate at an average ambient temperature of 30°C and with a winding temperature rise not to exceed 55°C. In Buyer's service area, the ambient temperature under full sun can reach as high as 45°C to 50°C.

The minimum thermal rating shall be 2.0.

If continuous load is going to be “X” amps, then the CT shall also be rated “X” amps. Before applying a lower rated CT to benefit from the rating factor the application shall be evaluated thoroughly, and it is generally acceptable only if the peak load is seldom expected and for a very short duration.

Generally, the current transformer rated primary current shall be 10% to 40% above maximum load current when peak load information in unknown. Consideration shall also be given to short circuit levels. The maximum CT ratio shall be selected so that the maximum fault current is less than 20 times the maximum current tap, and so that the maximum secondary CT current is less than 100 amps under maximum fault conditions. An additional rating margin of not less than 25% shall be provided to accommodate future increased fault levels.

Refer to Table 12 and Table 13 for required minimum CT ratios and CT accuracy, respectively.

Table 12: CT Ratios

Fault Current	**Minimum CT Ratio**
48 – 64kA	4000/5
32 – 48kA	3000/5
20 – 32kA	2000/5
0 - 20kA	1200/5

Table 13: CT Accuracy

	Accuracy

Metering Accuracy Class	At RF *100% Rated Current	At 10% Rated Current	At 5% Rated Current	At ≤ 1% Rated Current (Note)
0.3	0.3%	0.6%		
0.3S	0.3%		0.3%	
0.15	0.15%	0.3%		
0.15S	0.15%		0.15%	0.15%

The CT shall have the following primary current and minimum short-time thermal current rating, rms for one second. For bushing and slip-over CTs these ratings apply to the secondary winding only.

Table 14: CT Short-Time Thermal Current

Maximum System Voltage	Primary Current	Short – time Thermal Current
15.5 kV	1200 A	25 kA
	2000 A	31.5 kA
	3000 A	40 kA
25.5 kV	1200 kA	25 kA
	2000 A	31.5 kA
36.5 kV	1200 A	25 kA
	2000 A	31.5 kA
	3000 A	40 kA
72.5 kV	2000 A	40 kA
	3000 A	63 kA
123 kV	2000 A	40 kA
	3000 A	63 kA
145 kV	2000 A	40 kA
	3000 A	63 kA
170 kV	2000 A, 3000 A	40 kA
245 kV	2000 A	40 kA
	3000 A	63 kA, 80 kA
362 kV	2000 A	40 kA
550 kV	3000 A	40 kA

5.3.13.2 CT/PT Combo Units

CT/PT Combo units are not allowed. Exceptions must be approved by Buyer in writing.

5.3.14 Circuit Breakers

Circuit breakers shall be three phase dead tank design with current transformers (CTs) on each bushing. A sufficient number of CTs will be supplied to support the system protection and metering requirements. Circuit breakers shall use SF6 or vacuum interrupters.

DC power for the circuit breaker operation and protection will be 125VDC.

Bushings shall comply with the requirements of IEEE Std C37.017. Voltage class and the current rating of the bushings and insulators shall not be less than that of the circuit breaker.

Continuous current rating factor (RF) shall be 2.0 in accordance with IEEE Std. C57.13.

HV and MV breakers shall not have internal 43 Local/Remote switches. If the breakers do come with a 43 device, the device shall be jumpered out. The only 43 Local/Remote switch shall be in the relay panel in the control house, near the 52 CS. The relay panel 43 switch associated with each breaker shall be a three-position switch, with Local, Remote, and Maintenance positions only (i.e., no “Off” position).

HV and MV breakers shall permit local tripping (i.e., tripping via the control switch in the breaker cabinet OR the 52 CS in the relay panel) regardless of the position of the relay panel 43 switch associated with that breaker. HV and MV breakers shall permit local closing ONLY when the relay panel 43 switch associated with that breaker is in the “Local” position. HV and MV breakers shall permit remote closing ONLY when the relay panel 43 switch associated with that breaker is in the “Remote” position. The Maintenance position will be used when working on the circuit and shall initiate a different set of relay settings.

All circuit breakers shall have dual trip coils. Trip coil 1 and the close coil shall be on the same 125 VDC circuit. Trip coil 2 shall be on a separate 125 VDC circuit. Trip circuits shall be in separate cables.

A platform shall be installed for maintenance access if operators will not or would not reasonably be expected to be able to reach all breaker equipment while standing at grade (cabinet access 60” or higher). Seller shall perform a detailed review of breaker manufacturer drawings to ensure that operability concerns, such as proper cabinet heights or the need for a platform, are addressed.

5.3.14.1 High Voltage Circuit Breaker:

HV power circuit breakers shall be SF6 gas insulated, dead-tank, “puffer” type design with a spring-spring type operating mechanism. Auxiliary contacts for breaker internal control functions shall be provided plus additional form “a” and form “b” field convertible contacts per Table 15. Circuit breakers shall conform to IEEE C37. Circuit breaker ratings shall be as shown in Table 15.

Table 15: HV Circuit Breaker Ratings

Rated Maximum Voltage		**72.5 kV**	**123 kV**	**145 kV**	**170 kV**	**242 kV**
Rated Continuous Current (as specified)		1200 A 2000 A	2000 A 3000 A	2000 A 3000 A	2000 A 3000 A	2000 A 3000 A
Rated Short Circuit Current (to be determined after study results)		40 kA	40 kA 63kA	40 kA 63kA	40 kA	40 kA 63kA
Lightning Impulse Withstand Voltage		350 kV	650 kV	650 kV	750 kV	900 kV
Rated Interrupting Time		5 cycles	3 cycles	3 cycles	3 cycles	3 cycles
Rated shunt Capacitor Switching current		630 A	315 A	315 A	400 A	400 A
Additional Auxiliary Contacts	Form “a”	12				
	Form “b”	12				

The alarm for SF6 gas breakers shall be annunciated at the operations control center. SF6 meter/monitor shall be suitable for the loss of SF6 emissions. All of the available alarms for HV breakers shall be inputs into the substation RTU and made available to the Electric Reliability Coordinating Council (ERCC) via the communications network.

All HV circuit breakers shall have low SF6 pressure alarms and emergency operations for:

Stage 1: Low gas pressure

Stage 2: Auto-trip of the Trip Coil 1 and Trip Coil 2 circuits and block close of the Close Coil circuit.

Stage 3: Block-trip of the Trip Coil 1 and Trip Coil 2 circuits and block close of the Close Coil circuit.

5.3.14.2 EHV Circuit Breakers (345 kV & 500 kV)

Additional specific requirements pertaining to 345 kV & 500 kV circuit breakers will be provided under separate cover where applicable.

5.3.14.3 Medium Voltage: Collector Feeders and Reactive Breakers:

MV Circuit breakers shall be rated for outdoor, three-poles, gang operated, dead tank, frame mounted vacuum type with motor charged operating mechanism in conform to IEEE C37. MV Circuit breaker ratings shall be as shown in Table 16.

Table 16: MV Circuit Breaker Ratings

Nominal Operating Voltage (phase-to-phase)	34.5 kV
Maximum Voltage (phase-to-phase)	See Table 2
Basic Impulse Level (BIL)	See Table 2
Maximum Continuous Current (amperes)	To be determined after study results
Short Circuit Interrupting Current (kA)	40kA with full back to back switching capability; tested and proven*
Interrupting Time (cycles)	3
Independent Pole (Phase) Operators	N/A
Duty Cycle	O-0.3 sec – CO -3 min - CO
Spring Motor Voltage	125VDC
AC Heaters and Receptacle Voltage	120/240VAC
Additional Auxiliary Contacts	Forms “a” and “b”

***40kA analysis - use conservative design/results. The results of final short circuit model shall dictate the final rating.**

5.3.14.4 Generator Step-up Unit (GSU) / Main Power Transformer (MPT)

This section describes requirements for the Main Power Transformer (MPT) within the collector substation. This item is also referred to as the Generator Step-up Unit (GSU). The GSU connects the medium voltage collector system to the high voltage interconnecting transmission system.

The GSU shall be built to ANSI/IEEE C57. The GSU shall be an outdoor, oil-filled power transformer and designed in accordance with the Project Site climactic conditions listed in Attachment 2. The transformer shall be a wye-g/wye-g/delta (internally buried) configuration with a neutral grounding bushing on the high and low sides.

The GSU ratings shall be based on the project expected total generation at all operating power factors, including all applicable derating factors and confirmed through software simulations. A minimum 10% design margin shall be included.

The GSU shall be purchased complete as a two winding with LV & HV bushings, current transformers, tap changers, surge arresters, cooling equipment (such as radiators & fans), and control/monitoring system equipment.

Table 17 below provide some recommended transformer specifications to consider.

Table 17: Transformer Recommended Specifications

Project MW		**270**	**250**	**200**	**150**	**100**	**20**
Transformer MVA	ONAN	180	168	135	102	69	18
	ONAF1	240	224	180	136	92	24
	ONAF2	300	280	225	170	115	
%Z (H-X, Positive Sequence)		9.0%	9.0%	8.5%	8.5%	8.0%	8.0%
X_0 Neutral Reactor		Yes	Yes	Yes	Yes	No	No

Assumptions:

1. Power factor range required at point of interconnect is +/- 0.95
2. Inverters are capable of +/- 0.9 power factor
3. Substation is not close to synchronous generation switchyard
4. Transformers over 300 MVA not recommended due to 34.5 kV fault current
5. Based on transformer winding configuration: HV (wye-gnd); XV (wye-gnd); XV (delta-buried)

5.3.14.5 Loss Evaluation

The test system accuracy for measuring losses shall be as specified in IEEE C57.12.00. The calibration and the accuracy of the test equipment shall be traceable to the National Institute of Standards and Technology.

The Manufacturer shall guarantee the following losses for each transformer:

No-Load loss in kilowatts at rated voltage and rated frequency

Total losses (sum of no-load loss and load loss) in kilowatts at ONAN rated output, rated voltage and rated frequency

Auxiliary losses (all cooling in operation)

Load losses shall be evaluated on the ONAN 65°C rating for each transformer.

Transformer losses determined under tests shall be corrected to 85°C. No-Load loss shall not be corrected.

All control components shall be capable of operating in a temperature range of minus 20°C to plus 70°C in the control cabinet(s). The control cabinet design shall ensure that all control components will operate satisfactory when the transformer is loaded beyond its nameplate rating in a 40°C ambient temperature, 90% relative humidity, in full sun with no wind. The control cabinet design shall ensure that damage from condensation inside the cabinet is prevented.

The basic impulse level (BIL) of the transformer windings and bushings shall be as listed below for the specified nominal system voltage. The neutral BIL for all wye-connected windings shall be a minimum of 150 kV.

Table 18: Transformer Winding and Bushing BIL

Nominal System Voltage	**Winding Lightning Impulse Level**
500kV	1550 kV
345kV	1175 kV
230 kV	825 kV
161 kV	650 kV
138 kV	550 kV
115 kV	450 kV
69 kV	350 kV
34.5 kV	200 kV
24 kV	150 kV
13.8 kV	150 kV

The transformer percent impedance at the self-cooled (ONAN) rating shall be as specified in Table 19 below (for 345 kV and 500 kV, requirements will be provided under separate cover);

Table 19: GSU Impedance

HV Winding Voltage	Impedance %	
	Without LTC	With LTC
230 kV	10.0	10.5
161 kV	9.5	10.0
138kV	9.0	9.5
115kV	8.5	9.0
69 kV	8.0	8.5
34.5 kV	7.25	7.5
24 kV	6.75	7.0
13.8 kV	6.75	7.0

The maximum average winding temperature rise shall be 65°C. The maximum hottest-spot temperature rise of the winding shall not exceed 80°C. The maximum hottest-spot temperature rise of any metal components in the transformer core and tank whether in contact or not in contact with the paper insulation, shall not exceed 80°C at an ambient temperature of 40°C.

The calculated maximum temperature rise of any lead or connection shall not exceed the calculated maximum winding hottest spot temperature rise.

The temperature of any serviceable metal parts, gauges, switch handles, etc., located in the control cabinet that may be touched by an operator under normal operation shall not be affected by the transformer and shall not exceed the ambient temperature by more than 10°C at maximum rated load.

Winding hottest-spot calculations shall be made for each winding using the maximum localized losses including the eddy current losses, the insulation thickness at the points of maximum localized losses, and the oil rise in the winding. If Seller is unable to measure the oil rise in the windings, an allowance will be made for the added rise at the design review. These results shall be used in calibrating the hot-spot temperature indicator.

The use of metal oxide varistor (MOV) or other internal devices to control voltage transients is not preferred and Seller shall obtain approval from Buyer prior to use. When MOVs or other internal arrestors are used, their location shall be shown on the nameplate winding schematic and they must be accessible from the top of the transformer without oil drainage.

The calculated maximum temperature rise of any lead or connection shall not exceed the calculated maximum winding hottest spot temperature rise.

The sound pressure level of transformers with an equivalent two-winding rating of more than 25 MVA (ONAN) shall be 6 dB below the levels specified in the NEMA TR-1.

The inter-winding insulation system for windings shall be designed for a BIL impulse to one minute 60 Hz. withstand level ratio of 2.5 or less, using maximum voltage stress and with a safety margin of 20% for the oil space stresses. Weidmann oil gap curves shall be used to determine the field stresses.

Ancillary equipment such as bushings, tap changer, winding leads, etc., shall not restrict the transformer loading to levels below those permitted by the winding conductor. The transformer shall be capable of carrying loads above its nameplate rating in accordance with IEEE C57.91.

5.4 Short Circuit Capability

The transformer shall be designed and constructed to withstand, without damage, the effects of both three-phase and line-to-ground through-faults at either of the transformer HV, LV, or TV terminals. The windings shall not exceed the IEEE thermal limits for the duration of 2 seconds. The pre-fault operating voltage on the non-faulted terminals shall be 1.05 per unit rated voltage.

All windings shall be designed for an infinite bus condition i.e. system impedance shall not be used in the calculation of the fault currents. The inner windings shall be designed to withstand maximum short circuit forces in an unsupported buckling mode (free buckling), assuming no radial mechanical support from the core. The windings shall also be designed for forced or supported buckling.

The transformer shall be designed according to the requirements of IEEE Std 693 Annex D. The transformer assembly shall be designed to withstand seismic loading as specified in IEEE 693.

High temperature fiberglass or Nomex insulation or other Entergy approved high temperature material shall be used for the insulation between the tie plates and the core.

The iron core shall be designed such that at full load and with 105% rated secondary voltage, the maximum core temperature (hotspot) shall not exceed 120°C (80°C rise at 40°C ambient), and the maximum tie plate or core surface temperature rise shall also not exceed 120°C (80°C rise at an ambient of 40°C).

5.4.1.1 Windings:

All winding conductor material shall be copper and all other current-carrying parts shall be copper or silver, or alloy(s) of copper and/or silver.

The current density in the winding conductor under maximum rated power at 65°C temperature rise shall not exceed 4 A / mm2 (2580 amps per square inch).

The winding conductor insulation shall be thermally upgraded paper meeting the life criteria as defined and verified in IEEE C57.100. The minimum nitrogen content of the upgraded paper when tested by ASTM standards shall not be less than 2%.

5.4.2 Tank

All welding shall be in accordance with ANSI/AWS D1.1/ D1.1M, American Welding Society Steel Structural Welding Code.

The transformer tank shall be of welded sheet steel construction, free from distortion.

The transfer tank shall withstand full vacuum and at least 10 psig positive pressure without leakage or distortion.

The transformer tank cover shall be welded on with at least a 20-inch diameter manhole.

The transformer tank cover shall be welded to the tank using flanges to facilitate removal. With the exception of the main tank top and bottom plates, no side plate welding shall be within 6” of the corners. All tank joints shall be welded both on the inside and the outside.

The tank cover shall be peaked or sloped to prevent rainwater accumulation. All oil and gas seal designs shall have grooves for gasket retention and shall have groove-depth controlled compression for maximum seal life. Glue should not be used for the gasket retention.

All gaskets shall be one-piece, oil-resistant nitrile elastomer or Fluoroelastomer, such as Viton, compatible with the transformer operating temperature. All gasket materials shall be verified in accordance with ASTM D3455 to be compatible for the intended use with transformer oil. The gasket material shall also be fully compatible with the fluids used in the bushings. Gaskets shall not be exposed to the weather. Gasket material for the LV bushings shall be viton material or equivalent rating.

The location of the “shipping” and “dressed” center of gravity shall be marked with raised letters and symbols on the transformer tank.

The oil preservation system shall be a sealed-tank system with a constant pressure inert gas-pressure or conservator/diaphragm system.

5.4.3 Bushings and Terminals

All Bushings shall be in accordance with IEEE Std C57.19.01.

The minimum BIL of the bushings shall be as tabulated below.

Table 20: BIL ratings for GSU Bushings and Terminals

Nominal System Voltage	Rated Voltage of Bushing	Rated BIL of Bushing
500 kV		1675 kV
345 kV		1175 kV
230 kV	146 kV	900 kV
161 kV	102 kV	750 kV
138 kV	102 kV	650 kV
115 kV	88 kV	550 kV
69 kV	44 kV	350 kV
34.5 kV	22 kV	200 kV
24 kV	16 kV	150 kV
13.8 kV	10 kV	150 kV

The rated current of the bushing shall be as specified in IEEE Std C57.19.01 but not less than 1.2 times the transformer load current corresponding to its maximum MVA rating with full cooling in operation. The bushing shall not restrict the transformer loading to levels below those permitted by the winding conductor. The rate of loss of life of bushing shall not be more than that for the transformer when the transformer is loaded beyond its nameplate rating in accordance with IEEE Std C57.91

Bushing flange or (flange with adapter) sizes shall be such that the bushings and mountings supplied allow interchangeability with older IEEE standard bushings.

All bushings including the neutral bushing shall be provided with test taps.

All bushings shall be power factor tested. Values of “C1” and” C2” shall be stamped on the bushing nameplates.

The oil sight gauges or sight glass on cover-mounted bushings shall face “outward” so that the oil level sight glass in the bushing can be seen from ground level. All bushing nameplates are to face outward to allow reading of nameplates with spotting scope.

All bushings shall be paper-oil condenser type

Minimum clearance between the live parts of bushings and surge arresters to the components of the transformer that may be serviced (e.g. gas detector relay, valves, gauges, etc.) shall be in accordance with OSHA requirements. Bottom of the bushings shall be minimum 8.5 feet above ground including six inch foundation pad. Vertical clearance between the bushing terminal and the ground shall be in accordance with National Electrical Safety Code IEEE Std C2 requirements.

Bushings shall have the following creepage distance in Table 21

Table 21: GSU Bushing Creepage Distance

System Voltage	Creepage Distance
Up to 69 kV	48”
69 kV	69”
115 kV	138”
138 kV	138”
161 kV	230”
230 kV	230”
345 kV	345”
500 kV	415”

The H2 and X2 bushings shall be located on the same centerline, and where practicable shall be on the main tank centerline.

Minimum metal to metal clearance between the live parts of bushings in air shall be as tabulated below in Table 22

Table 22: GSU Bushing Minimum Clearance Between Live Parts

System Voltage (kV)	Clearance (inches)
Up to 69 kV	48”
115 kV	70”
138 kV	70”
161kV	70”
230 kV	78”
345kV	120”
500kV	160”

5.4.3.1 Bushing Current Transformers

Internal, multi-ratio, bushing-type current transformers (CT) shall be provided with all secondary terminals wired to shorting terminal blocks using ring type lugs without intermediary splices.

Typical CT Ratios are listed below in Table 23. Actual ratios to be confirmed as required to support protection relaying scheme requirements and shall be submitted to Buyer for approval. For 345 kV and 500 kV voltages, requirements will be provided under separate cover.

Table 23: GSU Bushing Typical CT Ratios

<table>
<tr><td rowspan="3">BUSHING VOLTAGE (kV L–L)</td><td>kV</td><td>600:5</td><td>1200:5</td><td>2000:5</td><td>3000:5</td><td>5000:5</td><td rowspan="3">XFMR WINDING MVA RATING: 3Ph @65C</td></tr>
<tr><td>13.8</td><td>12-14 MVA</td><td>19-28 MVA</td><td>28-47 MVA</td><td>47-71 MVA</td><td>71-100 MVA</td></tr>
<tr><td>14.4</td><td>12-14 MVA</td><td>19-29 MVA</td><td>29-49 MVA</td><td>49-74 MVA</td><td>74-100 MVA</td></tr>
</table>

	24	12-24 MVA	33-49 MVA	49-83 MVA	83-100 MVA		
	34.5	12-35 MVA	48-71 MVA	71-100 MVA			
	69	12-71 MVA	95-100 MVA				
	115	12-100 MVA					
	138	12-100 MVA					
	161	12-100 MVA					
	230	12-100 MVA					

The continuous thermal current-rating factor RF for the bushing current transformers shall be 2.0 based on temperature rise in accordance with IEEE Std C57.13 unless specified otherwise elsewhere in this Attachment.

All current transformers shall be multi-ratio with ratios in accordance with IEEE Std C57.13.

Provision shall be made to remove and replace the CTs without removing the tank cover.

Seller shall ensure that the manufacturer provides and includes on or as part of the transformer(s) for the Project:

Magnetic liquid level indicator with alarm contacts and threaded conduit hub, with two set points and two sets of alarm contacts per set point

Liquid filling and filter press connection in the top and bottom of the tank

Combination drain and bottom filter valve with sampler

Dial-type liquid thermometer and temperature-indicating switch with alarm contacts, maximum read pointer, and threaded conduit hub, with two set points and two sets of alarm contacts per set point

Vacuum pressure gauge with bleeder

Lifting hooks on the tank, lifting eyes on the cover and provisions for jacking

Stops shall be provided to prevent over-compression of gaskets; gaskets below oil level will be eliminated unless isolating valves are provided

Pressure relief device with alarm contacts and threaded conduit hub

A hot spot dial-type winding temperature indicator with alarm contacts shall be provided for each high voltage and low voltage winding, with a minimum of two (2) per transformer; each winding temperature indicator shall have two set points and two sets of alarm contacts per set point.

De-energized tap changer (DETC). A DETC is preferred, as follows:

Conform to IEEE C57.12.10, Article 5.1.1.

Steps at +5%, +2.5%, 0%, -2.5%, and -5%.

Operable from ground level, with a single external lockable operating handle not more than five feet above ground level.

The tap setting indicator shall be visible from ground level.

Capable of withstanding without damage the short-circuit duty specified for the transformer.

Load Tap Changer (LTC): If an LTC is determined to be required due to system and equipment requirements, then the following requires apply: A high-speed motor operated load tap changer with vacuum or resistance switching conforming to IEEE C57.12.10. Furnish as follows:

Range: plus-or-minus 10% in 32 - 5/8% steps with full MVA capacity on all taps above neutral position, and reduced MVA capacity on taps below neutral position. Preventive autotransformer (PA) if used shall be rated to maintain full capacity with the unequal steps.

Rated Current: not less than the maximum winding current at its rated maximum load (2 stages of supplemental cooling) even if provision only for cooling is initially supplied.

Tap position indicator: located where it can be readable and re-settable from the ground level and visible when manually operating the LTC. The position indicator shall have markings 16L – N - 16R to signify the Normal and the range extremes, and be in accordance with IEEE Std C57.12.10.

Each tap position indication shall provide a digital or analog output for indication in the substation control room and for SCADA indication.

Operation capability: Each contact shall be capable of 500,000 electrical and mechanical operations at the top MVA rating of the transformer before requiring contact replacement. The contacts shall be easily accessible.

The load tap changing equipment shall be contained in segment 2 in a compartment separate from the core and coils to prevent mixing of oil.

The hand crank for manual operation of the drive mechanism shall be operable while standing at the base of the transformer.

The automatic or manual operation of the LTC shall be blocked if the vacuum interrupter fails to interrupt and transfer the load current during a tap change operation.

LTC control relay. Wire to provide sequential or non-sequential operation.

LTC backup control relay

Latching relay for supervisory selection of AUTO or MANUAL REMOTE operation.

LTC Control devices: housed in the transformer control cabinet.

Switch for Manual-Off-Test-Auto control functions. A contact CLOSED when the selector switch is in either the “OFF” or “MANUAL” position shall be provided for the Buyer’s supervisory indication.

Switch for Local-Remote control.

Tap Position Indicator with Drag Hands.

Tap position indication sending unit

Operations Counter.

Raise/Lower Switch.

Automatic voltage control equipment.

Terminal blocks for cable connection.

Heaters for anti-condensation

Stainless steel nameplates and tap changer warning/instruction plates; nameplates shall not be attached to the radiators

5.4.3.2 Cooling Fans:

Three-phase and wired to an auxiliary cooling equipment control panel for power connection, individually fused or otherwise thermally protected, controlled by the winding hot spot temperature.

Shall not be located on top of the radiators nor directly mounted on radiator fins. Separate, removable mounting support for fans shall be supplied and bolted to the transformer tank.

Fan guards shall be hot-dipped galvanized, totally enclose the fan blades, and meet OSHA safety requirements.

The radiators shall be equipped with bolted flanges and valves to permit the removal of any radiator without draining the oil from the transformer or any other radiator; lifting eyes shall be provided on each radiator/cooler group

Connection provisions shall be made in the cooling equipment controls circuit to allow external interlocking with the transformer protective relaying scheme, such that operation of normally closed contacts of the transformer protection lockout relay (86T) will shut down the cooling equipment in the event of an internal transformer fault

Copper grounding pads shall be provided at opposite corners of the tank base. A NEMA 4-hole compression type lug for connection of a 500 kcmil ground cable to the station ground grid shall be provided for each ground pad and for the transformer neutral bushing ground connection which shall be bussed to the tank base.

Insulating Oil: Seller shall ensure the manufacturer fills the tank with oil and the transformer shall be provided with the necessary amount of high-grade insulating oil that contains no detectable PCBs; the oil shall be manufactured and tested in accordance with the requirements of ASTM D3487; identification of non-PCB liquid shall be placed on outside of tank.

Bushing mounted, station-type lightning arresters. Arrester ratings shall be as follows:

Table 24: GSU Arrester Ratings

System Voltage	Surge Arrester Rated Voltage	Surge Arrester MCOV
500 kV	420 kV	335 kV
345 kV	276 kV	220 kV
230 kV	192 kV	152 kV
161 kV	132 kV	106 kV
138kV	120 kV	98 kV
115kV	96 kV	76 kV
69 kV	60 kV	48 kV
34.5 kV	30 kV	24.4 kV
24 kV	21 kV	17 kV
14.4 kV	12 kV	10.2 kV
13.8 kV	12 kV	10.2 kV
13.2 kV	12 kV	10.2 kV
4.16 kV	6 kV	5.1 kV
2.4 kV	3 kV	2.55 kV

The height, from base to the terminal, of the arresters up to 34.5 kV shall be the same as that of the associated LV bushing to reduce probability of flash cause by wildlife. Spacers should be added at the base of the arresters if necessary.

All control wiring shall be 600-volt, 90 degrees C, and XLPE insulation, with stranded copper wire, No. 12 AWG (minimum) for power, No. 14 AWG (minimum) for controls, and No. 10 AWG (minimum) for current transformers

Terminal blocks shall be rated for 600 volts and accept conductors sized #18 through # 8 AWG; an additional 20% spare or extra terminal blocks shall be provided; heat shrink wire markers are required

A core grounding strap shall be provided and accessible from a tank top man-way.

5.4.3.3 Radiators

Radiators shall be detachable from the main tank and preferably shall be interchangeable. The radiators shall be equipped with bolted flanges and valves to permit the removal of any radiator without draining the oil from the transformer or any other radiator and without the loss of cooling from other radiator banks. Lifting eyes shall be provided on each radiator/cooler group.

Studs welded to the tank or headers for mounting of the radiators are not acceptable.

Radiator shut-off valves (butterfly type) shall be provided for each detachable radiator or header, at both top and bottom openings to the main transformer tank. It shall be possible to remove individual radiators for maintenance without the loss of cooling from other radiator banks. The open and closed positions on the radiator shut-off valves shall be clearly and marked

Radiators shall be heavy hot-dip galvanized in accordance with ASTM A123. As measured in accordance with ASTM A386, minimum zinc-coating thickness shall be 3 mils or 1.8 oz/ft2. If any repair of the galvanizing coating is necessary, Supplier shall make such repairs in accordance with ASTM 780.

Radiator banks shall have lifting eyes.

Cooling Equipment Control

Winding temperature indicators/sensors shall be calibrated to simulate the winding(s) actual hottest spot temperature and shall actuate automatic control of the fans.

An alarm relay shall be provided for each stage for cooling failure.

A two-position “Fan Transfer Switch” shall be provided to allow selection of either bank of cooling equipment to operate on either stage of cooling.

A three position switch shall be provided to allow manual or automatic operation of cooling equipment. Switch positions shall be marked Auto-Off-Manual.

Each bank of cooling equipment shall be fed separately from and protected by a two pole breaker of adequate rating, 20 kA interrupting capacity minimum.

Means shall be provided to turn off the cooling system with a remote contact.

The first cooler group shall turn ON as soon as the transformer is energized.

The second cooler group shall be temperature-controlled and turn ON when the top oil reaches a pre-determined temperature – typically 65C.

5.4.4 Control Cabinets

Shall comply with the requirements of IEEE C37.21.

The inside pocket on the door shall contain one copy of the instruction manual. Cabinets wider than four (4) feet shall have two approximately equal sized doors.

All control, power, CT, cooling system and alarm wiring shall be terminated in the control cabinet. The control cabinet shall be insulated from transformer so that the "vibrations and heat" are not transmitted to devices within the cabinet.

Sufficient space and clearances shall be provided at the bottom of the cabinet to facilitate cable entry and termination.

Heaters: The heaters shall be rated to operate at 120 V ac and each heater shall be on its own circuit, protected by an appropriate 20 kA interrupting capacity circuit breaker. The heaters shall be PTC (Positive Temperature Coefficient for temperature limiting) heater(s) of sufficient size to prevent moisture condensation. Fan-less PTC heaters, where used, shall be oriented to facilitate convective air flow over their fins to maximize heat transfer.

A 120 volt 15 Amp weatherproof convenience duplex receptacle with ground fault protection shall be provided on the exterior of the control cabinet. A circuit breaker for this receptacle shall be provided inside the cabinet.

Lighting: Shall have a switched convenience light. Large cabinets shall have two switched convenience lights.

The cabinet shall be provided with a grounding bar for individually grounding current transformers, control cable shields, etc.

Provisions for a fall protection system

All standard accessories and maintenance devices as applicable and described in IEEE Std C57.12.10

The oil preservation system of transformer with a conservator shall be equipped with an automatically self-regenerating, maintenance-free dehydrating breather to prevent outside air from having direct contact with the desiccant. A separate unit shall be supplied for the LTC gas space (if applicable). Separate tap-changer compartments shall be equipped with separate dehydrating breathers. Top of the breathers shall be within approximately five feet of the transformer base.

See Section 11.11.5 for additional requirements for integral protective devices.

5.4.4.1 Transformer Monitoring

Transformer On line Monitoring Systems
The transformer shall be provided with an on-line monitoring system to continuously monitor the condition of LV and HV bushings, transformer dissolved gases and temperatures and other transformer parameters, including loss of insulation life. The on-line monitoring system shall be capable of controlling the coolers'/radiators' operation in parallel with the conventional cooler controls. Buyer currently uses Dynamic Ratings Monitoring Control Communication (DRMCC) on-line monitoring with a bushing monitoring system. The latest DRMCC monitoring system or better system

approved by Buyer shall be provided with the transformer. The type and model of the on-line monitoring system and multi-gas monitoring for the transformer shall be specified in the bid proposal. The on-line monitoring system shall have communications protocols built in to monitor all parameters in Buyer's DCS and PI data server. The transformer shall be provided with the latest model of a Vaisala multi-gas monitor (or better), to be specified by Seller and approved by Buyer, for continuously monitoring and detecting fault gasses in the transformer oil. The system shall be complete with necessary hardware, software, and interfaces. This gas monitor shall perform the following functions or as specified by Buyer: Detect, analyze, and correlate quantity of all dissolved fault gasses, including hydrogen (H_2), carbon monoxide (CO), carbon dioxide (CO_2), methane (CH_4), ethylene (C_2H_4), ethane (C_2H_6), acetylene (C_2H_2) moisture-in-oil, and oil temperature.

Annunciator/Data Logger and Alarms
The transformer shall include an annunciator/data logger panel in the transformer control cabinet. The type of annunciator/data logger shall be Rochester Instrument Systems Inc. (RIS) or equivalent approved by Buyer. The annunciator shall monitor the system's health and indicate occurrences of alarms, trips, and other general signaling messages.

The annunciator shall be mounted on a hinged weather-tight panel, for easy access to rear wiring, in a cabinet of dead-front construction arranged so that water cannot enter the wiring area of the cabinet when resetting the annunciator in rainy or inclement weather. A plexiglass panel shall be provided for external viewing of the annunciator. The panel door shall be equipped with a handle mechanism to allow easy access to the annunciator.

The following is a typical list of alarms generated by the monitoring devices that the annunciator system shall be required to monitor and display. All alarms will be discussed and approved during the design review meeting with Buyer.

- Loss of Normal AC Power
- Loss of Standby AC Power
- Power Supply Auto Transfer
- Loss of AC Control Power
- Group 1 Cooler Fail
- Group 1 Cooler Oil Flow Stop
- Group 2 Cooler Fail
- Group 2 Cooler Oil Flow Stop
- Oil Level Low
- Oil Level Low-Low
- Sudden Pressure Seal-in Relay
- Top Oil Temp.100° C
- Top Oil Temp.110° C
- Winding Temp. 110° C
- Winding Temp. 120° C
- Gas Detector Relay
- Monitoring Devices Fail
- Control Cabinet Temp. High

Alarm contacts shall be Form C type, and shall be wired independently to terminal blocks in the control cabinet to make possible any grouping of alarms by Buyer for remote indications. The contacts shall be rated 125 volts dc, 5 Amps continuous and 0.2 Amps dc non-inductive tripping.

Protection and Monitoring Devices
The transformers shall be equipped with the following devices for monitoring, control, and protection of the transformer (all of which shall have independent alarm contacts wired to the terminal blocks in the control cabinet):

Oil Level Gauge
A magnetic oil level gauge, Qualitrol or Buyer-approved equivalent, with a 6-inch dial, visible from the ground level shall be provided on the transformer tank and conservator.

The oil level gauge shall be a two-stage oil level monitor. Each stage shall be provided with two normally open contacts for alarm and trip functions. Contacts of the second stage shall close when the oil level in the transformer tank falls to a critical level and will result in an internal flashover of the unit.

Top Oil Temperature Gauge
A conventional oil temperature indicator, Qualitrol or Buyer-approved equivalent, with a minimum six (6)-inch dial, with drag hands, shall be supplied to indicate the temperature of the top oil. The instrument shall be mounted at eye level. The indicator shall be vibration-insulated from the transformer. The temperature indicator shall have two adjustable normally open contacts. Top oil alarm contacts shall be set at 105ºC and used to turn on all of the cooling equipment.

Pressure Relief Devices
A spring-loaded diaphragm-type pressure relief device, Qualitrol Type XRPD or Buyer-approved equivalent, complete with animal intrusion screen P/N SCN-600-1 and a DPDT alarm contact shall be mounted on the transformer tank cover or the tank wall near the top. Transformer tanks containing more than 10,000 gallons of oil shall be provided with two pressure relief devices mounted on diagonally opposite corners of the transformer tank. The device(s) shall be located remote from the control cabinet(s) and equipped with directional shield to direct oil flow downward. Pressure relief value shall be stamped on the device.

Sudden Pressure Rise Relays
A transformer with conservator tank shall be equipped with two sudden pressure rise relays, Qualitrol Type 900-014-02, to detect rapid pressure increase in the transformer tank. The relays shall be located on diagonally opposite corners of the transformer and shall be flange-mounted with gate-type shut-off valves located between three (3) and six (6) feet above the base of the transformer.

Sealed tank transformers shall be supplied with two sudden pressure rise relays, Qualitrol Type 910, to detect rapid pressure increase in the transformer tank. The relays shall be flange-mounted with gate-type shut-off valves in the gas space on the tank wall.

The sudden pressure relays shall be provided with Qualitrol type 909-200-01 seal-in relays set up for 125 volts dc and reset feature. A target relay shall be provided to give visual indication of sudden pressure relay operation. The target relay shall also have a reset feature. The alarm and trip contacts of the relays shall be wired to the terminal blocks in the control cabinet.

Actuation of each relay will result in an alarm. Actuation of both relays will result in a unit trip.

Gas Accumulation Detecting Relay
The transformers with a conservator tank shall be equipped with a gas accumulation detection device for detecting the presence of combustible gas within the tank and auxiliary oil-filled compartments. The device shall be Qualitrol type 038-003-01 complete with a sampling valve and alarm contacts. Sample test valves shall be located a maximum of five (5) feet above the transformer base.

The design of the gas detecting system, showing the location of the gas detection device and the gas accumulation system, shall be submitted for Buyer's approval before manufacture. Seller shall also submit a complete written description of operation as applied to the particular transformer with above submittal that will later become part of the Instruction Book.

A buchholz gas monitor relay shall be installed based on the transformer design with the COPs tank.

Dehydrating Breather(s)
The oil preservation system of transformer with a conservator shall be equipped with a Waukesha/HVS, or Reinhausen or other Buyer-approved, automatically self-regenerating, maintenance-free dehydrating breather containing an oil bath to prevent outside air from having direct contact with the desiccant.

Top of the breathers shall be within approximately five feet of the transformer base.

Temperature Monitoring System
Transformer shall be provided with an electronic temperature monitoring system (ETMS) in which the temperature rise of the winding hottest spot over the top oil temperature is added digitally by calculation. The traditional simulated Winding Hotspot Measuring System consisting of winding temperature CTs, heater circuit, and analog dial type thermometers is to be supplied only when specifically requested in the purchase order.

The transformer shall be provided with sufficient number of winding temperature CTs, thermo wells, sensors, dual element RTDs (Pt100Ω or Cu10Ω), probes, etc., to monitor the transformer oil and winding temperatures using a digital temperature monitoring system. The transformer shall be equipped with an APT TTC-1000 from Advanced Power Technologies or Buyer-approved temperature monitoring system with digital displays easily readable in daylight.

The sensors, probes, thermowells, etc., shall be located on the transformer tank sidewall (not the tank cover), and capable of being installed or replaced without de-energizing the transformer, opening the transformer, or lowering the oil in the transformer.

The ETMS shall have the digital displays for the following:

- HV winding hottest spot temperature, each phase
- LV winding hottest spot temperature, each phase

- Transformer tank top oil
- Transformer tank bottom oil
- Ambient temperature
- Control cabinet temperature

  The temperature monitor shall have large LED displays for easy readability in any lighting condition. The monitor shall operate with a solid state LED light source that will under normal operating conditions last for the life of the transformer without the need to replace the light source.

The monitor shall cover a temperature range from -30 0C to +150 0C, and shall have a display resolution of ± 1 0C and a 0.7% accuracy at full scale. The device should display the future temperature gradient projection and the load current. The monitor shall be complete with 4–20 mA analog outputs for oil temperature and winding temperature and have contacts to control cooling, for alarms, and for trips.

The monitoring system with digital display gauges shall be mounted in the control cabinet five (5) feet above the base of the transformer. The temperature monitor shall be installed in a manner such that all controls are visible and adjustable from the front, and such that adjustments may be made without interference to other devices. The monitor shall be labeled as TMS.

The transformer shall be provided with sufficient number of winding embedded fiber optic sensors at least three (3) fibers per phase per winding (HV & LV) for winding temperature monitoring and three fibers for top oil temperature monitoring. The fiber shall be terminated into Luma Sense digital temperature monitor or Buyer-approved equivalent located inside the control cabinet. The temperature monitor shall have outputs to connect to other plant devices, DCS, and monitors, including the transformer on-line monitoring system.

5.5 Generator Step-Up Transformer Warranty

The GSU transformer(s) shall be provided with an original equipment manufacturer's warranty that the GSU transformer(s) shall be free from defects in material, manufacture, workmanship, and design for a minimum period of five (5) years from the date of such GSU transformer's energization; provided that, if such GSU transformer has not been energized within six (6) months after delivery thereof to the Project Site, the warranty period shall be at least five (5) years commencing six (6) months after the date of delivery to the Project Site. The GSU transformer manufacturer shall be required to repair or replace at its cost any GSU transformer (or component thereof) in breach of such warranty. The warranty shall cover the cost of removal from the Project Site, transportation to and from the repair facility, reinstallation after repairs, and any and all other "in and out" work.

Seller shall notify Buyer of any procedure, activity, or other Work that may void a manufacturer warranty or violate any law or applicable permit reasonably in advance of the performance of such procedure, activity, or Work. Seller shall provide to Buyer all original equipment manufacturer warranty documents.

The original equipment manufacturer's warranty shall cover the equipment is free from defects in material, manufacture, workmanship, and design.

5.6 Neutral Grounding Reactor (NGR)

The neutral grounding reactor shall be used to limit the fault current magnitude on the 34.5kV.

The rating of the NGR shall be based on underground collection design, short circuit analysis and ampacity calculation design criteria. Table 9 shows typical MPT MVA where the X0 Neutral Grounding Reactor is required. The requirement of the NGR shall be evaluated during planning phases.

5.7 Station Service Transformer (Auxiliary Loads)

All HV substations, and other major and strategic substations, shall be provided with two independent AC station service sources with automatic transfer from one source to the other for redundancy.

Recommended station service ac voltage ratings is as follow:

- 240/120 V AC 60Hz, single phase, 3 wire.

  The AC station service capacity shall be sufficient to supply all loads for the following as applicable:

- Control house lighting, heating, and air conditioning,
- Power transformer cooling fans, pumps, LTC and control cabinet space heaters,
- Circuit breaker control cabinet heaters, and operating mechanism charging motors,
- Substation lighting,
- Battery chargers.
- Maintenance equipment, including gas cart, and oil filter truck if feasible
- Future Loads

  Approved sources of ac station service include the following:

- Distribution line(s) area feeder
- Distribution transformer connected to a substation bus
- Station Service voltage transformers (SSVT) up to 230 kV (suitably rated for this service, but not less than 50 kVA)

  SSVTs are used as the primary station service source in critical substations or in substations up to 230 kV without a MV source. The backup station service in such substations shall be from a nearby area distribution feeder based on economics and station importance. If a distribution feeder is not available, then a second SSVT shall be used as a backup. The SSVTs shall have sufficient kVA rating to be able to supply all substation loads including maintenance equipment.

  SSVTs are typically connected to the substation bus or a transmission line and are within the associated primary protection zones. Surge protection shall be required on the HV side of the SSVT unless arresters protecting other equipment are close enough to protect the SSVT.

  Alternate sources of AC station service, including but not limited to the following, are to be used only in special circumstances and require Buyer approval.

- Inverter system
- Solar panels
- Autotransformer tertiary
- SSVTs above 230kV

An engine generator shall not be acceptable for providing AC station service source.

See IEEE Std. 1818; Guide for the Design of Low-Voltage Auxiliary Systems for Electric Power Substations for additional guidance.

5.8 Reactive Equipment

Reactive equipment used to provide power quality and reliability to the electrical system (where required) shall be done through capacitor banks and reactors at the 34.5 kV level. To protect and control the reactive equipment, a circuit/reactor switcher shall be used. The MV circuit breaker (See Section 5.3.13.3) shall be used to protect for external faults of the reactive zone of protection (bus differential, etc.)

5.8.1 Circuit Switcher

Fully rated dead tank circuit breakers shall be used for the switching of power transformers and shunt capacitor banks; however, circuit switchers may be used with Buyer approval. For switching of the shunt capacitor banks rated up to and including 170 kV, the circuit switchers shall be equipped with pre-insertion resistors for suppression of transients.

Each application where a fully rated dead tank circuit breaker is not justifiable and circuit switcher with a desired fault interrupting rating is not available, a live tank circuit breaker without post type instrument current transformers may be considered in lieu of circuit switcher with Buyer approval.

Circuit switchers are typically rated to interrupt lower fault currents than circuit breakers. As the circuit switchers are normally installed to protect shunt capacitor banks, they are designed to be rated to the expected capacitive switching current as mentioned in the IEEE standards. The circuit switcher application shall ensure that these ratings are not exceeded.

5.8.2 Shunt Reactors

Air core reactors present unique design and safety considerations because they produce very high magnetic fields during normal operation. The distance from adjacent iron and steel structures and apparatus must be sufficient to prevent induction heating. Safety fencing with reactor safety signage shall be provided as needed to prevent personnel from getting too close to a set of reactors. A worker approaching too close could experience overheating of ferrous items he is carrying. There is a danger that implanted medical electronic devices such as pacemakers, insulin pumps, or hearing aids will malfunction or fail, causing injury or death. The manufacturer’s documentation shall include minimum phase spacing and magnetic clearance requirements for perimeter fencing and these requirements shall be adhered to in the design of the substation.

The Substation Designer shall consult with the manufacturer of the reactors with any additional questions including clear instructions for reactor grounding. To protect personnel working near the reactors the

Substation Designer shall also request the manufacturer to supply magnetic field plots, needed to determine the perimeter fence spacing.

The ratings of the shunt reactors shall be provided during detail analysis (project specific not required in all projects).

5.8.2.1 Shunt Capacitor Banks

Shunt capacitor banks may be installed in ungrounded wye configuration up to 115 kV, and shall be grounded wye for 138 kV and above. Fuseless capacitor units shall be installed in capacitor banks. Seller must obtain Buyer approval for any exception.

The ratings of the shunt capacitor banks shall be provided during detail analysis (project specific not required in all projects).

5.9 Control House

5.9.1 General

There shall be no wood framing or trim. Eave height is to be manufacturer's standard to accommodate a clear interior height of 10'-0" (minimum) including specified insulation.

See Section 8 for control house structural design information.

5.9.2 Roof

All roof panels in all locations shall have a U.L. wind uplift classification of class 90 (minimum).

5.9.3 Ceiling

Insulation shall be R-19 minimum and shall have a U.L. Flame Spread Rating of 25 (minimum).

5.9.4 Walls

For metal buildings, the exterior building walls shall be constructed with a minimum of 16-gauge aluminized steel (or a zinc-aluminum finish), flat or corrugated surface, with a factory baked on light reflecting finish including a minimum ten-year guarantee.

For concrete buildings, the exterior building walls shall be solid concrete design with 6" walls and steel rebar reinforced high strength concrete.

The building walls shall be insulated with a non-combustible blanket type insulator with a glued-on vapor barrier facing material rated at R-11 (minimum) and a U.L. Flame Spread Rating of 25 (minimum).

5.9.5 Doors

Substation control house doors shall be level 3 full flush doors (Level 3 - 16 gauge per ANSI/SDI A250.8-2003) with weather stripping. All doors are to be equipped with metal, weather-tight thresholds.

The main room (relay room) exit door shall be 6' wide (double leaves, 3' each). The battery room entrance and exit doors shall be 3' wide.

All doors shall be 8' in height. All exit doors shall open outwards and be equipped with panic bars and lighted or photo luminescent exit signs.

The battery room outside exit door shall have no outside handle and shall only be capable of being opened from the inside. All battery room doors (entrance and exit) shall have an emergency push bar. In the battery room, the floor and all interior wall panels shall be acid resistant.

5.9.6 Paint

If steel building, steel shall be coated with either aluminum or aluminum-zinc mix (containing at least 4% aluminum) and shall conform to the proper thickness as specified by ASTM. All structural steel is to have two shop coats of red oxide paint which meets or exceeds Federal Specification TT-P686.

5.9.6.1 Color Schedule

Exterior wall panels:	Light Gray unless specified otherwise by Entergy
All trim:	As specified by Entergy (specified during planning phases)
Interior wall panels:	White
Ceiling panels:	White
Partition door:	White
Exit doors:	to match exterior trim
Interior partition wall:	White

5.9.7 Cable Tray

The tray shall be Aluminum, ladder type, two side rails, with six inch rung spacing.

All cable tray entrances into the house shall be 36 inches wide and reducers shall be utilized to connect to 24 inch cable tray inside of the control house when required. A minimum four (4) cable tray entrances is required.

A solid flanged aluminum tray cover (.040 inches thick) with heavy duty cover clamps and stainless-steel mounting hardware shall be installed over all cable trays located on the outside wall of the control house.

Separate cable tray for communication cables shall be provided.

5.9.8 Lighting

Interior lighting shall be LED (Light Emitting Diode) light fixtures that provide 40 foot-candles of light at a level of three feet above the floor.

External lighting shall be supplied above the exterior doors using weatherproof fixtures.

Exit Lighting (OSHA-approved) shall be an LED (Light-Emitting Diode) illumination or self-illuminating device.

5.9.9 Air Handling

The battery room exhaust fan shall be rated for 90 cfm. Battery room exhaust fan(s) shall be equipped with animal deterrent and mounted 8 feet above the floor for security purposes. Exhaust fan(s) shall be controlled and operated with an electro-mechanical timer. Operation intervals of exhaust fan shall be a minimum of four twenty-minute cycles every twenty-four hours.

The air conditioner shall be controlled by a remote low voltage heating/cooling control thermostat, such as Accustat Energy Guard or equivalent, with design set points of 78°F for cooling and 68°F for heating.

5.9.10 Warranty

Building finish: minimum twenty (20) year non-prorated warranty.

The walls, including all wall openings for doors and louvered openings, are to be warranted weather-tight for a period of five years from the date of completion of the building.

Ceiling: minimum ten (10) year warranty.

Roof: minimum twenty (20) year non-prorated warranty.

A full five-year warranty on the control house including equipment with parts and service is to be included.

5.10 Substation Civil/Structural Design Criteria

Seller shall complete all civil works to furnish a collector substation site design, access road(s), and any other outdoor civil works required inside the Project Site or as needed for interconnection of the Project to the Buyer's Transmission System. The design shall meet all applicable federal, state, and local Laws and regulations and requirements of the Agreement, including the Scope Book and this Appendix 1, and provide a relatively maintenance-free design (e.g., provide adequately-sized culverts to limit the possibly of clogging, provide erosion control means on slopes to eliminate maintenance re-grading, design access road cross-section to minimize rutting, etc.).

5.10.1 Siting and Civil

5.10.1.1 Floodplain

5.10.1.2 Flood Risk Evaluation

Flood risk shall be evaluated, and an Elevation Basis selected. This includes evaluation of the flood risk to the substation from rain, river elevation, storm surge, or other causes. It also includes the placement of structures within known Federal Emergency Management Agency (FEMA) special flood hazard areas (SFHA) or other flood prone areas.

The substation location flood evaluation and decisions made with respect to site and equipment elevations shall be documented on the applicable substation site and foundation drawings.

The process to establish the Elevation Basis shall be as follows:

1. Determine if the site location is located within or near a FEMA SFHA.

2. If published information is available, determine the Base Flood Elevation (BFE, 100-year flood) of the proposed site and if the location is within or adjacent to a mapped floodplain.

3. Evaluate the FEMA Flood Insurance Rate Map (FIRM) to determine the most recent revision to the map (including Letters of Map Revision).

4. Determine the date of the underlying Flood Insurance Study (FIS), if the FIS is available, and if the FIS method can be determined.

5. Evaluate local development and the potential impacts to flooding since the publication of the FIS.

6. Obtain written documentation about local ordinances regarding development in a SFHA, including any local requirements for development.

For locations outside of a mapped SFHA, but that are suspected to be at an elevated flood risk, document the known information and attempt to quantify the risk in relation to the site. An example of this type of risk evaluation is floodway extents or floodplain extents ending in a straight line in the vicinity of the site. This occurrence might indicate a road or railway embankment but may be indicative of an arbitrary study limit.

Determine planned access routes to the site for construction, operation, and maintenance and if such routes could be adversely affected by surface water flooding. The evaluation should consider the probability of surface water flooding at critical elevation points such as control houses, equipment cabinets, and access roads for the expected life cycle of the facility.

If the site is located within a FEMA SFHA, the underlying FIS was conducted within the previous 10 years, and the 100 year BFE is available, the 100-year BFI shall be used as the Elevation Basis.

If the site location is not located in a FEMA SFHA, the FIS was conducted more than 10 years ago, or the BFE is not otherwise available, engineering judgement and input from the Project Team shall be utilized to determine if local knowledge will be used as a basis for the site and equipment elevations or if a Hydrologic and Hydraulic study by a suitably experienced individual or company would need to be performed to determine.an Elevation Basis. If it is deemed a study is needed to determine a proper Elevation Basis, a study should be ordered along with a site topographic survey. If applicable, the study shall be used to determine the Elevation Basis.

5.10.1.3 Flood Design Requirements

The Finished Grade of the site shall be at or above the Elevation Basis. Equipment foundation top of concrete (TOC) elevations shall be a minimum of one (1) foot above the Elevation Basis and a minimum of six (6) inches above the Final Grade. The final TOC elevations shall be chosen to keep all equipment control cabinets a minimum two (2) feet and if possible four (4) feet above the Elevation Basis. The Project Team will determine the Elevation Basis, make the final TOC elevation determination, and document those determinations. The TOC elevations shall be recorded on the station foundation plan and foundation details.

When establishing the TOC elevation for the control house foundation, the relative elevations of the control house and equipment control cabinets shall be evaluated. In all stations the control house floor shall be a minimum of six (6) inches above the Final Grade to prevent rainwater from entering the house. If the control house has trenches in the floor, then the bottom of the trenches shall be a minimum of six (6) inches above final grade. In stations within a FEMA SFHA or otherwise determined to be prone to flooding, the control house floor should be at or above the elevation of the bottom of the lowest equipment control cabinet. A higher control house elevation may be selected to allow for easy maintenance access under the house. In existing substations where the control house is raised due to flooding concerns, the ability to raise equipment cabinets to the same elevation as the control house floor should be evaluated for feasibility.

5.10.1.4 Earthwork

The existing site shall be cleared, grubbed/stripped to a depth sufficient to remove organic material, leveled, filled, compacted, and sloped to drain. The substation yard shall be graded to accommodate drainage. The preferred substation site shall be graded with a slope of no less than 0.5% - 1.5% to facilitate water drainage from the site, storm sewers, catch basins, and/or manholes may be used if required for proper drainage.

A soil drainage analysis may be performed at the same time as soil boring investigation to determine the site's characteristics for water infiltration and retention for sites with aggregate implications larger than 1 acre where AHJs may require additional site permitting.

The drawings shall note the control points on the site, and which coordinate system is to be used.

5.10.1.5 Erosion Control

The design shall comply with the Storm Water Pollution Prevention Plan (SWPPP) and Environmental Management Plan (EMP).

5.10.1.6 Wetland Delineation and Mitigation

Seller shall comply with all wetland requirements specified by Laws and applicable Permits. Wetlands shall be confirmed by a qualified third party.

5.10.1.7 Stormwater Management

Seller shall design the Project Site stormwater management plan. Seller shall complete and submit all necessary permitting applications, including stormwater discharge NPDES Permit applications, to the appropriate Governmental Authorities. The design shall provide quality control of stormwater prior to discharge.

Seller's design for stormwater management on the Project Site shall meet stormwater quality and quantity requirements of local, state, and, if applicable, federal Governmental Authorities. The design shall consist of the following, as a minimum:

Size and design details of stormwater, oil containment, run-off basin, and outfall

Location and size of stormwater piping, inlets and manholes as needed

Location and size of stormwater ditches or channels

Project Site relative grades and slope including the drainage area to each stormwater feature

5.10.1.8 Site Surfacing

Thickness: The Project Site shall be graded to drain and then be surfaced with a minimum of six inches of compacted crushed stone.

Aggregate shall meet the following:

If the Collector Substation is not in Arkansas or Louisiana: Material designation - #610- Crushed limestone, primarily used in the Entergy system.

If the Collector Substation is in Arkansas: Material designation: Arkansas Department of Transportation Class 7 Base - Crushed granite or limestone, primarily used in Arkansas. Class 7 Base is a new designation that replaces the old designation (SB2). The materials in Class 7 and SB2 have the same gradation.

If the Collector Substation is in Louisiana: Material designation - Grade D Base (DGA) Dense Grade Aggregate m-crushed limestone.

Compaction: The crushed stone shall be compacted to a minimum density equal to 95% of the maximum density obtained by a Modified Proctor Test (ASTM D-1557). Do not grade ruts down; fill with additional aggregate and compact.

Sterilant: after sub grade preparation and prior to applying the crushed rock, a non-toxic vegetation eradicator (sterilant) shall be applied. Sterilant shall be applied from a minimum of five feet to a maximum of ten feet outside the fence.

5.10.1.9 Drive Access and Road Design

Substation ingress/egress points are to be compliant with all State and local permitting requirements. A permanent all-weather twenty (20) feet wide roadway shall be provided for access and egress to the substation site directly from a public street or road. Access Road shall be adequate for construction and maintenance activities including hauling heavy equipment such as the collector substation GSU. Access Road shall have no less than 50 ft. centerline turn radii.

Roadways within the substation shall be provided, along the fence if possible, for personnel and equipment movement. All roadways within the substation shall be at least twenty (20) feet wide with at least a fifty (50) feet centerline minimum turn radius. A reduced turn radius inside the substation is acceptable provided that an 18-wheeled low-bed vehicle loaded with equipment can easily negotiate all roads and turns within the substation fence enclosure. Road crossings over cable trenches, and culverts, shall be designed to withstand heavy traffic. Substation shall have only two point of entry in and out of the yard. The yard shall allow for vehicles to turn around or back out of the yard.

Note that new substations designated as CODE (see Section 13) shall include a vehicle access corridor around the exterior of the perimeter to allow drive-around access by security or law enforcement personnel.

5.10.2 Oil Containment

5.10.2.1 Federal Regulatory Requirements

Design and construction shall conform to Code of Federal Regulations, Title 40, (40CFR), Parts 110 and 112.

Oil spill containment shall be provided for the main transformer. Oil spill containment shall be provided for other equipment when required by authority having jurisdiction.

5.10.2.2 State and Local Regulatory Requirements

Oil containment shall comply with state and local requirements which are contained in 40 CFR Part 109. State and local governments have generally adopted the existing federal regulations prohibiting discharges of oil.

5.10.2.3 Containment System

Secondary oil containment type shall be an above grade containment pit.

Minimum containment volume is to be 100% of oil contained within protected equipment in addition to the volume of rainwater retained during a 24 hour 25 year recurrent interval storm event.

All designed water removal systems shall incorporate a method of monitoring discharged water quality. Monitors shall be connected to alarm systems.

In designing (sizing) a stone filled collection pit, the final oil level elevation shall be situated approximately 12 inches below the top elevation of the stone. This provides a fire extinguishing capability designed to quench flames if a piece of oil filled equipment catches fire. The use of 1.5 inch or larger stone (washed and uniformly sized) is recommended to permit quicker penetration to avoid a pool fire. Void Volume Ratio for stone filled devices shall be between 30 to 40 percent.

Pits using drainpipes shall assure that the drainpipe material shall be capable of withstanding the higher temperatures associated with an oil fire.

5.10.2.4 Oil Filled Equipment Separation

Oil-filled equipment shall be separated from other equipment and buildings to prevent potential fire hazards that may impede restoring or maintaining electric service. The following minimum separations from NFPA 850 Section 5.1.4 are suggested:

Power transformers containing between 500 and 5,000 gallons of oil shall be located a minimum of 25 feet from any building unless the exposed walls consist of or are protected by a wall or barrier having a two-hour fire rating. The barrier shall extend horizontally and vertically such that any exposed part of the building is a minimum of 25 feet from the transformer. Transformers shall also be spaced an adequate distance from a fire-rated building wall to ensure that this 25 foot minimum is maintained to any other parts of the building that do not have a two-hour fire rating.

For outdoor transformers with an oil capacity of greater than 5,000 gallons, maintain clear separation of 50 feet from other structures or provide a 2-hour fire rated barrier

A minimum distance of 8 feet shall exist between the transformer and any building or wall to ensure there is adequate space for normal operating and maintenance work. Cable trenches shall not be routed adjacent to oil immersed equipment.

Barriers that are required due to inadequate separation to equipment or buildings shall be constructed of non-combustible, heat-resistant, fire-rated material. The barrier height shall extend a minimum of 1 foot above the top of any oil filled equipment and any of their components. Barriers shall also extend horizontally a minimum of 2 feet beyond the line of sight of the subject building or equipment.

For transformers with less than 500 gallons of oil and where a firewall is not provided, the edge of the postulated oil spill (i.e., containment basin, if provided) should be separated by a minimum of 5 feet from the exposed structure to prevent direct flame impingement on the structure.

Any transformer for the Project using a listed "less flammable" insulating oil (e.g., Envirotemp FR3) shall be installed with and maintain a separation distance and barriers as provided above. If Seller seeks a modification of a separation distance or a barrier requirement for a transformer on the basis that the transformer will use a listed less flammable insulating oil, Seller shall perform and provide to Buyer a detailed hazard evaluation of such transformer with the proposed less flammable insulating oil. Buyer will consider such evaluation in its review of the modification request.

6 EQUIPMENT SUPPORT STRUCTURE LOADING

6.1 Load Cases

The load cases specified shall include the following environmental requirements:

Dead Load: The weight of equipment and support structures shall be included with appropriate increases for all equipment accessories and structure connections.

NESC District Loading (Rule 250B) - NESC District Loading shall be selected from Table 25, Table 26, Table 27, or Table 28 based on project location (Note that these districts may not match the district depicted in NESC for a given county). The ambient air temperature shall be taken as 0°F. Note that the load factors specified in NESC Table 253-1 shall only be used for this condition.

Extreme Wind: An Extreme Wind Speed shall be selected from Table 25, Table 26, Table 27, or Table 28 based on project location (Note that the values in the tables may not match the maps depicted in NESC or ASCE 113 for a given county). Wind pressure shall be developed using ASCE 113. The importance factor (IFW) for Extreme Wind loading shall be 1.0 corresponding to a 50 year mean recurrence interval per ASCE 113, Table 3-3. The ambient air temperature shall be taken as 60°F.

Concurrent Ice and Wind: A wind speed of 30 mph from any direction and a radial ice thickness selected from Table 25, Table 26, Table 27, or Table 28: Load Districts by County – Texas based on project location applied on the equipment or structure. The importance factor (IFI) for Concurrent Ice and Wind loads shall be 1.0 corresponding to a 50 year mean recurrence interval per ASCE 113, Table 3-11. The ambient air temperature shall be taken as 15°F.

Short Circuit Loading: Determined in accordance with ASCE 113 and IEEE 605-2008 using electrical parameters determined from a site-specific analysis.

Seismic: Seismic design parameters (accelerations, site class, etc.) will be provided in the geotechnical report for each site. The seismic loads shall be calculated in accordance with ASCE MOP 113. Unless larger values are provided in the geotechnical report, the following minimum values shall be used for the mapped ground motion spectral response accelerations: Ss = 0.140 and S1 = 0.051. The ambient air temperature shall be taken as 60°F.

Other: For equipment mounted on structures, the same design weather conditions shall apply. Loads associated with operation of the equipment shall be added to applicable load combinations.

Table 25: Load Districts by County – Arkansas and Missouri

State	County	Extreme Wind mph	NESC District			Concurrent Ice & Wind Case Ice Thickness inches
			Light	Medium	Heavy	
AR	Arkansas	100		M		1
AR	Ashley	100		M		1
AR	Baxter	100			H	1
AR	Benton	100			H	1
AR	Boone	100			H	1
AR	Bradley	100		M		1
AR	Calhoun	100		M		1
AR	Carroll	100			H	1
AR	Chicot	100		M		1
AR	Clark	100			H	1
AR	Clay	100			H	1
AR	Cleburne	100			H	1
AR	Cleveland	100		M		1
AR	Columbia	100		M		1
AR	Conway	100			H	1
AR	Craighead	100		M		1
AR	Crawford	100			H	1
AR	Crittenden	100		M		1
AR	Cross	100		M		1
AR	Dallas	100		M		1
AR	Desha	100		M		1
AR	Drew	100		M		1
AR	Faulkner	100			H	1
AR	Franklin	100			H	1
AR	Fulton	100			H	1
AR	Garland	100			H	1
AR	Grant	100		M		1
AR	Greene	100			H	1
AR	Hempstead	100			H	1
AR	Hot Spring	100			H	1
AR	Howard	100			H	1
AR	Independence	100			H	1
AR	Izard	100			H	1
AR	Jackson	100			H	1

State	County	Extreme Wind mph	NESC District			Concurrent Ice & Wind Case Ice Thickness inches
			Light	Medium	Heavy	
AR	Jefferson	100		M		1
AR	Johnson	100			H	1
AR	Lafayette	100		M		1
AR	Lawrence	100			H	1
AR	Lee	100		M		1
AR	Lincoln	100		M		1
AR	Little River	100			H	1
AR	Logan	100			H	1
AR	Lonoke	100		M		1
AR	Madison	100			H	1
AR	Marion	100			H	1
AR	Miller	100		M		1
AR	Mississippi	100		M		1
AR	Monroe	100		M		1
AR	Montgomery	100			H	1
AR	Nevada	100		M		1
AR	Newton	100			H	1
AR	Ouachita	100		M		1
AR	Perry	100			H	1
AR	Phillips	100		M		1
AR	Pike	100			H	1
AR	Poinsett	100		M		1
AR	Polk	100			H	1
AR	Pope	100			H	1
AR	Prairie	100		M		1
AR	Pulaski	100			H	1
AR	Randolph	100			H	1
AR	St. Francis	100		M		1
AR	Saline	100			H	1
AR	Scott	100			H	1
AR	Searcy	100			H	1
AR	Sebastian	100			H	1
AR	Sevier	100			H	1
AR	Sharp	100			H	1
AR	Stone	100			H	1
AR	Union	100		M		1
AR	Van Buren	100			H	1
AR	Washington	100			H	1
AR	White	100			H	1
AR	Woodruff	100		M		1
AR	Yell	100			H	1
MO	Dunklin	100			H	1

State	County	Extreme Wind mph	NESC District			Concurrent Ice & Wind Case Ice Thickness inches
			Light	Medium	Heavy	
MO	New Madrid	100			H	1
MO	Oregon	100			H	1
MO	Pemiscot	100			H	1
MO	Stoddard	100			H	1
MO	Taney	100			H	1

Table 25: Load Districts by Parish – Louisiana

State	Parish	Extreme Wind mph	NESC District			Concurrent Ice & Wind Case Ice Thickness inches
			Light	Medium	Heavy	
LA	Acadia	150	L			0.5
LA	Allen	125	L			0.5
LA	Ascension	150	L			0.5
LA	Assumption	150	L			0.5
LA	Avoyelles	110	L			0.5
LA	Beauregard	125	L			0.5
LA	Bienville	100		M		0.75
LA	Bossier	100		M		0.75
LA	Calcasieu	150	L			0.5
LA	Caldwell	100		M		0.75
LA	Cameron	150	L			0.5
LA	Catahoula	100	L			0.5
LA	Claiborne	100		M		0.75
LA	Concordia	100	L			0.5
LA	Desoto	100		M		0.75
LA	East Baton Rouge	150	L			0.5
LA	East Carrol	100		M		0.75
LA	East Feliciana	125	L			0.5
LA	Evangeline	125	L			0.5
LA	Franklin	100		M		0.75
LA	Grant	100	L			0.75
LA	Iberia	150	L			0.5
LA	Iberville	150	L			0.5
LA	Jackson	100		M		0.75
LA	Jefferson	150	L			0.5
LA	Jefferson Davis	150	L			0.5
LA	Lafayette	150	L			0.5

State	Parish	Extreme Wind mph	NESC District			Concurrent Ice & Wind Case Ice Thickness inches
			Light	Medium	Heavy	
LA	Lafourche	150	L			0.5
LA	Lasalle	100	L			0.75
LA	Lincoln	100		M		0.75
LA	Livingston	150	L			0.5
LA	Madison	100	L			0.75
LA	Morehouse	100		M		0.75
LA	Natchitoches	100		M		0.75
LA	Orleans	150	L			0.5
LA	Ouachita	100		M		0.75
LA	Plaquemines	150	L			0.5
LA	Point Coupee	125	L			0.5
LA	Rapides	100	L			0.5
LA	Red River	100		M		0.75
LA	Richland	100		M		0.75
LA	Sabine	100		M		0.75
LA	St. Bernard	150	L			0.5
LA	St. Charles	150	L			0.5
LA	St. Helena	125	L			0.5
LA	St. James	150	L			0. 5
LA	St. John the Baptist	150	L			0.5
LA	St. Landry	125	L			0.5
LA	St. Martin, North	150	L			0.5
LA	St. Martin, South	150	L			0.5
LA	St. Mary	150	L			0.5
LA	St. Tammany	150	L			0.5
LA	Tangipahoa	150	L			0.5
LA	Tensas	100	L			0.5
LA	Terrebonne	150	L			0.5
LA	Union	100		M		0.75
LA	Vermillion	150	L			0.5
LA	Vernon	100	L			0.5
LA	Washington	125	L			0.5
LA	Webster	100		M		0.75
LA	West Baton Rouge	150	L			0.5
LA	West Carrol	100		M		0.75

State	Parish	Extreme Wind mph	NESC District			Concurrent Ice & Wind Case Ice Thickness inches
			Light	Medium	Heavy	
LA	West Feliciana	125	L			0.5
LA	Winn	100		M		0.75

Table 26: Load Districts by County – Mississippi

State	County	Extreme Wind mph	NESC District			Concurrent Ice & Wind Case Ice Thickness inches
			Light	Medium	Heavy	
MS	Adams	100	L			0.5
MS	Amite	110	L			0.5
MS	Attala	100	L			0.5
MS	Benton	100		M		1
MS	Bolivar	100		M		1
MS	Calhoun	100		M		1
MS	Carrol	100		M		1
MS	Chickasaw	100		M		1
MS	Choctaw	100		M		1
MS	Claiborne	100	L			0.5
MS	Clay	100		M		1
MS	Coahoma	100		M		1
MS	Copiah	100	L			0.5
MS	Covington	110	L			0.5
MS	Desoto	100		M		1
MS	Franklin	100	L			0.5
MS	Grenada	100		M		1
MS	Hinds	100	L			0.5
MS	Holmes	100		M		1
MS	Humphreys	100		M		1
MS	Issaquena	100	L			1
MS	Jefferson	100	L			0.5
MS	Jefferson Davis	110	L			0.5
MS	Lafayette	100		M		1
MS	Lawrence	110	L			0.5
MS	Leake	100	L			0.5
MS	Leflore	100		M		1
MS	Lincoln	110	L			0.5
MS	Madison	100	L			0.5
MS	Marion	110	L			0.5
MS	Marshall	100		M		1

State	County	Extreme Wind mph	NESC District			Concurrent Ice & Wind Case Ice Thickness inches
			Light	Medium	Heavy	
MS	Montgomery	100		M		1
MS	Neshoba	100	L			0.5
MS	Newton	100	L			0.5
MS	Panola	100		M		1
MS	Pike	110	L			0.5
MS	Ponotoc	100		M		1
MS	Quitman	100		M		1
MS	Rankin	100	L			0.5
MS	Scott	100	L			0.5
MS	Sharkey	100	L			0.75
MS	Simpson	100	L			0.5
MS	Smith	110	L			0.5
MS	Sunflower	100		M		1
MS	Tallahatchie	100		M		1
MS	Tate	100		M		1
MS	Tippah	100		M		1
MS	Tunica	100		M		1
MS	Union	100		M		1
MS	Walthall	110	L			0.5
MS	Warren	100	L			0.5
MS	Washington	100		M		1
MS	Webster	100		M		1
MS	Wilkinson	110	L			0.5
MS	Winston	100	L			0.5
MS	Yalobusha	100		M		1
MS	Yazoo	100	L			0.75

Table 27: Load Districts by County – Texas

State	County	Extreme Wind mph	NESC District			Concurrent Ice & Wind Case Ice Thickness inches
			Light	Medium	Heavy	
TX	Angelina	100		M		0.75
TX	Brazos	100		M		0.75
TX	Burleson	100		M		0.5
TX	Chambers	150	L			0.5
TX	Galveston	150	L			0.5
TX	Grimes	100		M		0.75
TX	Hardin	125	L			0.5
TX	Harris	125	L			0.5
TX	Houston	100		M		0.75

State	County	Extreme Wind mph	NESC District			Concurrent Ice & Wind Case Ice Thickness inches
			Light	Medium	Heavy	
TX	Jasper	125		M		0.5
TX	Jefferson	150	L			0.5
TX	Leon	100		M		0.75
TX	Liberty	125	L			0.5
TX	Limestone	100		M		0.75
TX	Madison	100		M		0.75
TX	Montgomery	110		M		0.5
TX	Nacoqdoches	100		M		0.75
TX	Newton	125		M		0.5
TX	Orange	150	L			0.5
TX	Polk	110		M		0.75
TX	Robertson	100		M		0.75
TX	Sabine	100		M		0.75
TX	San Augustine	100		M		0.75
TX	San Jacinto	100		M		0.75
TX	Trinity	100		M		0.75
TX	Tyler	110		M		0.75
TX	Walker	100		M		0.75
TX	Waller	110	L			0.5
TX	Washington	100	L			0.5

6.2 Load Combinations

All substation equipment support structures shall be designed using the load cases in Section 7 and using the provisions and load combinations of ASCE 113. Wire- supporting structures shall be additionally be designed per the National Electric Safety Code (NESC), Construction Grade B.

6.3 Structural Analysis

Computer aided analysis and design shall include secondary moments from non-linear effects (p-delta) for structure stresses. Analysis procedures shall be based on the applicable design document (AISC 360 for steel structural shapes, ASCE 48 for tubular steel structures, ACI 318 for concrete structures, ASCE 10 for lattice structures, the Aluminum Design Manual for aluminum structures, etc.).

6.4 Equipment Support Structure Design

Transmission line dead ends shall be located outside the substation, with a slack span inside the substation.

Structural supports for bus work, switches, and all other equipment shall be designed in compliance with ASCE MOP 113, and IEEE 605.

All substation structures, except dead-end structures, shall be designed and constructed using hot-rolled, structural steel square, rectangular, or tapered polygonal tubes. The dead-end structures shall be designed using tapered tubular polygonal shapes.

Per ASCE 113, polygonal tube structures shall be designed in accordance with ASCE 48. Per ASCE 113, structures designed with other structural shapes shall be designed in accordance with AISC 360.

6.5 Structure Deflection

For deflection Load Combinations, the deflection extreme wind shall not be determined by using a reduced return period per ASCE 113, Table 3-14. For the Ice with Wind load Combination, the deflection ice thickness shall not be determined by reducing the ice thickness per ASCE 113, Table 3-15.

Structure deflections shall be checked for loading combinations with all load factors equal to 1.1.

The calculated deflections shall not exceed the values listed below.

Wire-Supporting Structures and Shield Poles

Horizontal deflection of vertical members: 1/100 of height

Horizontal deflection of horizontal members: 1/200 of span

Vertical deflection of horizontal members: 1/200 of span

All other Equipment Support Structures

Horizontal deflection of vertical members: 1/200 of height

Horizontal deflection of horizontal members: 1/300 of span

Vertical deflection of horizontal members: 1/300 of span

7 CONTROL HOUSE STRUCTURAL DESIGN

The control house shall be designed using the applicable building code as required by the Authority Having Jurisdiction (AHJ). If no AHJ oversight is required, the International Building Code 2015 edition shall be used for design.

Design, fabrication, and erection of structural steel shall meet the requirements of the IBC, AISC Steel Construction Manual (AISC specification and AISC code of standard practice). Structural design shall comply with seismic design and detailing requirements of the IBC, ASCE 7, and AISC 341. It is preferred to have an Engineered/prefabricated and delivered to site precast concrete building. Steel, concrete, and CMU buildings are all acceptable options.

7.1 Design Loads

Design Loads shall be determined in accordance with IBC assuming a Risk Category III.

Roof dead load: Weight of built-up roof, roof joists, insulation, structural members, permanent equipment, cable tray fully loaded with cables, lighting, and any other items supported by the roof.

Floor dead load: Weight of AC/DC panels, control/relay panels, batteries, cable termination cabinets, and other electrical equipment supported on the floor.

Roof live load: 40 psf (minimum)

Snow load: Per the applicable building code. 10 psf ground snow load minimum.

Floor live load: 250 psf or a 1,300-pound load concentrated in any 2½ square foot area.

Wind load: Per the applicable building code. 120 mph (minimum)

Seismic: Per the applicable building code.

7.2 Fall Protection

Building shall be constructed to include permanent anchorage points to accommodate personal fall protection systems capable of supporting 5,000 pounds per worker (OSHA defined impact load). For elevated houses, permanent anchorage points shall additionally be included on the walls of the control house adjacent to each exterior door to accommodate personal fall protection systems for use when working on the platform. All anchorage points shall be shown on roof drawings and marked on control house if not easily visible.

7.3 Roof

The roof shall have a minimum slope of ¼" in 12"; designed and constructed as specified by the IBC. Control house shall have a freestanding roof with no interior vertical supports to support the roof ridge beam.

7.4 Cable Tray

Cable tray and other suspended items shall be adequately supported to resist applied loads including, but not limited to, dead load, cable pulling loads, and seismic loads.

The cable tray shall be capable of carrying a uniformly distributed load of 75 lbs/ft in addition to the weight of the cable tray with a safety factor of 2.0 when supported as a simple span.

8 FOUNDATIONS

Foundation design will incorporate the soil capacity determined from the geotechnical study. Foundation design shall conform to ACI 318 and County and State Codes.

Drilled Pier/Shaft and Slab-type foundations shall be used. Alternative foundation systems may be considered if agreed upon between Buyer and Seller.

Ground supported pieces of equipment, such as circuit breakers and transformers, shall be supported by cast-in-place reinforced concrete slabs unless otherwise indicated by the geotechnical report.

Transformers shall be positively anchored to supporting foundations.

Foundations for the equipment support structures (bus supports, switches, etc.) and transmission line dead end structures shall be cast-in-place reinforced concrete drilled piers or spread footings, whichever is appropriate based on the subsurface soil information, unless otherwise indicated by the geotechnical report. Anchor bolts for all structures shall be of sufficient length to allow for the use of leveling nuts. The use of grout between the structure base plate and the top of the structure foundation is not required.

The control house foundation shall be piers or concrete slab. A cable routing and pulling area will be designed to facilitate connection with the conduit or pre-cast concrete cable trench entry from the substation and shall be located beneath the termination cabinet(s).

Foundation designs shall be in accordance with the following general minimum criteria:

a) Concrete Strength fc = 4,500 psi at 28 days

b) Grout Auger Cast Pilingfc = 5,000 psi at 28 days

c) Reinforcing Steel (ASTM A615 Gr 60) fy = 60,000 psi

d) Foundation Loads

Structures From structure design calculations

Equipment From equipment manufacturer shop drawings or product literature

Importance Factor

Structures/Foundations - 1.0 for non-essential facilities

Safety factors (foundation reactions shall be service loads)

Shallow Foundations – Bearing Capacity 3.0

Shallow Foundations – Stability (Overturning, Sliding, and Uplift)1.5

Drilled Piers Not less than 1.5, preferably 2.0

In general, foundations shall extend below the final grade as required by local or state code and the recommendations in the geotechnical report. The geotechnical report shall clearly state the safety factors needed for each site.

8.1 Foundation Deflection and Rotation

Deflection and rotation of drilled pier foundations shall be limited to 0.5 inch of deflection (vertical and horizontal) and 0.5 degrees of rotation due to unfactored (service) loads.

8.2 Materials

Structural steel shapes, plates, and appurtenances for general use shall conform to ASTM A992 or ASTM A572 grade 50 (wide-flange shape and ASTM A36 (other shapes)). Steel pipes shall conform to ASTM A53 grade B. Structural tubing shall conform to ASTM A500 grade B. Primary connection bolts shall conform to ASTM A325, type 1 or ASTM A490, type 1 with ASTM A194 grade 2H heavy hex nuts and steel washers conforming to ASTM F436 or Compressible-Washer-Type Direct Tension Indicators conforming to ASTM F959. Connection plates shall be ASTM A36 or ASTM A572 grade 50 steel. Steel components for metal wall panels, roof decking, and cold-formed girts and purlins shall conform to the North American specification for design of cold-formed steel structural members (AISI-S100).

Welded connections shall be made with welding electrodes with a minimum tensile strength of 70 ksi. Bolted connections shall be made with minimum 5/8 inch diameter ASTM F3125 Grade A325 high strength bolts, and shall typically be fully pre-tensioned Type N connections with threads included in the shear plane, unless noted otherwise. Connections subject to significant stress reversals or as otherwise required by the AISC shall be designed as slip-critical connections.

Welding procedures and qualifications for welders shall be in accordance with AWS D1.1 structural steel welding code and AWS D1.3 sheet steel welding code. Welding electrodes shall be as specified by AWS.

Preparation of metal surfaces for coating systems shall follow the specifications and standard practices of the SSPC, NACE, and the specific instructions of the coatings manufacturer. All structural steel for exterior use shall be hot dip galvanized steel per ASTM A123 and ASTM 153, unless noted otherwise. All structural bolts shall be galvanized, unless noted otherwise. Steel assemblies shall be safeguarded against embrittlement and warping during hot dip galvanizing per ASTM A143 and ASTM A384. Repair of damaged and uncoated areas of hot-dip galvanized steel shall be per ASTM A780.

8.3 Record documents

Seller shall provide buyer with structure and foundation detail drawings and supporting calculations. The drawings shall note all loading criteria used in the design. Foundation details shall note the structure base reactions used in the design. Drawings shall contain appropriate information (e.g. dimensions, materials, weld data, etc.) to allow reanalysis of the structure under future loading conditions.

9 FENCE & SIGNAGE

All substations shall have a fence at least eight feet high (seven-foot fabric and one foot of barbed wire). Fences shall consist of chain link fabric, with 3 strands of barbed wire on 45 degree extension arms, with no ground gaps greater than two (2) inches and secure. All steel, including pipe, roll-formed sections, and fittings to be first quality, full weight, "hot-dipped galvanized" as per ASTM-F1234 or ASTM-F1083. The fence fabric shall be aluminum coated steel according to ASTM-A491. Safe step and touch potential of the perimeter fence shall be verified by an IEEE 80 compliant grounding study.

9.1 Gates

Drive gates shall be equipped with heavy duty drop bars, drop bar keepers, stops, and flip-over latches (as required) to be locked by standard Entergy lock. Hinges shall be heavy duty and shall allow gates to swing either in, or out, or in and out of all gate leaves.

Gates shall be operational from both sides of gate. Gates shall clear finished grade by not more than 3". Gate locking mechanism shall be installed with 3/8" diameter case hardened bolts. The nuts on the bolts shall be incapable of being removed, either by using lock nuts, splitting the end of the bolts or by welding the nuts on the bolts.

The Collector Substation shall have one motor operated sliding gate and and additional non-motor operated sliding gate or one man gate.

Features of the motor operated sliding gates shall include the following:

- Sliding gate shall be four (4') greater than width of entrance road
- An electric gate operator (Lift Master Elite or newer equivalent or better), including associated items
- A hard-wired continuous power connection (if available)
- A hard-wired keypad gate opener (not wireless) located at the gated entrance (exterior side of the PV Project Site fence)
- A pedestal mount, conduits, and wiring at the gated entrance
- A hard-wired push-button gate opener located at the gated exit (interior side of the PV Project Site fence; exit ground loop not required
- A pedestal mount, conduits, and wiring for the gated exit
- Sliding gate shall be grounded
- Additional security requirements are found in Section 12.

9.2 Signage

A "Danger – High Voltage – Keep Away" sign shall be placed on the exterior of the fence at a maximum spacing of 50 ft. The signs shall be visible and readable from any angle the substation fence can be approached.

10 SUBSTATION PHYSICAL DESIGN CRITERIA

10.1 Substation Bus System

10.1.1 Bus Systems

The bus system consists of the bus conductor, bus insulators and supporting structures, and jumper conductors to equipment and lines. The bus system shall be designed to meet the voltage and continuous current rating requirement, as well as the mechanical requirements for bus design strength and deflection for all cases and conditions.

Rigid Bus structures shall be designed per IEEE Standard 605, IEEE Standard 1427 and in compliance with the NESC. The bus work must be designed to withstand all required weather conditions appropriate for the location of the station and withstand all forces due to maximum fault current.

Bus dampening shall be accounted for during detailed design and be between 10% and 33% of the bus conductor weight.

10.1.2 Bus Configuration

The layout of the bus design shall minimize the crossing of bus sections and equipment by lines and other station buses. This is to reduce or eliminate possible common mode failures and to permit service work to be performed without having to take additional busses or equipment out of service.

The design shall be of the low-profile type using rigid bus in a horizontal (flat) configuration on vertically mounted station post insulators.

Hookstick-operated disconnect switches shall be provided on both sides of all feeder breakers.

If so directed, the bus configurations of the substation facilities shall take into account future expansion. The physical layout shall be made so that expansion can be accomplished with the least amount of outage time when required.

10.1.3 Bus Fittings

Bus fittings used for rigid bus connections shall consist of welded connectors.

Fittings used for stranded conductor shall consist of either bolted, compression or welded types. For incoming lines to the substation DE structure, the use of quadrant clamps is acceptable. In applications where connection to a line surge arrester is required, the use of bolted connectors is preferred to compression connectors due to the potential chance of incorrect installation and bird caging effect on the incoming conductor. If using compression fittings for the incoming transmission line span, the compression tee and dead-end fittings shall have NEMA 4-hole or 6 hole terminal pads for connection of conductor jumpers.

Fittings used for conductor jumpers shall be of the bolted, compression, or welded type to a bolted pad. Jumpers shall be designed so that they can be unbolted and removed from equipment for maintenance, repair, or replacement.

10.2 Station Layout

The collection system shall be identified and marked. This includes all the phases on pad mount transformers, as well as any time the system transitions from underground to over ground or vice versa. An acceptable method of identification is stickers.

10.3 Phase Orientation

The phasing orientation of the substation shall be A-B-C when facing the low side transformer bushing left to right. If the phasing is different for the interconnecting utility, notation shall be added to the drawings detailing the phase rotation. Additionally, all equipment and busses shall be labeled.

10.4 Grounding System

High voltage equipment and structures will be connected to a ground grid. All metallic equipment, structures, and fencing will be conducted to the grounding grid of buried conductors and ground rods, as required for personnel safety.

10.5 Grounding Design Criteria

Grounding system shall be design using field resistivity values obtained from geotechnical studies. Substation ground grid design shall be based upon IEEE Std. 80 and NESC. Parameters to be used in the design, such as fault current magnitude and duration, will come from various studies, such as the Facility Study and other interconnection studies, and relay and protection system evaluation. Seller shall use fault current split factor calculations that consider OHGW, OPGW and feeder neutral grounding, in order to lower the effective ground fault current. The substation ground grid shall be connected to the overheard transmission line shield wires unless specifically isolated due to other engineering considerations. Clearing time for grounding analysis shall not be shorter than the total time for backup relay operation plus breaker time.

The ground grid analysis shall seek to optimize the cost and complexity of the installation. Multiple design iterations shall be developed, considering varying depths of substation rock, grounding conductor size, grid spacing, ground rod depth, etc., until an optimized, lowest-cost design is achieved.

Grounding analysis shall address seasonal conditions as appropriate, such as seasonally dry soil conditions or frozen earth conditions. The ground grid shall be designed to account for the most-restrictive weather condition.

The grounding system shall be modeled using the SES CDEGS grounding analysis software or equivalent.

10.6 Grounding System Components

10.6.1 Soil Structure:

Grounding analysis software shall be used to determine the number of soil layers present based on field test results input. The soil model results are considered usable if the resultant soil model accurately reflects the measured data.

The original soil model shall be adjusted to minimize the RMS error.

10.6.2 Ground Grid:

Ground grid conductor shall be optimized for cost, considering the fault current magnitude and other parameters. Copper clad steel should be considered where appropriate, but soil corrosivity shall be considered when evaluating the use of copper clad steel.

The ground grid shall be installed at a minimum depth of eighteen (18) inches below finished grade (i.e. grade not including any rock cover).

Ground grid shall extend to cover the swing access for all man and vehicle gate access points as well as any pad mount transformers and other medium or low voltage station service equipment located close to the substation fence. Recommended to go 3ft beyond the fence or overall equipment/gate offset.

10.6.3 Grounding Rods

The standard ground rod shall be 10-foot-long and made of 5/8-inch diameter copper-clad steel rod. It is acceptable for longer lengths to be made by joining multiple rods together with ground rod couplers. Longer ground rods shall be considered before more costly methods (such as ground wells) are implemented.

Ground rods shall be installed at applicable ground grid locations or at locations dictated by design. Applicable locations include substation perimeter, dead-end structures, lightning masts, surge arrestors, control house corners, etc.

10.6.4 Grounding Connections

All underground ground grid cable-to-cable and cable-to-ground rod connections shall be made with exothermic connections (Cadweld or equivalent). All above ground grounding connections shall be made with mechanical, bolted, or compression connections.

10.6.5 Above Grade Grounding Provisions

The perimeter fence shall be connected to the substation ground grid at each gate post, every corner and along the fence at intervals dictated by design. Grounding of the fence shall also include grounding provisions for the fence fabric and barbed wire.

All four corners of the control house shall be connected to the substation ground grid.

Two grounding conductors shall be installed the entire length of all pre-cast concrete cable trench greater than 36 inches wide. For pre-cast concrete cable trench less than 36 inches wide a single grounding conductor shall be installed. These conductors shall provide a convenient access to the substation ground and shall provide some shielding of control cables from electrostatic interference. They shall be connected to the ground grid at all main grid crossings and sized to match the ground grid conductor size.

Personnel safety mats (galvanized steel grating) shall be installed on top of the crushed rock surfacing at each disconnect switch operator, manual or motor-operated gang switches, and each personnel entrance to the control enclosure if metal steps are used. Safety mats shall be bonded to the station ground system in accordance with IEEE 80.

Equipment and structure grounds, or "stingers," consisting of bare conductors shall connect each piece of the substation equipment and steel structure to the ground grid. The minimum conductor size shall be calculated but never be smaller than the ground grid conductor size. There will be two (2) ground connections to each structure and piece of equipment.

Ground studs shall be installed on every breaker bushing pad. Provisions for portable safety ground installations, either bus ≤ 3-inch diameter, ground studs, or grounding stirrups, shall be included at both sides of all disconnect switches. Grounding studs shall be placed such that there is no interference from other equipment (for example, disconnect switch blades).

10.6.6 Crushed Rock

The site will be covered with a layer of crushed rock as defined in Section 5.10.1.8. The crushed rock shall be installed throughout the entire substation area and extend 5 feet beyond the fence and swing radius of the gates.

Resistivity tests shall be performed on potential material sources early in the design phase, and those results shall be integrated into the overall grounding system design. The IFC grounding design shall use material with a known, tested resistivity; no assumptions should be made as to the availability of rock of a certain resistivity.

10.6.7 Grounding Drawings

The design input from the grounding calculation shall be recorded on the grounding drawing in a concise table. The table shall include all pertinent information, including, but not limited to, final design grid resistivity, depth of crushed rock, rock resistivity, length of ground rods, size of grounding conductor, soil parameters, design fault current, and fault duration. Additionally, it shall be included a field on the grounding drawing for the contractor to record the final fall of potential test results.

10.7 Conduit System

All conduit and raceway systems shall comply with NEC and NESC requirements. The conduit and raceway system design shall accommodate power and control cables, communication circuits, underground feeders, and optical fiber cables.

10.7.1 Conduits

Low voltage cables used for protection and control or station power shall be placed in conduit wherever they connect to oil immersed equipment to reduce the risk of burning oil flowing in raceways and causing severe damage to cables. All conduit systems including wiring size shall be detailed on drawings.

Conduit shall be schedule 40 or greater PVC for below grade or above grade applications. Flexible conduit may be used for transitions where necessary. Galvanized steel conduits shall not be used in below-grade applications. Conduits shall be sized in accordance with the National Electrical Code (NFPA-70). Where applicable, 2” and 4” conduits shall be used.

Designs shall incorporate one spare conduit per transformer (main GSU) and circuit breakers 138 kV and above.

All below-grade conduits shall be buried to a minimum depth of twenty-four (24) inches below the finished grade (approximately six inches below the ground grid).The conduit system for the 34.5 kV collector cables shall extend 10 feet beyond the fence and shall be concrete-encased. Additional coordination shall be made with collector system designer.

10.7.2 Cable Trench

For substations and collector facilities that have more than one main GSU transformer, precast concrete trench systems shall be installed. It shall be identified early in detailed design if the current project will ever be expanded with second or third phase. If additional phases are planned, the initial layout shall be designed such that adding new cable trench can be implemented while minimizing impact to existing facilities.

Precast concrete trench with a pedestrian strength rating shall be specified for the substation yard raceway system. HS-20 rated road crossing cable trench shall be used for all vehicle crossing locations. Each vehicle crossing location will be marked with high visibility bollards extending at minimum three (3) feet above the ground and visible during winter snow conditions. Applications for the use of a barrier internal to the cable trench or multiple trench systems may be utilized where required.

Conduits shall be provided between the concrete trench system and yard mounted equipment

On two transformer stations or an integrated ring bus switchyard, a partial cable trench system is normally required, and provisions shall be provided in detailed design.

10.7.3 Pullboxes

Cables entering the control house from the substation yard shall be routed through a pre-cast cable vault and pulling area into the control house termination cabinet.

10.7.4 Cable Entry and Trays

All conduit and cable entry openings into the control house shall be tightly sealed as a barrier to animals to keep out moisture and to minimize heat loss. Cables entering the control house shall be terminated at the appropriate termination cabinet or AC or DC panel board.

Inside the control house overhead cable tray suspended from the ceiling shall be used to route cables between the termination cabinet, control and relay panels, and other equipment.

10.8 Lightning System

The substation direct lightning stroke shielding design shall be performed in accordance with IEEE Standard 998-2012 “IEEE Guide for Direct Lightning Stroke Shielding of Substations” using the “electro-geometrical model” or the “rolling sphere technique”. For small stations it is acceptable to use the fixed angle method as a means for determining proper shield protection locations.

After the substation layout is completed, the direct stroke shielding shall be analyzed to verify that the equipment within the substation fence is adequately protected. The transmission line static wires shall be connected to the substation ground grid.

The following criteria shall be used for the lightning shielding design:

- Station BIL, Table 2.
- Lightning stroke density shall be that for the project area as reported by the Fault Analysis and Lightning Location System
- A design failure rate of less than one shielding failure in one hundred (100) years.

The shielding design shall utilize a combination of shield wires, shielding masts and/or mast poles. Shield wires over substation buses shall be arranged such that there is no more than a single bus between shield wire supporting structures.

All static wires from the transmission lines shall terminate into the station lightning shielding system.

10.8.1 Lighting System

The primary purpose of substation lighting is to provide sufficient illumination for personnel safety and emergency equipment maintenance. The substation shall be provided sufficient illumination during the night for safe passage of the maintenance crew who might be performing equipment inspection or maintenance. Outdoor lighting is often also intended to deter vandalism; however excessive illumination may attract vandals or result in complaints from the surrounding community. Lighting is also used in certain areas to deter birds from roosting and/or nesting. Yellow color lighting such as sodium vapor does not attract as many bugs, flying bats and birds that in turn attract snakes and climbing animals.

Proper placement of lighting is important. Placement of lighting shall consider the collection of insects on adjacent energized equipment. Large quantities of these bugs can attract animals and increase risk of animal outage.

At least minimum illumination levels recommended by National Electrical Safety Code C2 shall be provided in generating stations and substations. Illumination levels relevant to substations are as follows:

a) Emergency exit path: 1 foot-candle (11 lux)

b) Control house (occupied): 15 foot-candles (165 lux)

c) Control house (unoccupied): 5 foot-candles (55 lux)

d) Front of switchboards and panels: 15 to 25 foot-candles (165 to 275 lux)

e) Fence: 0.2 foot-candles (2.2 lux)

f) Substation general horizontal: 2 foot-candles (22 lux)

g) Substation vertical (on disconnects etc.) 2 foot-candles (22 lux)

h) Roadway: 0.5 foot-candles (5.5 lux)

i) Open yard: 0.2 foot-candles (2.2 lux)

The need for detailed lighting design for each substation shall be individually evaluated

depending upon the substation's location, site area, type of buswork structures, and the equipment installed in it. LED light fixtures shall be installed for all new installations. The following is required as a minimum for typical substation lighting:

a) The entrance gate into the substation shall be provided with a motion-activated photocell-controlled light.

b) The substation control house entry doors shall be provided with motion activated photocell-controlled lights.

c) The substation shall have switched, photocell-controlled lights, preferably with a timer, for safe passage. The control switch shall be in the control house.

d) A sufficient number of GFCI outlets shall be provided in the substation near the equipment e.g. circuit breakers and power transformers for portable light hookup for night time repairs and maintenance. GFCI outlets provided in the equipment control cabinets shall be used for this function.

10.9 Substation Security/Safety (CODE)

Substation Security shall not apply for substations below 161 kV. However, depending of project interconnection area, additional requirements may exist due to other evolving cyber security concerns. Check with Buyer - Transmission Planning for site specific concerns.

10.10 Animal Deterrents

Means for animal deterrent and mitigation shall be provided in all medium voltage substations, and the MV section of all high voltage substations.

IEEE Std 1264 provides guidance in methods and designs to mitigate animal intrusion and resulting interruptions and equipment damage.

Animal mitigation shall be achieved by applying substation insulators that have a large enough flashover distance to prevent bridging by animals, such as snakes and squirrels, by increasing phase spacing and by providing guards and covers for insulators or adding barriers between phases to prevent phase to phase bridging by birds. Guards and covers shall be installed on all MV equipment bushings listed below regardless of the spacing.

Insulating covers shall be installed on all medium voltage equipment bushings as follows:

a) Power transformers

b) Station service transformers

c) Voltage regulators

d) Circuit breakers and reclosers

e) Surge arresters

f) Capacitors

g) Instrument current and voltage transformers

h) UG cable terminations

i) MV switches and jumpers

Insulators in substations where higher BIL bus and disconnect insulators cannot be applied shall be protected by suitable guards and covers.

MV substation equipment including 34.5 kV equipment shall be provided with guards and covers and each phase shall be covered for a distance of three (3) feet, unless otherwise specified during the constructability review. The center phase shall be fully covered. Depending upon location and known animal intrusion problems, additional mitigation may be required.

10.11 Substation Protection & Control Design Criteria

10.11.1 Protection and Control Requirements

The protective relaying shall:

a) Preserve the integrity of the Entergy transmission system by being dependable and secure to the appropriate level of required reliability as specified by Entergy Transmission Planning.

b) Properly coordinate and function with other Entergy relay schemes, and neighboring utilities.

10.11.2 Backup and Transfer Trip

Breaker Failure Backup and/or transfer trip circuits to interface with other stations shall always be provided.

10.11.3 Transmission Line Protection

Transmission line protective relay equipment at the collector substation shall be provided to meet the requirements of Buyer - Transmission (as the host utility).

HV transmission lines shall have a dual primary line protection scheme comprising of dual primary communication assisted tripping relaying scheme. Each primary protection scheme shall utilize separate instrument current transformers, or separate current transformer cores of a free-standing current transformer, separate CVT or PT secondary windings, and separated dc and ac supplies from a common distribution panel. Breaker Control is typically on the same line panel.

10.11.4 Bus Protection

HV and MV bus shall use single low or high impedance protection scheme. Low impedance is preferred. If using high impedance protection, all of the current transformers in the circuit shall have the same ratio and must be tapped at the full ratio.

10.11.5 Transformer Protection

Each power transformer shall be protected by a minimum of one and, preferably, two differential relaying schemes. The transformer differential relay shall be connected to the transformer high side bushing current transformers. Low-side circuit breaker or transformer bushing current transformers shall be positioned to provide a sufficient area of overlap between adjacent protective zones. Protection zones shall be created to prevent through-bus interruption for transformer differential operation.

Back up time overcurrent transformer overload relaying shall be provided.

Generator Step-up Transformers shall be purchased and supplied with the following integral monitoring devices:

a) Oil level gauge on tank wall or conservator.

b) Pressure relief device(s). The pressure relief device is used for alarms. Transformer tanks containing more than 10,000 gallons of oil shall be provided with two pressure relief devices mounted on diagonally opposite corners of the transformer tank. The device(s) shall be located remote from the control cabinet(s),. Pressure relief value shall be stamped on the device.

Sudden pressure rise relays. Transformers are specified to have two sudden pressure relays used to trip the transformer when both relays have operated. A sudden pressure or Bucholtz relay (Device 63) shall be provided, including seal-in contacts in an enclosure with a threaded conduit hub and “loss of DC indication”

Gas accumulation detecting relay (conservator tank units). Contacts of the gas accumulation detecting relay are used for alarm.

c) Temperature monitoring system to indicate top oil and winding temperatures.

Seller shall design the system so as not to trip and isolate transformers due to the operation of pressure relief devices, high oil temperature, and high winding temperatures. Main power transformers shall be tripped and isolated when the oil level in the transformer tank falls below the critical level to prevent internal flashovers. GSUs or main power transformers shall have critical oil level as an alarming feature only and no tripping.

10.11.6 Capacitor Bank Protection

See IEEE Std C37.99 Guide for Protection of Shunt Capacitor Banks for detailed guidance on the capacitor bank protection schemes. Seller shall employ Unbalance Detection scheme for the protection of the capacitor bank. The aim of this scheme is to trip the capacitor bank if there are unbalances in the phases that result in voltages 110% or more across the individual capacitor unit.

10.11.7 Shunt Reactor Protection

See IEEE Std C37.109 for guidance on the protection of shunt reactors. Studies shall be conducted to determine if snubbers are required for reactor switching. Surge arresters are recommended for all reactor applications.

10.11.8 HV Breaker Control

Gas insulated circuit breakers are specified to be equipped with two or more stages of gas pressure/density monitoring contacts.

a) Contact of the first stage closes on falling pressure at approximately 10% loss of pressure, and

b) Contact of the second stage closes on falling pressure at a further 10% reduction of gas pressure.

Most manufacturers comply with these requirements except that the first stage and second stage contacts may not necessarily close at 10% loss of pressure for all makes and models of the circuit breakers.

A circuit breaker retains its full electrical and mechanical rating at this second stage pressure/density of gas in the circuit breaker. However, the circuit breaker manufacturer will not guarantee any rating below this pressure and, accordingly, the circuit breaker operation shall be disabled below this pressure.

The manufacturers of circuit breakers generally do not offer any specific recommendations for the circuit breaker's continued operation when the second stage contacts of the gas density monitor close. It will be the responsibility of Buyer to determine whether a circuit breaker should be tripped (if it was already closed) or block any close/open operation under these conditions.

Since the system security, substation importance, and the circuit breaker applications within the substation vary throughout the system, a common system wide approach on whether to trip or block operation of all circuit breakers cannot be specified.

The following is a recommended plan of action, keeping in mind that the circuit breaker retains full rated values at the second alarm stage, and it is capable of withstanding normal system voltage with the gas in the interrupters at atmospheric pressure. Under ideal conditions and with a standard 0.5% gas leakage rate it would take more than five years for any alarm stage to be generated for most breakers. A second stage alarm usually signifies a rapid loss of gas.

The circuit breaker control scheme shall address the loss of gas alarms as follows:

1. First Stage Alarm: Effort shall be made to investigate the cause within eight hours (or the next day at the latest).

2. Second Stage Alarm received within one day of receiving the first stage alarm: In locations where the system continuity can be maintained (ring bus, or breaker and half bus substations) the circuit breaker shall be tripped immediately. If the system continuity cannot be maintained, then the circuit breaker operation shall be blocked. In substations with a single bus the circuit breaker operation shall be blocked. It may be necessary to include timers in the relay scheme to achieve this requirement. This should be evaluated during detail design.

3. Second stage alarm received more than one day after receiving the first stage alarm: Block circuit breaker operation

All HV Breaker Control relays shall include LOR (lockout relays).

10.11.9 HV Motor Operated Switch Control

When HV motor operated switches (MOS) are used, if a control building is used, it is preferred that the MOS controls be located on the applicable line protection, transformer protection, or breaker control panel.

If no control house is required, the panel design must be modified to fit in a suitable NEMA type 4X stainless steel outdoor enclosure.

10.11.10 MV Collection Feeder Protection

Primary feeder protection will be provided by an SEL-351S or similar relay at each feeder breaker. Instantaneous and time overcurrent phase and residual ground are typical elements to protect the feeder section. Additional voltage and frequency elements will be enabled to ensure compliance with NERC reliability requirements (e.g., PRC 019, 024, and 026, if applicable).

Breaker failure initiate will be enabled to ensure coordination with MV bus and transformer differential if a breaker fail occurs.

10.12 Relay Calculations and Setting Requirements

For relay settings, refer to TE-SD-AD-007 (Relay Settings Procedure) and PM1804 (Transmission Line Relay Setting Criteria, Design and Operation Guide) for guidance. Relay settings shall meet the requirements of NERC Reliability Standards PRC-019, -023, -024, -025, and -026, as applicable.

Typical Relay Engineering Calculations:

- Battery Bank Sizing & Design: IEEE-485 & NEC – Article 480.
- Battery Charger Sizing: EPRI Stationary Battery Guide (Design, Application, and Maintenance)
- DC Load Center Sizing: Requires building DC loading table (Watts / Amps) for yard and enclosure (panel) equipment – Nameplate information and/or equipment manuals required.
- AC Load Center Sizing: Requires building AC loading table (Watts / Amps) for yard and enclosure (panel) equipment – Nameplate information and/or equipment manuals required.
- Station Service Sizing
- Voltage Drop Calculations (Use as Guide only): NEC: 215.2(A)(4)

- Conductor Ampacity Calculations (Use as Guide only): NEC Table(s) 310.15 (Engineer to select correct table for use)
- Grounding Methods for Electrical Supply: NESC Sec. 9
- Size of Equipment Grounding Conductors (Use as a Guide only): NEC Sec. 250.122 and Table 250.122.
- Cable in Conduit Fill Calculations: NEC Tables 310.15(B)(2)(a) & 310.15(B)(3)(a), Chapter 9, Table 1, Table 4
- Cable Tray Fill Calculations: NEC 392.22, Table 392.22(A).

11 CONTROL HOUSE

The control house shall be designed to comply with the latest version of the IBC, and with local building code requirements. See Section 5.9. It is preferred to have an Engineered/prefabricated and delivered to site precast concrete building. Steel, concrete and CMU buildings are all acceptable options.

The control enclosure shall contain Vendor-provided station services such as primary and backup AC supply disconnects, an automatic AC transfer switch, AC Load Centers, DC power system and storage battery, and air conditioning units.

The Vendor shall be capable of meeting any state-specific certification and/or inspection requirements.

The control enclosure shall be suitable for placement upon both concrete slab and concrete pier foundation types. An indication of design loads for both foundation types shall be supplied with the Vendor's engineering documentation.

All Vendor-supplied equipment within the control enclosure shall use equipment enclosures conformant to at least the NEMA 1 specification. External equipment shall be appropriately rated and weatherproofed for exterior installation.

The control enclosure shall contain space for equipment including:

a) Control enclosure shall be sized to account for all necessary equipment in the station ultimate configuration. No more than sixteen 27-inch, free-standing relaying and control panels in a single row. All cable access to the panels will be from a cable tray system above the panels.

b) One wall-mounted termination cabinet having dimensions of up to 72" x 90" x 24".

c) Communications equipment including fiber-optic, telecommunications, and related interfacing gear.

d) Separated control room is required to all projects.

e) The control enclosure shall have a minimum internal ceiling height of 10'-0" to allow for adequate equipment clearance below the cable tray.

Wall space shall be left open to the greatest extent practical. Conduit and raceway provided by Vendor for building services and included equipment shall be placed at or near the ceiling with vertical service drops. Horizontal raceways and conduits between adjacent equipment such as load centers are acceptable.

The control enclosure shall include one eye-wash system with two saline cartridges when there isn't water brought to the site.

11.1 DC System

One (1) VLA 125 VDC battery system shall be provided along with (2) 130 VDC battery chargers. The batteries and chargers shall be size in accordance of IEEE 485 and considering substation ultimate configuration (if any). The calculation shall consider worst case tripping scenario along with dual trip coil operation. A single charger shall be able to fully charge a completed battery within eight to twelve hours while supplying normal loads.

Dual DC Load Centers shall be provided within the control house. DC load centers shall be designed with enough circuit positions for the substation's ultimate configuration. Each DC load center shall be rated 125 VDC and shall have a main circuit breaker. The DC load centers breaker position and total circuits requirement shall be dictated by final approved DC Calculation considering ultimate substation configuration. DC load centers shall be dead-front design, installed on the control enclosure wall, and provided with conduit access to the cable tray.

Battery chargers shall not have an alarm on/off switch. Each battery charger installed in the station shall alarm on zero current output. Dual charger setups shall be wired for parallel operation. When properly set up each charger shall share half of the battery bank charging current.

Battery banks shall be located in a separate room of the control house. There shall be enough space so field personnel can reach each cell and battery terminals for testing and maintenance. A minimum of 24 inches height separation between battery racks is needed to accomplish this.

Battery DC grounds shall be monitored via indicating lights on the front panel of the battery charger and indication of a DC ground shall be an input to the station RTU. Battery voltage shall be an input to the station RTU.

11.2 AC System

The substation will be equipped with normal and backup AC station service sources supplying 120/240 VAC, 3 wire, single phase power. Station service is preferred to be provided by low- side SSVT, local distribution, or on-site generator in that order. The design shall include two (2) fused disconnect switches for the incoming feeds (secondary feed of the SSVT and emergency feed). The system neutral must be bonded to ground in one and only one of the fused disconnects. These two disconnects shall both be in the control building. The normal station power source also needs to have a fused disconnect switch below the station service transformer. The fuses shall be Type LPN.

Also, the unprotected conductors between the normal or backup station service transformers and the first disconnect cannot be routed in the same conduit with feeders or branch circuits.

There shall be specified an automatic transfer switch (ATS) with microprocessor control. The ATS shall be equipped with alarms for loss of normal service and loss of backup service. The ATS shall be capable of managing a standby generator on the backup source. The ATS shall have neutral bonding provisions.

There shall be specified AC load centers with enough circuit positions for the substation's ultimate configuration. Each AC Load Center shall be 120/240 VAC, three-wire, single phase, having a 100% rated, main breaker. The final AC load center breaker position and total circuits shall be dictated by final approved AC Calculation considering ultimate substation configuration. AC Load Centers shall be dead-front design, installed on the control building wall, and provided with conduit or wireway access to the cable tray for use by Others. The load centers shall use a commonly available circuit breaker type.

11.3 Metering Requirements

The metering panel shall be designed and constructed as specified in GIA or project planning phases.

Multi-conductor cables no smaller than #10 AWG shall be used to connect the instrument transformer secondary windings to the meter location. Under no circumstances shall CT cables contain splices. Larger conductor size may be required depending on the location of instrument transformers in relation to the meters. Seller shall perform burden calculations to determine appropriate conductor size.

Conductor used for grounding the metering instrument transformer tank shall be the same size as that used for the ground grid and in no case be smaller than #4/0 AWG.

Metering CTs and PTs shall be 0.15B1.8 sized so that tapping down is not required and 3% extended range TR=2 respectively.

All meters shall conform to ANSI Standards C12.20, C12.1, and C12.10. Acceptable meters are Landis and Gyr E850 MAXsys Elite, SEL-734 or SEL-735.

11.4 SCADA

A Remote Terminal Unit (RTU) and/or gateway device shall be specified, and installed to provide supervisory control, status indication, alarm monitoring, and to gather accumulated and instantaneous data to be telemetered to Entergy Distribution Operations Center (DOC), Transmission Center (TCC) and Entergy Local Balancing Authority (LBA). The RTU shall comply with all GIA requirements.

While all substations require a TCC / DOC RTU to be present, some existing substations host a "dual-port" RTU design in which data is provided to a TCC and LBA SCADA host. Confirmation of existing substation RTU-SCADA host configuration shall be done by contacting the IT-OT EMCS SCADA teams and/or IT-OT Substation Services. Substations that serve as a generation interconnection or system tie boundary with another utility may also require a dual-port RTU-SCADA host configuration.

Relay Design Personnel shall perform the following activities per TMM TE-SD-AD-006;

RTU/Communication Processor Configuration and Edit Sheet Procedure.

a) Obtain Initial baseline TOC RTU Edit Sheet from IT OP- Tech Personnel of what the SCADA Host has programmed to date of the request, or latest revision if there are revisions being documented.

b) Provide SOC and/or GMS personnel needed information for them to provide new updated SOC and/or GMS edit sheets.

c) Issue final approved TCC, SOC, and/or GMS edit sheets with relay design package.

11.5 Communications

The communications media (pilot wire, fiber optic cable, power line carrier or digital microwave) required, and the communications system for supervisory control, telemetering and equipment status indication will generally be known at the project initiation stage. Note that Entergy will usually consider digital microwave as adequate communication media. This will vary depending of the interconnection substation communication capabilities and GIA requirements.

Designers of communication circuits shall consider redundant, dual-purpose paths.

A telephone is required to facilitate voice receipt of switching orders, emergency services, and restoration of service during outages.

For fiber optic cable facilities, two conduits from the substation fence to the fiber optic cable terminal board in the control building shall be furnished and installed. The fiber optic cable between the fence and the terminal board shall be installed in conduit(s).

Multiplexers used for fiber-optic interface for digital relay communications schemes system protection shall be hardened per IEEE Std 1613; Standard Environmental and Testing Requirements for Communications Networking Devices Installed in Electric Power Substations, and compatible with IEEE Std C37.94; Standard for N Times 64 Kilobit Per Second Optical Fiber Interfaces Between Teleprotection and Multiplexer Equipment.

11.6 Digital Fault Recorder (DFR)

If project requires DFR, TESLA 4000 or similar DFR may be used. This shall include enough current and voltage inputs as per project design.

11.7 Low Voltage Cable (Wiring)

The following is a partial list of the requirements for station power, instrumentation and control cabling within the substation.

- The voltage drop for all control cables shall be verified not to exceed 10%.
- All current carrying control cables shall be sized based on the anticipated maximum load currents. Factors that shall be considered to determine the adequate cable size are conductor material, ambient conditions, cable insulation, cable stranding, proximity of parallel current carrying cables and whether the cables are in conduit, in a cable tray or suspended in the air.
- All low voltage power, instrumentation and control cables within the substation shall be insulated for a 600 volt rating.
- Coaxial and instrumentation cable shall be fully shielded both inside and outside the control house.
- All other control cables inside the control house are not required to be shielded.

- Shielded cables shall be required in 345 kV yards and above (CT, Trip and Control Circuits) and in 69 kV and above capacitor banks (grounded and ungrounded). All control and low voltage power cables outside the control house shall have a longitudinally corrugated copper tape shield.
- Returns for power, currents, potentials, controls, analogs and others shall be within the same cable.
- Cable shields and unused conductors are not required to be terminated or grounded for cables within the control house. For shielded field cables, the shield shall be terminated at one end, preferably within the termination cabinet, and unused conductors shall be left ungrounded. The termination cabinet ground bar shall be sized to accommodate shield grounding.
- Analog connections shall be made with 2 pair #18 AWG instrumentation cable, communication connections shall use shielded 4/C #18 AWG control cable, and status point connections shall use shielded 8/C #18 AWG control cable when new cables are required.
- Power line carrier signals shall be shielded via a shielded coaxial type cable.
- Splicing of cables is not permitted.

12 PHYSICAL AND ELECTRONIC SECURITY

Refer to IEEE Std. 1402 Guide for Electric Power Substation Physical and Electronic Security for guidance in providing physical and electronic security for the substation. Additional security design elements may be required by NERC Critical Infrastructure Protection (CIP) standards.

The following NERC CIP standards provide mandatory security requirements:

a) CIP-002; Cyber Security-BES Cyber System Categorization

b) CIP-005; Cyber Security-Electronic security Perimeter(s)

c) CIP-006; Cyber Security-Physical Security of BES Cyber Systems

d) CIP-014; Physical Security

Critical Substations are designated as Critical or CODE. CODE substations include the Critical Asset and infrastructure but also the larger assets which if destroyed, damaged degraded or otherwise rendered unavailable would have a significant impact on the Bulk Electric System (BES) affecting its stability or ability to transport large loads or would have a detrimental impact on the reliability or operability of the electric grid or would cause significant risk to the public health and safety.

NERC standard CIP-014-1 provides the following criteria for critical designation:

a) All 500 kV substations

b) Substations operating at 200 kV to 499 kV with an aggregate weight exceeding 3000 per table below

c) Substations operating at 200 kV and above and connected to three or more substations with an aggregate weight exceeding 3000 per table below:

Voltage of Line	Weight Value per Line
200 kV to 299 KV	700
300 kV to 499 kV	1300

In general, all 500 kV substations, all substations with four 230 kV lines or all substations with three 230 kV and several 161 kV or lower transmission lines may be considered as CODE. The criteria noted above are the minimum threshold for CODE designation. A substation may also be designated CODE as necessary per the unique risks that justify.

Substations that are designated as Critical or Deemed Essential (CODE) assets require additional physical and electronic security from physical and electronic intrusion, vandalism as required by NERC CIP-002, -005, and -006.

Additional requirements may exist due to other evolving cyber security concerns. Check with Transmission Planning for site specific concerns.

Minimum security requirements are defined in the following able:

Location	Description	Equipment by Seller	Equipment by Buyer
Collector Substation	Minimum two cameras located at opposite corners of substation area	Wiring (power and communications) and required hardware supports	Cameras
	Electrically operated slide gate with keycard reader	Keypad, slide gate, gate operator, wiring (power and communications), grounding loop, exit button and hardware for mounting keycard reader	Keycard reader
Collector Substation Control House	Keycard reader for lock on control house personnel door	Keypad, wiring (power and communications), and required hardware supports for mounting keycard reader	Keycard reader

13 DELIVERABLES

In addition to any submittals and deliverables defined in the contract documents, in accordance with NERC reliability standards, Seller shall provide the following documentation to Buyer thirty (30) days prior to initial synchronization of the Project, along with any other documentation reasonably requested by Buyer or required by NERC:

- BAL-005 – One-line diagram that displays the Electrical Interconnection Point (and includes unique line identifiers/names ensuring that the Project Site and Buyer - Transmission use the same naming convention when referring to the PV Plant (e.g., breakers, lines, etc.) by Seller

- COM-002 – Network diagram of voice and data links by Seller
- FAC-008 – Identification of most limiting equipment factor based on application of Generator Buyers Facility Rating Methodology by Seller
- MOD-032 – Data for Power System and Analysis, as applicable, by Seller.
- VAR-002 - Transformer information, including the following, as applicable, by Seller and Buyer (or its Affiliate), and as obtained by Seller from the Approved Vendor of the GSU:

    - Tap Settings
    - Available fixed tap ranges
    - Impedance data
    - The + / - voltage range with step-change in % for load-tap changing transformers.

ATTACHMENT 1: APPROVED MANUFACTURERS LIST FOR COLLECTOR SUBSTATION*

*Attachment 1 to Appendix 1 (Collector Substation) of this Scope Book provides an Approved Manufacturers List. The Approved Manufacturers List in this Attachment 1 is in addition to the Approved Manufacturers and EPC Contractor List in Appendix 9 of the Scope Book.

Attachment 1: Approved Manufacturers List

Purchase Spec.	Class	Description	Qualifier	Approved Manufacturer(s) - (Preferred)	Preferred Supplier	Type	Notes
SA0102	Arresters	Arrester, Surge		(Cooper), Siemens, ABB	Cooper	Substation	
PM0201	Battery	Batteries & Battery Racks		(Enersys)	Nolan Power	Relay	125VDC 58 Cell EC-XM/CC-XM only
PM0301	Battery	Battery Charger		(Hindel)	Nolan Power	Relay	AT-10 Models
PM0303	Battery	Battery Charger Rack		(Enersys)	Nolan Power	Relay	
	Bolts	Bolts Anchor		Valmont, Distran, Threaded Fasteners		Substation	
	Bolts	Anchor bolt cage for foundations		Valmont, Distran, Threaded Fasteners-w/size limit		Substation	
SD0203	Breaker	Breaker, EHV	500 & 345kV (Live Tank)	(MEPPI), ABB	MEPPI	Substation	
SD0203	Breaker	Breaker, EHV	500 & 345kV (Dead Tank)	(MEPPI), ABB	MEPPI	Substation	
SD0202	Breaker	Breaker, HV, IPO	245kV - 145kV	(Siemens), ABB, MEPPI	Siemens	Substation	Per Entergy review

Purchase Spec.	Class	Description	Qualifier	Approved Manufacturer(s) - (Preferred)	Preferred Supplier	Type	Notes
SD0202	Breaker	Breaker, HV	245kV - 72.5kV	(Siemens), ABB, MEPPI	Siemens	Substation	See table below
SD0201	Breaker	Breaker, MV	27kV - 15kV	(ABB), MEPPI	ABB	Substation	
SD0201	Breaker	Breaker, MV	34.5 kV	(ABB)	ABB	Substation	
SB0101	Bus	Bus, Aluminum Pipe		(Williams Metals), AFL	(W illiams Metals)	Substation	
PB0401	Cable, Control	Control Cable - Shielded and Non-Shielded		(Southwire), Priority	Southwire	Relay	ICEA Method 1 for color coding
SA0301	Capacitor Bank	Capacitor Banks, Shunt		(Cooper), GE, ABB	Cooper-Eaton	Substation	
	Capswitcher	Capswitcher	170kV - 72.5kV	(Southern States)	Preferred Sales	Substation	
	Carrier Relays	Power line Carrier	UPLC	Pulsar-Ametek	Ametek	Relay	
PN0201	CCVT	CCVT	500kV - 69kV	(GE-Alstom), Trench, ABB	Crescent Power	Relay	Polymer only. Trench required when Line trap to be mounted on CCVT.
SD1801	Circuit Switcher	Circuit Switcher	Series 2000	(S&C)	Curtis Stout	Substation	
	Conductor	Cable, Aluminum	ACSS, ACSR	(General Cable), Southwire	Aertker Co.	Substation	
	Conductor	Copper (Not Control cable)		Copperweld/Alcoa	Stuart Irby	Substation	Grounding conductor
	Conductor	Cable, Fiber	OPT-GW	AFL	Preferred Sales	T-Line	

Purchase Spec.	Class	Description	Qualifier	Approved Manufacturer(s) - (Preferred)	Preferred Supplier	Type	Notes
	Conductor	Cable, Fiber	ADSS	AFL	Preferred Sales	T-Line	
	Conduit	Conduit & Accessories		Cantex, Carlon	Stuart Irby	Substation	
	Connector	Connectors, T-Line	ACCR	AFL / 3M	Preferred Sales	T-Line	
	Connector	Connectors, T-Line	ACSS	AFL	Preferred Sales		
	Connector	Connectors line (Fiber, OPGW, ACSR)	Fiber, OPGW, ACSR	AFL	Preferred Sales	T-Line	
	Connector	Connectors, T-Line		Maclean Power Sys	Preferred Sales	T-Line	
	Connectors /Fittings	Connectors/Fittings - Substation		Anderson, AFL, Homac, Travis, Sefcor, Burndy		Substation	
SL0403	Control House	Control House	Drop-In (turnkey)	VFP	VFP	Relay	Concrete only.
SL0403	Control House	Control House		Modular Connections, VFP, Atkinson, Trachte, Oldcastle		Substation	Concrete only.
PN0301	CT	CT	Slipover only	ITEC, ABB, Meramac, Siemens		Relay	
PN0301	CT	CT	34.5kV - 15kV	ABB, GE		Relay	
PN0301	CT	CT	500kV - 69kV	(GE-Alstom), Trench, ABB	Cresent Power	Relay	Polymer only
	DFR	DFR (Digital Fault Recorder)		MehtaTech	Louisiana, Mississippi, Arkansas only	Relay	

Purchase Spec.	Class	Description	Qualifier	Approved Manufacturer(s) - (Preferred)	Preferred Supplier	Type	Notes
	DFR	DFR (Digital Fault Recorder)		Qualitrol	Texas only	Relay	
	Fittings	Conductor Fittings Compression		AFL, Secor, Anderson, Hubell	Stuart Irby	Substation	
	Grounds Rods Clamps	Ground Rods, Clamps		Cadweld, Erico, Thermoweld	Stuart Irby	Substation	
TA0504	Insulators	Insulator, Line, Toughened Glass		Sediver		T-Line	
TA0504	Insulators	Insulator, Line, Polymer	(Polymer Insulator Only)	Maclean Power Sys	Preferred Sales	T-Line	
TA0504	Insulators	Insulator, Line, Polymer	(Polymer Insulator Hardware Assembly)	Maclean Power Sys	Preferred Sales	T-Line	
SA0502	Insulators	Insulator, Station Post, Porcelain	500kV-69kV	(Seves), Victor, Lapp,NGK, Newell, Vanguard		Substation	
SA0502	Insulators	Insulator, Station Post, Polymer	230kV-15kV	(Maclean Power Sys)		Substation	
	Junction Box	Junction Boxes		MMR, SEL, Custom Automated, Premier Control		Relay	
	Meter	Meter & Cables	Elite Model	Landis+Gyr		Relay	
CP Approved Panels Appendix S	Panel	Panel - Battery Switching		SEL	Power Connections	Relay	
CP Approved Panels Appendix S	Panel	Panel - AC & DC Stand Alone		Peterson Electric Panel	Peterson	Relay	No AC/DC Combo Panel permitted

Purchase Spec.	Class	Description	Qualifier	Approved Manufacturer(s) - (Preferred)	Preferred Supplier	Type	Notes
PM3507	Panel	Panel - Autoxfmr Differential		MMR, SEL, Custom Automated, Premier Control		Relay	
PM3505	Panel	Panel - Power xfmr Differential		MMR, SEL, Custom Automated, Premier Control		Relay	
PM0501	Panel	Panel - Breaker Control		MMR, SEL, Custom Automated, Premier Control		Relay	
PM0602	Panel	Panel - Bus Differential		MMR, SEL, Custom Automated, Premier Control		Relay	
PM1803	Panel	Panel - Line, Line/Breaker		MMR, SEL, Custom Automated, Premier Control		Relay	
MI0200	Panel	Panel - Meter		MMR, SEL, Custom Automated, Premier Control		Relay	
	Poles	Pole Caissons		(Valmont)	Preferred Sales	T-Line	
TC0609	Poles	Pole, Concrete		(Valmont)	Preferred Sales	T-Line	
TC0608	Poles	Pole, Steel		(Valmont)	Preferred Sales	T-Line	
PN0701	PT	PT	34.5kV and below	ABB, GE, Trench		Relay	
PN0701	PT	PT	230kV - 69kV	GE-Alstom, Trench, (ABB)		Relay	Polymer only
SN0903	Reactor	Reactor, Dry Type Shunt	Below 230kV	Alstom Grid, Coil Innovations, Trench		Substation	
SN0902	Reactor	Reactor, Current Limiting		Alstom Grid, Coil Innovations, Trench		Substation	

Purchase Spec.	Class	Description	Qualifier	Approved Manufacturer(s) - (Preferred)	Preferred Supplier	Type	Notes
SN0904	Reactor	Reactor, Oil filled Shunt	230kV, 500kV	ABB, Alstom Grid, Mitsubishi, Siemens, SMIT		Substation	
SN1002	Regulators	Regulator		Pennsylvania Transformers	Curtis Stout	Substation	
	Relay	Protective Relays & associated accessories		SEL	Power Connections	Relay	
	RTU		Accessories & Cables	(ACS), GE Grid Solutions	Ruffin & Associates	Relay	
PM3002	RTU	RTU	SEL RTAC	SEL	Power Connections	Relay	
SL1301	Signs	Signs - Entergy Substation Switchyard Placard w/Address		Impco	Impco	Substation	This is the substation name and address sign on the front fence.
SL1301	Signs	Signs - General		Stuart Irby	Stuart Irby	Substation	
SC0401, SL0505	Structure	Steel	Substation, Tubular / Tapered	(Distran), Valmont	Distran	Substation	
SC0401, SL0505	Structure	Steel	Substation, Lattice	(Distran), Industrial Steel	Distran	Substation	
SC0401, SL0505	Structure	Steel Standard and Tapered Tubular	Substation, pre-existing designs w/details	(Distran), Valmont	Distran	Substation	
PM3401	Switch	ATS (Automatic Transfer Switch)		ASCO	Utility and Industrial Supply LLC, WESCO	Relay	

Purchase Spec.	Class	Description	Qualifier	Approved Manufacturer(s) - (Preferred)	Preferred Supplier	Type	Notes
	Switch	Switch, T-Line	Switch group operated 245kV and below	SEECO	Southern Utility Sales Agency	T- Line	
SD1502	Switch	Switch, Disconnect	500 & 345kV	(Southern States), Pascor Atlantic	Preferred Sales	Substation	
SD1501	Switch	Switch, Disconnect	230kV - 69kV	(Southern States), USCO, Pascor Atlantic	Preferred Sales	Substation	
SD0601	Switch	Switch, Disconnect	34.5kV - 15kV	(Southern States), USCO	Preferred Sales	Substation	
SD0701	Switch	Switch, Disconnect, Hookstick	34.5kV - 15kV	(Southern States), USCO	Preferred Sales	Substation	
	Switch	Switch, Fuse (SMD style)	34.5kV - 15kV	(S&C)	Curtis Stout	Substation	
SD1601	Switch/Motor Operators	Motor Operator	Southern States	(Southern States)	Preferred Sales	Substation	For Southern States switches
SN1101	Transformer	SSVT; Station Service Voltage Transformer	230kV - 69kV	Alstom Grid, ABB		Substation	Polymer only
SN0103, SN0104	Transformer	Transformer, Auto	230kV and Above 100MVA	ABB, HICO, MEPPI, Siemens, SMIT, SPX-Waukesha Electric		Substation	See chart below
SN0102	Transformer	Transformer, Small Auto	below 230kV and 100MVA	(SPX-Waukesha Electric), ABB, HICO, Howard	Aertker Co.	Substation	See chart below
SN0801	Transformer	Power Transformers	230kV and below	(SPX-Waukesha Electric), ABB, HICO	Aertker Co.		See chart below

Purchase Spec.	Class	Description	Qualifier	Approved Manufacturer(s) - (Preferred)	Preferred Supplier	Type	Notes
PM0802	Trap	Trap, Line Carrier		Trench (No other supplier approved)	Curtis Stout	Relay	See CCVT note above
	Trench	Trench (Cable Trench)		(Concast), Trenway, Old Castle	GHMR	Substation	
PM0804	Tuner	Tuner, Line Carrier		Trench	Curtis Stout	Relay	
	Xfmr Firewall						

ENTERGY APPROVED SUBSTATION TRANSFORMER SUPPLIERS					
TWO-WINDING & AUTO-TRANSFORMERS RATED < 100MVA (3-phase) and HV ≤ 230kV					
Production Facility & Location	Currently qualifying or already qualified	Maximum ratings approved by Entergy		Capabilities reported by facility	
		MVA (3ø)	KV	MVA (3ø)	KV
ABB / Crystal Springs, MS USA	Qualified	50 (MS)	161 (MS)	~60 (MS)	161 (MS)
Delta Star / Lynchburg, VA	Qualified	60	230	~200	230
HICO-Memphis	Qualified	1000	230	1000	230
Waukesha Electric (SPX), Goldsboro, NC & Waukesha, WI USA	**Qualified**	**80 (NC), 100 (WI)**	**230 (NC), 230 (WI)**	**~80 (NC), 800 (WI)**	230 (NC), 345 (WI)
AUTO-TRANSFORMERS RATED ≥ 100MVA (3-phase) or HV > 230kV					
Production Facility & Location	**Currently qualifying or already qualified**	**Maximum ratings approved by Entergy**		**Capabilities reported by facility**	
		MVA (3ø)	**KV**	**MVA (3ø)**	**KV**

ABB / Varennes, Quebec, Canada; Guarulhos, Brazil; Cordoba, Spain	Qualified	1000 (Can), 500 (Br), 800 (Sp)	500 (Can), 500 (Br), 500 (Sp)	1200 (Can), 600 (Br), 800 (Sp)	765 (Can), 765 (Br), 500 (Sp)
HICO-Memphis	Qualified	1000	765	1000	765
Mitsubishi / Ako, Japan	Qualified	~1000	500	~1500	1000+
Siemens / Linz & Weiz, Austria; Nuremburg, Germany; Jundiai, Brazil; Bogota, Colombia	Qualified	1000 (Aus, Ger), 750 (Br), 200 (Col)	500 (Aus, Ger, Br), 230 (Col)	2000 (Aus), 1100 (Ger), 1000 (Br), 250 (Col)	765 (Aus), 1000+ (Ger), 765 (Br), 345 (Col)
SMIT / Nijmegen, Netherlands	Qualified	~800	500	~1200	500
Waukesha Electric (SPX), Waukesha, WI USA	Qualified	400	345	~800	345

ENTERGY APPROVED HV CIRCUIT BREAKER MODEL NUMBERS						
Voltage	**Continuous Current (A)**	**Interrupting Rating (A)**	**Siemens Breaker to be ordered**	**CT Ratio and Accuracy**	**CT Quantity**	
230 KV	3000	50KA	SPS2-245-50-3000	3000:5 C800	3 per bushing	
	3000	63KA	SPS2-245-63-3000(reference)	3000:5 C1200	3 per bushing	non-standard
161 KV	3000	40KA	SPS2-170-40-3000	3000:5 C800	3 per bushing	
	3000	63KA	SPS2-170-63-3000(reference)	3000:5 C1200	3 per bushing	non-standard
138 KV	3000	40KA	SPS2-145-40-3000	3000:5 C800	2 per bushing	
	3000	63KA	SPS2-145-63-3000(reference)	3000:5 C1200	2 per bushing	non-standard

115 KV	3000	40KA	SPS2-145-40-3000	3000:5 C800	2 per bushing	
	3000	63KA	SPS2-145-63-3000(reference)	3000:5 C1200	2 per bushing	non-standard
69 KV	3000	40KA	SPS2-72.5-40-3000	3000:5 C800	2 per bushing	
	3000	63KA	SPS2-145-63-3000(reference)	3000:5 C1200	2 per bushing	non-standard

ATTACHMENT 2: SITE ENVIRONMENTAL CHARACTERISTICS

The Project Site environmental data that Seller shall use for the design of the Collector Substation shall have been determined prior to bid submission. The minimum required Project Site environmental data to be included is shown in Table 2-1 below. This Table 2-1 shall have been completed by Seller and included with the bid. Additional pertinent criteria shall be provided as needed.

Table 2-1. Project Site Environmental Characteristics

Description	Data (Units)
Elevation (substation)	
Contamination Level (light, medium, heavy, extra heavy) *	
Average Annual Temperature	
Average High Temperature	
Extreme High Temperature	
Average Low Temperature	
Extreme Low Temperature	
Average Annual Precipitation	
Maximum 24-hour Rainfall	
Maximum 1-hour Rainfall	
Maximum 24-hour Snowfall	
Ground Snow Load	
Design Ice Load	
Design Wind Speed	
Isokeraunic Level	
Seismic Referenced Code	
Mapped Spectral Response Acceleration at Short Period (0.2-Second) S_S	
Mapped Spectral Response Acceleration at 1-Second Period S_1	

Description	Data (Units)
Site Class	
Seismic Design Category	

***All equipment external bushing creepage distance shall be based on this criterion. If not available, medium (35mm/kV) shall be used. This factor is applied to nominal line to ground voltage.**

***** END OF APPENDIX 1**

Appendix 2
to BOT Scope Book

High Voltage Overhead Transmission

Rev. 1

June 6, 2024

REVISION RECORD			
Revision No.	Approval Date	Section / Page Revised	Reason / Description of Change
0	9/14/2023	All	Initial Issue
1	6/6/24	9.3.8.1	Updated maximum wind speed to 150 mph

APPENDIX 2

TO BOT SCOPE BOOK

HIGH VOLTAGE OVERHEAD TRANSMISSION

TABLE OF CONTENTS

Appendix 2: High Voltage Overhead Transmission

1 INTRODUCTION

1.1 Purpose

This Appendix 2 to the Scope Book (this "Appendix 2") provides design requirements and reference material for the design of the high voltage ("HV") (69 kV and above) overhead transmission lines that will be built and/or connected to the Entergy transmission system by or for Seller as part of the Project ("Transmission Lines"). This document pertains to the transmission linae between the collector substation and the deadend structure delivered by the GIA. This document is intended to provide to Seller and others acting at Seller's request requirements, recommendations, and guidance in the planning, design, construction, asset management, use, and operation of the Transmission Lines.

1.2 Scope

This Appendix 2 applies to all Transmission Lines.

This Appendix 2 primarily describes technical requirements, both performance-based and prescriptive for the design and installation of the Transmission Lines. Refer to the Scope Book and other parts of the Agreement for information regarding project sequencing and milestones, the project execution plan, project schedule and schedule management, project controls reporting, health and safety information, factory acceptance tests, training, required submittals, design reviews, equipment records, specified deliverables, project documentation, and other relevant matters not covered by this Appendix 2.

1.3 General Data

This Appendix 2 addresses aspects of the Work relating to the Transmission Lines. It is not intended to be, and shall not be construed to be, a comprehensive list of each and every element or other requirement applicable to the Work and shall in no way limit Seller's obligations under the Agreement or any Ancillary Agreement. Without limiting the other terms of the Agreement or any Ancillary Agreement, in performing the Work relating to the Transmission Lines, Seller shall comply with, and cause its Contractors and Subcontractors to comply with, the terms of this Appendix 2, all Laws (including codes) and applicable Permits.

This Appendix 2 provides the minimum functional specification ("MFS") for the Transmission Lines, including scope and design requirements. In addition to the requirements set forth in the Agreement (including the Scope Book), the Transmission Lines shall comply with all requirements specified in the GIA or any other Required Deliverability Arrangement.

This Appendix 2 is part of the Scope Book.

Article, Section, Table, Figure, and Attachment references in this Appendix 2 are to this Appendix 2 unless otherwise provided or the context otherwise requires.

1.4 Deviations

Any deviations from the MFS for the Transmission Lines or the terms of this Appendix 2 shall require Buyer's prior approval and will be subject to the terms of the Agreement.

2 DEFINITIONS

2.1 Definitions

BIL - Basic Lightning Impulse Insulation Level is a reference insulation level in terms of the crest voltage of a standard lightning impulse.

Conductor Displacement - With respect to clearances, conductor displacement is the conductor movement, including the effects of insulator swing and structure deflection, due to a prescribed ice, wind, or thermal load case. With respect to right-of-way ("ROW") determinations, conductor displacement is the maximum horizontal conductor displacement from its initial unloaded position, including the effects of insulator swing and structure deflection due to the extreme wind load case. See also (WCD) in Figure 6.3.4.1-3.

Conductor Movement Envelope - With respect to clearances, the conductor movement envelope is the full range of conductor positions in the prescribed ice, wind, or thermal load cases. With respect to ROW determinations, the conductor movement envelope is the full range of conductor movement, including the effects of insulator swing and structure deflection due to the extreme wind load case applied from both directions, and including the initial effective structure width. See also (WCME) in Figure 6.3.4.1-3.

Designer – Individual (in-house or contractor) responsible for analyzing and selecting transmission line components, structures, or foundations.

Effective Structure Width – the width between a structure's outboard conductors (e.g., for an H-frame configuration, it is twice the phase spacing, and for a vertical conductor configuration it is effectively zero). See also (wS) in Figure 6.3.4.1-3.

LIDAR (Light Detection and Ranging) – A method of detecting and determining the position, velocity, or other characteristics of distant objects by analysis of pulsed laser light reflected from the surfaces of such objects.

Meridian – Electronic document management system used to archive transmission standards and documents and track revisions.

PLS-CADD – A software package used during optimization of pole spotting, design analysis, and the development of material lists.

Vegetation Management Width – Right of way width outside of the conductor movement envelope, purchased solely for establishment of a vegetation management cycle. See (WVM) in Figure 6.3.4.1-1 and Figure 6.3.4.1-2.

2.2 Acronyms and Abbreviations

ACAR Aluminum Conductor Alloy Reinforced

ACCC Aluminum Conductor Composite Core

ACCR Aluminum Conductor Composite Reinforced

ACSR Aluminum Conductor Steel Reinforced

ACSS Aluminum conductor Steel Supported

BIL Basic Lightning Impulse Insulation Level

EPRI Electric Power Research Institute

FAA Federal Aviation Administration

FAD Foundation Analysis & Design

GFD Ground Flash Density

IEEE Institute of Electrical and Electronics Engineers

LIDAR Light Detection and Ranging

MFAD Moment Foundation Analysis & Design

MVATD Minimum Vegetation Action Threshold Distance

MVCD Minimum Vegetation Clearance Distance

NESC National Electrical Safety Code

OCF Overload Capacity Factor

ROW Right of Way

SRF Strength Reduction Factor

UBS Ultimate Breaking Strength

3 REFERENCES AND DOCUMENTS

3.1 Industry Standards

The following Industry Standards are referenced in this Appendix 2:

ASCE MOP 91	Design of Guyed Electrical Transmission Structures
ASCE MOP 123	Prestressed Concrete Transmission Pole Structures
ASCE 48	Design of Steel Transmission Pole Structures

ASCE 74	Guidelines for Electrical Transmission Line Structural Loading
ANSI C2	National Electric Safety Code (NESC)
IEEE Std 80	IEEE Guide for Safety in AC Substation Grounding
IEEE Std 524	Guide to the Installation of Overhead Transmission Line Conductors
IEEE Std 738	Standard for Calculating the Current-Temperature of Bare Overhead Conductors
IEEE Std 1313.2	Guide for the Application of Insulation Coordination
IEE Std 1542	Guide for Installation, Maintenance, and Operation of Irrigation Equipment Located Near or Under Power Lines
APLIC 2012	Reducing Avian Collisions with Power Lines – State of the Art– 2012
APLIC 2006	Suggested Practices for Avian Protection on Power Lines
NACE RP0177	Mitigation of Alternating Current and Lightning Effects of Metallic Structures and Corrosion Control System
OSHA Std 2207, Part 1926	Safety and Health Regulations for Construction
IEEE 738	Standard for Calculating Current-Temperature Relationship of Bare Conductors
IEEE Std. 1243-1997	Guide for Improving the Lightning Performance of Transmission Lines
EPRI	Handbook for Improving Overhead Transmission Line Lightning Performance
EPRI	AC Transmission Line Reference Book - 200kV and Above
EPRI	Guide for Transmission Line Grounding
EPRI	Outline of Guide for Application of Transmission Line Surge Arrestors – 42 to 765 kV
	Pre-stressed Concrete Institute Guide Specifications
	FAA Advisory Circular AC 70/7460-1K, Obstruction Marking and Lighting

The latest issued Standards and Codes at the issuance of the effective date of the Agreement shall be used. Earlier editions are not allowed unless specifically identified in this Appendix 2.

If a revision to a standard or code is issued, it is not required to be implemented unless the Authority Have Jurisdiction (AHJ) has adopted it, in which case, Seller is obligated to any increased compliance above what is required by the Standards and Codes at the effective date of the Agreement. This risk is borne by Seller.

3.1.1 Materials

Seller shall use the descriptions of materials set out in the standard drawings provided in Attachment 1 along with the Approved Vendor List in Attachment 5 to procure the equipment, materials, systems, and other items required for the development, engineering, design, procurement, construction, testing, commissioning, use, and operation of the Transmission Lines in accordance with the terms of the Agreement.

4 SAFETY AND ENVIRONMENT

4.1 Safety

The safety of individuals, the Project, and other life or property in the development, engineering, design, procurement, construction, testing, commissioning, use, and operation shall be the Designer's highest priority.

4.2 Avian Design

The primary issues to consider for avian protection on transmission lines are clearances, marking, and nests. Transmission clearances for all voltages shall exceed the established minimums, shown in Attachment 2. Where Entergy standard structure configurations, shown in Attachment 1, are used, the design will meet the guidelines. Marking of wires is addressed in Section 7.13.4 and is to be done only in areas where such marking is required by authorized wildlife agencies, Laws, or applicable Permits.

4.3 Future Impacts

Proper consideration shall be given to working space and access during siting to address direct impacts on both work safety and the need for environmental remediation. Similarly, proper consideration shall be given to the ability to re-conductor a line vs. rebuilding to address the potential considerable ecological benefits.

5 LOAD COMBINATIONS

5.1 Loading Combinations

This section covers the transmission line load cases and load case combinations to be used in the design of the Transmission Lines for the Project. It also includes the Overload Capacity Factors ("OCF") and Strength Reduction Factors ("SRF") used to calculate forces on the individual components of each structure within the Transmission Lines. The load combinations below are consistent with the loading requirements of NESC Rule 250; however, the boundaries for loading areas have been shifted from those in NESC Rule 250. All references to NESC 250B, 250C, and 250D refer to the District Loading, Extreme Wind, and Concurrent Ice and Wind as modified based on these shifts in loading areas.

5.1.1 District Maps

Based on the NESC figures, districts were established along county and parish boundaries which envelope the NESC requirements. These boundaries were further modified to address other commitments and past operating experience. Notably: several coastal parishes and counties have design wind speeds increased to 150 mph to address hardening study recommendations and other commitments; roughly the NW half of Arkansas has been treated as NESC Heavy rather than NESC Medium based upon past operating experience and design practice; and the 1" ice loading was extended throughout Arkansas and much of northern Mississippi based on extensive damage from past ice storms. They are collectively presented as **Error! Reference source not found.** illustrating the enveloping districts as follows:

Transmission Line Designers shall use the most conservative loading requirements required along the entire line if the line crosses several counties or parishes requiring different loadings. Exception to this requirement may be taken where a containment structure is placed at the district boundary.

5.1.2 Load Cases - Summary

Table 5.1.2 summarizes the various load cases used to design and analyze structures.

Table 5.1.2 – Structural Load Cases

Description	Wind Loading	Ice Loading	Temperature	NESC Ref.
NESC 250B District Loading				
Heavy	4 psf	0.50 in.	0°F (-20°C)	250B, Table 250-1
Medium	4 psf	0.25 in.	15°F (-10°C)	250B, Table 250-1
Light	9 psf	0.00 in.	30°F (-1°C)	250B, Table 250-1
NESC 250C Extreme Wind				
100 mph	25.6 psf	0.00 in.	60°F (15°C)	250C, Table 250-1
110 mph	31.0 psf	0.00 in.	60°F (15°C)	250C, Table 250-1
125 mph	40.0 psf	0.00 in.	60°F (15°C)	250C, Table 250-1
140 mph	50.2 psf	0.00 in.	60°F (15°C)	250C, Table 250-1
150 mph	57.6 psf	0.00 in.	60°F (15°C)	250C, Table 250-1
NESC 250D Concurrent Ice and Wind				
0.5 in.	2.3 psf	0.50 in.	15°F (-10°C)	250D, Table 250-1
0.75 in.	2.3 psf	0.75 in.	15°F (-10°C)	250D, Table 250-1
1.0 in.	2.3 psf	1.00 in.	15°F (-10°C)	250D, Table 250-1
Cold Case – Uplift	0 psf	0.00 in.	0°F (-20°C)	
Every Day – Deflection	0 psf	0.00 in.	60°F (15°C)	
Unbalanced	See Section 5.1.4	See Section 5.1.4	60°F (15°C)	See Section 5.1.4

5.1.3 Loads – Structure Analysis

In addition to the cases in Table 5.1.2, the following load cases shall be used in the analysis and structure design of all Transmission Line structures.

5.1.4 Stringing Loads on Custom Davit and Cross Arms

For arms, the everyday load case shall include a vertical load of 5000 lbs. suspended from the ends of each arm (to address vertical construction loads). The described vertical load is an allowance for steep stringing angles and other construction loads.

5.1.5 NESC Load Cases with OCF = 1.0

In addition to the standard NESC Overload Capacity Factors, all concrete structures shall have loads applied for NESC Load Cases with OCF = 1.0.

5.1.6 Special Load Cases - Structure Analysis

The following load cases shall be used in the analysis and structure design of the following structure types.

5.1.7 Single Dead-End and Failure Containment (Dead-End Structures)

All wires up, One Side Only Loading, Initial or Final Condition using the Structural Load Cases in Table 5.1.2.

5.1.8 Stringing Longitudinal Unbalanced Load (Tangents & Run. Angles)

0 mph Wind & 0” Ice, 60°F (15°C), Initial (Everyday Loads) with 3000 lb. Longitudinal Force (1000 lb. per phase) or with 2000 lb. Longitudinal Force per conductor (H-Frames only).

5.1.9 Pole without Conductors (NESC 261A1c) (Guyed Poles)

Extreme Wind applied on pole in any direction.

5.1.10 Stringing loads on Dead-Ends

Everyday loads on one side only (0 mph wind, 0” ice, 60F (15C), Initial.

5.1.11 PLS Wind Direction for Structure Loading

Designers shall conservatively use wind applied normal to all spans simultaneously when selecting structures for new designs.

5.2 Load Cases – Clearance Verification

The following clearance load cases shall be included to check vertical and horizontal clearances. "Line Design Clearances" are shown in Attachment 2.

Table 5.2.1 – Clearance Load Cases

Description	Wind Loading	Ice Loading	Temp.	NESC Ref.	Condition	Clearance Check
Max. Temp. (ACSR)	0 psf	0 in.	212°F (100°C)	232A	Final	Vertical Clearance
Max. Temp (ACSS & ACCC)	0 psf	0 in.	347°F (175°C)	232A	Final	Vertical Clearance
Max. Temp (ACAR)	0 psf	0 in.	176°F (80°C)	232A	Final	Vertical Clearance
NESC Zone						
Heavy	4 psf	0.5 in.	0°F (-20°C)	230B, Table 230-1, Table 230-2	Final	
Heavy Ice	0 psf	1.0in	32°F (0°C)	232A	Final	Vertical clearance to ground, other conductors, and structures
Medium Wind	6 psf	0 in.	60°F (15°C)	234A2	Initial and Final	Horizontal clearance to ground, other conductors and structures.
High Wind (ROW)	Extreme Wind from Table 5.1.2	0.0 in.	60°F (15°C)		Final	Horizontal Clearance to Edge of Right-of-Way
High Wind (Horizontal. Clearance)	100 mph	0.0in.	60°F (15°C)		Final	Insulator swing and Conductor movement (See Section 6.3.3 for more information)
No Wind	0 psf	0.00 in.	60°F (15°C)		Initial and Final	Horizontal clearance to ground, other

Description	Wind Loading	Ice Loading	Temp.	NESC Ref.	Condition	Clearance Check
						conductors and structures.

5.3 Load Cases – Wire Stringing

The following load cases shall be used to calculate stringing tensions for conductors and shield wires.

Conductor & Shield Wire Stringing Tensions

0 mph Wind, 0” Ice, 60°F (15°C), Initial & Final Stringing Temperature – 10 to 120°F (-12 to 49°C)

5.4 Load Factor and Strength Reduction

Overload Capacity Factors (OCF) shall be coordinated with the appropriate Strength Reduction Factors (SRF) and confirm that material strengths are presented as ultimate or working material strengths.

Table 5.4A – NESC & Entergy Design Overload Capacity Factors (OCF)

LOAD CASE	VERT (OCF)	WIND (OCF)	TENSION (OCF)	CODE REF.
Structural Analysis				
NESC Zone Loading (Intact)	1.5	2.5	1.65	253-1
Extreme Wind - (Intact)	1	1	1	
Concurrent Ice & Wind – (Intact)	1	1	1	
Unbalanced – (Intact)	1	1	1	
Single DE NESC Failure Containment	1.5	2.5	1.65	
Single DE Extreme Wind & Heavy Ice	1	1	1	
Cold Case – for Uplift	1	1	1	
Every Day Loads – for Deflection	1	1	1	
Clearance Calculations				
Clearance – Vertical – Heavy Ice (NESC)	1	1	1	232A3
Clearance – Vertical – Max. Temp. (NESC)	1	1	1	232A2
Clearance – Vertical – Static (NESC)	1	1	1	
Clearance – Horizontal Med. Wind – (NESC)	1	1	1	234A2
Clearance – Horizontal R/W – Entergy Max. Wind	1	1	1	

Table 5.4B - Strength Reduction Factors (SRF)

Structure Component	SRF NESC Loads (250B)	SRF Extreme Wind and Ice Loads (250C & 250D)	NESC Code Reference
Steel & Pre-stressed Concrete Structures	1.0	1.0	Rule 261-A, Table 261-1
Foundation & Guy Anchors	1.0	1.0	Rule 261-B, Table 261-1
Guys & Guy Insulator	0.9	0.9	Rule 261-C& 264, Tab. 261-1
Steel Crossarms & Braces	0.9	0.9	Rule 261-D1, Table 261-1
DE Fittings, Splices & Hardware(3)	1.0	0.8	Rule 261-H2C
Support Hardware(2)	1.0	1.0	Rule 261-D-1, Table 261-1
Insulators – Suspension	0.50	0.65	Table 277-1(4)
Insulators – Post	0.50	0.50	Table 277-1(4)
Conductor & Shield Wire	(1)	(1)	Rule 261-H1

(1) Conductor and shield wire maximum wire tensions are taken from NESC Code Section 261- H1.

(2) Support hardware includes bolts and plates supporting davit arms, braced post and post insulators, brackets, suspension tees and other miscellaneous supports not supporting conductor or shield wire dead-ends. The reduction factors shown are multiplied by the ultimate strength of the part as indicated by the manufacturer.

(3) Dead-end fittings include bolts and dead-end tees used to dead-end conductors and shield wires. The manufacturer generally gives the ultimate strength of the tees. This value is then reduced by the reduction factor shown. The "minimum tensile strength" shown for bolts by the Vendor is the allowable tensile load that shall be used on the bolt without the combined load of shear produced in a guyed structure. These loads are not reduced by the reduction factor; however, the shear values given shall be reduced depending on the actual tensile stress, in accordance with the interaction equation.

(4) NESC 2017

6 CLEARANCE AND RIGHT OF WAY REQUIREMENTS

This section covers vertical and horizontal clearance requirements for the Transmission Lines, which include NESC vertical and horizontal clearance requirements from Section 23 of the 2017 Code or counterpart for subsequent codes for HV transmission lines in Entergy's Service Area plus an added safety buffer, as described below.

6.1 Vertical Clearance – Over Ground

NESC and Entergy vertical clearances over various ground surfaces are shown in Attachment 2. These clearances are based on the 2017 Code, Table 232-1, with the voltage adder defined in Rule 232C1a, using the sags calculated under Rules 232A2 and 232A3.

See Section **Error! Reference source not found.** for Clearance Load Cases.

The actual clearance to ground shall be based on the measurement to ground at the low point in the line as determined when the line is at maximum sag. For purposes of determining the required clearance for the Transmission Lines,

NESC Clearance = Table 232-1 Clearance + Voltage Adder (.4”/kV in excess of 22kV)

Entergy-Required Minimum Clearance = NESC Clearance + Safety Buffer

NESC provides consideration for clearances over water surfaces, including floodwaters. Footnotes 17-21 to Table 232-1 shall be carefully considered when determining necessary clearances. For flood-prone areas that do not typically have standing surface water and are not subject to USACE or other permits, the normal flood level (10-year flood level) shall be considered along with required clearances for areas not suitable for boating. For most spans over such areas, clearances that consider or are based on vehicle access with un-flooded ground surfaces will continue to apply. Lines leading into generating facilities, EHV interconnections, or other lines where increased reliability is desired shall consider less frequent flood events (e.g., 50-year floods or 100 year floods) to avoid potential service interruptions. Such lines shall be designed to higher flood levels where the incremental costs are justified and will generally be compared to NESC requirements for water surface not suitable for sailboats.

6.2 Other Vertical Clearances

6.2.1 Supply Conductors (69 kV and above)

NESC and Entergy vertical clearances between various electricity supply lines and non-current carrying wires are also shown in Attachment 2. These clearances are based on the 2017 Code, Table 233-1, with the voltage adder defined in Rule 233C2a, using the sags calculated under Rules 233A1a (3)(b) and 233A1a (3)(c).

The design clearance shall be measured as the distance between the field measured existing line and the design maximum sag.

The Entergy-Required Minimum Clearance: NESC Clearance + Safety Buffer

Attachment 2 shows the minimum vertical clearances over various ground surfaces and uses.

The line Designer shall establish “Prohibitive Zones” with the appropriate Design Clearances on the plan profiles within PLS-CADD in the areas where these considerations occur. Considerations could be but not limited to environmental, archaeological, landowner constraints, etc.

6.2.2 Substations

Transmission line vertical clearances inside substations shall meet the vertical clearance requirements shown in Attachment 2.

6.2.3 Miscellaneous

To every extent possible, ROW shall be selected, and ROW agreements written, to preclude structures, signage, and other miscellaneous items from being located beneath the transmission circuits. To the extent such items cannot be so precluded, the vertical clearances for the Transmission Line shall meet the basic

NESC clearance requirements for each applicable clearance set forth in Attachment 2, plus an additional 4.5 feet.

6.3 Horizontal Clearance

All horizontal clearances shall include the deflection of the structure and the displacement of the conductor added to the clearance requirements defined below. Clearances per Section 6.3.1 and Section 6.3.2 shall be based on the development of the clearance envelopes shown in the NESC for each situation plus 4.5 feet at a minimum. Basic NESC clearances, including horizontal clearances, are summarized in Attachment 2.

6.3.1 Adjacent Supply Lines

Horizontal clearances to adjacent supply lines shall be calculated using loads described in Section **Error! Reference source not found.**. This clearance is based on an envelope as shown in NESC Figures 233-1, 2&3 and using the following loadings:

The horizontal movement shall be calculated using the medium wind defined under Rule 233A1a(1&2) using (1) a 6 lb/sf wind at 60°F (15°C) and no ice or (2) no wind at 60°F (15°C).

The maximum sag, Rule 233A1a(3), shall be calculated (a) using 120° F (49°C) with no wind; (b) using the max temperature; or (c) the Code Ice thickness with a temperature of 32°F (0°C) and no wind.

PLS-CADD shall be used to define the envelope vertices and check clearance to adjacent supply lines.

6.3.2 Adjacent Buildings and other Structures

The required clearance between conductors and buildings or other structures is covered in Rule 234 and varies between the various structure types. The loadings used for the clearance envelopes are given in Section **Error! Reference source not found.**. The Designer shall use PLS-CADD to check these clearances after specifying the required load cases and clearances.

6.3.3 Insulator/Conductor Swing Clearance

Clearances to the supporting structure resulting from insulator swing are addressed in Section 8.1. Additionally, air gap clearances between adjacent circuits on different structures are to be checked under the high wind load case in Section **Error! Reference source not found.**. Minimum clearance shall be that associated for the higher voltage for the 100 mph swing clearance given in Table 8.1.2.

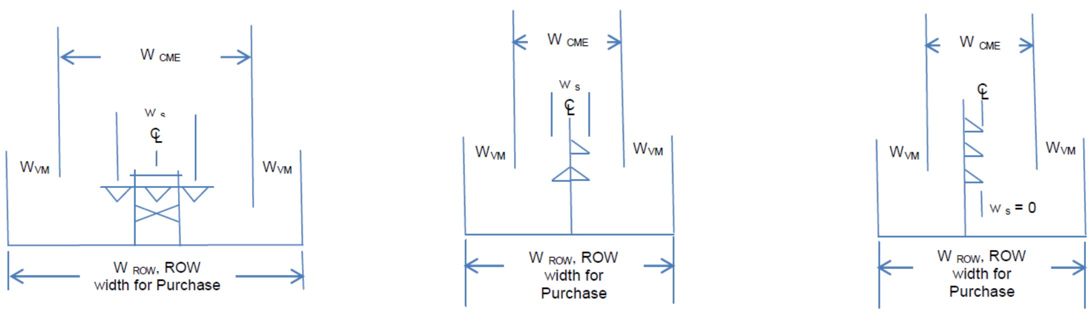
6.3.4 Right of Way Requirements

6.3.4.1 Rights of Way for New Lines

Rights of way (ROW) for new transmission lines must provide spacing sufficient to assure reliability and equipment accessibility for maintenance and construction.

Required ROW widths for new lines must be determined considering four primary parameters: (a) the effective structure width(s), taken as the outboard conductor spacing for the structure; (b) the minimum required spacing between adjacent circuits on separate structures; (c) the conductor displacement due to wind; and (d) a vegetation management width at the edges of the ROW to allow for a cyclical growth and periodic trimming schedules. The sum of the structure widths, any additional circuit spacing dimensions, and the conductor displacements (including the effects of structure deflection, insulator swing, and conductor movement) is called the conductor movement envelope (W_{CME}). Adding the appropriate vegetation management width on each side of W_{CME} gives the minimum allowed ROW width for purchase. Note that total minimum allowed ROW widths for purchase will be rounded upward in whole 5' increments (e.g., 161' is rounded to 165'.) The four parameters described above are illustrated for typical ROW situations in Figure 6.3.4.1-1 and Figure 6.3.4.1-2. Additional figures are found in Attachment 4.

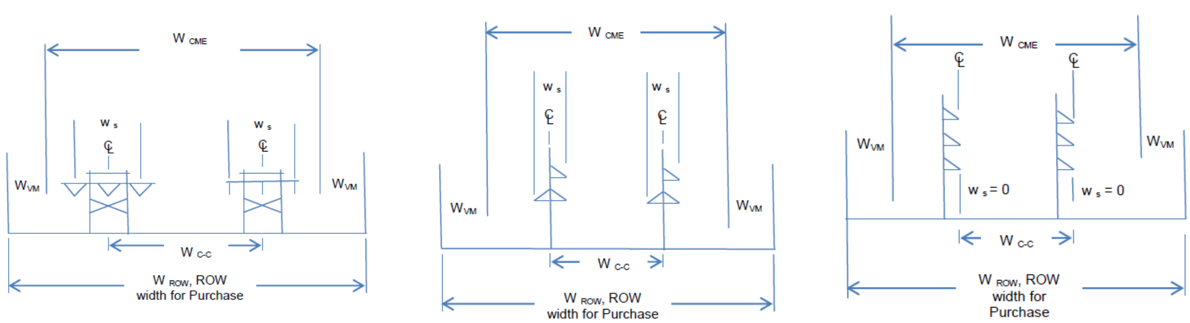
Figure 6.3.4.1-1 – Typical Single Structure ROW



(a) H-Frame (b) Monopole Delta (c) Monopole Vertical

Notes: w_s = Effective Structure Width (Outboard Conductor Spacing) W_{VM} = Vegetation Management Width; W_{CME} = Width, Conductor Movement Envelope; Add Width = c/c Spacing

Figure 6.3.4.1-2 – Typical Double Structure ROW



(a) H-Frame (b) Monopole Delta (c) Monopole Vertical

Notes: w_s = Effective Structure Width (Outboard Conductor Spacing) W_{VM} = Vegetation Management Width; W_{CME} = Width, Conductor Movement Envelope $W_{c\text{-}c}$ = Center to Center Structure Spacing

6.3.4.2 Effective Structure Width (ws) or Outboard Conductor Spacing

Except where special circumstances warrant use of larger values, the minimum allowed ROW widths for new construction shall be based on the effective structure widths (ws) for standard structure framings as set forth in Table 6.3.4.2-1.

Table 6.3.4.2-1 – Typical Effective Structure Widths

		Single Pole	
Voltage	H-frames (ft.)	Delta/ Vert. Double Circuit (ft.)	Single Circuit Vertical (ft.)
500kV	67.66	28.00	0.00
345kV	51.00	24.00	0.00
230kV	40.00	18.00	0.00
161/138/115 kV	32.00	14.33	0.00
69kV	24.00	12.00	0.00

Note that for vertical conductor configurations, the conductors fall on the centerline of the circuit/ROW and the monopole structure itself is offset by a function of the insulator length. In such configurations there are no outboard conductors, and the effective width of the structure is treated as zero.

When determining ROW requirements for constructing a new transmission line adjacent to an existing transmission line (discussed in more detail below), the actual effective widths of the existing structure shall be determined and used in the calculation.

Adjacent Circuit Separation (Wc-c)

Circuit center to center horizontal spacing for ROW determinations shall be as shown in Table 6.3.4.2-2 unless the Performance Standard requires use of a higher value.

Table 6.3.4.2-2 – Minimum Spacing for Adjacent Circuits (W_{c-c})

		Single Pole	
Voltage	H-frames (ft.)	Delta/ Vert. Double Circuit (ft.)	Single Circuit Vertical (ft.)
500kV	140	96	70

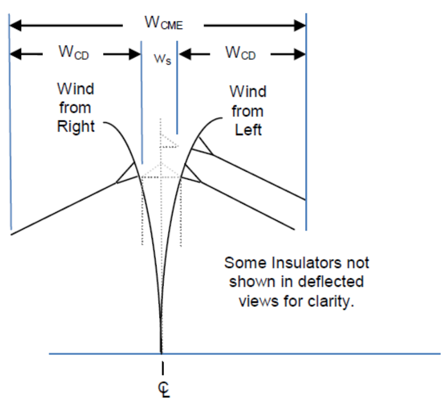
		Single Pole	
Voltage	H-frames (ft.)	Delta/ Vert. Double Circuit (ft.)	Single Circuit Vertical (ft.)
345kV	120	65	45
230kV	75	50	35
161/138/115 kV	60	40	30
69kV	45	30	20

For 345 kV and 500 kV Transmission Lines, the distances specified for adjacent single pole circuits reflect geometrical limits only. Electrical effects (audible noise, EMF, etc.) must be studied, and will require additional separation if indicated by the study. For two adjacent circuits of different voltage or framing, the larger of the two required separation distances shall be used.

6.3.4.3 Displaced Conductor Position (WCD)

During detailed line design, the displaced conductor positions are calculated including the effects of structure deflection and insulator/hardware swing; and using the load cases contained in Section 5. Wind loads are applied transversely in each direction to displace the conductor away from the centerline as illustrated below.

Figure 6.3.4.3-1 – Displaced Conductor Position & Relationship to W_{CME} and w_s



Notes: w_s = Effective Structure Width (Outboard Conductor Spacing) W_{CME} = Width, Conductor Movement Envelope; W_{CD} = Displaced Conductor Position Including Structure Deflection

In addition to checking required horizontal clearances per Sections 6.3.1 and 6.3.2, the displaced conductor position shall stay within the available conductor movement envelope under the extreme wind cases described in Table 5.1.2. As part of the line design, pole placements and span lengths must be adjusted if required to maintain required clearances and keep the conductor within the available width.

The available CME widths in Table 6.3.4.4-1 and Table 6.3.4.5-1 contemplate and accommodate standard framings, typical spans, the current list of typical conductors and their specified stringing limits, etc. Markedly atypical designs may require a more rigorous evaluation of the ROW requirements. Conversely, severe ROW restrictions will likely require atypical design such as shortened spans.

Note that all tabulated values consider the use of V-string assemblies, braced-post assemblies, suspension units with struts, or other configurations where insulator swing is confined.

6.3.4.4 Vegetation Management Width (WVM)

It is assumed that trees grow or someday will grow at the edge of the ROW, and that normal growth cycles will result in further encroachment into the Vegetation Management Width. Therefore, the conductor movement envelope (CME) alone is insufficient as a ROW. Vegetation management in the area adjacent to ROW edges is required to prevent grow-in and to comply with the Minimum Vegetation Clearance Distance (MVCD see also definitions). Thus, additional width between the ROW edge and the outboard conductors is essential to allow planned, efficient vegetation management without violating the MVCD.

To accomplish this, apply a Minimum Vegetation Action Threshold Distance (MVATD) for prioritizing corrective maintenance. The Vegetation Management Width (W_{VM}) to be used when determining ROW width shall bound the MVATD and MVCD, and is tabulated below (values for MVATD and MVCD are provided for reference):

Table 6.3.4.4-1 – Vegetation Management Widths

Voltage	W_{VM} (ft.)	MVATD (ft.)	MVCD (ft.)
500kV	22.5	14.68	7.4
345kV	15.0	9.44	4.5
230kV	12.5	5.14	4.3
161/138/115 kV	10	3.42 / 2.94 / 2.45	2.9 / 2.4 / 2.0
69kV	7.5	2.45	1.2

Where a circuit is to be built at a given voltage but operated at a lower voltage, the W_{VM} for the higher voltage shall be used to determine ROW width.

6.3.4.5 Calculation of Minimum Allowed ROW Width for Purchase - New Single Circuit Line or Double Circuit on the Same Structures

As illustrated in the preceding figures, at any given point, the minimum allowed ROW shall equal the applicable CME plus the applicable vegetation management width (W_{VM}) on each side of the ROW. Assuming multiple circuits are the same voltage, standard ROW widths are determined as:

ROW = WCME + 2(WVM), rounded up to the next whole 5' increment

and are tabulated by voltage and framing type in Table 6.3.4.5-1 and Table 6.3.4.5-2.

Table 6.3.4.5-1 – Minimum Required ROW Widths for Single Structures (Single Circuit or Multi-Circuit on Same Structure)

		Typical ROW Width (ft.) for Purchase			Conductor Movement Envelope - CME (ft.)		
Line Voltage (kV)	WVM (ft.)	H-Frame	Single Pole Delta/Vertical Double Circuit	Single Pole Vertical	H-Frame	Single Pole Delta/Vertical Double Circuit	Single Pole Vertical
500	22.50	225	125	125	180	80	80
345	15.00	190	155	135	160	125	105
230	12.50	150	125	110	125	100	85
161	10.00	120	100	90	100	80	70
69	7.50	90	75	65	75	60	50

Table 6.3.4.5-2 – Minimum Allowed ROW Widths for Multiple Structures and Circuits

	ROW Widths (ft.) assuming two identical lines								
Line Voltage (kV)	ROW Width for Purchase (ft.)			Conductor Movement Envelope - CME (ft.)			Add. Width per line (ft.)		
	H-Frame	Single Pole Delta/Vertical Double Circuit	Single Pole Vertical	H-Frame	Single Pole Delta/Vertical Double Circuit	Single Pole Vertical	H-Frame	Single Pole Delta/Vertical Double Circuit	Single Pole Vertical

500	365	225	195	320	180	150	140	96	70
345	310	220	180	280	190	150	120	65	45
230	225	175	145	200	150	120	75	50	35
161	180	140	120	160	120	100	60	40	30
69	135	105	85	120	90	70	45	30	20

Notes regarding Tables 6.3.4.5-1 and 6.3.4.5-2:

1. Tabulated 500 kV single pole ROW reflect an atypical short span design intended to compact lines on narrower ROWs.

2. As noted in 6.3.4.1, tabulated values reflect Vee-String, Brace Post, Suspension/Strut or other insulator assemblies where conductor attachments are somewhat restrained. Where suspension I-String assemblies are used: at 230 kV and below the ROW widths given shall be increased by 5 feet; and at 345 kV they shall be increased by 10 feet. Only Vee-String assemblies are currently approved for 500 kV.

3. The ROW values presented are indicative of what would be required in straight sections of ROW containing tangent or light angle structures. Large angle changes using multi-pole structures or extensive guying patterns will require additional ROW in the vicinity of the angle structure.

7 CONDUCTOR AND SHIELD WIRE INFORMATION

This section includes design information about standard conductors, both in single and in bundled configurations, along with standard shield wires, including fiber optic wires. It includes tension and vibration control data for the NESC and Entergy design conditions. Conductors and shield wires shall be selected from these standards unless Buyer and Seller otherwise agree in a writing signed by authorized representatives of the Parties.

7.1 Entergy Standard Conductors

The required technical standards for conductors are set forth in this Section 7.1 (properties based on Southwire® data unless noted.):

Table 7.1A – Standard Conductors – Mechanical Properties

Type	**Size**	**Stranding**	**Code Word**	**Area (in^2)**	**Dia. (in.)**	**Weight (lb/ft)**	**Strength (lbs)**
ACCC/TW (5)	1949	56/1	LAPWING (4)	1.647	1.504	1.938	48,900
	1582	33/1	BITTERN (4)	1.336	1.345	1.566	39,400

Type	Size	Stranding	Code Word	Area (in^2)	Dia. (in.)	Weight (lb/ft)	Strength (lbs)
	1428.5	33/1	BEAUMONT [(4)]	1.232	1.294	1.436	43,700
	1222	33/1	CARDINAL [(4)]	1.053	1.198	1.224	37,100
	821.2	18-1	GROSBEAK [(4)]	0.725	0.990	0.836	30,400
ACSS	1590	45/7	LAPWING	1.34	1.50	1.79	27,900
ACSS	1272	45/7	BITTERN	1.07	1.35	1.43	22,300
ACSS	954	54/7	CARDINAL	0.85	1.20	1.23	26,000
ACSS	666.6	24/7	FLAMINGO	0.59	1.00	0.86	18,200
ACSR	1780	84/19	CHUKAR	1.51	1.60	2.08	51,000
ACSR	1590	45/7	LAPWING	1.34	1.50	1.79	42,200
ACSR	1272	45/7	BITTERN	1.07	1.35	1.43	34,100
ACSR	1033.5	45/7	ORTOLAN [(1)]	0.87	1.21	1.163	27,700
ACSR	954	54/7	CARDINAL	0.85	1.20	1.23	33,800
ACSR	954	45/7	RAIL [(2)]	0.80	1.165	1.075	25,290
ACSR	666.6	24/7	FLAMINGO	0.59	1.00	0.86	23,700
ACSR	336.4	26/7	LINNET	0.31	0.72	0.46	14,100
ACAR	1024.5	34/13	N/A [(3)]	0.80	1.165	0.96	23,100
ACAR	649.5	18/19	N/A	0.51	0.93	0.61	17,100
ACAR	395.2	15/7	N/A	0.31	0.72	0.37	10,100

(1) Not for New Construction, Capital Maintenance only

(2) 345 kV and 500 kV only – Use for new construction

(3) 500 kV only – for Capital Maintenance work only

(4) Source: General Cable/LAMIFIL Data

(5) It is generally preferential to develop a custom conductor solution using an ACCR conductor in lieu of the ACCC conductors. Use of the ACCC standards will generally be limited to extension of existing ACCC lines or other similar circumstances.

Ampacity ratings for the standard conductors are determined using the commercially available software SWRate, which is based on the methodology of IEEE 738. Ampacity was determined using design parameters specified in Entergy standards and the conductor properties contained in the SWRate program library. Line ratings are also expressed as conductance in MVA using the expression MVA = V * A * 0.001 * 3^0.5, where V is voltage in kV, and A is rated ampacity in amps. Ampacity and conductance ratings for the standard conductors are summarized below.

Table 7.1B – Standard Conductors – Capacity

Type	Size / Code Word	Rated Amps (1)	MVA 69kV	MVA 115kV	MVA 138kV	MVA 161 kV	MVA 230kV	MVA 345kV	MVA 500kV
ACCC/TW (3)	1949 / LAPWING	2490	298	496	595	694	992	-	-
	1582 / BITTERN	2180	261	434	521	608	868	-	-
	1429 / BEAUMONT	2050	245	408	490	572	817	-	-
	1222 / CARDINAL	1857	222	370	444	518	740	-	-
	821.4 / GROSBEAK	1439	172	287	344	401	573	-	-
ACSS	1590 / LAPWING	2263	270	451	541	631	902	-	-
	1272 / BITTERN	1957	234	390	468	546	780	-	-
	954 / CARDINAL	1607	192	320	384	448	640	-	-
	666.6 / FLAMINGO	1312	157	261	314	366	523	-	-
ACSR	1780 / CHUKAR	1608	192	320	384	448	641	-	-

Type	Size / Code Word	Rated Amps (1)	MVA 69kV	MVA 115kV	MVA 138kV	MVA 161 kV	MVA 230kV	MVA 345kV	MVA 500kV
	1590 / LAPWING	1494	179	298	357	417	595	-	-
	1272 / BITTERN	1303	156	260	311	363	519	-	-
	1033.5/ ORTOLAN (2)	1144	137	228	273	319	456	-	-
	954 / CARDINAL	1088	130	217	260	303	433	-	-
	954 / RAIL	1088	130	217	260	303	433	650	942
	666.6 / FLAMINGO	882	105	176	211	246	351	-	-
	336.4 LINNET	575	69	115	137	160	229	-	-
ACAR	ACAR 1024.5 (2)	878	105	175	210	245	350	-	760
	ACAR 649.5	658	79	131	157	183	626	-	-
	ACAR 395.2	483	58	96	115	135	192	-	-

(1) At normal operating temperatures, 212ºF (100ºC) for ACSR, 347ºF (175ºC) for ACSS and ACCC, and 176ºF (80ºC) for ACAR.

(2) Other historical limits may govern.

(3) It is generally preferential to develop a custom conductor solution using an ACCR conductor in lieu of the ACCC conductors. Use of the ACCC standards will generally be limited to extension of existing ACCC lines or other similar circumstances.

7.2 Standard Shield Wires

The required technical standards for shield wires are set forth in Table 7.2 below:

Table 7.2 – Standard Shield Wires

Code Word	Class Type	Size	Strand-Ing	Area (in^2)	Dia. (in.)	Weight (lb/ft)	Strength (lbs)
7 #7	Alumoweld	0.0	7	0.11	0.43	0.33	19,060

7.3 Standard Optical Ground Wires

The required technical standards for optical ground wires (OPGW) are set forth below:

Table 7.3 – Standard OPGW Wires

Code Word	Class Type	Fibers	Strand-Ing	Area (in^2)	Dia. (in.)	Weight (lb/ft)	Strength (lbs)
DNO-5651	AlumaCore	24LT	13	0.151	0.528	0.36	18,391
DNO-6651	AlumaCore	48LT	9/6	0.221	0.646	0.42	18,053
DNO-3476	AlumaCore	24	13	0.151	0.528	0.36	18,433
DNO-4596	AlumaCore	48	9/6	0.221	0.646	0.42	18,053
DNO-6205	CentraCore	24	10	0.166	0.528	0.41	21,845
DNO-6210	CentraCore	48	10	0.166	0.528	0.41	21,845
DNO-8161 (1)	AlumaCore	48	13	0.151	0.528	0.36	18,391
DNO-9800 (2)	AlumaCore	48	13	0.151	0.528	0.36	19,391

(1) DNO-8161, 48 fiber AlumaCore will be the default OPGW selection unless project specifics warrant a different selection.

(2) DNO-9800, 48 fiber AlumaCore will be the default OPGW selection for "backbone" applications where dispersion shifted fibers are required by the telecommunications department.

Alternative optical ground wires may be used, provided they meet the same specifications as the above-referenced wires. Similar hardware to that used for standard wires specified herein must be used so that nonstandard hardware does not have to be stocked for maintenance.

7.4 Bundled Conductors

7.4.1 Bundled Conductors (New Construction, excluding 500 kV)

The standard bundled configuration is a vertical bundle in which no spacers are required. If other configurations are used, the conductor supplier and/or manufacture of the spacers shall be consulted regarding spacers requirements.

The standard assembly for bundled dead-end structures shall be the "DEPY" dead-end assembly with a two-insulator attachment to the structure.

Bundled dead-end structures where the maximum tension (with OCF) in each sub-conductor is less than 9700 lbs. may use the "DEP- 2 wire" dead-end assemblies with a single insulator. This assembly shall mainly be used in reduced tension situations.

All bundled structures with angles less than 30 degrees shall be designed as running angle structures, including Structure Types "C", "F" and "G". Those with angles greater than 30 degrees shall be designed as dead-end structures.

7.4.2 Bundled Conductors (500 kV)

The standard 500 kV bundled conductor is a triple delta configuration with spacers at approximately 250 foot intervals.

7.5 Sag and Tension Limitations

7.5.1 NESC Tension Limits

Following are the maximum tension limits allowed in the determination of project sag and tension values. The "Zone Loading" tension limit is an NESC requirement for all load cases with an overload capacity factor of 1.65. The tension limits for extreme wind and heavy ice are Entergy requirements and have an overload capacity factor of 1.0. Load cases are shown in **Section 5.4.** The limit is a percent of the Ultimate Breaking Strength (UBS) of the wire. Limits are based on the Initial tension of the wire.

Load	Tension Limits
• Zone loading (OCF=1.65)	60% UBS - @ Initial Ten. (NESC 261H1)
• Extreme Wind (OCF=1.0)	75% UBS - @ Initial Ten.
• Concurrent Ice & Wind (OCF=1.0)	5% UBS - @ Initial Ten.

Additionally, the NESC (Section 261 H1) requires that the tension at each of the applicable NESC Zone temperatures shown in Table 5.1.2, without external load, shall not exceed the following percent of their UBS:

Initial unloaded tension35% UBS

Final unloaded tension25% UBS

These tension limits apply at each of the applicable NESC Zone temperatures shown in Table 5.1.2, unless dampers are used, in which case this limitation is at a maximum of 60°F (15°C).

7.5.2 Tension Limits for Vibration Control

Except for ACCC and ACCR conductors, for vibration control, maximum catenaries (horizontal tension/weight), or "C" values, will be calculated at 0°F (-20°C), 0 mph wind, and 0 inches ice. Calculated values for "C final" shall be 4710 and for "C initial" shall be 6000. Lesser values of "C" will require approval by Buyer.

For ACCC conductors, vibration dampers shall be placed in accordance with the manufacturer's recommendations.

The following table," Vibration Control Values", provides Entergy's tension limits for the standard conductors. The table was developed considering 900 ft. ruling spans. However, these values may be used for other ruling spans with only slight variations. Other ruling spans will require approval by Buyer.

Table 7.5.2 – Vibration Control Values

Type	Conductor Name	Load Case	Max Tension (pounds)	% of Ultimate Strength
ACSS	LAPWING	0-0-0 (I)	10740	38.5
ACSS	LAPWING	0-0-0 (F)	8431	30.2
ACSS	BITTERN	0-0-0 (I)	8580	38.5
ACSS	BITTERN	0-0-0 (F)	6735	30.2
ACSS	CARDINAL	0-0-0 (I)	7380	28.4
ACSS	CARDINAL	0-0-0 (F)	5793	22.3
ACSS	FLAMINGO	0-0-0 (I)	5160	28.4
ACSS	FLAMINGO	0-0-0 (F)	4051	22.3
ACSR	CHUKAR	0-0-0 (I)	12480	24.5
ACSR	CHUKAR	0-0-0 (F)	9796	19.2
ACSR	LAPWING	0-0-0 (I)	10740	25.5
ACSR	LAPWING	0-0-0 (F)	8431	20.0
ACSR	BITTERN	0-0-0 (I)	8580	25.2
ACSR	BITTERN	0-0-0 (F)	6735	19.8
ACSR	ORTOLAN	0-0-0 (I)	6978	25.2

Type	Conductor Name	Load Case	Max Tension (pounds)	% of Ultimate Strength
	ORTOLAN	0-0-0 (F)	5478	19.8
	CARDINAL	0-0-0 (I)	7380	21.8
	CARDINAL	0-0-0 (F)	5793	17.1
	RAIL	0-0-0 (I)	6450	24.9
	RAIL	0-0-0 (F)	5063	19.5
	FLAMINGO	0-0-0 (I)	5160	21.8
	FLAMINGO	0-0-0 (F)	4051	17.1
	LINNET	0-0-0 (I)	2760	19.6
	LINNET	0-0-0 (F)	2167	15.4
ACAR	649.5 ACAR	0-0-0 (I)	3660	21.4
	649.5 ACAR	0-0-0 (F)	2873	16.8
	395.2 ACAR	0-0-0 (I)	2220	22.0
	395.2 ACAR	0-0-0 (F)	1743	17.3
	1024.5 ACAR	0-0-0 (I)	5760	24.9
	1024.5 ACAR	0-0-0 (F)	4522	19.6
SW	7#7 AW	0-0-0 (I)	1980	10.4
	7#7 AW	0-0-0 (F)	1554	8.2
	7/16" Steel	0-0-0 (I)	2400	11.5
	7/16" Steel	0-0-0 (F)	1884	9.1
OPGW	* AlumaCore, DNO-8161	0-0-0 (I)	2160	11.7
	* AlumaCore, DNO-8161	0-0-0 (F)	1696	9.2
	* AlumaCore, DNO-9800	0-0-0 (I)	2160	11.1

Type	Conductor Name	Load Case	Max Tension (pounds)	% of Ultimate Strength
	* AlumaCore, DNO-9800	0-0-0 (F)	1696	8.7
ADSS	ADSS-AE024HG611CA2	0-0-0 (I)	546	18.2
	ADSS-AE024HG611CA2	0-0-0 (F)	429	14.3

*AlumaCore, DNO-8161 is the default.

Note ADSS is not a transmission standard transmission conductor but is frequently used as an under-built non-transmission conductor. Typical ADSS span is on the order of 200 feet.

Also note that (F) load cases shall be controlled by both Creep RS and Load RS, and that bimetallic conductors shall consider the effects of compression at high temperatures

7.5.3 Vibration Control for Long Spans Exceeding the Ruling Span

For span lengths greater than the ruling span, the Designer shall take special care to compare the conductor and shield wire sags, to ensure that adequate clearances at mid-span are maintained under all conditions. The shield wire tension shall not exceed 16% of its ultimate strength at 60ºF (15ºC), final. To account for unusual circumstances (e.g., ravine crossings), it may be necessary to dead-end the shield wire to account for tension differentials and/or increase the tensions along with adding dampers per manufacturer's specifications.

7.6 Correction to Sag when Final Installation is Interrupted

Prolonged stringing durations can affect final sags due to creep beyond that considered in the sagging algorithm. Conductors and shield wires shall be clipped in within 72 hours of achieving the intended stringing tension. Where stringing operations are interrupted or extend beyond this 72-hour threshold, engineering evaluation/approval is required with final approval by Buyer, and the cable manufacturer shall be contacted to obtain technical instructions on the issue.

7.7 Galloping

Certain areas within the Entergy Service Area have been identified as areas prone to galloping and shall require the installation of vibration control devices. These areas are generally in north Arkansas along the Mississippi River in open, flat areas where it is possible for ice to form on the cables.

Phase spacing shall be set to avoid mid-span interference between phases through the required assumption that double ellipse galloping will occur on any span exceeding 400 feet. A galloping overlap of less than 10 percent between phases will be allowed in the design process. It is generally assumed that using span lengths between 400 and 900 feet would eliminate this overlap. The ruling span is set at 80% of the limiting span for this analysis.

7.8 Aeolian Vibration

Aeolian vibration fatigue damage typically occurs in flat, open areas. The most effective way to reduce this type of vibration is to reduce the line tension. Also, the installation of dampers may eliminate or reduce this vibration; however, the conductor and damper suppliers shall be consulted regarding these conditions.

The use of ACSS type conductors may also reduce this vibration after one year of operation because of the self-damping characteristics built into this type of conductor.

7.9 Conductor Corona

Two solutions to reduce conductor corona are larger conductors and/or bundled conductors.

For 161 kV, 115 kV, and 69 kV, 336 kcmil ACSR "Linnet" shall be the minimum conductor size.

At 230 kV, bundled 395 kcmil ACAR conductors or, for single conductor lines, a recommended standard wire size of 954 kcmil ACSR. The minimum wire size for 230 kV using industry standards is approximately one inch in diameter. The smallest standard wire size that meets the industry standard minimum wire size is "Flamingo" 666.6 kcmil ACSR.

For 500 kV transmission lines, 1024 kcmil ACAR and 954 kcmil ACSR "Rail" shall be the minimum conductor sizes to avoid corona effects. The standard for new construction is 954 kcmil "Rail".

The selection of conductor size, considering corona losses, shall be estimated using the attached figure (obtained from the Westinghouse Transmission and Distribution Manual) entitled "Fig. 31 - Quick Estimating Corona-Loss Curves". This figure is attached as Attachment 3.

7.10 ACSS and ACSS/TW Conductor

7.10.1 ACSS Sags – Tensions - Stringing

ACSS suppliers have recommended that the ACSS & ACSS/TW conductors be pre-tensioned for approximately 10 to 15 minutes before final sagging of the line. This procedure inelastically stretches and elongates the aluminum wires and the steel core provides total support of the conductor in normal operation. Since little or no stress is left in the aluminum wires, initial and final sags and tensions are nearly the same. Pre-stressing is a means of reducing creep and enhancing self-damping capability. Recommendations for pre-stressing vary and range from the maximum tension. Consult with cable manufacturer for prestressing methodology and specifications.

7.11 Fiber Optic/Shield Wire Requirements

Fiber Optic Shield Wire (OPGW) is often the preferred shield wire. For structures with two shield wires, one shield wire will typically be OPGW and one shield wire will typically be 7#7. Project specific shield wire requirements is subject to approval by Buyer. Substation Relay Design, SCADA, Substation Networking and Corporate Telecommunications will need to determine the number of fibers that they will need. Standard Entergy shield wires are found in Section 7.

7.11.1 Fiber Optic Details

The fiber optic line may be dead-ended if the line angle is over 30°. For line angles between 30° and 50°, a heavy angle suspension assembly may be utilized. Fiber optic construction details are shown on the standard assembly drawings, shown in Attachment 1.

7.11.2 Splice Box Locations

Splice boxes shall be placed at existing or expected future laterals and substations. Additional boxes will be needed at intervals along the line, generally corresponding to reel wire length, line angles, and considering the nearest points of access.

7.12 SW Sagging Relative to Conductors

Every effort shall be made to ensure that the shield wire(s) have less sag than the conductor, so that any flashovers are encouraged to occur at a structure rather than at mid-span. It is suggested that the shield wire have a lesser amount of sag by approximately 0.33 percent of the span length, or approximately two (2) feet, under normal stringing loads, i.e., 60°F (15°C). Where this is not feasible, the tension limits to control vibration in Table 7.5.2 may be relaxed to pull the shield wire more tightly and achieve greater separation. Where the tension limits of Table 7.5.2 are relaxed, a conductor vibration study shall be performed, and vibration dampers shall be installed on the shield wire per the recommendations of the vibration study. Alternately, the standard framing may be modified with approval from Buyer to provide greater separation between the shield wire and the conductor.

7.13 Conductor and Shield Wire Marking

7.13.1 Aerial Patrol Marking

Aerial patrol marking to provide early warning of the hazards due to crossing transmission lines shall be applied as described herein.

7.13.2 Marking for Federal Aviation Administration (FAA) regulations

Marking required to comply with Federal Aviation Administration (FAA) regulations shall not be confused with the aerial patrol marking described in paragraph 7.13.1. When routing new lines, it is generally better to avoid selecting routes that pass within close proximity of airports, landing strips, heliports and facilities such as hospitals that might have aircraft landing on improvised landing sites. Such facilities can be generally identified by examining aerial navigation maps available at pilot centers in most public airports, examination of quadrangle maps published by the U.S. Geological Commission, examination of aerial photographs acquired for the line project, and other sources. Where these facilities cannot be avoided and where it is determined that FAA rules apply, the requirements of FAA Advisory Circular AC 70/7460-1K shall apply.

7.13.3 Navigable Waterway Marking

Lines crossing navigable waterways shall be marked as delineated in the applicable permits.

7.13.4 Avian

Avian markers are to be installed where appropriate to make the line more visible to birds. Several forms of markers are commercially available and marketed to increase line visibility and reduce the possibility of avian mortality. Avian markers shall be required only where specified by wildlife agencies or by applicable permits.

7.13.5 Slow-Moving Vehicle Signs

Slow-moving vehicle signs shall be placed on the third and fourth adjacent structures on both sides of any crossover lines, with the signs facing the approach to the lines from either side of the crossover. It is very important that all crossings be marked on the same number of advance structures for safety reasons. One sign on each structure shall be used to indicate a single crossover ahead. If two crossovers in close proximity exist ahead, then two signs shall be installed on each structure, one sign over the other, if possible. Two-crossover situations shall also have single signs on both sides of structures between the crossovers. Details of the installation are covered in an attachment to this Appendix 2, but generally the signs shall be near the top of the poles or towers of the structures. When used on wooden poles, the signs shall be outside any woodpecker wire covering the pole.

7.13.6 Spiral Vibration Dampers (Yellow)

Spiral dampers in addition to slow-moving vehicle signs may be desirable in some cases with extraordinary visibility difficulty. When used, such dampers shall be installed with a minimum of one pair of dampers on both sides of centerline of the line being patrolled at a point just outside the conductor locations but not less than 15 feet between the pairs. If there are two shield wires on the crossover line, half of the dampers shall be installed on each shield wire.

7.13.7 QuikMark Devices

QuikMark devices, in addition to slow-moving vehicle signs, may be desirable in some cases with extraordinary visibility difficulty. When used, QuikMark devices shall be installed with a minimum of three QuikMark devices on each side of centerline of the line being patrolled at a point just outside the conductor locations but not less than 15 feet between each trio. If there are two shield wires on the crossover line, install half of the QuikMarks on each shield wire.

7.13.8 QuikMark Devices Combined with Spiral Vibration Dampers

QuikMark devices and spiral dampers may be combined to mark shield wires by keeping equal numbers of each on each side of the line being patrolled so the visual effects are balanced on the line. When the Transmission Line crosses under the line of another, the minimum requirement is for QuikMark devices or spiral dampers or both to be installed on the shield wires of the other line. This is for the safety of Entergy aerial patrollers and to protect Entergy and others from claims by the owner of the other line for property damage, lost revenues on the other line, and other claims.

8 OTHER ELECTRICAL CRITERIA

8.1 Electrical Insulation

All insulators shall be polymer (non-ceramic). Insulators that are procured from one of Entergy's approved vendors for insulators and adhere to Entergy's standards are assumed to meet this specification. Insulator types include dead-end, braced post, post, suspension and jumpers. All new HV (69 kV and above) Transmission Lines shall have insulators with corona rings installed. Details for these insulators are included in Attachment **1**.

8.1.1 Insulator Swing

8.1.1.1 Mechanical Clearance

Post and braced post assemblies have the potential for contact between their suspension shoe and their post insulator. The suspension shoe may swing towards the supporting post insulator without any wind due to line deflection angle and/or phase position changes between consecutive structures. With a 6 PSF wind (60 degrees Fahrenheit and final wire tension) further displacing the conductor hardware from its everyday displacement, contact with the sheds (or corona ring) is not allowed. With extreme wind specified in Table 5.1.2 of the design criteria (60 degrees Fahrenheit and final wire tension) further displacing the conductor hardware from its everyday displacement, contact with the rod's sheath is not allowed. A swing angle adapter shall be used to increase mechanical clearance. This adapter does not preclude mechanical conflict, so conductor position shall still be checked.

8.1.1.2 Electrical Clearance

Table 8.1.1.2 specifies required certain clearances from the energized conductor shoe to non–energized portions of the structure under the prescribed conditions specified in the footnotes. These clearances were built into Entergy's standard framings shown in Attachment 1. Certain atypical conditions, such as short spans, structures in dips, transition between framings or phasing, deflection angles near the top of the range, and higher tensions, can warrant deviations from standard, such conditions will require Seller to acquire approval from Buyer. Conductor position shall be verified against Table 8.1.1.2 that the required minimum clearances are met, especially for suspension insulators. For posts and braced posts, the standard post lengths will ensure that these clearances are met, except for the no-wind clearance for bundled conductors. For bundled posts and bundled braced posts, the conductor hardware shall not be allowed to swing more than 30 degrees toward the pole without wind (0 degrees F, initial). Note that the swing angle adapters mentioned in Section 8.1.1 do not improve electrical clearance.

Table 8.1.1.2 – Minimum Insulator Swing Clearances

FRAMING VOLTAGE	CONDITION	CLEARANCE TO ARM OR STRUCTURE	CLEARANCE TO GUY
500 kV	6 psf wind (1)	123 in	11 ft.
500 kV	100 mph (2)	60 in	5 ft.
500 kV	no wind (3)	140 in	12 ft.
500 kV	no wind (4)	140 in	12 ft.

FRAMING VOLTAGE	CONDITION	CLEARANCE TO ARM OR STRUCTURE	CLEARANCE TO GUY
345 kV	6 psf wind (1)	85 in	8 ft.
345 kV	100 mph (2)	41 in	4 ft.
345 kV	no wind (3)	105 in	9 ft.
345 kV	no wind (4)	105 in	9 ft.
230 kV	6 psf wind (1)	52 in	6 ft.
230 kV	100 mph (2)	27 in	3 ft.
230 kV	no wind (3)	83 in	8 ft.
230 kV	no wind (4)	88 in	8 ft.
161 kV	6 psf wind (1)	37 in	5 ft.
161 kV	100 mph (2)	19 in	2 ft.
161 kV	no wind (3)	60 in	7 ft.
161 kV	no wind (4)	71 in	7 ft.
138 kV	6 psf wind (1)	34 in	5 ft.
138 kV	100 mph (2)	16 in	2 ft.
138 kV	no wind (3)	54 in	7 ft.
138 kV	no wind (4)	65 in	7 ft.
115 kV	6 psf wind (1)	28 in	5 ft.
115 kV	100 mph (2)	13 in	2 ft.
115 kV	no wind (3)	49 in	7 ft.
115 kV	no wind (4)	60 in	7 ft.
69 kV	6 psf wind (1)	17 in	3 ft.
69 kV	100 mph (2)	8 in	1 ft.
69 kV	no wind (3)	49 in (36 in) (5)	6 ft.
69 kV	no wind (4)	60 in (49 in) (5)	6 ft.

(1) Max required value between switch surge and NESC air gap. Controlled by NESC with 10% Voltage Surge (1.1 x nom. Voltage).

(2) 60 Hz minimum flash over distance.

(3) No wind clearance for suspension insulator (Impulse Air Gap).

(4) No wind clearance for running angles (Impulse Air Gap).

(5) 69 kV framings use 115 kV no-wind air gaps for improved lightning performance. On existing structures where there isn't room for longer insulators and air gaps, the numbers in parentheses apply.

8.1.1.3 Typical Standard Davit Arms

For the purpose of determining clearances presented in Table 8.1.1.2 accounting for insulator swing; as well as for the purpose of evaluating shield angle and determining conductor coordinates, the following arm lengths and insulator lengths shall be used:

Table 8.1.1.3 – Typical Davit Arm and Insulator Lengths for New Construction

INSULATOR LENGTH[2]			
VOLTAGE (kV)	**TYPE**	**INSULATOR LENGTH (IN)**	**DESIGN LENGTH (IN.)**
69	SUS	59	66
161	SUS	73	78
230	SUS	89	96
69	DE/RA	62	80
161	DE/RA	92	98
230	DE/RA	104	110
69	LP/BP	60	60
161	LP/BP	76	78
230	LP/BP	94	94
DAVIT ARM LENGTH[1]			
VOLTAGE (kV)	**TYPE**	**LENGTH**	**RISE (IN.)**
69	Tangent	5'-6"	13
161	Tangent	8'-6"	25
230	Tangent	11'-0"	24
69	Swing	3'-0"	N/A
161	Swing	4'-0"	N/A
230	Swing	5'-0"	N/A
69	DE	5'-0"	12
161	DE	6'-0"	15
230	DE	8'-0"	20

(1) Davit Arm Length is from pole face to conductor attachment

(2) Design length includes hardware.

8.1.1.4 Insulator Attachments – 69 kV, 161 kV, and 230 kV Structures

Braced post and line post insulators are limited to a line angle of 6 degrees based on the limited compression capacities of these insulators. Insulator capacities shall be obtained from manufacturer.

8.1.1.5 General

The same insulator type can be used for concrete and steel poles. Insulator attachments for post insulators are required to be provided by thru-bolting standard insulators to the pole structures.

Dead-end and suspension insulators are required to be attached to the poles via vangs on steel poles or pole-eye plates on concrete poles.

8.1.1.6 Conductor and Shield Wire Vangs

Standard conductor and shield wire attachment vangs on all steel poles shall be 3/4" plate with 1 1/8" diameter holes and 1 1/2" radius and shall be the same on both ends.

Conductor attachment vangs on concrete poles will be 60,000 or 70,000 pound strength pole-eye plates mounted with 7/8" diameter all-thread rods, similar to those provided by Hughes Brothers in Lincoln, Nebraska.

8.1.1.7 Guy Vangs

Standard guying vangs on all steel poles shall be 3/4" plates with 1 1/8" diameter holes and 11/2" radius and shall be the same on both ends. All guy attachment vangs on all concrete poles will be 60,000 or 70,000 pound strength pole-eye plates mounted with 7/8" diameter all-thread rods, similar to those provided by Hughes Brothers in Lincoln, Nebraska.

8.1.1.8 Polymer Insulator Standard Drawing

Attachment 1 has detailed drawings of the Entergy Standard Insulator drawings for 115 kV, 138 kV, 161 kV and 230 kV voltages. Seller shall use the Entergy Standard Insulators and must verify they meet the requirements for the design. The drawing includes the following information:

Braced Post Insulators

Horizontal Line Post Insulators

Suspension Insulators

Dead-End Insulators

Minimum Flashover Characteristics

Minimum Leakage Distance

8.2 Transmission Line Lightning Protection Design

8.2.1 Reference Guides

IEEE Std. 1243-1997	Guide for Improving the Lightning Performance of Transmission Lines
EPRI	Handbook for Improving Overhead Transmission Line Lightning Performance

EPRI	AC Transmission Line Reference Book - 200kV and Above
EPRI	Guide for Transmission Line Grounding
EPRI	Outline of Guide for Application of Transmission Line Surge Arrestors – 42 to 765 kV

Where applicable Seller shall apply the following parameters during the design process.

8.2.2 GFD

The GFD varies greatly throughout Entergy's transmission system and average from 2-7 flashes/Km^2/yr. However, the GFD for any area for a particular year can be more than 3X the historic average. Therefore, Entergy's design parameters do not consider the GFD for the specific line but assume the standard design methods will ensure an adequate reliability throughout the system no matter the GFD of any particular location.

8.2.3 Structure BIL

Although local atmospheric conditions can affect the ability of air to insulate against a flashover the typical breakdown rate for a negative dry arc is 650 kV per meter. Therefore, the structure BIL is 650 kV X air gap in meters.

It is very difficult to maintain an acceptable BIL for distribution circuits on a transmission line structure. In order to maintain acceptable lightning performance when attached to tall shielded transmission structures, fiberglass arms and transmission class insulators are required.

Distribution underbuild is considered a last resort for new construction. It complicates maintenance for both organizations.

8.2.4 Shield Wire Installation

The installation of a shield wire is the required method of lightning protection.

8.2.5 Shield Wire Type and Size

The size and type of shield wire used will be determined by needs other than that required for lightning protection, such as fault current. Any of Entergy's standard shield wires conforming to the parameters set out in the referenced guideline will be adequate for the lightning protection of the line. Note: Supporting distribution phases on transmission structures exposes transmission shield wire to long duration distribution faults for which it was not designed. Therefore, a neutral conductor shall be bonded to each transmission structure.

8.2.6 Shielding Angle

The shielding angle, as measured at the structure from the vertical plane of the shield wire clamp to the conductor clamp, shall be no more than 25° for structures adjacent to spans averaging less than 150 feet above ground level. The required shielding angle on structures where the average conductor height is greater than 150 feet above ground level need to be designed on a case by case basis and shall be subject to approval from Buyer. The average height taken as the height at the structure minus 2/3 the sag.

On single pole structures with one shield wire, the shielding angle shall be checked to the top conductor as well as to the bottom conductor opposite the shield wire attachment.

On H-type structures, the shielding angle shall be checked for each shield wire to its corresponding outer conductor. Unless the distance between the shield wires exceeds 60 feet, the shielding angle to the middle conductor is not considered.

8.2.7 Maximum Grounding Resistance

The maximum allowable grounding resistance shall be obtained as specified in Section 8.3.

8.2.8 Lightning Arrestors

Lightning arrestors shall be used on transmission lines only in cases where a shield wire cannot be installed (e.g., clearance near an airport), the maximum allowable grounding resistance cannot be obtained, or adjacent to extremely long spans where the lightning protection software shows the shield wire is insufficient.

8.3 Grounding and Cathodic Protection

This section covers the design of the grounding and cathodic protection systems for concrete and steel structures for transmission lines.

8.3.1 Grounding

8.3.1.1 Grounding Systems

Entergy's steel and concrete pole structures shall be "effectively grounded" as defined in Section 2 of the NESC. Shield wires are constructed, along with the associated grounding system, on all of Entergy's transmission lines for lightening protection. The use of proper structure grounding will reduce the ground resistance at the structures and will reduce line outages due to lightning strikes.

8.3.1.2 Steel Structure Grounding System

Steel poles shall be bonded to the shield wire by a copperweld jumper. The pole then acts as a ground rod to the ground line. Because the coating at the bottom of direct embedded steel poles insulates the steel, direct embedded poles shall be grounded. This grounding shall be done with ground rods driven into the earth and bonded to the pole. The same grounding is used to ground a steel pole bolted to a concrete pier or set in a concrete pile. Steel poles socketed into steel piles shall be bonded to the steel pile.

8.3.1.3 Concrete Structure Grounding System

Concrete poles shall be bonded to the shield wire through the grounding clip and a terminal lug at the pole top by a copperweld jumper. A copperweld wire shall then run down the pole to another terminal lug below ground. The wire may be internal or external. There are four options for grounding the direct buried pole: (1) connect the ground wire to the pancake at pole bottom; (2) extend the ground wire from the pancake to the ground rod; (3) connect the ground wire from the terminal directly to the ground rod; and (4) connect the ground to the substation ground grid using 4/0 copper. Ground wires shall be continuous (no splices).

For concrete poles set in steel piles, the ground wire shall be extended from the bottom lug and bonded to the pile.

8.3.1.4 Guy Wire Grounding System

In accordance with NESC requirements, guy wires shall be bonded directly to the steel structure or to the ground wire on a concrete structure using a copperweld wire bonded to the guy wire.

8.3.1.5 Achieving Desired Structure Resistance

Tests to verify that the required footing resistance has been obtained using the standard methods shall be performed by Seller.

Seller shall test for grounding resistance, which shall not be greater than:

69 kV & 115kV 13 ohms

138 kV & 161 kV 10 ohms

230 kV 7 ohms

345 kV & 500 kV (H-frames) 18 ohms

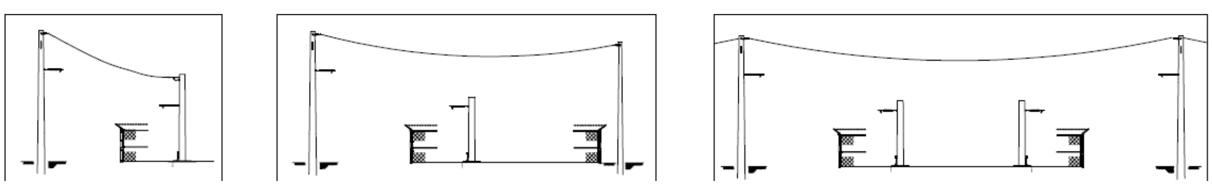
There are two acceptable methods to achieve these requirements: (1) driving additional rods and (2) installing a counterpoise that consists of 100 feet of conductor buried 18" deep parallel to the line.

8.3.1.6 Grounding at Substations

Bonding of Transmission Line Shield Wire to Substation Ground Grid

Electrical currents can be introduced on shield wires from a variety of sources. To prevent these currents from arcing across mechanical connections to get to the substation ground grid, a bonding conductor shall be provided.

The following common shielding configurations and requirements shall be permitted are detailed below:



a b c

a. Shield wire attached to Substation pull-off structure

Generally, the transmission line will be dead-ended outside the substation and the shield wire slack span into the station will be positively grounded to the pull-off tower with a jumper and the pull-off tower will be connected to the substation ground grid. It is the responsibility of the substation to make these connections. The last transmission structure in the immediate vicinity of the station shall not be bonded to the substation ground grid unless a specific grounding analysis is performed.

b. Shield wire across station to dedicated shield wire pole

Since the shield wire pole is usually installed within close proximity to the substation; it shall be bonded to the substation ground grid. The last transmission structure in the immediate vicinity of the station shall not be bonded to the station grid unless a specific grounding analysis is performed.

c. Shield wire across station to exiting transmission line structure

One of the transmission structures on either side of the station shall be bonded to the substation ground grid. The structure selected for bonding shall be the one closest to the station or having the fewest physical obstacles between the structure and the station.

8.3.2 Cathodic Protection

The cathodic protection system is a method of protecting steel transmission line structures from corrosion, generally at the ground-line where moisture can mix with air to cause corrosion and thus deterioration and loss of strength of the structures. The protection system used is to attach either magnesium or zinc anodes to the structure.

These anodes provide sacrificial protection for the steel in the structures.

8.3.2.1 Soil Investigations

The soil investigation shall include soil corrosion recommendations to determine the need for anodes and the number required for each structure.

8.3.2.2 Anode Types

Magnesium anodes shall be used except that, in areas such as coastal marshes, zinc anodes may be used where recommended over magnesium anodes by the corrosion engineer based on in-situ conditions

8.3.3 Structure Protection

Steel poles, steel piles and steel guy anchors shall be protected as described below.

8.3.3.1 Steel Dead-End and Guyed Structures

All buried steel (embed poles and piles) at dead-end and guyed steel structures shall be installed with anodes as shown on the Framing Drawings and provided Assembly Drawings. The number of anodes per structure shall be as recommended in the corrosion consultation report or as deemed necessary by the corrosion engineer based on in-situ conditions.

8.3.3.2 Steel Tangent Structures

Steel tangent structures are generally not installed with anodes, anodes shall be installed on structures in areas of known corrosion problems, or when structures are to be installed adjacent to a pipeline or railroad. In these cases, installation shall be in accordance with provided Assembly Drawings in Attachment 1.

Guy Anchors for Steel and Concrete Structures

The steel helix type anchors for both steel and concrete poles shall be installed with anodes.

9 STRUCTURE DESIGN CRITERIA

9.1 Steel Poles

Entergy standard structure framings are shown in Attachment **1**.

9.1.1 Tubular Steel Pole Purchase Specification

Details of structure design that shall be included in the purchase specification are:

ASCE Design Manual Requirements

Material Specifications

Pole Deflection Limitations

Fabrication Requirements

Protective Coating Requirements

Cathodic Protection

Grounding Requirements

Seller shall procure (or cause to be procured) tubular steel poles from tubular steel pole vendors on the Approved Vendor List (Attachment 5) for tubular steel pole vendors and direct the vendor to provide items in conformance with their applicable standard Energy specifications.

9.1.2 General Design Requirements

9.1.2.1 General

All designs shall be in accordance with the provisions of the latest NESC, ASCE/SEI Standard 48, and the requirements stated in this document. All construction shall be Grade B, as defined in Section 24 of the NESC Code.

9.1.2.2 Foundation Rotation

In addition to the applied loadings, all self-supported monopole and un-braced H-frame structures shall be designed with a 3 degree foundation rotation. The point of rotation is assumed to be at the ground line. Smaller foundation rotations for braced H-frame structures shall be considered on a case-by-case basis.

9.1.2.3 Deflection Limitations

The following pole deflection limitations assume 0 degree foundation rotation and shall be adhered to in the design of all poles. The percentage listed is the percent of the pole height above ground.

Table 9.1.2.3 – Deflection Limitations

Load Case / Wires	Tangent (Intact)	Running Angle (Intact)	Dead-end (Intact)	Dead-end (DE One Side)
NESC w/OLF See Loading District	10%	10%	10%	NSL
NESC without/OLF See Loading District	NSL	NSL	NSL	NSL
High Wind See Loading District	10%	10%	10%	NSL
Wind & Ice See Loading District	10%	10%	10%	NSL
Everyday No Wind or Ice - 60°F	3%(1)	3%(1)	3%(1)	NSL
Longitudinal Unbalance 1K at Each Phase Location	NSL	NSL	NA	NA
DE Stringing No Wind or Ice - 60°F	NA	NA	NA	1%(2)

NA - Not Applicable

NSL - No Specified Deflection Limit

(1) Camber if Deflection Exceeds 1%
(2) Only if Specifically Requested

9.1.2.4 Pole Raking

For new project construction, cambering the pole when deflection exceeds 1% of the pole height above ground is the required resolution to concerns arising from what might (aesthetically) appear to be excess pole deflection.

9.1.2.5 Guyed Structures – Pre-Designed

The Designer shall select a pre-designed light duty pole, such as an SW Class H-6 equivalent, to be used as the pole in guyed framings in the pole spotting procedure. This type of pole will make available the range of heights to complete the spotting process. PLS-CADD will select the optimal pole height.

9.1.2.6 Selection of Pre-designed Poles – Optimizing Process

To use the line optimization features PLS-CADD, the Designer must select and input the pre-designed pole types and framings most suited for the Transmission Lines. This shall include the material, framings and pole heights, types and sizes.

9.1.2.7 Pole Design and Verification Process

The purchase order for the structures selected by PLS-CADD during the optimization process is then forwarded to the pole vendor along with a calculated load tree for each pole. The vendor will then review the design of the selected poles before pricing and fabrication. In some cases the poles selected may have to be revised to meet the design criteria.

9.1.3 Procurement

To purchase the poles and associated materials, Seller shall use a type of purchase requisition known as a “White Requisition”.

“White Requisition” – This type of order is used to purchase material from Entergy’s preferred vendors including steel and concrete poles, insulators and conductors. The pole order will generally include the preferred item plus most of the assembly attachment material, such as nuts, bolts, vangs. It is the vendor’s responsibility to verify the size and number of each item. “White Requisitions” are also used to order non-stock-coded items.

9.1.4 Structure Hardware

The Entergy “Standard Structure Framings” in Attachment 1 lists the standard assemblies required for each structure framing. Each assembly drawing lists the bill of materials required for that assembly. The standard hardware parts were designed to meet the maximum tensions and loads calculated for the pre-designed structures previously described but shall be verified by the designer. Unless Buyer grants an exception in writing, poles shall be ordered with sufficient step bolt mounting provisions.

9.1.5 Grounding and Cathodic Protection

See Section 8.3 for design information regarding the required grounding and cathodic protection for steel poles.

9.1.6 Hybrid Structures

Hybrid structures, a combination of a steel top section and a concrete bottom section, shall be used where ground water conditions may cause excessive corrosion of a steel pole. For such structures, the concrete bottom piece shall directly embedded using standard embedment details. Foundation and grounding details are discussed in Section 10 and Section 8.3, respectively.

9.2 Concrete Poles

This section covers the design and analysis of concrete pole structures for single and bundled conductor transmission lines. It covers single pole, two pole, and three pole structures with direct-embedded foundations, socket-type foundations and base-plated foundations all for use on tangent, running angle or dead-end structures. All standard structure framings applicable to this work are delineated in Attachment **1**.

9.2.1 Spun Pre-stressed Concrete Pole Purchase Specification

Details of structure design that shall be included in the purchase specification include:

ASCE and PCI Design Guide Requirements

Material Specifications Pole Deflection Limitations

Fabrication Requirements

Testing Requirements.

Seller shall select a concrete pole vendor from the list of concrete pole vendors set forth in the Approved Vendor List (Attachment 5) and direct the concrete pole vendor to provide items in conformance with their applicable standard Entergy specifications.

9.2.2 General Design Requirements

9.2.2.1 General

All concrete pole and related designs shall be in accordance with the provisions of the latest NESC, the PCI and ASCE Guide Specifications, and the requirements stated in this document. All concrete pole construction shall be at least Grade B, as defined in Section 24 of the NESC Code.

9.2.2.2 Foundation Rotation

In addition to the applied loadings, all self-supporting structures shall be designed with a 3 degree foundation rotation. The point of rotation shall be assumed to be at the ground line.

9.2.2.3 Deflection Limitations

The following pole deflection limitations assume 0 degree foundation rotation and shall be adhered to in the design of all concrete poles. The percentage listed is the percent of the pole height above ground.

Load Case / Wires	*Concrete Structure Type*			
	Tangent	Running Angle	Dead-end	Dead-end
	(Intact)	(Intact)	(Intact)	(DE One Side)
NESC w/OLF See Loading District	10%	10%	10%	NSL
NESC without/OLF See Loading District	2%	2%	2%	NSL
High Wind See Loading District	10%	10%	10%	NSL
Wind & Ice See Loading District	10%	10%	10%	NSL
Everyday No Wind or Ice - 60°F	1%	1%	1%	NSL
Longitudinal Unbalance 1K at Each Phase Location	NSL	NSL	NA	NA

Load Case / Wires	*Concrete Structure Type*			
	Tangent	Running Angle	Dead-end	Dead-end
	(Intact)	(Intact)	(Intact)	(DE One Side)
DE Stringing No Wind or Ice - 60°F	NA	NA	NA	1%

NA - Not Applicable

NSL - No Specified Deflection Limit

9.2.2.4 Pole Raking

Where deflections under the everyday load case exceed 1% of the above ground pole height as described in Section 9.2.2.3, but do not exceed 2% the pole shall be raked to improve aesthetic concerns and minimize secondary moment effects. Where poles are to be raked, the Designer shall provide specific instructions identifying the degree to which the pole shall be raked to compensate for the calculated deflection under the everyday load case.

9.2.3 Procurement

To purchase the poles and associated materials, Seller shall use a type of purchase requisition known as a "White Requisition".

"White Requisition" – This type of order is used to purchase material from Entergy's preferred vendors, including steel and concrete poles, insulators and conductors. The pole order will generally include the poles plus most of the assembly attachment material, such as nuts, bolts, vangs. It is the vendor's responsibility to verify the size and number of each item.

9.2.4 Structure Hardware

The applicable Entergy "Standard Structure Framings" included as Attachment **1** lists the standard assemblies required for each structure framing. Each assembly drawing lists the Bill of Materials required for that assembly. The standard hardware parts are designed to meet the maximum tensions and loads calculated for the pre-designed structures previously described. Unless a deviation is granted by Buyer, poles shall be ordered by Seller with sufficient mounting locations for attachment of climbing provisions.

9.3 H-Frame Design

This section covers the design of concrete and steel H-Frame structures to be used in construction of the Transmission Lines. These standard framings cover transmission structures for single and double circuit construction using standard suspension insulators. Clearance has been provided for the possible use of bundled conductors.

9.3.1 Structure Types

Standard framings are developed for single and double circuit “Light” and “Medium” (HA2) tangent (0° – 1.5°) structures and “Light” and “Medium” (HB2) small angle (1.5° – 6.0°) structures. Standard tubular steel cross arms have been pre-designed and detailed for use in “Light” and “Medium” structures.

The standard framings are based on the base assumption that steel structures will be X-braced and concrete structures will not be X-braced. The pole supplier shall determine if X-braces are required for each structure and shall detail and supply the X-braces and connection hardware if required.

Special “Uplift” framings are included for use in certain structures to address uplift forces in those structures. These structures use the “Light” cross arms with extra vangs to dead-end the conductors.

9.3.2 Cross Arm Design

The maximum allowable spans for the pre-designed standard cross arms are based on the maximum vertical load imposed on the arms. The load cases reviewed for each cross arm are NESC designated loadings with overload factors. Maximum arm deflections range from 1 inch to 2 inches.

The tubular steel cross arms are designed to support the vertical load of the various standard conductors used by Entergy on the standard H-Frame framings. The maximum loads for each of the Standard Framings are shown on the Framing Drawings.

The “Light” and “Medium” standard cross arm sizes are as follows:

Light Cross Arm – TS 6” x 6” x 3/16”

Medium Cross Arm – TS 8” x 8” x ¼”

Shield Wire Arm – TS 4” x 4” x 3/16”

The required use (loading) for the standard cross arms is as follows:

69 kV – Use the Light Cross Arm – for all conditions

161 kV – Use the Light Cross Arm – for ½” Ice loadings

Use the Medium Cross Arm – for 1” Ice loadings

230 kV – Use the Medium Cross Arm for all conditions

9.3.3 Cross Arm Assembly Details

The assembly drawings for attaching cross arms to poles are included in the voltage specific assemblies.

9.3.4 Rock Anchors

In rock formations, where screw type anchors will not penetrate the rock, rock anchors shall be used. There are two types of rock anchors available, to be selected based on in-situ conditions and engineering calculations.

9.3.5 Expanding Rock Anchors

Rods have a diameter of 1.0 inch and an ultimate strength of 36,000 lbs. The limitation of 36,000 lbs can be overcome by using twin anchors. A more stringent limitation is that the rods are non-extendable. This prevents the expanding rock anchors from being used when the non-fractured bedrock is deeper than about four feet below the surface.

9.3.6 Grouted Rock Anchors

The anchors have a 1 ¼ inch diameter round shaft ending in a 4-inch diameter bell. The anchors can be extended with either 1 ¼" round shaft extensions or 1 ½" square shaft extensions. The anchor assembly has an ultimate strength of 70,000 lbs. The strength of the installed anchor (resistance to pullout) is dependent upon the rock type and the dimensions of the grout column. The characteristic of the rock that dominates the calculation for anchor depth is the equivalent cohesion. The installed anchor strength is calculated by multiplying the surface area of the grout column in each layer by the equivalent cohesion of the rock in that layer. For conservatism, any contribution from the overburden shall be ignored.

The High Wind and Heavy Ice Tensions shall be multiplied by 1.65 to provide a safety factor for the anchor installation. For the NESC Zone load case (NESC 250B) a safety factor of 1.0 shall be used as allowed by the code, since that load case already includes an Overload Factor of 1.65. The resulting worst case force shall be resisted by the friction between the grout column and the surrounding rock.

Anchor strength = (circumference) (column length per vertical foot) (constant of 0.9) [(layer 1 thickness)(layer 1 cohesion) + (layer 2 thickness)(layer 2 cohesion) + …]

Seller shall procure that the anchor manufacturer calculates the required anchor depth using their software, but the effective cohesion shall be the parameter that dominates the result. For simplicity, the formula above uses just the effective cohesion. The constant 0.9 is a factor to account for the possible effects of other rock characteristics

The dimension that is to be specified is the distance along the anchor shaft from the ground surface to the bottom of the anchor. The minimum anchor length engaging rock is five feet.

The grout shall be pumped into the hole to ensure that a solid column is produced.

9.3.7 Guying Hardware

Following are listed the strength values in Entergy's Standard Guying Assembly which limit line conductor tensions and are required for this Project.

9.3.7.1 Insulator Assembly

Entergy's Standard Polymer Dead-End Insulators have an ultimate tension capacity of 50,000 lbs. The NESC Strength Factor for insulators is 0.5, therefore the Routine Test Load (RTL or working load) of 25,000 lbs is used.

9.3.7.2 Steel Vangs (Steel Poles)

Steel Dead-End vangs are thru vangs and can be designed for any applied tensions. The NESC Strength Factor for the vangs is 1.0.

9.3.7.3 Pole Eye Plates for Conductor or Shield Wire (Concrete Poles)

The standard guying attachment is the "AS2720 Double Guying Tee" from Hughes Bros. The Ultimate Strength (maximum tension load) is 35,000 lbs per hole. The NESC Strength Factor is 1.0 for NESC Rule 250B Tensions (OLF=1.65) and 0.8 for Extreme Load Tensions (OLF=1.0) for Rule 250C.

9.3.7.4 Pole Eye Plates for Guy Wire (Concrete Poles)

The standard guying attachment is the "A2132 Heavy Dead End Tee" from Hughes Bros. The Ultimate Strength (maximum tension load) is 70,000 lbs. The Strength Factors are the same as for the above "Double Guying Tee". The maximum tension is along the guy slope, thus limiting the line tension depending on the actual guy slope.

9.3.7.5 Double Arming Bolts (Concrete Poles)

The standard bolt used in Entergy's Dead-End Assemblies is an ANSI C135.1, 7/8" "Double Arming Bolt". The maximum Tensile Strength is 25,400 lbs, the maximum shear strength through threads is 17,270 lbs. and the maximum shear strength through the shaft is 24,350 lbs. The shear strength through the threads is always used for the Dead-End Connection. The NESC Strength Factors are also the same as for the "Double Guying Tee". The allowable bolt strength for combination shear and tension loads, such as the guying assembly, is the calculated "interaction stress". These bolts are the limiting factor, depending on guy slope, of the line tension in the guying assembly.

9.3.7.6 Thimble Clevis

The thimble clevis used in the Dead-End Assembly has a 1" pin and is rated at 60,000 lbs. Ultimate Strength. The NESC Strength Factors are the same as the "Double Guying Tee".

9.3.7.7 Extension Link

The extension link is used in place of the thimble clevis when a double down-guy is used with two anchors. The link uses a 1" pin and is rated at 60,000 lbs. Ultimate Strength. The NESC Strength Factors are the same as the "Double Guying Tee".

9.3.7.8 Vari-Grip Dead-End

The vari-grip shall be rated for a 19#8 guy wire with an Ultimate Strength of 43,240 lbs. and 61,500 lbs. with a 19#6 guy wire. The NESC Strength Factor is 1.0.

9.3.7.9 Turnbuckle

The turnbuckle shall be a 1” x 6” with jaw and eye ends with an Ultimate Strength of 50,000 lbs. The NESC Strength Factor is 1.0.

The following table gives the allowable line tension based on the guy assembly and guy wire slopes. All loads are in Kips.

Table 9.3.7.9 – Allowable Line Tensions based on Hardware Limitations

Assembly Part	Ultimate Strength	NESC Strength Factor	Allowable Load	Line Tension Guy Slope 1.5:1	Line Tension Guy Slope 1:1
Dead-End Insulator	50.0	0.5	25	25	25
19#8 Guys	43.2	0.9	38.9	21.6	30.6
19#6 Guys	61.7	0.9	55.5	30.8	39.4
Double Guy Tee (NESC)	35.0	1.0	35.0	19.4	24.8
Extreme Loads	35.0	0.8	28.0	15.5	19.9
Dead-End Tee (NESC)	70.0	1.0	70.0	38.9	49.6
Extreme Loads	70.0	0.8	56.0	31.1	39.7
7/8” D. A. Bolt (NESC)	T=25.4	1.0		21.2	28.0
Extreme Loads	V=17.3	0.8		17.0	23.0
1-1/2” SS Screw Anchor	70.0	1.0	70.0	38.9	49.6
Thimble Clevis (NESC)	60.0	1.0	60.0	33.3	42.5
Extreme Loads	60.0	0.8	48.0	26.7	34.0
Vari-Grip (NESC) w/ 19#8	43.2	1.0	43.2	24.0	30.6
Extreme Loads	43.2	0.8	34.6	19.2	24.5
Turnbuckle (NESC)	50.0	1.0	50.0	27.8	35.5
Extreme Loads	50.0	0.8	40.0	22.2	28.4
Extension Link (NESC)		1.0			
Extreme Loads		0.8			

9.3.8 Guyed Structure Limitations

9.3.8.1 Concrete Structures

The maximum line tension that can be applied on a guyed concrete structure is limited by the combined stress on the 7/8" D. A. Bolts, where the maximum guy tension is 18.0 kips on the 1.5:1 slope. The governing design condition, which is considerably less than the ultimate applied tensions that shall be applied on the larger standard conductors for the Hurricane loads (150 mph wind speed.).

9.3.8.2 Steel Structures

Welded steel thru vangs replace the tees and bolts on the concrete pole and these vangs shall be designed to support all of the possible applied loads. Therefore, as provided in the table, the 19#8 guys, the standard guy material, will govern the line tension limit when this guy wire is used. Where 19#6 guys are used, the anchor hardware will govern the line tension limit.

9.3.8.3 Heavy Ice Zone

In the heavy ice zones (NESC 250D zones), standard through bolts, guy tees and single 19#8 guy wire may be inadequate for larger conductors or bundled configurations. Special design considerations shall be investigated under these conditions.

9.3.8.4 Double Down-guy Assemblies

Double down-guy assemblies shall be used when it is determined that the soil is incapable of supporting the applied load with one anchor or where the loads exceed the allowable guy tension. The double down guy assembly shall consist of one attachment to the pole, a link with two rollers, and two guy wires and two anchors. Double Down-guy assemblies shall use 19#8 guy wires. The anchors shall be separated by at least five (5) feet.

9.3.8.5 Guy Anchor Groups

All standard guyed structure framings reference a particular Guy/Anchor Group which defines the structure voltage, and in turn provides the required number and size of guys, type of anchor, guy configuration and structure type.

9.3.8.6 Cathodic protection

Guy anchor assemblies shall be provided with cathodic protection by the installation of anodes.

Guy anchor assemblies shall be protected by anodes as shown on the "Guy Anchor Group" detail drawings. Refer to Section 8.3 for details.

9.4 Spacing of Dead-End Structures

Dead-end structures shall be required where necessary to carry eccentric loads developed due to conductor tensions. Such dead-end structures shall also be required where necessary as anti-cascading structures, or where they are necessary to facilitate construction. At a maximum spacing, dead-end structure shall be spaced such that no more than two reels of conductor and a single splice are needed between them. While the length of conductor contained on a reel can vary based on the conductor's diameter and unit weight, for most commonly used conductors this will result in a maximum spacing of approximately 4 miles between dead-end structures.

9.5 Considerations at Major Crossings

The Transmission Lines shall be designed to provide additional reliability at major crossings, in particular along major highway crossings serving as evacuation routes from coastal area. Design and maintenance/replacement activities will apply the following:

1. All crossing structures are non-wood, for all voltages

2. If a wood crossing structure is to be replaced, it shall be replaced with non-wood structure

3. All highways are crossed at an angle as close to perpendicular as possible

4. No conductor or shield wire splices within two spans of the crossing span unless expressly approved in writing by Buyer

5. Where conductor/shield wire splices are unavoidable, or where they are installed during conductor maintenance, install implosive, full tension splices or shunt devices in conjunction with the conventional splice.

6. Install redundant insulator configurations on all crossings (e.g., braced post insulators, V-string insulators, semi-strain insulators, etc.)

7. Make shield wire connections more robust at the crossings (e.g., use shackles with nut, vs. shackles with pins, etc.)

8. No guys on crossing structures if possible, and where guys shall be installed, install double guys

9. Install highway crossing structures in locations difficult for vehicles to hit, e.g. behind ditches

10. Provide crash barriers on all highway crossing structures that are not installed in locations difficult for vehicles to hit

10 STRUCTURE FOUNDATIONS

This section covers the design of structure foundations.

Structure foundations shall be designed to meet the NESC District Loading and Everyday Load Cases, as discussed in Section 5.1; and considering the safety factors and deflection limitations discussed in Section 10.2. Note that loads shall generally be extracted from pole manufacturer calculations where the structure has been optimized for a high percentage of utilization. Where structures are designed in groups, the reaction used shall be that of the group (as opposed to loads derived from PLS or elsewhere for the specific location). Where manufacturer calculations are not available, foundations shall be designed for the published class/capacity of the pole used (to assure that future modifications on the line do not overestimate the foundation capacity based on the strength of the pole). Where this is not done, a notation shall be made on the plan and profile sheet stating that the foundation was determined considering actual loads in lieu of the structure's capacity.

10.1 Soil Information

The Designer shall obtain as much subsurface information as practicable. The basic sources of information are: (1) actual soil boring samples obtained from geotechnical investigations; (2) Geological maps; (3) data from existing U.S. Dept. of Agriculture maps; or (4) other Geotechnical sources (e. g., DOT files, customer soil records, etc.)

Actual soil data obtained from structure locations is preferable. Generally, soil borings are made at angle and dead-end structures and at intervals of approximately two miles within tangent runs depending on the terrain.

Soil information used in design shall be provided by Seller to Buyer.

10.2 Design Methodology – Lateral Load

10.2.1 Program Description

The Designer shall use the computer programs Moment Foundation Analysis and Design (MFAD), and Foundation Analysis and Design (FAD) to design for lateral loads.

10.2.2 General Acceptance Criteria

The Designer shall apply the following generally accepted factors of safety for the calculated lateral loads as related to the calculated ultimate capacity of the pile and the acceptable deflection and rotation of the pile:

Description	**Normal Soil**
Total Ground Line Deflection (1)	3.0 in.
Total Fnd. Rotation (1)	1.5 deg.
Non Recoverable Deflection	1.0 in.
Non Recoverable Rotation	1.0 deg.
Safety Factor (Tangents)	1.2
Safety Factor (Angles/DEs) NESC 250B	1.0
Safety Factor (Angles/DEs) other load cases	1.65

(1) Additionally, for DE Structures, total foundation rotation and ground-line deflection shall be limited to 0.5 degrees and 1 inch under Everyday load case with all conductors on one side only.

10.3 Foundation Types

10.3.1 Basic Foundation Types

The Designer shall select from the following six basic foundation types typically used by Entergy on steel and concrete pole structures: Direct Embedment Foundation, Steel Pile with Socket Foundation, Cap/Base Plate Foundation, Steel Pile with Anchor Bolt Foundation, Drilled Pier with Anchor Bolts Foundation, and Concrete Pile with Steel or Concrete Pole using Socket Foundation. Seller's foundation engineer shall determine suitable foundation types and dimensions. Alternative foundation types shall only be used if expressly approved in writing by Buyer.

Foundation elements shall be designed using applicable material design specifications (e.g. AISC 360 for steel elements, ACI 318 for concrete elements, etc.)

Reveal height for concrete or steel socket piles shall be between 4 feet and 5 feet to facilitate concrete placement and to minimize required excavation for the socketed pole. Foundation height for base-plated poles shall be at least 2 feet, to raise anchor bolts above the ground and the bulk of the wet underbrush. The Designer shall require taller reveals in floodplains, where requested for constructability purposes, or where otherwise needed. The Designer shall not all reveals outside these specifications on the foundation drawings and/or staking sheet.

10.3.2 Grounding and Cathodic Protection

The steel pile shall be designed to act as a ground for both steel and concrete structures. Socket connections and anchor bolt connections using steel piles shall be positively connected between the pole and pile using a #4 copperweld wire connected between the pole and the Two Hole NEMA Pad welded to the pile for a good ground. The cap/base plated connections shall be designed to provide a good grounded connection. Steel and concrete poles supported by concrete drilled piers shall be grounded to copperclad steel ground rods.

Where cathodic protection is required, the anodes shall be connected to the NEMA Pads as indicated on the cathodic protection detailed drawings. In general, unless an analysis for corrosion potential indicates otherwise or the structure is located in exposed bedrock, anodes will be required at all guy anchors, and dead-end or large angle structures supported on steel foundations or embedments. In general, unless local conditions warrant (brackish marsh, shared ROW with railroads or pipelines protected by impressed current cathodic protection, etc.) anodes are not usually required for tangent structures on structures supported on concrete foundations or embedments. Reference is made to Section 8.3 of this Appendix 2.

11 ATTACHMENTS

Attachment 1 – Applicable Standard Framing and Assembly Drawings

Attachment 2 – NESC and Entergy Clearance Requirements

Attachment 3 – Quick Estimating Corona Loss Curves

Attachment 4 – Example ROW

Attachment 5 – Approved Vendor List[1]

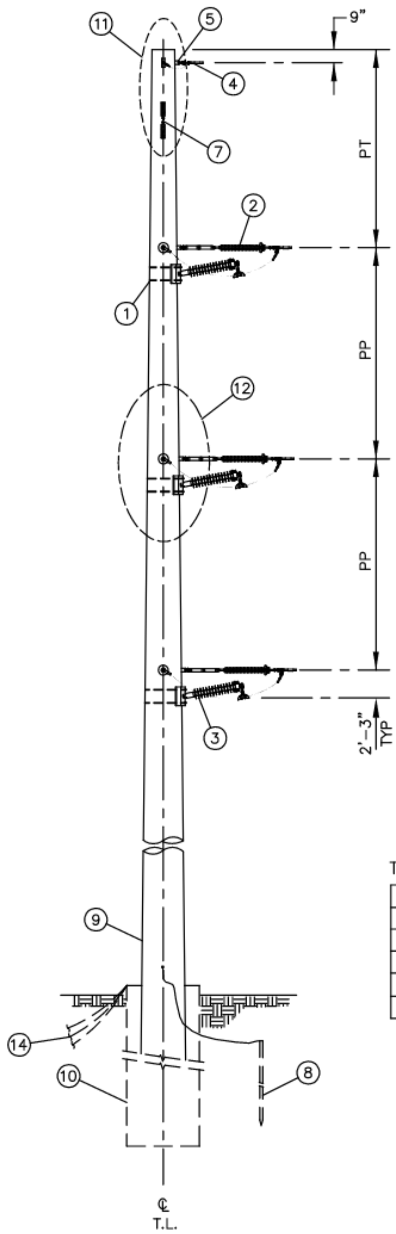
Attachment 6 – Entergy Loading Districts

1 This Attachment provides an Approved Vendor List. This Approved Vendor List is in addition to that found in the Scope Book and is considered acceptable for use, and actually preferred.

ATTACHMENT 1

APPLICABLE STANDARD FRAMING AND ASSEMBLY DRAWINGS

0"–5", SELF SUPPORTING, DE, JUMPER, VERTICAL,
SINGLE CIRCUIT, DE POLYMER, CONC



ASSEMBLY LIST

ITEM	QTY.	ASSEMBLY/DRAWING
1	3	BLT–P–C
2	6	INSUL (SEE TABLE 1)
3	3	INSUL2 (SEE TABLE 1)
4	2	OHG–DE–XX
5	4	TEE–B–B
REFERENCE DRAWINGS		
7	1	SGN–C
8	–	GND–C–XX
9	–	SEE MFR. DWG.
10	1	FOUNDATION TYPE T.B.D.
11	1	OHGCFG, SHT1, DET. OD
12	3	CONCFG, SHT11, DET. CJ3
13	–	PVO, SHT 1, VW PV–19
14	–	ANODE–XX (IF REQD.)

TABLE 1

VARIABLE DIMENSIONS & REF. DWGS.			
	69 kV	161 kV	230 kV
PT	10'–6"	13'–0"	15'–0"
PP	9'–0"	14'–0"	16'–0"
INSUL	DEP/TRB–69–XX	DEP/TRB–161–XX	DEP/TRB–230–XX
INSUL2	JLP–69–XX	JLP–161–XX	JLP–230–XX

NOTES:
1. For General Notes, See Dwg. TMS220.

SDJA–V–DEP–C

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
0–5° SC S. SPPT. DE, DEP W/J, CONC
STRUCTURE DRAWING & DETAIL

STD NO. | SCALE: NONE

Entergy

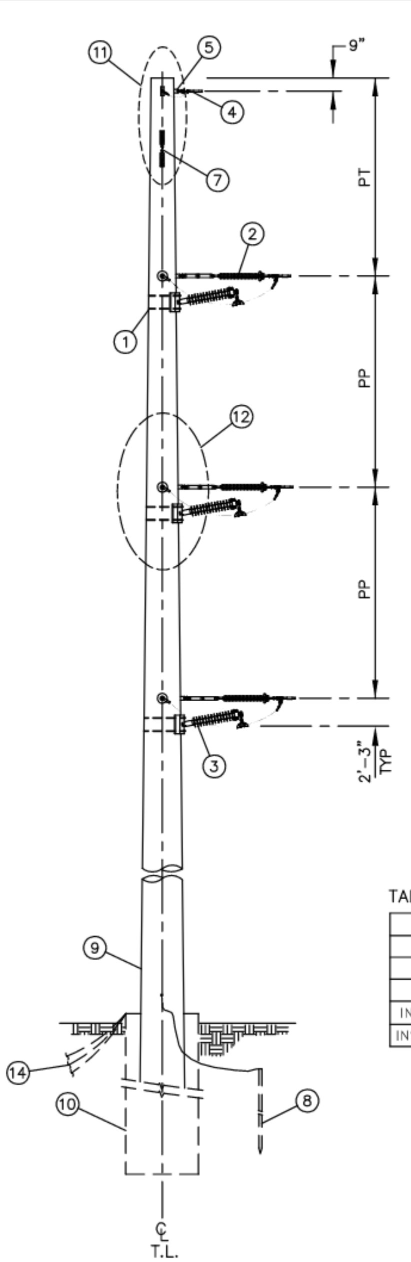
No. TMS627A0

PLOT 1=1 | SH. 1 OF 1

NO.	DATE:	REVISION	BY:	CHK:	APPR:
0	01–02–16	REPLACES DWS TAS525A0, TCS626A1, & TDS556A1	WRK	KC	ECW

rkugl90 12/2/2015 SDJA–V–DEP–C

5°–70°, SELF SUPPORTING, DE, JUMPER, VERTICAL,
SINGLE CIRCUIT, DE POLYMER, CONC



ASSEMBLY LIST		
ITEM	QTY.	ASSEMBLY/DRAWING
1	3	BLT–P–C
2	6	INSUL (SEE TABLE 1)
3	3	INSUL2 (SEE TABLE 1)
4	2	OHG–DE–XX
5	8	TEE–B
REFERENCE DRAWINGS		
7	1	SGN–C
8	–	GND–C–XX
9	–	SEE MFR. DWG.
10	1	FOUNDATION TYPE T.B.D.
11	1	OHGCFG, SHT2, DET. OF
12	3	CONCFG, SHT2, DET. CJ
13	–	PVO, SHT 1, VW PV–19
14	–	ANODE–XX (IF REQD.)

TABLE 1

	VARIABLE DIMENSIONS & REF. DWGS.		
	69 kV	161 kV	230 kV
PT	10'–6"	13'–0"	15'–0"
PP	9'–0"	14'–0"	16'–0"
INSUL	DEP/TRB–69–XX	DEP/TRB–161–XX	DEP/TRB–230–XX
INSUL2	JLP–69–XX	JLP–161–XX	JLP–230–XX

NOTES:
1. For General Notes, See Dwg. TMS220.

SDJ–V–DEP–C

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
5–70° SC S. SPPT. DE, DEP W/J, CONC
STRUCTURE DRAWING & DETAIL

STD NO. | SCALE: NONE

No. TMS626A0

Entergy | PLOT 1=1 | SH. 1 OF 1

NO.	DATE:	REVISION	BY:	CHK:	APPR:
0	01–02–16	REPLACES DWS TAS286A2, TCS298A3, & TDS298A3	WRK	KC	ECW

rkugl90 12/2/2015 SDJ–V–DEP–C

70°–120°, SELF SUPPORTING, DE, VERTICAL,
SINGLE CIRCUIT, DE POLMER, CONC

ASSEMBLY LIST		
ITEM	QTY.	ASSEMBLY/DRAWING
1	6	INSUL (SEE TABLE 1)
2	2	OHG–DE–XX
3	8	TEE–B
REFERENCE DRAWINGS		
7	1	SGN–C
8	–	GND–C–XX
9	–	SEE MFR. DWG.
10	1	FOUNDATION TYPE T.B.D.
11	1	OHGCFG, SHT2, DET. OF
12	3	CONCFG, SHT1, DET. CC
13	–	PVO, SHT2, VW PV–15
14	–	ANODE–XX (IF REQD.)

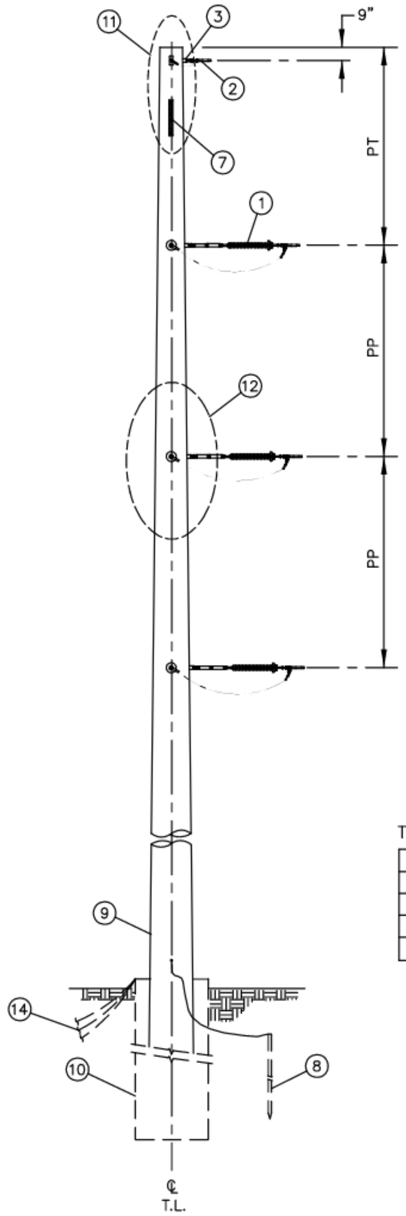


TABLE 1

VARIABLE DIMENSIONS & REF. DWGS.			
	69 kV	161 kV	230 kV
PT	10'–6"	13'–0"	15'–0"
PP	9'–0"	14'–0"	16'–0"
INSUL	DEP/TRB–69–XX	DEP/TRB–161–XX	DEP/TRB–230–XX

NOTES:
1. For General Notes, See Dwg. TMS220.

SD–V–DEP–C

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
70–120° SC S. SPPT. DE, DEP, CONC
STRUCTURE DRAWING & DETAIL

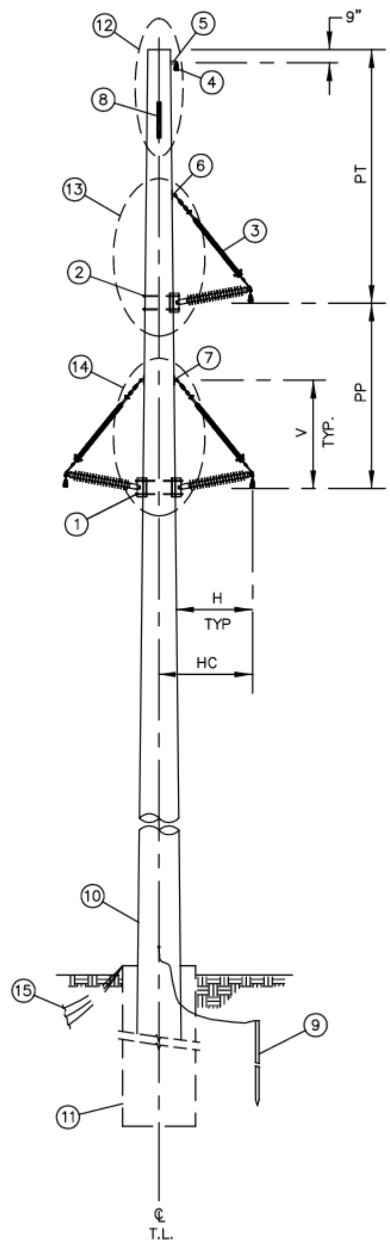
STD NO. | SCALE: NONE

Entergy | No. TMS625A0 | PLOT 1=1 | SH. 1 OF 1

NO.	DATE:	REVISION	BY:	CHK:	APPR:
0	01–02–16	REPLACES DWS TAS288A1, TCS300A2, & TDS300A2	WRK	KC	ECW

rkugl90 12/2/2015 SD–V–DEP–C

0°–1.5°, DELTA, SINGLE CIRCUIT, BRACED POST 2–1/2", CONC.



ASSEMBLY LIST

ITEM	QTY.	ASSEMBLY/DRAWING
1	1	BLT–2P–C
2	1	BLT–P–C
3	3	INSUL (SEE TABLE 1)
4	1	OHG–SUS–XX
5	1	TEE–OHG–SUS
6	1	TEE–B
7	1	TEE–B–B
REFERENCE DRAWINGS		
8	1	SGN–C
9	–	GND–C–XX
10	–	SEE MFR. DWG.
11	1	FOUNDATION TYPE T.B.D.
12	1	OHGCFG, SHT1, DET. OA
13	1	CONCFG, SHT3, DET. CR
14	1	CONCFG, SHT3, DET. CQ
15	–	ANODE–XX (IF REQD.)

NOTES:

1) For General Notes, See Dwg. TMS220.

TABLE 1

VARIABLE DIMENSIONS & REF. DWGS.			
	69 kV	161 kV	230 kV
PT	10'–6"	15'–0"	19'–0"
PP	8'–0"	13'–0"	14'–0"
V	6'–8"	8'–6"	9'–10"
H	5'–0"	6'–4"	7'–10"
HC	6'–0"	7'–2"	9'–0"
INSUL	BP2–69–XX	BP2–161–XX	BP2–230–XX

A–D–BP2–C

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
0–1.5° SC Delta, BP2, Conc
STRUCTURE DRAWING & DETAIL

STD NO.	SCALE: 1"=1"	
Entergy	No. TMS236A0	
	PLOT 1=1	SH. 1 OF 1

NO.	DATE:	REVISION	BY:	CHK:	APPR
0	01–02–16	REPLACES DWS TAS402A1, TCS459A2, & TDS200A2	WRK	KC	ECW

rkugl90 12/8/2015 A–D–BP2–C

6'–20', SELF SUPPORTING, VERTICAL, SINGLE CIRCUIT,
BRACED POST 2–1/2", CONC

ASSEMBLY LIST		
ITEM	QTY.	ASSEMBLY/DRAWING
1	3	BLT–P–C
2	3	INSUL (SEE TABLE 1)
3	1	OHG–SUS–XX
4	1	TEE–OHG–SUS
5	3	TEE–B
6		
REFERENCE DRAWINGS		
7	1	SGN–C
8	–	GND–C–XX
9	–	SEE MFR. DWG.
10	1	FOUNDATION TYPE T.B.D.
11	1	OHGCFG, SHT1, DET. OA
12	3	CONCFG, SHT3, DET. CR
13	–	ANODE–XX (IF REQD.)

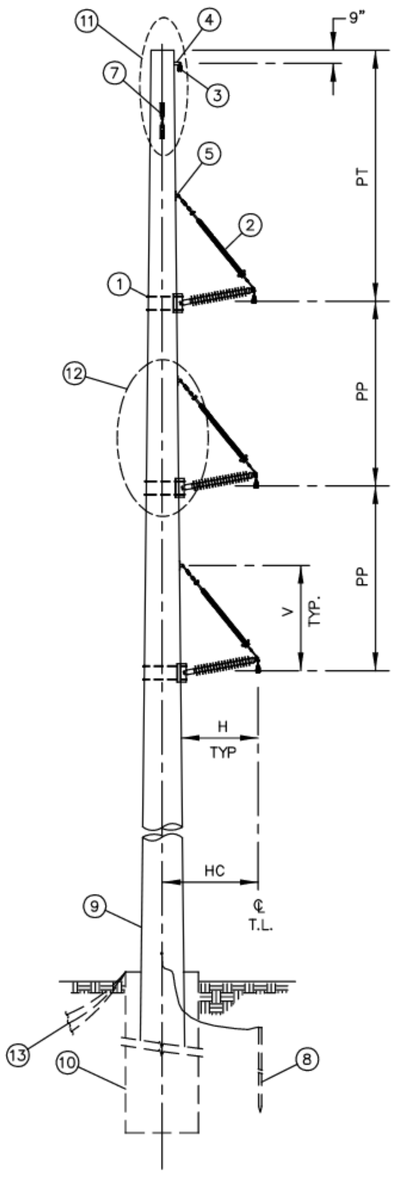


TABLE 1

VARIABLE DIMENSIONS & REF. DWGS.			
	69 kV	161 kV	230 kV
PT	10'–6"	15'–0"	19'–0"
PP	8'–0"	13'–0"	14'–0"
V	6'–8"	8'–6"	9'–10"
H	5'–0"	6'–4"	7'–10"
HC	6'–0"	7'–2"	9'–0"
INSUL	BP2–69–XX	BP2–161–XX	BP2–230–XX

NOTES:
1. For General Notes, See Dwg. TMS220.
2. Line post adapters are required where line angles greater than 3°, or phase transitions pull suspension hardward toward the pole. See Dwg. TMD415 for additional materials.

SC–V–BP2–C

ENTERGY SERVICES, INC.

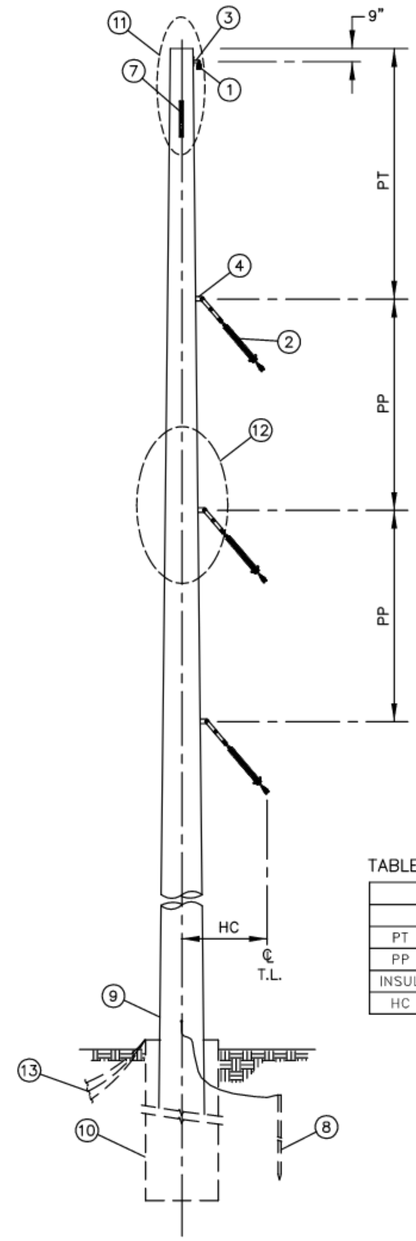
Transmission LineDesign Standard
6–20' SC VERT, BP2, CONC
STRUCTURE DRAWING & DETAIL

STD NO.	SCALE: NONE
No. TMS588A0	
PLOT 1=1	SH. 1 OF 1

NO.	DATE:	REVISION	BY:	CHK:	APPR
0	01–02–16	REPLACES DWS TAS458A0, TCS285A2, & TDS283A2	WRK	KC	ECW

rkugl90 12/2/2015 SC–V–BP2–C

15'–30', SELF SUPPORTING SUSPENSION, VERTICAL,
SINGLE CIRCUIT, SUSPENSION HEAVY POLYMER w/LINK, CONC.



ASSEMBLY LIST

ITEM	QTY.	ASSEMBLY/DRAWING
1	1	OHG–SUS–XX
2	3	INSUL (SEE TABLE 1)
3	1	TEE–OHG–SUS
4	3	TEE–B
5		
6		
REFERENCE DRAWINGS		
7	1	SGN–C
8	–	GND–C–XX
9	–	SEE MFR. DWG.
10	1	FOUNDATION TYPE T.B.D.
11	1	OHGCFG, SHT1, DET. OA
12	3	CONCFG, SHT1, DET. CA
13	–	ANODE–XX (IF REQD.)

TABLE 1

VARIABLE DIMENSIONS & REF. DWGS.			
	69 kV	161 kV	230 kV
PT	10'–6"	15'–0"	19'–0"
PP	9'–0"	14'–0"	16'–0"
INSUL	SHR–LINK–69–XX	SHR–LINK–161–XX	SHR–LINK–230–XX
HC	6'–0"	7'–0"	9'–0"

NOTES:
1. For General Notes, See Dwg. TMS220.

SF–V–SHR–C

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
15–30' SC S. SPPT. VERT, SUS, CONC
STRUCTURE DRAWING & DETAIL

STD NO.	SCALE: NONE
Entergy	No. TMS633A0
	PLOT 1=1 · SH. 1 OF 1

NO.	DATE:	REVISION	BY:	CHK:	APPR:
0	01–02–16	REPLACES DWS TAS292A1, TCS304A2, & TDS304A2	WRK	KC	ECW

rkugl90 12/2/2015 SF–V–SHR–C

0'–5', SELF SUPPORTING, DE, JUMPER, VERTICAL,
SINGLE CIRCUIT, DE POLYMER, STEEL

ASSEMBLY LIST

ITEM	QTY.	ASSEMBLY/DRAWING
1	3	BLT–P–S
2	6	INSUL (SEE TABLE 1)
3	3	INSUL2 (SEE TABLE 1)
4	2	OHG–DE–XX
REFERENCE DRAWINGS		
7	1	SGN–S
8	–	GND–S–XX
9	–	SEE MFR. DWG.
10	1	FOUNDATION TYPE T.B.D.
11	–	PVO, SHT 1, VW PV–19
12	–	ANODE–XX (IF REQ.)

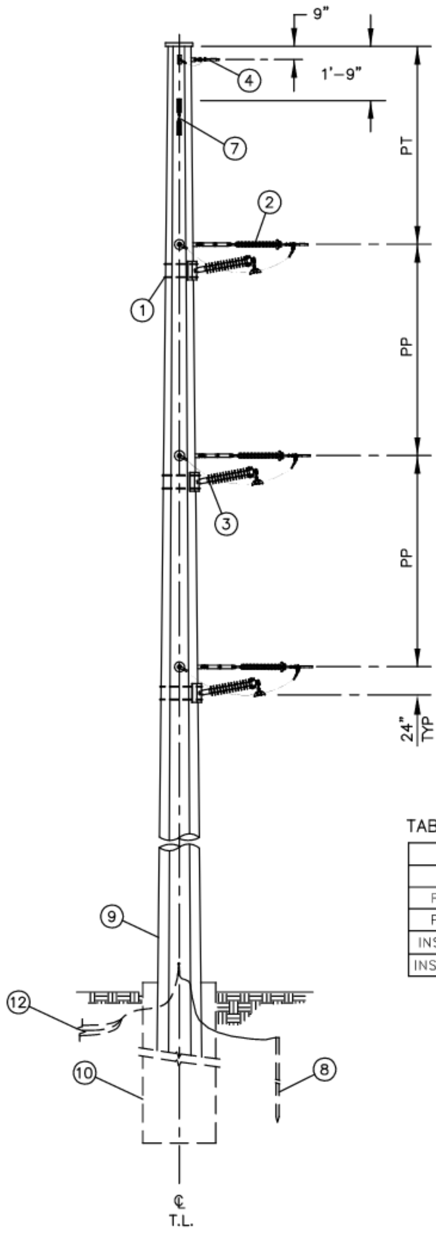


TABLE 1

VARIABLE DIMENSIONS & REF. DWGS.			
	69 kV	161 kV	230 kV
PT	10'–6"	13'–0"	15'–0"
PP	9'–0"	14'–0"	16'–0"
INSUL	DEP/TRB–69–XX	DEP/TRB–161–XX	DEP/TRB–230–XX
INSUL2	JLP–69–XX	JLP–161–XX	JLP–230–XX

NOTES:
1. For General Notes, See Dwg. TMS220.

SDJA–V–DEP–S

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
0–5' SC S. SPPT. DE, DEP W/J, STL
STRUCTURE DRAWING & DETAIL

STD NO. | SCALE: NONE

Entergy | No. TMS642A0 | PLOT 1=1 | SH. 1 OF 1

NO.	DATE:	REVISION	BY:	CHK:	APPR
0	01–02–16	REPLACES DWS TAS528A0, TCS629A1, & TDS559A1	WRK	KC	ECW

rkugl90 12/2/2015 SDJA–V–DEP–S

5"–70", SELF SUPPORTING, DE, JUMPER, VERTICAL,
SINGLE CIRCUIT, DE POLYMER, STEEL

ASSEMBLY LIST

ITEM	QTY.	ASSEMBLY/DRAWING
1	3	BLT–P–S
2	6	INSUL (SEE TABLE 1)
3	3	INSUL2 (SEE TABLE 1)
4	2	OHG–DE–XX

REFERENCE DRAWINGS

ITEM	QTY.	ASSEMBLY/DRAWING
7	1	SGN–S
8	–	GND–S–XX
9	–	SEE MFR. DWG.
10	1	FOUNDATION TYPE T.B.D.
11	–	PVO, SHT 1, VW PV–19
12	–	ANODE–XX (IF REQ.)

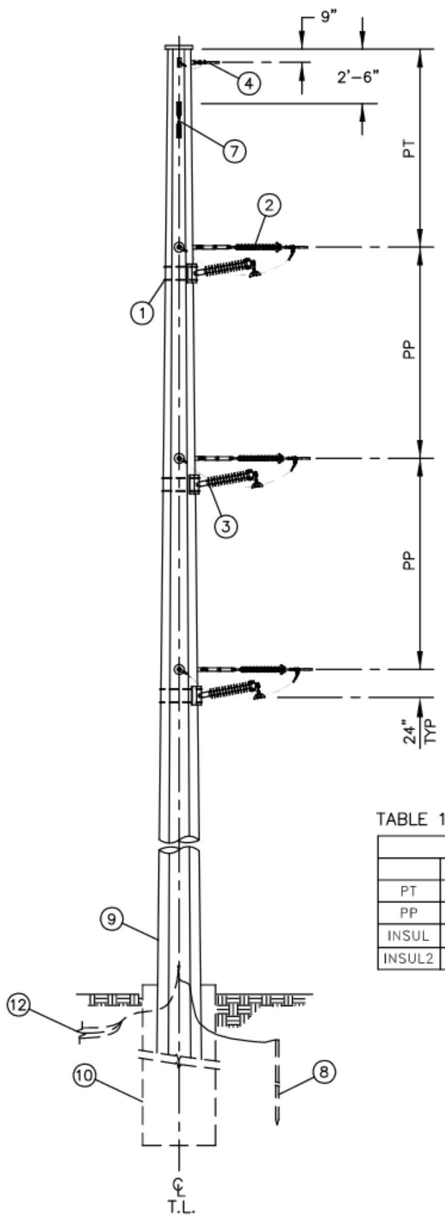


TABLE 1

VARIABLE DIMENSIONS & REF. DWGS.			
	69 kV	161 kV	230 kV
PT	10'–6"	13'–0"	15'–0"
PP	9'–0"	14'–0"	16'–0"
INSUL	DEP/TRB–69–XX	DEP/TRB–161–XX	DEP/TRB–230–XX
INSUL2	JLP–69–XX	JLP–161–XX	JLP–230–XX

NOTES:
1. For General Notes, See Dwg. TMS220.

SDJ–V–DEP–S

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
5–70" SC S. SPPT. DE, DEP W/J, STL
STRUCTURE DRAWING & DETAIL

STD NO.	SCALE: NONE
Entergy	No. TMS641A0
PLOT 1=1	SH. 1 OF 1

NO.	DATE:	REVISION	BY:	CHK:	APPR
0	01–02–16	REPLACES DWS TAS387A3, TCS444A4, & TDS417A4	WRK	KC	ECW

rkugl90 12/2/2015 SDJ–V–DEP–S

70"–120", SELF SUPPORTING, DE, VERTICAL, SINGLE CIRCUIT, DE POLMER, STEEL

ASSEMBLY LIST		
ITEM	QTY.	ASSEMBLY/DRAWING
1	6	INSUL (SEE TABLE 1)
2	2	OHG–DE–XX

REFERENCE DRAWINGS		
7	1	SGN–S
8	–	GND–S–XX
9	–	SEE MFR. DWG.
10	1	FOUNDATION TYPE T.B.D.
11	–	PVO, SHT 2, VW PV–15
12	–	ANODE–XX (IF REQ.)

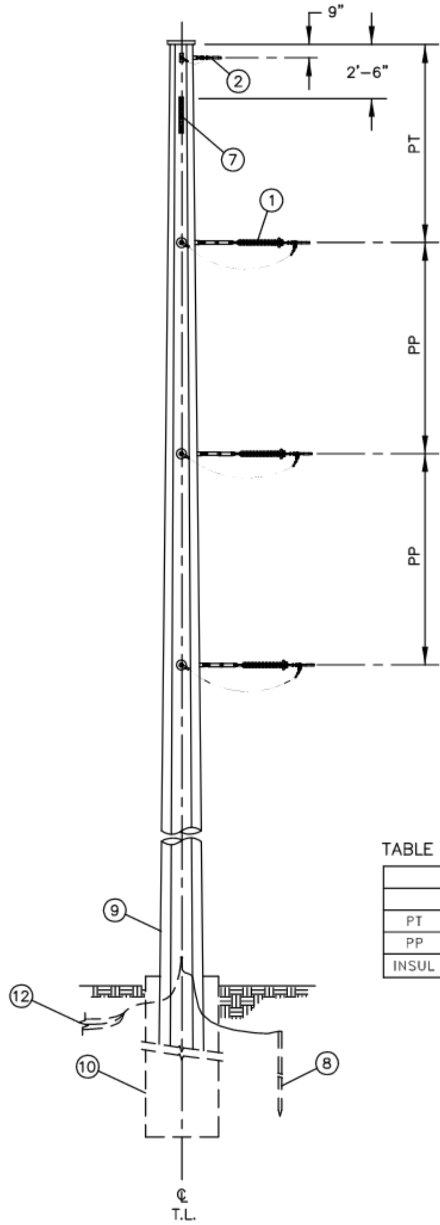


TABLE 1

VARIABLE DIMENSIONS & REF. DWGS.			
	69 kV	161 kV	230 kV
PT	10'–6"	13'–0"	15'–0"
PP	9'–0"	14'–0"	16'–0"
INSUL	DEP/TRB–69–XX	DEP/TRB–161–XX	DEP/TRB–230–XX

NOTES:

1. For General Notes, See Dwg. TMS220.

SD–V–DEP–S

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
70–120" SC S. SPPT. DE, DEP, STL
STRUCTURE DRAWING & DETAIL

NO.	DATE:	REVISION	BY:	CHK:	APPR:
0	01–02–16	REPLACES DWS TAS389A2, TCS446A3, & TDS419A3	WRK	KC	ECW

STD NO. | SCALE: NONE

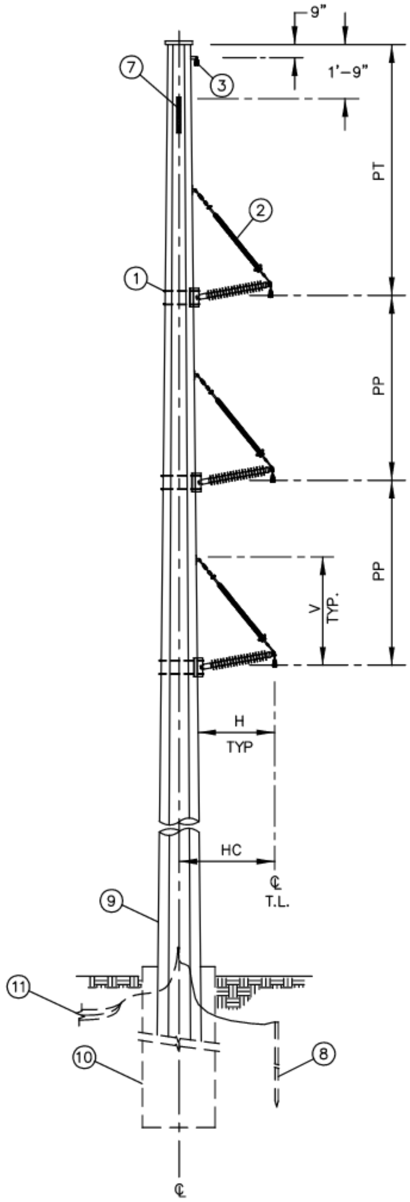
Entergy | No. TMS640A0

PLOT 1=1 | SH. 1 OF 1

rkugl90 12/2/2015 SD–V–DEP–S

0'-1.5', VERTICAL, SINGLE CIRCUIT, BRACED POST 2-1/2", STEEL

ASSEMBLY LIST		
ITEM	QTY.	ASSEMBLY/DRAWING
1	3	BLT-P-S
2	3	SEE INSUL TABLE 1
3	1	OHG-SUS-XX
4		
5		
6		
REFERENCE DRAWINGS		
7	1	SGN-S
8	–	GND-S-XX
9	–	SEE MFR. DWG.
10	1	FOUNDATION TYPE T.B.D.
11	–	ANODE-XX (IF REQ.)



NOTES:
1) For General Notes, See Dwg. TMS220.

TABLE 1

VARIABLE DIMENSIONS & REF. DWGS.			
	69 kV	161 kV	230 kV
PT	10'-6"	15'-0"	19'-0"
PP	8'-0"	13'-0"	14'-0"
V	6'-8"	8'-6"	9'-10"
H	5'-0"	6'-4"	7'-10"
HC	6'-0"	7'-2"	9'-0"
INSUL	BP2-69-XX	BP2-161-XX	BP2-230-XX

A-V-BP2-S

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
0-1.5' SC Vert, BP2, Stl
STRUCTURE DRAWING & DETAIL

0	01-02-16	Replaces Dws TAS411A1, TCS335A2, & TDS323A2	WRK	KC	ECW
NO.	DATE:	REVISION	BY:	CHK:	APPR

STD NO. SCALE: NONE

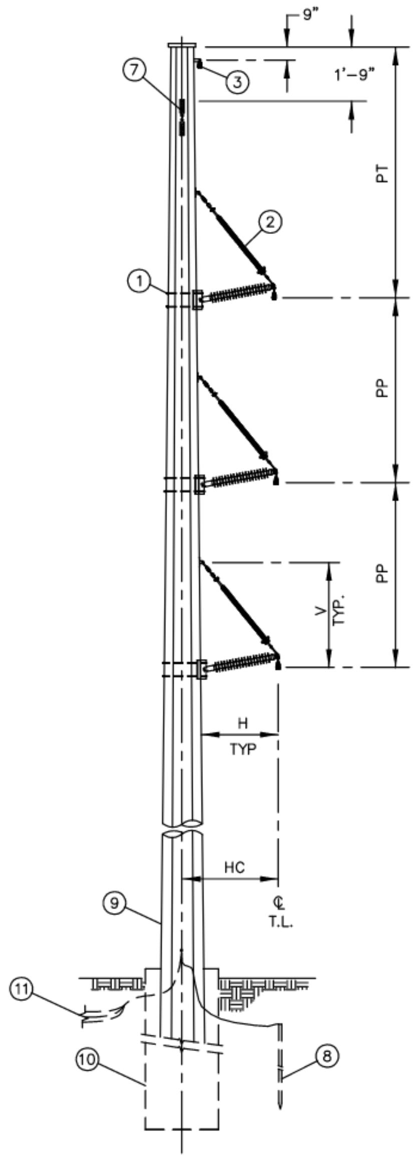
Entergy

No. TMS277A0

PLOT 1=1 SH. 1 OF 1

rkugl90 12/3/2015 A-V-BP2-S

6"–20", VERTICAL, SELF SUPPORTING, SINGLE CIRCUIT,
BRACED POST 2–1/2", STEEL



ASSEMBLY LIST

ITEM	QTY.	ASSEMBLY/DRAWING
1	3	BLT–P–S
2	3	INSUL (SEE TABLE 1)
3	1	OHG–SUS–XX
4		
5		
6		

REFERENCE DRAWINGS

7	1	SGN–S
8	–	GND–S–XX
9	–	SEE MFR. DWG.
10	1	FOUNDATION TYPE T.B.D.
11	–	ANODE–XX (IF REQ.)

TABLE 1

VARIABLE DIMENSIONS & REF. DWGS.			
	69 kV	161 kV	230 kV
PT	10'–6"	15'–0"	19'–0"
PP	8'–0"	13'–0"	14'–0"
V	6'–8"	8'–6"	9'–10"
H	5'–0"	6'–4"	7'–10"
HC	6'–0"	7'–2"	9'–0"
INSUL	BP2–69–XX	BP2–161–XX	BP2–230–XX

NOTES:

1. For General Notes, See Dwg. TMS220.
2. Line post adapters are required where line angles greater than 3", or phase transitions pull suspension hardware toward the pole. See Dwg. TMD415 for additional materials.

SC–V–BP2–S

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
6–20" SC VERT, BP2, STL
STRUCTURE DRAWING & DETAIL

STD NO.	SCALE: NONE
Entergy	No. TMS606A0
PLOT 1=1	SH. 1 OF 1

0	01–02–16	REPLACES DWS TAS465A0, TCS431A2, & TDS402A2	WRK	KC	ECW
NO.	DATE:	REVISION	BY:	CHK:	APPR:

rkugl90 12/2/2015 SC–V–BP2–S

15°–30°, SELF SUPPORTING SUSPENSION, VERTICAL,
SINGLE CIRCUIT, SUSPENSION HEAVY POLYMER w/LINK, STEEL

ASSEMBLY LIST

ITEM	QTY.	ASSEMBLY/DRAWING
1	1	OHG–SUS–XX
2	3	INSUL (SEE TABLE 1)
3		
4		
5		
6		

REFERENCE DRAWINGS

ITEM	QTY.	ASSEMBLY/DRAWING
7	1	SGN–S
8	–	GND–S–XX
9	–	SEE MFR. DWG.
10	1	FOUNDATION TYPE T.B.D.
11	–	ANODE–XX (IF REQ.)

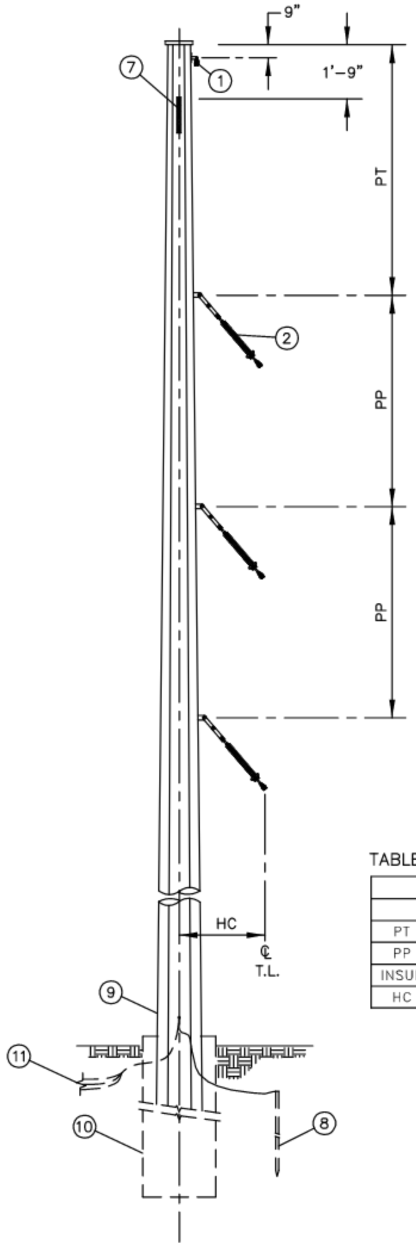


TABLE 1

VARIABLE DIMENSIONS & REF. DWGS.			
	69 kV	161 kV	230 kV
PT	10'–6"	15'–0"	19'–0"
PP	9'–0"	14'–0"	16'–0"
INSUL	SHR–LINK–69–XX	SHR–LINK–161–XX	SHR–LINK–230–XX
HC	6'–0"	7'–0"	9'–0"

NOTES:
1. For General Notes, See Dwg. TMS220.

SF–V–SHR–S

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
15–30° SC S. SPPT. VERT, SUS, STL
STRUCTURE DRAWING & DETAIL

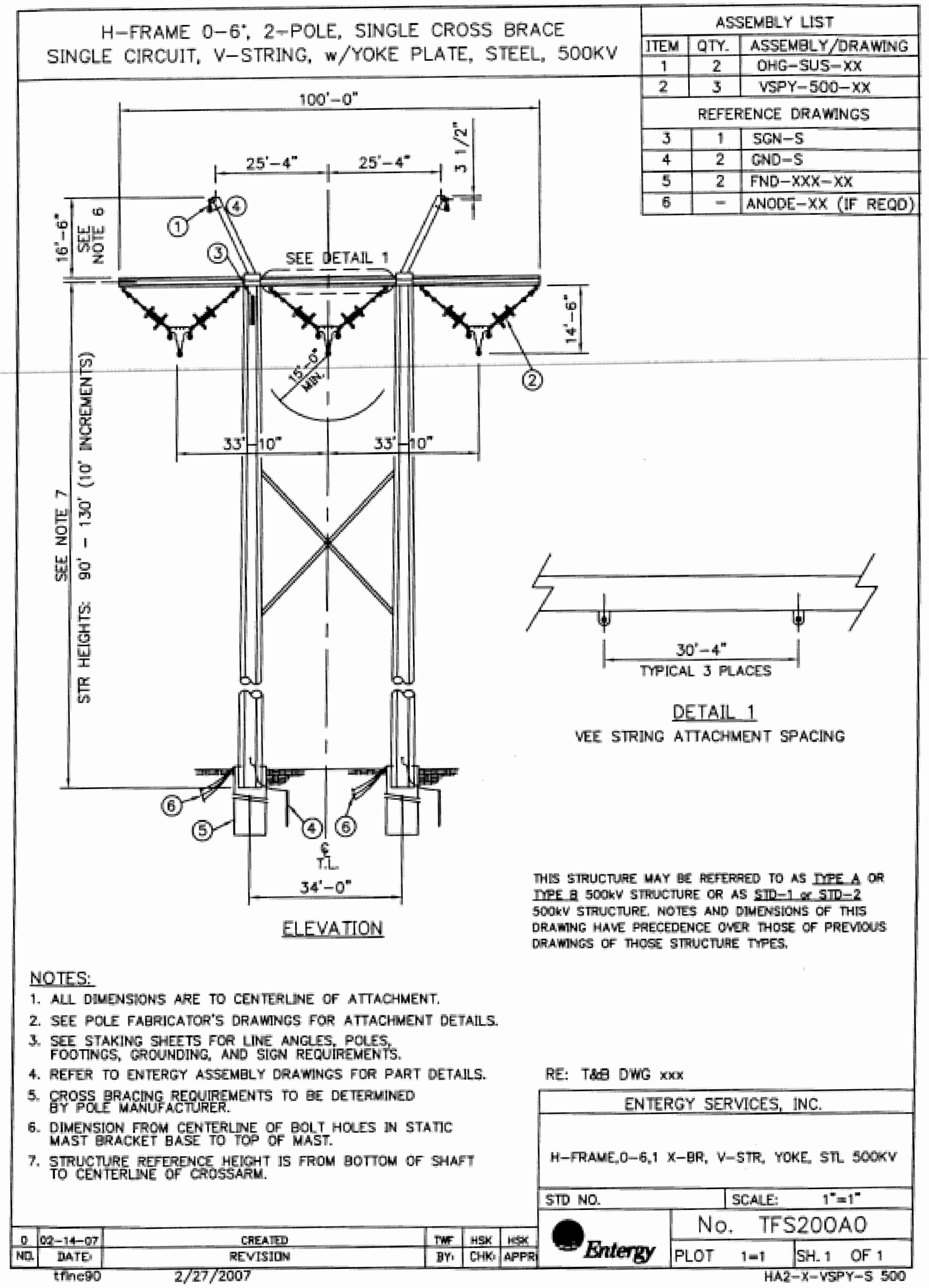
STD NO. | SCALE: NONE

No. TMS648A0

Entergy | PLOT 1=1 | SH. 1 OF 1

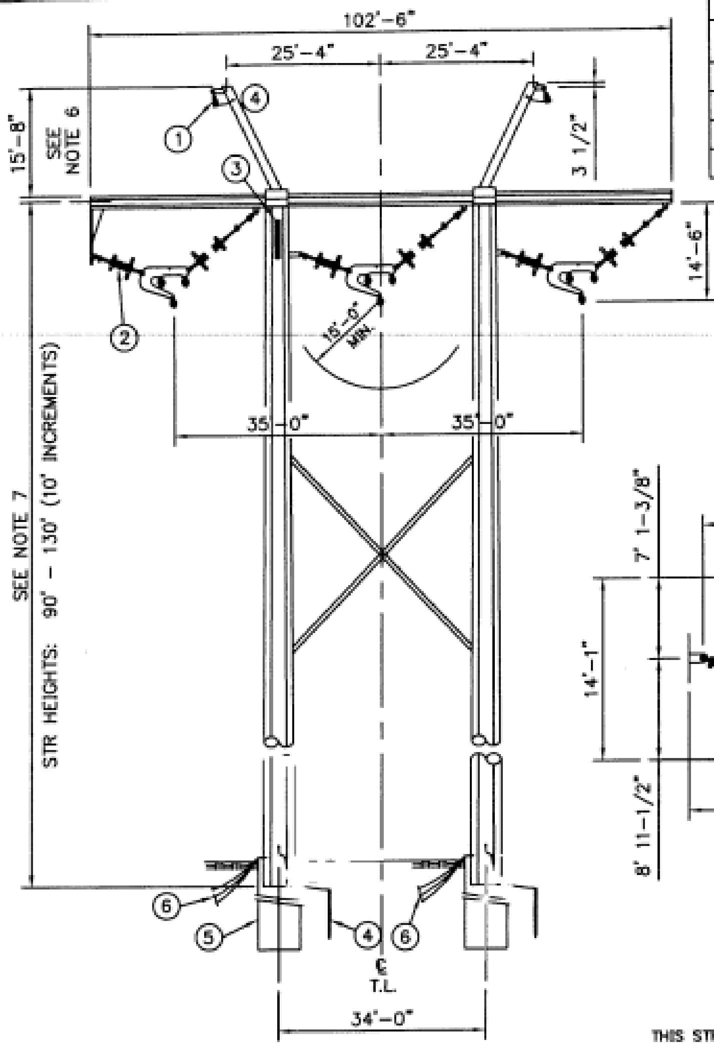
NO.	DATE:	REVISION	BY:	CHK:	APPR
0	01–02–16	REPLACES DWS TAS393A1, TCS450A2, & TDS423A2	WRK	KC	ECW

rkugl90 12/2/2015 SF–V–SHR–S

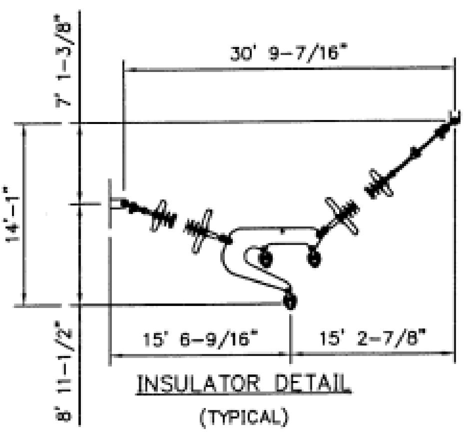

H-FRAME 0-6', 2-POLE, SINGLE CROSS BRACE
SINGLE CIRCUIT, V-STRING, w/YOKE PLATE, STEEL, 500KV
ASSEMBLY LIST
ITEM | QTY. | ASSEMBLY/DRAWING
1 | 2 | OHG-SUS-XX
2 | 3 | VSPY-500-XX
REFERENCE DRAWINGS
3 | 1 | SGN-S
4 | 2 | GND-S
5 | 2 | FND-XXX-XX
6 | - | ANODE-XX (IF REQD)
100'-0"
25'-4"
25'-4"
3 1/2"
16'-6"
SEE NOTE 6
SEE DETAIL 1
14'-6"
15'-0" MIN.
33'-10"
33'-10"
SEE NOTE 7
STR HEIGHTS: 90' - 130' (10' INCREMENTS)
30'-4"
TYPICAL 3 PLACES
DETAIL 1
VEE STRING ATTACHMENT SPACING
℄ T.L.
34'-0"
ELEVATION
THIS STRUCTURE MAY BE REFERRED TO AS TYPE A OR TYPE B 500kV STRUCTURE OR AS STD-1 or STD-2 500kV STRUCTURE. NOTES AND DIMENSIONS OF THIS DRAWING HAVE PRECEDENCE OVER THOSE OF PREVIOUS DRAWINGS OF THOSE STRUCTURE TYPES.
NOTES:
1. ALL DIMENSIONS ARE TO CENTERLINE OF ATTACHMENT.
2. SEE POLE FABRICATOR'S DRAWINGS FOR ATTACHMENT DETAILS.
3. SEE STAKING SHEETS FOR LINE ANGLES, POLES, FOOTINGS, GROUNDING, AND SIGN REQUIREMENTS.
4. REFER TO ENTERGY ASSEMBLY DRAWINGS FOR PART DETAILS.
5. CROSS BRACING REQUIREMENTS TO BE DETERMINED BY POLE MANUFACTURER.
6. DIMENSION FROM CENTERLINE OF BOLT HOLES IN STATIC MAST BRACKET BASE TO TOP OF MAST.
7. STRUCTURE REFERENCE HEIGHT IS FROM BOTTOM OF SHAFT TO CENTERLINE OF CROSSARM.
RE: T&B DWG xxx
ENTERGY SERVICES, INC.
H-FRAME,0-6,1 X-BR, V-STR, YOKE, STL 500KV
STD NO.
SCALE: 1"=1"
No. TFS200A0
Entergy
PLOT 1=1
SH. 1 OF 1
0 | 02-14-07 | CREATED | TWF | HSK | HSK
NO. | DATE | REVISION | BY | CHK | APPR
tfinc90
2/27/2007
HA2-X-VSPY-S 500

H-FRAME 6-15', 2-POLE, SINGLE CROSS BRACE
SINGLE CIRCUIT, V-STRING RUNNING ANGLE, w/YOKE PLATE, STEEL, 500KV

ASSEMBLY LIST		
ITEM	QTY.	ASSEMBLY/DRAWING
1	2	OHG-SUS-XX
2	3	VSPR-500-XX
REFERENCE DRAWINGS		
3	1	SGN-S
4	2	GND-S
5	2	FND-XXX-XX
6	-	ANODE-XX (IF REQD)



ELEVATION



INSULATOR DETAIL
(TYPICAL)

THIS STRUCTURE MAY BE REFERRED TO AS TYPE C 500kV STRUCTURE OR AS STD-3 500kV STRUCTURE. NOTES AND DIMENSIONS OF THIS DRAWING HAVE PRECEDENCE OVER THOSE OF PREVIOUS DRAWINGS OF THOSE STRUCTURE TYPES

NOTES:

1. ALL DIMENSIONS ARE TO CENTERLINE OF ATTACHMENT.
2. SEE POLE FABRICATOR'S DRAWINGS FOR ATTACHMENT DETAILS.
3. SEE STAKING SHEETS FOR LINE ANGLES, POLES, FOOTINGS, GROUNDING, AND SIGN REQUIREMENTS.
4. REFER TO ENTERGY ASSEMBLY DRAWINGS FOR PART DETAILS.
5. CROSS BRACING REQUIREMENTS TO BE DETERMINED BY POLE MANUFACTURER.
6. DIMENSION FROM CENTERLINE OF BOLT HOLES IN STATIC MAST BRACKET BASE TO TOP OF MAST.
7. STRUCTURE REFERENCE HEIGHT IS FROM BOTTOM OF SHAFT TO CENTERLINE OF CROSSARM.

RE: T&B DWG xxx

ENTERGY SERVICES, INC.

H-FRAME,6-15,1 X-BR,V-STR,RA,YOKE,STL 500kV

STD NO. | SCALE: 1"=1"

No. TFS201A0

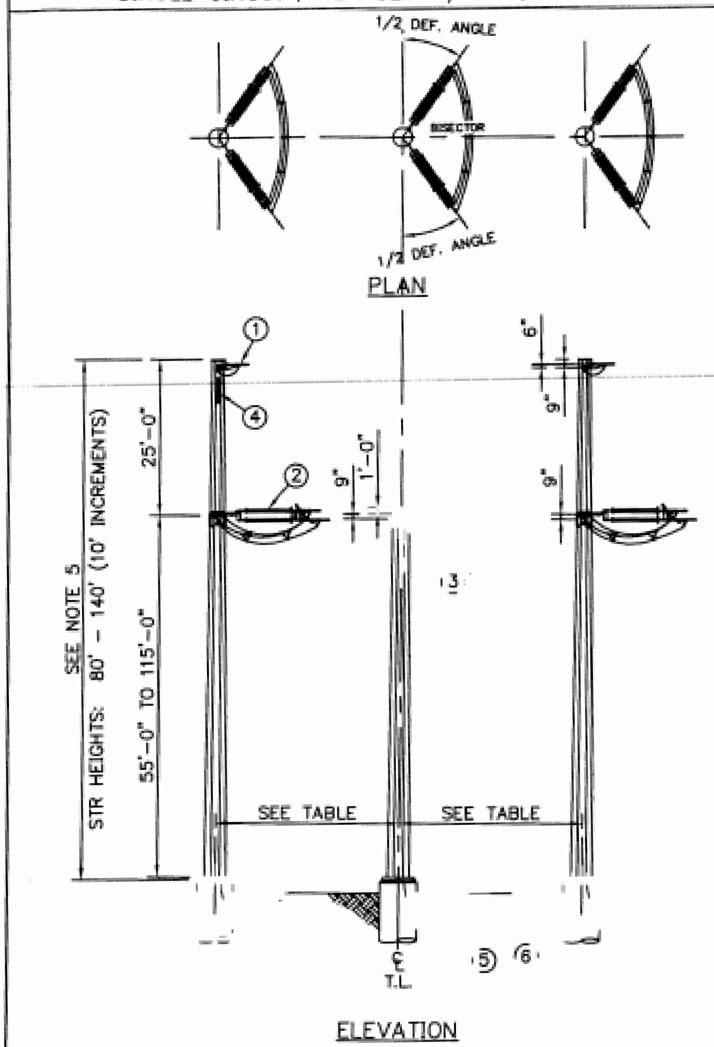
Entergy | PLOT 1=1 | SH. 1 OF 1

NO.	DATE	REVISION	BY	CHK	APPR
0	02-14-07	CREATED	TWF	HSK	HSK

tfinc90 2/27/2007 HC2-X-VSPR-S 500

DEADEND 70°–120° SELF SUPPORTING, 3–POLE SINGLE CIRCUIT, DE POLY w/YOKE, STEEL 500kV

ASSEMBLY LIST		
ITEM	QTY.	ASSEMBLY/DRAWING
1	4	OHG–DE–XX
2	6	DEPY–500–XX
REFERENCE DRAWINGS		
3	NOTE 6	SD–CG318–XX
4	1	SGN–S
5	2	GND–S
6	2	FND–XXX–XX



POLE SPACING TABLE	
DEF ANGLE RANGE	POLE SPACING
53 – 63	40
63 – 71	42
71 – 78	44
78 – 84	46
84 – 89	48
89 – 94	50
94 – 98	52
98 – 101	54
101 – 105	40
105 – 108	42
108 – 110	44
110 – 113	46
113 – 115	48
115 – 117	50
117 – 120	52
120 – 121	54

(SEE NOTE 7)

NOTES:

1. ALL DIMENSIONS ARE TO CENTERLINE OF ATTACHMENT.
2. SEE POLE FABRICATOR'S DRAWINGS FOR ATTACHMENT DETAILS.
3. SEE STAKING SHEETS FOR LINE ANGLES, POLES, FOOTINGS, GROUNDING, AND SIGN REQUIREMENTS.
4. REFER TO ENTERGY ASSEMBLY DRAWINGS FOR PART DETAILS.
5. STRUCTURE REFERENCE HEIGHT IS FROM BOTTOM OF SHAFT TO TOP OF POLE.
6. PLACE SPACERS ON JUMPERS AS REQUIRED TO MAINTAIN UNIFORM DISTANCE BETWEEN SUB–CONDUCTORS.
7. LEG SPACING BASED ON MAINTAINING 34' PHASE TO PHASE SPACING.

THIS STRUCTURE MAY BE REFERRED TO AS TYPE E 500kV STRUCTURE OR AS STD–5 500kV STRUCTURE. NOTES AND DIMENSIONS OF THIS DRAWING HAVE PRECEDENCE OVER THOSE OF PREVIOUS DRAWINGS OF THOSE STRUCTURE TYPES

RE: T&B DWG xxx

ENTERGY SERVICES, INC.

DE 70–120 SS, 3–POLE, POLY, YOKE, STL 500kV

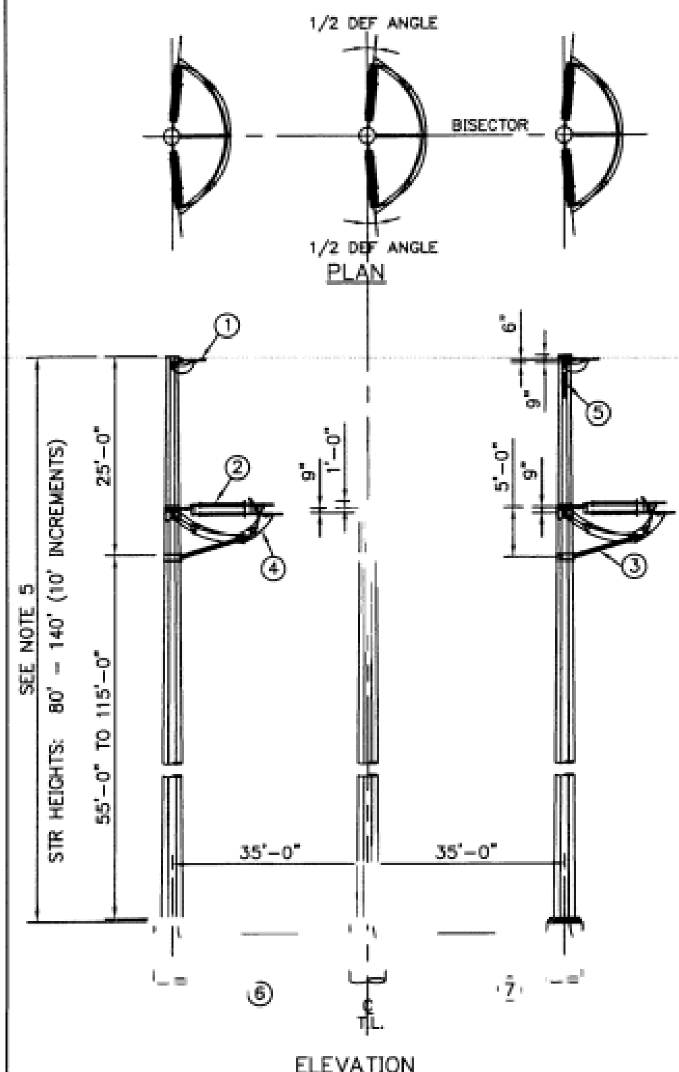
STD NO.	SCALE: 1"=1"
Entergy	No. TFS202A0
	PLOT 1=1 SH. 1 OF 1

NO.	DATE:	REVISION	BY:	CHK:	APPR
0	02–14–07	CREATED	TWF	HSK	HSK

tfinc90 2/27/2007 SLE3–DEPY–S 500

DEADEND 10°–70° SELF SUPPORTING, JUMPER, 3–POLE SINGLE CIRCUIT, DE POLY w/YOKE, STEEL 500kV

ASSEMBLY LIST		
ITEM	QTY.	ASSEMBLY/DRAWING
1	2	OHG–DE–XX
2	6	DEPY–500–XX
3	3	JLPH–500–XX
REFERENCE DRAWINGS		
4	NOTE 6	SD–CG318–XX
5	1	SGN–S
6	3	GND–S
7	3	FND–XXX–XX



POLE SPACING TABLE	
DEF ANGLE RANGE	POLE SPACING
00 – 27	35
27 – 38	36
38 – 46	37
46 – 53	38
53 – 58	39
58 – 63	40
63 – 67	41
67 – 71	42

(SEE NOTE 7)

NOTES:

1. ALL DIMENSIONS ARE TO CENTERLINE OF ATTACHMENT.
2. SEE POLE FABRICATOR'S DRAWINGS FOR ATTACHMENT DETAILS.
3. SEE STAKING SHEETS FOR LINE ANGLES, POLES, FOOTINGS, GROUNDING, AND SIGN REQUIREMENTS.
4. REFER TO ENTERGY ASSEMBLY DRAWINGS FOR PART DETAILS.
5. STRUCTURE REFERENCE HEIGHT IS FROM BOTTOM OF SHAFT TO TOP OF POLE.
6. PLACE SPACERS ON JUMPERS AS REQUIRED TO MAINTAIN UNIFORM DISTANCE BETWEEN SUB–CONDUCTORS.
7. LEG SPACING BASED ON MAINTAINING 34' PHASE TO PHASE SPACING.

THIS STRUCTURE MAY BE REFERRED TO AS TYPE D 500kV STRUCTURE OR AS STD–4 500kV STRUCTURE. NOTES AND DIMENSIONS OF THIS DRAWING HAVE PRECEDENCE OVER THOSE OF PREVIOUS DRAWINGS OF THOSE STRUCTURE TYPES

RE: T&B DWG xxx

ENTERGY SERVICES, INC.

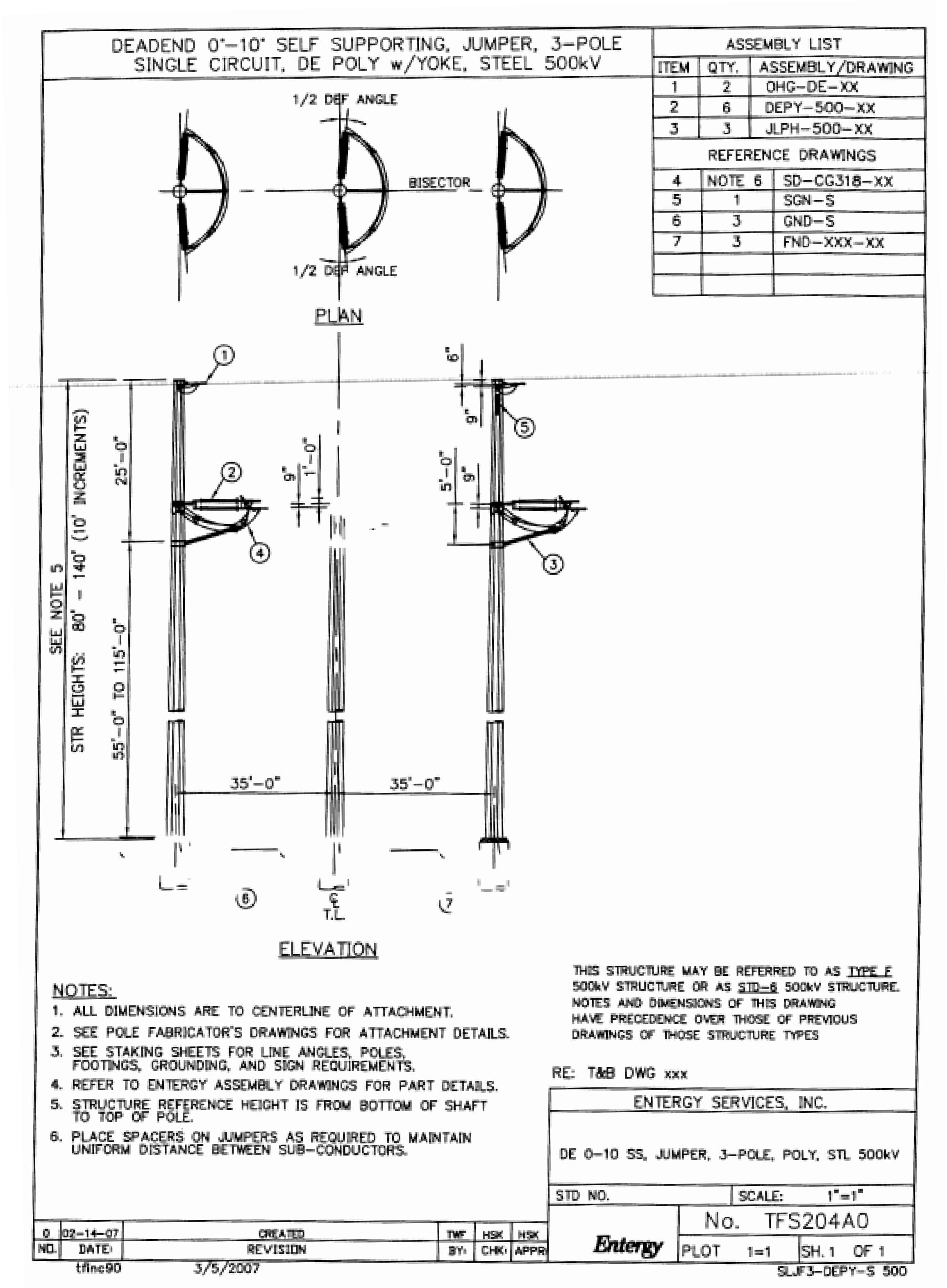
DE 10–70 SS, JUMPER, 3–POLE, POLY, STL 500kV

STD NO. | SCALE: 1"=1"

Entergy | No. TFS203A0 | PLOT 1=1 | SH. 1 OF 1

NO.	DATE	REVISION	BY	CHK	APPR
0	02–14–07	CREATED	TWF	HSK	HSK

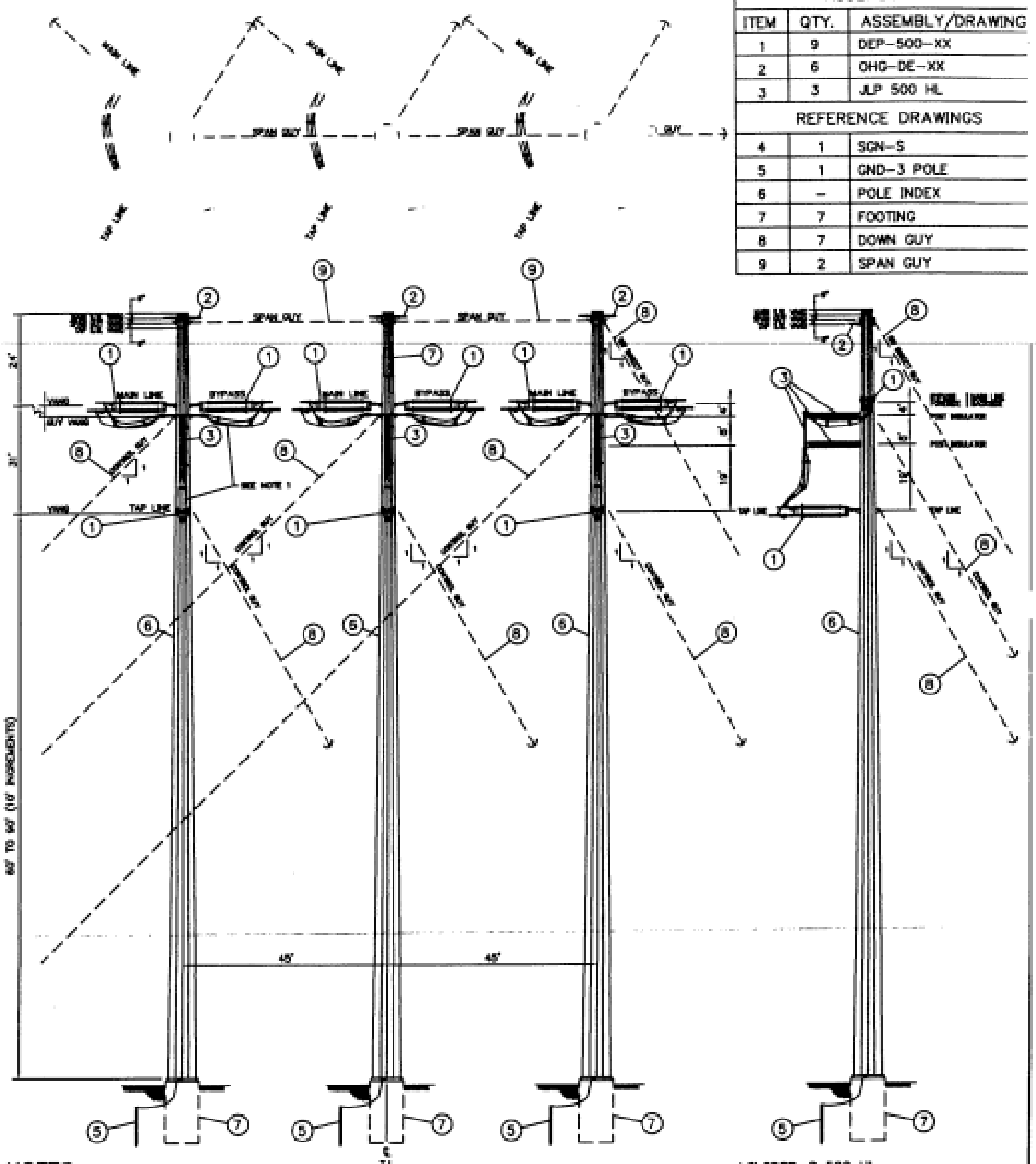
tfinc90 3/5/2007 SLJD3–DEPY–S 500


DEADEND 0°–10° SELF SUPPORTING, JUMPER, 3-POLE
SINGLE CIRCUIT, DE POLY w/YOKE, STEEL 500kV
ASSEMBLY LIST
ITEM | QTY. | ASSEMBLY/DRAWING
1 | 2 | OHG-DE-XX
2 | 6 | DEPY-500-XX
3 | 3 | JLPH-500-XX
REFERENCE DRAWINGS
4 | NOTE 6 | SD-CG318-XX
5 | 1 | SGN-S
6 | 3 | GND-S
7 | 3 | FND-XXX-XX
1/2 DEF ANGLE
BISECTOR
PLAN
SEE NOTE 5
STR HEIGHTS: 80' - 140' (10' INCREMENTS)
25'-0"
55'-0" TO 115'-0"
35'-0"
T.L.
ELEVATION
NOTES:
1. ALL DIMENSIONS ARE TO CENTERLINE OF ATTACHMENT.
2. SEE POLE FABRICATOR'S DRAWINGS FOR ATTACHMENT DETAILS.
3. SEE STAKING SHEETS FOR LINE ANGLES, POLES, FOOTINGS, GROUNDING, AND SIGN REQUIREMENTS.
4. REFER TO ENTERGY ASSEMBLY DRAWINGS FOR PART DETAILS.
5. STRUCTURE REFERENCE HEIGHT IS FROM BOTTOM OF SHAFT TO TOP OF POLE.
6. PLACE SPACERS ON JUMPERS AS REQUIRED TO MAINTAIN UNIFORM DISTANCE BETWEEN SUB-CONDUCTORS.
THIS STRUCTURE MAY BE REFERRED TO AS TYPE F 500kV STRUCTURE OR AS STD-6 500kV STRUCTURE. NOTES AND DIMENSIONS OF THIS DRAWING HAVE PRECEDENCE OVER THOSE OF PREVIOUS DRAWINGS OF THOSE STRUCTURE TYPES
RE: T&B DWG xxx
ENTERGY SERVICES, INC.
DE 0-10 SS, JUMPER, 3-POLE, POLY, STL 500kV
STD NO.
SCALE: 1"=1"
No. TFS204A0
Entergy
PLOT 1=1
SH. 1 OF 1
0 | 02-14-07 | CREATED | TWF | HSK | HSK
NO. | DATE | REVISION | BY | CHK | APPR
tfinc90
3/5/2007
SLJF3-DEPY-S 500

80'-100', DE, 3-POLE
HIGH-LOW, STEEL 500kV

ASSEMBLY LIST

ITEM	QTY.	ASSEMBLY/DRAWING
1	9	DEP-500-XX
2	6	OHG-DE-XX
3	3	JLP 500 HL
		REFERENCE DRAWINGS
4	1	SGN-S
5	1	GND-3 POLE
6	-	POLE INDEX
7	7	FOOTING
8	7	DOWN GUY
9	2	SPAN GUY



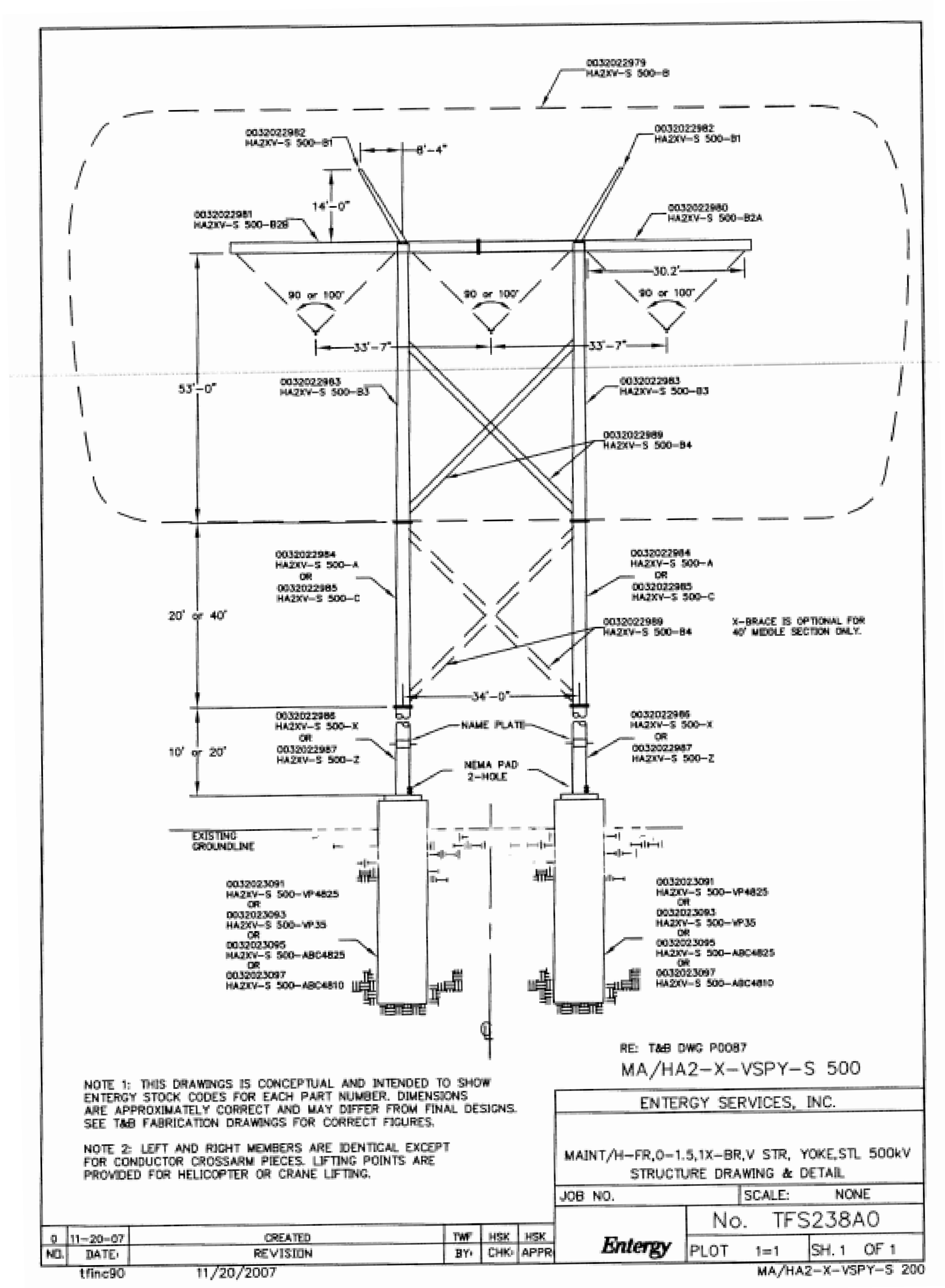
NOTES
1. BYPASS JUMPER AND TAP LINE JUMPER ARE NOT TO BE IN PLACE AT SAME TIME.
2. SEE DWG TFA206A FOR SPACING DETAIL AND BUS ORIENTATION
3. INSTALL NEMA PADS ON POLES AT ALL CONDUCTOR DEAD END LOCATIONS.
4. BYPASS SPANS SERVE TO TRANSFER TENSION THRU THE STRUCTURE.
5. DOWN GUYS ARE OPTIONAL. DESIGNER MUST SPECIFY FOR POLE SUPPLIER.
6. ALL THREE POLES ARE TO BE FRAMED IDENTICALLY WITH RESPECT TO HOLES, NEMA PADS, VANGS, ETC.

ENTERGY SERVICES, INC.
Transmission LineDesign Standard
80-100, DE, 3-POLE, HIGH-LOW, STEEL 500kV
STRUCTURE DRAWING & DETAIL

STD NO.	SCALE: NONE
Entergy	No. TFS205A0
	PLOT 1=40 / SH. 1 OF 1

NO.	DATE	REVISION	BY	CHK	APPR
0	6-15-07	CREATED	TWF	HSK	HSK

tflnc90 6/28/2007 L3LCDEP-S 500 HL



0032022979
HA2XV-S 500-B
0032022982
HA2XV-S 500-B1
8'-4"
14'-0"
0032022981
HA2XV-S 500-B2B
0032022980
HA2XV-S 500-B2A
30.2'
90 or 100'
33'-7"
53'-0"
0032022983
HA2XV-S 500-B3
0032022989
HA2XV-S 500-B4
0032022984
HA2XV-S 500-A
OR
0032022985
HA2XV-S 500-C
20' or 40'
X-BRACE IS OPTIONAL FOR 40' MIDDLE SECTION ONLY.
34'-0"
0032022986
HA2XV-S 500-X
OR
0032022987
HA2XV-S 500-Z
10' or 20'
NAME PLATE
NEMA PAD 2-HOLE
EXISTING GROUNDLINE
0032023091
HA2XV-S 500-VP4825
OR
0032023093
HA2XV-S 500-VP35
OR
0032023095
HA2XV-S 500-ABC4825
OR
0032023097
HA2XV-S 500-ABC4810
RE: T&B DWG P0087
MA/HA2-X-VSPY-S 500
NOTE 1: THIS DRAWINGS IS CONCEPTUAL AND INTENDED TO SHOW ENTERGY STOCK CODES FOR EACH PART NUMBER. DIMENSIONS ARE APPROXIMATELY CORRECT AND MAY DIFFER FROM FINAL DESIGNS. SEE T&B FABRICATION DRAWINGS FOR CORRECT FIGURES.
NOTE 2: LEFT AND RIGHT MEMBERS ARE IDENTICAL EXCEPT FOR CONDUCTOR CROSSARM PIECES. LIFTING POINTS ARE PROVIDED FOR HELICOPTER OR CRANE LIFTING.
ENTERGY SERVICES, INC.
MAINT/H-FR,0-1.5,1X-BR,V STR, YOKE,STL 500kV
STRUCTURE DRAWING & DETAIL
JOB NO.
SCALE: NONE
No. TFS238A0
Entergy
PLOT 1=1
SH. 1 OF 1
0 11-20-07 CREATED TWF HSK HSK
NO. DATE REVISION BY CHK APPR
tfinc90 11/20/2007
MA/HA2-X-VSPY-S 200

LOADING TABLE *

ITEMS	LOAD	CASE 1	CASE 2	CASE 3	CASE 4	CASE 5	CASE 6
SHIELDWIRE	T1	1760	820	1859	213	213	213
	V1	1343	3218	557	557	557	557
	L1	0	0	0	0	2036	0
CONDUCTOR	T2	9241	4278	12161	1540	1540	1540
	V2	10295	16327	5015	5015	5015	5015
	L2	0	0	0	0	0	14709
WIND ON STRUCTURE	W	10	0	25.6	0	0	0
STRUCTURE WEIGHT	VS	TO BE DETERMINED BY T&B					
LINEMAN & EQUIP. WEIGHT	V3	500					

* V, T AND L IN POUNDS, W IN PSF (OLF INCLUDED)
CONDUCTOR LOADS ARE TOTAL PER PHASE
(SEE ADDITIONAL CASE 7 BELOW)

WIRE DATA:

SHIELDWIRE (SEE NOTE 7)

24 FIBER OPGW (GW2400 – 64 mm2 / 528)
DIA=0.528", WT=0.362 LBS/FT, RTS=18,432 LBS
1" RADIAL ICE, 15F MAX TENSION 7833 LBS INITIAL
EVERYDAY CONDITION, 60F TENSION 2036 LBS INITIAL

7#7 ALLUMOWELD
DIA=0.433", WT=0.330 LBS/FT, RTS=19,060 LBS
1" RADIAL ICE, 15F MAX TENSION 7328 LBS INITIAL
EVERYDAY CONDITION, 60F TENSION 1740 LBS INITIAL

PHASE CONDUCTOR

(3) 954.0 KCMIL 45/7 STRAND ACSR "RAIL" (TRIPLE BUNDLED)
DIA=1.165", WT=1.0750 LBS/FT, RTS=25,900 LBS
1" RADIAL ICE, 15F MAX TENSION 13623 LBS INITIAL(SUB COND)
EVERYDAY CONDITION, 60F TENSION 4903 LBS INITIAL (SUB COND)

MECHANICAL LOADING CRITERIA:

CASE 1 – NESC MEDIUM: 4 PSF WIND ON WIRES AND STRUCTURE, 1/4" RADIAL ICE, 15° F, TRANSVERSE WIND OLF=2.50, LONGITUDINAL OLF=1.65; VERTICAL OLF=1.50.

CASE 2 – HEAVY ICE: 1" RADIAL ICE, NO WIND,15° F. OLF=1.0

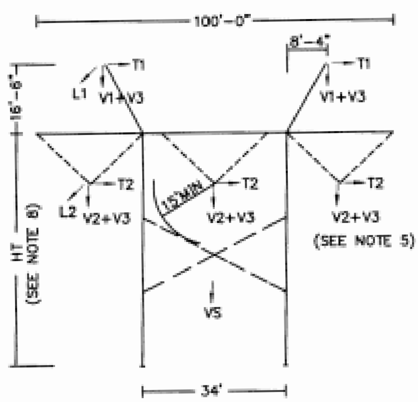
CASE 3 – HIGH WIND: 25.6 PSF WIND ON WIRES AND STRUCTURE, NO ICE, 60° F, OLF=1.00.

CASE 4 – PRECAMBER: NO WIND, NO ICE, 60° F. OLF=1.0

CASE 5 – BROKEN SHIELDWIRE: NO WIND, NO ICE, 60° F. OLF=1.0

CASE 6 – BROKEN PHASE: NO WIND, NO ICE, 60° F. OLF=1.0

CASE 7 – 25.6 PSF LONG. WIND ON STR. W/O WIRES, OLF=1.0



LOAD TREE 500KV

SPAN DATA:

WIND SPAN = 1200' at 6° Line Angle – 1600' at 0° Line Angle
WEIGHT SPAN = 1400 FEET
RULING SPAN = 1000 FEET

NOTES:

1. ALL LOADS ARE ULTIMATE LOADS AND INCLUDE OVERLOAD FACTORS.
2. FOR STRUCTURAL DESIGN, THE LONGITUDINAL (L), TRANSVERSE (T), AND VERTICAL (V) LOADS SHALL BE CONSIDERED TO ACT SIMULTANEOUSLY WITH WIND AND THE DEAD WEIGHT OF THE STRUCTURE.
3. THE TRANSVERSE LOADS (T) INCLUDE WIND ON THE WIRE AND TRANSVERSE COMPONENT OF THE TENSION DUE TO THE LINE ANGLE.
4. V1 INCLUDES 50 POUNDS FOR EACH SHIELDWIRE ASSEMBLY. V2 INCLUDES 500 POUNDS FOR EACH INSULATOR ASSEMBLY.
5. V3 (LINEMAN+EQUIPMENT) = 500 LBS AT ANY ONE LOCATION.
6. STRUCTURES TO BE DESIGNED FOR MAX OF EITHER 1200' WIND SPAN AT 6° LINE ANGLE OR 1600' WIND SPAN AT 0° LINE ANGLE. ABOVE TABLE REFLECTS CONTROLLING CONFIGURATION FOR EACH LOADING CONDITION. (6° CONTROLS ALL CASES)
7. STRUCTURES TO BE DESIGNED TO SUPPORT ANY COMBINATION OF TWO (2) SHIELD WIRES (FIBER OR 7#7 – ONE PER PEAK). ABOVE TABLE REFLECTS THE LOADINGS DUE TO THE OPGW WHICH CONTROLS THE DESIGN
8. STR. REF. HT. IS FROM BOTTOM OF SHAFT TO CL OF CROSSARM. DESIGN STRUCTURE FOR 90' TO 130' HTS. IN 10' INCREMENTS.
9. PROVIDE BASE PLATE DESIGN FOR EACH STRUCTURE.
10. PROVIDE SOCKET PILE DESIGN (DIAMETER, THICKNESS, AND OVERLAP) FOR EACH STRUCTURE.
11. PROVIDE BASE PLATED PILE DESIGN (DIAMETER & THICKNESS) FOR EACH STRUCTURE (BASED ON 4 FT PILE REVEAL).
12. SEE DRAWING STD-2 FOR STRUCTURE FRAMING.

HA2-X-VSPY-S 500 SK2

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
LOAD TREE, H-FRAME, 0°-6°, 90'-130'
STRUCTURE DRAWING & DETAIL

STD NO. | SCALE: NONE

Entergy | No. TFS239A0
PLOT 1=1 | SH. 1 OF 1

NO.	DATE	REVISION	BY	CHK	APPR
0	11-21-07	CREATED	TWF	HSK	HSK

tfinc90 12/7/2007 HA2-X-VSPY-S 500; SK2

LOADING TABLE *

ITEMS	LOAD	CASE 1	CASE 2	CASE 3	CASE 4	CASE 5	CASE 6
SHIELDWIRE	T1	2682	2045	2392	532	652	532
	V1	1343	3218	557	557	557	557
	L1	0	0	0	0	5000	0
CONDUCTOR	T2	14752	10669	15472	3840	3840	3604
	V2	10295	16327	5015	5015	5015	5015
	L2	0	0	0	0	0	8000
WIND ON STRUCTURE	W	10	0	25.6	0	0	0
STRUCTURE WEIGHT	VS	TO BE DETERMINED BY T&B					
LINEMAN & EQUIP. WEIGHT	V3	500					

* V, T AND L IN POUNDS, W IN PSF (OLF INCLUDED)
CONDUCTOR LOADS ARE TOTAL PER PHASE
(SEE ADDITIONAL CASE 7 BELOW)

WIRE DATA:

SHIELDWIRE (SEE NOTE 7)

24 FIBER OPGW (GW2400 – 64 mm2 / 528)
DIA=0.528", WT=0.362 LBS/FT, RTS=18,432 LBS
1" RADIAL ICE, 15°F MAX TENSION 7833 LBS INITIAL
EVERYDAY CONDITION, 60°F TENSION 2036 LBS INITIAL

7#7 ALLUMOWELD
DIA=0.433", WT=0.330 LBS/FT, RTS=19,060 LBS
1" RADIAL ICE, 15°F MAX TENSION 7328 LBS INITIAL
EVERYDAY CONDITION, 60°F TENSION 1740 LBS INITIAL

PHASE CONDUCTOR

(3) 954.0 KCMIL 45/7 STRAND ACSR "RAIL" (TRIPLE BUNDLED)
DIA=1.165", WT=1.0750 LBS/FT, RTS=25,900 LBS
1" RADIAL ICE, 15°F MAX TENSION 13623 LBS INITIAL(SUB COND)
EVERYDAY CONDITION, 60°F TENSION 4903 LBS INITIAL (SUB COND)

MECHANICAL LOADING CRITERIA:

CASE 1 – NESC MEDIUM: 4 PSF WIND ON WIRES AND STRUCTURE, 1/4" RADIAL ICE, 15° F, TRANSVERSE WIND OLF=2.50, LONGITUDINAL OLF=1.65; VERTICAL OLF=1.50.

CASE 2 – HEAVY ICE: 1" RADIAL ICE, NO WIND,15° F. OLF=1.0

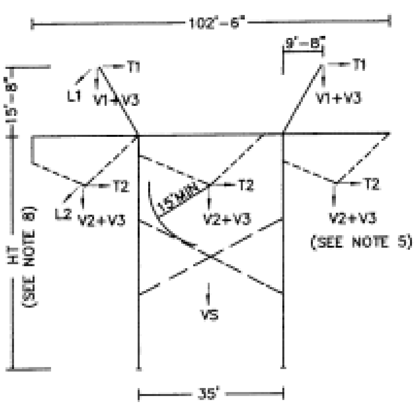
CASE 3 – HIGH WIND: 25.6 PSF WIND ON WIRES AND STRUCTURE, NO ICE, 60° F, OLF=1.00.

CASE 4 – PRECAMBER: NO WIND, NO ICE, 60° F. OLF=1.0

CASE 5 – BROKEN SHIELDWIRE: NO WIND, NO ICE, 60° F. OLF=1.0

CASE 6 – UNBALANCED PHASE: NO WIND, NO ICE, 60° F. OLF=1.0

CASE 7 – 25.6 PSF LONG. WIND ON STR. W/O WIRES, OLF=1.0



LOAD TREE 500KV

SPAN DATA:

WIND SPAN = 1000' at 15' Line Angle
WEIGHT SPAN = 1400 FEET
RULING SPAN = 1000 FEET

NOTES:

1. ALL LOADS ARE ULTIMATE LOADS AND INCLUDE OVERLOAD FACTORS.
2. FOR STRUCTURAL DESIGN, THE LONGITUDINAL (L), TRANSVERSE (T), AND VERTICAL (V) LOADS SHALL BE CONSIDERED TO ACT SIMULTANEOUSLY WITH WIND AND THE DEAD WEIGHT OF THE STRUCTURE.
3. THE TRANSVERSE LOADS (T) INCLUDE WIND ON THE WIRE AND TRANSVERSE COMPONENT OF THE TENSION DUE TO THE LINE ANGLE.
4. V1 INCLUDES 50 POUNDS FOR EACH SHIELDWIRE ASSEMBLY. V2 INCLUDES 500 POUNDS FOR EACH INSULATOR ASSEMBLY.
5. V3 (LINEMAN+EQUIPMENT) = 500 LBS AT ANY ONE LOCATION.
6. STRUCTURES TO BE DESIGNED FOR 1000' WIND SPAN AT 15' LINE ANGLE. PROVIDE SPAN AND ANGLE CHART FOR 6' TO 14' LINE ANGLE.
7. STRUCTURES TO BE DESIGNED TO SUPPORT ANY COMBINATION OF TWO (2) SHIELD WIRES (FIBER OR 7#7 – ONE PER PEAK). ABOVE TABLE REFLECTS THE LOADINGS DUE TO THE OPGW WHICH CONTROLS THE DESIGN
8. STR. REF. HT. IS FROM BOTTOM OF SHAFT TO CL OF CROSSARM. DESIGN STRUCTURE FOR 90' TO 130' HTS. IN 10' INCREMENTS.
9. PROVIDE BASE PLATE DESIGN FOR EACH STRUCTURE.
10. PROVIDE SOCKET PILE DESIGN (DIAMETER, THICKNESS, AND OVERLAP) FOR EACH STRUCTURE.
11. PROVIDE BASE PLATED PILE DESIGN (DIAMETER & THICKNESS) FOR EACH STRUCTURE (BASED ON 4 FT PILE REVEAL).
12. SEE DRAWING STD-3 FOR STRUCTURE FRAMING.

HC2-X-VSPR-S 500 SK3

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
LOAD TREE, H-FRAME, 6°-15°, 90'-130'
STRUCTURE DRAWING & DETAIL

STD NO.	SCALE: NONE
Entergy	No. TFS240A0
	PLOT 1=1 SH. 1 OF 1

NO.	DATE	REVISION	BY	CHK	APPR
0	11-21-07	CREATED	TWF	HSK	HSK

tfinc90 12/7/2007 HC2-X-VSPR-S 500; SK3

LOADING TABLE *

ITEMS		LOAD	CASE 1	CASE 2	CASE 3	CASE 4
INTACT	SW	T1	2468	2045	2111	532
		V1	1887	4576	774	774
		L1	0	0	0	0
	COND	T2	13712	10669	13608	3840
		V2	14386	23110	6950	6950
		L2	0	0	0	0
DE ONE SIDE	SW	T1	1234	1022	1055	266
		V1	1289	3082	535	535
		L1	6933	7766	4808	2019
	COND	T2	6856	5334	6804	1920
		V2	9586	15448	4622	4622
		L2	40218	40519	30442	14583
WIND ON STRUCTURE		W	10	0	25.6	0
STRUCTURE WEIGHT		VS	TO BE DETERMINED BY T&B			
LINEMAN & EQUIP. WEIGHT		V4	500			
JUMPER INSULATOR WEIGHT		V3	215			

* V, T AND L IN POUNDS, W IN PSF (OLF INCLUDED)

WIRE DATA:

SHIELDWIRE

(2) 24 FIBER OPGW (GW2400 – 64mm2 / 528)
DIA=0.528", WT=0.362 LBS/FT, RTS=18,432 LBS
1" RADIAL ICE, 15° F MAX TENSION 7833 LBS INITIAL
EVERYDAY COND, 60°F TENSION 2036 LBS INITIAL

PHASE CONDUCTOR

(3) 954.0 KCMIL 45/7 STRAND ACSR "RAIL" (TRIPLE BUNDLED)
DIA=1.165", WT=1.0750 LBS/FT, RTS=25,900 LBS
1" ICE, 15°F MAX TENSION 13623 LBS INITIAL (SUB CONDUCT)
EVERYDAY CONDITION, 60°F TENSION 4903 LBS INITIAL (SUB CONDUCT)

SPAN DATA:

WIND SPAN = 750 FT (INTACT) 375 FT (DE)
WEIGHT SPAN = 2000 FT (INTACT) 1340 FT (DE)
RULING SPAN = 1000 FT

MECHANICAL LOADING CRITERIA:

CASE 1 – NESC MEDIUM: 4 PSF WIND ON WIRES AND STRUCTURE, 1/4" RADIAL ICE, 15° F. TRANSVERSE WIND OLF=2.50, LONGITUDINAL OLF=1.65; VERTICAL OLF=1.50.

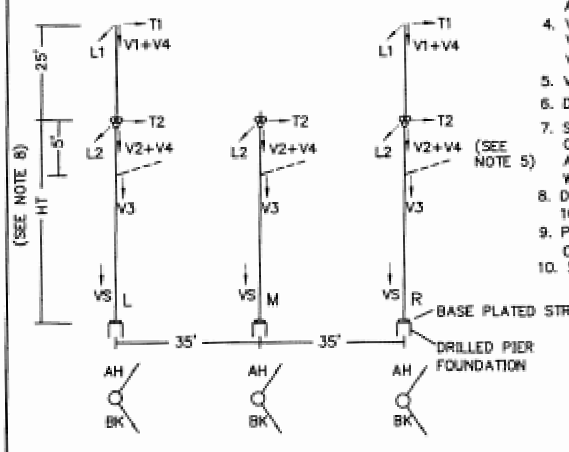
CASE 2 – HEAVY ICE: 1" RADIAL ICE, NO WIND, 15° F. OLF=1.0

CASE 3 – HIGH WIND: 25.6 PSF WIND ON WIRES AND STRUCTURE, NO ICE, 60° F, OLF=1.00.

CASE 4 – EVERYDAY: NO WIND, NO ICE, 60° F. OLF=1.0

NOTES:

1. ALL LOADS ARE ULTIMATE LOADS AND INCLUDE OVERLOAD FACTORS PER MECHANICAL LOADING CRITERIA.
2. FOR STRUCTURAL DESIGN, THE LONGITUDINAL (L), TRANSVERSE (T) AND VERTICAL (V) LOADS SHALL BE CONSIDERED TO ACT SIMULTANEOUSLY WITH WIND AND THE DEAD WEIGHT OF THE STRUCTURE.
3. THE TRANSVERSE LOADS (T) INCLUDE WIND ON THE WIRES AND TRANSVERSE (TENSION) LOADS FROM THE LINE ANGLE AT THE STRUCTURE.
4. V1 INCLUDES 50 LBS FOR SHIELDWIRE ASSEMBLY(S). V2 INCLUDES 500 LBS FOR INSULATOR ASSEMBLIES. (INTACT) V2 INCLUDES 300 LBS FOR INSULATOR ASSEMBLY. (DE)
5. V4 (LINEMAN+EQUIPMENT) = 500 LBS AT ANY ONE LOCATION.
6. DESIGN STRUCTURE FOR BOTH INTACT & DE ONE SIDE CONDITION.
7. STRUCTURES TO BE DESIGNED TO SUPPORT ANY COMBINATION OF TWO SHIELD WIRES (FIBER OR 7#7) – ONE PER OUTSIDE LEG. ABOVE TABLE REFLECTS THE LOADINGS DUE TO THE OPGW WHICH CONTROLLS THE DESIGN.
8. DESIGN FOR HEIGHTS TO CONDUCTOR FROM 55' TO 115' IN 10' INCREMENTS (OVERALL HT 80' TO 140").
9. PROVIDE SOCKET PILE DESIGN (DIAMETER, THICKNESS, AND OVERLAP) FOR EACH STRUCTURE.
10. SEE DRAWING STD-4 FOR STRUCTURE FRAMING.



LOAD TREE 500KV 3–POLE

SLE3–DEPY–S 500 SK4 (15)

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
LOAD TREE, DEADEND, 15°, SS, 55'–115'
STRUCTURE DRAWING & DETAIL

0	11–21–07	CREATED	TWF	HSK	HSK
NO.	DATE	REVISION	BY	CHK	APPR

STD NO. SCALE: NONE

Entergy

No. TFS241A0

PLOT 1=1 SH. 1 OF 1

tfinc90 12/7/2007 SLE3–DEPY–S 500; SK4 (15)

LOADING TABLE *

ITEMS		LOAD	CASE 1	CASE 2	CASE 3	CASE 4
INTACT	SW	T1	3669	3391	2944	881
		V1	1887	4576	774	774
		L1	0	0	0	0
	COND	T2	20682	17691	18884	6397
		V2	14386	23110	6950	6950
		L2	0	0	0	0
DE ONE SIDE	SW	T1	1835	1695	1472	441
		V1	1289	3082	535	535
		L1	6827	7647	4734	1988
	COND	T2	10341	8846	9442	3184
		V2	9586	15448	4622	4622
		L2	39604	39900	29977	14360
WIND ON STRUCTURE		W	10	0	25.6	0
STRUCTURE WEIGHT		VS	TO BE DETERMINED BY T&B			
LINEMAN & EQUIP. WEIGHT		V4	500			
JUMPER INSULATOR WEIGHT		V3	215			

* V, T AND L IN POUNDS, W IN PSF (OLF INCLUDED)

WIRE DATA:

SHIELDWIRE

(2) 24 FIBER OPGW (GW2400 – 64mm2 / 528)
DIA=0.528", WT=0.362 LBS/FT, RTS=18,432 LBS
1" RADIAL ICE, 15° F MAX TENSION 7833 LBS INITIAL
EVERYDAY COND, 60°F TENSION 2036 LBS INITIAL

PHASE CONDUCTOR

(3) 954.0 KCMIL 45/7 STRAND ACSR "RAIL" (TRIPLE BUNDLED)
DIA=1.165", WT=1.0750 LBS/FT, RTS=25,900 LBS
1" ICE, 15°F MAX TENSION 13623 LBS INITIAL (SUB CONDUCT)
EVERYDAY CONDITION, 60°F TENSION 4903 LBS INITIAL (SUB CONDUCT)

MECHANICAL LOADING CRITERIA:

CASE 1 – NESC MEDIUM: 4 PSF WIND ON WIRES AND STRUCTURE, 1/4" RADIAL ICE, 15° F. TRANSVERSE WIND OLF=2.50, LONGITUDINAL OLF=1.65; VERTICAL OLF=1.50.

CASE 2 – HEAVY ICE: 1" RADIAL ICE, NO WIND, 15° F. OLF=1.0

CASE 3 – HIGH WIND: 25.6 PSF WIND ON WIRES AND STRUCTURE, NO ICE, 60° F, OLF=1.00.

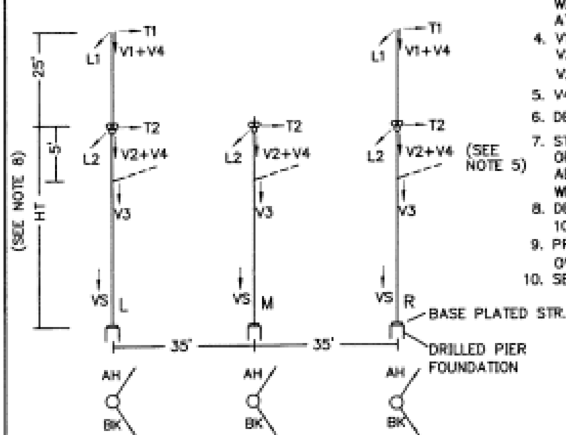
CASE 4 – EVERYDAY: NO WIND, NO ICE, 60° F. OLF=1.0

SPAN DATA:

WIND SPAN = 750 FT (INTACT) 375 FT (DE)
WEIGHT SPAN = 2000 FT (INTACT) 1340 FT (DE)
RULING SPAN = 1000 FT

NOTES:

1. ALL LOADS ARE ULTIMATE LOADS AND INCLUDE OVERLOAD FACTORS PER MECHANICAL LOADING CRITERIA.
2. FOR STRUCTURAL DESIGN, THE LONGITUDINAL (L), TRANSVERSE (T) AND VERTICAL (V) LOADS SHALL BE CONSIDERED TO ACT SIMULTANEOUSLY WITH WIND AND THE DEAD WEIGHT OF THE STRUCTURE.
3. THE TRANSVERSE LOADS (T) INCLUDE WIND ON THE WIRES AND TRANSVERSE (TENSION) LOADS FROM THE LINE ANGLE AT THE STRUCTURE.
4. V1 INCLUDES 50 LBS FOR SHIELDWIRE ASSEMBLY(S).
   V2 INCLUDES 500 LBS FOR INSULATOR ASSEMBLIES. (INTACT)
   V2 INCLUDES 300 LBS FOR INSULATOR ASSEMBLY. (DE)
5. V4 (LINEMAN+EQUIPMENT) = 500 LBS AT ANY ONE LOCATION.
6. DESIGN STRUCTURE FOR BOTH INTACT & DE ONE SIDE CONDITION.
7. STRUCTURES TO BE DESIGNED TO SUPPORT ANY COMBINATION OF TWO SHIRLD WIRES (FIBER OR 7#7) – ONE PER OUTSIDE LEG. ABOVE TABLE REFLECTS THE LOADINGS DUE TO THE OPGW WHICH CONTROLLS THE DESIGN.
8. DESIGN FOR HEIGHTS TO CONDUCTOR FROM 55' TO 115' IN 10' INCREMENTS (OVERALL HT 80' TO 140').
9. PROVIDE SOCKET PILE DESIGN (DIAMETER, THICKNESS, AND OVERLAP) FOR EACH STRUCTURE.
10. SEE DRAWING STD-4 FOR STRUCTURE FRAMING.



LOAD TREE 500KV 3–POLE

SLE3–DEPY–S 500 SK4 (25)

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
LOAD TREE, DEADEND, 25', SS, 55'–115'
STRUCTURE DRAWING & DETAIL

STD NO.	SCALE: NONE
Entergy	No. TFS242A0
PLOT 1=1	SH. 1 OF 1

NO.	DATE	REVISION	BY	CHK	APPR
0	11-21-07	CREATED	TWF	HSK	HSK

tfinc90 12/7/2007 SLE3–DEPY–S 500; SK4 (25)

LOADING TABLE *

ITEMS		LOAD	CASE 1	CASE 2	CASE 3	CASE 4
INTACT	SW	T1	4848	4711	3761	1224
		V1	1887	4576	774	774
		L1	0	0	0	0
	COND	T2	27518	24579	24058	8846
		V2	14386	23110	6950	6950
		L2	0	0	0	0
DE ONE SIDE	SW	T1	2424	2355	1881	612
		V1	1289	3082	535	535
		L1	6669	7470	4625	1942
	COND	T2	13759	12290	12029	4423
		V2	9586	15448	4622	4622
		L2	38688	38977	29284	14028
WIND ON STRUCTURE		W	10	0	25.6	0
STRUCTURE WEIGHT		VS	TO BE DETERMINED BY T&B			
LINEMAN & EQUIP. WEIGHT		V4	500			
JUMPER INSULATOR WEIGHT		V3	215			

* V, T AND L IN POUNDS, W IN PSF (OLF INCLUDED)

WIRE DATA:

SHIELDWIRE

(2) 24 FIBER OPGW (GW2400 – 64mm2 / 528)
DIA=0.528", WT=0.362 LBS/FT, RTS=18,432 LBS
1" RADIAL ICE, 15° F MAX TENSION 7833 LBS INITIAL
EVERYDAY COND, 60°F TENSION 2036 LBS INITIAL

PHASE CONDUCTOR

(3) 954.0 KCMIL 45/7 STRAND ACSR "RAIL" (TRIPLE BUNDLED)
DIA=1.165", WT=1.0750 LBS/FT, RTS=25,900 LBS
1" ICE, 15°F MAX TENSION 13623 LBS INITIAL (SUB CONDUCT)
EVERYDAY CONDITION, 60°F TENSION 4903 LBS INITIAL (SUB CONDUCT)

SPAN DATA:

WIND SPAN = 750 FT (INTACT) 375 FT (DE)
WEIGHT SPAN = 2000 FT (INTACT) 1340 FT (DE)
RULING SPAN = 1000 FT

MECHANICAL LOADING CRITERIA:

CASE 1 – NESC MEDIUM: 4 PSF WIND ON WIRES AND STRUCTURE, 1/4" RADIAL ICE, 15° F. TRANSVERSE WIND OLF=2.50, LONGITUDINAL OLF=1.65; VERTICAL OLF=1.50.

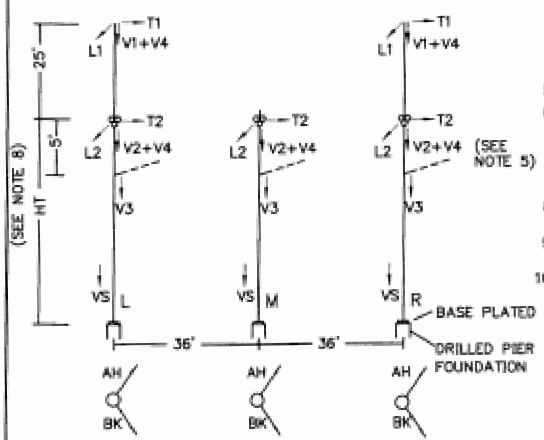
CASE 2 – HEAVY ICE: 1" RADIAL ICE, NO WIND,15° F. OLF=1.0

CASE 3 – HIGH WIND: 25.6 PSF WIND ON WIRES AND STRUCTURE, NO ICE, 60° F, OLF=1.00.

CASE 4 – EVERYDAY: NO WIND, NO ICE, 60° F. OLF=1.0

NOTES:

1. ALL LOADS ARE ULTIMATE LOADS AND INCLUDE OVERLOAD FACTORS PER MECHANICAL LOADING CRITERIA.
2. FOR STRUCTURAL DESIGN, THE LONGITUDINAL (L), TRANSVERSE (T) AND VERTICAL (V) LOADS SHALL BE CONSIDERED TO ACT SIMULTANEOUSLY WITH WIND AND THE DEAD WEIGHT OF THE STRUCTURE.
3. THE TRANSVERSE LOADS (T) INCLUDE WIND ON THE WIRES AND TRANSVERSE (TENSION) LOADS FROM THE LINE ANGLE AT THE STRUCTURE.
4. V1 INCLUDES 50 LBS FOR SHIELDWIRE ASSEMBLY(S). V2 INCLUDES 500 LBS FOR INSULATOR ASSEMBLIES. (INTACT) V2 INCLUDES 300 LBS FOR INSULATOR ASSEMBLY. (DE)
5. V4 (LINEMAN+EQUIPMENT) = 500 LBS AT ANY ONE LOCATION.
6. DESIGN STRUCTURE FOR BOTH INTACT & DE ONE SIDE CONDITION.
7. STRUCTURES TO BE DESIGNED TO SUPPORT ANY COMBINATION OF TWO SHIRLD WIRES (FIBER OR 7#7) – ONE PER OUTSIDE LEG. ABOVE TABLE REFLECTS THE LOADINGS DUE TO THE OPGW WHICH CONTROLLS THE DESIGN.
8. DESIGN FOR HEIGHTS TO CONDUCTOR FROM 55' TO 115' IN 10' INCREMENTS (OVERALL HT 80' TO 140').
9. PROVIDE SOCKET PILE DESIGN (DIAMETER, THICKNESS, AND OVERLAP) FOR EACH STRUCTURE.
10. SEE DRAWING STD-4 FOR STRUCTURE FRAMING.



LOAD TREE 500KV 3-POLE

SLE3-DEPY-S 500 SK4 (35)

ENTERGY SERVICES, INC.	
Transmission LineDesign Standard LOAD TREE, DEADEND, 35°, SS, 55'-115' STRUCTURE DRAWING & DETAIL	
STD NO.	SCALE: NONE
Entergy	No. TFS243A0
	PLOT 1=1 / SH. 1 OF 1

NO.	DATE:	REVISION	BY:	CHK:	APPR
0	11-21-07	CREATED	TWF	HSK	HSK

tfinc90 12/7/2007 SLE3-DEPY-S 500; SK4 (35)

LOADING TABLE *

ITEMS		LOAD	CASE 1	CASE 2	CASE 3	CASE 4
INTACT	SW	T1	5994	5995	4556	1558
		V1	1887	4576	774	774
		L1	0	0	0	0
	COND	T2	34169	31280	29093	11258
		V2	14386	23110	6950	6950
		L2	0	0	0	0
DE ONE SIDE	SW	T1	2997	2998	2278	779
		V1	1289	3082	535	535
		L1	6460	7237	4480	1881
	COND	T2	17085	15640	14546	5629
		V2	9586	15448	4622	4622
		L2	37477	37758	28368	13589
WIND ON STRUCTURE		W	10	0	25.6	0
STRUCTURE WEIGHT		VS	TO BE DETERMINED BY T&B			
LINEMAN & EQUIP. WEIGHT		V4	500			
JUMPER INSULATOR WEIGHT		V3	215			

* V, T AND L IN POUNDS, W IN PSF (OLF INCLUDED)

WIRE DATA:

SHIELDWIRE

(2) 24 FIBER OPGW (GW2400 – 64mm2 / 528)
DIA=0.528", WT=0.362 LBS/FT, RTS=18,432 LBS
1" RADIAL ICE, 15° F MAX TENSION 7833 LBS INITIAL
EVERYDAY COND, 60°F TENSION 2036 LBS INITIAL

PHASE CONDUCTOR

(3) 954.0 KCMIL 45/7 STRAND ACSR "RAIL" (TRIPLE BUNDLED)
DIA=1.165", WT=1.0750 LBS/FT, RTS=25,900 LBS
1" ICE, 15°F MAX TENSION 13623 LBS INITIAL (SUB CONDUCT)
EVERYDAY CONDITION, 60°F TENSION 4903 LBS INITIAL (SUB CONDUCT)

SPAN DATA:

WIND SPAN = 750 FT (INTACT) 375 FT (DE)
WEIGHT SPAN = 2000 FT (INTACT) 1340 FT (DE)
RULING SPAN = 1000 FT

MECHANICAL LOADING CRITERIA:

CASE 1 – NESC MEDIUM: 4 PSF WIND ON WIRES AND STRUCTURE, 1/4" RADIAL ICE, 15° F. TRANSVERSE WIND OLF=2.50, LONGITUDINAL OLF=1.65; VERTICAL OLF=1.50.

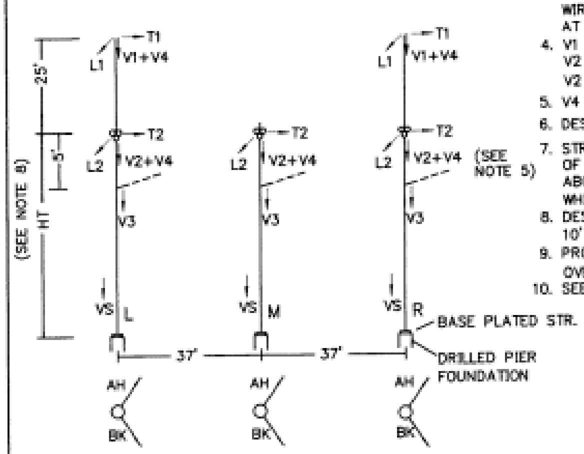
CASE 2 – HEAVY ICE: 1" RADIAL ICE, NO WIND, 15° F. OLF=1.0

CASE 3 – HIGH WIND: 25.6 PSF WIND ON WIRES AND STRUCTURE, NO ICE, 60° F, OLF=1.00.

CASE 4 – EVERYDAY: NO WIND, NO ICE, 60° F. OLF=1.0

NOTES:

1. ALL LOADS ARE ULTIMATE LOADS AND INCLUDE OVERLOAD FACTORS PER MECHANICAL LOADING CRITERIA.
2. FOR STRUCTURAL DESIGN, THE LONGITUDINAL (L), TRANSVERSE (T) AND VERTICAL (V) LOADS SHALL BE CONSIDERED TO ACT SIMULTANEOUSLY WITH WIND AND THE DEAD WEIGHT OF THE STRUCTURE.
3. THE TRANSVERSE LOADS (T) INCLUDE WIND ON THE WIRES AND TRANSVERSE (TENSION) LOADS FROM THE LINE ANGLE AT THE STRUCTURE.
4. V1 INCLUDES 50 LBS FOR SHIELDWIRE ASSEMBLY(S).
   V2 INCLUDES 500 LBS FOR INSULATOR ASSEMBLIES. (INTACT)
   V2 INCLUDES 300 LBS FOR INSULATOR ASSEMBLY. (DE)
5. V4 (LINEMAN+EQUIPMENT) = 500 LBS AT ANY ONE LOCATION.
6. DESIGN STRUCTURE FOR BOTH INTACT & DE ONE SIDE CONDITION.
7. STRUCTURES TO BE DESIGNED TO SUPPORT ANY COMBINATION OF TWO SHIRLD WIRES (FIBER OR 7#7) – ONE PER OUTSIDE LEG. ABOVE TABLE REFLECTS THE LOADINGS DUE TO THE OPGW WHICH CONTROLLS THE DESIGN.
8. DESIGN FOR HEIGHTS TO CONDUCTOR FROM 55' TO 115' IN 10' INCREMENTS (OVERALL HT 80' TO 140').
9. PROVIDE SOCKET PILE DESIGN (DIAMETER, THICKNESS, AND OVERLAP) FOR EACH STRUCTURE.
10. SEE DRAWING STD-4 FOR STRUCTURE FRAMING.



LOAD TREE 500KV 3-POLE

SLE3-DEPY-S 500 SK4 (45)

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
LOAD TREE, DEADEND, 45°, SS, 55'-115'
STRUCTURE DRAWING & DETAIL

STD NO.	SCALE: NONE
Entergy	No. TFS244A0
	PLOT 1=1 · SH. 1 OF 1

NO.	DATE	REVISION	BY	CHK	APPR
0	11-21-07	CREATED	TWF	HSK	HSK

tflnc90 12/7/2007 SLE3-DEPY-S 500; SK4 (45)

LOADING TABLE *

ITEMS		LOAD	CASE 1	CASE 2	CASE 3	CASE 4
INTACT	SW	T1	7100	7234	5323	1880
		V1	1887	4576	774	774
		L1	0	0	0	0
	COND	T2	40584	37742	33948	13584
		V2	14386	23110	6950	6950
		L2	0	0	0	0
DE ONE SIDE	SW	T1	3550	3617	2661	940
		V1	1289	3082	535	535
		L1	6203	6948	4301	1806
	COND	T2	20292	18871	16974	6792
		V2	9586	15448	4622	4622
		L2	35982	36251	27236	13047
WIND ON STRUCTURE		W	10	0	25.6	0
STRUCTURE WEIGHT		VS	TO BE DETERMINED BY T&B			
LINEMAN & EQUIP. WEIGHT		V4	500			
JUMPER INSULATOR WEIGHT		V3	215			

* V, T AND L IN POUNDS, W IN PSF (OLF INCLUDED)

WIRE DATA:

SHIELDWIRE

(2) 24 FIBER OPGW (GW2400 – 64mm2 / 528)
DIA=0.528", WT=0.362 LBS/FT, RTS=18,432 LBS
1" RADIAL ICE, 15' F MAX TENSION 7833 LBS INITIAL
EVERYDAY COND, 60'F TENSION 2036 LBS INITIAL

PHASE CONDUCTOR

(3) 954.0 KCMIL 45/7 STRAND ACSR "RAIL" (TRIPLE BUNDLED)
DIA=1.165", WT=1.0750 LBS/FT, RTS=25,900 LBS
1" ICE, 15'F MAX TENSION 13623 LBS INITIAL (SUB CONDUCT)
EVERYDAY CONDITION, 60'F TENSION 4903 LBS INITIAL (SUB CONDUCT)

MECHANICAL LOADING CRITERIA:

CASE 1 – NESC MEDIUM: 4 PSF WIND ON WIRES AND STRUCTURE, 1/4" RADIAL ICE, 15' F. TRANSVERSE WIND OLF=2.50, LONGITUDINAL OLF=1.65; VERTICAL OLF=1.50.

CASE 2 – HEAVY ICE: 1" RADIAL ICE, NO WIND,15' F. OLF=1.0

CASE 3 – HIGH WIND: 25.6 PSF WIND ON WIRES AND STRUCTURE, NO ICE, 60' F, OLF=1.00.

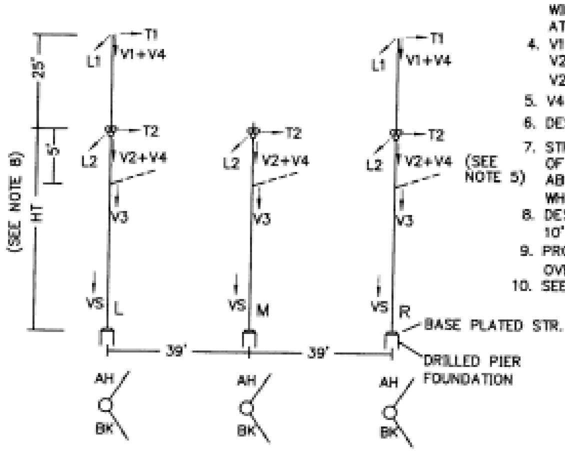
CASE 4 – EVERYDAY: NO WIND, NO ICE, 60' F. OLF=1.0

SPAN DATA:

WIND SPAN = 750 FT (INTACT) 375 FT (DE)
WEIGHT SPAN = 2000 FT (INTACT) 1340 FT (DE)
RULING SPAN = 1000 FT

NOTES:

1. ALL LOADS ARE ULTIMATE LOADS AND INCLUDE OVERLOAD FACTORS PER MECHANICAL LOADING CRITERIA.
2. FOR STRUCTURAL DESIGN, THE LONGITUDINAL (L), TRANSVERSE (T) AND VERTICAL (V) LOADS SHALL BE CONSIDERED TO ACT SIMULTANEOUSLY WITH WIND AND THE DEAD WEIGHT OF THE STRUCTURE.
3. THE TRANSVERSE LOADS (T) INCLUDE WIND ON THE WIRES AND TRANSVERSE (TENSION) LOADS FROM THE LINE ANGLE AT THE STRUCTURE.
4. V1 INCLUDES 50 LBS FOR SHIELDWIRE ASSEMBLY(S). V2 INCLUDES 500 LBS FOR INSULATOR ASSEMBLIES. (INTACT) V2 INCLUDES 300 LBS FOR INSULATOR ASSEMBLY. (DE)
5. V4 (LINEMAN+EQUIPMENT) = 500 LBS AT ANY ONE LOCATION.
6. DESIGN STRUCTURE FOR BOTH INTACT & DE ONE SIDE CONDITION.
7. STRUCTURES TO BE DESIGNED TO SUPPORT ANY COMBINATION OF TWO SHIRLD WIRES (FIBER OR 7#7) – ONE PER OUTSIDE LEG. ABOVE TABLE REFLECTS THE LOADINGS DUE TO THE OPGW WHICH CONTROLLS THE DESIGN.
8. DESIGN FOR HEIGHTS TO CONDUCTOR FROM 55' TO 115' IN 10' INCREMENTS (OVERALL HT 80' TO 140').
9. PROVIDE SOCKET PILE DESIGN (DIAMETER, THICKNESS, AND OVERLAP) FOR EACH STRUCTURE.
10. SEE DRAWING STD-4 FOR STRUCTURE FRAMING.



LOAD TREE 500KV 3-POLE

SLE3-DEPY-S 500 SK4 (55)

0	11-21-07	CREATED	TWF	HSK	HSK
NO.	DATE	REVISION	BY	CHK	APPR

tfinc90 12/7/2007

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
LOAD TREE, DEADEND, 55', SS, 55'–115'
STRUCTURE DRAWING & DETAIL

STD NO. | SCALE: NONE

Entergy

No. TFS245A0

PLOT 1=1 | SH. 1 OF 1

SLE3-DEPY-S 500; SK4 (55)

LOADING TABLE *

ITEMS		LOAD	CASE 1	CASE 2	CASE 3	CASE 4
INTACT	SW	T1	8157	8417	6056	2188
		V1	1887	4576	774	774
		L1	0	0	0	0
	COND	T2	46713	43918	38588	15806
		V2	14386	23110	6950	6950
		L2	0	0	0	0
DE ONE SIDE	SW	T1	4078	4209	3028	1094
		V1	1289	3082	535	535
		L1	5898	6606	4090	1717
	COND	T2	23357	21959	19294	7903
		V2	9586	15448	4622	4622
		L2	34212	34469	25896	12405
WIND ON STRUCTURE		W	10	0	25.6	0
STRUCTURE WEIGHT		VS	TO BE DETERMINED BY T&B			
LINEMAN & EQUIP. WEIGHT		V4	500			
JUMPER INSULATOR WEIGHT		V3	215			

* V, T AND L IN POUNDS, W IN PSF (OLF INCLUDED)

WIRE DATA:

SHIELDWIRE

(2) 24 FIBER OPGW (GW2400 – 64mm2 / 528)
DIA=0.528", WT=0.362 LBS/FT, RTS=18,432 LBS
1" RADIAL ICE, 15° F MAX TENSION 7833 LBS INITIAL
EVERYDAY COND, 60°F TENSION 2036 LBS INITIAL

PHASE CONDUCTOR

(3) 954.0 KCMIL 45/7 STRAND ACSR "RAIL" (TRIPLE BUNDLED)
DIA=1.165", WT=1.0750 LBS/FT, RTS=25,900 LBS
1" ICE, 15°F MAX TENSION 13623 LBS INITIAL (SUB CONDUCT)
EVERYDAY CONDITION, 60°F TENSION 4903 LBS INITIAL (SUB CONDUCT)

MECHANICAL LOADING CRITERIA:

CASE 1 – NESC MEDIUM: 4 PSF WIND ON WIRES AND STRUCTURE, 1/4" RADIAL ICE, 15° F. TRANSVERSE WIND OLF=2.50, LONGITUDINAL OLF=1.65; VERTICAL OLF=1.50.

CASE 2 – HEAVY ICE: 1" RADIAL ICE, NO WIND, 15° F. OLF=1.0

CASE 3 – HIGH WIND: 25.6 PSF WIND ON WIRES AND STRUCTURE, NO ICE, 60° F, OLF=1.00.

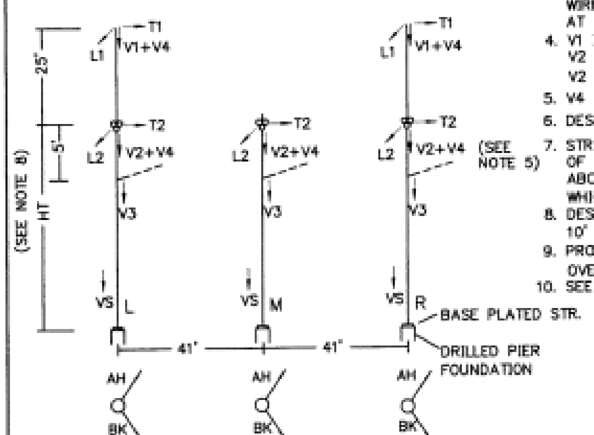
CASE 4 – EVERYDAY: NO WIND, NO ICE, 60° F. OLF=1.0

SPAN DATA:

WIND SPAN = 750 FT (INTACT) 375 FT (DE)
WEIGHT SPAN = 2000 FT (INTACT) 1340 FT (DE)
RULING SPAN = 1000 FT

NOTES:

1. ALL LOADS ARE ULTIMATE LOADS AND INCLUDE OVERLOAD FACTORS PER MECHANICAL LOADING CRITERIA.
2. FOR STRUCTURAL DESIGN, THE LONGITUDINAL (L), TRANSVERSE (T) AND VERTICAL (V) LOADS SHALL BE CONSIDERED TO ACT SIMULTANEOUSLY WITH WIND AND THE DEAD WEIGHT OF THE STRUCTURE.
3. THE TRANSVERSE LOADS (T) INCLUDE WIND ON THE WIRES AND TRANSVERSE (TENSION) LOADS FROM THE LINE ANGLE AT THE STRUCTURE.
4. V1 INCLUDES 50 LBS FOR SHIELDWIRE ASSEMBLY(S). V2 INCLUDES 500 LBS FOR INSULATOR ASSEMBLIES. (INTACT) V2 INCLUDES 300 LBS FOR INSULATOR ASSEMBLY. (DE)
5. V4 (LINEMAN+EQUIPMENT) = 500 LBS AT ANY ONE LOCATION.
6. DESIGN STRUCTURE FOR BOTH INTACT & DE ONE SIDE CONDITION.
7. STRUCTURES TO BE DESIGNED TO SUPPORT ANY COMBINATION OF TWO SHIRLD WIRES (FIBER OR 7#7) – ONE PER OUTSIDE LEG. ABOVE TABLE REFLECTS THE LOADINGS DUE TO THE OPGW WHICH CONTROLLS THE DESIGN.
8. DESIGN FOR HEIGHTS TO CONDUCTOR FROM 55' TO 115' IN 10' INCREMENTS (OVERALL HT 80' TO 140').
9. PROVIDE SOCKET PILE DESIGN (DIAMETER, THICKNESS, AND OVERLAP) FOR EACH STRUCTURE.
10. SEE DRAWING STD–4 FOR STRUCTURE FRAMING.



LOAD TREE 500KV 3–POLE

SLE3–DEPY–S 500 SK4 (65)

ENTERGY SERVICES, INC.					
Transmission LineDesign Standard LOAD TREE, DEADEND, 65°, SS, 55'–115' STRUCTURE DRAWING & DETAIL					
STD NO.		SCALE: NONE			
Entergy	No. TFS246A0				
	PLOT 1=1	SH. 1 OF 1			

NO.	DATE:	REVISION	BY:	CHK:	APPR
0	11–21–07	CREATED	TWF	HSK	HSK

tfinc90 12/7/2007 SLE3–DEPY–S 500; SK4 (65)

LOADING TABLE *

ITEMS		LOAD	CASE 1	CASE 2	CASE 3	CASE 4
INTACT	SW	T1	8664	8986	6407	2336
		V1	1887	4576	774	774
		L1	0	0	0	0
	COND	T2	49656	46883	40815	16873
		V2	14386	23110	6950	6950
		L2	0	0	0	0
DE ONE SIDE	SW	T1	4332	4493	3204	1168
		V1	1289	3082	535	535
		L1	5728	6416	3972	1668
	COND	T2	24828	23441	20408	8437
		V2	9586	15448	4622	4622
		L2	33229	33478	25152	12049
WIND ON STRUCTURE		W	10	0	25.6	0
STRUCTURE WEIGHT		VS	TO BE DETERMINED BY T&B			
LINEMAN & EQUIP. WEIGHT		V3	500			

* V, T AND L IN POUNDS, W IN PSF (OLF INCLUDED)

WIRE DATA:

SHIELDWIRE

(2) 24 FIBER OPGW (GW2400 – 64mm2 / 528)
DIA=0.528", WT=0.362 LBS/FT, RTS=18,432 LBS
1" RADIAL ICE, 15° F MAX TENSION 7833 LBS INITIAL
EVERYDAY COND, 60°F TENSION 2036 LBS INITIAL

PHASE CONDUCTOR

(3) 954.0 KCMIL 45/7 STRAND ACSR "RAIL" (TRIPLE BUNDLED)
DIA=1.165", WT=1.0750 LBS/FT, RTS=25,900 LBS
1" ICE, 15°F MAX TENSION 13623 LBS INITIAL (SUB CONDUCT)
EVERYDAY CONDITION, 60°F TENSION 4903 LBS INITIAL (SUB CONDUCT)

MECHANICAL LOADING CRITERIA:

CASE 1 – NESC MEDIUM: 4 PSF WIND ON WIRES AND STRUCTURE, 1/4" RADIAL ICE, 15° F. TRANSVERSE WIND OLF=2.50, LONGITUDINAL OLF=1.65; VERTICAL OLF=1.50.

CASE 2 – HEAVY ICE: 1" RADIAL ICE, NO WIND,15° F. OLF=1.0

CASE 3 – HIGH WIND: 25.6 PSF WIND ON WIRES AND STRUCTURE, NO ICE, 60° F, OLF=1.00.

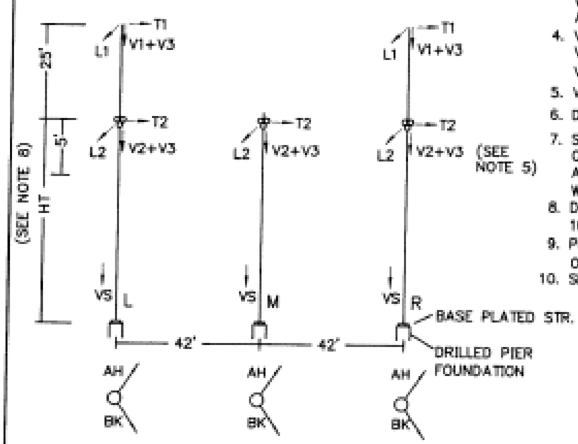
CASE 4 – EVERYDAY: NO WIND, NO ICE, 60° F. OLF=1.0

SPAN DATA:

WIND SPAN = 750 FT (INTACT) 375 FT (DE)
WEIGHT SPAN = 2000 FT (INTACT) 1340 FT (DE)
RULING SPAN = 1000 FT

NOTES:

1. ALL LOADS ARE ULTIMATE LOADS AND INCLUDE OVERLOAD FACTORS PER MECHANICAL LOADING CRITERIA.
2. FOR STRUCTURAL DESIGN, THE LONGITUDINAL (L), TRANSVERSE (T) AND VERTICAL (V) LOADS SHALL BE CONSIDERED TO ACT SIMULTANEOUSLY WITH WIND AND THE DEAD WEIGHT OF THE STRUCTURE.
3. THE TRANSVERSE LOADS (T) INCLUDE WIND ON THE WIRES AND TRANSVERSE (TENSION) LOADS FROM THE LINE ANGLE AT THE STRUCTURE.
4. V1 INCLUDES 50 LBS FOR SHIELDWIRE ASSEMBLY(S). V2 INCLUDES 500 LBS FOR INSULATOR ASSEMBLIES. (INTACT) V2 INCLUDES 300 LBS FOR INSULATOR ASSEMBLY. (DE)
5. V3 (LINEMAN+EQUIPMENT) = 500 LBS AT ANY ONE LOCATION.
6. DESIGN STRUCTURE FOR BOTH INTACT & DE ONE SIDE CONDITION.
7. STRUCTURES TO BE DESIGNED TO SUPPORT ANY COMBINATION OF TWO SHIRLD WIRES (FIBER OR 7#7) – ONE PER OUTSIDE LEG. ABOVE TABLE REFLECTS THE LOADINGS DUE TO THE OPGW WHICH CONTROLLS THE DESIGN.
8. DESIGN FOR HEIGHTS TO CONDUCTOR FROM 55' TO 115' IN 10' INCREMENTS (OVERALL HT 80' TO 140').
9. PROVIDE SOCKET PILE DESIGN (DIAMETER, THICKNESS, AND OVERLAP) FOR EACH STRUCTURE.
10. SEE DRAWING STD–5 FOR STRUCTURE FRAMING.



LOAD TREE 500KV 3–POLE

SLE3–DEPY–S 500 SK5 (70)

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
LOAD TREE, DEADEND, 70°, SS, 55'–115'
STRUCTURE DRAWING & DETAIL

STD NO. SCALE: NONE

Entergy No. TFS247A0

PLOT 1=1 SH. 1 OF 1

NO.	DATE:	REVISION	BY:	CHK:	APPR:
0	11–21–07	CREATED	TWF	HSK	HSK

tfinc90 12/7/2007

SLE3–DEPY–S 500; SK5 (70)

LOADING TABLE *

ITEMS		LOAD	CASE 1	CASE 2	CASE 3	CASE 4
INTACT	SW	T1	9632	10070	7079	2617
		V1	1887	4576	774	774
		L1	0	0	0	0
	COND	T2	55272	52540	45066	18910
		V2	14386	23110	6950	6950
		L2	0	0	0	0
DE ONE SIDE	SW	T1	4816	5035	3539	1309
		V1	1289	3082	535	535
		L1	5357	6000	3715	1560
	COND	T2	27636	26270	22533	9455
		V2	9586	15448	4622	4622
		L2	31075	31307	23521	11286
WIND ON STRUCTURE		W	10	0	25.6	0
STRUCTURE WEIGHT		VS	TO BE DETERMINED BY T&B			
LINEMAN & EQUIP. WEIGHT		V3	500			

* V, T AND L IN POUNDS, W IN PSF (OLF INCLUDED)

WIRE DATA:

SHIELDWIRE

(2) 24 FIBER OPGW (GW2400 – 64mm2 / 528)
DIA=0.528", WT=0.362 LBS/FT, RTS=18,432 LBS
1" RADIAL ICE, 15° F MAX TENSION 7833 LBS INITIAL
EVERYDAY COND, 60°F TENSION 2036 LBS INITIAL

PHASE CONDUCTOR

(3) 954.0 KCMIL 45/7 STRAND ACSR "RAIL" (TRIPLE BUNDLED)
DIA=1.165", WT=1.0750 LBS/FT, RTS=25,900 LBS
1" ICE, 15°F MAX TENSION 13623 LBS INITIAL (SUB CONDUCT)
EVERYDAY CONDITION, 60°F TENSION 4903 LBS INITIAL (SUB CONDUCT)

SPAN DATA:

WIND SPAN = 750 FT (INTACT) 375 FT (DE)
WEIGHT SPAN = 2000 FT (INTACT) 1340 FT (DE)
RULING SPAN = 1000 FT

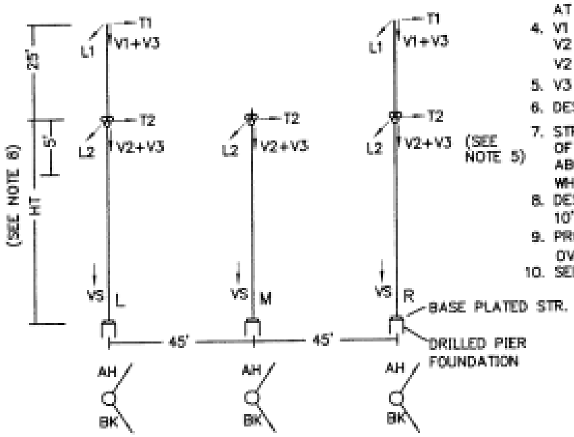
MECHANICAL LOADING CRITERIA:

CASE 1 – NESC MEDIUM: 4 PSF WIND ON WIRES AND STRUCTURE, 1/4" RADIAL ICE, 15' F. TRANSVERSE WIND OLF=2.50, LONGITUDINAL OLF=1.65; VERTICAL OLF=1.50.

CASE 2 – HEAVY ICE: 1" RADIAL ICE, NO WIND,15' F. OLF=1.0

CASE 3 – HIGH WIND: 25.6 PSF WIND ON WIRES AND STRUCTURE, NO ICE, 60' F, OLF=1.00.

CASE 4 – EVERYDAY: NO WIND, NO ICE, 60' F. OLF=1.0



NOTES:

1. ALL LOADS ARE ULTIMATE LOADS AND INCLUDE OVERLOAD FACTORS PER MECHANICAL LOADING CRITERIA.
2. FOR STRUCTURAL DESIGN, THE LONGITUDINAL (L), TRANSVERSE (T) AND VERTICAL (V) LOADS SHALL BE CONSIDERED TO ACT SIMULTANEOUSLY WITH WIND AND THE DEAD WEIGHT OF THE STRUCTURE.
3. THE TRANSVERSE LOADS (T) INCLUDE WIND ON THE WIRES AND TRANSVERSE (TENSION) LOADS FROM THE LINE ANGLE AT THE STRUCTURE.
4. V1 INCLUDES 50 LBS FOR SHIELDWIRE ASSEMBLY(S).
   V2 INCLUDES 500 LBS FOR INSULATOR ASSEMBLIES. (INTACT)
   V2 INCLUDES 300 LBS FOR INSULATOR ASSEMBLY. (DE)
5. V3 (LINEMAN+EQUIPMENT) = 500 LBS AT ANY ONE LOCATION.
6. DESIGN STRUCTURE FOR BOTH INTACT & DE ONE SIDE CONDITION.
7. STRUCTURES TO BE DESIGNED TO SUPPORT ANY COMBINATION OF TWO SHIRLD WIRES (FIBER OR 7#7) – ONE PER OUTSIDE LEG. ABOVE TABLE REFLECTS THE LOADINGS DUE TO THE OPGW WHICH CONTROLLS THE DESIGN.
8. DESIGN FOR HEIGHTS TO CONDUCTOR FROM 55' TO 115' IN 10' INCREMENTS (OVERALL HT 80' TO 140').
9. PROVIDE SOCKET PILE DESIGN (DIAMETER, THICKNESS, AND OVERLAP) FOR EACH STRUCTURE.
10. SEE DRAWING STD-5 FOR STRUCTURE FRAMING.

LOAD TREE 500KV 3-POLE

SLE3-DEPY-S 500 SK5 (80)

ENTERGY SERVICES, INC.	
Transmission LineDesign Standard LOAD TREE, DEADEND, 80', SS, 55'-115' STRUCTURE DRAWING & DETAIL	
STD NO.	SCALE: NONE
Entergy	No. TFS248A0
	PLOT 1=1 / SH. 1 OF 1

NO.	DATE:	REVISION	BY:	CHK:	APPR
0	11-21-07	CREATED	TWF	HSK	HSK

tfinc90 12/7/2007 SLE3-DEPY-S 500; SK5 (80)

LOADING TABLE *

ITEMS		LOAD	CASE 1	CASE 2	CASE 3	CASE 4
INTACT	SW	T1	10532	11078	7702	2879
		V1	1887	4576	774	774
		L1	0	0	0	0
	COND	T2	60490	57797	49015	20802
		V2	14386	23110	6950	6950
		L2	0	0	0	0
DE ONE SIDE	SW	T1	5266	5539	3851	1440
		V1	1289	3082	535	535
		L1	4945	5539	3429	1440
	COND	T2	30245	28899	24508	10401
		V2	9586	15448	4622	4622
		L2	28684	28899	21712	10401
WIND ON STRUCTURE		W	10	0	25.6	0
STRUCTURE WEIGHT		VS	TO BE DETERMINED BY T&B			
LINEMAN & EQUIP. WEIGHT		V3	500			

* V, T AND L IN POUNDS, W IN PSF (OLF INCLUDED)

WIRE DATA:

SHIELDWIRE

(2) 24 FIBER OPGW (GW2400 – 64mm2 / 528)
DIA=0.528", WT=0.362 LBS/FT, RTS=18,432 LBS
1" RADIAL ICE, 15° F MAX TENSION 7833 LBS INITIAL
EVERYDAY COND, 60°F TENSION 2036 LBS INITIAL

PHASE CONDUCTOR

(3) 954.0 KCMIL 45/7 STRAND ACSR "RAIL" (TRIPLE BUNDLED)
DIA=1.165", WT=1.0750 LBS/FT, RTS=25,900 LBS
1" ICE, 15°F MAX TENSION 13623 LBS INITIAL (SUB CONDUCT)
EVERYDAY CONDITION, 60°F TENSION 4903 LBS INITIAL (SUB CONDUCT)

MECHANICAL LOADING CRITERIA:

CASE 1 – NESC MEDIUM: 4 PSF WIND ON WIRES AND STRUCTURE, 1/4" RADIAL ICE, 15° F. TRANSVERSE WIND OLF=2.50, LONGITUDINAL OLF=1.65; VERTICAL OLF=1.50.

CASE 2 – HEAVY ICE: 1" RADIAL ICE, NO WIND, 15° F. OLF=1.0

CASE 3 – HIGH WIND: 25.6 PSF WIND ON WIRES AND STRUCTURE, NO ICE, 60° F, OLF=1.00.

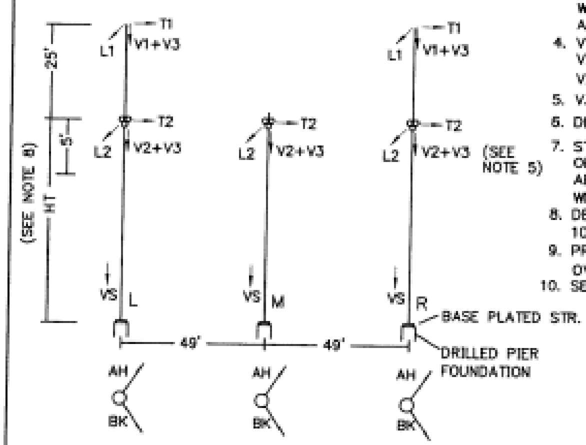
CASE 4 – EVERYDAY: NO WIND, NO ICE, 60° F. OLF=1.0

SPAN DATA:

WIND SPAN = 750 FT (INTACT) 375 FT (DE)
WEIGHT SPAN = 2000 FT (INTACT) 1340 FT (DE)
RULING SPAN = 1000 FT

NOTES:

1. ALL LOADS ARE ULTIMATE LOADS AND INCLUDE OVERLOAD FACTORS PER MECHANICAL LOADING CRITERIA.
2. FOR STRUCTURAL DESIGN, THE LONGITUDINAL (L), TRANSVERSE (T) AND VERTICAL (V) LOADS SHALL BE CONSIDERED TO ACT SIMULTANEOUSLY WITH WIND AND THE DEAD WEIGHT OF THE STRUCTURE.
3. THE TRANSVERSE LOADS (T) INCLUDE WIND ON THE WIRES AND TRANSVERSE (TENSION) LOADS FROM THE LINE ANGLE AT THE STRUCTURE.
4. V1 INCLUDES 50 LBS FOR SHIELDWIRE ASSEMBLY(S). V2 INCLUDES 500 LBS FOR INSULATOR ASSEMBLIES. (INTACT) V2 INCLUDES 300 LBS FOR INSULATOR ASSEMBLY. (DE)
5. V3 (LINEMAN+EQUIPMENT) = 500 LBS AT ANY ONE LOCATION.
6. DESIGN STRUCTURE FOR BOTH INTACT & DE ONE SIDE CONDITION.
7. STRUCTURES TO BE DESIGNED TO SUPPORT ANY COMBINATION OF TWO SHIRLD WIRES (FIBER OR 7#7) – ONE PER OUTSIDE LEG. ABOVE TABLE REFLECTS THE LOADINGS DUE TO THE OPGW WHICH CONTROLLS THE DESIGN.
8. DESIGN FOR HEIGHTS TO CONDUCTOR FROM 55' TO 115' IN 10' INCREMENTS (OVERALL HT 80' TO 140').
9. PROVIDE SOCKET PILE DESIGN (DIAMETER, THICKNESS, AND OVERLAP) FOR EACH STRUCTURE.
10. SEE DRAWING STD–5 FOR STRUCTURE FRAMING.



LOAD TREE 500KV 3–POLE

SLE3–DEPY–S 500 SK5 (90)

ENTERGY SERVICES, INC.	
Transmission LineDesign Standard LOAD TREE, DEADEND, 90°, SS, 55'–115' STRUCTURE DRAWING & DETAIL	
STD NO.	SCALE: NONE
Entergy	No. TFS249A0
	PLOT 1=1 / SH. 1 OF 1

NO.	DATE	REVISION	BY	CHK	APPR
0	11–21–07	CREATED	TWF	HSK	HSK

tfinc90 12/7/2007 SLE3–DEPY–S 500; SK5 (90)

LOADING TABLE *

ITEMS		LOAD	CASE 1	CASE 2	CASE 3	CASE 4
INTACT	SW	T1	11356	12001	8274	3119
		V1	1887	4576	774	774
		L1	0	0	0	0
	COND	T2	65271	62615	52635	22535
		V2	14386	23110	6950	6950
		L2	0	0	0	0
DE ONE SIDE	SW	T1	5678	6000	4137	1560
		V1	1289	3082	535	535
		L1	4495	5035	3117	1309
	COND	T2	32636	31307	26317	11268
		V2	9586	15448	4622	4622
		L2	26075	26270	19737	9455
WIND ON STRUCTURE		W	10	0	25.6	0
STRUCTURE WEIGHT		VS	TO BE DETERMINED BY T&B			
LINEMAN & EQUIP. WEIGHT		V3	500			

* V, T AND L IN POUNDS, W IN PSF (OLF INCLUDED)

WIRE DATA:

SHIELDWIRE
(2) 24 FIBER OPGW (GW2400 – 64mm2 / 528)
DIA=0.528", WT=0.362 LBS/FT, RTS=18,432 LBS
1" RADIAL ICE, 15° F MAX TENSION 7833 LBS INITIAL
EVERYDAY COND, 60°F TENSION 2036 LBS INITIAL

PHASE CONDUCTOR
(3) 954.0 KCMIL 45/7 STRAND ACSR "RAIL" (TRIPLE BUNDLED)
DIA=1.165", WT=1.0750 LBS/FT, RTS=25,900 LBS
1" ICE, 15°F MAX TENSION 13623 LBS INITIAL (SUB CONDUCT)
EVERYDAY CONDITION, 60°F TENSION 4903 LBS INITIAL (SUB CONDUCT)

MECHANICAL LOADING CRITERIA:

CASE 1 – NESC MEDIUM: 4 PSF WIND ON WIRES AND STRUCTURE, 1/4" RADIAL ICE, 15° F. TRANSVERSE WIND OLF=2.50, LONGITUDINAL OLF=1.65; VERTICAL OLF=1.50.

CASE 2 – HEAVY ICE: 1" RADIAL ICE, NO WIND,15° F. OLF=1.0

CASE 3 – HIGH WIND: 25.6 PSF WIND ON WIRES AND STRUCTURE, NO ICE, 60° F, OLF=1.00.

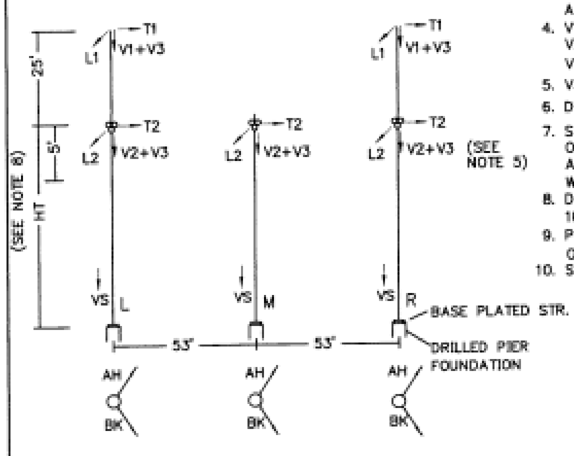
CASE 4 – EVERYDAY: NO WIND, NO ICE, 60° F. OLF=1.0

SPAN DATA:

WIND SPAN = 750 FT (INTACT) 375 FT (DE)
WEIGHT SPAN = 2000 FT (INTACT) 1340 FT (DE)
RULING SPAN = 1000 FT

NOTES:

1. ALL LOADS ARE ULTIMATE LOADS AND INCLUDE OVERLOAD FACTORS PER MECHANICAL LOADING CRITERIA.
2. FOR STRUCTURAL DESIGN, THE LONGITUDINAL (L), TRANSVERSE (T) AND VERTICAL (V) LOADS SHALL BE CONSIDERED TO ACT SIMULTANEOUSLY WITH WIND AND THE DEAD WEIGHT OF THE STRUCTURE.
3. THE TRANSVERSE LOADS (T) INCLUDE WIND ON THE WIRES AND TRANSVERSE (TENSION) LOADS FROM THE LINE ANGLE AT THE STRUCTURE.
4. V1 INCLUDES 50 LBS FOR SHIELDWIRE ASSEMBLY(S). V2 INCLUDES 500 LBS FOR INSULATOR ASSEMBLIES. (INTACT) V2 INCLUDES 300 LBS FOR INSULATOR ASSEMBLY. (DE)
5. V3 (LINEMAN+EQUIPMENT) = 500 LBS AT ANY ONE LOCATION.
6. DESIGN STRUCTURE FOR BOTH INTACT & DE ONE SIDE CONDITION.
7. STRUCTURES TO BE DESIGNED TO SUPPORT ANY COMBINATION OF TWO SHIRLD WIRES (FIBER OR 7#7) – ONE PER OUTSIDE LEG. ABOVE TABLE REFLECTS THE LOADINGS DUE TO THE OPGW WHICH CONTROLLS THE DESIGN.
8. DESIGN FOR HEIGHTS TO CONDUCTOR FROM 55' TO 115' IN 10' INCREMENTS (OVERALL HT 80' TO 140').
9. PROVIDE SOCKET PILE DESIGN (DIAMETER, THICKNESS, AND OVERLAP) FOR EACH STRUCTURE.
10. SEE DRAWING STD-5 FOR STRUCTURE FRAMING.



LOAD TREE 500KV 3–POLE
SLE3–DEPY–S 500 SK5 (100)

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
LOAD TREE, DEADEND, 100', SS, 55'–115'
STRUCTURE DRAWING & DETAIL

STD NO.	SCALE: NONE
No. TFS250A0	
PLOT 1=1	SH. 1 OF 1

NO.	DATE:	REVISION	BY:	CHK:	APPR
0	11–21–07	CREATED	TWF	HSK	HSK

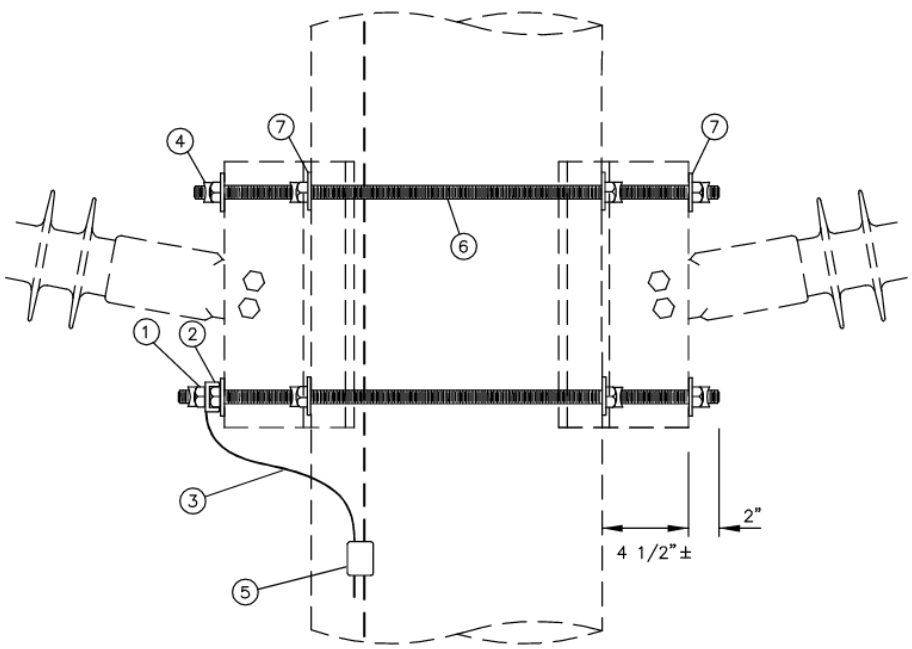
Entergy

tfinc90 12/7/2007 SLE3–DEPY–S 500; SK5 (100)

BILL OF MATERIALS

VARIABLE BOLT ASSY, DOUBLE POLY POST FOR CONCRETE WITH GROUNDING

ITEM	QTY.	STOCK NO.	DESCRIPTION
1	1	EN000171	NUT, SQUARE, STL, GALV, ANSI–C135.1, 7/8" DIA, 9 THD
2	1	EN000358	CLIP, BONDING, 7/8", STL, GALV, FOR GROUNDING TO 7/8" BOLT
3	1	EN000362	WIRE, COPPERWELD, #4 (.1158 lbs/ft)
4	8	EN000426	NUT, LOCK, SQUARE, STL, GALV. ANSI–C135.1, 7/8" DIA. 9 THD
5	1	EN000360	CONNECTOR, #4 COPPER CRIMPIT
6	2	LS909XX	BOLT, DOUBLE ARMING, 7/8"xVARIABLE LENGTH, GALV, w/4 SQ NUTS
7	8	EN005685	WASHER, FLAT ROUND, 2" STEEL, GALV, FOR 7\8" BOLT



1) All Double Arming Bolts shall be trimmed to avoid conflict with guys, grounding, conductors, etc. and painted with galvanized paint.

2) Grounding Lug location may be above or below assembly depending on pole tank ground location.

BLT–2P–C			
ENTERGY STANDARD DWG.			
DESIGN APPROVAL		STANDARDS APPROVAL	
SIGNED / DATE		SIGNED / DATE	
BOLT ASSY (CONCRETE) DOUBLE POLYMER POST INS.			
APPROVED BY: EJG		DATE: 01–27–97	
CHECKED BY: JWS		SCALE: NONE	
DRAWN BY: ECSI		ESI NO. TMD207A1	
Entergy		No. BLT2PC	
		PLOT 1=8	SH. 1 OF 1

NO.	DATE:	REVISION	BY:	APPR:
1	5–28–03	REV. DIM., CHANGE WASHER FROM SQ. TO FLAT ROUND	ITRON	

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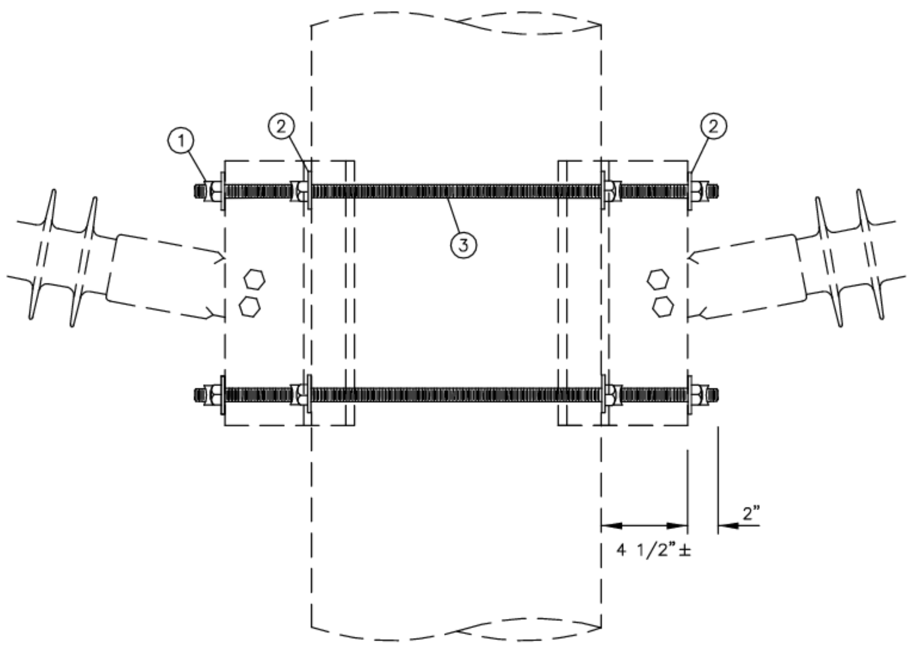
BILL OF MATERIALS

VARIABLE BOLT ASSY, DOUBLE POLY POST FOR STEEL

ITEM	QTY.	STOCK NO.	DESCRIPTION
1	8	EN000426	NUT, LOCK, SQUARE, STL, GALV, ANSI–C135.1, 7/8" DIA, 9 THD
2	8	EN005685	WASHER, FLAT ROUND, 2" STEEL, GALV, FOR 7\8" BOLT
3	2	LS909XX	BOLT, DOUBLE ARMING, 7/8"xVARIABLE LENGTH, GALV, w/4 SQ NUTS



1) All Double Arming Bolts shall be trimmed to avoid conflict with guys, grounding, conductors, etc. and painted with galvanized paint.

1	5–28–03	CHANGE WASHER, DIM.	ITRON	
NO.	DATE:	REVISION	BY:	APPR:

BLT–2P–S	
ENTERGY STANDARD DWG.	
DESIGN APPROVAL SIGNED / DATE	STANDARDS APPROVAL SIGNED / DATE
BOLT ASSY (STEEL) DOUBLE POLYMER POST INS.	
APPROVED BY:	DATE: 2–12–96
CHECKED BY:	SCALE: NONE
DRAWN BY: ECSI	ESI NO. TMD208A1
Entergy	No. BLT2PS
	PLOT 1=8 SH. 1 OF 1

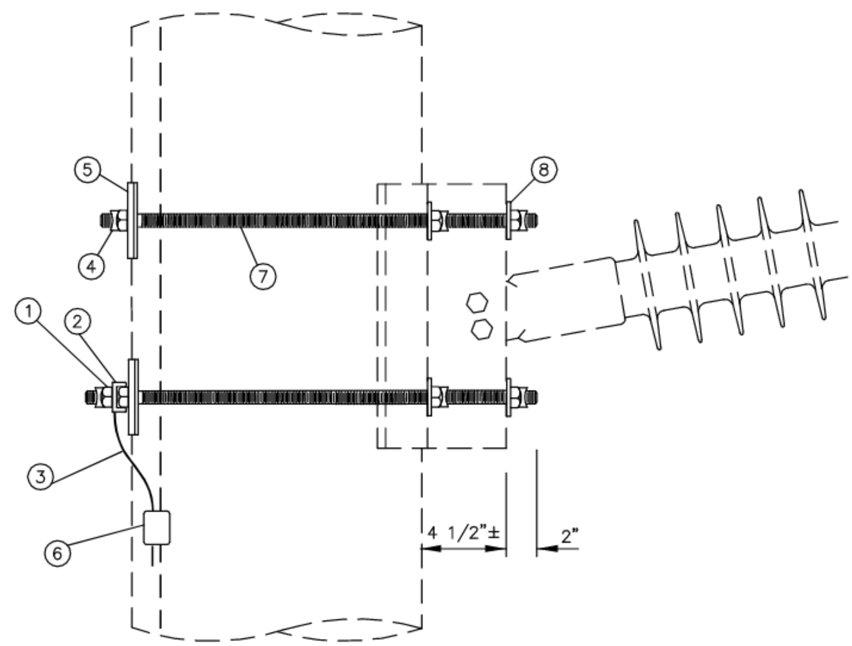
TEMP\AM-Work\ewilli2\M-LITAPETSP047,D-TDocs,S-Template\ESI\STANDARDS\Transmission\AMISC\TMD208A1.DWG, 5/20/2010 5:31:01 PM, ewilli2

TEMP\AM-Work\ewilli2\M-LITAPETSP047,D-TDocs,S-Template\ESI\STANDARDS\Transmission\AMISC\TMD211A1.DWG, 5/20/2010 5:21:50 PM, ewilli2

BILL OF MATERIALS

VARIABLE BOLT ASSY, SINGLE POLY POST FOR CONCRETE WITH GROUNDING

ITEM	QTY.	STOCK NO.	DESCRIPTION
1	1	EN000171	NUT, SQUARE, STL, GALV, ANSI–C135.1, 7/8" DIA, 9 THD
2	1	EN000358	CLIP, BONDING, 7/8", STL, GALV, FOR GROUNDING TO 7/8" BOLT
3	1	EN000362	WIRE, COPPERWELD, #4 (.1158 lbs/ft)
4	6	EN000426	NUT, LOCK, SQUARE, STL, GALV, ANSI–C135.1, 7/8" DIA, 9 THD
5	2	EN012280	WASHER, SQUARE CURVED, STL, GALV, 7/8" BOLT, 3"x3"x1/4"
6	1	EN000360	CONNECTOR, #4 COPPER CRIMPIT
7	2	LS909XX	BOLT, DOUBLE ARMING, 7/8"xVARIABLE LENGTH, GALV, w/4 SQ NUTS
8	4	EN005685	WASHER, FLAT ROUND, 2" STEEL, GALV, FOR 7\8" BOLT



1) All Double Arming Bolts shall be trimmed to avoid conflict with guys, grounding, conductors, etc. and painted with galvanized paint.

2) Grounding Lug location may be above or below assembly depending on pole tank ground location.

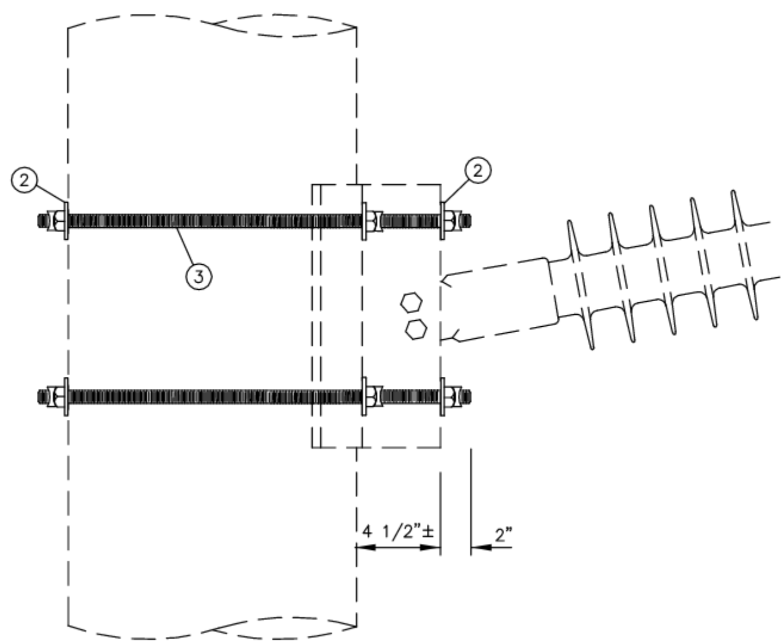
BLT–P–C			
ENTERGY STANDARD DWG.			
DESIGN APPROVAL		STANDARDS APPROVAL	
SIGNED / DATE		SIGNED / DATE	
BOLT ASSY (CONCRETE) SINGLE POLYMER POST INS.			
APPROVED BY:	EJG	DATE:	01–27–97
CHECKED BY:	JWS	SCALE:	NONE
DRAWN BY:	ECSI	ESI NO.	TMD211A1
Entergy	No. BLTPC		
	PLOT 1=8	SH. 1 OF 1	

NO.	DATE:	REVISION	BY:	APPR:
1	5–30–03	CHANGE WASHER, DIM.	ITRON	

BILL OF MATERIALS

VARIABLE BOLT ASSY, SINGLE POLY POST FOR STEEL

ITEM	QTY.	STOCK NO.	DESCRIPTION
1	6	EN000426	NUT, LOCK, SQUARE, STL, GALV, ANSI–C135.1, 7/8" DIA, 9 THD
2	6	EN005685	WASHER, FLAT ROUND, 2" STEEL, GALV, FOR 7/8" BOLT
3	2	LS909XX	BOLT, DOUBLE ARMING, 7/8"xVARIABLE LENGTH, GALV, w/4 SQ. NUTS



1) All Double Arming Bolts shall be trimmed to avoid conflict with guys, grounding, conductors, etc. and painted with galvanized paint.

BLT–P–S

ENTERGY SERVICES, INC.

Transmission LineDesign Standard

BOLT ASSEMBLY (STEEL) SINGLE POLYMER POST INS.

STRUCTURAL ASSEMBLY DETAIL

STD NO. | SCALE:

No. TMD212A3

Entergy

PLOT | SH. OF

NO.	DATE:	REVISION	BY:	CHK:	APPR
3	07–21–10	ADDED ASSEMBLY NAME	CBM	ECW	ECW
2	01–13–10	INCREASED STOCK NO. ITEM EN005685 FROM 4 TO 6	BAB		
1	05–30–03	CHANGE WASHER, DIM.	ITRON		
0	02–12–06	ISSUED	ECSI		

cmcgr91 8/11/2010 BLT–P–S

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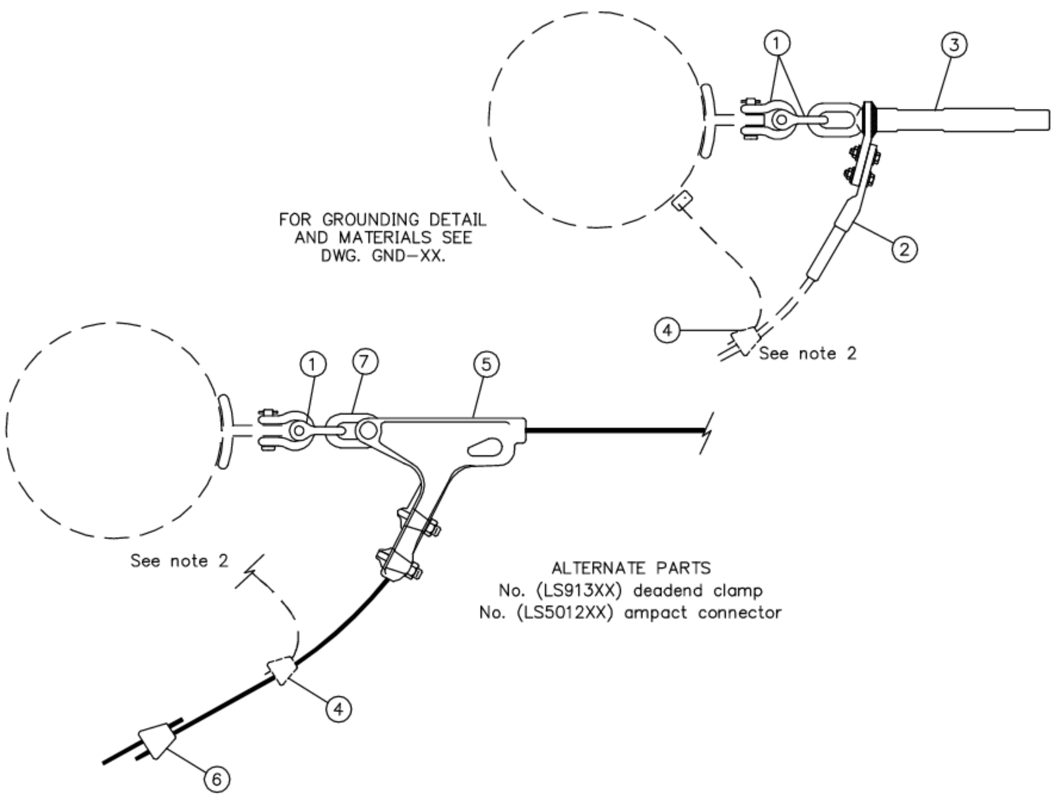
BILL OF MATERIALS

ITEM	QTY.	STOCK NO.	DESCRIPTION
		OHGW DEADEND	
1	2	EN000492	SHACKLE, ANCHOR, 40K ULT, 3/4" PIN DIA, 2-3/4" LONG
2	1	LS9004XX	TERMINAL CONNECTOR, 15 DEG, FOR VARIABLE SIZE WIRE
3	1	LS9005XX	DEADEND, ALUMINUM COMPRESSION BODY, SINGLE TONGUE, VARIABLE WIRE SIZE
4	–	LS5012XX	CONNECTOR, AMPACT, SEE GND ASSEMBLY DRAWING FOR MATERIAL
		ALTERNATE FOR BOLTED ASSEMBLY	
ITEM	QTY.	STOCK NO.	DESCRIPTION
1	2	EN000492	SHACKLE, ANCHOR, 40K ULT, 3/4" PIN DIA, 2-3/4" LONG
4	–	LS5012XX	CONNECTOR, AMPACT, SEE GND ASSEMBLY DRAWING FOR MATERIAL
5	1	LS913XX	DEADEND BOLTED STRAIN ALUMWELD
6	1	LS5012XX	CONNECTOR, AMPACT, VARIABLE CONDUCTOR SIZE TO VARIABLE CONDUCTOR SIZE
7	1	EN000390	LINK, CHAIN, XMSN: CONNECTING, CS, 1/2" PITCH; 2 1/4" LONG



1) Item #2, #3 and #6 are conductor dependent.
2) For grounding detail and materials, see applicable Gnd-xx drawing.
3) For horizontal vang orientation, omit one of item 1.

OHG-DE-XX

NO.	DATE:	REVISION	BY:	CHK:	APPR:
6	07-21-10	SHOW ITEM 4 ON ASSEMBLY	CBM	ECW	ECW
5	08-15-06	REVISIED ITEM #4	RJL		
4	01-31-01	MODIFIED STOCK NUMBER LS5029XX	LS		
3	01-04-01	MODIFIED CALLOUTS	LS		
2	06-07-00	MODIFIED STOCK NUMBER LS5012XX	RMB		
1	11-16-99	ADDED AMPACT & CARTRIDGE DESCRIPTION	RMB		
0		ISSUED	ECSI		

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
OVERHEAD GROUNDWIRE DEADEND ASSY
STRUCTURAL ASSEMBLY DETAIL

STD NO. | SCALE: NONE

Entergy | No. TMD222A6

PLOT 1=8 | SH. 1 OF 1

rlafon 8/15/2006 OHG-DE-XX

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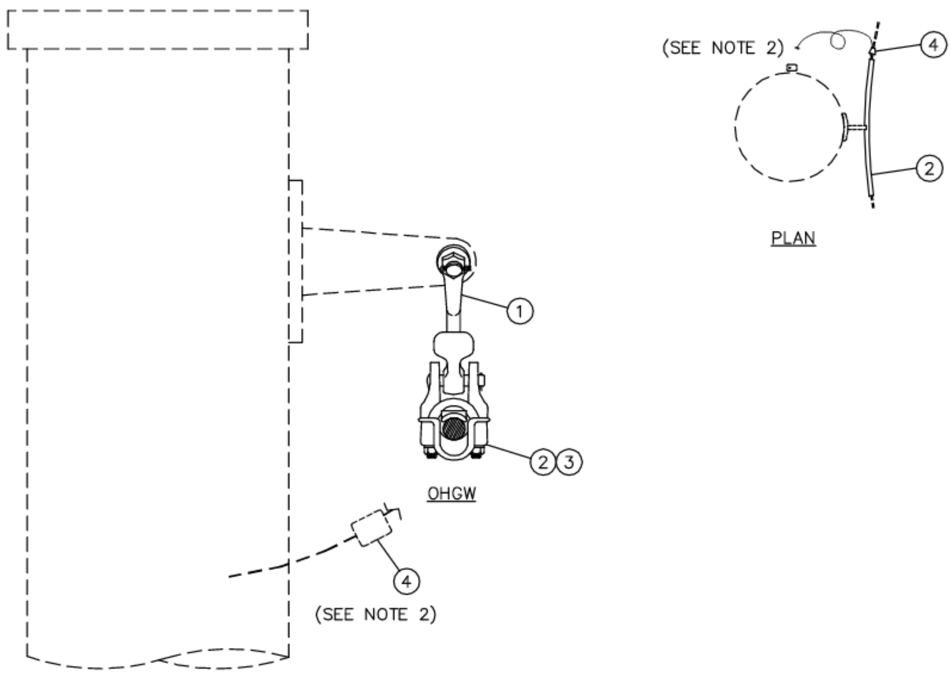
BILL OF MATERIALS

OHGW SUSPENSION, 0-30°

ITEM	QTY.	STOCK NO.	DESCRIPTION
1	1	EN004375	BALL CLEVIS, 45 DEG Y, 30K ULT, 3/4" PIN DIA
2	1	LS9003XX	ROD, ARMOR, PREFORMED, ALUMINUM, VARIABLE CONDUCTOR SIZE
3	1	LS9008XX	CLAMP, SUSPENSION, ALUMINUM, VARIABLE WIRE SIZE, w/SOCKET EYE
4	–	LS5012XX	CONNECTOR, AMPACT



1) Item #2 and #3 are conductor dependent. These items are selected for each project and may be with or without Armor Rod.

2) For grounding detail and materials see applicable GND–XX drawing.

NO.	DATE:	REVISION	BY:	APPR:
9	8–15–06	REMOVED OPTGW OPTION, DELETED ITEM #4	RJL	
8	12–9–03	ADDED BACK GROUNDING DETAILS	ITRON	
7	5–30–03	ADDED OPTGW OPTION	ITRON	
6	2–17–03	ADDED POLE CAP AND GROUNDING NOTE 2	ITRON	
5	10–15–02	REMOVE GROUNDING DETAIL	ITRON	
4	1–18–02	MODIFIED ITEMS 1, 2 AND 3.	LSFT	
3	1–29–01	MODIFIED STOCK NUMBER LS9007XX	LSFT	
2	1–29–01	MODIFIED STOCK NUMBER LS5012XX	RMB	

OHG–SUS–XX

ENTERGY STANDARD DWG.

DESIGN APPROVAL	STANDARDS APPROVAL
SIGNED / DATE	SIGNED / DATE

OVERHEAD GROUNDWIRE SUSPENSION ASSY

APPROVED BY:	DATE: 2–15–03
CHECKED BY:	SCALE: NONE
DRAWN BY: ITRON	ESI NO. TMD223A9
Entergy	No. OHGSUS
	PLOT 1=8 · SH. 1 OF 1

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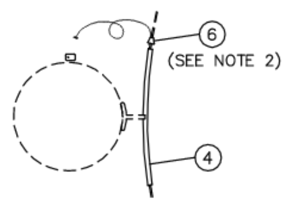
TEMP\AM-Work\ewilli2\M-LITAPETSP047,D-TDocs,S-Template\ESI\STANDARDS\Transmission\AMISC\TMD224A6.dwg, 5/28/2010 5:14:25 PM, ewilli2

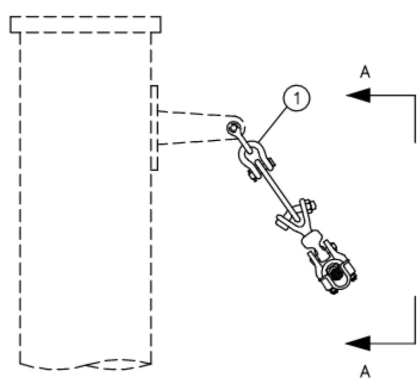
BILL OF MATERIALS

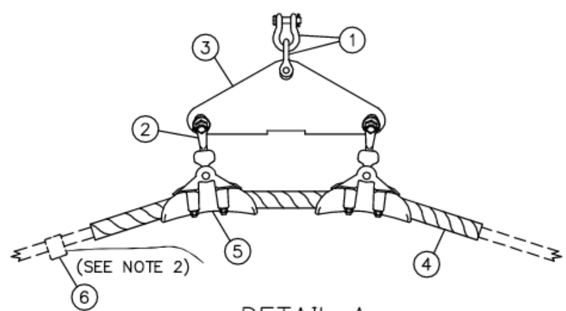
OHGW SUSPENSION, 30–50° WITH YOKE PLATE

ITEM	QTY.	STOCK NO.	DESCRIPTION
1	2	EN000492	SHACKLE, ANCHOR, 40K ULT, 3/4" PIN DIA, 2–3/4" LONG
2	2	EN004375	BALL CLEVIS, 45 DEG Y, 30K ULT, 3/4 PIN DIA
3	1	EN015676	PLATE, YOKE, DUCTILE IRON, 18" WIDTH, 30K ULT, 3/4" GALV
4	1	LS9003XX	ROD, ARMOR, PREFORMED, ALUMINUM, VARIABLE CONDUCTOR SIZE
5	2	LS9007XX	CLAMP, SUSPENSION, ALUMINUM, VARIABLE SIZE WIRE, W/SOCKET EYE
6	–	LS5012XX	CONNECTOR, AMPACT, SEE GROUND ASSEMBLY DRAWING FOR MATERIAL



PLAN





DETAIL A

YOKE ASSEMBLY

1) ITEM #4 AND #5 ARE CONDUCTOR DEPENDENT. THESE ITEMS ARE SELECTED FOR EACH PROJECT AND MAY BE WITH OR WITHOUT ARMOR ROD.

2) FOR GROUNDING DETAIL AND MATERIALS SEE APPLICABLE GND–XX DRAWING.

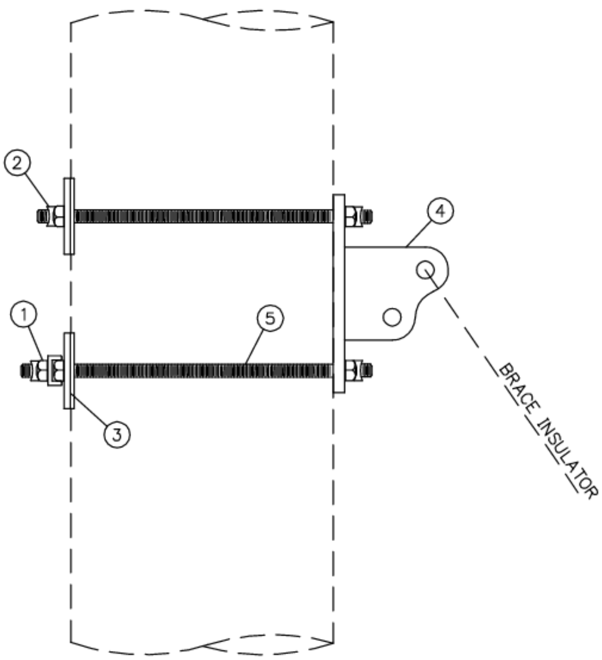
NO.	DATE:	REVISION	BY:	APPR:
6	8–15–06	REVISED ITEM #6	RJL	
5	12–8–03	ADDED BACK GROUNDING DETAILS	ITRON	
4	2–18–03	ADDED POLE CAP AND GROUNDING NOTE	ITRON	
3	1–29–01	MODIFIED STOCK NUMBER LS9007XX	LS	
2	6–7–00	MODIFIED STOCK NUMBER LS5012XX	RMB	
1	11–16–99	ADDED AMPACT & CARTRIDGE DESCRIPION	RMB	

OHG–SUY–XX	
ENTERGY STANDARD DWG.	
DESIGN APPROVAL SIGNED / DATE	STANDARDS APPROVAL SIGNED / DATE
OVERHEAD GROUNDWIRE HEAVY ANGLE ASSY	
APPROVED BY:	DATE: 1–29–01
CHECKED BY:	SCALE: NONE
DRAWN BY: ECSI	ESI NO. TMD224A6
Entergy	No. OHGSUY
	PLOT 1=16
	SH. 1 OF 1

BILL OF MATERIALS

TEE ASSY, BRACE POST FOR STEEL WITH BOLTS

ITEM	QTY.	STOCK NO.	DESCRIPTION
1	1	EN000171	NUT, SQUARE, STL, GALV, ANSI–C135.1, 7/8" DIA, 9 THD
2	4	EN000426	NUT, LOCK, SQUARE, STL, GALV, ANSI–C135.1, 7/8" DIA, 9 THD
3	2	EN003796	WASHER, SQUARE CURVED, STL, GALV, ANSI–C135.1, 7/8" BOLT, 1/4" THK, 4"x4"
4	1	EN011909	PLATE, POLE EYE, GALV STL, DBL EYE, 70K ULT, 8" BOLT SPACING
5	2	LS909XX	BOLT, DOUBLE ARMING, 7/8"xVARIABLE LENGTH, GALV, w/4 SQ NUTS



1) All Double Arming Bolts shall be trimmed to avoid conflict with guys, grounding, conductors, etc. and painted with galvanized paint.

2) Grounding Lug location may be above or below assembly depending on pole tank ground location.

TEE–B–S	
ENTERGY STANDARD DWG.	
DESIGN APPROVAL SIGNED / DATE	STANDARDS APPROVAL SIGNED / DATE
TEE ASSY (STEEL) BRACE	
APPROVED BY: EJG	DATE: 12–19–00
CHECKED BY: JWS	SCALE: NONE
DRAWN BY: ECSI	ESI NO. TMD279A0
Entergy	No. TBS
	PLOT 1=8 / SH. 1 OF 1

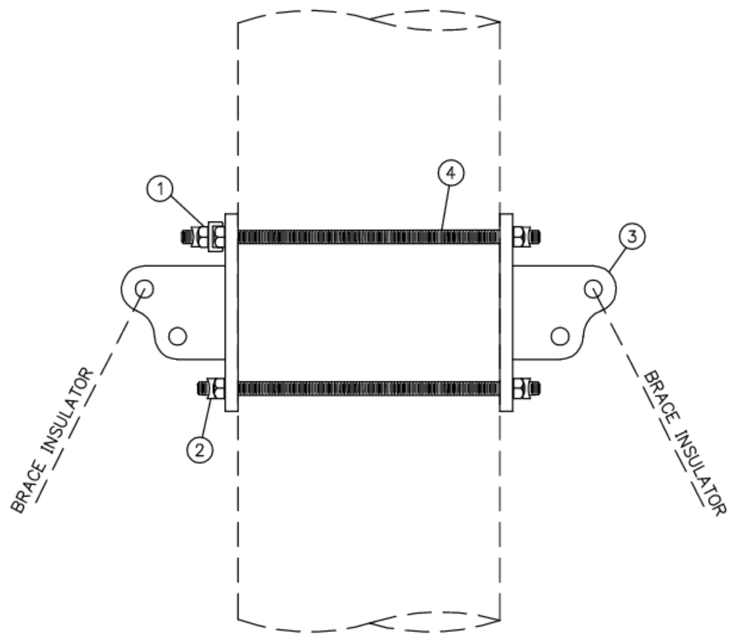
NO.	DATE:	REVISION	BY:	APPR:

TEMP\AM-Work\ewilli2\M-LITAPETSP047,D-TDocs,S-Template\ESI\STANDARDS\Transmission\AMISC\TMD279A0.DWG, 6/10/2010 5:04:20 PM, ewilli2

TEMP\AM-Work\ewilli2\M-LITAPETSP047,D-TDocs,S-Template\ESI\STANDARDS\Transmission\AMISC\TMD280A0.DWG, 6/10/2010 5:02:10 PM, ewilli2

BILL OF MATERIALS

TEE ASSY, BRACE TO BRACE FOR STEEL WITH BOLTS			
ITEM	QTY.	STOCK NO.	DESCRIPTION
1	1	EN000171	NUT, SQUARE, STL, GALV, ANSI–C135.1, 7/8" DIA, 9 THD
2	4	EN000426	NUT, LOCK, SQUARE, STL, GALV, ANSI–C135.1, 7/8" DIA, 9 THD
3	2	EN011909	PLATE, POLE EYE, GALV STL, DBL EYE, 70K ULT, 8" BOLT SPACING
4	2	LS909XX	BOLT, DBL ARMING, 7/8"xVARIABLE LENGTH, GALV, w/4 SQ NUTS



1) All Double Arming Bolts shall be trimmed to avoid conflict with guys, grounding, conductors, etc. and painted with galvanized paint.

2) Grounding Lug location may be above or below assembly depending on pole tank ground location.

TEE–B–B–S	
ENTERGY STANDARD DWG.	
DESIGN APPROVAL SIGNED / DATE	STANDARDS APPROVAL SIGNED / DATE
TEE ASSY (STEEL) BRACE – BRACE	
APPROVED BY: EJG	DATE: 12–19–00
CHECKED BY: JWS	SCALE: NONE
DRAWN BY: ECSI	ESI NO. TMD280A0
Entergy	No. TBBS
PLOT 1=8	SH. 1 OF 1

NO.	DATE:	REVISION	BY:	APPR:

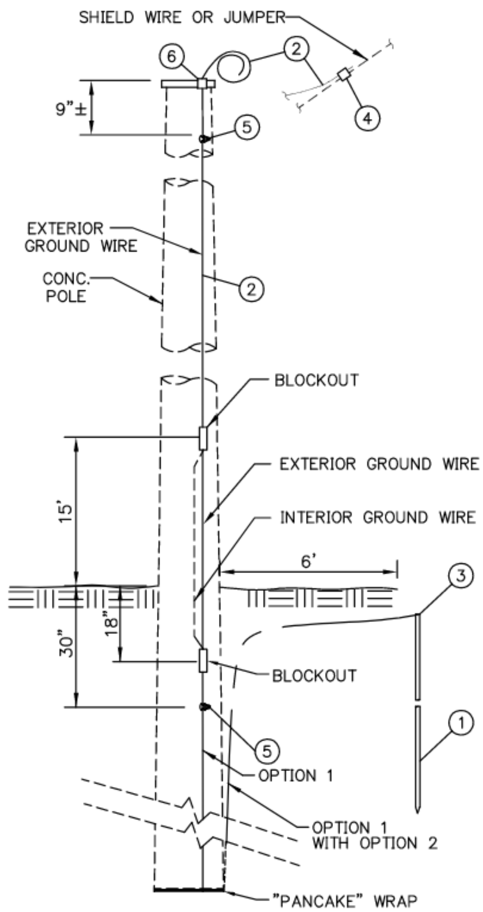
BILL OF MATERIALS – GROUNDING

ITEM	TYP. QUANTITY FOR STR. w/ 1 POLE	2POLE	3 POLE	STOCK NO.	DESCRIPTION
1	1 ***	2 ***	3 ***	EN013434	ROD, GROUND, 5/8"x8', COPPER CLAD
2	15 lb.**	30 lb.**	44 lb.**	EN000362	WIRE, COPPERWELD, #4 (.1158lbs/ft)
3	1 ***	2 ***	3 ***	EN008745	CONNECTOR, CADWELD, #4 TO TOP OF 5/8" GROUND ROD ("L")
4	1 *	2	2	LS5012XX	CONNECTOR, AMPACT, VARIABLE CONDUCTOR SIZE TO #4 COPPERWELD.
5	2	4	6	EN014861	TERMINAL, ELEC:, GROUNDING LUG, 1/2" DIA., 13THD, BRONZE
6	–	–	–	EN012112	GROUNDING CLIP SUPPLIED BY POLE MFG.

* FOR DOUBLE SHIELD WIRE, DOUBLE QTY, OF ITEM 4. ITEM 4 IS NOT USED FOR GROUNDING OPGW TO POLE. FOR OPGW SEE DRAWING TMD396.

** QUANTITY FOR ITEM 2 IS TYPICAL FOR POLES UP TO 100' ABOVE GROUND HEIGHT.

*** FOR HIGH-RESISTANCE SOILS, ADDITIONAL GROUND RODS WILL BE REQUIRED AND "T" CONNECTORS (EN009796) CAN BE USED TO FACILITATE ADDITIONAL RODS.



GENERAL

1. REFERENCE "GROUNDING AND CATHODIC PROTECTION CONSTRUCTION SPECIFICATION". TRANSMISSION LINE STANDARD T00109 FOR GROUNDING REQUIREMENTS.
2. REFERENCE DWGS. TMD222, TMD223 TMD224, AND TMD225 FOR OVERHEAD GROUND WIRE ASSEMBLIES; AND DWG. TMD390 FOR GUY TO POLE BONDING.
3. REFERENCE DWGS. TMD396, TMD397, AND TMD398 FOR OPGW GROUNDING ASSEMBLIES.

GROUNDING – NON OPGW SHIELD WIRE TO POLE

4. REMOVE POLE SUPPLIER PROVIDED GROUND CLIPS (2 ea. W/GREEN BOLTS) AND REPLACE WITH TERMINAL (GROUNDING) LUGS (ITEM 5) AS SHOWN.
5. ATTACH POLE GROUND TO POLE BY THREADING THRU TERMINAL LUGS (ITEM 5). EXTEND GROUND WIRE THRU GROUNDING CLIP (ITEM 6) AND EXTEND 5' COILED.
6. FOR SUSPENSION TYPE CONNECTION, CONNECT TO S.W. WITH AMPACT CONNECTOR (ITEM 4). APPROX. 5' BEYOND ARMOR ROD.
7. FOR DEAD END CONNECTION, CONNECT TO JUMPER WITH AMPACT CONN. (ITEM 4). PROVIDE ENOUGH WIRE TO ALLOW FREE MOVEMENT OF S.W. OR JUMPER. REMOVE EXCESS.

GROUNDING FOR ALL POLES:

8. PROVIDE GROUND WIRE BETWEEN THE TERMINALS (ITEM 5) AT TOP AND BELOW GROUND. BETWEEN THE BLOCKOUTS, THE WIRE MAY BE EXTERNAL OR INTERNAL. INTERNAL PROVIDES PROTECTION FROM THEFT AND SNAGGING BY EQUIPMENT.

OPTIONS FOR GROUNDING BELOW GROUNDLINE

(WIRES BELOW GROUNDLINE MUST CONNECT TO BOTTOM TERMINAL):

9. OPTION 1 – PROVIDE GROUND WIRE TO BUTT OF POLE AND FORM COIL OF WIRE (PANCAKE) ON CLIPS PROVIDED (GROUND RODS NOT USED).
10. OPTION 2 – PROVIDE CONTINUOUS GROUND WIRE (NO SPLICE) FROM PANCAKE TO GROUND ROD AND OR COUNTER POISE.

GND-C-EMBED

NO.	DATE:	REVISION	BY:	CHK:	APPR
5	9-6-17	REV. NOTES 2 & 3, CLARIFY MULTI-POLE BOM	ECW	CDHH	JRA
4	9-30-16	UPDATED AND REFORMATED BOM'S AND NOTES	ECW	PL	JRA
3	08-11-10	CORRECTED ITEM#'S IN NOTES	CBM	ECW	ECW
2	12-31-09	ADD GROUND ROD DIM	HDR	RCR	ECW
1	07-24-06	REVISED ITEM #5	RMB		
0	02-11-03	ISSUED	ITRON		

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
GROUNDING, CONCRETE POLE, DIRECT EMBED
STRUCTURAL ASSEMBLY DETAIL

STD NO. | SCALE: NONE
Entergy | No. TMD293A5
PLOT 1=32 | SH. 1 OF 1

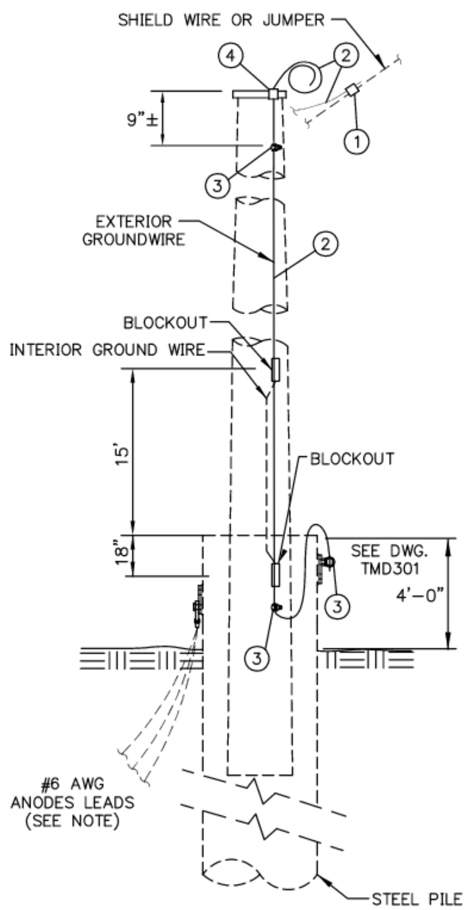
ewilli2 9/6/2017 GNDCEMB

BILL OF MATERIALS – GROUNDING

	TYP. QUANTITY FOR STR. w/				
ITEM	1 POLE	2 POLES	3 POLES	STOCK NO.	DESCRIPTION
1	1 *	2	2	LS5012XX	CONNECTOR, AMPACT, VARIABLE CONDUCTOR SIZE TO #4 COPPERWELD.
2	12 lb.**	24 lb.**	35 lb.**	EN000362	WIRE, COPPERWELD, #4 (.1158lbs/ft)
3	3	6	9	EN014861	TERMINAL, ELEC:, GROUNDING LUG, 1/2" DIA., 13THD, BRONZE
4	–	–	–	EN012112	GROUNDING CLIP SUPPLIED BY POLE MFG.

* FOR DOUBLE SHIELD WIRE, DOUBLE QTY, OF ITEM 1. ITEM 1 IS NOT USED FOR GROUNDING OPGW TO POLE. FOR OPGW SEE DRAWING TMD396.

** QUANTITY FOR ITEM 2 IS TYPICAL FOR POLES UP TO 100' ABOVE GROUND HEIGHT.



GENERAL

1. REFERENCE "GROUNDING APPLICATION GUIDELINE", TRANSMISSION LINE STANDARD TO0109 FOR GROUNDING REQUIREMENTS.
2. REFERENCE DWGS. TMD222, TMD223 TMD224, AND TMD225 FOR OVERHEAD GROUND WIRE ASSEMBLIES; AND DWG. TMD390 FOR GUY TO POLE BONDING.
3. REFERENCE DWGS. TMD396, TMD397, AND TMD398 FOR OPGW GROUNDING ASSEMBLIES.

GROUNDING – NON–OPGW SHIELD WIRE TO POLE

4. REMOVE POLE SUPPLIER PROVIDED GROUND CLIPS (2ea. W/GREEN BOLTS) AND REPLACE WITH TERMINAL (GROUNDING) LUGS (ITEM 3) AS SHOWN. ±
5. ATTACH POLE GROUND TO POLE BY THREADING THRU TERMINAL LUGS. (ITEM 3). EXTEND GROUND WIRE THRU GROUNDING CLIP (ITEM 4) AND EXTEND 5' COILED.
6. FOR SUSPENSION TYPE CONNECTION, CONNECT TO S.W. WITH AMPACT CONNECTOR (ITEM 1). APPROX. 5' BEYOND ARMOR ROD.
7. FOR DEAD END CONNECTION, CONNECT TO JUMPER WITH AMPACT CONNECTOR (ITEM 1). PROVIDE ENOUGH WIRE TO ALLOW FREE MOVEMENT OF S.W. OR JUMPER. REMOVE EXCESS.

GROUNDING FOR ALL POLES

8. PROVIDE GROUND WIRE BETWEEN THE TERMINALS (ITEM 3) AT TOP OF POLE AND BELOW TOP OF PILE BETWEEN THE BLOCKOUTS, THE WIRE MAY BE EXTERNAL OR INTERNAL. INTERNAL PROVIDES PROTECTION FROM THEFT.
9. PROVIDE GROUND WIRE FROM BOTTOM TERMINAL TO GROUND NEMA PAD ON EXTERIOR OF PILE.
10. PANCAKE IS NOT RECOMMENDED ON POLE BUTT BECAUSE OF INCOMPATABLE METALS THAT MIGHT CONTRIBUTE TO CORROSION.

ANODES

11. ANODES SHALL BE CONNECTED TO THE PILE AS DETAILED ON DWG. TMD299 AND INSTALLED ON DWG. TMD299 AND TMD302. ALL MATERIAL FOR ANODE INSTALLATION IS SHOWN ON DWG. TMD299.

GND–C–PILE

ENTERGY SERVICES, INC.

Transmission LineDesign Standard

Grounding, Concrete Pole, Steel Pile

STRUCTURAL ASSEMBLY DETAIL

NO.	DATE:	REVISION	BY:	CHK:	APPR
3	9–6–17	REV. NOTES 2 & 3, CLARIFY MULTI–POLE BOM	ECW	CDHH	JRA
2	9–30–16	UPDATED AND REFORMATED BOM'S AND NOTES	ECW	PL	JRA
1	08–15–06	REPLACE ANGLE BRACKET WITH NEMA PAD, ITEM #	RJL		
0	02–15–03	ISSUED	ITRON		

STD NO. | SCALE:

Entergy

No. TMD294A3

PLOT | SH. OF

ewilli2 9/6/2017 GND–C–PILE

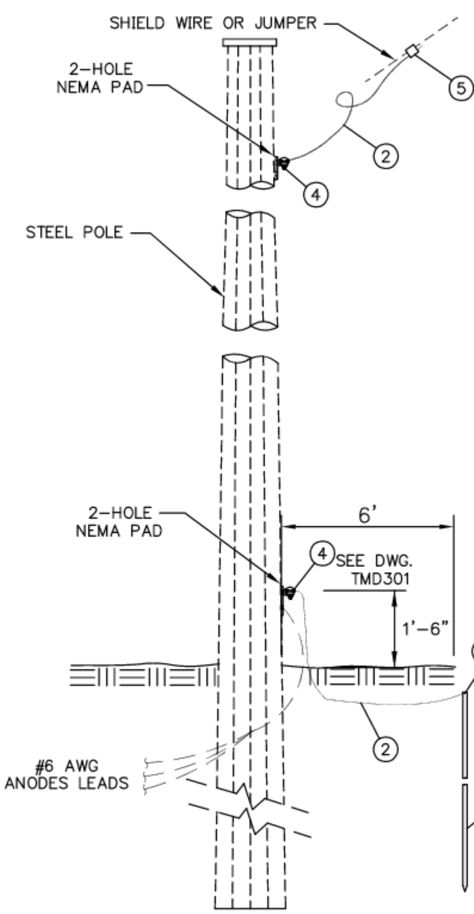
BILL OF MATERIALS – GROUNDING

ITEM	TYP. QUANTITY FOR STR. w/ 1 POLE	2 POLES	3 POLES	STOCK NO.	DESCRIPTION
1	1**	2**	3**	EN013434	ROD, GROUND, 5/8"x8', COPPER CLAD
2	2 lb. ***	4 lb. ***	4 lb. ***	EN000362	WIRE, COPPERWELD, #4 (.1158lbs/ft)
3	1**	2**	3**	EN008745	CONNECTOR, CADWELD, #4 TO TOP OF 5/8" GROUND ROD ("L")
4	2	4	5	EN014861	TERMINAL, GROUNDING LUG, #8-2/0 TO 1/2-13, BRONZE ALLOY
5	1 *	2 *	2 *	LS5012XX	CONNECTOR, AMPACT, VARIABLE CONDUCTOR SIZE TO #4 COPPERWELD.

* FOR DOUBLE SHIELD WIRE, DOUBLE QTY, OF ITEM 5. ITEM 5 IS NOT USED FOR GROUNDING OPGW TO POLE. FOR OPGW SEE DRAWING TMD343.

** FOR HIGH-RESISTANCE SOILS, ADDITIONAL GROUND RODS WILL BE REQUIRED AND "T" CONNECTORS (EN009796) CAN BE USED TO FACILITATE ADDITIONAL RODS.

*** SOFT DRAWN COPPER (32159134) MAY BE SUBSTITUTED FOR CONNECTIONS AT TOP OF POLE ONLY.



GENERAL

1. REFERENCE "GROUNDING APPLICATION GUIDELINE", TRANSMISSION LINE STANDARD T00109 FOR GROUNDING REQUIREMENTS.
2. REFERENCE DWGS. TMD222, TMD223 TMD224, AND TMD225 FOR OVERHEAD GROUND WIRE ASSEMBLIES; AND DWG. TMD389 FOR GUY TO POLE BONDING.
3. REFERENCE DWGS. TMD389, TMD399, AND TMD402 FOR OPGW GROUNDING ASSEMBLIES.

GROUNDING – NON-OPGW SHIELD WIRE TO POLE

4. ATTACH CONNECTING GROUND WIRE TO TERMINAL LUG (ITEM 4) AS DETAILED ON DET. "A", SHT. TMD301 AND TO SHIELD WIRE OR JUMPER WITH AMPACT CONNECTOR (ITEM 5).

GROUNDING – POLE TO GROUND ROD

5. ATTACH CONNECTING GROUND WIRE TO TERMINAL LUG ON POLE AS DETAILED ON DET. "A" DWG. TMD300 AND TO GROUND ROD AS SHOWN ON THIS DWG.

ANODES

6. ANODES SHALL BE CONNECTED TO THE POLE AS DETAILED ON DET. "A" DWG. TMD300 AND INSTALLED ON DWG. TMD302. ALL MATERIAL FOR ANODE INSTALLATION IS SHOWN ON DWG. TMD300.

GND-S-EMBED

ENTERGY SERVICES, INC.

Transmission LineDesign Standard

GROUNDING, STEEL POLE, DIRECT EMBED STRUCTURAL ASSEMBLY DETAIL

STD NO. | SCALE: NONE

Entergy | No. TMD295A4 | PLOT 1=32 | SH. 1 OF 1

NO.	DATE:	REVISION	BY:	CHK:	APPR
4	9-6-17	REV. NOTES 2/3, CLARIFY MULTI-POLE BOM, ALT. ITEM 1	ECW	CDHH	JRA
3	9-30-16	UPDATED AND REFORMATED BOM'S AND NOTES	ECW	PL	JRA
2	12-21-09	ADDED GROUND ROD DIMENSION	HDR	RLR	ECW
1	07-24-06	REVISED ITEM #5	RMB		
0	02-11-03	ISSUED	ITRON		

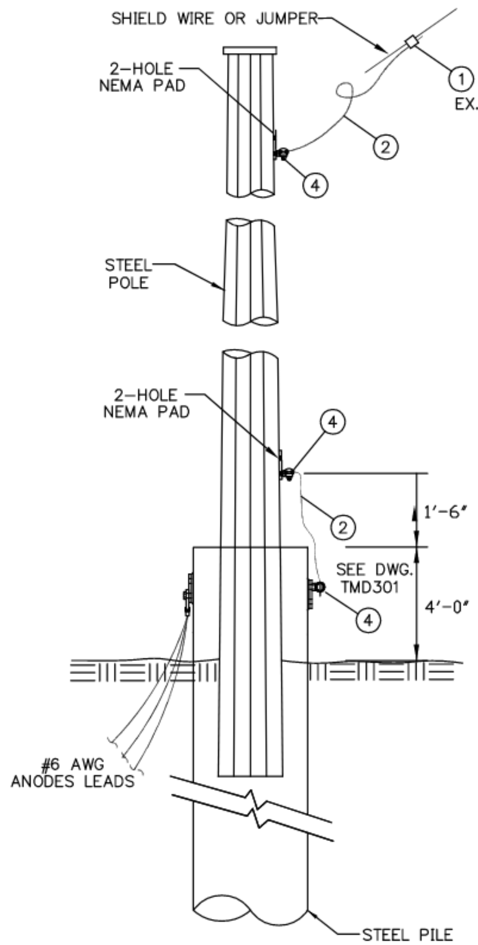
ewilli2 9/6/2017 GNDSEMB

BILL OF MATERIALS – GROUNDING

ITEM	TYP. QUANTITY FOR STR. w/ 1 POLE	2 POLES	3 POLES	STOCK NO.	DESCRIPTION
1	1 *	2	2	LS5012XX	CONNECTOR, AMPACT, VARIABLE CONDUCTOR SIZE TO #4 COPPERWELD.
2	2 lb. **	4 lb. **	6 lb. **	EN000362	WIRE, COPPERWELD, #4 (.1158lbs/ft)
3	0	0	0	–	–
4	3	6	8	EN014861	TERMINAL, GROUNDING LUG, #8–2/0 TO 1/2–13, BRONZE ALLOY

* FOR DOUBLE SHIELD WIRE, DOUBLE QTY, OF ITEM 1. ITEM 1 IS NOT USED FOR GROUNDING OPGW TO POLE. FOR OPGW SEE DRAWING TMD343.

** SOFT DRAWN COPPER (32159134) MAY BE SUBSTITUTED FOR CONNECTIONS AT TOP OF POLE ONLY.



GENERAL

1. REFERENCE "GROUNDING APPLICATION GUIDELINE", TRANSMISSION LINE STANDARD T00109 FOR GROUNDING REQUIREMENTS.
2. REFERENCE DWGS. TMD222, TMD223 TMD224, AND TMD225 FOR OVERHEAD GROUND WIRE ASSEMBLIES; AND DWG. TMD389 FOR GUY TO POLE BONDING.
3. REFERENCE DWGS. TMD389, TMD399, AND TMD402 FOR OPGW GROUNDING ASSEMBLIES.

GROUNDING – NON–OPGW SHIELD WIRE TO POLE

4. ATTACH CONNECTING GROUND WIRE TO TERMINAL LUG (ITEM 4) AS DETAILED ON DET. "A", SHT. TMD301 AND TO SHIELD WIRE OR JUMPER WITH AMPACT CONNECTOR (ITEM 5).

GROUNDING – POLE TO PILE

5. ATTACH GROUND WIRE TO POLE BY THREADING THROUGH TERMINAL LUG AS SHOWN ON DET. "A", DWG. TMD301. ATTACH GROUND WIRE TO PILE WITH GROUNDING CONNECTOR AS SHOWN ON DETAIL "B", DWG. TMD301.

ANODES

6. ANODES SHALL BE CONNECTED TO THE PILE AS DETAILED ON DET. "A", DWG. TMD299 AND INSTALLED ON DWG. TMD302 AND TMD299. ALL MATERIAL FOR ANODE INSTALLATION IS SHOWN ON DWG. TMD299.

GND–S–PILE

NO.	DATE:	REVISION	BY:	CHK:	APPR:
4	9–6–17	REV. NOTES 2/3, CLARIFY MULTI–POLE BOM, ALT. ITEM 1	ECW	CDHH	JRA
3	9–30–16	UPDATED AND REFORMATED BOM'S AND NOTES	ECW	PL	JRA
2	1–5–15	DELETE ITEM 3, REV. QUAN. ITEM 4	ECW	FWM	WLS
1	7–24–06	REVISED ITEM #1	RMB		
0	02–12–03	ISSUED	ITRON		

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
Grounding, Steel Pole, Steel Pile
STRUCTURAL ASSEMBLY DETAIL

STD NO. SCALE:

Entergy No. TMD296A4

PLOT SH. OF

ewilli2 9/6/2017 GND–S–PILE

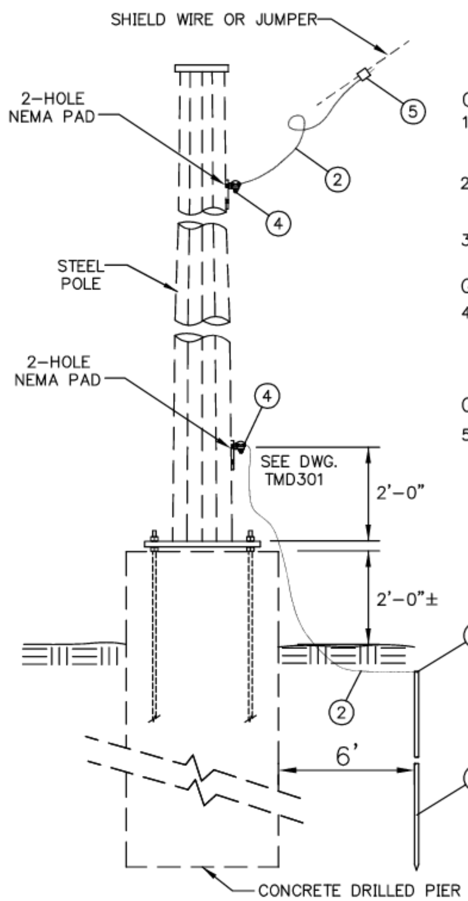
BILL OF MATERIALS – GROUNDING

ITEM	TYP. QUANTITY FOR STR. w/ 1 POLE	2 POLES	3 POLES	STOCK NO.	DESCRIPTION
1	1**	2**	3**	EN013434	ROD, GROUND, 5/8"x8', COPPER CLAD
2	2 lb. ***	4 lb. ***	6 lb. ***	EN000362	WIRE, COPPERWELD, #4 (.1158lbs/ft)
3	1**	2**	3**	EN008745	CONNECTOR, CADWELD, #4 TO TOP OF 5/8" GROUND ROD ("L")
4	2	4	5	EN014861	TERMINAL, GROUNDING LUG, #8-2/0 TO 1/2-13, BRONZE ALLOY
5	1 *	2 *	2 *	LS5012XX	CONNECTOR, AMPACT, VARIABLE CONDUCTOR SIZE TO #4 COPPERWELD.

* FOR DOUBLE SHIELD WIRE, DOUBLE QTY, OF ITEM 5. ITEM 5 IS NOT USED FOR GROUNDING OPGW TO POLE. FOR OPGW SEE DRAWING TMD343.

** FOR HIGH-RESISTANCE SOILS, ADDITIONAL GROUND RODS WILL BE REQUIRED AND "T" CONNECTORS (EN009796) CAN BE USED TO FACILITATE ADDITIONAL RODS.

*** SOFT DRAWN COPPER (32159134) MAY BE SUBSTITUTED FOR CONNECTIONS AT TOP OF POLE ONLY.



GENERAL

1. REFERENCE "GROUNDING APPLICATION GUIDELINE", TRANSMISSION LINE STANDARD T00109 FOR GROUNDING REQUIREMENTS.
2. REFERENCE DWGS. TMD222, TMD223 TMD224, AND TMD225 FOR OVERHEAD GROUND WIRE ASSEMBLIES; AND DWG. TMD389 FOR GUY TO POLE BONDING.
3. REFERENCE DWGS. TMD389, TMD399, AND TMD402 FOR OPGW GROUNDING ASSEMBLIES.

GROUNDING – NON-OPGW SHIELD WIRE TO POLE

4. ATTACH CONNECTING GROUND WIRE TO TERMINAL LUG AS DETAILED ON DET. "A", SHT. TMD301 AND TO SHIELD WIRE OR JUMPER WITH AMPACT CONNECTOR (ITEM 5).

GROUNDING – POLE TO GROUND ROD

5. ATTACH CONNECTING GROUND WIRE TO TERMINAL LUG (ITEM 4) ON POLE AS DETAILED ON DET. A DWG. TMD301 AND TO GROUND ROD AS SHOWN ON THIS DWG.

GND-S-PIER

NO.	DATE:	REVISION	BY:	CHK:	APPR
5	9-6-17	REV. NOTES 2/3, CLARIFY MULTI-POLE BOM, ALT. ITEM 1	ECW	CDHH	JRA
4	9-30-16	UPDATED AND REFORMATED BOM'S AND NOTES	ECW	PL	JRA
3	12-21-09	ADDED GROUND ROD DIMENSION	HDR	RLR	ECW
2	07-24-06	REVISED ITEM #5	RMB		
1	01-25-05	REMOVED ANODES	RMB		

ENTERGY SERVICES, INC.

Transmission LineDesign Standard

GROUNDING, STEEL POLE, CONCRETE DRILLED PIER STRUCTURAL ASSEMBLY DETAIL

STD NO. SCALE: NONE

No. TMD297A5

Entergy

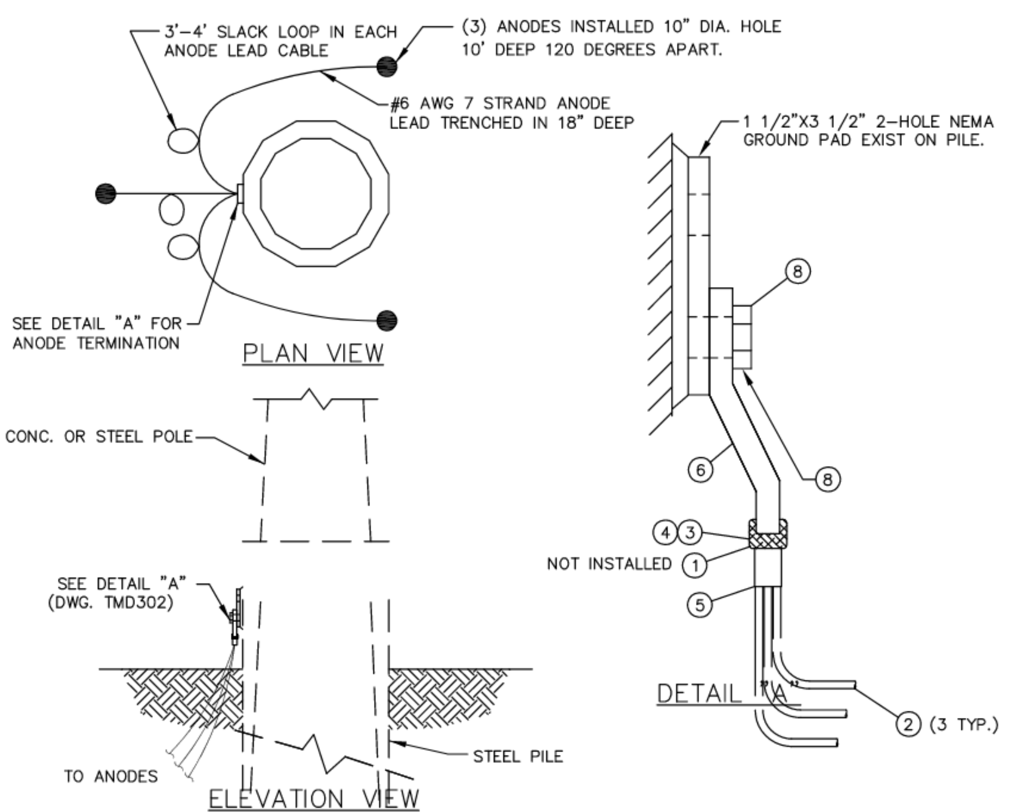
PLOT 1=32 SH. 1 OF 1

ewilli2 9/6/2017 GND-S-PIER

BILL OF MATERIALS

ITEM	QTY.	STOCK NO.	DESCRIPTION
1	1*	EN013170	HANDLE; CLAMP, METAL; CADWELD, FITS C/E/R 3" MOLDS (1 PER 50 CONN.)
2	3	SEE DWG TMD302	ANODE, W/#6 AWG., SIZE AND MATERIAL VARY WITH INSTALLATION
3	1*	32122722	MOLD, EXOTHERMIC, 3/0 STR. CU CABLE TO 1/4"X-1 1/2"LUG, (1 PER 50 CONN.)
4	1.5	EN019108	CARTRIDGE, THERMOWELD POWDER; #90 CHARGE, CADWELD METAL
5	1	EN019109	SLEEVE: CADWELD; ADAPTER SLEEVES ARE USED TO ADAPT 1/0, 1 STR
6	1	32074891	NEMA 1-HOLE COPPER BUS BAR FOR PIPE PILE FOUNDATIONS
7	1	EN019252	COMPOUND: ELECTRICAL JOINT, INHIBITOR, GREASE LIKE, 8 OZ TUBE
8	1	0000018450	ASSEMBLY, BOLT: MACH, SS, 1/2" DIA. x 1" LG. W/NUT & WASHERS. SEE NOTE 5.

* – ORDER ONE EA. PER 50 CONNECTIONS



NOTES

1) FOR INSTALLATION OF ANODES REFER STANDARD T00109 AND DWG. TMD302.
2) COAT ALL MECHANICAL CONNECTIONS (THREADS AND BUS BAR TO NUTS) WITH ELECTRICAL JOINT INHIBITOR COMPOUND.
3) ANODE MATERIAL PROVIDED TO PROTECT STEEL PILE. SEE DWG. TMD296 FOR BONDING OF STEEL POLE TO STEEL PILE.
4) USE GALVANIZING TOUCH-UP EN019331 IF REQUIRED.
5) ITEM 8 HAS 1 NUT & 1 WASHER THAT WILL NOT BE USED.

NO.	DATE:	REVISION	BY:	CHK:	APPR
3	8-21-14	REV. STK NO. ITEM 6, CHANGE MOLD ITEM 3	ECW		WLS
2	03-17-14	REVISED ITEMS 2 & 6, NOTES 1 & 3	ECW	JRA	WLS
1	08-10-06	GENERAL DRAWING REVISION	RJL		
0	2-11-03	CREATED	ITRON		

ANODE-S-PILE

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
ANODE INSTALLATION DETAILS FOR STEEL PILES
STRUCTURAL ASSEMBLY DETAIL

STD NO. T00109 | SCALE: NONE

Entergy | No. TMD299A3

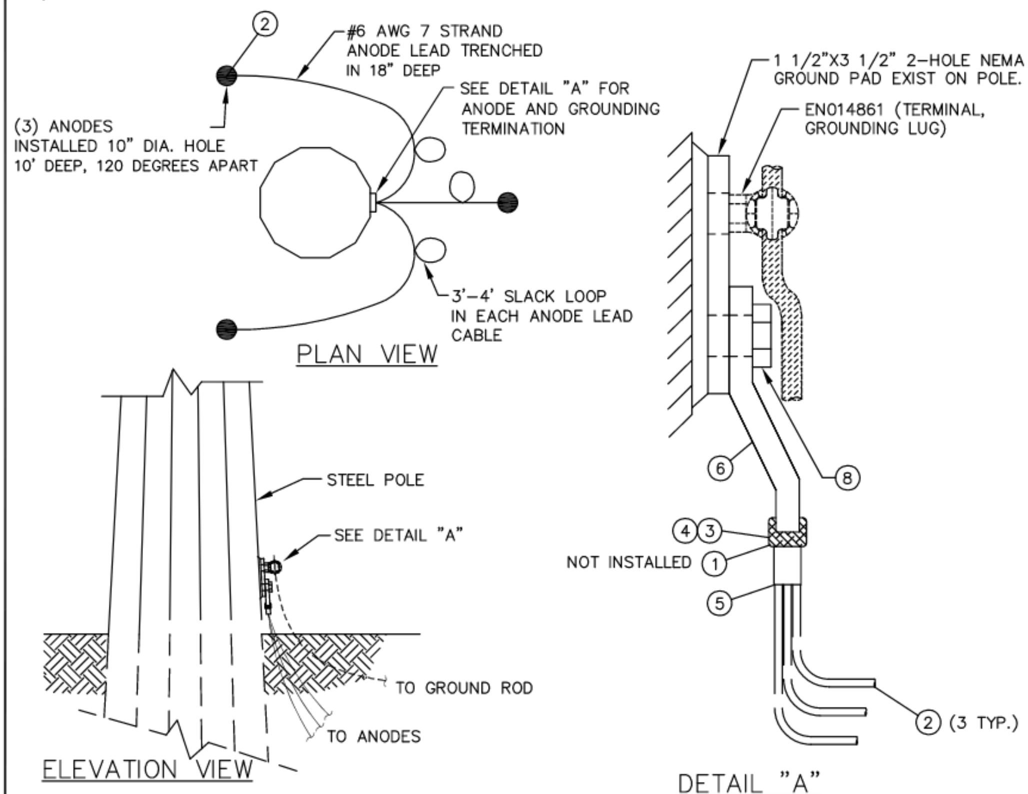
PLOT 1=32 | SH. 1 OF 1

EWILLI2 8-21-14 ANODE-S-PILE

BILL OF MATERIALS

ITEM	QTY.	STOCK NO.	DESCRIPTION
1	1*	EN013170	HANDLE; CLAMP, METAL; CADWELD, FITS C/E/R 3" MOLDS (1 PER 50 CONN.)
2	3	SEE DWG. TMD302	ANODE, W/#6 AWG., SIZE AND MATERIAL VARY WITH INSTALLATION
3	1*	32122722	MOLD, EXOTHERMIC, 3/0 STR. CU CABLE TO 1/4"X-1 1/2" (1 PER 50 CONN.)
4	1.5	EN019108	CARTRIDGE, THERMOWELD POWDER; #90 CHARGE, CADWELD METAL
5	1	EN019109	SLEEVE: CADWELD; ADAPTER SLEEVES ARE USED TO ADAPT 1/0, 1 STR
6	1	32074891	NEMA 1-HOLE COPPER BUS BAR FOR PIPE PILE FOUNDATIONS
7	1	EN019252	COMPOUND: ELECTRICAL JOINT, INHIBITOR, GREASE LIKE, 8 OZ TUBE
8	1	0000018450	ASSEMBLY, BOLT: MACH, SS, 1/2" DIA. x 1" LG. W/NUT AND WASHERS. (SEE NOTE 5)

* – ORDER ONE EA. PER 50 CONNECTIONS



1) FOR INSTALLATION OF ANODES REFER TO STANDARD T00109 AND DWG. TMD302.
2) COAT ALL MECHANICAL CONNECTIONS (THREADS AND BUS BAR TO NUTS) WITH ELECTRICAL JOINT INHIBITOR COMPOUND.
3) ANODES NOT REQUIRED FOR POLES SUPPORTED ON CONC. DRILLED PIERS, OR POLES BACKFILLED WITH CONCRETE. SEE DWG. TMD296 FOR BONDING OF STEEL POLE TO STEEL PILE.
4) USE GALVANIZING TOUCH-UP EN019331 IF REQUIRED.
5) ITEM 8 HAS 1 NUT & 1 WASHER THAT WILL NOT BE USED.

ANODE-S-EMBED/PIER

ENTERGY SERVICES, INC.

Transmission LineDesign Standard

ANODE INSTALLATION DETAILS FOR STEEL POLES

STRUCTURAL ASSEMBLY DETAIL

STD NO. T00109 | SCALE: NONE

No. TMD300A4

Entergy

PLOT 1=32 | SH. 1 OF 1

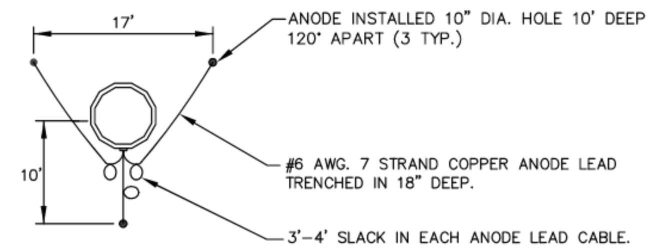
NO.	DATE:	REVISION	BY:	CHK:	APPR:
4	8-21-14	REV. STK. NO. ITEM 6, CHANGE MOLD ITEM 3	ECW		WLS
3	03-17-14	REVISED ITEMS 2 & 6, NOTES 1 & 3	ECW	JRA	WLS
2	8-10-06	REVISED ITEM 8, DEL ITEM 9, ADDED NOTE 4 & 5	MDB		
1	2-15-03	UPDATE MATERIALS LIST	ITRON		
0	2-11-03	CREATED	ITRON		

EWILLI2 8-21-14 ANODE-S-EMBED/PIER

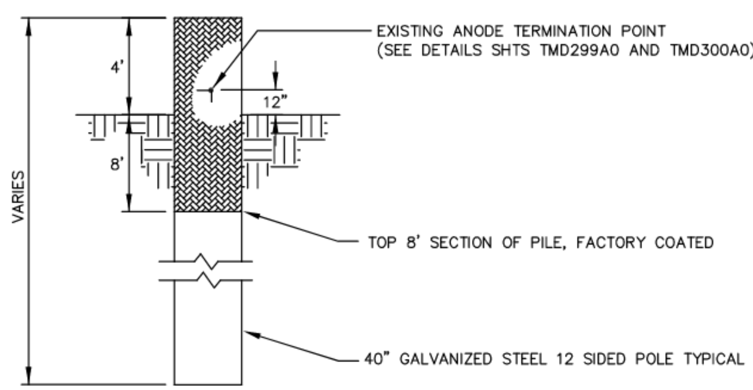
TYPICAL APPLICATION OF ANODE MATERIALS

STOCK NO.	DESCRIPTION	TYPICAL APPLICATION
EN015961 *	ANODE HIGH POTENTIAL MAGNESIUM, 32 LBS, W/ BACKFILL	RESISTIVITY > 2000 OHM-CM
EN015964	ANODE HIGH POTENTIAL MAGNESIUM, 60 LBS, W /BACKFILL	RESISTIVITY > 2000 OHM-CM
32108212 *	ANODE MAGNESIUM ALLOY, 32 LBS, W /BACKFILL	RESISTIVITY 1000 TO 2000 OHM-CM
32108213 *	ANODE MAGNESIUM ALLOY, 50 LBS, W /BACKFILL	RESISTIVITY 1000 TO 2000 OHM-CM
EN015968 *	ANODE ZINC, 30 LBS, W /BACKFILL	RESISTIVITY < 1000 OHM-CM
EN015970	ANODE ZINC, 60 LBS, W /BACKFILL	RESISTIVITY < 1000 OHM-CM
EN015972	ANODE ZINC, 120 LBS, W /BACKFILL	RESISTIVITY < 1000 OHM-CM
EN015967 *	ANODE ZINC, 30 LBS, W/O BACKFILL	RESISTIVITY < 1000 OHM-CM, VERY SOFT SOIL
EN015969	ANODE ZINC, 60 LBS, W/O BACKFILL	RESISTIVITY < 1000 OHM-CM, VERY SOFT SOIL
EN015971	ANODE ZINC, 120 LBS, W/O BACKFILL	RESISTIVITY < 1000 OHM-CM, VERY SOFT SOIL

*SEE NOTE 2.



PLAN VIEW



ELEVATION VIEW

1) ANODE WEIGHT IS WEIGHT OF METAL AND DOES NOT INCLUDE BACKFILL, LEADS, ETC., SEE INDUS FOR HANDLING WEIGHTS. LEAD NO. 6 AWG 7S, BSD COPPER THW INSULATION.
2) INSTALL IN 10"-DIA. X 10-FT HOLE. REMOVE PLASTIC BAG, LOWER IN BY LEAD; FILL SOIL AROUND AT ONCE. HOLE DEPTH MAY BE REDUCED TO 8' FOR 30#, 32# AND 50# ANODES.
3) LEAD CONNECTION AS SHOWN IN DRAWING DETAILS.

ANODE-INSTALLATION

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
CATHODIC PROTECTION FOR STEEL STRUCTURES
TYP. ANODE INSTALLATION

NO.	DATE:	REVISION	BY:	CHK:	APPR
1	03-17-14	ADD ALT. MATLS; COATING DIM., REV. NOTES 1 2, & 4	ECW	JRA	WLS
0	02-15-03	DRAWING ISSUED	ITRON		

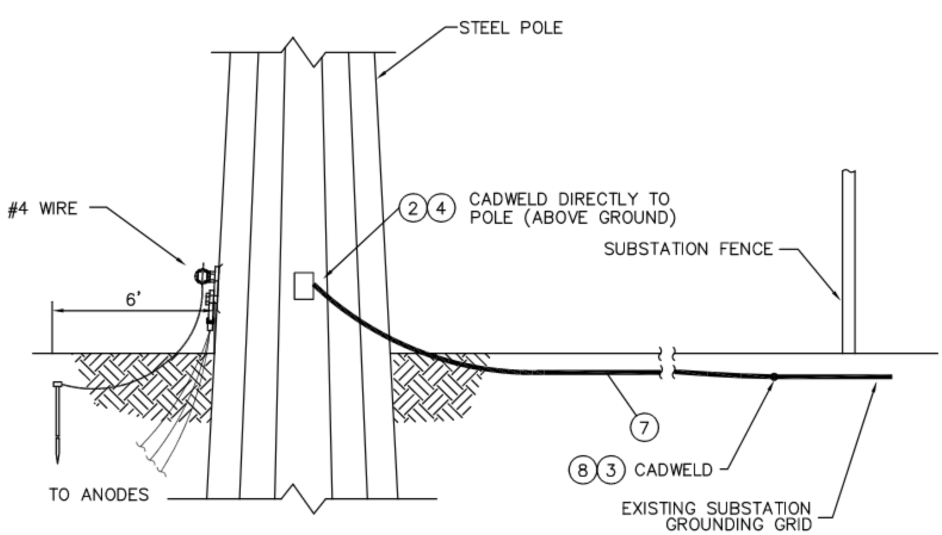
STD NO. T00109 | SCALE: NONE

Entergy | No. TMD302A1 | PLOT 1=32 | SH. 1 OF 1

BILL OF MATERIALS

ITEM	QTY.	STOCK NO.	DESCRIPTION
1	1*	EN013170	HANDLE; CLAMP, METAL; CADWELD, FITS C/E/R 3" MOLDS (1 PER 50 CONNECTIONS)
2	1	32046156	MOLD, 19 # 9 COPPERWELD STRANDED CABLE TO VERTICAL STEEL (1 PER 10 CONN.)
3	1	EN013619	CARTRIDGE, EXOTHERMIC, #150 CHARGE, F20 ALLOY FOR Cu-TO-Cu AND Cu-TO-STEEL
4	1	EN013173	CARTRIDGE, EXOTHERMIC, #200 CHARGE, WELD METAL
5	1	EN019252	COMPOUND: ELECTRICAL JOINT, INHIBITOR, GREASE LIKE, 8 OZ TUBE
6	1	EN019331	COATING; PROTECTIVE, 1/2 PINT; TOUCHUP FOR ALL TAR EXTENDED
7	50 ft.	32127987	WIRE, CAMO COPPERWELD, ANTI-THEFT, 19 #9 AWG, 40% CONDUCTIVITY
8	1	32046150	MOLD, 19 # 9 COPPERWELD STRANDED CABLE TO 4/0 (1 PER 10 CONNECTIONS)

* ORDER ONE EACH PER 50 CONNECTIONS.



NOTES:

1. FOR INSTALLATION OF ANODES REFER TO DOCUMENT TITLED "INSTALLATION OF CATHODIC PROTECTION ANODES". SEE DWG'S. TMD300 AND TMD302 FOR ANODE INSTALLATION DETAILS AND MATERIAL.
2. COAT ALL MECHANICAL CONNECTIONS (THREADS AND BUS BAR TO NUTS) WITH ITEM #5.
3. SEE DWG. TMD295, TMD296 OR TMD297 FOR POLE GROUNDING DETAILS AND MATERIAL.
4. GROUNDING IN ACCORDANCE WITH THIS DRAWING IS FOR POLE(S) THAT SUPPORT SHIELD WIRE SPAN(S) THAT CROSS OR TERMINATE IN A SUBSTATION.
5. ITEMS 1, 2 & 8 ARE CADWELD ITEMS – NOT INSTALLED.

GND-S-POLE-SUBSTA

NO.	DATE:	REVISION	BY:	CHK:	APPR
5	1-5-15	BOM, ITEMS 2,3,4,7,& 8, ADD ITEM NUMBERS TO DRG	ECW	FWM	WLS
4	07-22-10	NOTE 4, DEL. EN019108/RENUM IT. #'S, REV. IT. 3 QUAN.	CBM	JRA	ECW
3	07-22-10	GROUND ROD DIM	CBM	ECW	ECW
2	12-17-09	REV STK CODE FOR ITEM 8	HDR	ECW	ECW
1	06-30-06	GENERAL REVISION	MDB		
0	02-11-03	ISSUED	ITRON		

ENTERGY SERVICES, INC.

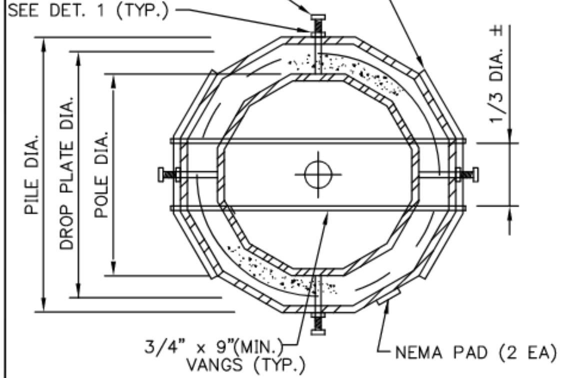
Transmission LineDesign Standard
GROUNDING, STEEL POLE TO SUBSTATION GRID
STRUCTURAL ASSEMBLY DETAIL

STD NO. | SCALE: NONE

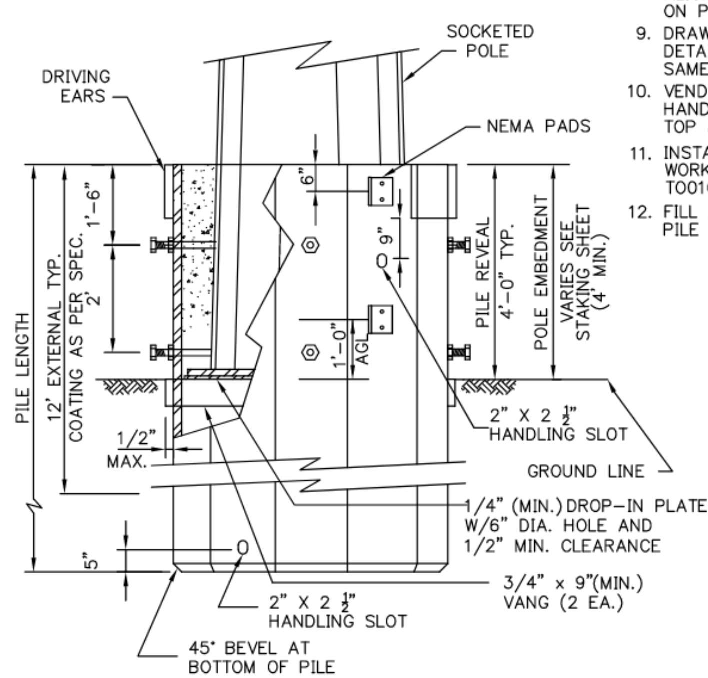
Entergy | No. TMD303A5

PLOT 1=1 | SH. 1 OF 1

EWILLI2 12-15-2014 GNDSPSUB



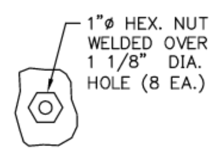
PLAN VIEW



ELEVATION VIEW
POLE/PILE BASE DETAIL

NOTES FOR STEEL PILE DETAIL–SOCKET

1. PROPOSED PILE LENGTHS AND DIA. ARE SHOWN ON THE PROJECT STAKING SHEET. PILE SUPPLIER SHALL VERIFY PROPOSED PILE THICKNESS AND DIAMETER. SEE STD # TC0301
2. POLE SUPPLIER SHALL DESIGN DRIVING EARS.
3. PILE TIP TO BE OPEN
4. PILE SUPPLIER TO PROVIDE THE FOLLOWING ACCESSORIES:
   - (8) 1"x12" ALIGNMENT BOLTS & NUTS
   - (1) 1/4" (MIN.) DROP-IN PLATE
   - (2) 1/2" TH. VIBRATING DRIVING EARS
   - (2) LARGE 2-HOLE NEMA PADS SEE STD# TC0301
   - (2) 3/4" x 9" (MIN.) VANGS
5. SUPPLIER TO COAT AS SPECIFIED IN STD# TC0301
6. NEMA PADS TO BE INSTALLED AS PER STD# TC0301 WELD ALL AROUND
7. SEE GROUNDING AND CATHODIC PROTECTION DETAILS ON STD DWG TMD297, LATEST REV.
8. PILES SHALL BE DELIVERED WITH ALIGNMENT BOLTS INSTALLED ON PILES.
9. DRAWING SHOWN FOR STEEL POLE. DETAIL FOR PILE SHALL BE THE SAME FOR CONCRETE POLES.
10. VENDOR SHALL PROVIDE HANDLING SLOTS (2 EA), TOP & BOTTOM OF PILE.
11. INSTALL PILE PER STANDARD T00107 WORK THIS DRAWING WITH STD. T00104.
12. FILL ANNULUS BETWEEN POLE AND PILE WITH CONCRETE PER STD. T00123



DETAIL 1

PILE–S

ENTERGY SERVICES, INC.

Transmission LineDesign Standard

Steel Pile, Socket Connection Details, Concrete or Steel Pole

STRUCTURAL ASSEMBLY DETAIL

NO.	DATE:	REVISION	BY:	CHK:	APPR
2	9–30–16	REV. NOTE 11 & 12, TO UPDATE REFS. TO STANDARDS	ECW	JRA	PL
1	09–15–11	COMPLETE REVISION TO MATCH VENDOR DETAILS	CBM	ECW	ECW
0		DRAWING ISSUED			

STD NO. | SCALE:

Entergy | No. TMD307A2

PLOT | SH. OF

ewilli2 9/12/2016 PILE–S

BILL OF MATERIALS

SPLICE BOX, POLE

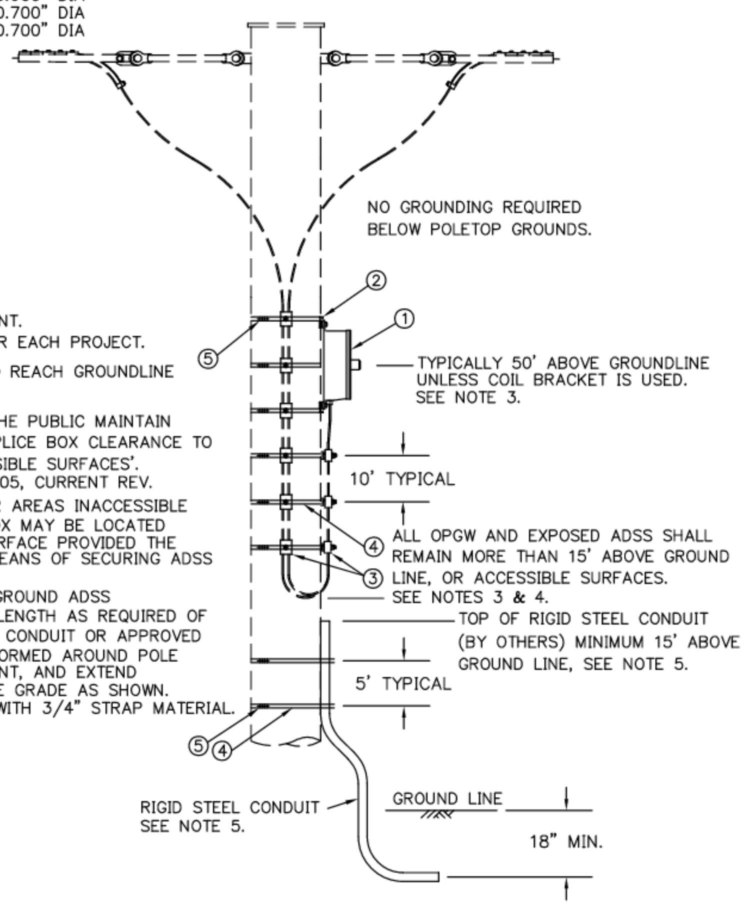
ITEM	QTY.	STOCK NO.	DESCRIPTION
1	1	0032018592	SPLICE BOX: FIBER OPTIC, HOLES FOR 1/2" LAG SCREW OR BOLT
2	1	0032026880	ADAPTER, ASSEMBLY, BANDING, FIBER OPTIC, FOR 3/4 BAND, CONSISTING OF TWO ADAPTERS AND TWO 1/2" HEX BOLT ASSEMBLIES
3	12	LS9014XX	CLAMP, DOWNLEAD: FIBER OPTIC, WITH BANDING ADAPTER
4	1 ROLL	0000017124	BAND, STRAPPING, 3/4" WD X 100FT LG ROLL, STAINLESS STEEL, 201
5	12	0000017123	CLAMP, BAND: ADJUSTABLE, 3/8" X 6" BOLT, FOR 3/4" BAND

ITEM #3 AVAILABLE

57MM 0032038843 0.400–0.500" DIA
64MM 0032038845 0.501–0.600" DIA
52MM 0032038846 0.601–0.700" DIA
92MM 0032038846 0.601–0.700" DIA

NOTES

1. ITEM #3 IS OPGW DEPENDENT. THIS ITEM IS SELECTED FOR EACH PROJECT.
2. PROVIDE ENOUGH OPGW TO REACH GROUNDLINE PLUS 35 FEET.
3. IN AREAS ACCESSIBLE TO THE PUBLIC MAINTAIN 15' MINIMUM OPGW AND SPLICE BOX CLEARANCE TO GROUND OR TOP OF ACCESIBLE SURFACES'. WORK WITH DRAWING SMC005, CURRENT REV.
4. IN SUBSTATIONS OR OTHER AREAS INACCESSIBLE TO THE PUBLIC, SPLICE BOX MAY BE LOCATED 5' ABOVE THE GROUND SURFACE PROVIDED THE THE ADSS IS SECURED. MEANS OF SECURING ADSS PROVIDED BY OTHERS.
5. WHEN SPLICING TO UNDERGROUND ADSS CONTRACTOR TO PROVIDE LENGTH AS REQUIRED OF GALV. STL. 2" SCHED. 40 CONDUIT OR APPROVED EQUAL. CONDUIT TO BE FORMED AROUND POLE FOUNDATION WHERE PRESENT, AND EXTEND 1.5' MINIMUM BELOW GRADE GRADE AS SHOWN. CONDUIT TO BE SECURED WITH 3/4" STRAP MATERIAL.



SB–P–XX

NO.	DATE:	REVISION	BY:	CHK:	APPR
5	9–6–17	ADD GUARD PIPE, REV NOTES 1 – 3, ADD NOTE 4 & 5	ECW	CDHH	JRA
4	2–18–10	CHANGED UNITS FOR ITEM 4	TWF	HSK	HSK
3	12–08–09	REPLACE ITEM NOS. IN BOM	HDR	ECW	ECW
2	8–3–07	REPL. ADAPT. W/ ASSY, REV. DIA. RANGES	TWF	HSK	HSK
1	05–15–07	REVISED NAME & DESCRIPTION	TWF	HSK	HSK

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
SPLICE BOX, POLE
STRUCTURAL ASSEMBLY DETAIL

STD NO.	SCALE: NONE	
Entergy	No. TMD337A5	
	PLOT 1=1	SH. 1 OF 1

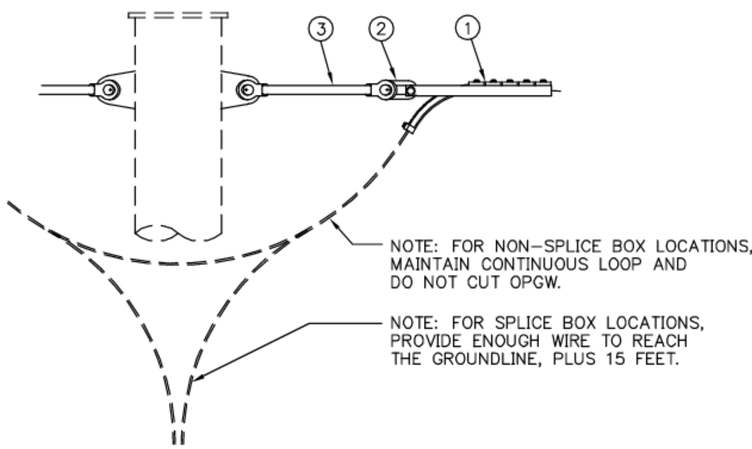
ewilli2 9/6/2017 SB–P–XX

BILL OF MATERIALS

OVERHEAD GROUND WIRE, DEADEND, OPGW, POLE

ITEM	QTY.	STOCK NO.	DESCRIPTION
1	1	LS9011XX	DEADEND: BOLTED STRAIN,OPGW,3/4" PIN DIA.
2	1	0000012586	LINK, CHAIN: 5/8" X 3-1/4", 40K
3	1	0000024787	CLEVIS CLEVIS: Y-Y, 30K, 3/4" PD, 15" LONG

NOTE: ILLUSTRATED AS TANGENT OR SMALL ANGLE STRUCTURE. LARGER ANGLES WILL HAVE THE PULLOFFS AT DIFFERENT ELEVATIONS BY SEVERAL INCHES.



ITEM #1 AVAILABLE

57MM	0000018531	0.465" DIA
64MM	0032018594	0.528" DIA
52MM	0032018595	0.646" DIA
92MM	0032018596	0.671" DIA

1) ITEM #1 IS OPGW DEPENDENT.
THIS ITEM IS SELECTED FOR EACH PROJECT.

OHG-DE-OP-P-XX

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
OVERHEAD GRNDWIRE, DE, OPGW, POLE
STRUCTURAL ASSEMBLY DETAIL

NO.	DATE:	REVISION	BY:	CHK:	APPR:
2	5-15-07	REVISED NOTES, NAME & DESCRIPTION	TWF	HSK	HSK
1	8-23-06	UPDATED BILL OF MATERIAL	RJL	HSK	HSK
0	X	CREATED		HSK	HSK

STD NO. | SCALE: NONE

Entergy | No. TMD339A2

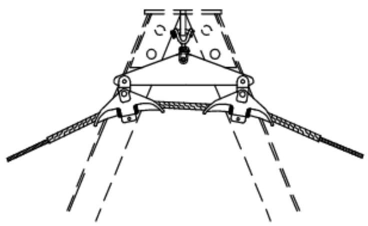
PLOT 1=1 | SH. 1 OF 1

tfinc90 6/25/2007 OHG-DE-OP-P-XX

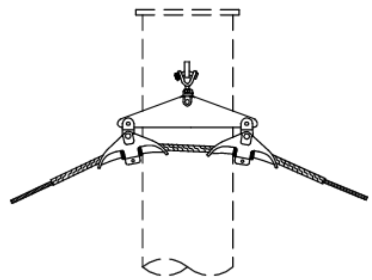
BILL OF MATERIALS

OVERHEAD GROUND WIRE, SUSP. 30–50° w/YOKE, OPGW

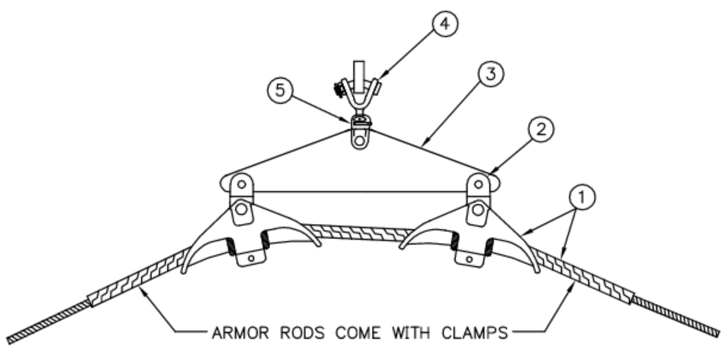
ITEM	QTY.	STOCK NO.	DESCRIPTION
1	1	LS9010XX	CLAMP, SUSP: DOUBLE (2 CLAMPS).,ALUM AL,15K,W/48" ARM RODS,30°–60° MAX. ANGLE
2	2	0032020410	CLEVIS EYE: STRAIGHT, 30K, 2–7/8" LG,1–5/8" EYE WD,3/4" EYE RAD, 5/8" PIN DIA
3	1	0032020414	PLATE, YOKE: DELTA, DUCTILE IRON, 18" LONG, 30K
4	1	0000004375	BALL CLEVIS: 45 DEG Y, 30K, 3/4" PD, CLASS 52–3/5
5	1	0000000486	SOCKET CLEVIS: STRAIGHT, 30K, 5/8" PD, CLASS 52–3/5



AS ON LATTICE TOWER



AS ON POLE



ITEM #1 AVAILABLE
57MM 0032018593 0.450–0.475" DIA
64MM 0000017195 0.528–0.555" DIA
52MM 0000017196 0.615–0.646" DIA
92MM 0000017198 0.647–0.679" DIA

OHG–SUY–OP–XX

1) ITEM #1 OPGW DEPENDENT.
THIS ITEM IS SELECTED FOR EACH PROJECT.

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
OVERHEAD GRNDWIRE, SUSP 30–50 W/YOKE, OPGW
STRUCTURAL ASSEMBLY DETAIL

STD NO. | SCALE: NONE

No. TMD341A2

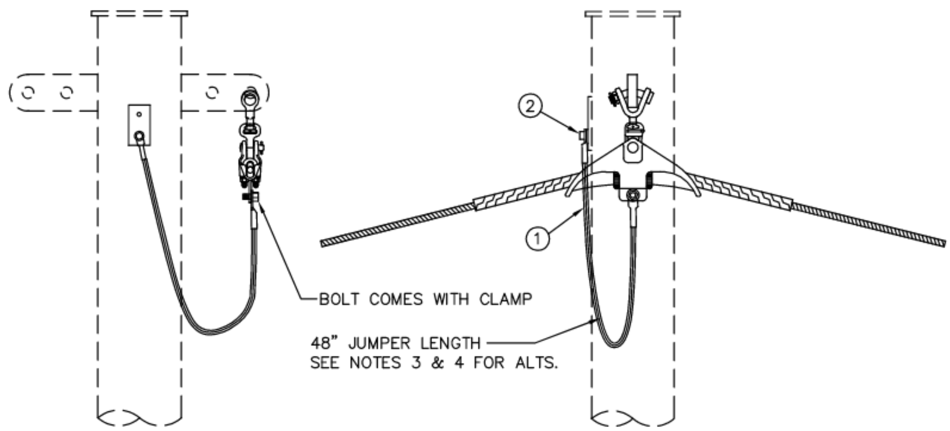
Entergy | PLOT 1=1 | SH. 1 OF 1

NO.	DATE:	REVISION	BY:	CHK:	APPR:
2	5–15–07	REVISED NAME & DESCRIPTION. COMBINED DWGS TMD340 & TMD341	TWF	HSK	HSK
1	8–01–06	EXPANDED DESCRIPTIONS OF ITEMS 1 & 2	CDR	HSK	HSK
0	5–24–04	CREATED	.	HSK	HSK

tfinc90 6/25/2007 OHG–SUY–OP–XX

BILL OF MATERIALS

GROUND, SUSP. 0-30°, OPGW, STEEL POLE			
ITEM	QTY.	STOCK NO.	DESCRIPTION
1	1	0032033755	JUMPER, STATIC LINE: MULTI-STRANDED TINNED COPPER, 133/.0177, 48" LG, W/TERMINALS
2	1	0000018450	ASSEMBLY, BOLT: MACH, SS, HEX HEAD, 1/2" DIA. X 1" LG., WITH NUT, 2 WASHERS AND 1 BELLEVILLE WASHER



NOTES:

1. ITEM 1 CAN BE MADE UP WITH 48" OF THE WIRE (0032018798) AND TWO TERMINALS (0032031548) AND COMPRESSING THE TERMINALS WITH AN INDENT DIE.
2. ITEM 2 HAS 1 NUT AND 1 WASHER THAT WILL NOT BE NEEDED.
3. USE 72" JUMPER (0032052394) FOR APPLICATION ON POLES WITH 3 FOOT SW DAVIT ARMS.
4. SEE DRAWING TMQ207 FOR OTHER AVAILABLE JUMPER LENGTHS.

GND-SUS-OP-S

NO.	DATE:	REVISION	BY:	CHK:	APPR:
3	3-26-14	ADD NOTES 3 AND 4 WITH ALT. JUMPER LENGTHS.	ECW	JRA	WLS
2	3-15-07	REV. NOTES, NAME & DESCRIPTION. SIDE VIEW ADDED.	TWF	HSK	HSK
1	8-17-06	DELETED 1 BOLT ON CLAMP, MADE JUMPER AND TERMINALS AN ASSEMBLY	RJL	HSK	HSK
0	5-24-04	CREATED	.	HSK	HSK

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
GROUND, SUSP, 0-30, OPGW, STEEL POLE
STRUCTURAL ASSEMBLY DETAIL

STD NO. | SCALE: NONE

Entergy | No. TMD343A3

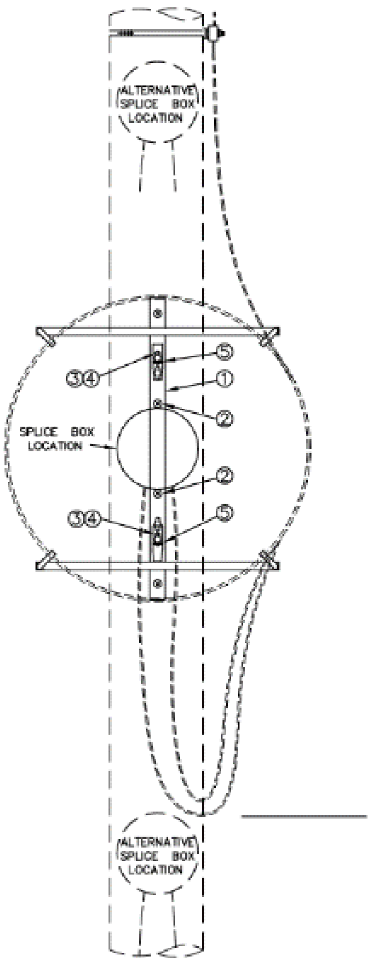
PLOT 1=1 | SH. 1 OF 1

ewilli2 3-17-14 GND-SUS-OP-S

BILL OF MATERIALS

COIL BRACKET, OPGW, STEEL POLE

ITEM	QTY.	STOCK NO.	DESCRIPTION
1	1	0032031230	BRACKET, COIL,: 60 INCH, GALV. STEEL, PER ENTERGY DWG TMM060A
2	2	–	BOLT, MACHINE, 1/2"–13 X 1", ALL THREAD, GALV. STEEL, NO NUT, NO WASHER (ANY SUPPLIER)
3	0	0000000139	BOLT ASSEMBLY, MACHINE: HEX HEAD, GALV. STEEL, 5/8"–11 X 1–1/2", WITH HEX NUT
4	0	0000005532	WASHER, ROUND, FLAT, 11/16" ID, 1–1/2" OD, 1/8" THICK, ASTM A153, GALV. STEEL
5	0	0032031232	PLATE, BENT, GALV. STEEL, PER ENTERGY DWG. TMM061A



NOTE #1: ASSEMBLY WILL TYPICALLY BE BANDED TO POLE USING 3/4" SS BAND MATERIAL AND ADAPTERS SUPPLIED WITH THE SPLICE BOX. ALTERNATELY, THE COIL BRACKET ASSEMBLY MAY BE SECURED WITH TWO 1/2: BOLTS (ITEM 2) USING ANY TWO OF THE FOUR THREADED RECEIVER PROVIDED.

NOTE #2: TWO EACH OF ITEMS 3 AND 5, AND FOUR OF ITEM 4 MAY ALSO BE USED TO SECURE THE COIL BRACKET ASSEMBLY TO POLES ALREADY IN SERVICE THAT WERE MANUFACTURED WITH STEP CLIPS. THE STEP CLIP DETAIL IS COMMON ON OLDER POLES MANUFACTURED BY THOMAS & BETTS.

NOTE #3: COIL BRACKET ASSEMBLY CAN BE INSTALLED WITH EITHER END UP. BEFORE TIGHTENING BOLTS, BE SURE THAT WEIGHT OF COMPONENTS PULLS THEM FIRMLY INTO SLOTTED HOLES IN THE CHANNEL.

NOTE #4: THE LOWEST PART OF THE INSTALLATION MUST BE A MINIMUM OF 15 FEET ABOVE GROUNDINE AND THE CABLE MUST COME INTO THE BOTTOM OF THE SPLICE BOX WITH NO STRAIN ON THE CONNECTORS. ADDITIONAL BANDING MAY BE NECESSARY TO GATHER AND STABILIZE THE EXCESS CABLE LENGTH TO THE BRACKET AND POLE. HOLES ARE PROVIDED IN THE END OF EACH ARM TO ACCOMMODATE CABLE TIES OR WIRE TIES.

15' MINIMUM ABOVE GL. IF ALTERNATE SPLICE BOX LOCATION IS USED, NO PART OF INSTALLATION CAN BE LOWER THAN 15' ABOVE THE GROUND LINE.

CB–OP–S

NO.	DATE	REVISION	BY	CHK	APPR
3	9–24–15	ADD REF. LINE FOR 15' MIN. DIMENSION	ECW		ECW
2	8–21–14	QTY. ITEMS 3–5, REV. NOTES 1 & 2	ECW		WLS
1	5–15–07	REVISED NAME & DESCRIPTION	TWF	HSK	HSK
0	3–30–06	CREATED	RMB	HSK	HSK

ENTERGY SERVICES, INC.

Transmission LineDesign Standard

COIL BRACKET, OPGW, STEEL POLE
STRUCTURAL ASSEMBLY DETAIL

STD NO. | SCALE: NONE

Entergy | No. TMD386A3

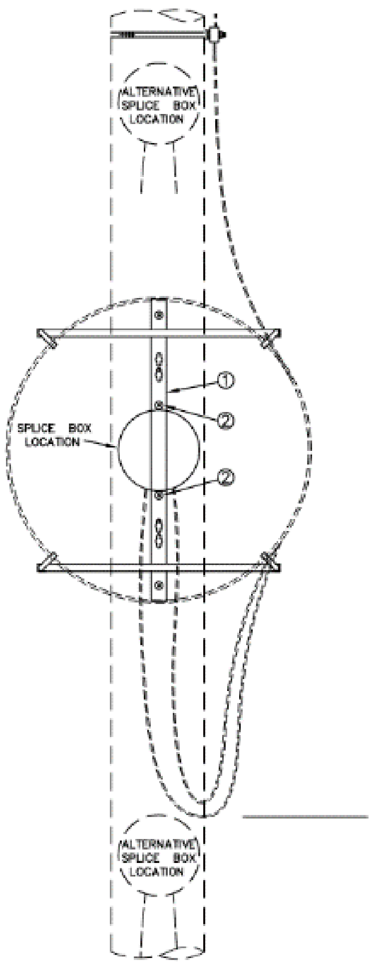
PLOT 1=1 | SH. 1 OF 1

EWILLI2 08–24–15 CB–OP–S

BILL OF MATERIALS

COIL BRACKET, OPGW, CONCRETE POLE

ITEM	QTY.	STOCK NO.	DESCRIPTION
1	1	0032031230	BRACKET, COIL,: 60 INCH, GALV. STEEL, PER ENTERGY DWG TMM060A
2	2	–	BOLT, MACHINE, 1/2"–13 X 1", ALL THREAD, GALV. STEEL, NO NUT, NO WASHER (ANY SUPPLIER)
–	–	–	–
–	–	–	–
–	–	–	–



NOTE #1: ASSEMBLY WILL TYPICALLY BE BANDED TO POLE USING 3/4" SS BAND MATERIAL AND ADAPTERS SUPPLIED WITH THE SPLICE BOX. ALTERNATELY, THE COIL BRACKET ASSEMBLY MAY BE SECURED WITH TWO 1/2: BOLTS (ITEM 2) USING ANY TWO OF THE FOUR THREADED RECEIVER PROVIDED.

NOTE #2: COIL BRACKET ASSEMBLY CAN BE INSTALLED WITH EITHER END UP. BEFORE TIGHTENING BOLTS, BE SURE THAT WEIGHT OF COMPONENTS PULLS THEM FIRMLY INTO SLOTTED HOLES IN THE CHANNEL.

NOTE #3: THE LOWEST PART OF THE INSTALLATION MUST BE A MINIMUM OF 15 FEET ABOVE GROUNDINE AND THE CABLE MUST COME INTO THE BOTTOM OF THE SPLICE BOX WITH NO STRAIN ON THE CONNECTORS. ADDITIONAL BANDING MAY BE NECESSARY TO GATHER AND STABILIZE THE EXCESS CABLE LENGTH TO THE BRACKET AND POLE. HOLES ARE PROVIDED IN THE END OF EACH ARM TO ACCOMMODATE CABLE TIES OR WIRE TIES.

15' MINIMUM ABOVE GL. IF ALTERNATE SPLICE BOX LOCATION IS USED, NO PART OF INSTALLATION CAN BE LOWER THAN 15' ABOVE THE GROUND LINE.

CB–OP–C

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
COIL BRACKET, OPGW, CONCRETE POLE
STRUCTURAL ASSEMBLY DETAIL

STD NO. | SCALE: NONE

Entergy | No. TMD387A3

PLOT 1=1 | SH. 1 OF 1

NO.	DATE:	REVISION	BY:	CHK:	APPR
3	9–24–15	ADD REF. LINE FOR 15' MIN. DIMENSION	ECW		ECW
2	8–21–14	REV NOTE 1, DEL ITEM 3 & NOTE 2, RENUM NOTES	ECW		WLS
1	5–15–07	REVISED NAME & DESCRIPTION	TWF	HSK	HSK
0	3–30–06	CREATED	RMB	HSK	HSK

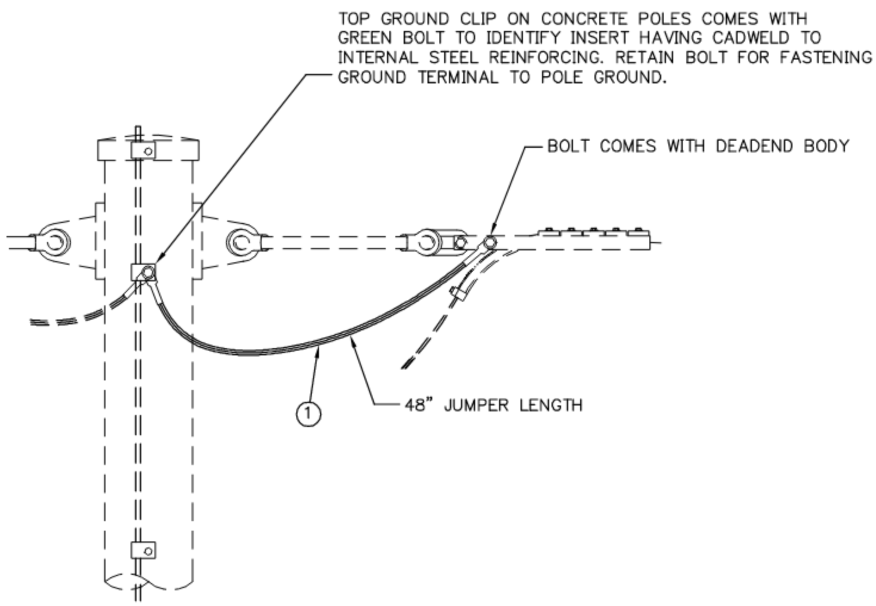
EWILLI2 8/24/15 CB–OP–C

BILL OF MATERIALS

GROUND, DEADEND, OPGW, CONCRETE POLE

ITEM	QTY.	STOCK NO.	DESCRIPTION
1	1	0032033755	JUMPER, STATIC LINE: MULTI-STRANDED TINNED COPPER, 133/.0177, 48" LG, W/TERMINALS

NOTE: ITEM 1 CAN BE MADE UP WITH 48" OF THE WIRE (0032018798) AND TWO TERMINALS (0032031548) AND COMPRESSING THE TERMINALS WITH AN INDENT DIE.



GND-DE-OP-C

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
GROUND, DEADEND, OPGW, CONCRETE POLE
STRUCTURAL ASSEMBLY DETAIL

STD NO. | SCALE: NONE

No. TMD398A0

PLOT 1=1 | SH. 1 OF 1

Entergy

NO.	DATE:	REVISION	BY:	CHK:	APPR:
0	5-15-07	CREATED	TWF	HSK	HSK

tfinc90 5/31/2007 GND-DE-OP-C

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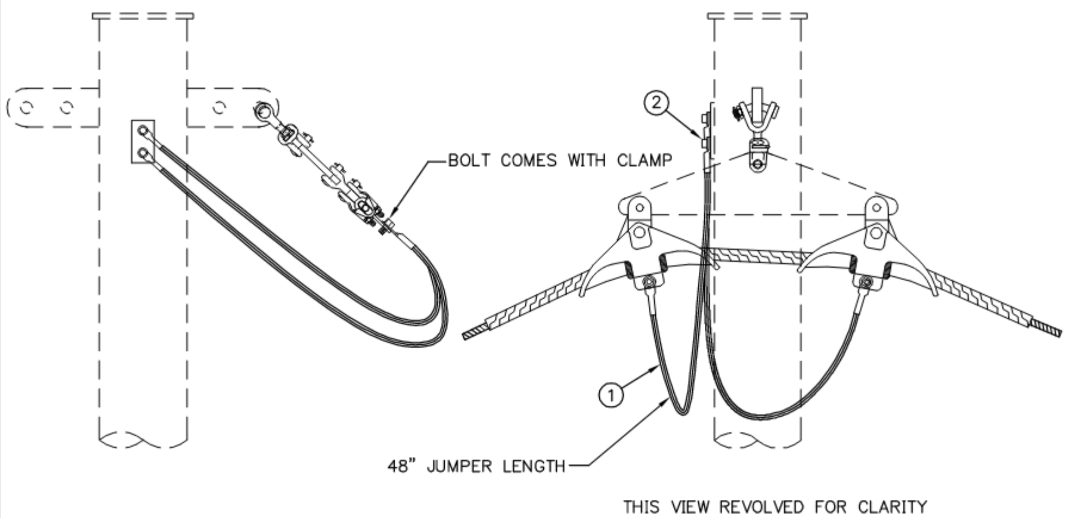
BILL OF MATERIALS			
GROUND, SUSP. 30-50' w/YOKE, OPGW, STEEL POLE			
ITEM	QTY.	STOCK NO.	DESCRIPTION
1	2	0032033755	JUMPER, STATIC LINE: MULTI-STRANDED TINNED COPPER, 133/.0177, 48" LG, W/TERMINALS
2	2	0000018450	ASSEMBLY, BOLT: MACH, SS, HEX HEAD, 1/2" DIA. X 1" LG., WITH NUT, 2 WASHERS AND 1 BELLEVILLE WASHER

NOTE: ITEM 1 CAN BE MADE UP WITH 48" OF THE WIRE (0032018798) AND TWO TERMINALS (0032031548) AND COMPRESSING THE TERMINALS WITH AN INDENT DIE.

NOTE: ITEM 2 HAS 1 NUT AND 1 WASHER THAT WILL NOT BE NEEDED.



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GND-SUY-OP-S

0	5-15-07	CREATED	TWF	HSK	HSK	
NO.	DATE:	REVISION	BY:	CHK:	APPR:	

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
GROUND, SUSP, 30-50, W/YOKE, OPGW, STEEL POLE
STRUCTURAL ASSEMBLY DETAIL

STD NO. | SCALE: NONE

Entergy | No. TMD399A0

PLOT 1=1 | SH. 1 OF 1

tfinc90 5/31/2007 GND-SUY-OP-S

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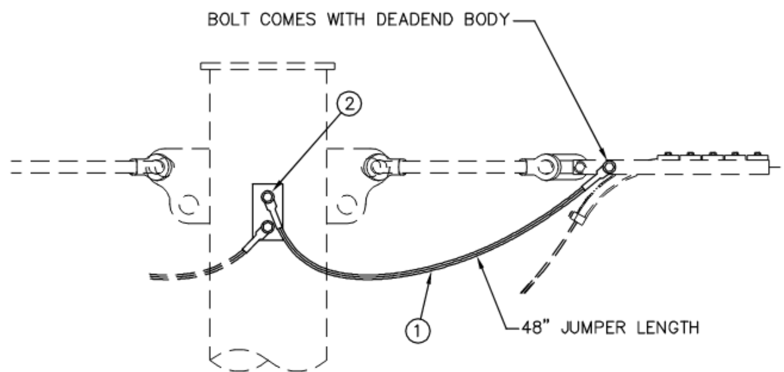
BILL OF MATERIALS

GROUND, DEADEND, OPGW, STEEL POLE

ITEM	QTY.	STOCK NO.	DESCRIPTION
1	1	0032033755	JUMPER, STATIC LINE: MULTI-STRANDED TINNED COPPER, 133/.0177, 48" LG, W/TERMINALS
2	1	0000018450	ASSEMBLY, BOLT: MACH, SS, HEX HEAD, 1/2" DIA. X 1" LG., WITH NUT, 2 WASHERS AND 1 BELLEVILLE WASHER

NOTE: ITEM 1 CAN BE MADE UP WITH 48" OF THE WIRE (0032018798) AND TWO TERMINALS (0032031548) AND COMPRESSING THE TERMINALS WITH AN INDENT DIE.
NOTE: ITEM 2 HAS 1 NUT AND 1 WASHER THAT WILL NOT BE NEEDED.



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GND-DE-OP-S

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
GROUND, DEADEND, OPGW, STEEL POLE
STRUCTURAL ASSEMBLY DETAIL

NO.	DATE:	REVISION	BY:	CHK:	APPR:
0	5-15-07	CREATED	TWF	HSK	HSK

STD NO. | SCALE: NONE

Entergy

No. TMD402A0

PLOT 1=1 | SH. 1 OF 1

tfinc90 5/31/2007 GND-DE-OP-S

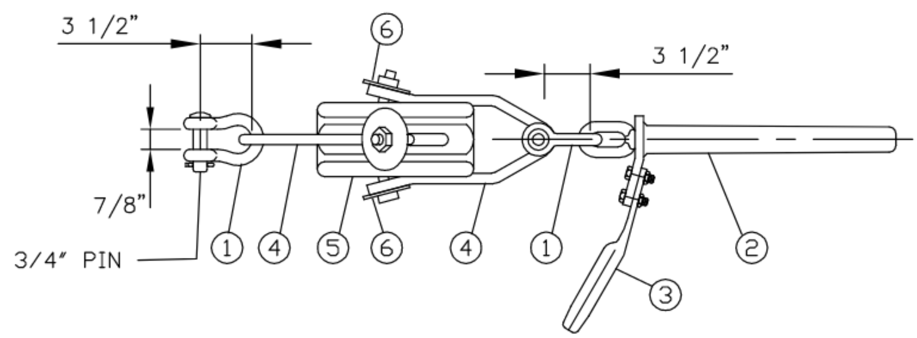
LIST OF COMPONENTS

QUAN ASSY	ITEM NO.	DESCRIPTION	CATALOG NUMBER	ULTIMATE STRENGTH	BASIC MATERIAL	WEIGHT EACH	ENTERGY STOCK NO.
2	1	ANCHOR SHACKLE	ASH-66A	50,000 #	F.S.	2.25 #	EN000491
1	2	COMPRESSION D.E.	*SEE TABLE*	–	ALUM.		*SEE TABLE*
1	3	TERMINAL	*SEE TABLE*	–	ALUM.		*SEE TABLE*
2	4	SHACKLE	J732	12,400#	F.S.	1.46#	**
1	5	INSULATOR	L506	20,000#	PORC.	2.90#	**
4	6	CLIPPED WASHER	ASM-7159-1		STL		**

** ITEMS 4, 5 & 6 ARE COMBINED INTO ENTERGY STOCK CODE 000125-308.
INDUS CAT ID 000125-308 LISTS THESE ITEMS AS ONE MACLEAN PART NUMBER XXXXXXXXXXXXXX.

FOR COMPRESSION DEAD END

SHIELD WIRE	SHIELD WIRE DIA.	COMP. D.E. (ITEM 2)	ENTERGY STOCK NO.	TERMINAL (ITEM 3)	ENTERGY STOCK NO.	ASSEMBLY CAT. NO.
7 NO. 7 ALUMOWELD	0.433	V3816.484T	EN005526	3916.484	EN028530	C-7687-OGWDE1-2
3/8" EHS STEEL	0.375	V3814.386T	EN005530	3914.386	EN028531	C-7687-OGWDE2-2
7/16" EHS STEEL	0.438	V3816.453T	EN005531	3914.386	EN028531	C-7687-OGWDE4-2



GENERAL NOTES
THESE INSULATED SHIELD WIRE ASSEMBLIES ARE PRIMARILY FOR SELECT LINES OF THE 500KV SYSTEM WHERE POWER LOSSES ARE A CONCERN. THERE MAY BE OTHER APPLICATIONS ON THE LOWER VOLTAGE LINES WHERE RADIO INTERFERENCE IS A CONCERN.

OHG-DEJB-XX

ENTERGY SERVICES, INC.

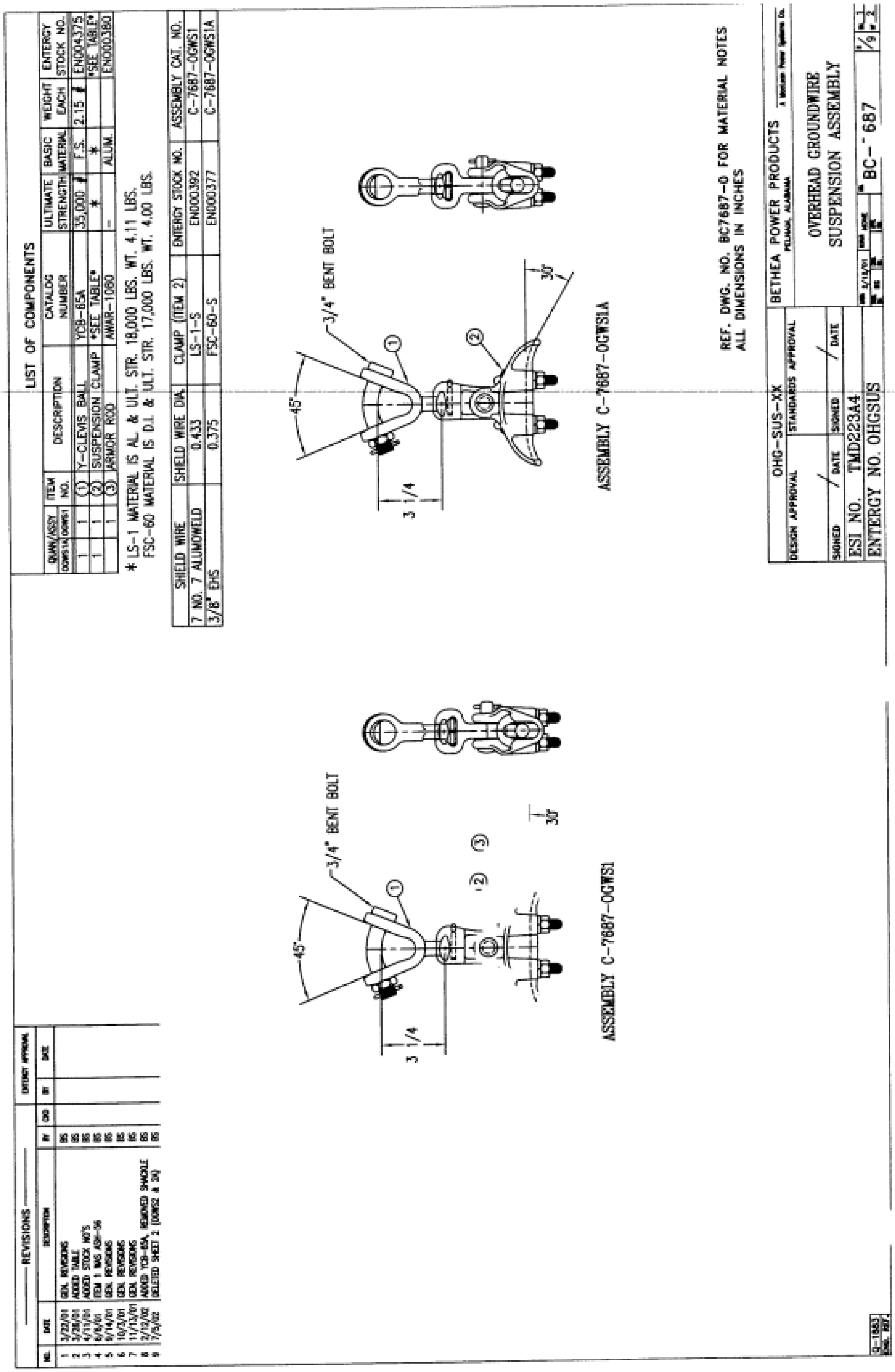
Transmission LineDesign Standard
OVERHEAD GROUNDWIRE DEADEND ASSY
STRUCTURAL ASSEMBLY DETAIL

STD NO. | SCALE: NONE

Entergy | No. TMD403A0 | PLOT 1=1 | SH. 1 OF 1

NO.	DATE:	REVISION	BY:	CHK:	APPR
0	12-13-07	CREATED	TWF	HSK	HSK

tfinc90 12/20/2007 OHG-DEJB-XX


REVISIONS
NO. DATE DESCRIPTION BY CKD
1 3/22/01 GEN. REVISIONS BS
2 3/28/01 ADDED TABLE BS
3 4/11/01 ADDED STOCK NO'S BS
4 6/8/01 ITEM 1 WAS ASH-56 BS
5 6/14/01 GEN. REVISIONS BS
6 10/3/01 GEN. REVISIONS BS
7 11/13/01 GEN. REVISIONS BS
8 2/12/02 ADDED YCB-65A, REMOVED SHACKLE BS
9 7/5/02 DELETED SHEET 2 (OGWS2 & 2A) BS
ENTERGY APPROVAL BY DATE
LIST OF COMPONENTS
QUAN/ASSY OGWS1A OGWS1 | ITEM NO. | DESCRIPTION | CATALOG NUMBER | ULTIMATE STRENGTH | BASIC MATERIAL | WEIGHT EACH | ENTERGY STOCK NO.
1 | 1 | (1) | Y-CLEVIS BALL | YCB-65A | 35,000 # | F.S. | 2.15 # | EN004375
1 | 1 | (2) | SUSPENSION CLAMP | *SEE TABLE* | * | * | | *SEE TABLE*
| 1 | (3) | ARMOR ROD | AWAR-1080 | – | ALUM. | | EN000380
* LS-1 MATERIAL IS AL. & ULT. STR. 18,000 LBS. WT. 4.11 LBS.
FSC-60 MATERIAL IS D.I. & ULT. STR. 17,000 LBS. WT. 4.00 LBS.
SHIELD WIRE | SHELD WIRE DIA. | CLAMP (ITEM 2) | ENTERGY STOCK NO. | ASSEMBLY CAT. NO.
7 NO. 7 ALUMOWELD | 0.433 | LS-1-S | EN000392 | C-7687-OGWS1
3/8" EHS | 0.375 | FSC-60-S | EN000377 | C-7687-OGWS1A
45°
3/4" BENT BOLT
3 1/4
30°
ASSEMBLY C-7687-OGWS1
ASSEMBLY C-7687-OGWS1A
REF. DWG. NO. BC7687-0 FOR MATERIAL NOTES
ALL DIMENSIONS IN INCHES
OHG-SUS-XX
DESIGN APPROVAL
STANDARDS APPROVAL
SIGNED DATE
ESI NO. TMD223A4
ENTERGY NO. OHGSUS
BETHEA POWER PRODUCTS
PELHAM, ALABAMA
OVERHEAD GROUNDWIRE
SUSPENSION ASSEMBLY
BC-7687
Q-1883

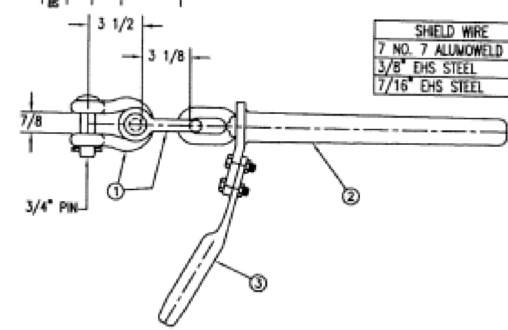
REVISIONS					ENTERGY APPROVAL	
NO.	DATE	DESCRIPTION	BY	CKD	BY	DATE
1	3/22/01	GEN. REVISIONS	BS			
2	4/11/01	ADDED STOCK NO'S	BS			
3	5/22/01	CHANGED COMPRESSION FOR 7#7	BS			
4	7/25/01	ADDED BOLTED STRAIN CLAMPS.	BC			
5	8/14/01	GEN. REVISIONS	BS			
6	10/3/01	GEN. REVISIONS	BS			
7	12/10/01	GEN. REVISIONS	BS			
8	5/8/02	ADDED ASSY OGWDE4	BS			

LIST OF COMPONENTS

QUAN ASSY	ITEM NO.	DESCRIPTION	CATALOG NUMBER	ULTIMATE STRENGTH	BASIC MATERIAL	WEIGHT EACH	ENTERGY STOCK NO.
2	(1)	ANCHOR SHACKLE	ASH-66A	50,000 #	F.S.	2.25 #	EN000491
1	(2)	COMPRESSION D.E.	*SEE TABLE*	–	ALUM.		*SEE TABLE*
1	(3)	TERMINAL	*SEE TABLE*	–	ALUM.		*SEE TABLE*

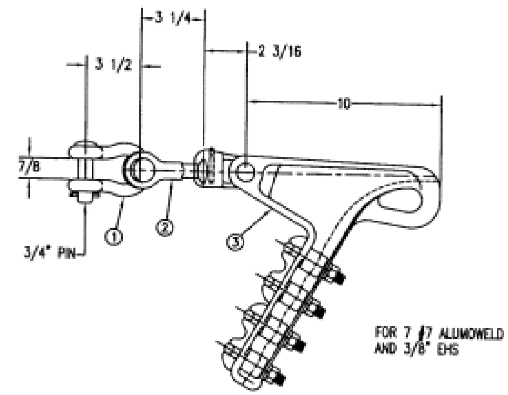
FOR COMPRESSION DEAD END

SHIELD WIRE	SHIELD WIRE DIA.	COMP. D.E. (ITEM 2)	ENTERGY STOCK NO.	TERMINAL (ITEM 3)	ENTERGY STOCK NO.	ASSEMBLY CAT. NO.
7 NO. 7 ALUMOWELD	0.433	V3816.484T	EN005526	3916.484	EN028530	C-7687-OGWDE1
3/8" EHS STEEL	0.375	V3814.386T	EN005530	3914.386	EN028531	C-7687-OGWDE2
7/16" EHS STEEL	0.438	V3816.453T	EN005531	3914.386	EN028531	C-7687-OGWDE4



LIST OF COMPONENTS

QUAN ASSY	ITEM NO.	DESCRIPTION	CATALOG NUMBER	ULTIMATE STRENGTH	BASIC MATERIAL	WEIGHT EACH	ENTERGY STOCK NO.
1	(1)	ANCHOR SHACKLE	ASH-66A	50,000 #	F.S.	2.25 #	EN000491
1	(2)	Y-CLEVIS BALL	YCB-65A	35,000 #	F.S.	2.15 #	EN004375
1	(3)	STRAIN CLAMP	ADE-22-S	20,000 #	AL.	6.00 #	EN005956

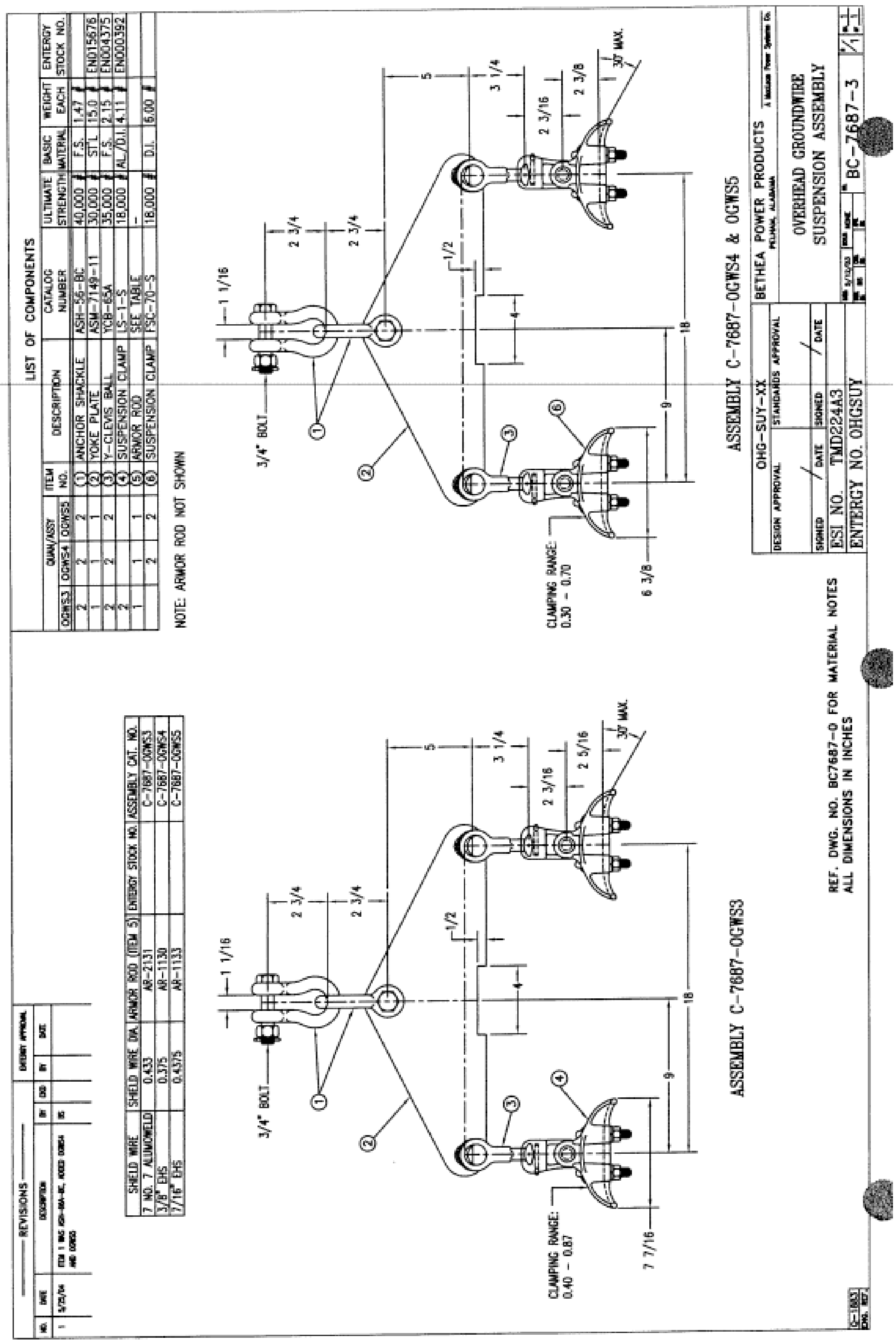


ASSEMBLY NUMBER C-7687-OGWDE3

ALL DIMENSIONS IN INCHES
SEE SHEET ONE FOR MATERIAL NOTES

OHG-DE-XX		BETHEA POWER PRODUCTS, PELHAM, ALABAMA
DESIGN APPROVAL	STANDARDS APPROVAL	OVERHEAD GROUNDWIRE DEADEND ASSEMBLY
SIGNED / DATE	SIGNED / DATE	
ESI NO. TMD222A4		
ENTERGY NO. OHGDE		BC-7687

Q-1683 ENG. REF.

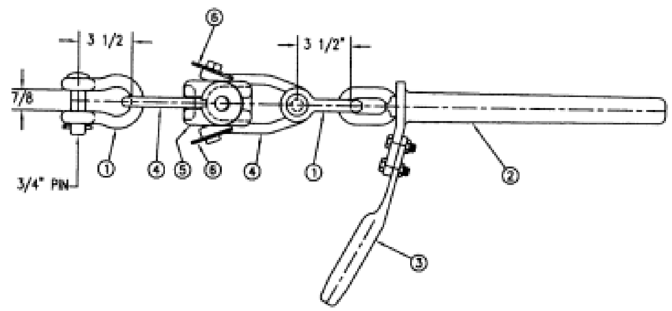

LIST OF COMPONENTS
QUAN/ASSY OGWS3 OGWS4 OGWS5
ITEM NO.
DESCRIPTION
CATALOG NUMBER
ULTIMATE STRENGTH
BASIC MATERIAL
WEIGHT EACH
ENTERGY STOCK NO.
ANCHOR SHACKLE ASH-56-BC 40,000 # F.S. 1.47 # EN015676
YOKE PLATE ASM-7149-11 30,000 # STL 15.0 # EN004375
Y-CLEVIS BALL YCB-65A 35,000 # F.S. 2.15 # EN004375
SUSPENSION CLAMP IS-1-S 18,000 # AL/D.I. 4.11 # EN000392
ARMOR ROD SEE TABLE
SUSPENSION CLAMP FSC-70-S 18,000 # D.I. 6.00 #
NOTE: ARMOR ROD NOT SHOWN
3/4" BOLT
CLAMPING RANGE: 0.30 - 0.70
CLAMPING RANGE: 0.40 - 0.87
30° MAX.
ASSEMBLY C-7687-OGWS4 & OGWS5
ASSEMBLY C-7687-OGWS3
SHIELD WIRE
7 NO. 7 ALUMOWELD
3/8" EHS
7/16" EHS
SHIELD WIRE DIA.
ARMOR ROD (ITEM 5)
ENTERGY STOCK NO.
ASSEMBLY CAT. NO.
0.433 AR-2131 C-7687-OGWS3
0.375 AR-1130 C-7687-OGWS4
0.4575 AR-1133 C-7687-OGWS5
REVISIONS
REF. DWG. NO. BC7687-0 FOR MATERIAL NOTES
ALL DIMENSIONS IN INCHES
BETHEA POWER PRODUCTS
PELHAM, ALABAMA
OVERHEAD GROUNDWIRE SUSPENSION ASSEMBLY
BC-7687-3
OHG-SUY-XX
DESIGN APPROVAL
STANDARDS APPROVAL
SIGNED DATE
ESI NO. TMD224A3
ENTERGY NO. OHGSUY

LIST OF COMPONENTS

QUAN ASSY	ITEM NO.	DESCRIPTION	CATALOG NUMBER	ULTIMATE STRENGTH	BASIC MATERIAL	WEIGHT EACH	ENTERGY STOCK NO.
2	1	ANCHOR SHACKLE	ASH-66A	50,000 #	F.S.	2.25 #	EN000491
1	2	COMPRESSION D.E.	*SEE TABLE*	-	ALUM.		*SEE TABLE*
1	3	TERMINAL	*SEE TABLE*	-	ALUM.		*SEE TABLE*
2	4	SHACKLE	J732	12,400 #	F.S.	1.46 #	
1	5	INSULATOR	L506	20,000 #	PORC.	2.90 #	
4	6	CLIPPED WASHER	ASM-7159-1		ST'L		

FOR COMPRESSION DEAD END

SHIELD WIRE	SHIELD WIRE DIA.	COMP. D.E. (ITEM 2)	ENTERGY STOCK NO.	TERMINAL (ITEM 3)	ENTERGY STOCK NO.	ASSEMBLY CAT. NO.
7 NO. 7 ALUMOWELD	0.433	V3816.484T	EN005526	3916.484	EN028530	C-7687-OGWDE1-2
3/8" EHS STEEL	0.375	V3814.386T	EN005530	3914.386	EN028531	C-7687-OGWDE2-2
7/16" EHS STEEL	0.438	V3816.453T	EN005531	3914.386	EN028531	C-7687-OGWDE4-2



REF. DWG. NO. BC7687-0 FOR MATERIAL NOTES
ALL DIMENSIONS IN INCHES

ENTERGY REV.	REVISION DATE
A	10/12/07

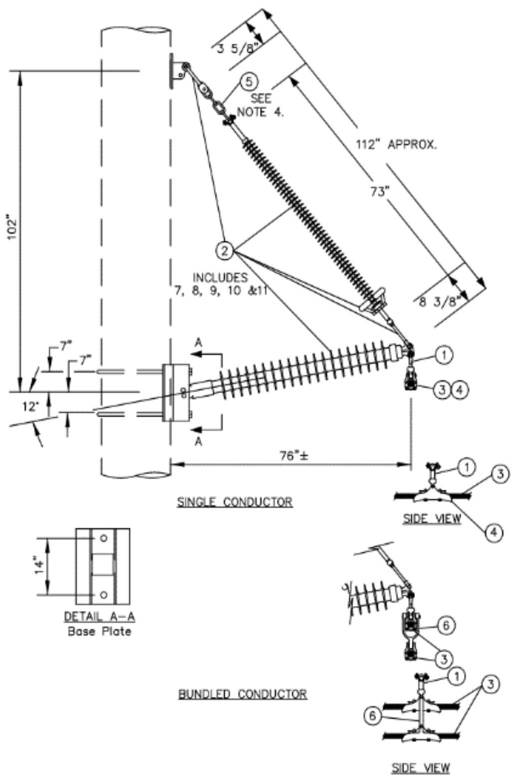
ESI NO.

MACLEAN POWER SYSTEMS
A MacLean-Fogg Company

OVERHEAD GROUNDWIRE
DEADEND ASSEMBLY

BC-7687-4

Q-1883



BILL OF MATERIALS

INSULATOR, 2-1/2" POLYMER BRACED LINE POST ASSY FOR 161kV

ITEM	QUANTITY BP2	QUANTITY BP2B	STOCK NO.	DESCRIPTION	CATALOG NUMBER	BASIC MATERIAL	WEIGHT EA. (LBS)	ULTIMATE STRENGTH (LBS)
1	1	1	EN004375	BALL CLEVIS, 45 DEG Y, 35K ULT, 3/4" PIN DIA	YCB-65A	F.S.	2.2	35,000
2	1	1	EN016149	INSULATOR, 2-1/2" BRACED POST ASSY., POLYMER, HIGH POL. 161kV	B291076AL48A	COMP.	101.3	SEE APP. CURVE
3	1	2	LS9003XX	ROD, ARMOR, PREFORMED, ALUMINUM, VARIABLE CONDUCTOR SIZE	SEE TABLE	ALUM.	VARIES	N/A
4	1	–	LS9008XX	CLAMP, SUSPENSION, ALUMINUM, VARIABLE WIRE SIZE, w/SOCKET EYE	SEE TABLE	AL./D.I.	VARIES	25,000 U.N.O.
5	1	1	32103543	CHAIN, STL., GALVANIZED, 1.78 LBS/FT., 72.4K ULT.	CH5/8-14LK	F.S.	4.2	72,400
6	–	1	LS915XX	YOKE, VERTICAL DOUBLE BUNDLE, VARIABLE SIZE WIRE	SEE TABLE	AL./D.I.	VARIES	25,000 *
7	–	–	EN018718	Y-CLEVIS-CLEVIS (SUPPLIED AS PART OF ITEM 2)	YCC-65	D.I.	1.4	30,000
8	–	–	EN014858	INSULATOR, SUSPENSION (SUPPLIED AS PART OF ITEM 2)	S148073VA12	COMP	16.5	25,000
9	–	–	EN018719	SOCKET CLEVIS H. L. (SUPPLIED AS PART OF ITEM 2)	SCHL-55	D.I.	3.3	30,000
10	–	–	EN014853	INSULATOR, POST (SUPPLIED AS PART OF ITEM 2)	H291076VX18	COMP.	75.2	SEE APP. CURVE
11	–	–	EN020681	RING, CORONA (SUPPLIED AS PART OF ITEM 8)	CR16/18-8	ALUM.	4.0	N/A

* ULTIMATE STRENGTH FOR BUNDLING YOKE IS AS AN ASSEMBLY

	CONDUCTOR	ARMOR ROD (ITEM 3)	ENTERGY STK. NO.	DIA. W/ARM. ROD (IN)	TAKEOFF ANGLE (DEG)	FOR SINGLE CONDUCTORS (BP2) CLAMP (ITEM 4)	ENTERGY STOCK NO.	ASSEMBLY CATALOG. NO.	FOR BUNDLED CONDUCTORS (BP2B) BUNDLE (ITEM 6)	ENTERGY STOCK NO.	ASSEMBLY CATALOG. NO.
ACCC/TW	1949 (56/1), LAPWING	INCL.	w/ ITEM 4	–	–	TLS-0119SE **	32068997	NOT YET ASSIGNED	N/A	N/A	N/A
	1582 (33/1), BITTERN	INCL.	w/ ITEM 4	–	–	TLS-0115SE **	32068992	NOT YET ASSIGNED	N/A	N/A	N/A
	1429 (33/1), BEAUMONT	INCL.	w/ ITEM 4	–	–	AGS-5138	32082067	NOT YET ASSIGNED	N/A	N/A	N/A
	1222 (33/1), CARDINAL	INCL.	w/ ITEM 4	–	–	TLS-0111SE	32068988	NOT YET ASSIGNED	N/A	N/A	N/A
	821 (18/1), GROSBEAK	INCL.	w/ ITEM 4	–	–	TLS-0105SE	32068975	NOT YET ASSIGNED	N/A	N/A	N/A
ACSS	1590 (45/7), LAPWING	AR-0163	EN000381	2.376	15	ACFS-244-20-20-S	EN028863	C-8083-BP2-4	VBACFS-18-2442020-S	32127531	NOT YET ASSIGNED
	1272 (45/7), BITTERN	AR-0146	EN000155	2.075	15	ACFS-214-20-20-S	32020718	C-8083-BP2-3	VBACFS-18-2142020-S	32127530	NOT YET ASSIGNED
	954 (54/7), CARDINAL	AR-0143	EN000383	1.816	15	ACFS-186-20-20-S	32020716	C-8083-BP2-2	VBACFS-18-1862020-S	32127529	NOT YET ASSIGNED
	666.6 (24/7), FLAMINGO	AR-0137	EN000384	1.620	15	ACFS-175-20-20-S	32020714	C-8083-BP2-1	VBACFS-18-1752020-S	32127527	NOT YET ASSIGNED
ACSR	1780 (84/19), CHUKAR	AR-0165	EN000382	2.474	30	ASC-11-S	EN004361	C-7648-BP2-6	VBLS-12-1111-S	EN027828	C-7648-BP2B-6
	1590 (45/7), LAPWING	AR-0163	EN000381	2.376	30	ASC-11-S	EN004361	C-7648-BP2-5	VBLS-12-1111-S	EN027828	C-7648-BP2B-5
	1272 (45/7), BITTERN	AR-0146	EN000155	2.075	30	ASC-11-S	EN004361	C-7648-BP2-4	VBLS-12-1111-S	EN027828	C-7648-BP2B-4
	1033.5 (45/7), ORTOLAN	AR-0144	EN027807	1.943	30	LS-9-S	EN028185	C-7648-BP2-8	VBLS-12-99-S	EN027829	C-7648-BP2B-8
	954 (54/7), CARDINAL	AR-0143	EN000383	1.816	30	LS-8-S	EN000370	C-7648-BP2-3	VBLS-12-88-S	EN027825	C-7648-BP2B-3
	954 (45/7), RAIL	AR-0143	EN000383	1.785	30	LS-8-S	EN000370	C-7648-BP2-3	VBLS-12-88-S	EN027825	C-7648-BP2B-3
	795 (26/7), DRAKE	AR-0141	EN004005	1.728	30	LS-8-S	EN000370	C-7648-BP2-7	VBLS-12-88-S	EN027825	C-7648-BP2B-7
	666.6 (24/7), FLAMINGO	AR-0137	EN000384	1.620	30	LS-8-S	EN000370	C-7648-BP2-2	VBLS-12-88-S	EN027825	C-7648-BP2B-2
	336.4 (26/7), LINNET	AR-0130	EN000385	1.129	30	LS-6-S	EN000158	C-7648-BP2-1	VBLS-12-66-S	EN027823	C-7648-BP2B-1
ACAR	1024.5 24/13	AR-0143	EN000383	1.785	30	LS-8-S	EN000370	C-7648-BP2-3	VBLS-12-88-S	EN027825	C-7648-BP2B-3
	649.5 18/19	AR-0135	EN027806	1.428	30	LS-6-S	EN000158	C-7648-BP2-9	VBLS-12-66-S	EN027823	C-7648-BP2B-9
	395.2 15/7	AR-0130	EN000385	1.129	30	LS-6-S	EN000158	C-7648-BP2-1	VBLS-12-66-S	EN027823	C-7648-BP2B-1

** ULTIMATE STRENGTH FOR TLS-0115SE & TLS-0119SE is 30k

NOTES

1) Item #3, #4 and #6 are conductor dependent. Clamps/Bundles are selected for each project and are Applied with Armor Rod, unless specifically noted.
2) For Braced Post individual part details see Insulator Mfg. drawings.
3) Note that 161 kV Insulators are used for 115 & 138 kV applications.
4) Stock Code shown is for Pre-Cut Chain. Alternately, cut 14 links from EN018717.
5) For Hardware Only, add suffix "-H" to Assembly Cat. No. Ex.: C-7648-BP2-1-H

MIN ELEC./MECH. SPECIFICATIONS

MIN. ELECTRICAL VALUES	
60 HZ DRY FO	590 KV
60 HZ WET FO	510 KV
CIFO+	960 KV
CIFO-	1020 KV
STRIKE DIST.	60 IN.
LEAKAGE DIST.	140 IN.
MIN. MECHANICAL STRENGTH	
MDCL	SUBMIT CURVES

NO.	DATE:	REVISION	BY:	CHK:	APPR:
–					
11	11-20-14	ADDED ELEC. SPECS. & COND. HARDWARE TABLE, RE-DRAWN 11X17	ECW	JPM	M.S
10	05-08-12	ADD STK CODE FOR PRE-CUT CHAIN; CORR. BUNDLE	ECW	HSK	RLR
9	10-19-11	CORRECT ANGLE DIMENSION OF POST	ECW	JRA	RLR
8	05-05-11	UPDATE ITEM 2 DESC., ADD CORONA RING	CBM	ECW	ECW
7	07-20-10	REV. BOM ITEM 5	CBM	ECW	ECW
6	05-28-03	ADDED DIMENSION	ITRON		

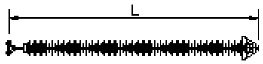
BP2-161-XX

ENTERGY SERVICES, INC.
TRANSMISSION LINE STANDARD
POLYMER ASSY., 2 1/2" BRACED POST
161 kV INSULATOR ASSEMBLY DETAIL
STD NO. TA0504 | SCALE: N. T. S.
Entergy | No. TCA200A11
PLOT 1:24 | SH. 1 OF 1

BP2-161-XX

10-15-2014 ewilli2

INSULATOR, SUSPENSION, 25,000 LBS.



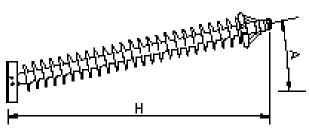
S1. SPECIFIED MECHANICAL LOAD (SML) = 25,000 LBS. ROUTINE TEST LOAD (RTL) = 12,500 LBS

S2. END FITTING TO BE A Y-CLEVIS, AND AN ANSI CLASS 52-5 BALL

S3. 115 kV AND 138 kV INSULATORS USED FOR MAINTENANCE ONLY. FOR NEW CONSTRUCTION 161 kV INSULATORS WILL BE USED IN 115 kV, 138 kV, AND 161 kV APPLICATIONS.

S4. USED IN SUSPENSION APPLICATIONS AND AS PART OF BRACED POST ASSEMBLIES.

INSULATOR, LINE POST, 2.5" ROD DIA.
AND
INSULATOR, LINE POST, 3" ROD DIA.



P1. SPECIFIED TENSILE LOAD (STL) = 15,000 LBS. (2.5" ROD) 20,000 LBS. (3" ROD)

P2. MAX. DESIGN CANTILEVER LOAD (MDCL) AND SPECIFIED CANTILEVER LOAD (SCL) TO BE NOTED ON VENDOR DRAWINGS AND CATALOG SHEETS.

P3. LINE END FITTING TO BE A DROP TONGUE FITTING WITH 2 HOLES FOR 3/4" PIN.

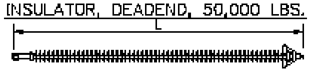
P4. STRUCTURE END FITTING TO BE BENDABLE GAIN BASE. BASE SHALL HAVE A HOLE AT THE TOP AND A SLOT AT THE BOTTOM SIZED FOR 7/8" BOLTS AT 14" CENTERS.

P5. 115 kV AND 138 kV INSULATORS USED FOR MAINTENANCE ONLY. FOR NEW CONSTRUCTION 161 kV INSULATORS WILL BE USED IN 115 kV, 138 kV, AND 161 kV APPLICATIONS.

P6. USED IN LINE POST AND JUMPER APPLICATIONS, AND AS PART OF BRACED POST ASSEMBLIES.

P7. 3" POST GENERALLY APPLIED FOR HEAVY ZONE LOADING, ANGLE STRUCTURES, AND/OR WHERE CONDUCTOR SWING IS TOWARD THE POLE.

INSULATOR, DEADEND, 50,000 LBS.



D1. SPECIFIED MECHANICAL LOAD (SML) = 50,000 LBS. ROUTINE TEST LOAD (RTL) = 25,000 LBS

D2. END FITTINGS ARE TO BE OVAL/CHAIN EYE AND ANSI CLASS 52-11 BALL

D3. 115 kV AND 138 kV INSULATORS USED FOR MAINTENANCE ONLY. FOR NEW CONSTRUCTION 161 kV INSULATORS WILL BE USED IN 115 kV, 138 kV, AND 161 kV APPLICATIONS.

D4. USED IN DEADEND AND HEAVY SUSPENSION APPLICATIONS.

INSULATOR ASSY., BRACED LINE POST, 2.5" ROD DIA.
AND
INSULATOR ASSY., BRACED LINE POST, 3" ROD DIA.

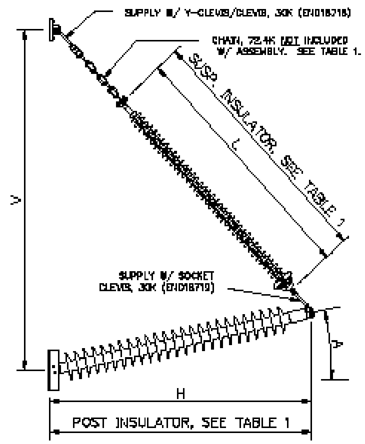


TABLE 1

	V (kV)	ENTERGY STOCK CODE: BP ASSY	SUSP.	POST	CHAIN
BP2	115	EN016144	EN014880	EN014788	32103533
	138	EN016146	EN014859	EN014852	32103536
	161	EN016149	EN014858	EN014853	32103543
	230	EN016150	EN014884	EN014789	32103548
BP3	115	EN016145	EN014880	EN014794	32103531
	138	EN016148	EN014859	EN014795	32103533
	161	EN016151	EN014858	EN014797	32103539
	230	EN016152	EN014884	EN014803	32103541

B1. EACH ASSEMBLY SHALL CONSIST OF ONE (1) 25K SUSPENSION INSULATOR; ONE (1) POST INSULATOR; ONE (1) 30K Y-CLEVIS/CLEVIS CONNECTOR; AND ONE (1) 30K SOCKET/CLEVIS CONNECTOR.

B2. SUSPENSION AND POST INSULATORS TO MAKE THE ASSEMBLY SHALL MEET ALL OTHER APPLICABLE REQUIREMENTS OF THIS DRAWING.

B3. ALLOWABLE LOADING DIAGRAMS FOR THE COMBINED ASSEMBLY SHALL ACCOMPANY THE VENDOR CATALOG SHEETS/DRAWINGS.

B4. 138 kV INSULATOR ASSEMBLY USED FOR MAINTENANCE ONLY. 115 kV INSULATOR ASSEMBLY USED FOR MAINTENANCE AND NEW 69 kV APPLICATIONS. FOR NEW CONSTRUCTION 161 kV INSULATORS WILL BE USED IN 115 kV, 138 kV, AND 161 kV APPLICATIONS.

B5. 3" BRACED POST GENERALLY APPLIED FOR HEAVY ZONE LOADING, ANGLE STRUCTURES, AND/OR WHERE CONDUCTOR SWING IS TOWARD THE POLE.

SPECIFIED DIMENSIONS AND ELECTRICAL CHARACTERISTICS

TYPE	LINE VOLTAGE (kV)	ENTERGY STOCK CODE	DESIGN DIMENSIONS H	V	L	A	PORC. BELL EQUIVALENT	MIN. LEAK. DIST. (IN.)	MIN. DRY ARC DIST. (IN.)	MIN. 60-Hz F. O. (kV) DRY	WET	MIN. CRITICAL IMPULSE F. O. (kV) POS.	NEG.	CORONA RING REQUIRED LINE END	STRUCT. END
SUSPENSION INSULATOR 25,000 LB.	69	EN014885	–	–	48"	–	8	90	38	380	330	640	660	–	–
	115	EN014880	–	–	60"	–	8	120	48	485	410	780	835	–	–
	138	EN014859	–	–	68"	–	8	130	58	540	480	865	955	–	–
	161	EN014858	–	–	75"	–	10	140	60	590	510	960	1020	8" HRL	–
	230	EN014884	–	–	90"	–	13	200	77	735	840	1240	1270	8" HRL	–
POST INSULATOR, 2.5" ROD DIA.	69	EN014787	45"	–	–	12"	8	90	38	380	330	640	660	–	–
	115	EN014788	60"	–	–	12"	8	120	48	485	410	780	835	–	–
	138	EN014852	68"	–	–	12"	8	130	58	540	480	805	955	–	–
	161	EN014853	78"	–	–	12"	10	140	60	590	510	960	1020	–	–
	230	EN014789	84"	–	–	12"	13	200	77	735	840	1240	1270	–	–
	161	32084117	78"	–	–	12"	10	140	80	590	510	960	1020	6" HRL	–
	230	32084119	84"	–	–	12"	13	200	77	735	840	1240	1270	6" HRL	–
POST INSULATOR, 3" ROD DIA.	69	EN014793	45"	–	–	17"	8	90	38	380	330	640	660	–	–
	115	EN014794	60"	–	–	17"	8	120	48	485	410	780	835	–	–
	138	EN014796	68"	–	–	17"	8	130	58	540	480	865	955	–	–
	161	EN014797	78"	–	–	17"	10	140	80	590	510	980	1020	–	–
	230	EN014803	84"	–	–	17"	13	200	77	735	840	1240	1270	–	–
	161	32084118	78"	–	–	17"	10	140	80	590	510	960	1020	6" HRL	–
	230	32084115	84"	–	–	17"	13	200	77	735	840	1240	1270	6" HRL	–
DEADEND INSULATOR 50,000 LB.	69	EN014856	–	–	64"	–	8	120	49	485	430	830	880	–	–
	115	EN014857	–	–	75"	–	10	135	61	590	510	870	1025	–	–
	138	EN014809	–	–	80"	–	11	170	88	640	560	1045	1105	–	–
	161	EN014810	–	–	92"	–	12	185	78	890	828	1215	1275	8" HRL	–
	230	EN016124	–	–	104"	–	16	220	88	830	708	1380	1440	8" HRL	–
BRACED POST INSULATOR 2.5" ROD DIA.	115	EN016144	60"	80"	60"	12"	8	120	48	485	410	780	835	–	–
	138	EN016146	66"	90"	66"	12"	8	130	58	540	480	865	955	–	–
	161	EN016149	78"	102"	73"	12"	10	140	60	590	510	960	1020	6" HRL	–
	230	EN016150	84"	120"	90"	12"	13	200	77	735	840	1240	1270	6" HRL	–
BRACED POST INSULATOR 3" ROD DIA.	115	EN016143	60"	80"	60"	17"	8	120	48	485	410	780	835	–	–
	138	EN016148	66"	90"	66"	17"	8	130	58	540	480	865	955	–	–
	161	EN016151	78"	102"	73"	17"	10	140	60	590	510	960	1020	6" HRL	–
	230	EN016152	84"	120"	90"	17"	13	200	77	735	840	1240	1270	6" HRL	–

NOTES:

1. DESIGN DIMENSIONS "H", "V" AND "L" MAY VARY BY +/− 1". DESIGN DIMENSION "A" MAY VARY BY +/− 1". MANUFACTURING TOLERANCES SHALL BE AS STATED IN THE VENDOR'S QUALITY ASSURANCE MANUAL AND APPROVED BY ENTERGY.
2. END FITTINGS ON SUSPENSION AND DEADEND INSULATORS SHALL HAVE INTEGRAL DESIGN ELEMENTS (e.g., CORONA BALLS) DEMONSTRATED TO EFFECTIVELY DISTRIBUTE ELECTRICAL FIELD STRESS GRADIENTS ON THE POLYMER. ALTERNATELY, MINI-RINGS MUST BE PROVIDED.
3. 161 kV AND 230 kV INSULATORS SHALL BE SUPPLIED WITH CORONA RINGS AS NOTED ABOVE. WHERE CORONA RINGS ARE REQUIRED FOR BRACED POST ASSEMBLIES, THE CORONA RING SHALL BE SUPPLIED FOR THE SUSPENSION INSULATOR ONLY.
4. WHERE CORONA RINGS ARE REQUIRED, THE INSULATOR MUST MEET THE TABULATED ELECTRICAL CHARACTERISTICS WITH CORONA RINGS INSTALLED.
5. ALL CORONA RINGS SHALL BE SHIPPED EITHER INSTALLED ON OR IN THE SAME PACKING FOR THE INSULATOR.
6. ALL INSULATORS SHALL BE IDENTIFIED BY PERMANENTLY MARKING EACH WITH:
   - MANUFACTURER'S NAME OR SYMBOL
   - MANUFACTURER'S PART NUMBER
   - LOT CODE NUMBER
   - YEAR MANUFACTURED
   - MECHANICAL STRENGTH IN POUNDS
   - ENTERGY STOCK CODE
   - VOLTAGE CLASS (230kV, 161kV, 138kV, 115kV OR 69kV)
   - 25K SUSPENSION UNITS SHALL BE MARKED "SUSPENSION"
   - 50K DEADEND UNITS SHALL BE MARKED "DEADEND"
7. STOCK CODES SHOWN ARE OLDER FORMAT TO BE CONSISTENT WITH OTHER DRAWINGS. NEW FORMAT CONSISTS OF 10 DIGIT NUMERAL WITH PRECEDING ZEROS (e.g. EN012345 WILL APPEAR AS 0000012345 ON PURCHASE ORDER.)

NO.	DATE	REVISION	BY	CHK	APPR
5	10-13-11	DEL. NOTE 8, REV. ELECTRICAL VALUES, REV. CHAIN	ECW		
4	10-13-11	COMPLETE REVISION	ECW	HSK	RLB
3	02-28-11	ADD CORONA SHIELDS TO 161 kV, REV. NOTES 1 & 2		ECW	RLB
2	03-05-07	CORRECTED DRAFTING STANDARD ERRORS	TRF	HSK	
1	3-30-06	REPLACED TURNBUCKLES WITH CHAIN LINKS	BMB		

ENTERGY SERVICES, INC.
Transmission Standard
POLYMER INSULATOR STANDARD, 69-230kV
STD NO. | SCALE: NONE
No. TMCD07A5
PLOT 1=1 | SH. 1 OF 1

TD0200 Attachment 5, Polymer Insulator Standard Drawing

ewill2 8/10/2012

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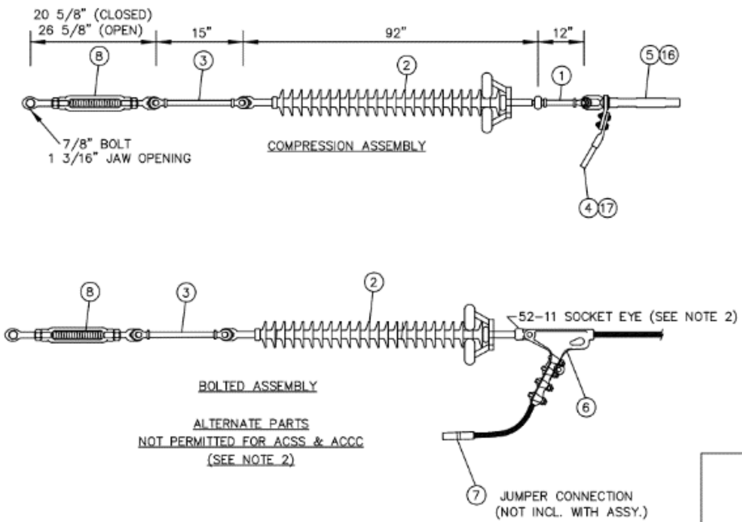


BILL OF MATERIALS

INSULATOR, DEADEND, POLYMER WITH TURNBUCKLE, 161kV

ITEM	QUANTITY DE2	QUANTITY DE4	STOCK NO.	DESCRIPTION	CATALOG NUMBER	BASIC MATERIAL	WEIGHT EA. (LBS)	ULTIMATE STR. (LBS)
1	1	–	EN015705	SKT. CLEVIS, HOT LINE, 45 DEG Y, 10-15/16" LONG, 50K ULT, 7/8" PIN	SYCHL-87	D.I.	3.45	50,000
2	1	1	EN014810	INSULATOR, DE, POLYMER, HIGH POLLUTION, 50K LB SML, 161kV	S298092VA10	COMP.	23.3	50,000
3	1	1	EN015176	LINK, EXTENSION, CLEVIS-CLEVIS, 15" C-C, 50K ULT	YCYCHL-77	D.I.	10.0	50,000
4	1	–	LS9004XX	TERMINAL CONNECTOR, 15 DEG, FOR VARIABLE SIZE WIRE	SEE TABLE	ALUM.	VARIES	–
5	1	–	LS9005XX	DEADEND, ALUM. COMPR. BODY, SINGLE TONGUE, FOR VAR. SIZE WIRE	SEE TABLE	ALUM.	VARIES	–
6	–	1	LS913XX	DEADEND BOLTED STRAIN ALUM. ALLOY	SEE TABLE	ALUM.	VARIES *	–
7	–	–	LS5029	JUMPER SPLICE (NOT INCLUDED WITH ASSEMBLY)	–	–	–	–
8	1	1	EN015815	TURNBUCKLE, 1"x6", JAW-EYE	G227N-BC-1x6	F.S.	9.2	50,000
9	–	–	–	–	–	–	–	–
10	–	–	–	–	–	–	–	–
11	–	–	–	–	–	–	–	–
12	–	–	–	–	–	–	–	–
13	–	–	–	–	–	–	–	–
14	–	–	–	–	–	–	–	–
15	–	–	EN020683	RING, CORONA (SUPPLIED WITH ITEM 2.)	CR24/32-8	ALUM.	5.0	N/A
16	0/1	–	NOTE 3	COMPOUND, ELECTRICAL FILLER	NOTE 3	–	–	N/A
17	0.5	0	NOTE 4	COMPOUND, ELECTRICAL JOINT	NOTE 4	–	–	N/A

* ADE-2526-S8; 30,000 LB. ULT. STR.
ADE-27-S8; 35,000 LB. ULT. STR.
ADE-24-S8; 27,000 LB. ULT. STR.
ADE-27CE-S8; 45,000 LB. ULT. STR.

	CONDUCTOR	COND. DIA. (IN)	FOR COMPRESSION ASSEMBLY (DE2) COMP. DE (ITEM 5)	ENTERGY STOCK NO.	TERMINAL (ITEM 4)	ENTERGY STOCK NO.	ASSEMBLY CATALOG. NO.	FOR BOLTED ASSEMBLY (DE4) STRAIN CLAMP (ITEM 6)	ENTERGY STOCK NO.	ASSEMBLY CATALOG. NO.
ACCC/TW	1949.0 (56/1), LAPWING	1.504	5600-1090NT	32118747	600-353-1	32118749	NOT YET ASSIGNED	N/A	N/A	N/A
ACCC/TW	1582.0 (33/1), BITTERN	1.345	5600-1080NT	32069426	600-253-11	32069448	NOT YET ASSIGNED	N/A	N/A	N/A
ACCC/TW	1428.5 (33/1), BEAUMONT	1.294	5600-1078NT	32118745	600-253-9	32101160	NOT YET ASSIGNED	N/A	N/A	N/A
ACCC/TW	1222.0 (33/1), CARDINAL	1.198	5600-1070NT	32069424	600-253-7	32069447	NOT YET ASSIGNED	N/A	N/A	N/A
ACCC/TW	821.2 (18/1), GROSBEAK	0.990	5600-1050NT	32069419	600-153-7	32069445	NOT YET ASSIGNED	N/A	N/A	N/A
ACSS	1590.0 (45/7), LAPWING	1.504	E33173HT-NT	32020679	5140.162HT-SS	32009549	C-8083-DE2-4	N/A	N/A	N/A
ACSS	1272.0 (45/7), BITTERN	1.345	E33161HT-NT	32020677	5136.144HT-SS	32020420	C-8083-DE2-3	N/A	N/A	N/A
ACSS	954.0 (54/7), CARDINAL	1.196	E33150HT-NT	32019804	5130.125HT-SS	32019813	C-8083-DE2-2	N/A	N/A	N/A
ACSS	666.6 (24/7), FLAMINGO	1.000	ENGE33135HT-NT	32020675	5127.106HT-SS	32020419	C-8083-DE2-1	N/A	N/A	N/A
ACSR	1780.0 (84/19), CHUKAR	1.602	VES-174-NT	EN004275	TF-17-SS	EN004445	C-7648-DE2-7	ADE-27-CE-S8	EN005957	C-7648-DE4-4
ACSR	1590.0 (45/7), LAPWING	1.504	VES-164-NT	EN004276	TF-16-SS	EN004446	C-7648-DE2-6	ADE-27-S8	EN005721	C-7648-DE4-2
ACSR	1272.0 (45/7), BITTERN	1.345	VES-153-NT	EN000161	TF-15-SS	EN000164	C-7648-DE2-5	ADE-27-S8	EN005721	C-7648-DE4-2
ACSR	1033.5 (45/7), ORTOLAN	1.213	VES-134-NT	32009718	TF-13-SS	EN004447	C-7648-DE2-13	ADE-2526-S8	EN006015	C-7648-DE4-1
ACSR	954.0 (54/7), CARDINAL	1.196	VES-135-NT	EN004083	TF-13-SS	EN004447	C-7648-DE2-4	ADE-2526-S8	EN006015	C-7648-DE4-1
ACSR	954.0 (45/7), RAIL	1.165	VES-133-NT	EN004352	TF-13-SS	EN004447	C-7648-DE2-3	ADE-2526-S8	EN006015	C-7648-DE4-1
ACSR	795.0 (26/7), DRAKE	1.108	VES-126-NT	EN027808	TF-12-SS	EN027977	C-7648-DE2-8	ADE-2526-S8	EN006015	C-7648-DE4-1
ACSR	666.6 (24/7), FLAMINGO	1.000	VES-115-NT	EN004277	TF-11-SS	EN004448	C-7648-DE2-2	ADE-2526-S8	EN006015	C-7648-DE4-1
ACSR	336.4 (26/7), LINNET	0.720	VES-086-NT	EN004278	TF-08-SS	EN004449	C-7648-DE2-1	ADE-24-S8	EN005298	C-7648-DE4-3
ACAR	1024.5 (24/13)	1.165	VES-130-NT	EN027818	TF-13-SS	EN004447	C-7648-DE2-12	ADE-2526-S8	EN006015	C-7648-DE4-1
ACAR	649.5 (18/19)	0.928	VES-100-NT	EN027817	TF-10-SS	EN027819	C-7648-DE2-11	ADE-2526-S8	EN006015	C-7648-DE4-1
ACAR	395.2 (15/7)	0.720	VES-080-NT	EN027816	TF-08-SS	EN004449	C-7648-DE2-10	ADE-24-S8	EN005298	C-7648-DE4-3

NOTES

1) Item #4, #5, #6 and #7 are conductor dependent and are selected for each project.
2) Designer may substitute #6 and #7 for items #1, #4 and #5. Strain clamp shall include socket eye for a 52-11 ball. Use of bolted clamps will require the use of non-tension jumper splices.
3) ACSR & ACAR terminals and compression DE fittings are supplied pre-filled (zero quantity req.). Make up as needed with EN005687. (AFC10T). ACSS compression hardware requires High Temp. Compound 32063032 (AFCHT10T). ACCC compression hardware requires High Temp. Compound 32119913 (PENHT-1LB).
4) ACSR & ACAR terminals require normal temperature joint compound EN019252 (CTB8). ACSS & ACCC terminals require high temperature joint compound 32121109 (ALNOX10T).
5) For hardware only, add suffix "-H" to assembly catalog number. Ex.: C-7648-DE2-1-H.

11-17-2014

ewill2

MIN ELEC./MECH. SPECIFICATIONS

MIN. ELECTRICAL VALUES	
60 HZ DRY FO	690 KV
60 HZ WET FO	625 KV
CIFO+	1215 KV
CIFO–	1275 KV
DRY ARC DIST.	75 IN.
LEAKAGE DIST.	180 IN.
MIN. MECHANICAL STRENGTH	
ULT.	50,000 LBS

NO.	DATE:	REVISION	BY:	CHK:	APPR:
–					
5	12-31-14	ADDED ELEC. SPECS. & COND. HARDWARE TABLE, RE-DRAWN 11X17	ECW	JPM	WLS
4	05-23-11	ADDED CORONA RING, UPDATE ITEM 2 DESC.	CBM	ECW	ECW
3	10-14-04	MODIFIED MATERIAL	RWB		
2	11-29-00	ADDED (1-WIRE) TO NAME	RWB		
1	06-09-00	ADDED ALT. PARTS	LSFT		
0		DRAWING CREATED	RWB		

DEP-TRB-161-XX (1-WIRE)

ENTERGY SERVICES, INC.

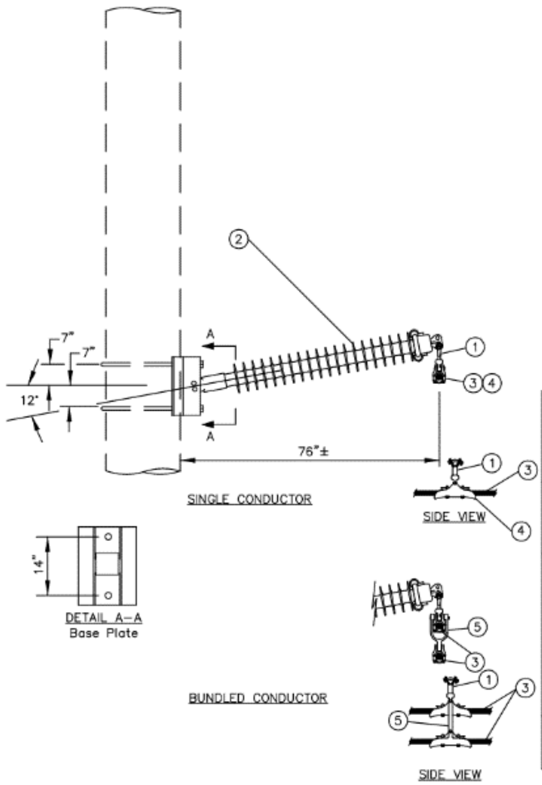
TRANSMISSION LINE STANDARD
POLYMER ASSY., DEADEND W/ TURNBUCKLE
161 kV INSULATOR ASSEMBLY DETAIL

STD NO. TA0504 | SCALE: N. T. S.

Entergy | No. TCA205A5

PLOT 1:24 | SH. 1 OF 1

DEP-TRB-161-XX (1 WIRE)



BILL OF MATERIALS

INSULATOR, 2-1/2" POLYMER JUMPER LINE POST ASSY FOR 161 kV

ITEM	QUANTITY JLP	QUANTITY JLPB	STOCK NO.	DESCRIPTION	CATALOG NUMBER	BASIC MATERIAL	WEIGHT EA. (LBS)	ULTIMATE STRENGTH (LBS)
1	1	1	EN004375	BALL CLEVIS, 45 DEG Y, 35K ULT, 3/4" PIN DIA	YCB-65A	F.S.	2.2	35,000
2	1	1	32094117	INSULATOR, 2-1/2" POST, POLYMER, HIGH POL. 161 kV	H291076VA04	COMP.	80.2	SEE APP. CURVE
3 *	1 *	2 *	LS9003XX	ROD, ARMOR, PREFORMED, ALUMINUM, VARIABLE CONDUCTOR SIZE	SEE TABLE	ALUM.	VARIES	N/A
4	1	–	LS9008XX	CLAMP, SUSPENSION, ALUMINUM, VARIABLE WIRE SIZE, w/SOCKET EYE	SEE TABLE	AL./D.I.	VARIES	25,000 U.N.O.
5	–	1	LS915XX	YOKE, VERTICAL DOUBLE BUNDLE, VARIABLE SIZE WIRE	SEE TABLE	AL./D.I.	VARIES	25,000 U.N.O **
6	–	–	32093707	RING, CORONA (SUPPLIED WITH ITEM 2.)	LP25CR6	ALUM.	5.0	N/A

* ITEM NOT REQUIRED WHEN USING ACAR & ACSR CONDUCTORS ** ULTIMATE STRENGTH FOR BUNDLING YOKE IS AS AN ASSEMBLY

	CONDUCTOR	ARMOR ROD (ITEM 3)	ENTERGY STK. NO.	DIA. (IN)	TAKEOFF ANGLE (DEG)	FOR SINGLE CONDUCTORS (JLP) CLAMP (ITEM 4)	ENTERGY STOCK NO.	ASSEMBLY CATALOG. NO.	FOR BUNDLED CONDUCTORS (JLPB) BUNDLE (ITEM 5)	ENTERGY STOCK NO.	ASSEMBLY CATALOG. NO.
ACCC/TW	1949 (56/1), LAPWING	INCL. w/ ITEM 4		–	–	TLS-0119SE ***	32068997	NOT YET ASSIGNED	N/A	N/A	N/A
	1582 (33/1), BITTERN	INCL. w/ ITEM 4		–	–	TLS-0115SE ***	32068992	NOT YET ASSIGNED	N/A	N/A	N/A
	1429 (33/1), BEAUMONT	INCL. w/ ITEM 4		–	–	AGS-5138	32082067	NOT YET ASSIGNED	N/A	N/A	N/A
	1222 (33/1), CARDINAL	INCL. w/ ITEM 4		–	–	TLS-0111SE	32068988	NOT YET ASSIGNED	N/A	N/A	N/A
	821 (18/1), GROSBEAK	INCL. w/ ITEM 4		–	–	TLS-0105SE	32068975	NOT YET ASSIGNED	N/A	N/A	N/A
ACSS	1590 (45/7), LAPWING	ARA1590-45-59	32117836	2.376	15	ACFS-244-20-20-S	EN028863	C-8083-JLP-4	VBACFS-18-2442020-S	32127531	NOT YET ASSIGNED
	1272 (45/7), BITTERN	ARA1272-45-55	32117835	2.075	15	ACFS-214-20-20-S	32020718	C-8083-JLP-3	VBACFS-18-2142020-S	32127530	NOT YET ASSIGNED
	954 (54/7), CARDINAL	ARA954-45-51	32117829	1.816	15	ACFS-186-20-20-S	32020716	C-8083-JLP-2	VBACFS-18-1862020-S	32127529	NOT YET ASSIGNED
	666.6 (24/7), FLAMINGO	ARA636-26-45	32117825	1.620	15	ACFS-175-20-20-S	32020714	C-8083-JLP-1	VBACFS-18-1752020-S	32127527	NOT YET ASSIGNED
ACSR	1780 (84/19), CHUKAR	–	–	1.602	30	LS-8-S	EN000370	C-7648-JLP-5	VBLS-12-88-S	EN027825	C-7648-JLPB-5
	1590 (45/7), LAPWING	–	–	1.504	30	LS-7-S	EN000386	C-7648-JLP-4	VBLS-12-77-S	EN027824	C-7648-JLPB-4
	1272 (45/7), BITTERN	–	–	1.345	30	LS-6-S	EN000158	C-7648-JLP-3	VBLS-12-66-S	EN027823	C-7648-JLPB-3
	1033.5 (45/7), ORTOLAN	–	–	1.213	30	LS-6-S	EN000158	C-7648-JLP-7	VBLS-12-66-S	EN027823	C-7648-JLPB-7
	954 (54/7), CARDINAL	–	–	1.196	30	LS-6-S	EN000158	C-7648-JLP-3	VBLS-12-66-S	EN027823	C-7648-JLPB-3
	954 (45/7), RAIL	–	–	1.165	30	LS-6-S	EN000158	C-7648-JLP-3	VBLS-12-66-S	EN027823	C-7648-JLPB-3
	795 (26/7), DRAKE	–	–	1.108	30	LS-6-S	EN000158	C-7648-JLP-6	VBLS-12-66-S	EN027823	C-7648-JLPB-6
	666.6 (24/7), FLAMINGO	–	–	1.000	30	LS-2-S	EN000387	C-7648-JLP-2	VBLS-12-22-S	EN027822	C-7648-JLPB-2
	336.4 (26/7), LINNET	–	–	0.720	30	LS-1-S ****	EN000392	C-7648-JLP-1	VBLS-12-22-S	EN027822	C-7648-JLPB-2
ACAR	1024.5 24/13	–	–	1.165	30	LS-6-S	EN000158	C-7648-JLP-7	VBLS-12-66-S	EN027823	C-7648-JLPB-7
	649.5 18/19	–	–	0.928	30	LS-2-S	EN000387	C-7648-JLP-2	VBLS-12-22-S	EN027822	C-7648-JLPB-2
	395.2 15/7	–	–	0.720	30	LS-1-S ****	EN000392	C-7648-JLP-1	VBLS-12-22-S	EN027822	C-7648-JLPB-2

**** ULTIMATE STRENGTH FOR LS-1-S is 18k
*** ULTIMATE STRENGTH FOR TLS-0115SE & TLS-0119SE is 30k

NOTES

1) Item #3, #4 and #5 are conductor dependent. Clamps/Bundles are selected for each project and are Applied with Armor Rod, unless specifically noted.
2) Note that 161 kV Insulators are used for 115 kV 138 kV and 161 kV applications.
3) For Hardware Only, add suffix "-H" to Assembly Cat. No. Ex.: C-7648-JLP-1-H

MIN ELEC./MECH. SPECIFICATIONS

MIN. ELECTRICAL VALUES	
60 HZ DRY FO	590 KV
60 HZ WET FO	510 KV
CIFO+	960 KV
CIFO-	1020 KV
STRIKE DIST.	60 IN.
LEAKAGE DIST.	140 IN.
MIN. MECHANICAL STRENGTH	
MDCL	1176 LBS.

JLP-161-XX

NO.	DATE:	REVISION	BY:	CHK:	APPR:
5	11-20-14	ADDED ELEC. SPECS. & COND. HARDWARE TABLE, RE-DRAWN 11X17	ECW	JPM	M.S
4	08-28-11	UPDATE ITEM 2 STOCK CODE & DESCRIPTION	ECW		
3	05-05-11	ADDED CORONA RING, UPDATE ITEM 2 DESCRIPTION	CBM	ECW	ECW
2	10-07-04	ADDED ACSS CONDUCTOR & REV. STK. NUMBER FOR ITEM 4	MDB		
1	11-30-00	COMBINED DWG TCA236 WITH TCA207	LSFT		
0		DRAWING CREATED			

ENTERGY SERVICES, INC.

TRANSMISSION LINE STANDARD
POLYMER ASSY., 2 1/2" JUMPER LINE POST
161 kV INSULATOR ASSEMBLY DETAIL

STD NO. TA0504 | SCALE: N. T. S.

Entergy | No. TCA207A5

PLOT 1:24 | SH. 1 OF 1

JLP-161-XX

11-7-2014

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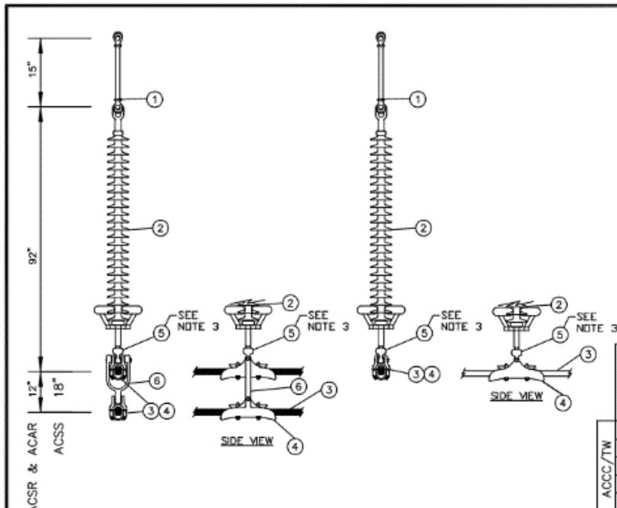

BUNDLED CONDUCTOR

SINGLE CONDUCTOR

BILL OF MATERIALS

INSULATOR LINE SUSPENSION HEAVY POLYMER WITH LINK 161kV

ITEM	QUANTITY SHL	SHLB	STOCK NO.	DESCRIPTION	CATALOG NUMBER	BASIC MATERIAL	WEIGHT EA. (LBS)	ULTIMATE STRENGTH (LBS)
1	1	1	EN015176	LINK, EXTENSION, CLEVIS-CLEVIS, 15" 50K ULT	YCYCHL-77	D.I.	10	50,000
2	1	1	EN014810	INSULATOR, DEADEND, EYE-BALL, POLYMER, HIGH POLL, 161 kV, 50K	S298092VA10	COMP.	23	50,000
3	1	2	LS9003XX	ROD, ARMOR, PREFORMED, ALUMINUM, VARIABLE CONDUCTOR SIZE	SEE TABLE	ALUM.	VARIES	N/A
4	1	–	LS9008XX	CLAMP, SUSPENSION, ALUMINUM, VARIABLE WIRE SIZE, w/SOCKET EYE	SEE TABLE	AL./D.I.	VARIES	25,000 U.N.O.
5	1	1	LS5044XX	SOCKET EYE, VARIABLE WIDTH, FOR 52-11 BALL (ACCC ONLY)	VARIES	F.S.	VARIES	VARIES
6	–	1	LS915XX	YOKE, VERTICAL DOUBLE BUNDLE, VARIABLE SIZE WIRE	SEE TABLE	AL./D.I.	VARIES	25,000 *
7	–	–	EN020683	RING, CORONA (SUPPLIED WITH ITEM 2.)	CR24/32-8	ALUM.	5	N/A
8	–	–						
9	–	–						
10	–	–						
11	–	–						

* ULTIMATE STRENGTH FOR BUNDLING YOKE IS AS AN ASSEMBLY

	CONDUCTOR	ARMOR ROD (ITEM 3)	ENTERGY STK. NO.	DIA. W/ARM. ROD (IN)	TAKEOFF ANGLE (DEG)	FOR SINGLE CONDUCTORS (SHL) CLAMP (ITEM 4)	ENTERGY STOCK NO.	ASSEMBLY CATALOG. NO.	FOR BUNDLED CONDUCTORS (SHLB) BUNDLE (ITEM 6)	ENTERGY STOCK NO.	ASSEMBLY CATALOG. NO.
ACCC/TW	1949 (56/1), LAPWING	INCL.	w/ ITEM 4	–	–	TLS-0119SE **	32068997	NOT YET ASSIGNED	N/A	N/A	N/A
	1582 (33/1), BITTERN	INCL.	w/ ITEM 4	–	–	TLS-0115SE **	32068992	NOT YET ASSIGNED	N/A	N/A	N/A
	1429 (33/1), BEAUMONT	INCL.	w/ ITEM 4	–	–	AGS-5138	32082067	NOT YET ASSIGNED	N/A	N/A	N/A
	1222 (33/1), CARDINAL	INCL.	w/ ITEM 4	–	–	TLS-0111SE	32068988	NOT YET ASSIGNED	N/A	N/A	N/A
	821 (18/1), GROSBEAK	INCL.	w/ ITEM 4	–	–	TLS-0105SE	32068975	NOT YET ASSIGNED	N/A	N/A	N/A
ACSS	1590 (45/7), LAPWING	AR-0163	EN000381	2.376	15	ACFS-244-20-20-S8	32020729	C-8083-SS3-4	VBACFS-18-2442020-S8	32127537	NOT YET ASSIGNED
	1272 (45/7), BITTERN	AR-0146	EN000155	2.075	15	ACFS-214-20-20-S8	32020719	C-8083-SS3-3	VBACFS-18-2142020-S8	32127536	NOT YET ASSIGNED
	954 (54/7), CARDINAL	AR-0143	EN000383	1.816	15	ACFS-186-20-20-S8	32020717	C-8083-SS3-2	VBACFS-18-1862020-S8	32127535	NOT YET ASSIGNED
	666.6 (24/7), FLAMINGO	AR-0137	EN000384	1.620	15	ACFS-175-20-20-S8	32020715	C-8083-SS3-1	VBACFS-18-1752020-S8	32127532	NOT YET ASSIGNED
ACSR	1780 (84/19), CHUKAR	AR-0165	EN000382	2.474	30	ASC-11-S8	EN027804	C-7648-SSL-6	VBLS-12-1111-S8	EN028534	C-7648-SSLB-6
	1590 (45/7), LAPWING	AR-0163	EN000381	2.376	30	ASC-11-S8	EN027804	C-7648-SSL-5	VBLS-12-1111-S8	EN028534	C-7648-SSLB-5
	1272 (45/7), BITTERN	AR-0146	EN000155	2.075	30	ASC-11-S8	EN027804	C-7648-SSL-4	VBLS-12-1111-S8	EN028534	C-7648-SSLB-4
	1033.5 (45/7), ORTOLAN	AR-0144	EN027807	1.943	30	LS-9-S8	EN027805	C-7648-SSL-8	VBLS-12-99-S8	EN028535	C-7648-SSLB-8
	954 (54/7), CARDINAL	AR-0143	EN000383	1.816	30	LS-8-S8	EN027801	C-7648-SSL-3	VBLS-12-88-S8	EN028533	C-7648-SSLB-3
	954 (45/7), RAIL	AR-0143	EN000383	1.785	30	LS-8-S8	EN027801	C-7648-SSL-3	VBLS-12-88-S8	EN028533	C-7648-SSLB-3
	795 (26/7), DRAKE	AR-0141	EN004005	1.728	30	LS-8-S8	EN027801	C-7648-SSL-7	VBLS-12-88-S8	EN028533	C-7648-SSLB-7
	666.6 (24/7), FLAMINGO	AR-0137	EN000384	1.620	30	LS-8-S8	EN027801	C-7648-SSL-2	VBLS-12-88-S8	EN028533	C-7648-SSLB-2
	336.4 (26/7), LINNET	AR-0130	EN000385	1.129	30	LS-6-S8	EN027802	C-7648-SSL-1	VBLS-12-66-S8	EN028532	C-7648-SSLB-1
ACAR	1024.5 24/13	AR-0143	EN000383	1.785	30	LS-8-S8	EN027801	C-7648-SSL-3	VBLS-12-88-S8	EN028533	C-7648-SSLB-3
	649.5 18/19	AR-0135	EN027806	1.428	30	LS-6-S8	EN027802	C-7648-SSL-9	VBLS-12-66-S8	EN028532	C-7648-SSLB-9
	395.2 15/7	AR-0130	EN000385	1.129	30	LS-6-S8	EN027802	C-7648-SSL-1	VBLS-12-66-S8	EN028532	C-7648-SSLB-1

** ULTIMATE STRENGTH FOR TLS-0115SE & TLS-0119SE is 30k

NOTES

1) Item #3 and #4 are conductor dependent.
Clamps/Bundles are selected for each project and are Applied with Armor Rod, unless specifically noted.
2) For hardware only add suffix "-H" to assembly catalog number
EX: C-7648-SSLB-1-H
3) For ACCC conductors, replace socket eye supplied with clamp with socket eye intended for 52-11 ball. EN015435 shall be substituted when using ACCC GROSBEAK and ACCC BEAUMONT. 32139415 shall be substituted when using ACCC CARDINAL, ACCC BITTERN and ACCC LAPWING.

MIN ELEC./MECH. SPECIFICATIONS

MIN. ELECTRICAL VALUES	
60 HZ DRY FO	690 KV
60 HZ WET FO	625 KV
CIFO+	1215 KV
CIFO-	1275 KV
STRIKE DIST.	75 IN.
LEAKAGE DIST.	180 IN.
MIN. MECHANICAL STRENGTH	
ULT.	50,000 LBS.

SHR-LINK-161-XX

NO.	DATE:	REVISION	BY:	CHK:	APPR:
6	6-17-15	ADD NOTE 3	KC	ECW	ECW
5	12-31-14	ADDED ELEC. SPECS. & COND. HARDWARE TABLE, RE-DRAWN 11X17	ECW	JPM	WLS
4	5-23-11	ADDED CORONA RING, UPDATED ITEM 2 DESC.	CBM	ECW	ECW
3	1-10-02	MODIFIED ITEM 1 ON BUNLED MATERIAL LIST	LSFT		
2	6-22-01	CHANGED NAME TO SHRLINK	LSFT		

ENTERGY SERVICES, INC.

TRANSMISSION LINE STANDARD
POLYMER ASSY., HEAVY SUSPENSION
161 kV INSULATOR ASSEMBLY DETAIL

STD NO. TA0504 | SCALE: N. T. S.

Entergy

No. TCA214A6

PLOT 1:24 | SH. 1 OF 1

SHRLINK-161-XX

06-11-15

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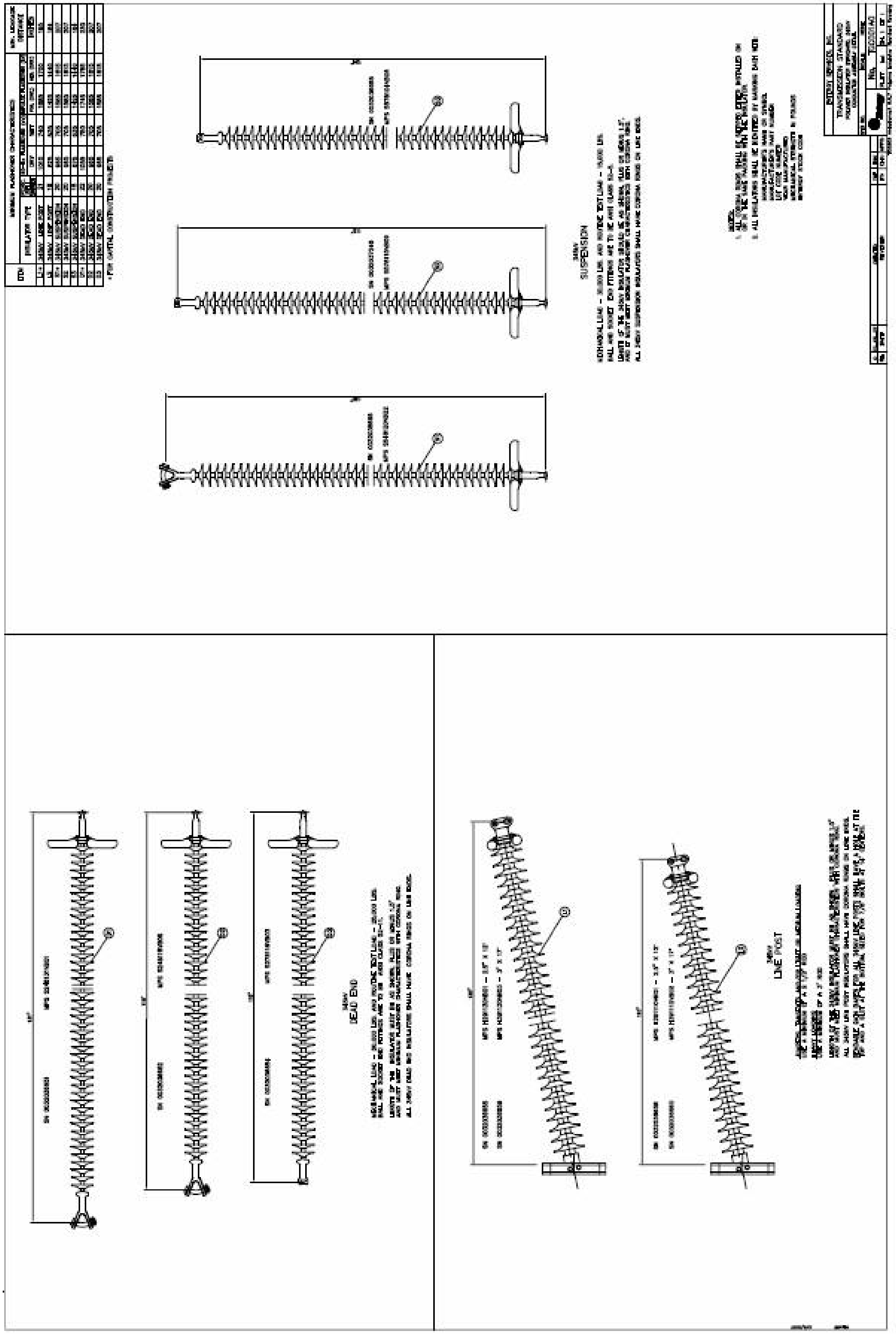

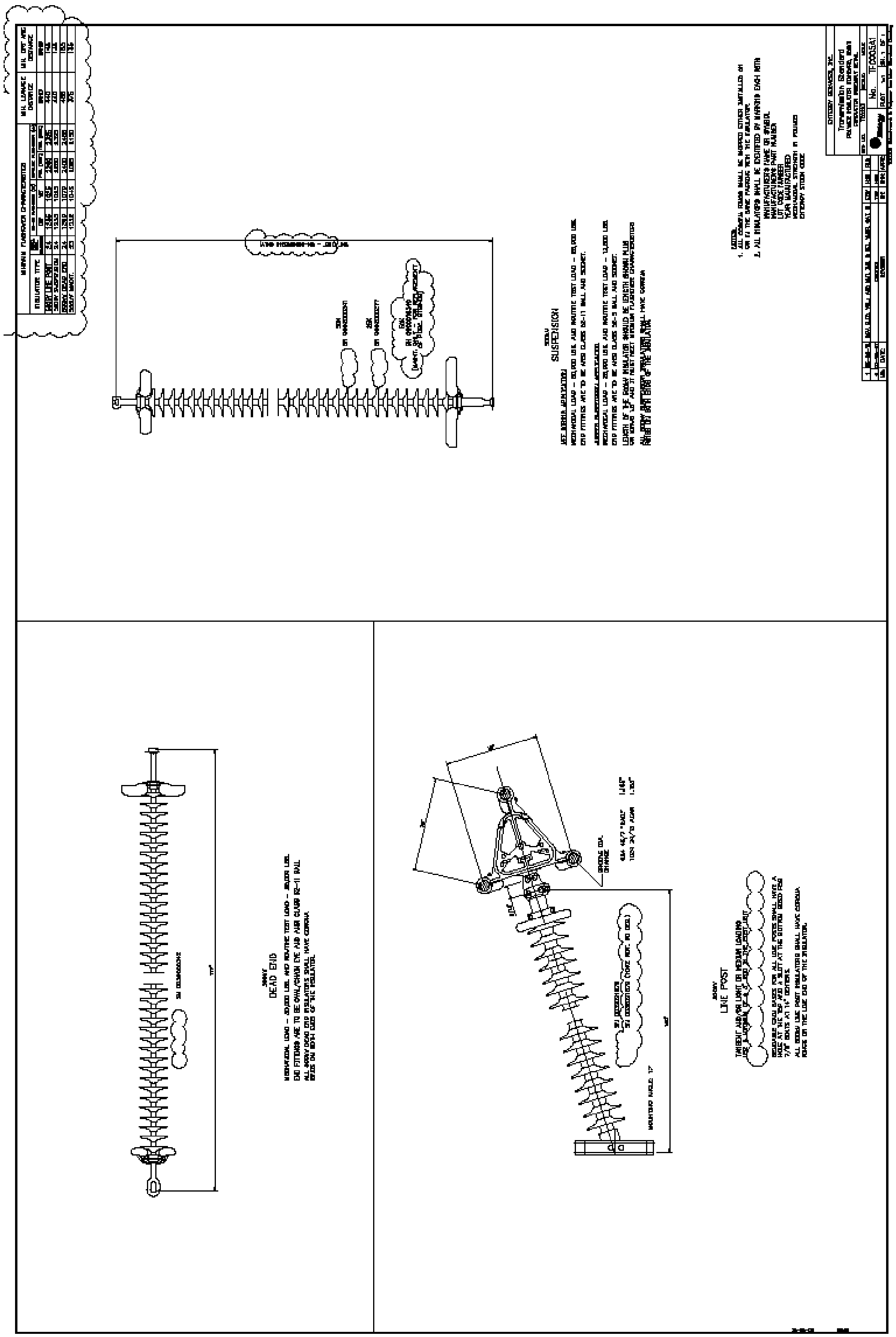

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BILL OF MATERIALS

DEADEND, POLYMER, WITH BUNDLING YOKE, 500KV

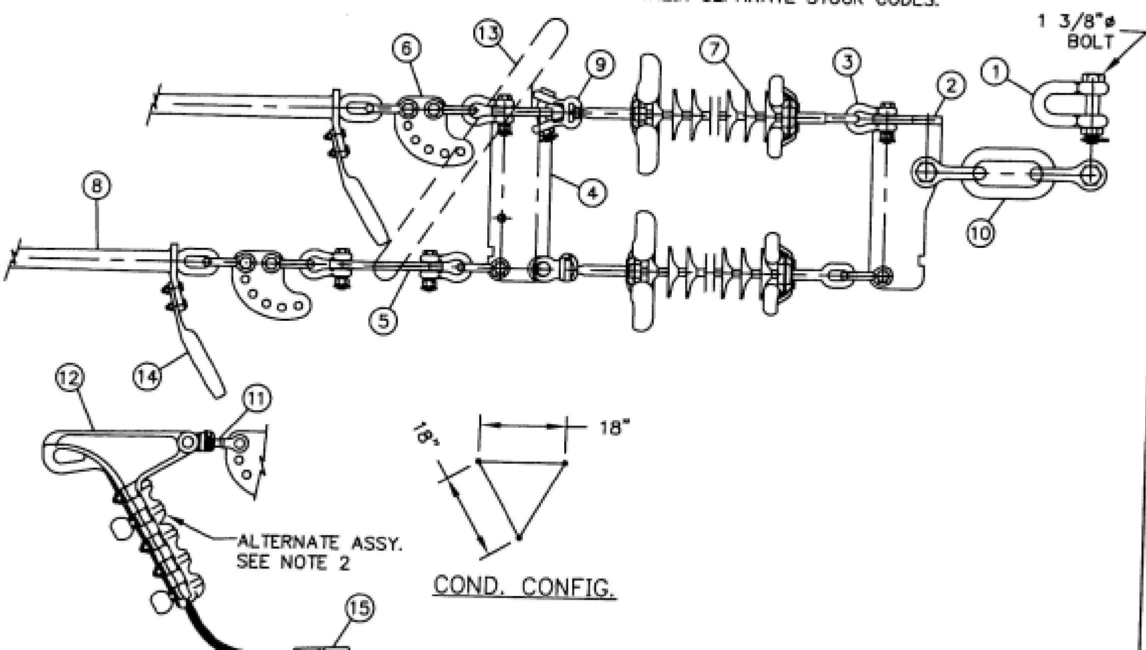
ITEM	COMP. QTY.	BOLTED QTY.	STOCK NO.	DESCRIPTION
1	2	2	0032009672	SHACKLE, CHAIN, 150k ULT .STR.
2	1	1	0032009669	YOKE PLATE, TRIPLE BUNDLE, DEADEND, 18" SEPARATION, 110k ULT. STR.
3	14	11	0000000689	SHACKLE, ANCHOR, 60k ULT. STR.
4	1	1	0032009670	YOKE PLATE, TRIPLE BUNDLED, DEADEND, 18" SEPARATION, 110k ULT. STR.
5	1	1	0032009665	LINK EXTENSION, EYE-EYE, 40k ULT. STR.
6	3	3	0032009668	PLATE, ADJUSTMENT, 40k ULT. STR.
7	3	3	0032000342	INSULATOR, LINE, EYE-BALL, POLYMER, 500kV, 50k ULT .STR.
8	3		LS9012XX	DEADEND, COMPRESSION, ALUMINUM, SINGLE TONGUE, 33k, FOR VARIABLE
9	3	3	0000028529	SOCKET, Y-CLEVIS, 50k
10	1	1	0032000136	LINK, CHAIN, 132k ULT., 7" LONG
11		3	0032021867	CLEVIS BALL, 35k, BALL CLASS 52-3/5
12		3	LS9013XX	DEADEND, BOLTED, STRAIN, ALUM., 30K, FOR VARIABLE WIRE SIZE
13	1	1	0032009685	CORONA RING, 500kV DEADEND, ALUM.
14	3		LS9014XX	~~TERMINAL CONNECTOR, 15 DEG., FOR VARIABLE WIRE SIZE~~
15*		3	LS5029XX	JUMPER, SPLICE, FOR VARIABLE WIRE SIZE

CONDUCTOR	CONDUCTOR DIA.	COMP. D.E. (ITEMS 8 & 14)	ENTERGY STOCK NO.	ASSEMBLY CAT. NO.	ENTERGY STOCK NO.
1024 ACAR	1.165	VES-130-EHV**	0032000078	C-7686-DE1	NA
954.0 45/7 "RAIL"	1.165	VES-133-EHV**	0032021873	C-7686-DE2	NA
954 54/7 "CARDINAL"	1.196	VES-135-EHV**	0032021874	C-7686-DE4	NA

CONDUCTOR RANGE:	BOLTED STRAIN CLAMP (ITEM 12)	ENTERGY STOCK NO.	ASSEMBLY CAT. NO.	ENTERGY STOCK NO.
.710" - 1.318"	ADE-2526-S-SPH4	0000028892	C-7686-DE3	NA

* ITEMS 15 ARE NOT FURNISHED WITH THE MACLEAN ASSEMBLIES.

** COMPRESSION DEADEND BODIES COME WITH JUMPER TERMINALS, ITEM 14. EITHER OF OF ITEMS 8 AND 14 CAN BE RETURNED TO STORES WITH THEIR SEPARATE STOCK CODES.



RE: MACLEAN DWG. BC-7686-1

1) ITEM #8, #12, #14 & #15 ARE CONDUCTOR DEPENDENT.
2) DESIGNER MAY SUBSTITUTE #11 & #12 & #15, FOR ITEMS #3 (QTY. 2) & #8. STRAIN CLAMP SHALL INCLUDE SOCKET EYE FOR A 52-3/5 BALL. USE OF BOLTED CLAMPS WILL REQUIRE THE USE OF NON-TENSION JUMPER SPLICES.

ENTERGY SERVICES, INC.

DEADEND, POLYMER, W/BUNDLING YOKE, 500kV

STD NO. | SCALE: NONE

Entergy | No. TFA200A0 | PLOT 1=1 | SH. 1 OF 1

NO.	DATE:	REVISION	BY:	CHK:	APPR
0	03-05-07	CREATED	TWF	HSK	

tflnc90 3/5/2007

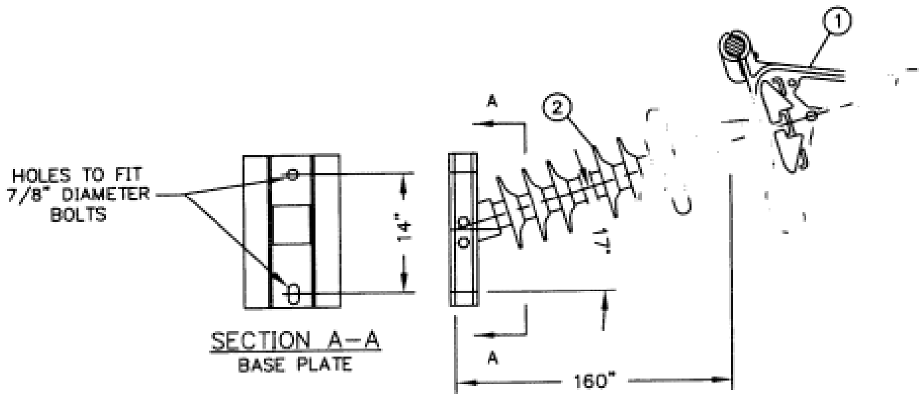
DEPY-500-XX; BC-7686-1

BILL OF MATERIALS

JUMPER LINE POST, POLYMER, w/BUNDLING YOKE, HORIZONTAL, 500kV

ITEM	QTY.	STOCK NO.	DESCRIPTION
1	1	LS9015XX	JUMPER YOKE, 10k ULT. STR. 18" SEPARATION, ALUMINUM ALLOY
2	1	0032021878	INSULATOR, LINE POST, 3", POLYMER, 500kV, 10k ULT. STR.

CONDUCTOR	CONDUCTOR DIA.	JMPR. YOKE (ITEM 1)	ENTERGY STOCK NO.	ASSEMBLY CAT. NO.	ENTERGY STOCK NO.
1024 ACAR	1.165	C-7686-4	0032021850	C-7686-J2	NA
954.0 45/7 "RAIL"	1.165	C-7686-4	0032021850	C-7686-J2	NA
954 54/7 "CARDINAL"	1.196	C-7686-4A	0032021860	C-7686-J2A	NA



1) ITEM #1 IS CONDUCTOR DEPENDENT. THIS ITEM IS SELECTED FOR EACH PROJECT (WITHOUT ARMOR RODS).

RE: MACLEAN DWG. BC-7686-4

ENTERGY SERVICES, INC.

JUMPER LINE POST, POLYMER, W/YOKE, HOR, 500kV

STD NO.	SCALE: NONE
Entergy	No. TFA201A0
	PLOT 1=1 / SH. 1 OF 1

NO.	DATE:	REVISION	BY:	CHK:	APPR
0	03-05-07	CREATED	TWF	HSK	

tfinc90 3/19/2007

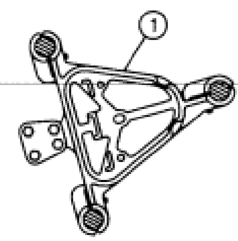
JLPB-HJ-500-XX; BC-7686-4

BILL OF MATERIALS

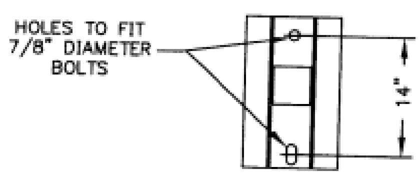
JUMPER LINE POST, POLYMER, w/BUNDLING YOKE, VERTICAL, 500kV

ITEM	QTY.	STOCK NO.	DESCRIPTION
1	1	LS9015XX	JUMPER YOKE, 10k ULT. STR. 18" SEPARATION, ALUMINUM ALLOY
2	1	0032021879	INSULATOR, LINE POST, 3", POLYMER, 500kV, 10k ULT. STR.

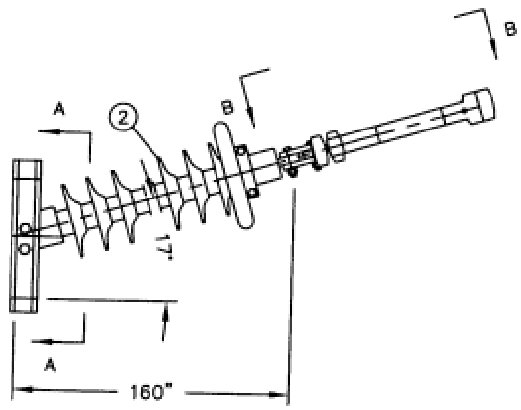
CONDUCTOR	CONDUCTOR DIA.	JMPR. YOKE (ITEM 1)	ENTERGY STOCK NO.	ASSEMBLY CAT. NO.	ENTERGY STOCK NO.
1024 ACAR	1.165	C-7686-4	0032021850	C-7686-J3	NA
954.0 45/7 "RAIL"	1.165	C-7686-4	0032021850	C-7686-J3	NA
954 54/7 "CARDINAL"	1.196	C-7686-4A	0032021860	C-7686-J3A	NA



SECTION B–B
YOKE PLATE



SECTION A–A
BASE PLATE



1) ITEM #1 IS CONDUCTOR DEPENDENT. THIS ITEM IS SELECTED FOR EACH PROJECT (WITHOUT ARMOR RODS).

RE: MACLEAN DWG. BC-7686-5

ENTERGY SERVICES, INC.		
JUMPER LINE POST, POLYMER, W/YOKE, VER, 500kV		
STD NO.	SCALE: NONE	
Entergy	No. TFA202A0	
	PLOT 1=1	SH. 1 OF 1

NO.	DATE:	REVISION	BY:	CHK:	APPR
0	03-05-07	CREATED	TWF	HSK	

tfinc90 3/5/2007

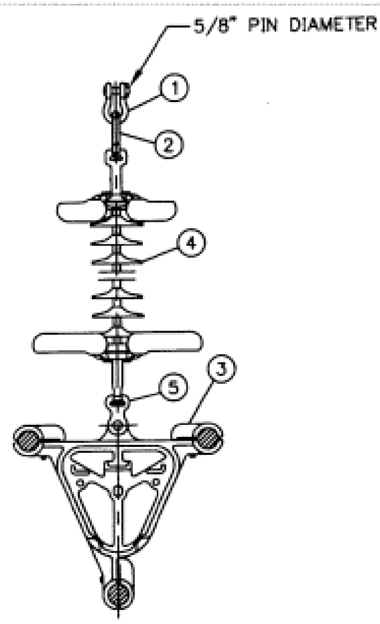
JLPB-VJ-500-XX; BC-7686-5

BILL OF MATERIALS

JUMPER SUSPENSION, POLYMER, w/ BUNDLING YOKE 500kV

ITEM	QTY.	STOCK NO.	DESCRIPTION
1	1	0000004466	SHACKLE, ANCHOR, 30k ULT .STR., 5/8" PIN DIA. 2-13/16"
2	1	0000028889	BALL EYE, OVAL, 35k ULT. STR., BALL CLASS 52-3/5
3	1	LS9016XX	YOKE, JUMPER, 10k ULT. STR. 18" SEPARATION, ALUM. ALLOY
4	1	0032000277	INSULATOR, SUSPENSION, B&S, POLYMER, 500kV, 25k ULT. STR.
5	1	0032021870	CLEVIS, SOCKET, 30k ULT. STR., CLASS 52-3/5

CONDUCTOR	CONDUCTOR DIA.	JMPR. YOKE (ITEM 3)	ENTERGY STOCK NO.	ASSEMBLY CAT. NO.	ENTERGY STOCK NO.
1024 ACAR	1.165	C-6549-3	0032021827	C-7686-J1	NA
954.0 45/7 "RAIL"	1.165	C-6549-3	0032021827	C-7686-J1	NA
954 54/7 "CARDINAL"	1.196	C-7686-5	0032021863	C-7686-J1A	NA



1) ITEM #3 IS CONDUCTOR DEPENDENT. THIS ITEM IS SELECTED FOR EACH PROJECT WITHOUT ARMOR RODS.

RE: MACLEAN DWG. BC-7686-2

ENTERGY SERVICES, INC.	
JUMPER SUSPENSION, POLYMER, W/YOKE, 500kV	
STD NO.	SCALE: NONE
Entergy	No. TFA203A0
	PLOT 1=1 SH. 1 OF 1

JSPB-500-XX; BC-7686-2

-05-07	CREATED	TWF	HSK	
DATE:	REVISION	BY:	CHK:	APP

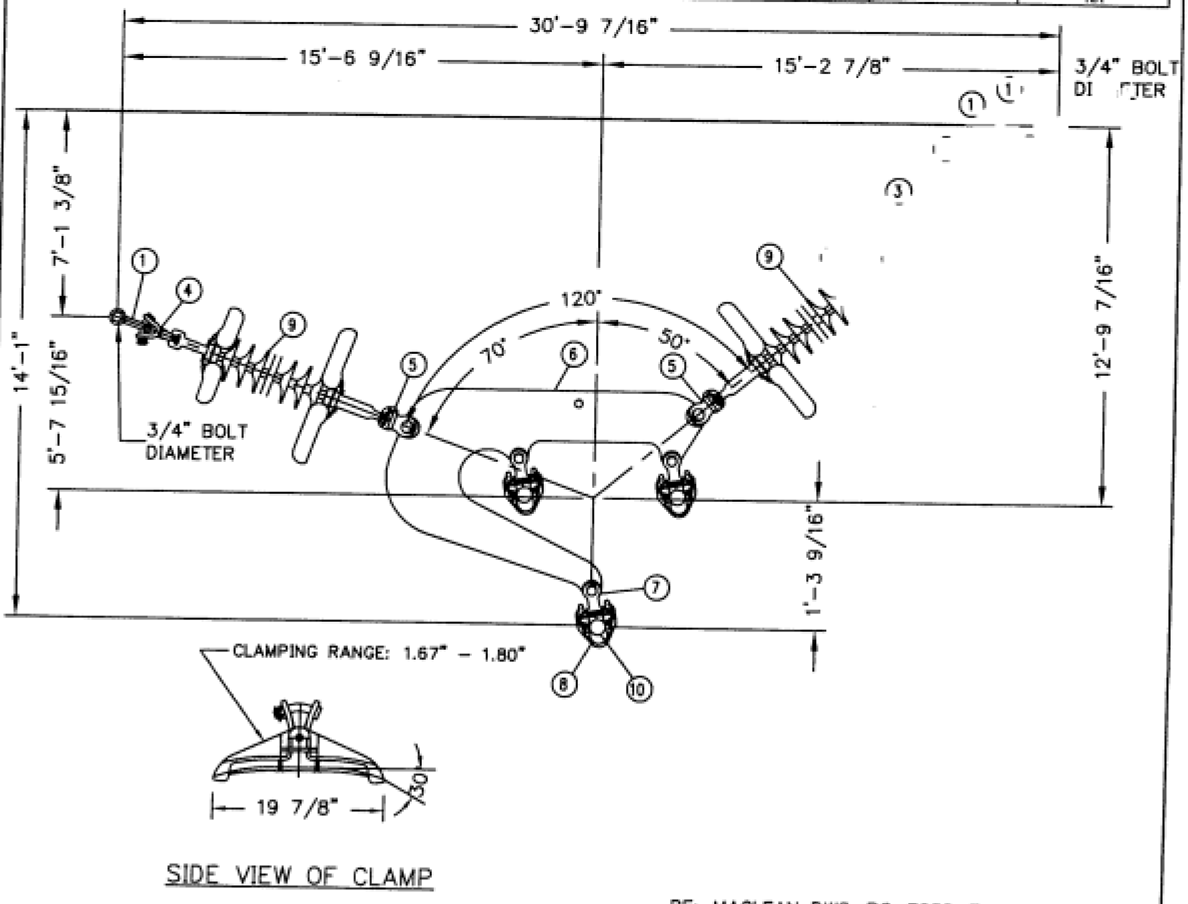
tfinc90 3 5 2007

BILL OF MATERIALS

VEE-STRING, POLYMER, W/BUNDLING YOKE, RUNNING ANGLE, 500kV

ITEM	QTY.	STOCK NO.	DESCRIPTION
1	3	0000000689	SHACKLE, ANCHOR, 60k ULT. STR.
2	1	0032036825	LINK, EXTENSION, 50k
3	1	0000028891	BALL CLEVIS, 50k, HL
4	1	0000000410	BALL Y-CLEVIS, 50k
5	2	0000028529	SOCKET, Y-CLEVIS, 50k, 90 DEGREE
6	1	0032036830	YOKE PLATE, TRIPLE BUNDLE, 18" SEPARATION
7	3	0000028888	CLEVIS EYE, 45 DEG. Y, 30k
8	3	LS9017XX	CLAMP, SUSPENSION, ALUM. ALLOY, 25k, CORONA FREE
9	2	0032000341	INSULATOR, SUSPENSION, B&S, POLYMER, 500kV, 50k ULT. STR.
10	3	LS9018XX	ARMOR ROD, EHV

CONDUCTOR	CONDUCTOR DIA.	CLAMP CAT. NO.	ENTERGY STOCK NO.	ARMOR ROD CAT. NO.	ENTERGY STOCK NO.	ASSEMBLY CAT. NO.	ENTERGY STOCK NO.
1024 ACAR	1.165	ACFS1802025N	0032036831	AR-0506(EHV)	000121-558	C-7686-RA1	NA
954 45/7 "RAIL"	1.165	ACFS1802025N	0032036831	AR-0506(EHV)	000121-558	C-7686-RA1	NA
954 54/7 "CARDINAL"	1.196	ACFS1802025N	0032036831	AR-0506(EHV)	000121-558	C-7686-RA1	NA



1) ITEMS #8 & #10 ARE CONDUCTOR DEPENDENT. THESE ITEMS ARE SELECTED FOR EACH PROJECT AND MAY BE WITH OR WITHOUT ARMOR RODS.

RE: MACLEAN DWG. BC-7686-7

ENTERGY SERVICES, INC.

VEE-STRING, POLYMER, W/YOKE, RUN. ANG, 500kV

STD NO. | SCALE: NONE

No. TFA204A0

Entergy | PLOT 1=1 | SH. 1 OF 1

NO.	DATE	REVISION	BY	CHK	APPR
0	03-05-07	CREATED	TWF	HSK	

tfinc90 3/5/2007

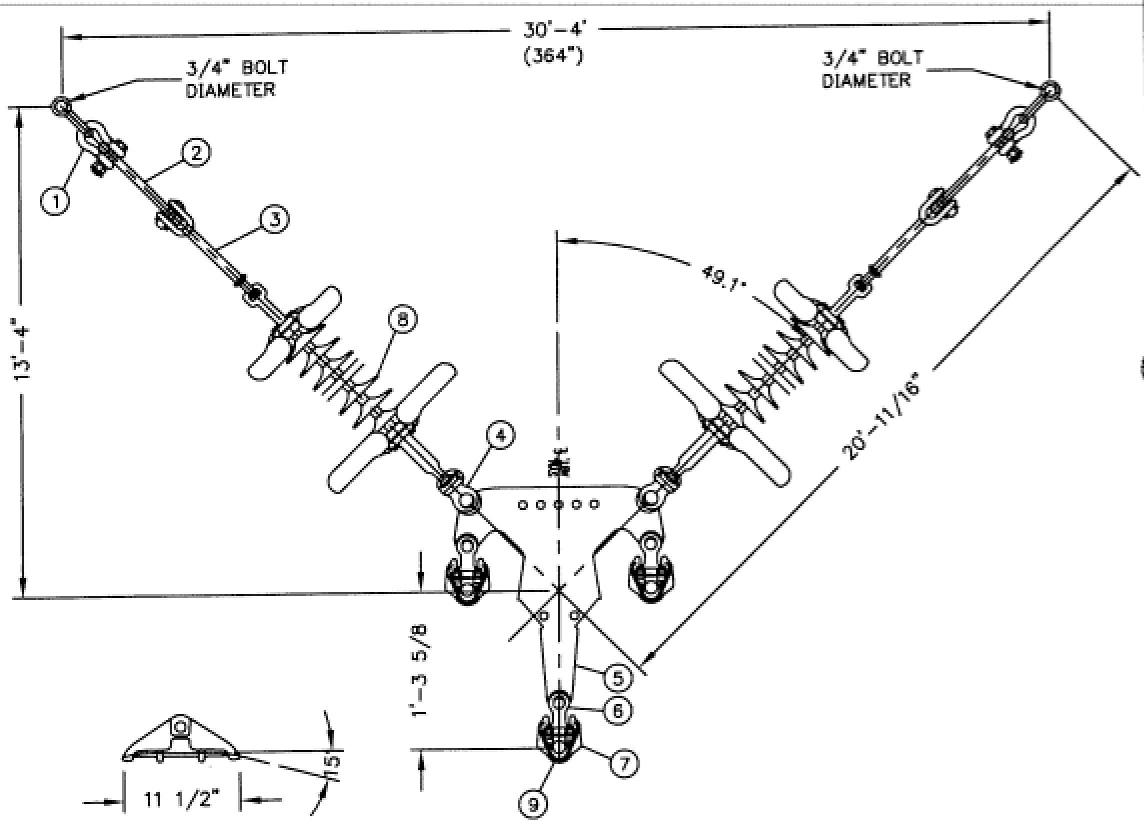
VSPR-500-XX; BC-7686-7

BILL OF MATERIALS

VEE-STRING, POLYMER, W/BUNDLING YOKE, 500kV

ITEM	QTY.	STOCK NO.	DESCRIPTION
1	4	0000000689	SHACKLE, ANCHOR, 60k ULT. STR.
2	2	0032034296	LINK, EXTENSION, 50k
3	2	0000028891	BALL CLEVIS, 50k
4	2	0000028529	SOCKET, Y-CLEVIS, 50k
5	1	0032021845	YOKE PLATE, TRIPLE BUNDLE, 18" SEPARATION
6	3	0000028888	CLEVIS EYE, 45 DEG. Y, 30k
7	3	LS9019XX	CLAMP, SUSPENSION, ALUM. ALLOY, 25k, CORONA FREE
8	2	0032000341	INSULATOR, SUSPENSION, B&S, POLYMER, 500kV, 50k ULT. STR.
9	3	LS9018XX	ARMOR ROD, EHV

CONDUCTOR	CONDUCTOR DIA.	CLAMP CAT. NO.	ENTERGY STOCK NO.	ARMOR ROD CAT. NO.	ENTERGY STOCK NO.	ASSEMBLY CAT. NO.	ENTERGY STOCK NO.
1024 ACAR	1.165	CF-184-N	0000028890	AR-0506(EHV)	000121-558	C-8098-VS1	NA
954 45/7 "RAIL"	1.165	CF-184-N	0000028890	AR-0506(EHV)	000121-558	C-8098-VS1	NA
954 54/7 "CARDINAL"	1.196	CF-184-N	0000028890	AR-0506(EHV)	000121-558	C-8098-VS1	NA



SIDE VIEW OF CLAMP

1) ITEMS #7 & #9 ARE CONDUCTOR DEPENDENT. THESE ITEMS ARE SELECTED FOR EACH PROJECT AND MAY BE WITH OR WITHOUT ARMOR RODS.

RE: MACLEAN DWG. BC-8098-1

ENTERGY SERVICES, INC.

VEE-STRING, POLYMER, W/BUNDLING YOKE, 500kV

NO.	DATE	REVISION	BY	CHK	APPR
0	03-05-07	CREATED	TWF	HSK	

STD NO. | SCALE: NONE

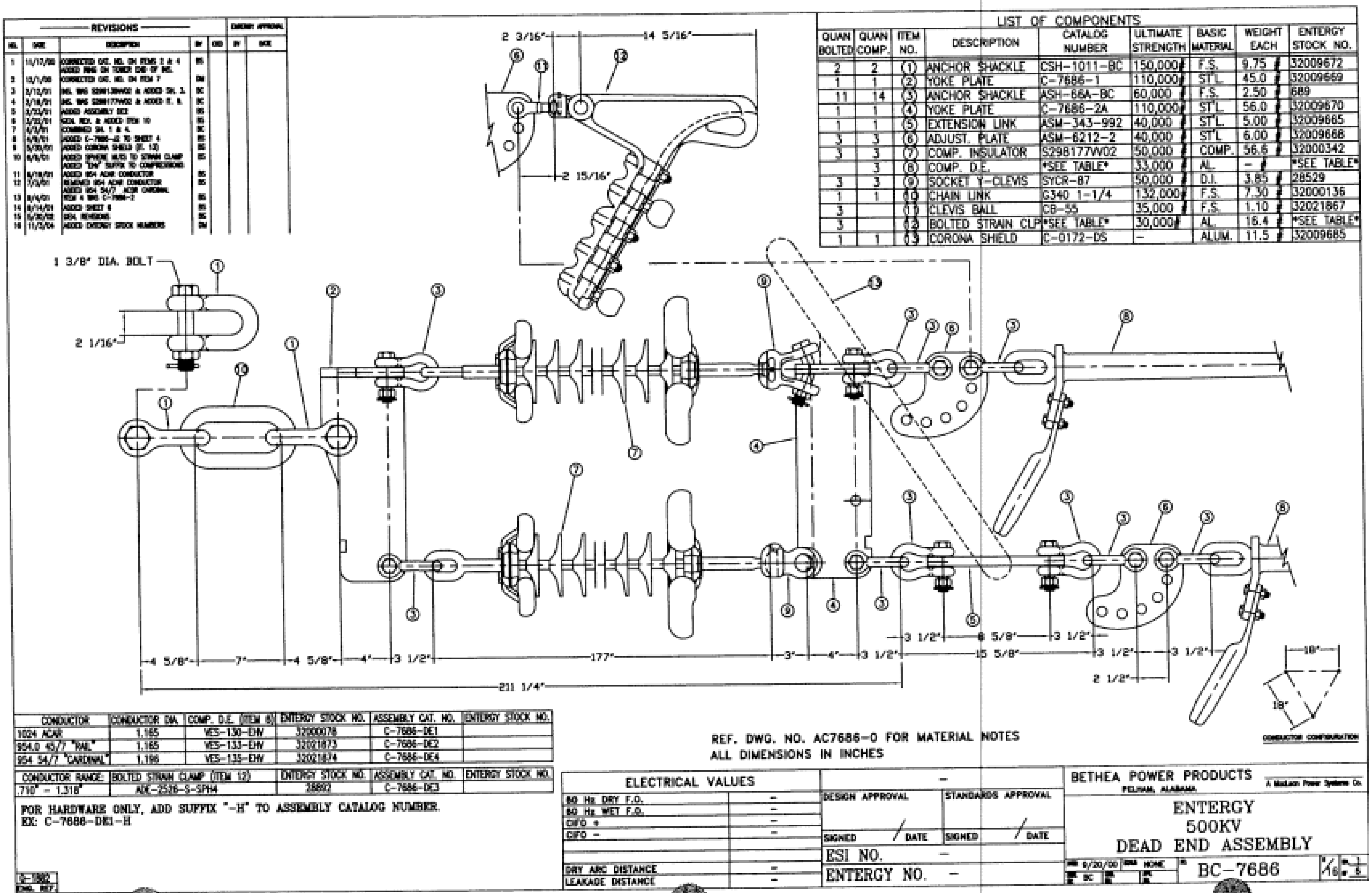
Entergy

No. TFA205A0

PLOT 1=1 | SH. 1 OF 1

tfinc90 3/5/2007

VSPY-500-XX; BC-8098-1

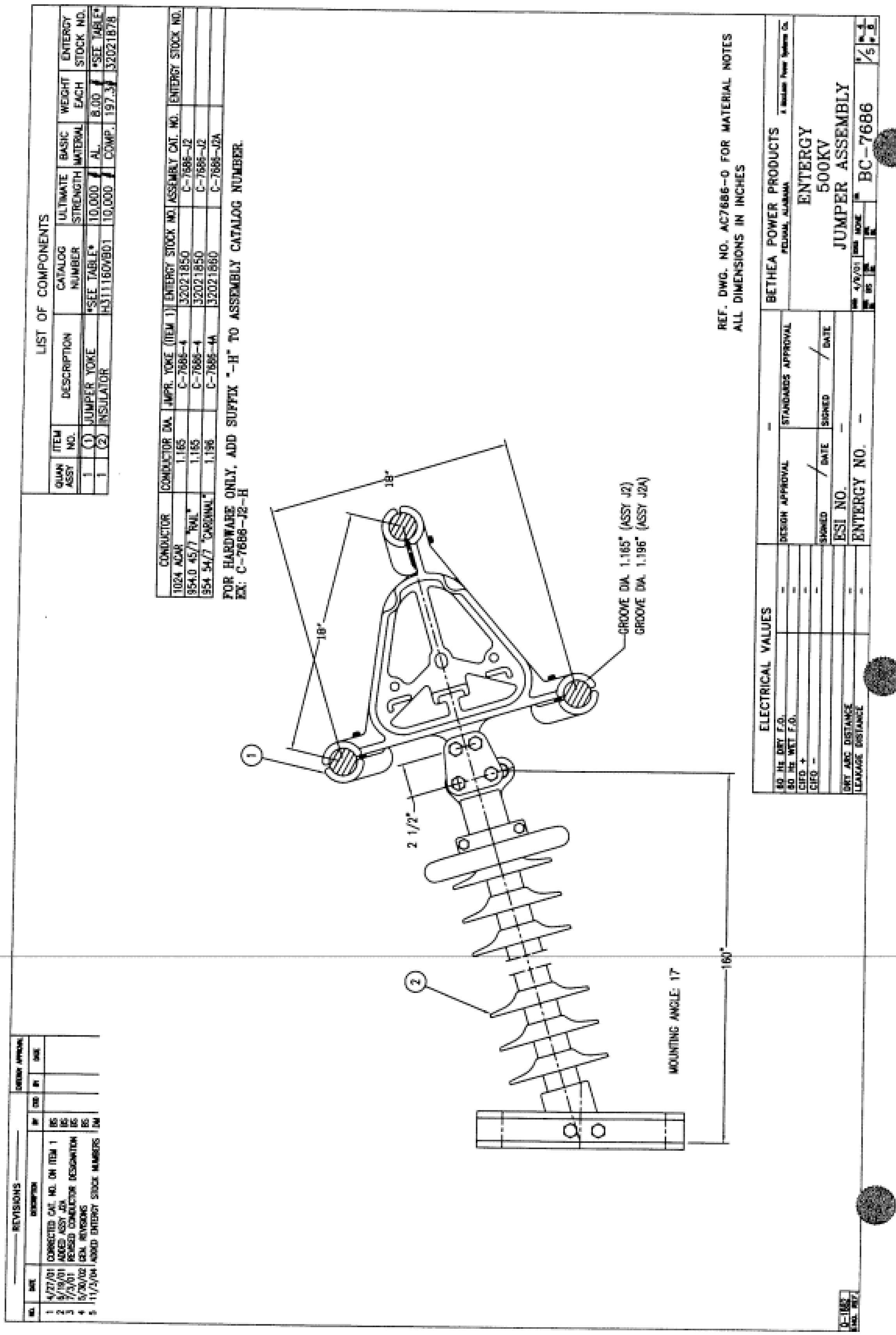


LIST OF COMPONENTS

QUAN BOLTED	QUAN COMP.	ITEM NO.	DESCRIPTION	CATALOG NUMBER	ULTIMATE STRENGTH	BASIC MATERIAL	WEIGHT EACH	ENTERGY STOCK NO.
2	2	1	ANCHOR SHACKLE	CSH-1011-BC	150,000#	F.S.	9.75 #	32009672
1	1	2	YOKE PLATE	C-7686-1	110,000#	ST'L.	45.0 #	32009669
11	14	3	ANCHOR SHACKLE	ASH-66A-BC	60,000 #	F.S.	2.50 #	689
1	1	4	YOKE PLATE	C-7686-2A	110,000#	ST'L.	56.0 #	32009670
1	1	5	EXTENSION LINK	ASM-343-992	40,000 #	ST'L.	5.00 #	32009665
3	3	6	ADJUST. PLATE	ASM-6212-2	40,000 #	ST'L	6.00 #	32009668
3	3	7	COMP. INSULATOR	S298177W02	50,000 #	COMP.	56.6 #	32000342
	3	8	COMP. D.E.	*SEE TABLE*	33,000 #	AL.	- #	*SEE TABLE*
3	3	9	SOCKET Y-CLEVIS	SYCR-87	50,000 #	D.I.	3.85 #	28529
1	1	10	CHAIN LINK	G340 1-1/4	132,000#	F.S.	7.30 #	32000136
3		11	CLEVIS BALL	CB-55	35,000 #	F.S.	1.10 #	32021867
3		12	BOLTED STRAIN CLP	*SEE TABLE*	30,000#	AL.	16.4 #	*SEE TABLE*
1	1	13	CORONA SHIELD	C-0172-DS	-	ALUM.	11.5 #	32009685

CONDUCTOR	CONDUCTOR DIA.	COMP. D.E. (ITEM 8)	ENTERGY STOCK NO.	ASSEMBLY CAT. NO.	ENTERGY STOCK NO.
1024 ACAR	1.165	VES-130-EHV	32000078	C-7686-DE1	
954.0 45/7 "RAIL"	1.165	VES-133-EHV	32021873	C-7686-DE2	
954 54/7 "CARDINAL"	1.196	VES-135-EHV	32021874	C-7686-DE4	

CONDUCTOR RANGE	BOLTED STRAIN CLAMP (ITEM 12)	ENTERGY STOCK NO.	ASSEMBLY CAT. NO.	ENTERGY STOCK NO.
.710" - 1.318"	ADE-2526-S-SPH4	28892	C-7686-DE3	

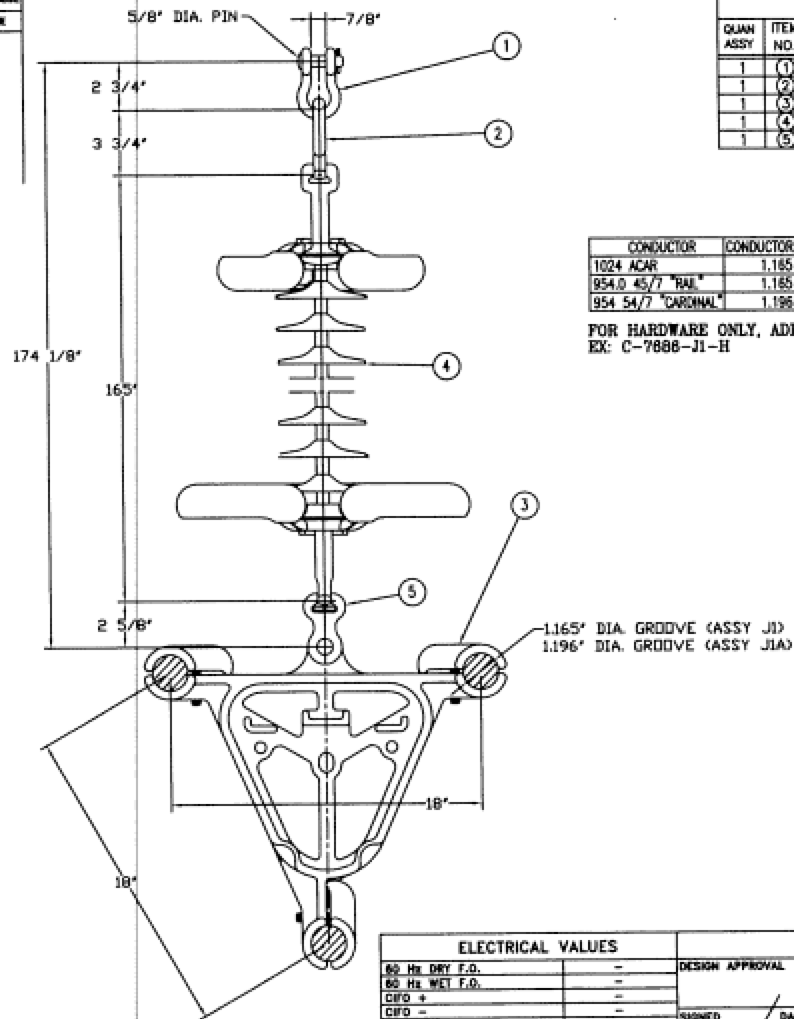


NO.	DATE	DESCRIPTION	BY	CKD
1	4/27/01	CORRECTED CAT. NO. ON ITEM 1	BS	
2	6/19/01	ADDED ASSY J2A	BS	
3	7/3/01	REVISED CONDUCTOR DESIGNATION	BS	
4	5/30/02	GEN. REVISIONS	BS	
5	11/3/04	ADDED ENTERGY STOCK NUMBERS	DM	

QUAN ASSY	ITEM NO.	DESCRIPTION	CATALOG NUMBER	ULTIMATE STRENGTH	BASIC MATERIAL	WEIGHT EACH	ENTERGY STOCK NO.
1	(1)	JUMPER YOKE	*SEE TABLE*	10,000 #	AL.	8.00 #	*SEE TABLE*
1	(2)	INSULATOR	H311160VB01	10,000 #	COMP.	197.3#	32021878

CONDUCTOR	CONDUCTOR DIA.	JMPR. YOKE (ITEM 1)	ENTERGY STOCK NO.	ASSEMBLY CAT. NO.	ENTERGY STOCK NO.
1024 ACAR	1.165	C-7686-4	32021850	C-7686-J2	
954.0 45/7 "RAIL"	1.165	C-7686-4	32021850	C-7686-J2	
954 54/7 "CARDINAL"	1.196	C-7686-4A	32021860	C-7686-J2A	

REVISIONS					ENTERGY APPROVAL	
NO.	DATE	DESCRIPTION	BY	CKD	BY	DATE
1	2/12/01	TAB. INS & ADDED SH. 3.	BC			
2	2/14/01	ADDED UPPER RING.	BC			
3	2/23/01	ITEM 3 WAS P-646-2	BS			
4	3/22/01	GENERAL REV.	BS			
5	4/3/01	DWG WAS 2 OF 4.	BC			
6	4/9/01	DWG WAS 2 OF 3.	BS			
7	6/19/01	ADDED ASSY J1A	BS			
8	7/3/01	REVISED CONDUCTOR DESIGNATION	BS			
9	5/30/02	GEN. REVISIONS	BS			
10	11/3/04	ADDED ENTERGY STOCK NUMBERS	DM			



LIST OF COMPONENTS

QUAN ASSY	ITEM NO.	DESCRIPTION	CATALOG NUMBER	ULTIMATE STRENGTH	BASIC MATERIAL	WEIGHT EACH	ENTERGY STOCK NO.
1	(1)	ANCHOR SHACKLE	ASH-55	30,000 #	F.S.	1.12 #	4466
1	(2)	OVAL EYE BALL	OEB-55	35,000 #	F.S.	1.10 #	28889
1	(3)	JUMPER YOKE	*SEE TABLE*	10,000 #	AL.	8.00 #	*SEE TABLE*
1	(4)	INSULATOR	S178165W06	25,000 #	COMP.	49.3 #	32000277
1	(5)	SOCKET CLEVIS	SC-55	30,000 #	D.I.	1.97 #	32021870

CONDUCTOR	CONDUCTOR DIA.	JMPR. YOKE (ITEM 3)	ENTERGY STOCK NO.	ASSEMBLY CAT. NO.	ENTERGY STOCK NO.
1024 ACAR	1.165	C-6549-3	32021827	C-7686-J1	
954.0 45/7 "RAIL"	1.165	C-6549-3	32021827	C-7686-J1	
954 54/7 "CARDINAL"	1.196	C-7686-5	32021863	C-7686-J1A	

FOR HARDWARE ONLY, ADD SUFFIX "-H" TO ASSEMBLY CATALOG NUMBER.
EX: C-7686-J1-H

REF. DWG. NO. AC7686-0 FOR MATERIAL NOTES
ALL DIMENSIONS IN INCHES

ELECTRICAL VALUES	
60 Hz DRY F.O.	-
60 Hz WET F.O.	-
CIFO +	-
CIFO -	-
DRY ARC DISTANCE	-
LEAKAGE DISTANCE	-

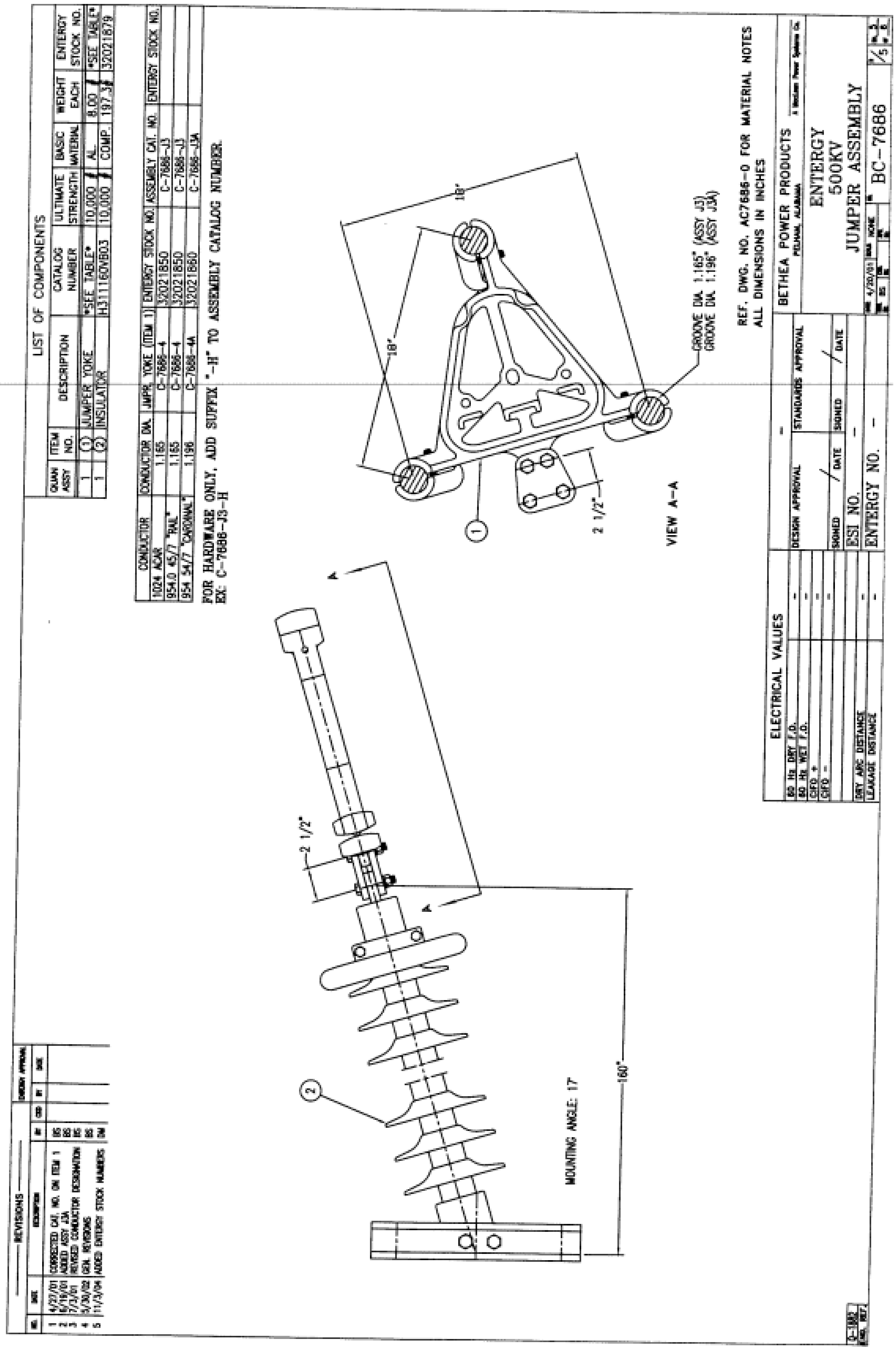
-	
DESIGN APPROVAL	STANDARDS APPROVAL
SIGNED / DATE	SIGNED / DATE
ESI NO. -	
ENTERGY NO. -	

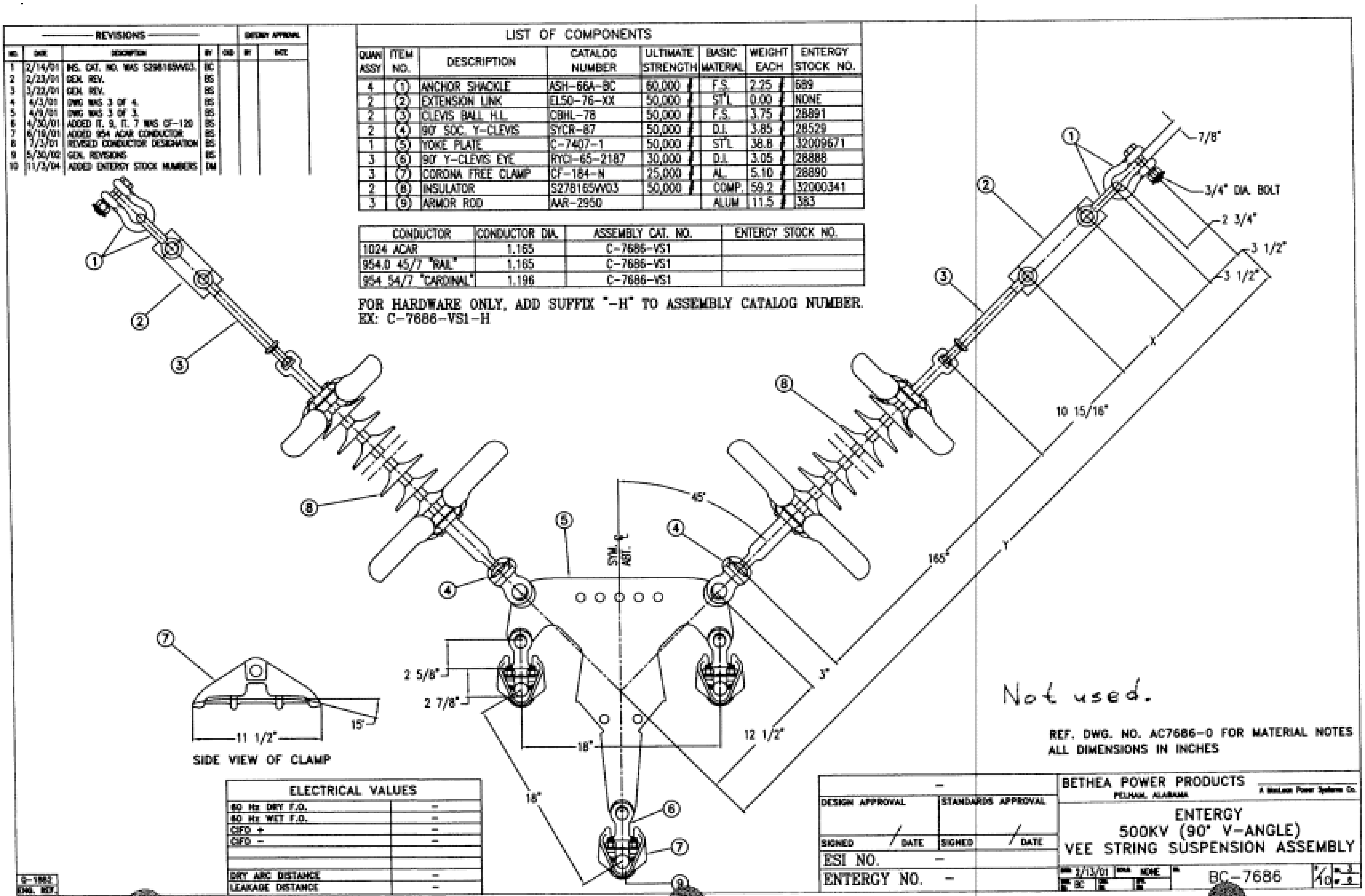
BETHEA POWER PRODUCTS
PELHAM, ALABAMA
A MacLean Power Systems Co.

ENTERGY
500KV
JUMPER ASSEMBLY

DATE 9/21/00 | SCALE NONE | NO. BC-7686 | REV. 10 | SH. 2 OF 3
DR. BC

D-1862
DWG. REF.


REVISIONS
1 4/27/01 CORRECTED CAT. NO. ON ITEM 1 BS
2 6/18/01 ADDED ASSY J3A BS
3 7/3/01 REVISED CONDUCTOR DESIGNATION BS
4 5/30/02 GEN. REVISIONS BS
5 11/3/04 ADDED ENTERGY STOCK NUMBERS DM
LIST OF COMPONENTS
QUAN ASSY | ITEM NO. | DESCRIPTION | CATALOG NUMBER | ULTIMATE STRENGTH | BASIC MATERIAL | WEIGHT EACH | ENTERGY STOCK NO.
1 | 1 | JUMPER YOKE | *SEE TABLE* | 10,000 # | AL. | 8.00 # | *SEE TABLE*
1 | 2 | INSULATOR | H311160VB03 | 10,000 # | COMP. | 197.3# | 32021879
CONDUCTOR | CONDUCTOR DIA. | JMPR. YOKE (ITEM 1) | ENTERGY STOCK NO. | ASSEMBLY CAT. NO. | ENTERGY STOCK NO.
1024 ACAR | 1.165 | C-7686-4 | 32021850 | C-7686-J3
954.0 45/7 "RAIL" | 1.165 | C-7686-4 | 32021850 | C-7686-J3
954 54/7 "CARDINAL" | 1.196 | C-7686-4A | 32021860 | C-7686-J3A
FOR HARDWARE ONLY, ADD SUFFIX "-H" TO ASSEMBLY CATALOG NUMBER.
EX: C-7686-J3-H
2 1/2"
MOUNTING ANGLE: 17°
160"
18"
18"
2 1/2"
VIEW A-A
GROOVE DIA. 1.165" (ASSY J3)
GROOVE DIA. 1.196" (ASSY J3A)
REF. DWG. NO. AC7686-0 FOR MATERIAL NOTES
ALL DIMENSIONS IN INCHES
ELECTRICAL VALUES
60 Hz DRY F.O.
60 Hz WET F.O.
CIFO +
CIFO -
DRY ARC DISTANCE
LEAKAGE DISTANCE
DESIGN APPROVAL
STANDARDS APPROVAL
ESI NO.
ENTERGY NO.
BETHEA POWER PRODUCTS
PELHAM, ALABAMA
ENTERGY
500KV
JUMPER ASSEMBLY
BC-7686



REVISIONS / ENTERGY APPROVAL

NO.	DATE	DESCRIPTION	BY	CHK	BY	DATE
1	2/14/01	INS. CAT. NO. WAS S298165W03.	BC			
2	2/23/01	GEN. REV.	BS			
3	3/22/01	GEN. REV.	BS			
4	4/3/01	DWG WAS 3 OF 4.	BS			
5	4/9/01	DWG WAS 3 OF 3.	BS			
6	4/30/01	ADDED IT. 9, IT. 7 WAS CF-120	BS			
7	6/19/01	ADDED 954 ACAR CONDUCTOR	BS			
8	7/3/01	REVISED CONDUCTOR DESIGNATION	BS			
9	5/30/02	GEN. REVISIONS	BS			
10	11/3/04	ADDED ENTERGY STOCK NUMBERS	DM			

LIST OF COMPONENTS

QUAN ASSY	ITEM NO.	DESCRIPTION	CATALOG NUMBER	ULTIMATE STRENGTH	BASIC MATERIAL	WEIGHT EACH	ENTERGY STOCK NO.
4	1	ANCHOR SHACKLE	ASH-66A-BC	60,000	F.S.	2.25	689
2	2	EXTENSION LINK	EL50-76-XX	50,000	ST'L	0.00	NONE
2	3	CLEVIS BALL H.L.	CBHL-78	50,000	F.S.	3.75	28891
2	4	90° SOC. Y-CLEVIS	SYCR-87	50,000	D.I.	3.85	28529
1	5	YOKE PLATE	C-7407-1	50,000	ST'L	38.8	32009671
3	6	90° Y-CLEVIS EYE	RYCI-65-2187	30,000	D.I.	3.05	28888
3	7	CORONA FREE CLAMP	CF-184-N	25,000	AL.	5.10	28890
2	8	INSULATOR	S278165W03	50,000	COMP.	59.2	32000341
3	9	ARMOR ROD	AAR-2950		ALUM	11.5	383

CONDUCTOR	CONDUCTOR DIA.	ASSEMBLY CAT. NO.	ENTERGY STOCK NO.
1024 ACAR	1.165	C-7686-VS1	
954.0 45/7 "RAIL"	1.165	C-7686-VS1	
954 54/7 "CARDINAL"	1.196	C-7686-VS1	

FOR HARDWARE ONLY, ADD SUFFIX "-H" TO ASSEMBLY CATALOG NUMBER.
EX: C-7686-VS1-H

ELECTRICAL VALUES

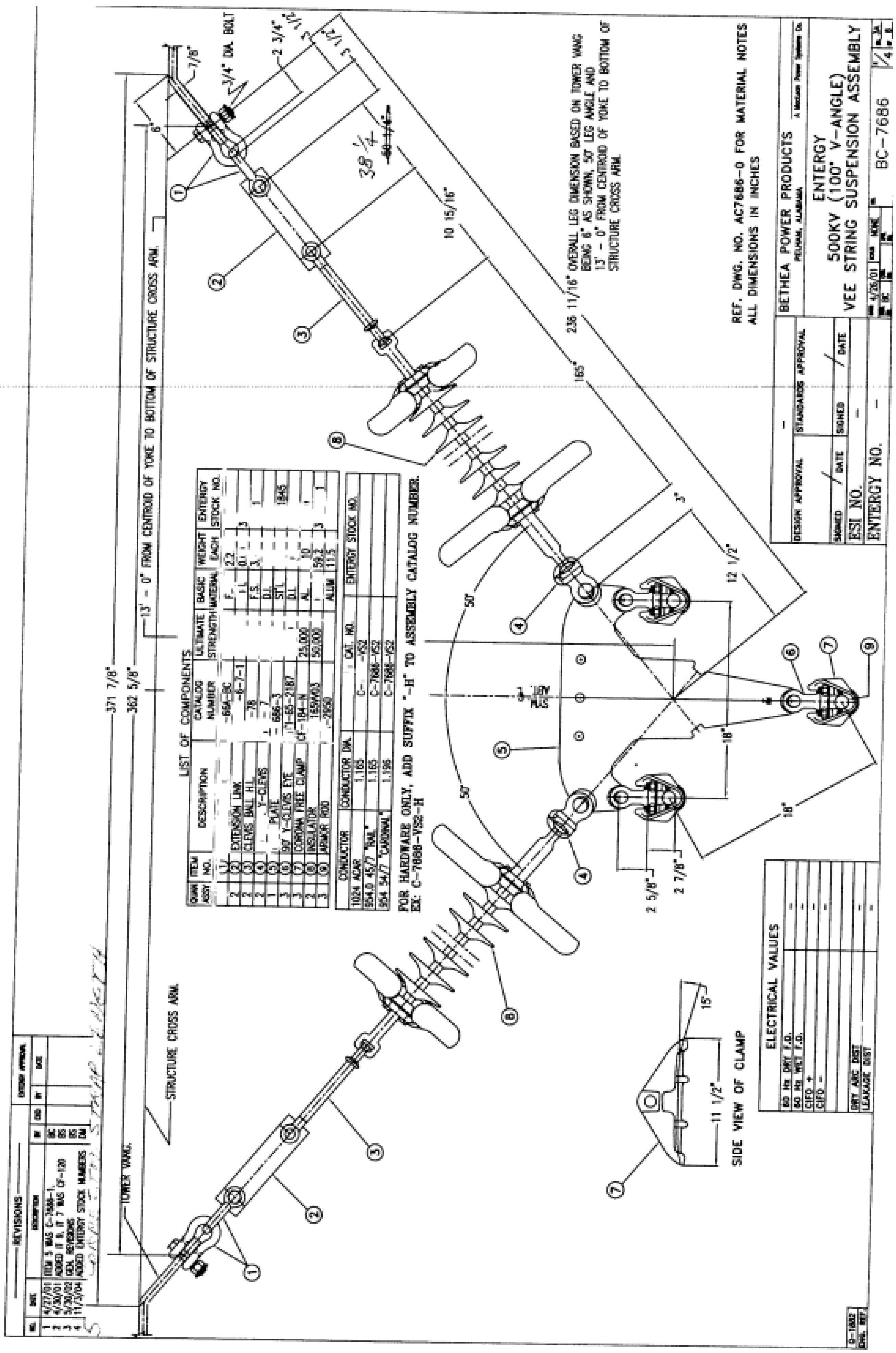
60 Hz DRY F.O.	-
60 Hz WET F.O.	-
CIFO +	-
CIFO -	-
DRY ARC DISTANCE	-
LEAKAGE DISTANCE	-

DESIGN APPROVAL	STANDARDS APPROVAL
SIGNED / DATE	SIGNED / DATE
ESI NO. -	
ENTERGY NO. -	

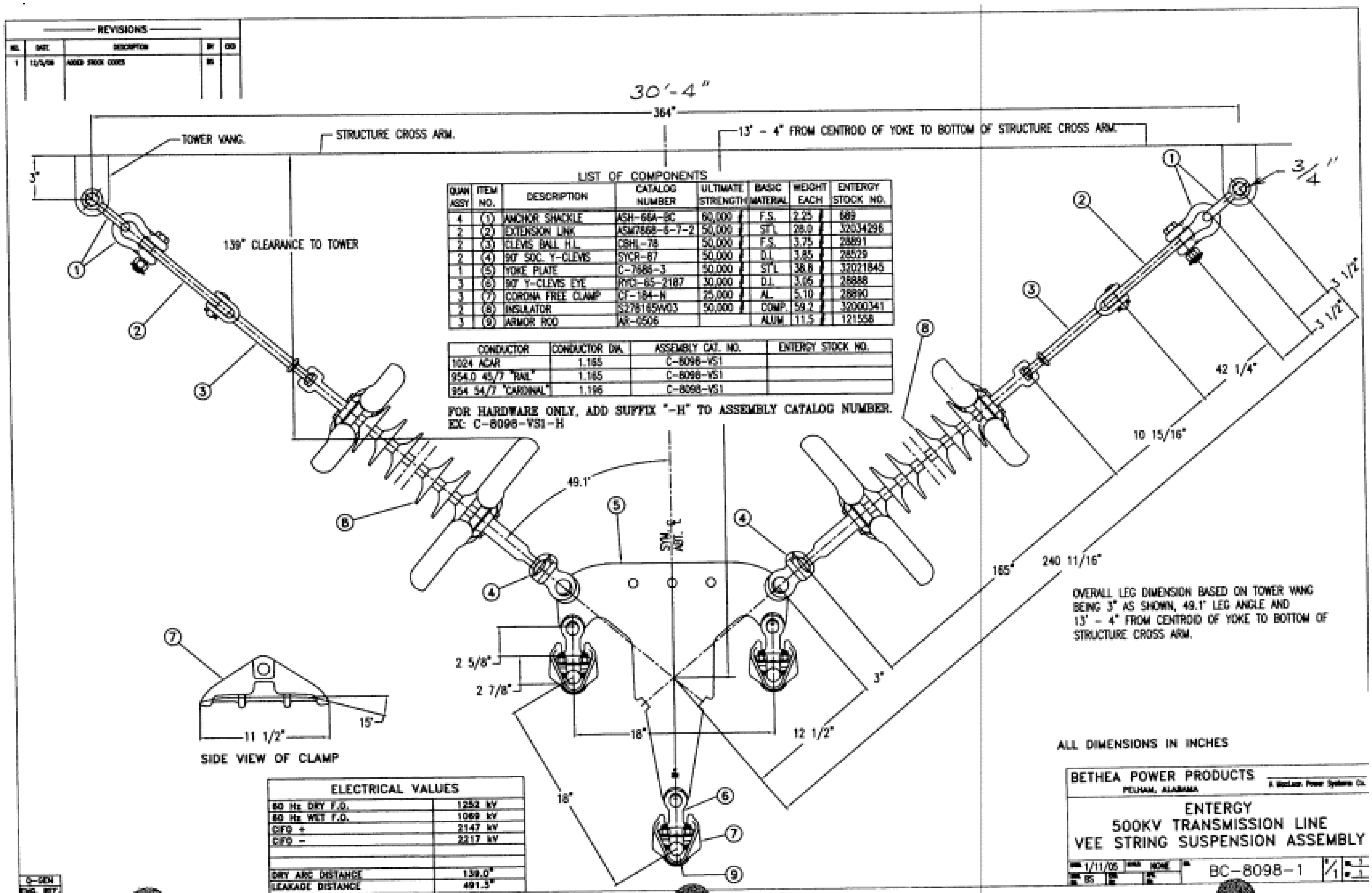
BETHEA POWER PRODUCTS
PELHAM, ALABAMA
A MacLean Power Systems Co.

ENTERGY
500KV (90° V-ANGLE)
VEE STRING SUSPENSION ASSEMBLY

2/13/01 NONE BC BC-7686



REF. DWG. NO. AC7686-0 FOR MATERIAL NOTES
ALL DIMENSIONS IN INCHES
BETHEA POWER PRODUCTS
ENTERGY
500KV (100° V-ANGLE)
VEE STRING SUSPENSION ASSEMBLY
BC-7686
LIST OF COMPONENTS
ELECTRICAL VALUES
SIDE VIEW OF CLAMP
STRUCTURE CROSS ARM
TOWER VANG



LIST OF COMPONENTS

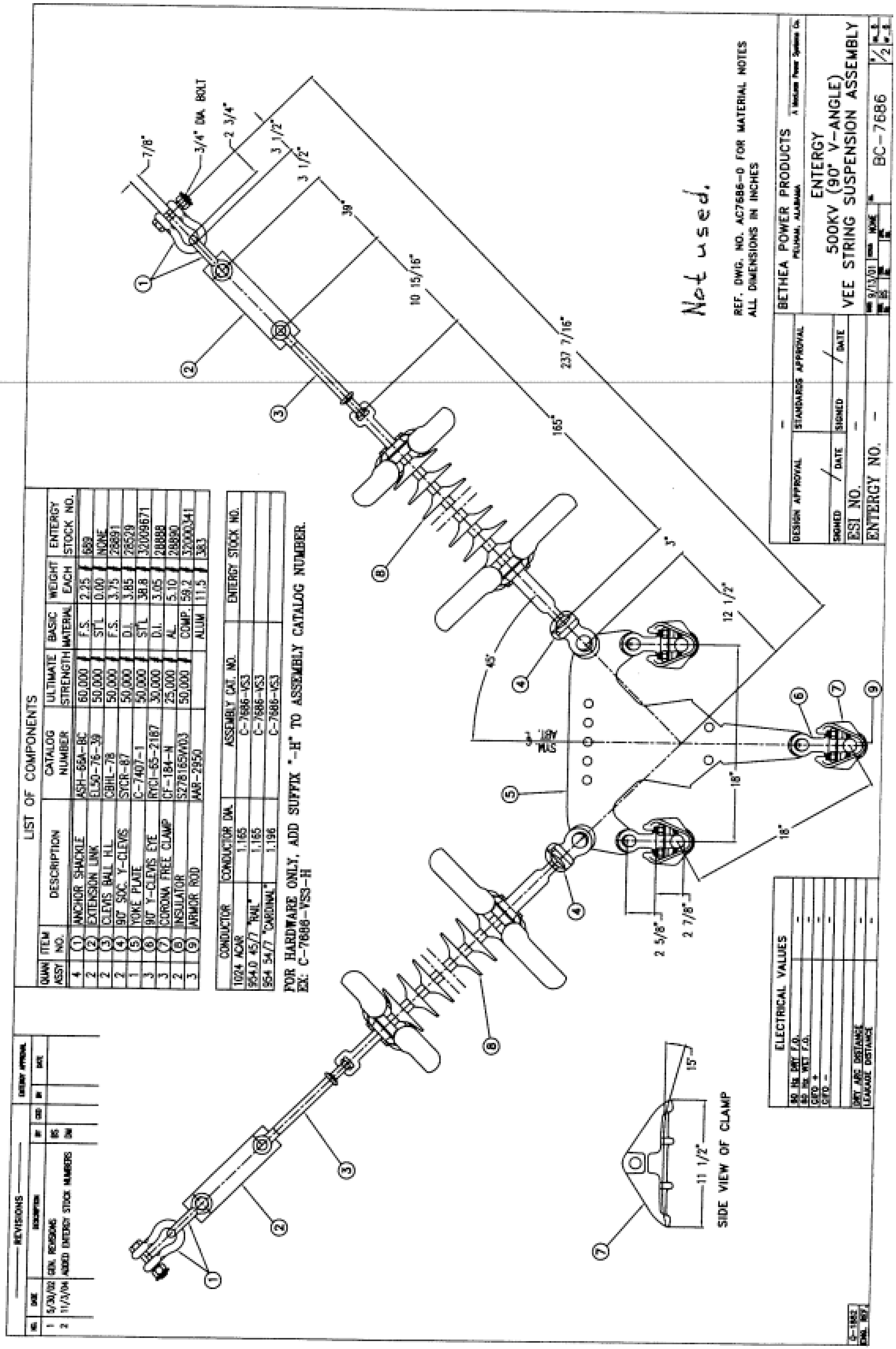
QUAN ASSY	ITEM NO.	DESCRIPTION	CATALOG NUMBER	ULTIMATE STRENGTH	BASIC MATERIAL	WEIGHT EACH	ENTERGY STOCK NO.
4	1	ANCHOR SHACKLE	ASH-66A-BC	60,000	F.S.	2.25	689
2	2	EXTENSION LINK	ASM7868-6-7-2	50,000	ST'L	28.0	32034296
2	3	CLEVIS BALL H.L.	CBHL-78	50,000	F.S.	3.75	28891
2	4	90° SOC. Y-CLEVIS	SYCR-67	50,000	D.I.	3.85	28529
1	5	YOKE PLATE	C-7686-3	50,000	ST'L	38.8	32021845
3	6	90° Y-CLEVIS EYE	RYCI-65-2187	30,000	D.I.	3.05	28888
3	7	CORONA FREE CLAMP	CF-184-H	25,000	AL.	5.10	28890
2	8	INSULATOR	S276185W03	50,000	COMP.	59.2	32000341
3	9	ARMOR ROD	AR-0506		ALUM.	11.5	121558

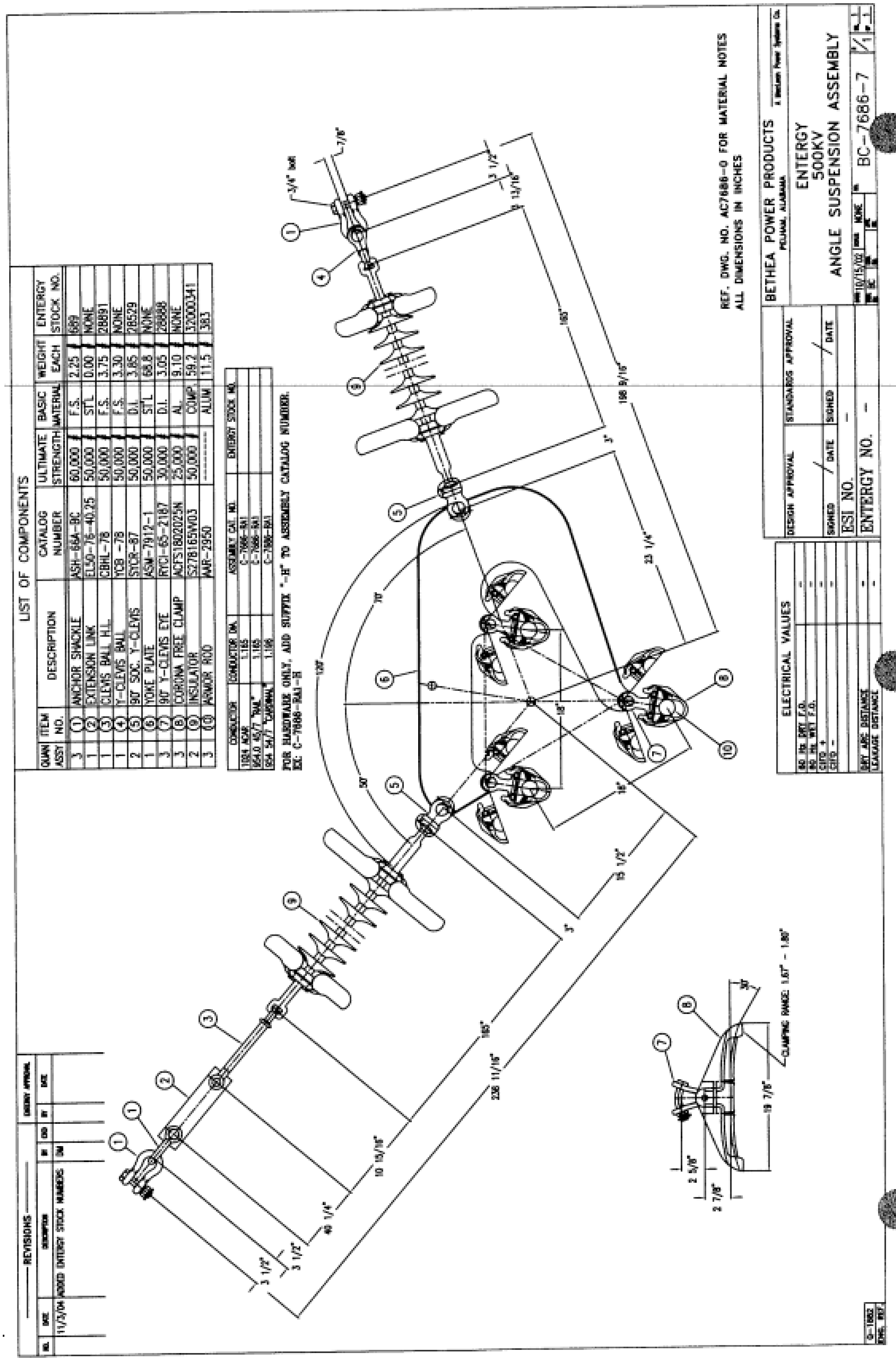
CONDUCTOR	CONDUCTOR DIA.	ASSEMBLY CAT. NO.	ENTERGY STOCK NO.
1024 ACAR	1.165	C-8098-VS1	
954.0 45/7 "RAIL"	1.165	C-8098-VS1	
954 54/7 "CARDINAL"	1.196	C-8098-VS1	

FOR HARDWARE ONLY, ADD SUFFIX "-H" TO ASSEMBLY CATALOG NUMBER.
EX: C-8098-VS1-H

ELECTRICAL VALUES

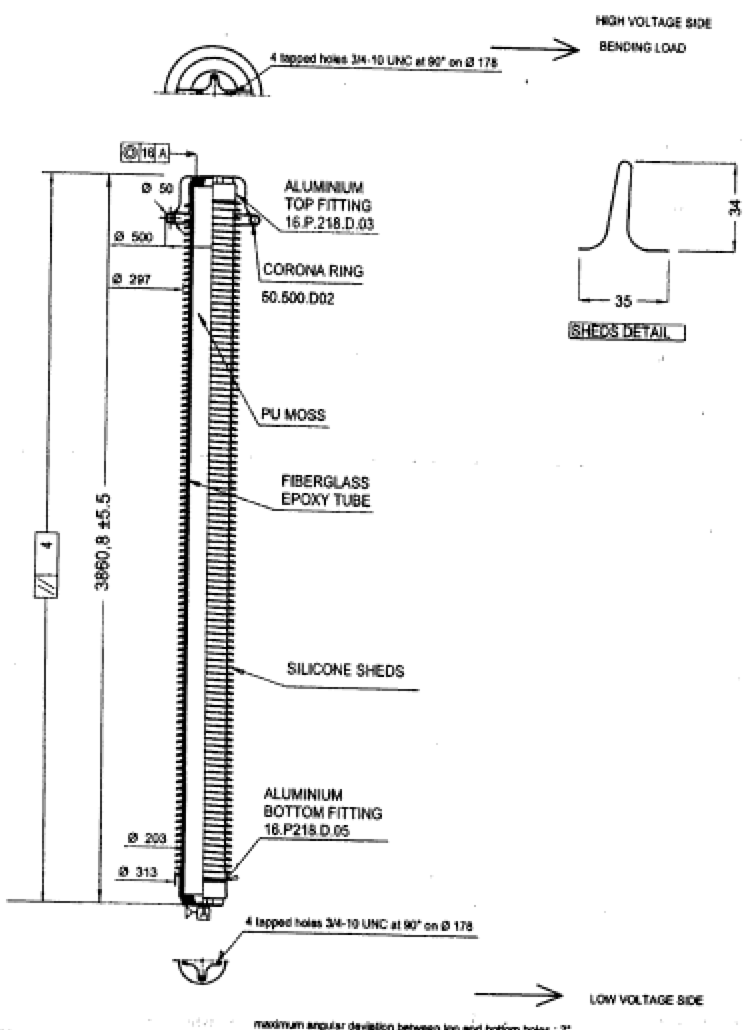
60 Hz DRY F.O.	1252 kV
60 Hz WET F.O.	1069 kV
CIFO +	2147 kV
CIFO −	2217 kV
DRY ARC DISTANCE	139.0"
LEAKAGE DISTANCE	491.3"


LIST OF COMPONENTS
QUAN ASSY | ITEM NO. | DESCRIPTION | CATALOG NUMBER | ULTIMATE STRENGTH | BASIC MATERIAL | WEIGHT EACH | ENTERGY STOCK NO.
4 | 1 | ANCHOR SHACKLE | ASH-66A-BC | 60,000 | F.S. | 2.25 | 689
2 | 2 | EXTENSION LINK | EL50-76-39 | 50,000 | STL | 0.00 | NONE
2 | 3 | CLEVIS BALL H.L. | CBHL-78 | 50,000 | F.S. | 3.75 | 28891
2 | 4 | 90° SOC. Y-CLEVIS | SYCR-87 | 50,000 | D.I. | 3.85 | 28529
1 | 5 | YOKE PLATE | C-7407-1 | 50,000 | STL | 38.8 | 32009671
3 | 6 | 90° Y-CLEVIS EYE | RYCI-65-2187 | 30,000 | D.I. | 3.05 | 28888
3 | 7 | CORONA FREE CLAMP | CF-184-N | 25,000 | AL | 5.10 | 28890
2 | 8 | INSULATOR | S278165W03 | 50,000 | COMP. | 59.2 | 32000341
3 | 9 | ARMOR ROD | AAR-2950 | | ALUM | 11.5 | 383
CONDUCTOR | CONDUCTOR DIA. | ASSEMBLY CAT. NO. | ENTERGY STOCK NO.
1024 ACAR | 1.165 | C-7686-VS3
954.0 45/7 "RAIL" | 1.165 | C-7686-VS3
954 54/7 "CARDINAL" | 1.196 | C-7686-VS3
FOR HARDWARE ONLY, ADD SUFFIX "-H" TO ASSEMBLY CATALOG NUMBER.
EX: C-7686-VS3-H
Not used.
REF. DWG. NO. AC7686-0 FOR MATERIAL NOTES
ALL DIMENSIONS IN INCHES
BETHEA POWER PRODUCTS
PELHAM, ALABAMA
ENTERGY
500KV (90° V-ANGLE)
VEE STRING SUSPENSION ASSEMBLY
BC-7686
DESIGN APPROVAL
STANDARDS APPROVAL
SIGNED
DATE
ESI NO.
ENTERGY NO.
ELECTRICAL VALUES
SIDE VIEW OF CLAMP
REVISIONS
GEN. REVISIONS
ADDED ENTERGY STOCK NUMBERS
5/30/02
11/3/04
7/8"
3/4" DIA. BOLT
2 3/4"
3 1/2"
39"
10 15/16"
237 7/16"
165"
3"
12 1/2"
45°
SYM ABT ℄
18"
2 5/8"
2 7/8"
11 1/2"
15°



QUAN ASSY	ITEM NO.	DESCRIPTION	CATALOG NUMBER	ULTIMATE STRENGTH	BASIC MATERIAL	WEIGHT EACH	ENTERGY STOCK NO.
3	1	ANCHOR SHACKLE	ASH-66A-BC	60,000	F.S.	2.25	689
1	2	EXTENSION LINK	EL50-76-40.25	50,000	ST'L	0.00	NONE
1	3	CLEVIS BALL H.L.	CBHL-78	50,000	F.S.	3.75	28891
1	4	Y-CLEVIS BALL	YCB -78	50,000	F.S.	3.30	NONE
2	5	90° SOC. Y-CLEVIS	SYCR-87	50,000	D.I.	3.85	28529
1	6	YOKE PLATE	ASM-7912-1	50,000	ST'L	68.8	NONE
3	7	90° Y-CLEVIS EYE	RYCI-65-2187	30,000	D.I.	3.05	28888
3	8	CORONA FREE CLAMP	ACFS1802025N	25,000	AL.	9.10	NONE
2	9	INSULATOR	S278165W03	50,000	COMP.	59.2	32000341
3	10	ARMOR ROD	AAR-2950	--------	ALUM	11.5	383

CONDUCTOR	CONDUCTOR DIA.	ASSEMBLY CAT. NO.	ENTERGY STOCK NO.
1024 ACAR	1.165	C-7686-RA1	
954.0 45/7 "RAIL"	1.165	C-7686-RA1	
954 54/7 "CARDINAL"	1.196	C-7686-RA1	



COMPOSITE POLYMER POST INSULATOR

TOLERANCES OF DIMENSIONS ANSI C29.9-1983

1- ELECTRICAL SPECIFICATION	ANSI C29.9-1983-TR391	
1.1- APPLICATION	support	
1.2- RATED VOLTAGE	550 KV	
-	-	-
2- INSULATOR MECHANICAL SPECIFICATION	-	-
2.1- BENDING WITHSTAND		
2.1.a- BENDING WITHSTAND MOMENT(1mm)	2404 daN.m	212800 inch-lbs
EQUIVALENT BENDING WITHSTAND LOAD (SML)	623 daN	1400 lbs
2.1.b- MAXIMUM DEFLECTION	100 mm	4"
UNDER BENDING LOAD (MML)	249 daN	560 lbs
		-
2.2 TORSIONAL STRENGTH	10170 N.m	90000 inch.pounds
3- DIMENSIONS		
3.1- INSULATOR	-	
3.1.a- OVERALL HEIGHT OF INSULATOR	3860.8 mm	152"
TOLERANCE ±	5.5 mm	7/32"
3.1.b- MAX INTERNAL DIAMETER OF TUBE	203mm	8"
3.1.c- MAX EXTERNAL DIAMETER OF SHEDS	313 mm	12" 9/32
3.2- HIGH VOLTAGE FITTING (OR TOP)	-	-
3.2.a- MAX DIAMETER	208 mm	8" 3/16
3.2.b- BOLT CIRCLE (PITCH CIRCLE DIAMETER)	178 mm	7 inches
3.2.c- NUMBER AND TYPE OF HOLES	4 Holes 3/4" 10 UNC	
3.3- LOW VOLTAGE FITTING (OR BOTTOM)	-	-
3.3.a- MAX DIAMETER	208 mm	8" 3/16
3.3.b- BOLT CIRCLE (PITCH CIRCLE DIAMETER)	178 mm	7 inches
3.3.c- NUMBER AND TYPE OF HOLES	4 Holes 3/4"-10 UNC	
3.4- APPROXIMATIVE TOTAL WEIGHT	136 kg	300 pounds
3.5- NOMINAL LEAKAGE DISTANCE	9347 mm	368"
3.6- NOMINAL DRY ARCING DISTANCE	3540 mm	139" 3/8"

MACLEAN POWER FRANCE
A MacLean-Fogg Company

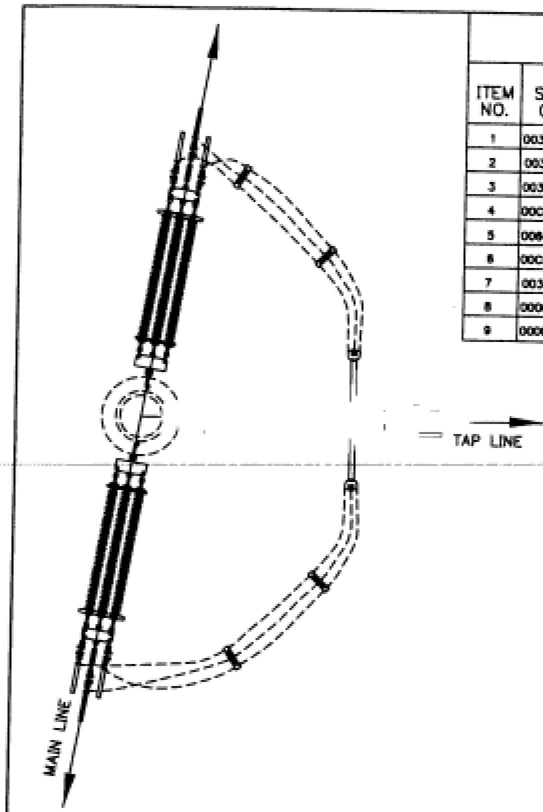
DESSINE :	23/10/2000	RV
VERIFIE :		
APPROUVE :		
DATE du TIRAGE :		
ECHELLE :		
ECH. SEC. :		

COMMERCIAL DRAWING

T-04684

N° T-04684

500KV STATION POST - ENTERGY STOCK CODE 0032034655



BILL OF MATERIAL

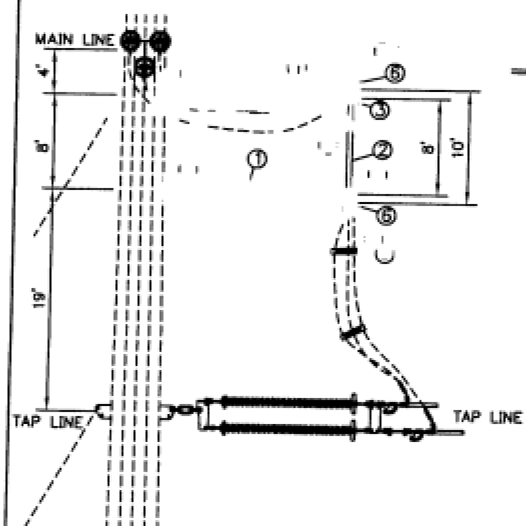
ITEM NO.	STOCK CODE	QTY.	UNIT	DESCRIPTION	MFR.	PART NO.
1	0032034655	2	EA.	STATION POST INSULATOR 500kV, 7" B.C.	MPS	T-04684
2	0032040241	20	FT.	TUBING, COND, ALUM, 5", SCH 40, EHV, 40' LG	AFL	500S40YTBE
3	0032040322	2	EA.	SUPPORT, BUS, 5" TUBE TO 7" B.C., W/ MTG HDWR	SEFCOR	WCTI-67-7-EHV
4	00CSPERCPD	3	EA.	EHV BUS COUPLER, 5" TUBING , 3-TERMINAL, 500kV	SEFCOR	WSTC3-67-40
5	00607-6810	1	EA.	CONNECTOR, TEE, 5" RUN/5" TAP, 90 DEGREE, EHV	SEFCOR	WFTT-6767
6	00CSPERHSP	9	EA.	EHV HARDWARE SHIELD, CORONA PAD COVER	SEFCOR	AA-1094
7	0032031610	1	EA.	STUD, GROUND, WELD, ALUM, FOR 3" TO 6" TUBE	SEFCOR	WTS-6064
8	0000004659	6	EA.	BOLT ASSEMBLY,3/4"X1-1/2",HEX,GALV,A394, W/NUT	ANY	3/4" X 1-1/2"
9	0000000544	36	EA.	BOLT,1/2X2-1/2, SS,W/NUT, 2 WASH, BELLV. WASH	ANY	1/2" X 2-1/2"

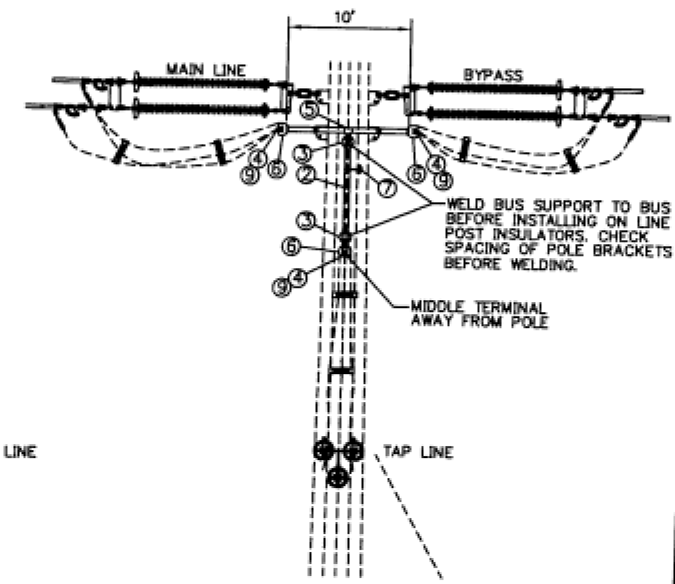
REFERENCE DRAWINGS:

80'-100', DE, 3-POLE HIGH-LOW, STEEL 500KV
FOUNDATION PLAN, 500KV HIGH-LOW
WIRES PLAN, 500KV HIGH-LOW

NOTES:

1. EXACT TAKE OFF ANGLE/DIRECTION OF JUMPERS TO BE FIELD FITTED TO MATCH ASSOCIATED COMPRESSION DEAD END BODIES.
2. DISCARD NUTS FURNISHED WITH ITEM 8.
3. HOLES IN POLE END OF LINE POST ARE 1-1/8" DEEP. IF BOLT BOTTOMS OUT, OBTAIN A WASHER TO PROVIDE TAKEUP OF LENGTH.
4. ORDER TOTAL FEET OF ITEM 2 NEEDED. STANDARD LENGTH PER TUBE IS 40'.
5. BUS LENGTHS SHOWN MAY BE SLIGHTLY LONGER WHEN FITTINGS ARE MADE UP. LENGTHS SHOWN ARE END-TO-END OF TUBES.





JLP-500-HL

ENTERGY SERVICES, INC.		
Transmission LineDesign Standard BUS ASSY FOR 500kV HIGH-LOW STRUCTURE VOLTAGE SPECIFIC ASSEMBLY DETAIL		
STD NO.	SCALE:	NONE
Entergy	No. TFA206A0	
	PLOT 1=48	SH. 1 OF 1

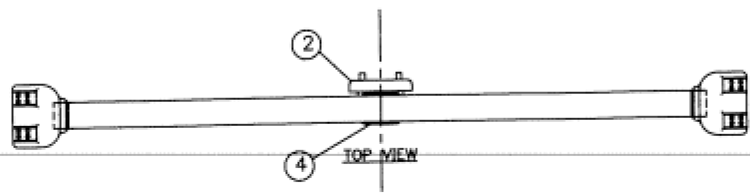
NO.	DATE:	REVISION	BY:	CHK:	APPR
0	6-15-07	CREATED	TWF	HSK	HSK

tflnc90 7/3/2007

JLP-500-HL

BILL OF MATERIAL

ITEM NO.	STOCK CODE	QTY	UNIT	DESCRIPTION	MFR.	PART NO.
1	0032040241	20	FT.	TUBING, COND, ALUM, 5", SCH 40, EHV, 40' LG	AFL	500S40YT6E
2	0032040322	2	EA.	SUPPORT, BUS, 5" TUBE TO 7" B.C., W/ MTG HDWR	SEFCOR	WCTI-67-7-EHV
3	00CSPERCPD	3	EA.	EHV BUS COUPLER, 5" TUBING , 3-TERMINAL, 500kV	SEFCOR	WSTC3-67-4B
4	00607-6810	1	EA.	CONNECTOR, TEE, 5" RUN/5" TAP, 90 DEGREE, EHV	SEFCOR	WFTT-6767
5	0032031810	1	EA.	STUD, GROUND, WELD, ALUM, FOR 3" TO 6" TUBE	SEFCOR	WTS-6064



NOTES:

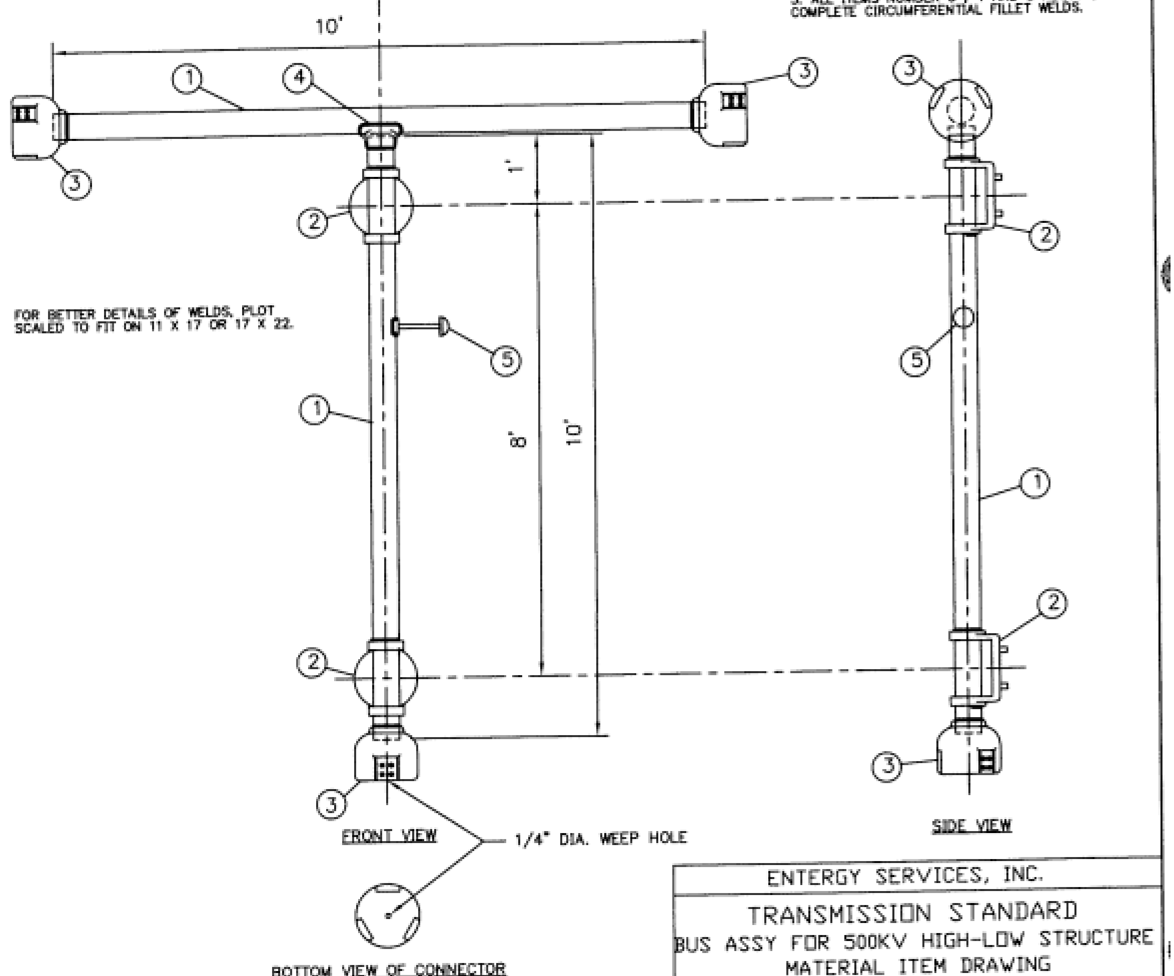
1. ORDER TOTAL FEET OF ITEM 1 NEEDED. STANDARD LENGTH PER TUBE IS 40'.

2. BUS LENGTHS SHOWN MAY BE SLIGHTLY LONGER WHEN FITTINGS ARE MADE UP. LENGTHS SHOWN ARE END-TO-END OF TUBES.

3. ALL WELDS TO BE MADE IN CONFORMANCE WITH ENTERGY STANDARD SL0206, HIGH VOLTAGE ELECTRICAL CONNECTIONS – CONSTRUCTION GUIDE. SEE SECTION 10 FOR WELDS.

4. ITEMS NUMBER 2 REQUIRES COMPLETE CIRCUMFERENTIAL FILLET WELDS ON TOP OF TOP RING AND 1/3 CIRCUMFERENTIAL FILLETWELDS ON BOTTOM OF BOTTOM RING TOWARD THE BASE SO THE RING DOES NOT HOLD WATER AND FREEZE.

5. ALL ITEMS NUMBER 3 , 4 AND 5 REQUIRE COMPLETE CIRCUMFERENTIAL FILLET WELDS.



ENTERGY SERVICES, INC.

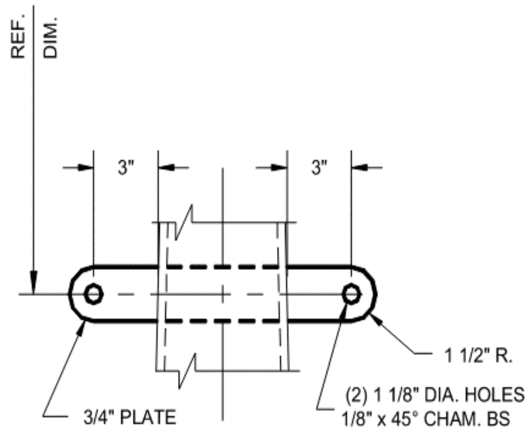
TRANSMISSION STANDARD
BUS ASSY FOR 500KV HIGH-LOW STRUCTURE
MATERIAL ITEM DRAWING

STD NO. SL0206 | SCALE: NONE

No. TFM001A0

Entergy | PLOT 1=1 | SH. 1 OF 1

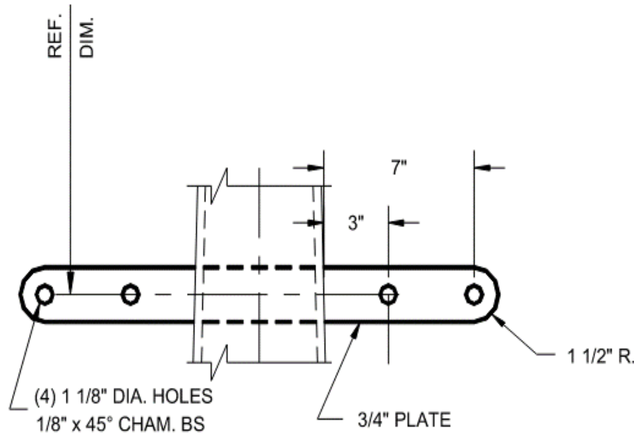
NO.	DATE	REVISION	BY	CHK	APPR
0	12-15-07	CREATED	TWF	HSK	HSK



LIGHT-DUTY 2-HOLE VANG

Primary uses:

Support shield wire span guys
Support top of braced-post insulator assemblies
Support conductor swinging angle assemblies

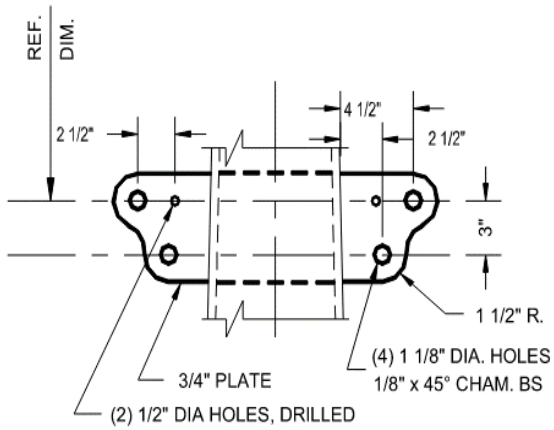


LIGHT-DUTY 4-HOLE VANG

Primary use:

Support shield wire suspension

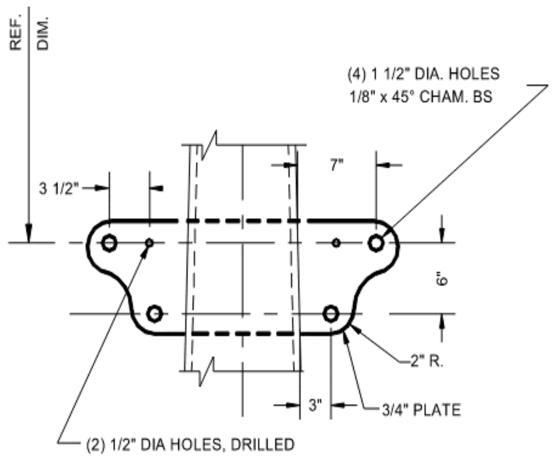
Vang Details for Steel Poles



HEAVY-DUTY 4-HOLE VANG

Primary use:

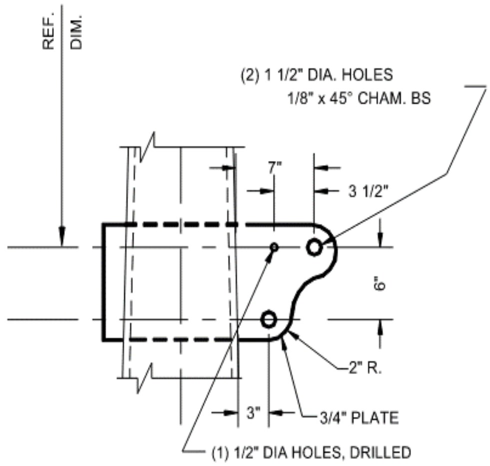
Support shield wire deadend assemblies
Support conductor deadend assemblies
Support conductor deadend down guys
Support conductor bisector down guys
Support shield wire deadend down guys
Support shield wire bisector down guys
All conductor and shield wire vangs on structures with running angle insulators (E, F and G)



HEAVY-DUTY 4-HOLE VANG FOR TRIPLE BUNDLE SINGLE POINT DEAD ENDS

Primary use:

Support 500kv conductor dead end assemblies where guys will be at the same elevation as the conductors and when guys are not specified.

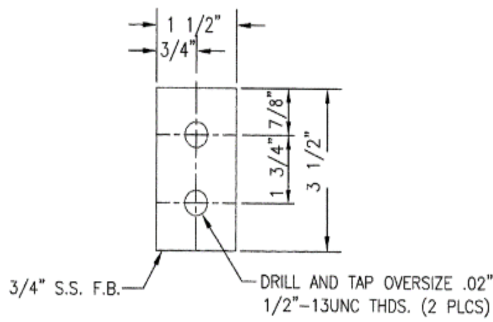


HEAVY-DUTY 2-HOLE VANG FOR TRIPLE BUNDLE SINGLE POINT DEAD ENDS

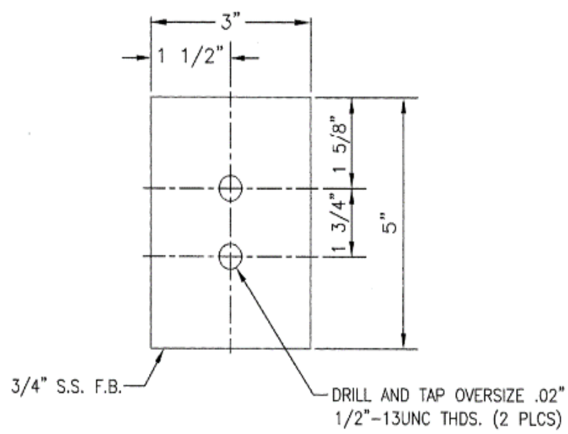
Primary use:

Support 500kv conductor dead end assemblies and guys where guys are specified and will attach at locations below the conductors. Do not install guy vangs on unguyed structures with this type of vang unless specified by Entergy.

NEMA Pad Details for Steel Poles or Caissons

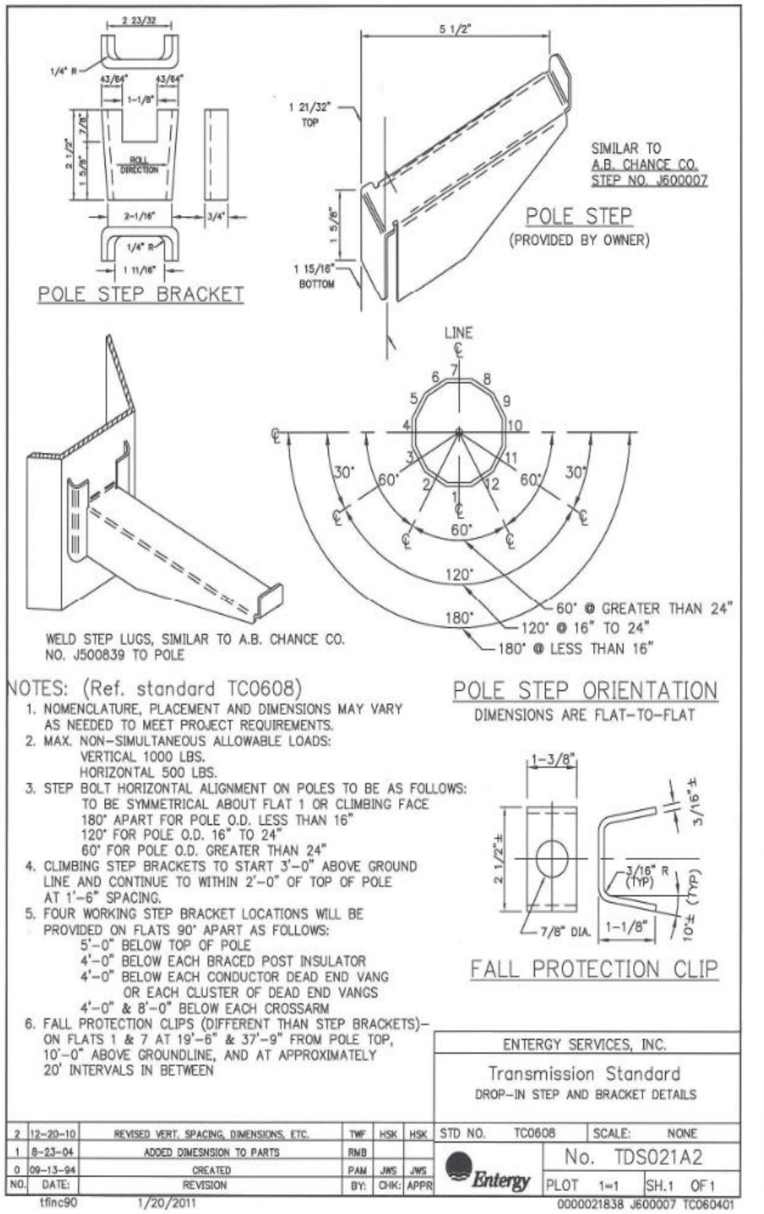


SMALL NEMA 2-HOLE PAD



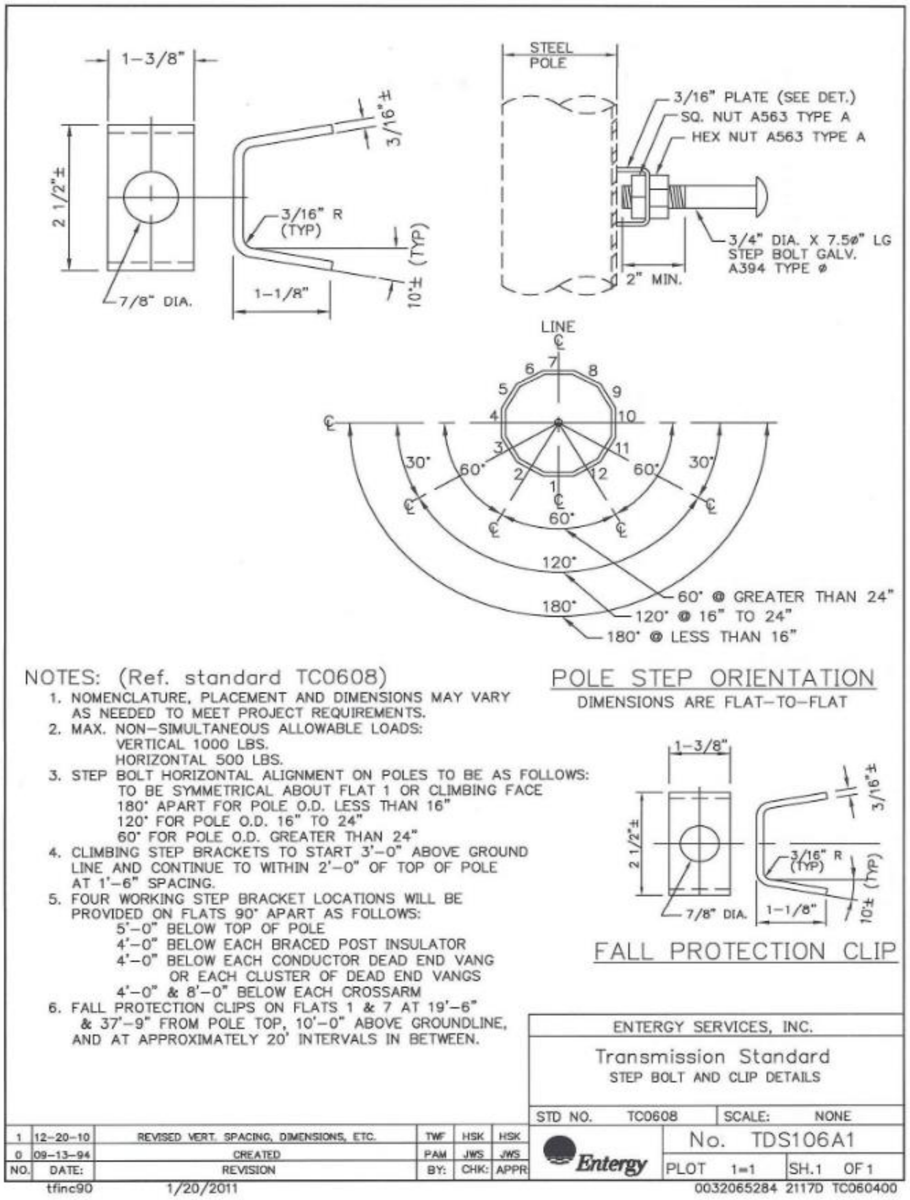
LARGE NEMA 2-HOLE PAD

TDS021A1, Step and Bracket Details, represents the Entergy specifications for drop-in steps.



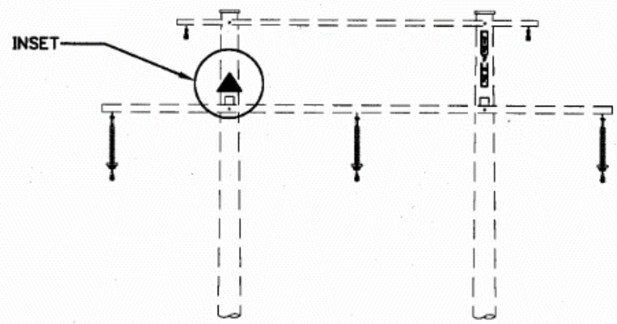
Climbing Details

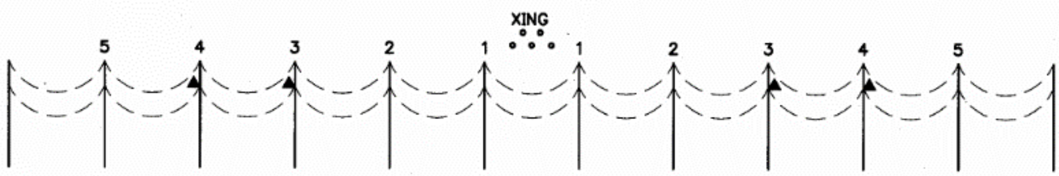
TDS106A1, Step Bolt Details, represents the Entergy specifications for pole steps.

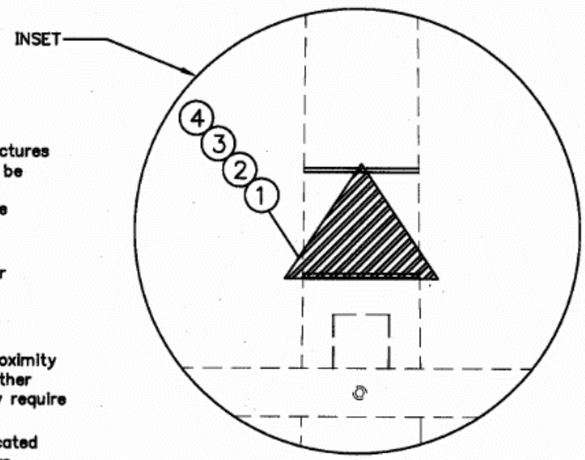


BILL OF MATERIAL

ITEM	QTY.	STOCK NO.	DESCRIPTION
1	1	NONE	SIGN, SLOW-VEHICLE, ACQUIRED BY LOCAL PURCHASE
2	8 FT.	0000017124	BAND, STRAPPING, 3/4" WD X 100FT LG ROLL, STAINLESS STEEL, 201
3	2	0032047234	BRACKET, BANDING, FLARED LEG, SS, WITH ONE 5/16"-18 X 3/4" HEX HEAD SS BOLT AND FIBER WASHER, 3/4" SLOT, SHIPPED 50/BOX
4	2	0000017123	BOLT, CLAMP ASSEMBLY, CARRIAGE HD, GALVANIZED STEEL, HIGH STRENGTH, ASTM B221 MILITARY QQ-A-200/8, 5 GR, 3/8" DIA, 6" LG HIGH STR CARR BOLT, WASH AND NUT.







NOTES:

1) This installation is optional with the grids, and represents a standard for uniformity across the system wherever it is used.
2) Install one slow-vehicle sign on <u>third & fourth</u> structures on each side of overhead line crossings of lines to be patrolled by helicopter to provide advance warning of aerial hazard ahead. Additional structures may be marked where sight distance or visibility is limited.
3) Place the markers near the pole tops and away from the hazard so it will be seen as the helicopter approaches the line crossing.
4) Slow-vehicle signs are available for local purchase at farm supply stores and major hardware stores.
5) If there are two overhead line crossings in close proximity of each other, install two markers one above the other on each structure. Some structures in between may require single markers on both sides of each structure.
6) Fasten markers to poles with 3/4" banding as indicated in the Bill of Material above. Wooden poles may have the markers fastened with galvanized lag screws, 1/4" by 2-1/2" and washers. Additional holes or enlarged holes may be necessary in the marker.
7) On wooden poles, do not install hardware cloth over the face of the markers.

SGN-HAZ-XNG

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
LINE CROSSING HAZARD MARKING
STRUCTURAL ASSEMBLY DETAIL

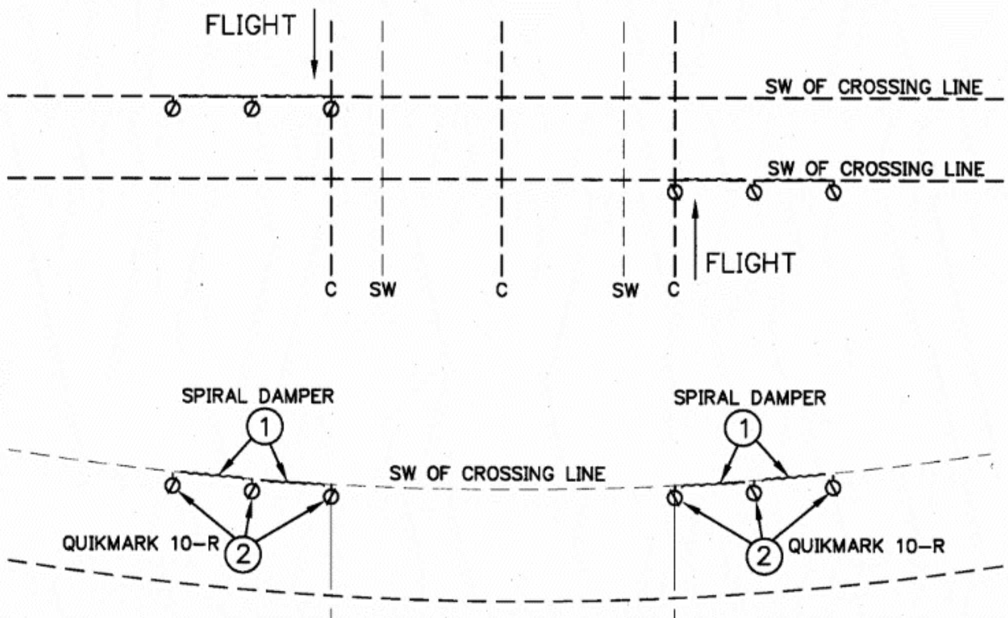
STD NO.	SCALE: NONE
Entergy	No. TMD407A0
PLOT 1=1	SH. 1 OF 1

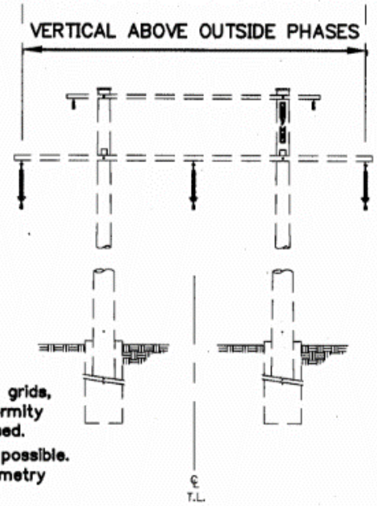
NO.	DATE:	REVISION	BY:	CHK:	APPR
0	12-10-08	CREATED	TWF	HSK	HSK

tflnc90 12/11/2008 SGN-HAZ-XNG

BILL OF MATERIAL

ITEM	QTY.	STOCK NO.	DESCRIPTION
1	4	0032045036	DAMPER, VIBRATION, SPIRAL, YELLOW, FOR 3/8" HSG & 7#7 AW CDR
2	6	0032054555	PROTECTOR, WILDLIFE, BIRD, 10" DIA, PLASTIC,ORANGE COLOR WITH REFLECTIVE PANELS ON BOTH SIDES, AND CONDUCTOR CLAMPS. QUIKMARK 10-R





NOTES:

1) This installation is optional with the grids, and represents a standard for uniformity across the system wherever it is used.
2) Install these exact quantities when possible. If variance is needed, maintain symmetry about the centerline.
3) Place the inside QUIKMARK 10-R's immediately above the outside conductors, but not closer than 15 feet apart.
4) Place the dampers between the QUIKMARK 10-R's and about 1 feet from them.
5) If there are 2 overhead shield wires crossing the Entergy line, place half the devices on each wire unless the owner specifies differently.

SGN-HAZ-OHG

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
OVERHEAD GROUND HAZARD MARKING
STRUCTURAL ASSEMBLY DETAIL

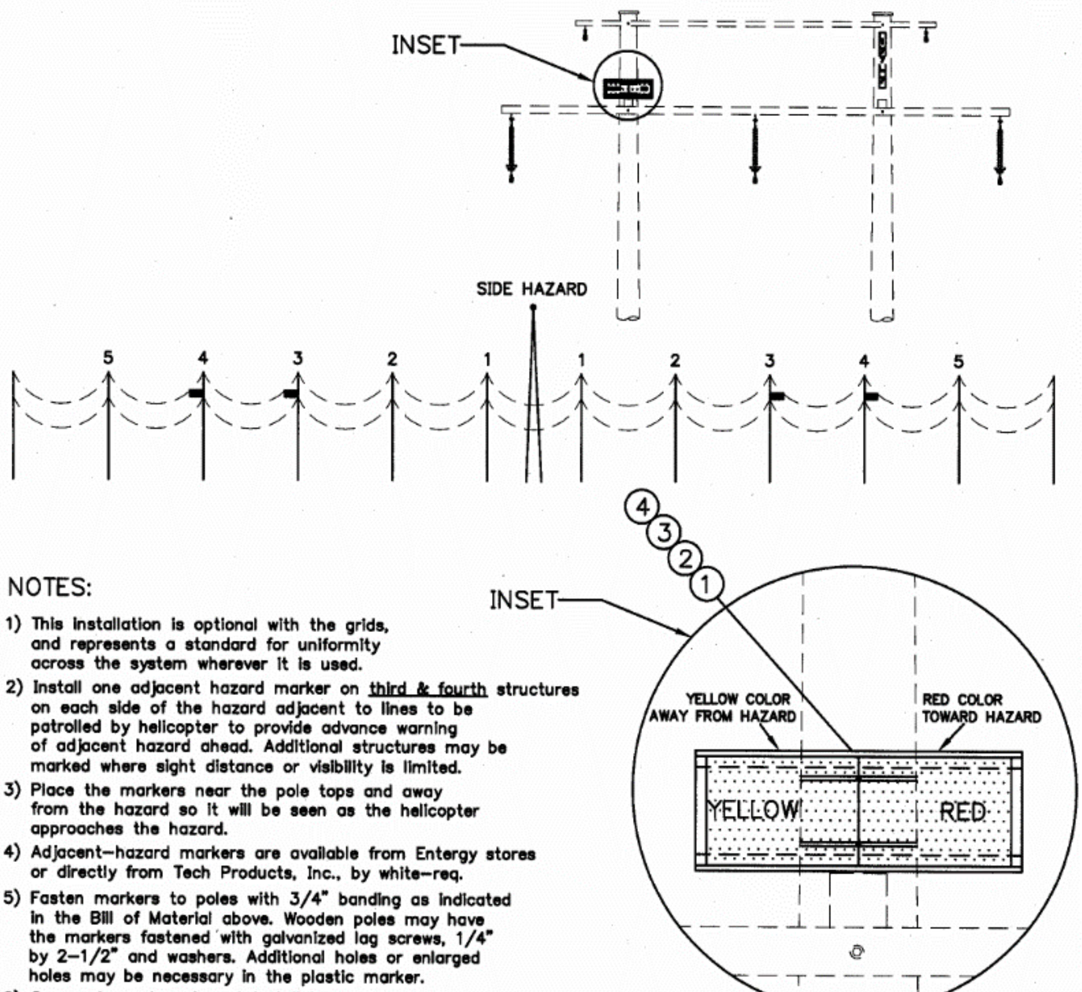
STD NO.	SCALE: NONE
Entergy	No. TMD406A0
PLOT 1=1	SH. 1 OF 1

NO.	DATE:	REVISION	BY:	CHK:	APPR
0	12-10-08	CREATED	TWF	HSK	HSK

tflnc90 12/11/2008 SGN-HAZ-OHG

BILL OF MATERIAL

ITEM	QTY.	STOCK NO.	DESCRIPTION
1	1	0032048218	NUMBER, BLANK, 10" X 14", POLYPROPYLENE, ALL YELLOW BACKGROUND, 0.23" TH
2	1	0032048221	NUMBER, BLANK, 10" X 14", POLYPROPYLENE, ALL RED BACKGROUND, 0.23" TH
3	1	0032048222	BRACKET, AERIAL NUMBER, ALUM, 30" LG, FOR 2 10"X14" EVERLAST PLAQUES
4	8 FT.	0000017124	BAND, STRAPPING, 3/4" WD X 100FT LG ROLL, STAINLESS STEEL, 201
5	2	0032047234	BRACKET, BANDING, FLARED LEG, SS, WITH ONE 5/16"–18 X 3/4" HEX HEAD SS BOLT AND FIBER WASHER, 3/4" SLOT, SHIPPED 50/BOX
6	2	0000017123	BOLT, CLAMP ASSEMBLY, CARRIAGE HD, GALVANIZED STEEL, HIGH STRENGTH, ASTM B221 MILITARY QQ–A–200/8, 5 GR, 3/8" DIA, 6" LG HIGH STR CARR BOLT, WASH AND NUT.



NOTES:

1) This installation is optional with the grids, and represents a standard for uniformity across the system wherever it is used.
2) Install one adjacent hazard marker on third & fourth structures on each side of the hazard adjacent to lines to be patrolled by helicopter to provide advance warning of adjacent hazard ahead. Additional structures may be marked where sight distance or visibility is limited.
3) Place the markers near the pole tops and away from the hazard so it will be seen as the helicopter approaches the hazard.
4) Adjacent–hazard markers are available from Entergy stores or directly from Tech Products, Inc., by white–req.
5) Fasten markers to poles with 3/4" banding as indicated in the Bill of Material above. Wooden poles may have the markers fastened with galvanized lag screws, 1/4" by 2–1/2" and washers. Additional holes or enlarged holes may be necessary in the plastic marker.
6) On wooden poles, do not install hardware cloth over the face of the markers.

SGN–HAZ–ADJ

0	12–10–08	CREATED	TWF	HSK	HSK	
NO.	DATE:	REVISION	BY:	CHK:	APPR	

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
ADJACENT HAZARD MARKING
STRUCTURAL ASSEMBLY DETAIL

STD NO. | SCALE: NONE

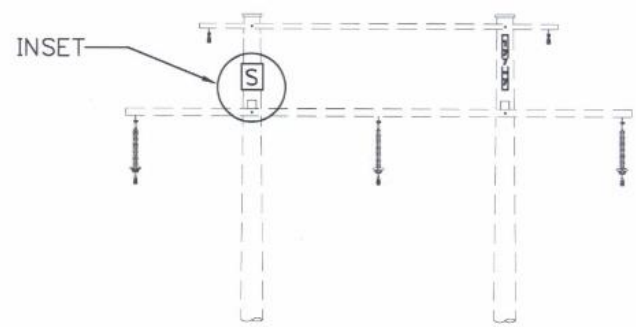
Entergy | No. TMD408A0

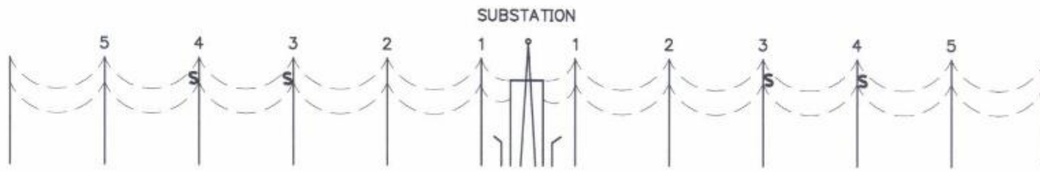
PLOT 1=1 | SH. 1 OF 1

tfinc90 12/11/2008 SGN–HAZ–ADJ

BILL OF MATERIAL

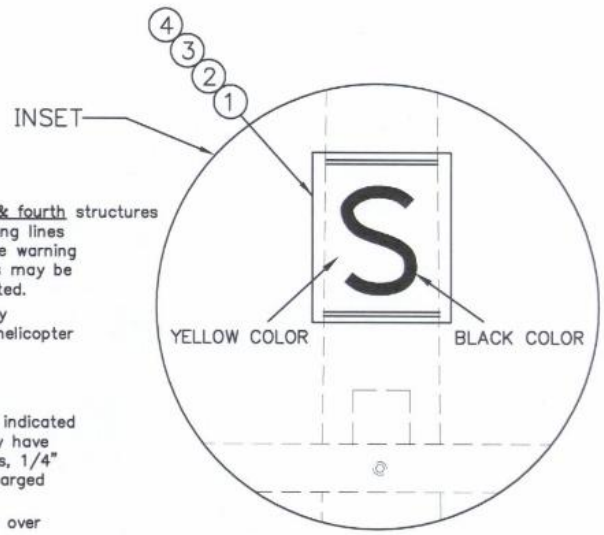
ITEM	QTY.	STOCK NO.	DESCRIPTION
1	1	0032054553	LETTER, "S", 10" X 14", BLACK ON YELLOW, TECH PRODUCTS PART NUMBER EL 12KYS
2	8 FT.	0000017124	BAND, STRAPPING, 3/4" WD X 100FT LG ROLL, STAINLESS STEEL, 201
3	2	0032047234	BRACKET, BANDING, FLARED LEG, SS, WITH ONE 5/16"-18 X 3/4" HEX HEAD SS BOLT AND FIBER WASHER, 3/4" SLOT, SHIPPED 50/BOX
4	2	0000017123	BOLT, CLAMP ASSEMBLY, CARRIAGE HD, GALVANIZED STEEL, HIGH STRENGTH, ASTM B221 MILITARY QQ-A-200/8, 5 GR, 3/8" DIA, 6" LG HIGH STR CARR BOLT, WASH AND NUT.





NOTES:

1) This installation is optional with the grids, and represents a standard for uniformity across the system wherever it is used.
2) Install one substation hazard marker on <u>third & fourth</u> structures on each side of the substation with hazard along lines to be patrolled by helicopter to provide advance warning of potential hazard ahead. Additional structures may be marked where sight distance or visibility is limited.
3) Place the markers near the pole tops and away from the substation so it will be seen as the helicopter approaches the substation
4) Substation hazard markers are available from Tech Products, Inc., EL12KYS.
5) Fasten markers to poles with 3/4" banding as indicated in the Bill of Material above. Wooden poles may have the markers fastened with galvanized lag screws, 1/4" by 2-1/2" and washers. Additional holes or enlarged holes may be necessary in the marker.
6) On wooden poles, do not install hardware cloth over the face of the markers.



SGN-HAZ-SUB

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
SUBSTATION HAZARD MARKINGS
STRUCTURAL ASSEMBLY DETAIL

STD NO.	SCALE: NONE
Entergy	No. TMD409A0
PLOT 1=1	SH. 1 OF 1

NO.	DATE:	REVISION	BY:	CHK:	APPR
0	12-10-08	CREATED	TWF	HSK	HSK

tfinc90 12/11/2008 SGN-HAZ-SUB

ATTACHMENT 2
NESC AND ENTERGY CLEARANCE REQUIREMENTS

Basic NESC Clearance Requirements

Rule 230A2, Emergency Vertical Clearances to Ground							
	69	115	138	161	230	345	500
Truck Accessible	16.2	17.1	17.6	18.0	19.4	21.7	24.9
Pedestrian Only	9.7	10.6	11.1	11.5	12.9	15.2	18.4

RULE 232B&C - Vertical Clearance over Ground, Roadway, Rail or Water Surfaces							
	69	**115**	**138**	**161**	**230**	**345**	**500**
Railroad	27.16	28.09	28.56	29.02	30.41	32.74	35.87
Roads	19.16	20.09	20.56	21.02	22.41	24.74	27.87
Other Area Traversed by Vehicles	19.16	20.09	20.56	21.02	22.41	24.74	27.87
Accessible to Pedestrian Traffic Only	15.16	16.09	16.56	17.02	18.41	20.74	23.87

RULE 233C - Vertical Clearance over Another Wire With or Without Wind							
	69	**115**	**138**	**161**	**230**	**345**	**500**
0	2.66	3.59	4.06	4.52	5.91	8.24	11.85
13.8	2.93	3.86	4.32	4.79	6.18	8.50	12.12
34.5	3.32	4.25	4.72	5.18	6.58	8.90	12.52
69	4.06	4.98	5.45	5.91	7.31	9.63	13.25
115	4.98	5.91	6.38	6.84	8.24	10.56	14.18
138	5.45	6.38	6.84	7.31	8.70	11.03	14.64
161	5.91	6.84	7.31	7.77	9.17	11.49	15.10
230	7.31	8.24	8.70	9.17	10.56	12.89	16.50
345	9.63	10.56	11.03	11.49	12.89	15.21	18.82
500	13.25	14.18	14.64	15.10	16.50	18.82	22.44

RULE 234B, C & G - Vertical Clearance over Various Structures							
	69	115	138	161	230	345	500
Lighting Supports	5.23	6.16	6.62	7.09	8.48	10.80	13.94
Traffic Signal Supports	5.23	6.16	6.62	7.09	8.48	10.80	13.94
Supporting Structures of Other Lines	5.23	6.16	6.62	7.09	8.48	10.80	13.94
Intermediate Poles in Skip-Span Construction	5.23	6.16	6.62	7.09	8.48	10.80	13.94
Building Roofs not Accessible to Pedestrians	13.16	14.09	14.56	15.02	16.41	18.74	21.87
Building Areas Accessible to Pedestrians	14.16	15.09	15.56	16.02	17.41	19.74	22.87

Building Areas Accessible to Vehicles (not Trucks)	14.16	15.09	15.56	16.02	17.41	19.74	22.87
Building Areas Accessible to Trucks	19.16	20.09	20.56	21.02	22.41	24.74	27.87
Signs, Chimneys, Billboards, Radio and TV antennas, Flagpoles and Flags, Banners, Tanks with Catwalks	14.16	15.09	15.56	16.02	17.41	19.74	22.87
Signs, Chimneys, Billboards, Radio and TV antennas, Flagpoles and Flags, Banners, Tanks without Catwalks	8.66	9.59	10.06	10.52	11.91	14.24	17.37

RULE 234B, C & G - Horizontal Clearance to Various Structures with No Wind							
	69	**115**	**138**	**161**	**230**	**345**	**500**
Lighting Supports	5.00	5.66	6.12	6.59	7.98	10.30	13.44
Traffic Signal Supports	5.00	5.66	6.12	6.59	7.98	10.30	13.44
Supporting Structures of Other Lines	5.00	5.66	6.12	6.59	7.98	10.30	13.44
Intermediate Poles in Skip Span Construction	5.00	5.66	6.12	6.59	7.98	10.30	13.44
Buildings	8.16	9.09	9.56	10.02	11.41	13.74	16.87
Signs, Chimneys, Billboards,	8.16	9.09	9.56	10.02	11.41	13.74	16.87
Radio and TV Antennas, Flagpoles & Flags	8.16	9.09	9.56	10.02	11.41	13.74	16.87
Banners, Tanks	8.16	9.09	9.56	10.02	11.41	13.74	16.87

RULE 234B, C & G - Horizontal Clearance to Various Structures with Wind							
	69	**115**	**138**	**161**	**230**	**345**	**500**

Lighting Supports	5.16	6.09	6.56	7.02	8.41	10.74	13.87
Traffic Signal Supports	5.16	6.09	6.56	7.02	8.41	10.74	13.87
Supporting Structures of Other Lines	5.16	6.09	6.56	7.02	8.41	10.74	13.87
Intermediate Poles in Skip Span Construction	5.16	6.09	6.56	7.02	8.41	10.74	13.87
Buildings	5.16	6.09	6.56	7.02	8.41	10.74	13.87
Signs, Chimneys, Billboards,	5.16	6.09	6.56	7.02	8.41	10.74	13.87
Radio and TV Antennas, Flagpoles & Flags	5.16	6.09	6.56	7.02	8.41	10.74	13.87
Banners, Tanks	5.16	6.09	6.56	7.02	8.41	10.74	13.87

RULE 235C2b1 - Vertical Clearance Between Wires Supported at Different Levels on the Same Structures

	69	**115**	**138**	**161**	**230**	**345**	**500**
0	2.03	2.58	3.02	3.47	4.79	7.01	9.99
13.8	2.03	2.85	3.29	3.73	5.06	7.27	10.25
34.5	2.36	3.24	3.69	4.13	5.46	7.67	10.65
69	3.02	3.91	4.35	4.79	6.12	8.33	11.32
115	3.91	4.79	5.24	5.68	7.01	9.22	12.20
138	4.35	5.24	5.68	6.12	7.45	9.66	12.64
161	4.79	5.68	6.12	6.56	7.89	10.10	13.09
230	6.12	7.01	7.45	7.89	9.22	11.43	14.42
345	8.33	9.22	9.66	10.10	11.43	13.65	16.63
500	11.32	12.20	12.64	13.09	14.42	16.63	19.61

RULE 235B - Horizontal Clearance Between Wires Supported on the Same Structure							
	69	**115**	**138**	**161**	**230**	**345**	**500**
0	2.08	2.96	3.41	3.85	5.18	7.39	10.37
13.8	2.34	3.23	3.67	4.11	5.44	7.66	10.64
34.5	2.74	3.63	4.07	4.51	5.84	8.05	11.04
69	3.41	4.29	4.73	5.18	6.50	8.72	11.70
115	4.29	5.18	5.62	6.06	7.39	9.60	12.59
138	4.73	5.62	6.06	6.50	7.83	10.05	13.03
161	5.18	6.06	6.50	6.95	8.27	10.49	13.47
230	6.50	7.39	7.83	8.27	9.60	11.82	14.80
345	8.72	9.60	10.05	10.49	11.82	14.03	17.01
500	11.70	12.59	13.03	13.47	14.80	17.01	20.00

RULE 233B1 - Horizontal Clearance to Other Wires (With or without Wind)							
	69	115	138	161	230	345	500
0	5.66	6.59	7.06	7.52	8.91	11.24	14.37
13.8	5.94	6.87	7.33	7.80	9.19	11.52	14.65
34.5	6.36	7.29	7.75	8.22	9.61	11.94	15.07
69	7.06	7.98	8.45	8.91	10.31	12.63	15.76
115	7.98	8.91	9.38	9.84	11.24	13.56	16.69
138	8.45	9.38	9.84	10.31	11.70	14.03	17.16
161	8.91	9.84	10.31	10.77	12.17	14.49	17.62
230	10.31	11.24	11.70	12.17	13.56	15.89	19.02
345	12.63	13.56	14.03	14.49	15.89	18.21	21.34

500	15.76	16.69	17.16	17.62	19.02	21.34	24.47

Vertical Clearance Requirements; NESC 2012 & Entergy Design Clearance

	69 kV(1)		115/138/161 kV(1)		230 kV(1)		345 kV(1)		500 kV(1) (3)	
	NESC(2) @ Max. Sag(ft.)	ETR @ Max. Sag(ft.)	NESC(2) @ Max. Sag(ft.)	ETR @ Max. Sag(ft.)	NESC(2) @ Max. Sag(ft.)	ETR @ Max. Sag(ft.)	NESC(2) @ Max. Sag(ft.)	ETR @ Max. Sag(ft.)	NESC(2) @ Max. Sag(ft.)	ETR @ Max. Sag(ft.)
Railroads	27.16	33.00	29.02	35.00	30.41	37.00	32.74	41.00	35.87	48.00
Roads	19.16	28.00	21.02	30.00	22.41	32.00	24.74	33.00	27.87	40.00
Other Land Traversed by any kind of Vehicle	19.16	24.00	21.02	26.00	22.41	28.00	24.74	33.00	27.87	40.00
Cultivated Farmland	19.16	27.00	21.02	29.00	22.41	31.00	24.74	33.00	27.87	40.00
Land accessible to pedestrians only	15.16	24.00	17.02	26.00	18.41	28.00	20.74	29.00	23.87	36.00
Water Areas Suitable for sailboats:										
Less than 20 acres	21.16	24.00	23.02	26.00	24.41	28.00	26.74	35.00	29.87	42.00
20-200 acres	29.16	32.00	31.02	34.00	32.41	36.00	34.74	43.00	37.87	50.00
200-2000 acres	35.16	37.00	37.02	40.00	38.41	42.00	40.74	49.00	43.87	56.00
Over 2000 acres	41.16	44.00	43.02	46.00	44.41	48.00	46.74	55.00	49.87	62.00
Sailboat launch sites adjacent to water: Add 5'										
Less than 20 acres	26.16	29.00	28.02	31.00	29.41	33.00	31.74	40.00	34.87	47.00
20-200 acres	34.16	37.00	36.02	39.00	37.41	41.00	39.74	48.00	42.87	53.00

200-2000 acres	40.16	43.00	42.02	45.00	43.41	47.00	45.74	54.00	48.87	61.00
Over 2000 acres	46.16	49.00	48.02	51.00	49.41	53.00	51.74	60.00	54.87	67.00
Other supply lines 34.5kV and under	2.66	8.00	4.52	10.00	5.91	15.00	8.24	17.00	11.85	23.00
Other supply lines:										
69 kV	4.06	10.00	5.91	11.00	7.31	16.00	9.63	18.00	13.25	20.00
115/138/161 kV	5.91	11.00	7.77	13.00	9.17	18.00	11.49	20.00	15.10	22.00
230 kV	7.31	16.00	9.17	18.00	10.56	20.00	12.89	22.00	16.50	24.00
345 kV	9.63	18.00	11.49	20.00	12.89	22.00	15.21	24.00	18.82	26.00
500 kV	13.25	20.00	15.10	22.00	16.50	24.00	18.82	26.00	22.44	28.00
Guys, Neutrals and shield wires	2.66	8.00	4.52	10.00	5.91	15.00	8.24	17.00	11.85	19.00
Communications lines	5.66	10.00	7.52	12.00	8.91	15.00	11.24	17.00	14.37	19.00

Notes:

(1) Conductor Temperature: 100°C for ACSR, see table 7.1(b) for other conductor types
(2) NESC Vertical Clearance = Basic Clearance + Voltage Adder; Voltage Adder = 0.4”/kV in excess of 22kV; refer to 2012 NESC Clearance Calculations.
(3) For 500 kV, the NESC clearance is approximately equal to the clearance requirements derived from a Switching Surge factor of 2.6.

ATTACHMENT 3
QUICK ESTIMATING CORONA LOSS CURVES

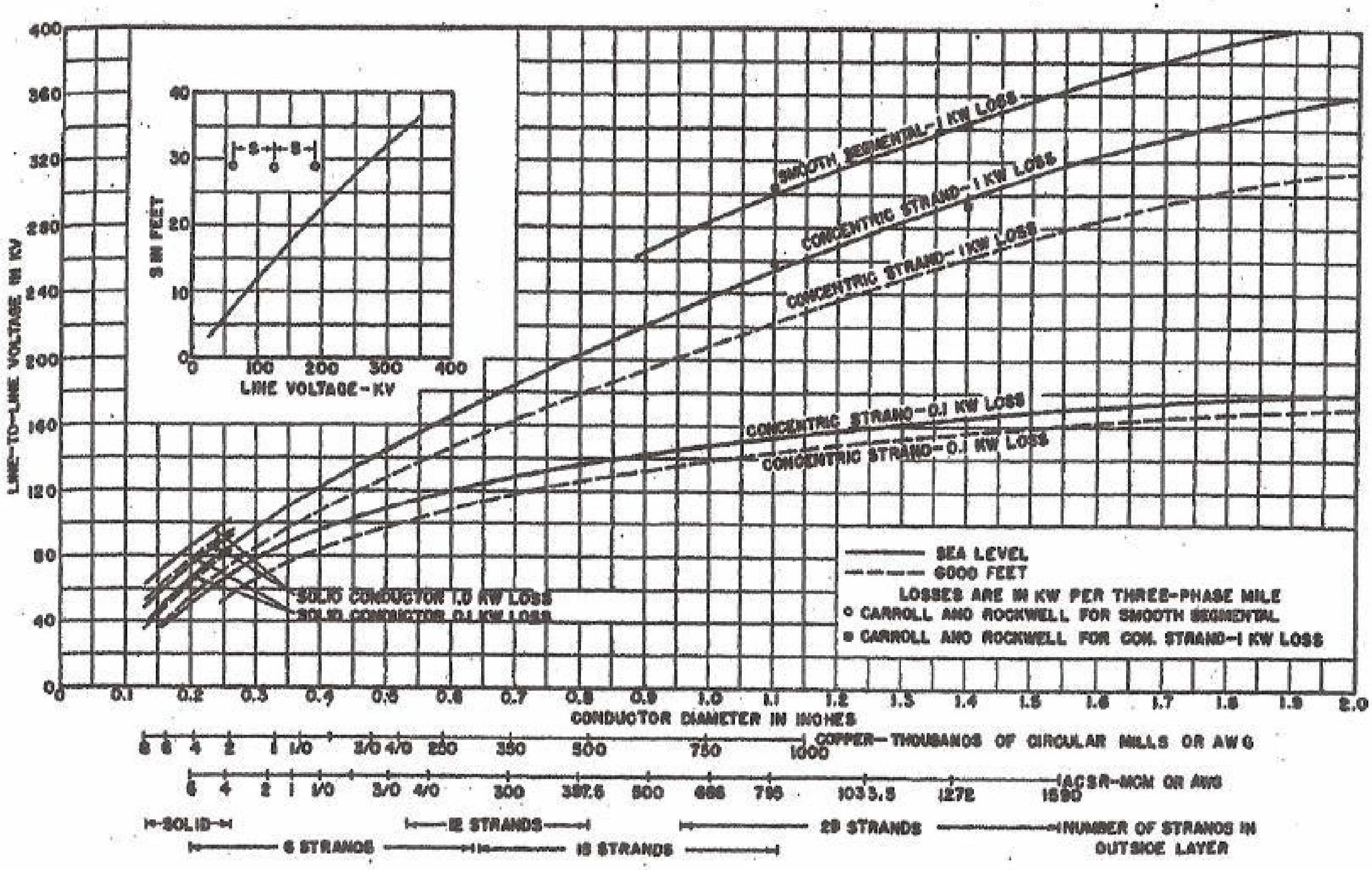
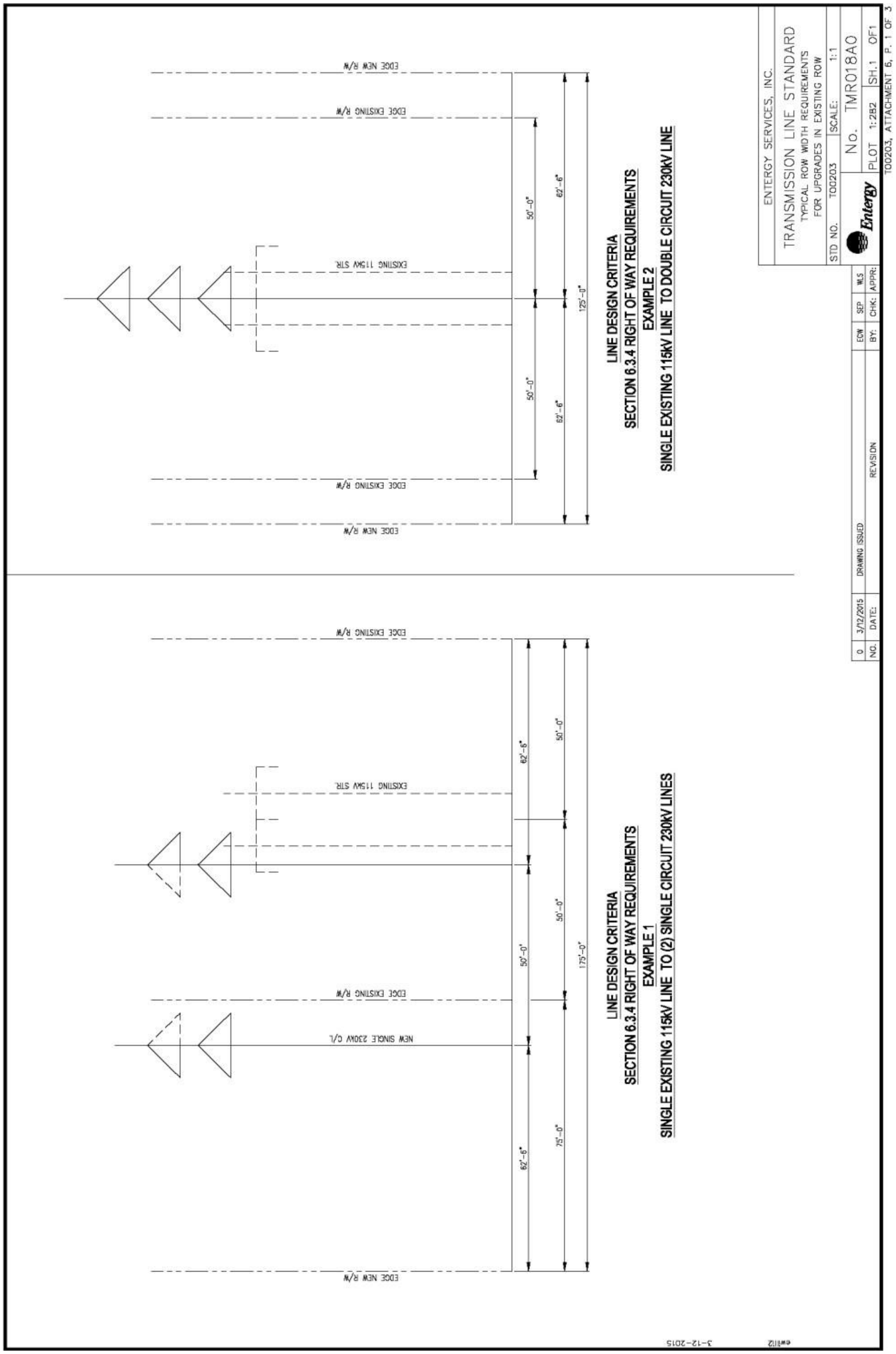
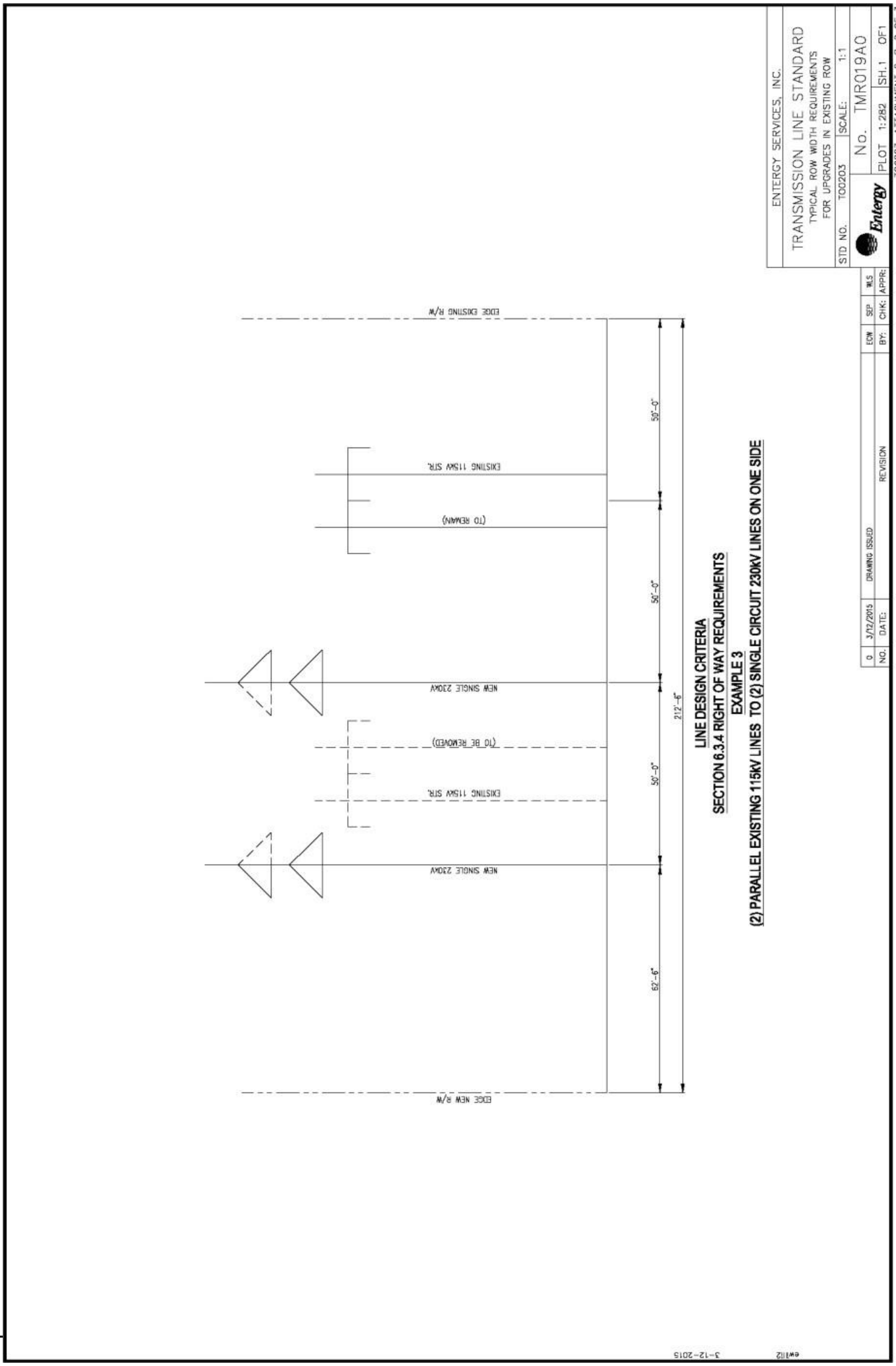


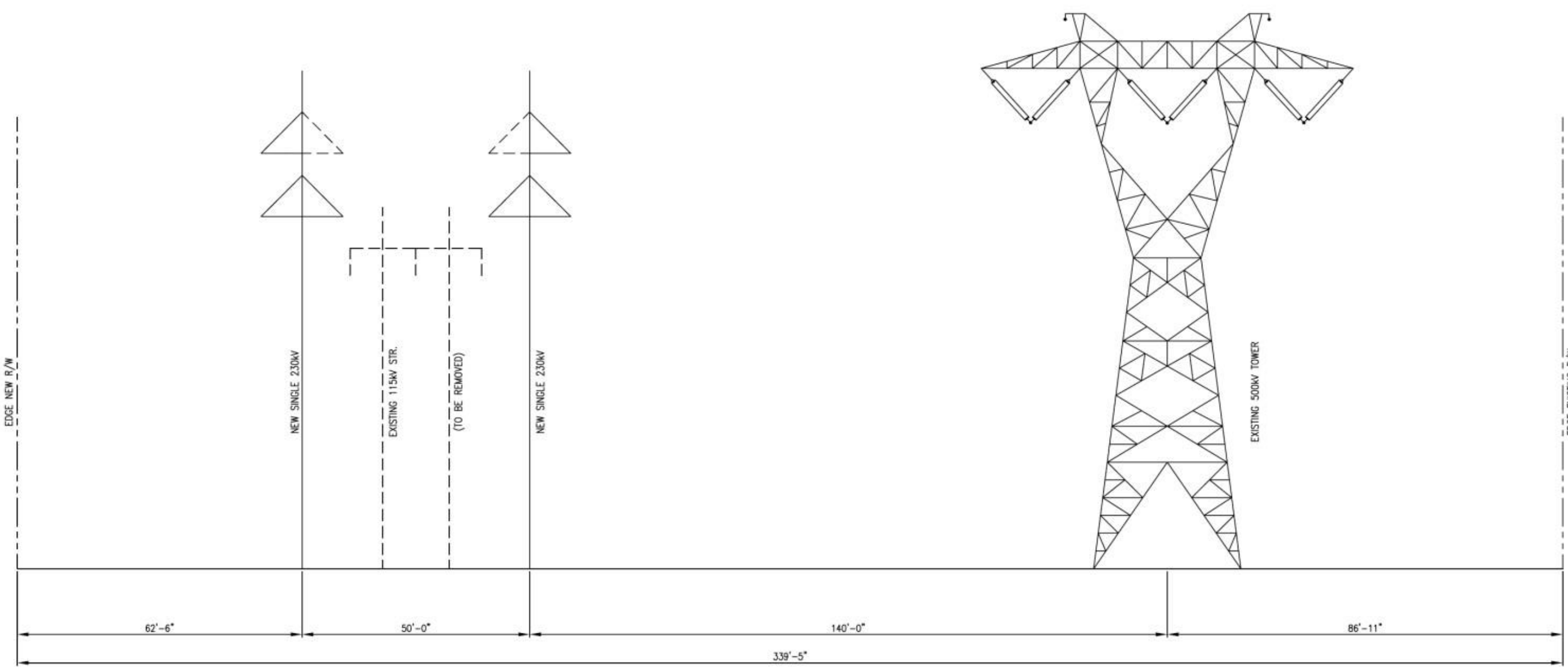
Fig. 31—Quick-Estimating Corona-Loss Curves. Curves based on Peterson's formula with a few check points from the Carrol and Rockwell paper for comparison.

ATTACHMENT 4
EXAMPLE ROW



LINE DESIGN CRITERIA
SECTION 6.3.4 RIGHT OF WAY REQUIREMENTS
EXAMPLE 2
SINGLE EXISTING 115KV LINE TO DOUBLE CIRCUIT 230KV LINE
EDGE NEW R/W
EDGE EXISTING R/W
EXISTING 115KV STR.
50'-0"
62'-6"
125'-0"
LINE DESIGN CRITERIA
SECTION 6.3.4 RIGHT OF WAY REQUIREMENTS
EXAMPLE 1
SINGLE EXISTING 115KV LINE TO (2) SINGLE CIRCUIT 230KV LINES
NEW SINGLE 230KV C/L
75'-0"
175'-0"
ENTERGY SERVICES, INC.
TRANSMISSION LINE STANDARD
TYPICAL ROW WIDTH REQUIREMENTS
FOR UPGRADES IN EXISTING ROW
STD NO. T00203
SCALE: 1:1
Entergy
No. TMR018A0
PLOT 1:282
SH.1 OF1
T00203, ATTACHMENT 6, P. 1 OF 3
0
3/12/2015
DRAWING ISSUED
ECW
SEP
WLS
NO.
DATE:
REVISION
BY:
CHK:
APPR:
3-12-2015


ENTERGY SERVICES, INC.
TRANSMISSION LINE STANDARD
TYPICAL ROW WIDTH REQUIREMENTS FOR UPGRADES IN EXISTING ROW
STD NO. TO0203
SCALE: 1:1
No. TMR019A0
PLOT 1:282
SH.1 OF1
TO0203, ATTACHMENT 6, P. 2 OF 3
LINE DESIGN CRITERIA
SECTION 6.3.4 RIGHT OF WAY REQUIREMENTS
EXAMPLE 3
(2) PARALLEL EXISTING 115KV LINES TO (2) SINGLE CIRCUIT 230KV LINES ON ONE SIDE
0 3/12/2015 DRAWING ISSUED
NO. DATE: REVISION
ECW SEP WLS
BY: CHK: APPR:
EDGE EXISTING R/W
EXISTING 115KV STR.
(TO REMAIN)
NEW SINGLE 230KV
(TO BE REMOVED)
EDGE NEW R/W
50'-0"
62'-6"
212'-6"
3-12-2015



LINE DESIGN CRITERIA
SECTION 6.3.4 RIGHT OF WAY REQUIREMENTS
EXAMPLE 4
SINGLE 115kV LINE PARALLEL TO EXISTING 500kV LINE TO (2) SINGLE CIRCUIT 230kV LINES ON ONE SIDE

NO.	DATE:	REVISION	BY:	CHK:	APPR:
1	11/15/2016	REVISED C-C DIMENSION, 500 KV TOWER TO ADJACENT STRUCTURE	ECW	DJR	WLS
0	3/12/2015	DRAWING ISSUED	ECW	SEP	WLS

ENTERGY SERVICES, INC.
Transmission Standard
Typical ROW Widths

STD NO.	T00203	SCALE:	1:1
Entergy	No. TMR020A0		
	PLOT 1:282	SH.11	OF1

10/27/2016
ewilli2

ATTACHMENT 5
APPROVED VENDOR LIST

Lead Time

Date last updated: August 22, 2023

Purchase Spec.	Class	Description	Qualifier	Approved Manufacturer(s) ( )-Preferred	Preferred Supplier
SA0102	Arresters	Arrester, Surge		(Cooper), Siemens, Hitachi Energy	Series 2000
PM0202	Battery	Batteries	CC	(Enersys)	Exponential Power
PM0201	Battery	Batteries	EC	(Enersys)	Exponential Power
PM0301	Battery	Battery Charger AT-10		(Hindle)	Exponential Power
PM0301	Battery	Battery Charger ATEVO		(Hindle)	Exponential Power
	Battery	Battery Fiberglass Enclosure with A/C		(Exponential)	Exponential Power
PM0303	Battery	Battery Rack		(Enersys)	Exponential Power
	Bolts	Bolts Anchor		Valmont, Threaded Fasteners	
	Bolts	Bolts Anchor cage for Substation Steel		Valmont, Threaded Fasteners (size limit)	
SD0203	Breaker	Breaker, EHV	345/500kV (Live Tank)	Hitachi Energy	
SD0203	Breaker	Breaker, EHV	345/500kV (Dead Tank)	(MEPPI), Hitachi Energy	MEPPI
SD0202	Breaker	Breaker, HV	69kv	(Siemens), MEPPI, Hitachi Energy	Siemens
SD0202	Breaker	Breaker, HV	115kV - 40kA	(Siemens), MEPPI, Hitachi Energy	Siemens
SD0202	Breaker	Breaker, HV	115kV - 63kA	(Siemens), MEPPI, Hitachi Energy	Siemens
SD0202	Breaker	Breaker, HV	161kV - 40kA	(Siemens), MEPPI, Hitachi Energy	Siemens
SD0202	Breaker	Breaker, HV	161kV - 63kA	(Siemens), MEPPI, Hitachi Energy	Siemens
SD0202	Breaker	Breaker, HV	245kV	(Siemens), MEPPI, Hitachi Energy	Siemens
SD0202	Breaker	Brekaer, HV	245KV, 80ka	(Siemens), MEPPI, Hitachi Energy	Siemens
SD0201	Breaker	Breaker, MV	15 kV- 27kV	(ABB INC.) MEPPI	ABB Inc. Approval drawings 5 wks from issue date of po
SD0201	Breaker	Breaker, MV	34.5 kV	(ABB INC.)	ABB Inc. Approval drawings 5 wks from issue date of po
SB0101	Bus	Bus, Aluminum Pipe		(Three D Metals) AFL	Three D Metals
PB0401	Cable, Control	Control Cable -Shielded and Non-Shielded		(Southwire), Priority	Southwire
SA0303	Capacitor Bank	Capacitor Banks, Series		Cooper, Hitachi Energy	Cooper Approval drawings 4 wks from issue date of po
SA0301	Capacitor Bank	Capacitor Banks, Shunt		Cooper, GE, Hitachi Energy	Cooper Approval drawings 4 wks from issue date of po
	Capacitor Bank	Capacitor Cans	Capacitor Cans	Cooper, GE, Hitachi Energy	
	Capswitcher	Capswitcher	34.5kV and below	(Southern States)	Preferred Sales Approval drawings 4-6 wks from issue date of po
	Capswitcher	Capswitcher	245kV - 362kV	(Southern States)	Preferred Sales Approval drawings 4-6 wks from issue date of po
	Capswitcher	Capswitcher	115kV and above	(Southern States)	Preferred Sales Approval drawings 4-6 wks from issue date of po
	Capswitcher	Capswitcher	69kV	(Southern States)	Preferred Sales Approval drawings 4-6 wks from issue date of po
	Carrier	Power line Carrier	UPLC	Pulsar	Ametek
PN0201	CCVT	CCVT	69kV - 500kV	(Ritz), GE, Trench, Hitachi Energy	Aertker Approval drawings 2 wks from issue date of po

Lead Time

Date last updated: August 22, 2023

Purchase Spec.	Class	Description	Qualifier	Approved Manufacturer(s) ( )-Preferred	Preferred Supplier
SD1801	Circuit Switcher	Circuit Switcher	Series 2000	(S&C)	Curtis Stout Approval drawings 3 wks from issue date of po
SD1802	Circuit Switcher	Circuit Switcher	Mark V	(S&C)	Curtis Stout Approval drawings 3 wks from issue date of po
	Conductor	Cable, Aluminum	ACSS, ACSR	(General Cable) - Southwire	Aertker co
	Conductor	Cable, Copper (Not Control cable)		Copperweld /Alcoa	Stuart Irby
	Conductor	Cable, Fiber	OPT-GW	AFL	Preferred Sales
	Conductor	Cable, Fiber	ADSS	AFL	Preferred Sales
	Conduit	Conduit & Accessories		Cantex, Carlon	Stuart Irby
	Connector	Connectors line	ACSS	AFL	Preferred Sales
	Connector	Connectors line (Fiber, OPGW, ACSR)	Fiber, OPGW, ACSR	AFL	Preferred Sales
	Connector	Connectors, Trans. Line - Insulator Assemblies		(Maclean Power Sys)	Preferred Sales
	Connectors/Fittings	Connectors/Fittings - Substation		Any Approved Manufacturer	Stuart Irby
SL0403	Control House	Control House	Drop-In (turnkey)	VFP	VFP
SL0403	Control House	Control House		(Modular Connections), AZZ Inc., Trachte, VFP	Modular Connections
PN0301	CT	CT	15kV - 34.5kV	ABB Inc, Ritz	
PN0301	CT	CT	69kv - 138kv	GE, Trench, Hitachi Energy, Ritz	
PN0301	CT	CT	161kV -230kV	GE, Trench, Hitachi Energy, Ritz	
PN0301	CT	CT	345kv - 500kV	GE, Trench, Hitachi Energy	
	CT	CT	Slipover only	ITEC, ABB Inc., Meramec	ITEC Approval drawings 2-3 wks from issue date of po
	DFR	DFR (Digital Fault Recorder)		MehtaTech	Louisiana, Mississippi, Arkansas only
	DFR	DFR (Digital Fault Recorder)		Qualitrol	Texas only
	Fittings	Conductor Fittings Compression		AFL, Sefcor, Anderson, Hubell	Stuart Irby
	Grounds Rods Clamps	Ground Rods, Clamps, & Anodes		Any Approved Manufacturer	Stuart Irby
	Helical Piles	Foundation Piling		Hubbell, Cyntech	
TA0504	Insulators	Insulator, Line, Polymer		(Maclean Power Sys)	Preferred Sales
TA0504	Insulators	Insulator, Line, Polymer	(Polymer Insulator Only)	(Maclean Power Sys)	Preferred Sales
TA0504	Insulators	Insulator, Line, Polymer	(Polymer Insulator Assembly)	(Maclean Power Sys)	Preferred Sales
TA0504	Insulators	Insulator, Line, Polymer	Hardware Assembly Only	(Maclean Power Sys)	Preferred Sales

Lead Time

Date last updated: August 22, 2023

Purchase Spec.	Class	Description	Qualifier	Approved Manufacturer(s) ( )-Preferred	Preferred Supplier
SA0502	Insulators	Insulator, Station Post, Porcelain	161kV (Porcelain)	(Hubbell), Victor, Lapp,NGK, Newell, Vanguard, Seves	Hubbell Power Systems
SA0502	Insulators	Insulator, Station Post, Porcelain	345/500kV (Porcelain) HI / EXTRA HIGH STRENGTH	Hubbell, Victor, Lapp,NGK, Newell, Vanguard, Seves	
SA0502	Insulators	Insulator, Station Post, Porcelain	230kV (Porcelain) STANDARD STRENGTH	(Hubbell), Victor, Lapp,NGK, Newell, Vanguard, Seves	Hubbell Power Systems
SA0502	Insulators	Insulator, Station Post, Porcelain	69kV, 115kV, (Porcelain)	(Hubbell), Victor, Lapp,NGK, Newell, Vanguard, Seves	Hubbell Power Systems
SA0502	Insulators	Insulator, Station Post, Porcelain	230kV (Porcelain) HI / EXTRA HIGH STRENGTH	Hubbell, Victor, Lapp,NGK, Newell, Vanguard, Seves	
	Insulators	Insulator, Station Post, Porcelain	34.5kV and below (Porcelain)	(Vanguard), Victor, Lapp,NGK, Newell, Seves , Hubbell	Preferred Sales
SA0502	Insulators	Insulator, Station Post, Polymer	15kV - 230kV	(Maclean Power Sys)	Preferred Sales
	Interrupter	Interrupter, Joslyn		Joslyn	Ruffin
	Interrupter	Switches LLS I		(Southern States)	Preferred Sales
	Interrupter	Switches LLS II		(Southern States)	Preferred Sales
	Interrupter	Whip		(Southern States)	Preferred Sales
	Interrupter	Interrupter		S&C	Curtis Stout
	Junction Box	Junction Boxes		MMR, Premier Control, SEL	All Junction Boxes – (2) weeks before Entergy's delivery date as stated on the PO
	Panel	Panel - Battery Switching		MMR, SEL, Premier Control	(4) weeks before Entergy's delivery date as stated on the PO.
	Panel	Panel - Communication rack		MMR, SEL, Premier Control	(3) weeks before Entergy's delivery date as stated on the PO.
PM0101	Panel	Panel - AC & DC Cabinets		MMR, SEL, Premier Control, Peterson Panel	(4) weeks before Entergy's delivery date as stated on the PO.
	Panel	Panel - Breaker Line		MMR, SEL, Premier Control	(4) weeks before Entergy's delivery date as stated on the PO.
PM0602	Panel	Panel - Bus Differential		MMR, SEL, Premier Control	Bus Diff/XFMR Diff/ Breaker Control/ACDC Breaker – (3) weeks before Entergy's delivery date as stated on the PO.
PM1803	Panel	Panel - Line Protection		MMR, SEL, Premier Control	(4) weeks before Entergy's delivery date as stated on the PO.
	Panel	Panel - Meter		MMR, SEL, Premier Control	(4) weeks before Entergy's delivery date as stated on the PO.

Lead Time

Date last updated: August 22, 2023

Purchase Spec.	Class	Description	Qualifier	Approved Manufacturer(s) ( )-Preferred	Preferred Supplier
	Poles	Pole Caissons	T-Line - after approval	(Valmont)	Preferred Sales
TC0609	Poles	Pole, Concrete		(Valmont)	Preferred Sales
TC0608	Poles	Pole, Steel	after approval	Valmont)	Preferred Sales
PN0701	PT	PT	15kV - 34.5kV	ABB Inc, GE, Ritz	
PN0701	PT	PT	69kv - 230kv	Hitachi Energy, GE, Trench,	
SN0903	Reactor	Reactor, Dry Type Shunt	Below 230kV	Hitachi Energy, Coil Innovations, Trench	
SN0902	Reactor	Reactor, Limiting		Hitachi Energy, Coil Innovations, Trench	
SN0904	Reactor	Reactor, Oil filled Shunt	230kV, 500kV	Hitachi Energy, Prolec GE, MEPPI, Siemens, SMIT	
SN1002	Regulators	Regulator		Pennsylvania Transformers	Curtis Stout
	Relay	SEL Relays	SEL Relay	SEL	Power Connection
	Relay	SEL cables	Cable & Fiber	SEL	Power Connection
	RTU	ACS RTU - Peripherals	NTX-U20 & Upgrades	ACS (Automated Control Systems)	Ruffin & Associates
	RTU	ACS Cables	NTX cables	ACS (Automated Control Systems)	Ruffin & Associates
	RTU	GE Parts	Accessories & Cables	G.E. Grid Solutions	Perferred Sales
PM3002	RTU	RTU	IO cabinet standard RTU	G.E. Grid Solutions	Perferred Sales
PM3002	RTU	RTU - Kits & Parts	D400, D20, DNPIO Kits & Parts	G.E. Grid Solutions	Perferred Sales
	Rupter	Rupters/S&C ALDUTI 15 kV Vac		(S&C)	Curtis Stout Approval drawings 5 wks from issue date of po
SL1301	Signs	Signs - Entergy Substation Switchyard		Impco	Impco
	Signs	Signs - General		Stuart Irby	Stuart Irby

Attachment 4: Example ROW

Lead Time

Date last updated: August 22, 2023

Purchase Spec.	Class	Description	Qualifier	Approved Manufacturer(s) ( )-Preferred	Preferred Supplier
SC0401, SL0505	Structure	Steel	Substation, Octagonal	(Distran), Valmont	Distran
SC0401, SL0505	Structure	Steel	Substation, Lattice	(Distran), Industrial Steel	Distran
	Structure	Steel	MISC Substation Steel	Distran, Industrial Steel	
	Structure	Steel Standard and Tapered Tubular	Substation, existing details	(Distran),Valmont	Distran
	Structure	Steel Standard and Tapered Tubular	(Design Required)	(Distran), Valmont Note: * Pending approval	Distran
PM3401	Switch	ASCO ATS (Automatic Transfer Switch)		Utility and Industrial Supply,LLC, WESCO	
	Switch	Switch, T-Line	Switch group operated 245kV and below	SEECO	Southern Utility Sales Agency
SD1501	Switch	Switch, Disconnect	115 & 230kV Air Break	(Southern States), USCO, Pascor Atlantic	Preferred Sales Approval drawings 4-6 wks from issue date of po
SD1501	Switch	Switch, Disconnect	69kV - 230kV	(Southern States), USCO, Pascor Atlantic	Preferred Sales Approval drawings 4-6 wks from issue date of po
SD1501	Switch	Switch, Disconnect	69kV Air Break	(Southern States), USCO, Pascor Atlantic	Preferred Sales Approval drawings 4-6 wks from issue date of po
SD0601	Switch	Switch, Disconnect	15kV - 34.5kV	(Southern States), USCO	Preferred Sales Approval drawings 4-6 wks from issue date of po
SD1502	Switch	Switch, Disconnect	345/500kV	(Southern States), Pascor Atlantic	Preferred Sales Approval drawings 4-6 wks from issue date of po
SD0701	Switch	Switch, Disconnect, Hookstick	15kV - 34.5kV	(Southern States), USCO	Preferred Sales Approval drawings 4-6 wks from issue date of po
	Switch	Switch, Fuse (SMD style)	15 kV	(S&C)	Curtis Stout Approval drawings 5 wks from issue date of po
SD1601	Switch/Motor Operators	Motor Operator	Southern States MO	(Southern States)	Preferred Sales
	Switch/Motor Operators	Motor Operator	S&C MO	(S&C)	Curtis Stout Approval drawings 5 wks from issue date of po
SN1101	Transformer	SSVT; Station Service Voltage Transformer	230kV	Trench, Hitachi Energy	
SN1101	Transformer	SSVT; Station Service Voltage Transformer	46kV -161kV	Trench, Hitachi Energy	Hitachi 46

Lead Time

Date last updated: August 22, 2023

Purchase Spec.	Class	Description	Qualifier	Approved Manufacturer(s) ( )-Preferred	Preferred Supplier
SN0103, SN0104	Transformer	Transformer, Auto	230kV and Above 100MVA	Hitachi Energy, MEPPI, Siemens, SMIT, Waukesha	
SN0102	Transformer	Transformer, Small Auto	below 230kv and 100MVA	(Waukesha), Hitachi Energy, Delta Star	Aertker Co. Approval drawings 16 wks from issue date of po
	Transrupter	Transrupter II		(S&C)	Curtis Stout Approval drawings 5 wks from issue date of po
PM0802	Trap	Trap, Line Carrier		Trench (No other supplier approved)	Curtis Stout Approval drawings 4-5 wks from issue date of po
	Trench			(Concast), Trenway, Old Castle	GHMR
PM0804	Tuner	Tuner, Line Carrier		Trench	Curtis Stout Approval drawings 4-5 wks from issue date of po

TWO-WINDING & AUTO-TRANSFORMERS RATED < 100MVA (3-phase) and HV ≤ 230kV

Production Facility & Location	Currently qualifying or already qualified	Maximum ratings approved by Entergy		Capabilities reported by facility	
		MVA (3ø)	KV	MVA (3ø)	KV
ABB / Crystal Springs, MS USA	qualified	50 (MS)	161 (MS)	~60 (MS)	161 (MS)
Delta Star / Lynchburg, VA	qualified	100	230	~200	230
Waukesha Electric (SPX), Goldsboro, NC & Waukesha, WI USA	qualified	80 (NC), 100 (WI)	230 (NC), 230 (WI)	~80 (NC), 800 (WI)	230 (NC), 345 (WI)

AUTO-TRANSFORMERS RATED ≥ 100MVA (3-phase) or HV > 230kV

Production Facility & Location	Currently qualifying or already qualified	Maximum ratings approved by Entergy		Capabilities reported by facility	
		MVA (3ø)	KV	MVA (3ø)	KV
ABB / Varennes, Quebec, Canada; Guarulhos, Brazil; Cordoba, Spain	qualified	1000 (Can), 500 (Br), 800 (Sp)	500 (Can), 500 (Br), 500 (Sp)	1200 (Can), 600 (Br), 800 (Sp)	765 (Can), 765 (Br), 500 (Sp)
Mitsubishi / Ako, Japan	qualified	~1000	500	~1500	1000+
Siemens / Linz & Weiz, Austria; Nuremburg, Germany; Jundiai, Brazil; Bogota, Colombia	qualified	1000 (Aus, Ger), 800 (Br), 200 (Col)	500 (Aus, Ger, Br), 230 (Col)	2000 (Aus), 1100 (Ger), 1000 (Br), 250 (Col)	765 (Aus), 1000+ (Ger), 765 (Br), 345 (Col)
SMIT / Nijmegen, Netherlands	qualified	~800	500	~1200	765
Waukesha Electric (SPX), Waukesha, WI USA	qualified	~600	345	~800	345

ATTACHMENT 6
ENTERGY LOADING DISTRICTS

State	County	Extreme Wind mph	NESC District			Extreme Ice inches	Entergy Load Case
			Light	Medium	Heavy		
AR	Arkansas	100		M		1	LC-2
AR	Ashley	100		M		1	LC-2
AR	Baxter	100			H	1	LC-1
AR	Benton	100			H	1	LC-1
AR	Boone	100			H	1	LC-1
AR	Bradley	100		M		1	LC-2
AR	Calhoun	100		M		1	LC-2
AR	Carroll	100			H	1	LC-1
AR	Chicot	100		M		1	LC-2
AR	Clark	100			H	1	LC-1
AR	Clay	100			H	1	LC-1
AR	Cleburne	100			H	1	LC-1
AR	Cleveland	100		M		1	LC-2
AR	Columbia	100		M		1	LC-2
AR	Conway	100			H	1	LC-1
AR	Craighead	100		M		1	LC-2
AR	Crawford	100			H	1	LC-1
AR	Crittenden	100		M		1	LC-2
AR	Cross	100		M		1	LC-2
AR	Dallas	100		M		1	LC-2
AR	Desha	100		M		1	LC-2
AR	Drew	100		M		1	LC-2
AR	Faulkner	100			H	1	LC-1
AR	Franklin	100			H	1	LC-1
AR	Fulton	100			H	1	LC-1
AR	Garland	100			H	1	LC-1
AR	Grant	100		M		1	LC-2
AR	Greene	100			H	1	LC-1
AR	Hempstead	100			H	1	LC-1
AR	Hot Spring	100			H	1	LC-1
AR	Howard	100			H	1	LC-1
AR	Independence	100			H	1	LC-1
AR	Izard	100			H	1	LC-1
AR	Jackson	100			H	1	LC-1
AR	Jefferson	100		M		1	LC-2

State	County	Extreme Wind mph	NESC District			Extreme Ice inches	Entergy Load Case
			Light	Medium	Heavy		
AR	Johnson	100			H	1	LC-1
AR	Lafayette	100		M		1	LC-2
AR	Lawrence	100			H	1	LC-1
AR	Lee	100		M		1	LC-2
AR	Lincoln	100		M		1	LC-2
AR	Little River	100			H	1	LC-1
AR	Logan	100			H	1	LC-1
AR	Lonoke	100		M		1	LC-2
AR	Madison	100			H	1	LC-1
AR	Marion	100			H	1	LC-1
AR	Miller	100		M		1	LC-2
AR	Mississippi	100		M		1	LC-2
AR	Monroe	100		M		1	LC-2
AR	Montgomery	100			H	1	LC-1
AR	Nevada	100		M		1	LC-2
AR	Newton	100			H	1	LC-1
AR	Ouachita	100		M		1	LC-2
AR	Perry	100			H	1	LC-1
AR	Phillips	100		M		1	LC-2
AR	Pike	100			H	1	LC-1
AR	Poinsett	100		M		1	LC-2
AR	Polk	100			H	1	LC-1
AR	Pope	100			H	1	LC-1
AR	Prairie	100		M		1	LC-2
AR	Pulaski	100			H	1	LC-1
AR	Randolph	100			H	1	LC-1
AR	St. Francis	100		M		1	LC-2
AR	Saline	100			H	1	LC-1
AR	Scott	100			H	1	LC-1
AR	Searcy	100			H	1	LC-1
AR	Sebastian	100			H	1	LC-1
AR	Sevier	100			H	1	LC-1
AR	Sharp	100			H	1	LC-1
AR	Stone	100			H	1	LC-1
AR	Union	100		M		1	LC-2
AR	Van Buren	100			H	1	LC-1
AR	Washington	100			H	1	LC-1
AR	White	100			H	1	LC-1
AR	Woodruff	100		M		1	LC-2
AR	Yell	100			H	1	LC-1
MO	Dunklin	100			H	1	LC-1
MO	New Madrid	100			H	1	LC-1
MO	Oregon	100			H	1	LC-1
MO	Pemiscot	100			H	1	LC-1
MO	Stoddard	100			H	1	LC-1
MO	Taney	100			H	1	LC-1

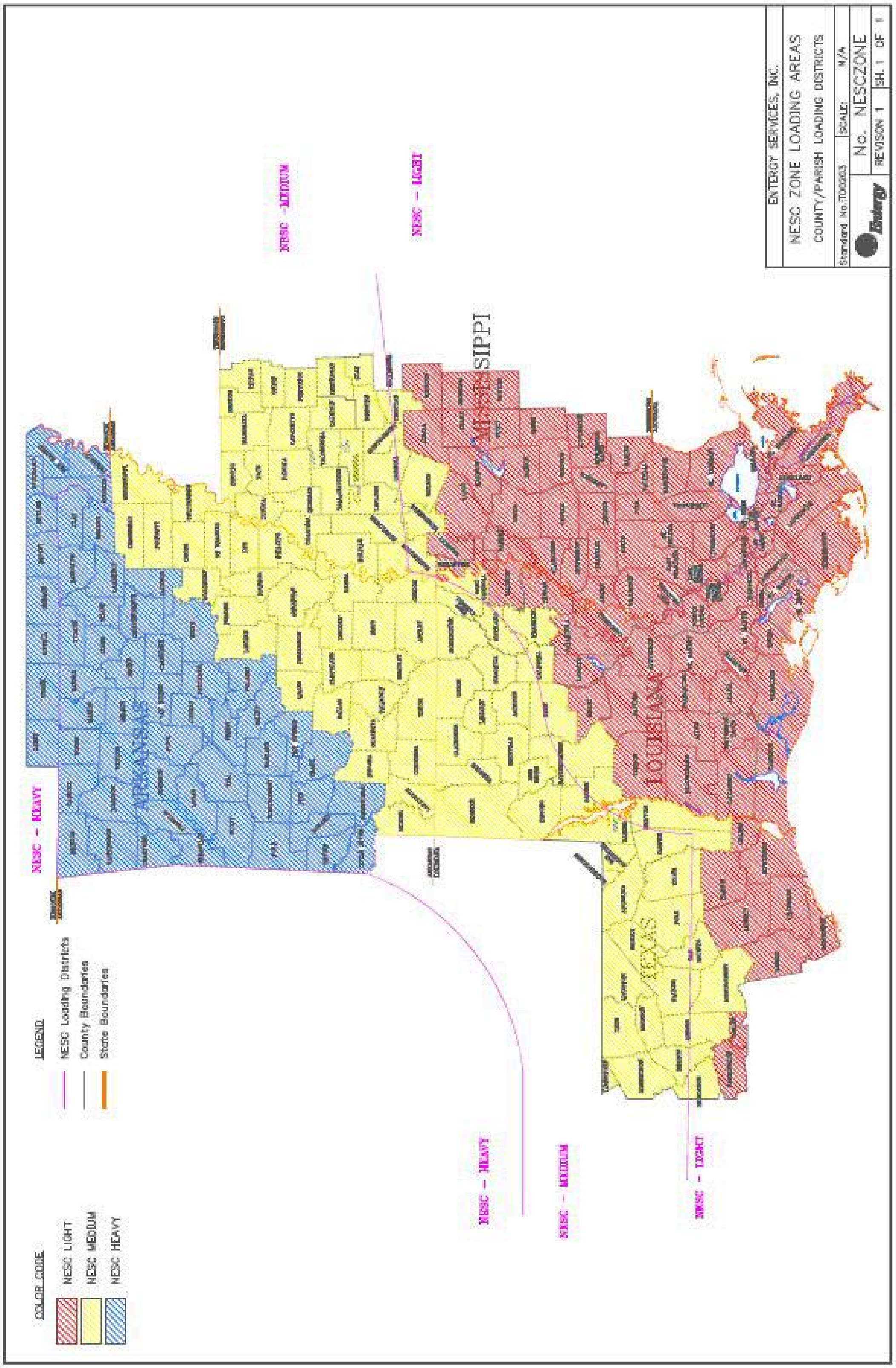
State	Parish	Extreme Wind mph	NESC District			Extreme Ice inches	Entergy Load Case
			Light	Medium	Heavy		
LA	Acadia	150	L			0.5	LC-3D
LA	Allen	125	L			0.5	LC-3B
LA	Ascension	150	L			0.5	LC-3D
LA	Assumption	150	L			0.5	LC-3D
LA	Avoyelles	110	L			0.5	LC-3F
LA	Beauregard	125	L			0.5	LC-3B
LA	Bienville	100		M		0.75	LC-2D
LA	Bossier	100		M		0.75	LC-2D
LA	Calcasieu	150	L			0.5	LC-3D
LA	Caldwell	100		M		0.75	LC-2D
LA	Cameron	150	L			0.5	LC-3D
LA	Catahoula	100	L			0.5	LC-3E
LA	Claiborne	100		M		0.75	LC-2D
LA	Concordia	100	L			0.5	LC-3E
LA	Desoto	100		M		0.75	LC-2D
LA	East Baton Rouge	150	L			0.5	LC-3D
LA	East Carrol	100		M		0.75	LC-2D
LA	East Feliciana	125	L			0.5	LC-3B
LA	Evangeline	125	L			0.5	LC-3B
LA	Franklin	100		M		0.75	LC-2D
LA	Grant	100	L			0.75	LC-2C
LA	Iberia	150	L			0.5	LC-3D
LA	Iberville	150	L			0.5	LC-3D
LA	Jackson	100		M		0.75	LC-2D
LA	Jefferson	150	L			0.5	LC-3D
LA	Jefferson Davis	150	L			0.5	LC-3D
LA	Lafayette	150	L			0.5	LC-3D
LA	Lafourche	150	L			0.5	LC-3D
LA	Lasalle	100	L			0.75	LC-3C
LA	Lincoln	100		M		0.75	LC-2D
LA	Livingston	150	L			0.5	LC-3D
LA	Madison	100	L			0.75	LC-3C
LA	Morehouse	100		M		0.75	LC-2D
LA	Natchitoches	100		M		0.75	LC-2D
LA	Orleans	150	L			0.5	LC-3D
LA	Ouachita	100		M		0.75	LC-2D
LA	Plaquemines	150	L			0.5	LC-3D
LA	Point Coupee	125	L			0.5	LC-3B
LA	Rapides	100	L			0.5	LC-3E
LA	Red River	100		M		0.75	LC-2D
LA	Richland	100		M		0.75	LC-2D
LA	Sabine	100		M		0.75	LC-2D
LA	St. Bernard	150	L			0.5	LC-3D
LA	St. Charles	150	L			0.5	LC-3D

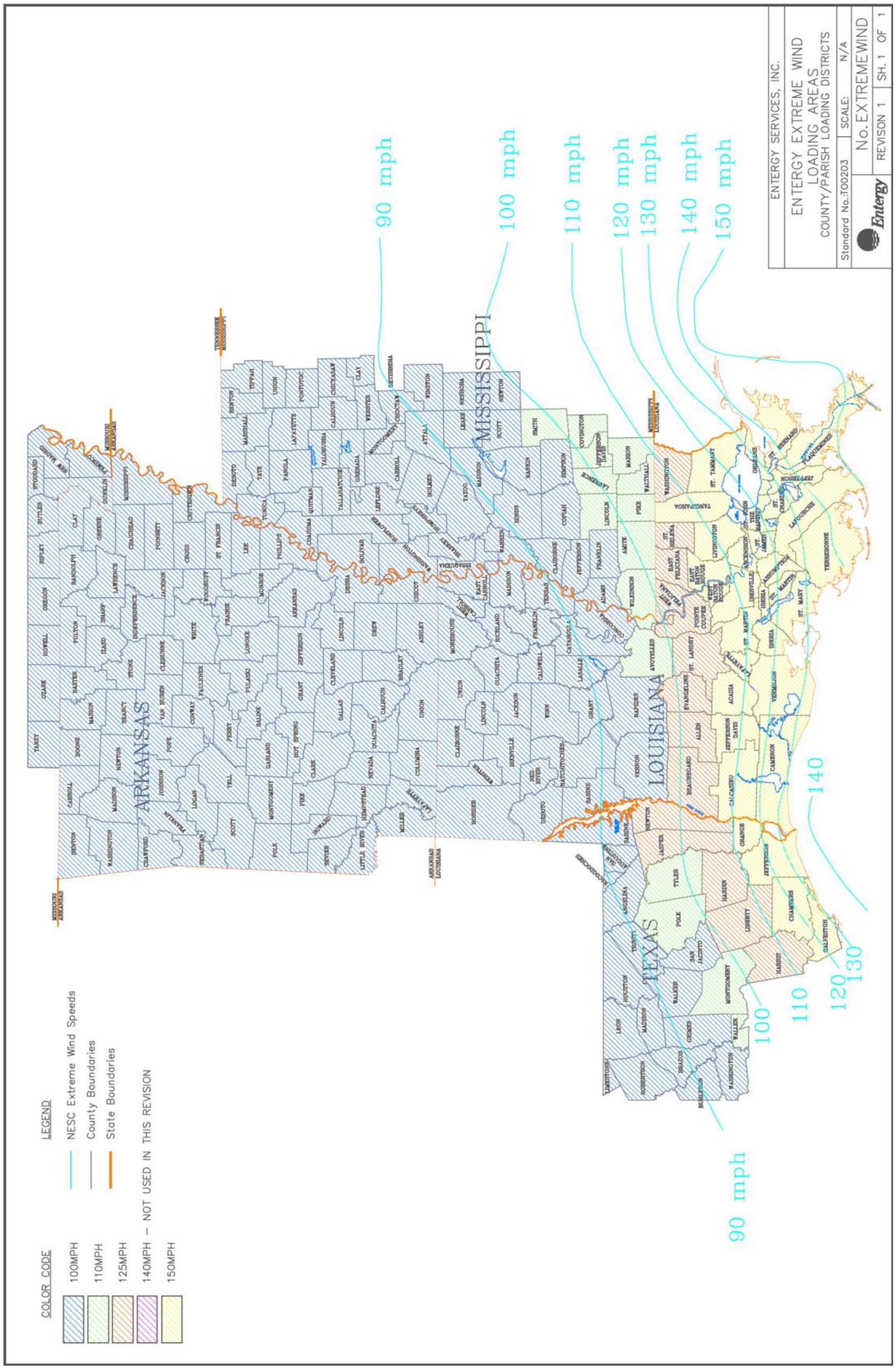
State	Parish	Extreme Wind mph	NESC District			Extreme Ice inches	Entergy Load Case
			Light	Medium	Heavy		
LA	St. Helena	125	L			0.5	LC-3B
LA	St. James	150	L			0. 5	LC-3D
LA	St. John the Baptist	150	L			0.5	LC-3D
LA	St. Landry	125	L			0.5	LC-3B
LA	St. Martin, North	150	L			0.5	LC-3D
LA	St. Martin, South	150	L			0.5	LC-3D
LA	St. Mary	150	L			0.5	LC-3D
LA	St. Tammany	150	L			0.5	LC-3D
LA	Tangipahoa	150	L			0.5	LC-3D
LA	Tensas	100	L			0.5	LC-3E
LA	Terrebonne	150	L			0.5	LC-3D
LA	Union	100		M		0.75	LC-2D
LA	Vermillion	150	L			0.5	LC-3D
LA	Vernon	100	L			0.5	LC-3E
LA	Washington	125	L			0.5	LC-3B
LA	Webster	100		M		0.75	LC-2D
LA	West Baton Rouge	150	L			0.5	LC-3D
LA	West Carrol	100		M		0.75	LC-2D
LA	West Feliciana	125	L			0.5	LC-3B
LA	Winn	100		M		0.75	LC-2D

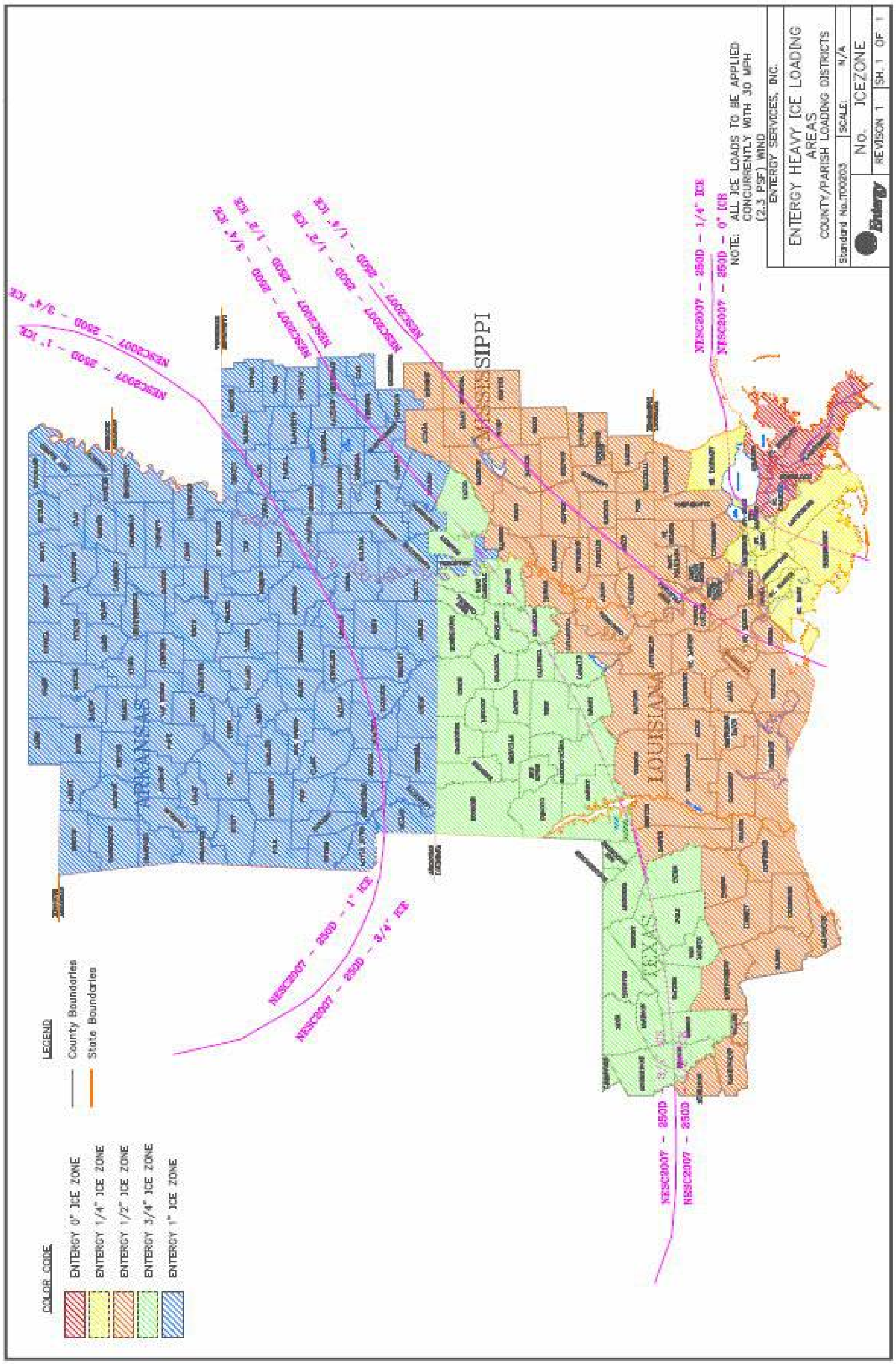
State	County	Extreme Wind mph	NESC District			Extreme Ice inches	Entergy Load Case
			Light	Medium	Heavy		
MS	Adams	100	L			0.5	LC-3E
MS	Amite	110	L			0.5	LC-3F
MS	Attala	100	L			0.5	LC-3E
MS	Benton	100		M		1	LC-2
MS	Bolivar	100		M		1	LC-2
MS	Calhoun	100		M		1	LC-2
MS	Carrol	100		M		1	LC-2
MS	Chickasaw	100		M		1	LC-2
MS	Choctaw	100		M		1	LC-2
MS	Claiborne	100	L			0.5	LC-3E
MS	Clay	100		M		1	LC-2
MS	Coahoma	100		M		1	LC-2
MS	Copiah	100	L			0.5	LC-3E
MS	Covington	110	L			0.5	LC-3F
MS	Desoto	100		M		1	LC-2
MS	Franklin	100	L			0.5	LC-3E
MS	Grenada	100		M		1	LC-2
MS	Hinds	100	L			0.5	LC-3E
MS	Holmes	100		M		1	LC-2
MS	Humphreys	100		M		1	LC-2
MS	Issaquena	100	L			1	LC-3G
MS	Jefferson	100	L			0.5	LC-3E
MS	Jefferson Davis	110	L			0.5	LC-3F
MS	Lafayette	100		M		1	LC-2
MS	Lawrence	110	L			0.5	LC-3F
MS	Leake	100	L			0.5	LC-3E
MS	Leflore	100		M		1	LC-2
MS	Lincoln	110	L			0.5	LC-3F
MS	Madison	100	L			0.5	LC-3E
MS	Marion	110	L			0.5	LC-3F
MS	Marshall	100		M		1	LC-2
MS	Montgomery	100		M		1	LC-2
MS	Neshoba	100	L			0.5	LC-3E
MS	Newton	100	L			0.5	LC-3E
MS	Panola	100		M		1	LC-2
MS	Pike	110	L			0.5	LC-3F
MS	Ponotoc	100		M		1	LC-2
MS	Quitman	100		M		1	LC-2
MS	Rankin	100	L			0.5	LC-3E
MS	Scott	100	L			0.5	LC-3E
MS	Sharkey	100	L			0.75	LC-3C
MS	Simpson	100	L			0.5	LC-3E
MS	Smith	110	L			0.5	LC-3F

State	County	Extreme Wind mph	NESC District			Extreme Ice inches	Entergy Load Case
			Light	Medium	Heavy		
MS	Sunflower	100		M		1	LC-2
MS	Tallahatchie	100		M		1	LC-2
MS	Tate	100		M		1	LC-2
MS	Tippah	100		M		1	LC-2
MS	Tunica	100		M		1	LC-2
MS	Union	100		M		1	LC-2
MS	Walthall	110	L			0.5	LC-3F
MS	Warren	100	L			0.5	LC-3E
MS	Washington	100		M		1	LC-2
MS	Webster	100		M		1	LC-2
MS	Wilkinson	110	L			0.5	LC-3F
MS	Winston	100	L			0.5	LC-3E
MS	Yalobusha	100		M		1	LC-2
MS	Yazoo	100	L			0.75	LC-3C

State	**County**	**Extreme Wind mph**	**NESC District**			**Extreme Ice inches**	**Entergy Load Case**
			Light	**Medium**	**Heavy**		
TX	Angelina	100		M		0.75	LC-2D
TX	Brazos	100		M		0.75	LC-2D
TX	Burleson	100		M		0.5	LC-2B
TX	Chambers	150	L			0.5	LC-3D
TX	Galveston	150	L			0.5	LC-3D
TX	Grimes	100		M		0.75	LC-2D
TX	Hardin	125	L			0.5	LC-3B
TX	Harris	125	L			0.5	LC-3B
TX	Houston	100		M		0.75	LC-2D
TX	Jasper	125		M		0.5	LC-2C
TX	Jefferson	150	L			0.5	LC-3D
TX	Leon	100		M		0.75	LC-2D
TX	Liberty	125	L			0.5	LC-3B
TX	Limestone	100		M		0.75	LC-2D
TX	Madison	100		M		0.75	LC-2D
TX	Montgomery	110		M		0.5	LC-2A
TX	Nacoqdoches	100		M		0.75	LC-2D
TX	Newton	125		M		0.5	LC-2C
TX	Orange	150	L			0.5	LC-3D
TX	Polk	110		M		0.75	LC-2E
TX	Robertson	100		M		0.75	LC-2D
TX	Sabine	100		M		0.75	LC-2D
TX	San Augustine	100		M		0.75	LC-2D
TX	San Jacinto	100		M		0.75	LC-2D
TX	Trinity	100		M		0.75	LC-2D
TX	Tyler	110		M		0.75	LC-2E
TX	Walker	100		M		0.75	LC-2D
TX	Waller	110	L			0.5	LC-3F
TX	Washington	100	L			0.5	LC-3E


ENTERGY SERVICES, INC.
NESC ZONE LOADING AREAS
COUNTY/PARISH LOADING DISTRICTS
SCALE: N/A
No. NESCZONE
REVISON 1
SH. 1 OF 1
NESC - MEDIUM
NESC - LIGHT
NESC - HEAVY
NESC - HEAVY
NESC - MEDIUM
NESC - LIGHT
ARKANSAS
MISSISSIPPI
LOUISIANA
TEXAS
LEGEND
NESC Loading Districts
County Boundaries
State Boundaries
COLOR CODE
NESC LIGHT
NESC MEDIUM
NESC HEAVY


ENTERGY SERVICES, INC.
ENTERGY EXTREME WIND LOADING AREAS
COUNTY/PARISH LOADING DISTRICTS
Standard No.:T00203
SCALE: N/A
No. EXTREMEWIND
REVISON 1
SH. 1 OF 1
Entergy
COLOR CODE
100MPH
110MPH
125MPH
140MPH - NOT USED IN THIS REVISION
150MPH
LEGEND
NESC Extreme Wind Speeds
County Boundaries
State Boundaries
90 mph
100 mph
110 mph
120 mph
130 mph
140 mph
150 mph
ARKANSAS
MISSISSIPPI
LOUISIANA
TEXAS
100
110
120
130
140
90 mph



***** END OF APPENDIX 2*****

Appendices 3-14 to
Wind BOT Scope Book

Revision 1

DATE: 06/26/2024

REVISION RECORD

Revision No.	Approval Date	Section / Page Revised	Reason / Description of Change
0		All	Initial Issue
1		Appendix 11	Updated PEP Overview Guidance

WIND BOT SCOPE BOOK APPENDICES

TABLE OF CONTENTS

*APPENDICES 1 AND 2 ARE MAINTAINED IN A SEPARATE DOCUMENT

APPENDIX 3: PROPOSED PROJECT INFORMATION

Bidder shall fill out this table for the proposed wind project and attach equipment datasheets.

Item	Site Information	Responses	Units
1	Site coordinates		
2	Project Size		Mwac
3	Project Land Area		ac
4	Distance to POI		miles
5	Average Wind Turbine Base Elevation		ft a.s.l
6	Ambient Temperature Recorded (Minimum/Average/Maximum)		°F
7	Site average hub height air density		kg/m^3
8	Average Hub Height wind speed		m/s
9	Average turbulence intensity at hub height at 15 m/s		%
10	Average turbulence intensity at hub height (all wind speeds)		%
11	Average hub height Weibull A parameter		m/s
12	Average hub height Weibull K parameter		
13	Rainfall (Annual Avg/Annual Max/1-day Max)		in.
14	Lightning Density		$\#/m^2s$
15	Isokeraunic Levels		
16	Snow Loading (occupancy category, ground snow load, terrain category, exposure factor, snow importance factor, and ice loading)		
17	Wind Loading (maximum recorded wind speed, basic wind speed, occupancy category and exposure category)		mph
18	Seismic Zone (Zone and ground acceleration values shall be confirmed by the geotechnical study).		

Item	Wind Turbine Generators (WTG)	Responses	Units
1	Attach datasheets, including power curves and sound		
2	Manufacturer		
3	Model Number		
4	Wind Turbine IEC Classification		
5	Wind Turbine Design Certification		
6	Wind Turbine Nameplate for MW		
7	Wind Turbine Nameplate for Power Factor		
8	Wind Turbine Nameplate for MVA		
9	Cut-in Wind Speed		m/s
10	Rated Wind Speed		m/s
11	Cut-Out Wind Speed		m/s
12	Survival Wind Speed		m/s
13	Standard Operating Temperature Range		
14	Cold Weather Package Temperature Range		
15	Hot Weather Package Temperature Range		
16	Hub Height		m
17	Rotor Diameter		m
18	Rotor Swept Area		m^2
19	Gearbox or Direct Drive		
20	Gearbox Manufacturer		
22	Gearbox Model		
22	Generator Manufacturer		
23	Generator Model		
24	Blade Manufacturer		
25	Blade Model		
26	Plant Control Platform / System		
27	SCADA for Wind Turbine or complete Project including MET tower		
28	WTG transformer location (up tower, down tower, pad mount)		
29	Can the Gearbox be replaced without removing the blades?		Y/N
30	Can the Generator be replaced without removing the blades?		Y/N
31	How often does the WTG require regular maintenance?		
32	Warranty for WTG Performance		
33	Warranty for Gearbox (years)		YRS
34	Warranty for Generator (years)		YRS
35	Warranty for Blades (years)		YRS
36	Warranty for Tower (years)		YRS
37	Warranty for Other Parts		YRS

Item	Wind Turbine Generators (WTG)	Responses	Units
38	How many of these WTG Models are operational in the USA?		
39	How many years has this WTG model been operational in the USA?		
40	Please confirm the WTGs meet each of the following conditions:		
41	Curtailment Control		Y/N
42	Voltage Control		Y/N
43	Voltage Droop Control		Y/N
44	Power Factor Controls		Y/N
45	Frequency Controls		Y/N
46	Integrated Control of Capacitor and Inductor Banks		Y/N
47	Reactive Power Production During Zero Real Power Production		Y/N
48	Mechanical Loads Analysis included in SCADA?		Y/N
49	Low/High/Zero Voltage Ride-Through		Y/N
50	Special Installation Tools Included		Y/N
51	Wind Farm Control Management System included in SCADA?		Y/N
52	Does the WTG include electrically driven service Lift?		Y/N
53	Which of the following WTG options are included in this Proposal:		
54	Weather Condition Monitoring System		Y/N
55	24/7 Offsite Monitoring (if yes, how many years)		Y/N
56	Icing Detection System		Y/N
57	Corrosion protection category for exposed sections		category C1 - C5

Item	WTG Transformer	Responses	Units
1	Attach datasheets		
2	Manufacturer		
3	Model Number		
4	WTG transformer location (up tower, down tower, pad mount)		
5	Rating / Cooling		kVA
6	Is the transformer Dry-type or oil insulated?		Y/N
7	If wet, what is the oil quantity?		

Item	Permanent Wind Monitoring Stations	Responses	Units
1	Type of System to be Used (Met Towers, LIDAR/Sodar, etc.)		
2	Attach datasheets		
3	Number of towers or LIDAR/Sodar installations		
4	Tower or LIDAR/Sodar Manufacturer		
5	Tower or LIDAR/Sodar Model		
6	Are the towers in accordance to IEC 61400-12?		
7	Is the data integrated with the WTG OEM SCADA system?		
8	Is remote monitoring available?		
9	Provide list of sensors installed and data provided to SCADA system		
10	What wind heights (i.e. 40m, 60m & 80m) or range of heights will be measured?		m
11	Are met towers guyed or free standing?		
12	Do the monitoring systems and fiber switches have UPS system? How many hours?		Y/N

Notes:
“Final” – Seller may update data or other information for the specified characteristic only with the prior written agreement of Buyer and Seller, which shall not be unreasonably withheld by either Party.

***** END OF APPENDIX 3 *****

APPENDIX 4: ENERGY MODEL

Reserved.

***** END OF APPENDIX 4 *****

APPENDIX 5: DESIGN AND OPERATIONAL DATA

The following table sets forth certain design and operational requirements for the overall Project and should match that assumed in the energy model within Appendix 4. Seller shall update items in Appendix 5 as noted below. Once Seller and Buyer agree to the inputs, any Seller change in the inputs that may decrease performance must be approved by Buyer.

DESIGN AND OPERATIONAL DATA				
Nº	**CHARACTERISTICS**	**UNITS**	**DATA**	**COMMENTS / CLARIFICATIONS**
1	**DESIGN CONDITIONS**	**-**		
1.1	Design lifetime of the plant (Required / As Bid)	years	20	
1.2	Extended lifetime of the plant	years		
1.3	Design Temperature for Operation (Minimum/Maximum)	°F		
1.4	Design Temperature for Survival (Minimum/Maximum)	°F		
1.5	Temperatures any curtailment (hot or cold) are initiated	°F		
1.6	Risk Category	-	III	Per IBC and ASCE 7-10
1.7	Seismic Ground Accelerations, Ss and S1	g		Ground acceleration values shall be confirmed by Project's geotech study

MONTHLY Average Production	Units	Value
January	MWh	
February	MWh	
March	MWh	
April	MWh	
May	MWh	
June	MWh	
July	MWh	
August	MWh	
September	MWh	
October	MWh	
November	MWh	
December	MWh	
Annual	**MWh**	

12x24												
HOUR / MO.	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												

5	ANNUAL AVAILABILITY and BLADE DEGRADATION FACTOR	Availability [%]	Blade Degradation [%]
5.1	Year 1 (starting at the Substantial Completion Payment Date)		
5.2	Year 2		
5.3	Year 3		
5.4	Year 4		
5.5	Year 5		
5.6	Year 6		
5.7	Year 7		
5.8	Year 8		
5.9	Year 9		
5.10	Year 10		
5.11	Year 11		
5.12	Year 12		
5.13	Year 13		
5.14	Year 14		
5.15	Year 15		
5.16	Year 16		
5.17	Year 17		
5.18	Year 18		
5.19	Year 19		
5.20	Year 20		
5.21	Year 21		
5.22	Year 22		
5.23	Year 23		
5.24	Year 24		
5.25	Year 25		
5.26	Year 26		
5.27	Year 27		
5.28	Year 28		
5.29	Year 29		
5.30	Year 30		

6	YEARLY PRODUCTION (Net P50)	UNITS	VALUE
6.1	Year 1 (starting at the Substantial Completion Payment Date)	MWh/yr	
6.2	Year 2	MWh/yr	
6.3	Year 3	MWh/yr	
6.4	Year 4	MWh/yr	
6.5	Year 5	MWh/yr	
6.6	Year 6	MWh/yr	
6.7	Year 7	MWh/yr	
6.8	Year 8	MWh/yr	
6.9	Year 9	MWh/yr	
6.10	Year 10	MWh/yr	
6.11	Year 11	MWh/yr	
6.12	Year 12	MWh/yr	
6.13	Year 13	MWh/yr	
6.14	Year 14	MWh/yr	
6.15	Year 15	MWh/yr	
6.16	Year 16	MWh/yr	
6.17	Year 17	MWh/yr	
6.18	Year 18	MWh/yr	
6.19	Year 19	MWh/yr	
6.20	Year 20	MWh/yr	
6.21	Year 21	MWh/yr	
6.22	Year 22	MWh/yr	
6.23	Year 23	MWh/yr	
6.24	Year 24	MWh/yr	
6.25	Year 25	MWh/yr	
6.26	Year 26	MWh/yr	
6.27	Year 27	MWh/yr	
6.28	Year 28	MWh/yr	
6.29	Year 29	MWh/yr	
6.30	Year 30	MWh/yr	

*** END OF APPENDIX 5 ***

APPENDIX 6: KEY EQUIPMENT DATASHEETS

Seller shall submit manufacturer's approval drawings or product sheets (material cut sheets) for all permanently installed equipment and materials. Seller to also include equipment datasheets for the following major equipment:

- Wind Turbines, including all major components
- Wind Turbine SCADA
- Electrical BOS: MV Transformer, medium voltage cable manufacturer

***** END OF APPENDIX 6 *****

APPENDIX 7: PROJECT PERFORMANCE TEST PROCEDURES

To be added at Agreement execution.

***** END OF APPENDIX 7 *****

APPENDIX 8: PROJECT SITE MAP

To be added at Agreement execution

***** END OF APPENDIX 8 *****

APPENDIX 9: APPROVED MANUFACTURERS AND EPC CONTRACTORS LIST

A vendor appearing in the list below as an Approved Vendor for a particular type of equipment, system, or item shall not be an Approved Vendor for the manufacture of any other type of equipment, system, or item unless it is also identified therein as an Approved Vendor for such other type of equipment, system, or item. The inclusion of an entity on the list does not mean that such entity has been determined to satisfy or been pre-approved with respect to the requirements in, and other terms of, this Scope Book or the Agreement that apply, directly or indirectly, to EPC Contractors, vendors, manufacturers, or providers of equipment, systems, or items on (or not on) the list. Nothing in this Appendix 9 is intended to or shall limit the application of such requirements or terms, directly or indirectly, to any entity on the list.

Vendors or EPC Contractors not included in the list shall be considered and permitted upon Buyer's approval in its sole and absolute discretion. Vendors and EPC Contractors submitted for approval shall be evaluated based on a combination of installed capacity of largest facilities, total installed capacity of all facilities, bankability of product, company net worth, legal standing of the company, safety record and policies, quality assurance/quality control procedures, and other factors.

Approved Manufacturers List					
Major Equipment					
Meteorological Towers	Nello Corporation	NRG Systems (Temporary Met Towers Only)	Rohn	Sabre	
LIDARs	Leosphere/Vaisala	Zephir			
Wind Turbines	GE Vernova	Siemens Gamesa	Vestas		
Transformer	ABB	Waukesha	Siemens	Alstom	Hyundai
	Virginia Transformer	Pennsylvania Transformer	Cooper	PACS	Howard
Switchgear	ABB	Cutler-Hammer	GE	Powell	
Balance of Plant					
Disconnects	Square D	Siemens	Eaton	ABB	SMA
Data Logger	Campbell Scientific	Kipp and Zonen			
Power Distribution Center	Powell	Zachry	PACS	Alstom	
HV Circuit Breakers	ABB	GE-Hitachi	Mitsubishi	Siemens	
HV Disconnect Switch	Pascor	Southern-States			

EPC Contractors: [Seller to provide a list of EPC Contractor(s) for Buyer's approval]

*** END OF APPENDIX 9 ***

APPENDIX 10: NERC Requirements - Effective Date

NERC Standard	Title	Deliverable	Due Date
CIP-002-5.1a	Cyber Security - BES Cyber System Categorization	1) Provide real MW power capability of generator 2) Provide MVAR nameplate rating capability of generator	At FNTP
CIP-003-8	Cyber Security — Security Management Controls	1)Provide Physical Security Controls 2) Provide Electronic Access Controls 3) Provide Transient Cyber Assets and Removeable Media if required	60 Days Prior to Substantial Completion
COM-001-3	Communications	Documentation showing the interpersonal communications channels (phones, backup systems) exist and are functioning including network diagram	30 Days Prior to Substantial Completion
EOP-012-1	Extreme Cold Weather Preparedness and Operations	Evidence of implementation of freeze protection features to assure continued operation in extreme cold weather. OR Declaration explaining why not feasible to comply.	120 Days Prior to Substantial Completion
FAC-002-3	Facility Interconnection Studies	Evidence of the coordination/communication with the TO as port of GIA development	120 Days Prior to Substantial Completion
FAC-008-5	Facility Ratings	Facility Rating Report with supporting documentation supporting each equipment rating	150 Days Prior to Substantial Completion
MOD-032-1	Data for Power System Modeling and Analysis	Evidence that all required modeling data has been provided including model files.	30 days prior to Substantial Completion Final updates (if required) within 90 days of Post Substantial Completion
PRC-028-1	Disturbance Monitoring and Reporting Requirements	Provide the required Sequence of Event Recording, Fault Recording, and/or Dynamic Disturbance Recording equipment	60 Days Prior to Substantial Completion
PRC-005-6	Protection System, Automatic Reclosing, and Sudden Pressure Relaying Maintenance	List of equipment that must be in the Protective System Maintenance Program (PSMP) plan. Must include all facility equipment generation and substation. (Buyer uses a PRC-005 Component list). Test reports or documentation that all listed equipment has been tested. Documentation (such as highlighted schematics) indicating that all circuits with protective system components have been functional verified.	List of equipment and test documentation: 90 days prior to Substantial Completion
PRC-006-5 PRC-006-PRC-006-SERC-3	Automatic Underfrequency Load Shedding	Attestation that no UFLS is included in facility design. OR Specific documentation for under frequency/over frequency of protection and control devices included in the facility (including the control systems).	90 Days Prior to Substantial Completion
PRC-012-2	Remedial Action Schemes	Attestation that no RAS is included in facility design. OR Specific documentation for remedial action scheme settings of protection and control devices included in the facility (including the control systems).	30 Days prior to Substantial Completion
PRC-017-1	Remedial Action Scheme Maintenance and Testing	Attestation that no RAS is included in facility design. OR Specific documentation for remedial action scheme settings of protection and control devices included in the facility (including the control systems).	30 Days prior to Substantial Completion
PRC-019-2	Coordination of Generating Unit or Plant Capabilities, Voltage Regulating Controls, and Protection	Relay setting documentation and a specific report showing that all limiters operate before protection and control devices including the control systems and the protective system limits damage to equipment.	90 Days Prior to Substantial Completion
PRC-023-4	Transmission Relay Loadability	Attestation that PRC-023-4 does not apply or evidence of compliance	90 Days Prior to Substantial Completion

NERC Standard	Title	Deliverable	Due Date
PRC-024-3	Generator Frequency and Voltage Protective Relay Settings	Relay setting documentation and a specific report showing the frequency and voltage responsive relays and control function device comply with the setting requirements of PRC-024 by not tripping in the "No-Trip" zone.	90 Days Prior to Substantial Completion
PRC-025-2	Generator Relay Loadability	Relay setting documentation and a specific report showing the load responsive relays comply with the setting requirements of PRC-025.	90 Days Prior to Substantial Completion
PRC-026-1	Relay Performance During Stable Power Swings	Relay Setting Documentation and analysis showing the load responsive relays will not trip during power swings.	90 Days Prior to Substantial Completion
PRC-027-1	Coordination of Protection Systems for Performance During Faults	Evidence that all relay settings have been coordinated with (issued to for review) the transmission owner ad provider as well as other impacted entities. Complete package of relays setting documents including analysis to support review by Buyer's Transmission Team. Documentation should include verification of electrical coordination for expected fault currents.	Should be provided before equipment is energized.
VAR-002-4.1	Generator Operation for Maintaining Network Voltage Schedules	1) Report showing facility design must include alarms for AVC mode off, PSS off, and out of voltage schedule. 2) Report showing pop-up notification in the HMI telling the operator that changing the AVR/controller from AVR to any other mode (PF, VAR control) MUST have documented/written approval from the TCC before changing modes.	60 Days Prior to Substantial Completion

***** END OF APPENDIX 10 *****

APPENDIX 11: PROJECT CONTROLS

Buyer's goal is to have a safe construction environment in which we deliver a quality plant, on time, at the agreed upon cost, that can be safely, timely and efficiently operated for the next several decades by the Buyer we are building it for. ***A key element of successful project delivery is having execution plans that clarify roles, responsibilities, and expectations for the various companies and persons managing the execution effort.*** It is presumed that Buyer is contracting with companies experienced in executing the work and that Buyer's partners already have their own set of plans. Buyer's execution team will then review Buyer's partners' plans to establish a confidence-level that the work will be executed safely, efficiently and to scope, and also offer suggestions based on lessons learned.

Buyer will not be providing templates of the required plans, because it risks diminishing the ownership that a partner would have if the plan wasn't developed by their company with their own subject matter experts. However, the below guidelines may help provide context as to Seller's minimum information expectations.

Buyer is not requiring its partners to rewrite or reformat their existing plans,but confirming that Buyer's partners have established a methodical approach that serves as a roadmap for internal management and Seller's contractors to ensure successful project execution. Some plans might be stand-alone due to their complexity or importance, i.e. Environmental, Health and Safety or Quality plans, while other information may be embedded in an overall Project Execution Plan, as contemplated below.

Health, Safety, and Environmental Plan

Purpose: Protocols to safeguard the health and safety of all persons who visit/work on the site, as well as environmental protections for the site, as well as adjacent landowners/public/communities. Seller shall prepare, implement, manage, and observe the health and safety plan, and the environmental plan (collectively, the "HSE Plan") conforming to the minimum requirements below.

- Developer's and/or EPC's Corporate HSE policy, setting forth minimum expectations and confirmation that all subcontractors' plans meet the minimum expectations
- Safety Programs
    - General Safety plan
    - Responsibilities of Contractors, Employees and Visitors
    - Subcontractor safety plans
    - Site specific safety protocols, including, but not limited to: drug testing, surveillance, on-site training/orientation, stop work authority, hazardous materials, LOTO-High Energy, emergency response, record retention, incident follow-up, commitment to action if a safety protocol and/or safeguard is violated, etc.
    - Reporting information: Timeline for reporting severe incidents between the contractors (sub to EPC to Developer) and to the Buyer, statistics information, incident investigations/lessons learned
    - Describe the steps that will be taken to educate and inform local law and EMS personnel about the site to increase their efficiency should their assistance be needed
- Extreme Weather / Hurricane Plan
    - Guidelines for protecting the workers and preparing the project site and loose materials for extreme weather i.e. hurricanes, tornadoes, freeze/ice-snow,
    - Establishing management communication before, during and after severe weather events, and
    - Assessing the site after an extreme weather event
- Environmental
    - Protection of the project land and biodiversity, as well as adjacent land/communities/public
    - Permitting: SWPPP, SPCC, Waters of the US, et al
    - Protocols for monitoring adherence to Best Management Practices listed in the permitting
    - Protocols for ensuring compliant disposal of damaged modules or other e-waste or hazardous waste
    - Protocols for preventing any new ENV issues from happening

- If a Developer's intention is to submit *their EPC's Environmental and/or Safety plan*, then articulate how the Developer will oversight their EPC's compliance with their plan

Quality Assurance/Quality Control Plan

Purpose: Protocols for verification that the project is built in compliance with the Agreement, IFC drawings, the Scope of Work, and that the installation will meet the Performance Standard for a plant that can be safely maintained, and timely and efficiently operated. Seller shall prepare, implement, and manage a detailed quality assurance plan that is specific to the Project and Project Site. This plan shall conform to the minimum requirements below.

- Developer's and/or EPC's Corporate QA/QC policy, setting forth minimum expectations and confirmation that all subcontractors' plans meet the minimum expectations
- Accountability of contractors
- Process control
- Design Control
- Document Control
- Reporting
- Training
- Materials Quality
- Installation Quality Assurance (PV: civil, mechanical, electrical and HV: Collector Sub, transmission, distribution)
- Equipment calibration
- Identifying and managing nonconformance
- Articulate the process for tiered inspection oversight, i.e. Subs QA their work, the EPC then QAs the subs' work, the Developer then QAs the sub's work
- If a Developer's intention is to submit their EPC's QA/QC plan, then articulate how the Developer will oversight that EPC's compliance with their stated protocols
- Include information on the onsite inspection process/program that will conducted by the major materials OEMs' QA/QC teams, i.e. for trackers, inverters, modules, major Collector Substation components, etc.

Project Execution Plan (PEP) Overview Guidance

Purpose: A Project Execution Plan (PEP) is a governing document that establishes the means and methods to execute, monitor and control projects. In the context of the business partners working with Buyer to execute renewable projects, the PEP should contain high-level information about the project, discuss stakeholders and provide an organizational chart of the entities and persons that will manage the project. The PEP may include Design, Engineering and Construction management protocols, articulate the approach for contracting and procurement, intended methods for security of the site, people and material, how project performance will be monitored with scheduling and installation velocity tracking, identification or risks and risk-monitoring, and how documentation and required information will be transmitted. The PEP shall also contain construction management plans, including, but not limited to, cost controls, schedule controls, mobilization, document management, materials management, details for receipt, offloading, and transport of equipment, traffic management (including cranes and concrete trucks), construction sequencing, movement of cranes during construction, and other similar items. A completed PEP document shall be provided 60 days after FNTP with the final draft being provided 4 months prior to site mobilization.

The following plans can be stand-alone or grouped as one over-arching document:

Project Organization Plan

- Project Organization and Roles/Responsibilities
- Include primary companies (Developer and EPC), could also include Seller's primary contacts

- Meeting and Report Distribution Matrix (listing of personnel to be included in mtgs/reports/etc.)

Engineering Plan

Purpose: Acknowledge requirements in the Agreement and the Scope Of *Work (SOW) by communicating the plan to meet key deliverables and expectations.*

- Articulates the engineering strategy, identifies who is performing the engineering tasks
- Discuss Basis of Design document development (PV and HV)
- Provide a submittal list of ENG documents that correlates with the SOW and the engineering phase
- Design review cycle, i.e. 30-60-90 or Phase A/B/C, RFIs/tracking
    - List the deliverables that will be in each deliverable phase
    - Define what constitutes achieving IFC drawings
- Dates and Milestones for Engineering deliverables
- PV Engineering, including civil, mechanical, electrical, Cx, et al
- HV/Substation Engineering
- Drawings, etc.
- Approach for developing plans defined in the Agreement/SOW, i.e. the Hot Commissioning Plan, the Performance Testing Plan, Harmonics Studies, etc.
- Establishing, implementing, and adhering to NERC-CIP requirements (as will be further detailed in the stand-alone Cyber Security Plan)

Document Control Plan

- Describe the method for transmitting documentation deliverables to Buyer
- Articulate the process for tracking review comments and resolution of comments (ball-in-court process)
- Ensure that the external team members are aware of Buyer's >10MB email attachment restrictions
- Document numbering and naming conventions

Contracting Plan

- Articulates the contracting strategies, identify primary suppliers, discuss long-lead times
- List of anticipated contractors for major services
- Key supply risks and mitigating actions
- Narrative on actively pursuing using qualified/capable local and diverse suppliers and labor resources, and sharing this information with Buyer

Procurement Plan

- Articulates the procurement strategies and approach used to purchase equipment and materials for the project
- Narrative of how procurement functions through contracts and responsibilities
- Estimated start and end delivery dates of equipment
- Key supply risks and mitigating actions

Construction Plan

- Narrative of how the work will be managed and by whom, include titles and corresponding roles and responsibilities
- Articulate the planned approach to constructing the plant, from initial grading to cold and hot commissioning
- Due to the importance of commissioning (Cx), as well as the increased safety focus that is required, include discussion on the Cx plan

- Reference applicable project plans, i.e. Safety/ENV, QA/QC, Procurement, Performance Monitoring, and how the Developer/EPC will provide engagement and oversight to ensure plans are being followed
- Include specific discussion acknowledging the challenges for building in the Deep South, including weather, terrain, labor availability - list construction practices that will be implemented to ensure safety and schedule optimization
- Describe the plan to minimize items that can/will be addressed during the construction cycle to minimize elongated periods to achieve Mechanical Completion, Substantial Completion and Final Acceptance (drainage and water conveyance, high vegetation, Pre-Punch List items with the EPC, rut remediation, trash/litter, damaged components, etc.)
- Describe the oversight and communications that will occur between all entities to ensure continued focus of safety, environmental, and quality when personnel changes occur and/or conditions change on site, for example the transformation that often occurs on the site when transitioning to the Substantial Completion through Final Acceptance phase

Site Security Plan (Project Custody)

- Explain how the site will be secured to protect the people on site as well as the project's assets
- Ensure how the site will restrict unauthorized access
- Describe the signage for the site that will communicate authorized access requirements, i.e. project signage, main gate(s) descriptor signage, directional signs, Site Rules and Required PPE signage, explanation of authorized access / badging if applicable, speed limit signs, muster locations, Hot Cx / LOTO signage/roping (i.e. Red Rope process)

Project Risk Register

- Identify, track and manage risks, i.e.:
  - Safety, environmental, weather, labor/contractor resources
  - Design/Engineering progressing to IFC
  - Supply chain issues
  - PV Installation: Civil, mechanical/electrical/civil work, electrical
  - HV Installation: Collector substation, transmission lines, etc.
  - Handover requirements/readiness
  - Political changes
- Ensure risks are listed with potential schedule and/or cost impacts
- Articulate the frequency that the Risk Matrix will reviewed, updated and shared with Buyer, i.e. included in the monthly Report
- Request Buyer to share lessons learned from previous projects
- *Please provide an example of your risk matrix for review*

Schedule and Performance Management:

Purpose: Planning the work involves having a project schedule that shows a sophisticated approach to planning the work, including demonstrating an understanding of the resources that will be required (Labor Hours, equipment, subcontractors), weather, procurement, labor availability, etc. Communicating the plan to all supervisors, managers, and project leaders is critical in establishing universal and unified performance. Ensuring that the plan is being worked involves tracking progress and updating the schedule and plan when challenges or changes occur; to accomplish this, frequent reporting to all project leadership is critical.

Seller shall prepare, implement, and manage a detailed Project schedule that reflects the Project execution plan and anticipated sequence of site operations, and shall cause the reports summarized herein to be submitted with each weekly Project Schedule update; the Project Schedule shall comply with the minimum requirements set forth herein. Contractor shall also provide an individual (the "Scheduler") who shall (a) be dedicated to the Project; (b) develop and maintain the Project Schedule; (c) be an experienced specialist that is skilled in critical path method scheduling; (d) be capable of producing CPM reports within 24 hours of Buyer's request; and (e) attend (either remotely or in person) and actively participate as needed in all Project meetings related to construction progress, alleged delays, or time impact.

Schedule Management Plan

- Articulate the schedule strategy, control requirements, software tool selection, frequency of updates, etc. Refer to the detailed expectations in the Scope of Work document
- Describe how installation velocity will be tracked
- Articulate how often the velocity reporting and schedules will be reviewed and updated and how the information will be shared with Buyer, i.e. Weekly for velocity, monthly for P6 schedule updates, etc.
- Refer to the detailed expectations in the Scope of Work document
- Please provide an example of your weekly velocity tracker for review

Preliminary Baseline Level I and Level II Project Schedules and WBS

- Baseline schedules – provide the initial baseline schedule for the project
- Refer to the detailed expectations in the Scope of Work document

Performance Measurement Baseline

- Describe how performance will be tracked, managed and reported, i.e. in the monthly report
- Describe key commodities that will be tracked via Velocity Installation Curves
- Refer to the detailed expectations in the Scope of Work document
- Articulate the information that will be shared in the Monthly Reporting/Weekly Reporting
- *Please provide an example of your Monthly Reporting / Weekly Reporting*

Schedule Requirements

Without limiting the information summarized herein, the purpose of this Appendix is to summarize the minimum contents and requirements for the Seller-prepared Project Schedule, post NTP.

The Project Schedule shall contain target dates, project milestones, contractual events, deadlines, decision points, deliverables, and will have a clearly defined Critical Path (CP) to complete the (EPC) engineering, procurement, construction. The Project Schedule shall be developed in Primavera (preferred) or Microsoft Project.

Contractors will provide documentation / evidence to support claimed schedule activity progress and / or schedule slippage. Contractors shall provide three (3) levels of the Project Schedule:

- Level I Schedule shall be an integrated Project summary schedule showing major activities and milestones in a one-page Gantt chart format with network features to show major constraints. The Schedule will show a time-now line (status line) and reflect schedule performance; it will reflect major interdependencies (logically tied) and the CP.
- Level II Schedule activities will be WBS summary tasks that are driven by the Level III activities falling under the associated WBS. The Level II Project Schedule shall be developed with activities tied logically throughout using CPM.
- Level III Schedule shall consist of the Contractor's, fully integrated, Network Schedule that clearly defines the sequences and restraints between activities at a detailed level.

Monthly reports will include progress (with % complete), cost and schedule status / forecasts, and will provide narratives on variances.
Contractors submit monthly reports per the EPC Agreement (PDF and native file) which include:

- Updated Project Schedule including lookahead for coming month

- Updated schedule narrative including descriptions of the following:
    - Progress narrative, including engineering, procurement, and construction activities
    - Monthly planned activity adherence (planned vs. actual)
    - Milestone comparisons from previous updates
    - Description of critical/near critical path
    - Narrative of any duration change
    - Narrative of any schedule variance
    - Visual report of completed activities using layout drawings and photographs
- Updated commodity / quantity reporting matrix breaking down key scopes of work
- Updated cumulative and monthly planned vs. actual physical progress s-curve (% complete).
- Safety related information (near misses, incidents, accidents, training, etc.)

Beginning with mobilization to site and continuing until Substantial Completion, the Contractor shall also submit a weekly status report including:

- Safe work hours for the previous week
- Target installation vs actual installation for the previous week
- Upcoming three week forecast of activities
- Equipment and Material receiving summary
- Construction Status Narrative
- Prior Week Weather Summary
- Construction Manpower Forecasting (including weekly Baseline Planned and Actual FTEs onsite).

***** END OF APPENDIX 11 *****

APPENDIX 12: RISK

PROPERTY PROTECTION DESIGN BASIS DOCUMENT

Applicability of Chapter 4 Through 10 of NFPA 850

Per NFPA 850 13.2, Chapters 4 through 10 apply wind generating facilities. The Property Protection Design Basis Document should determine which recommendations apply to any specific wind generating facility. This determination is done by evaluating the specific hazards that exist in the facility and evaluating the level of acceptable risk for the facility. The remaining paragraphs in this chapter provide recommendations that are beyond the scope of other chapters in this recommended practice.

1. Site-Specific Property Protection Design considerations

Plant Name:	
Location:	
General Fire Protection Philosophy (e.g., methods to provide passive protection):	
Assumptions:	
Site Specific Information that contributes to risk	
Source Documents (e.g., adopted codes, standards, regulations, insurance documents) applicable to the site	
Plant Layout (description of fire areas) (e.g., hazard separation, fire barriers, drainage)	
Responding fire department: Equipment and response summary.	
Hazards (e.g., transformers, etc.):	
Administrative Controls (e.g., items covered in NFPA 850 Chapter 5):	

2. Wind Generation – Risk Mitigation Strategy

Adjacent Wind Turbine units consistent with land and wind topography constraints	
Adjacent structures or exposures, including transformers	
Adjacent properties (e.g., aboveground pipelines, tank farms, or natural gas facilities that could present a severe exposure)	

3. Fire Management Policies/Recommendations Suggestions (to include in discussions, not to limit discussion)

For each of the following elaborate on the design features that are used (as applicable) to mitigate the effects of fire:

(1) Adjacent Wind Turbine units consistent with land and wind topography constraints	

Physical separation or grouping of area	
Other Suggestions	
(2) Adjacent structures or exposures, including transformers	
Physical separation to prevent fire propagation.	
Other Suggestions	
(3) Adjacent properties (e.g., aboveground pipelines, tank farms, or natural gas facilities that could present a severe exposure)	
Physical separation to prevent fire propagation.	
Other Suggestions	

4. Fire Protection Systems

The following should be addressed.

(1) Closest source of firefighting water	
Municipal Water Main (distance to nearest hydrant)	
Lake or river accessible water	
Fire Department water shuttle capacity	
(2) Site Accessibility (Means of Egress) for emergency response vehicles	
On-site roadway plan to access interior and perimeter fires	
Road surface	
Bridge / road weight limitations along routes	
(3) Fire Detection Systems:	
Required if a building (e.g., Control House) is provided	
Nacelle fire protection / suppression	
(4) Portable fire extinguishers for structures and major components	

***** END OF APPENDIX 12 *****

APPENDIX 13: O&M STRUCTURE AND REQUIREMENTS

Seller shall provide an option to furnish all labor, equipment, and materials that are necessary for a complete, fully functional, and safe O&M Building configuration. Buildings at the Project Site shall be designed in accordance with the requirements of all laws and applicable permits, including ADA compliance for parking, doorways, bathrooms, and other building features.

The O&M building shall be a weather tight metal building that is suitable for the proposed development. Optimum design for the project should be proposed, reviewed, and accepted by the developer based upon requirements of the Turbine Supply Agreement. The O&M building shall comply with all Turbine Supplier requirements, including office quantity, furnishings, warehouse requirements and other similar items.

Seller shall provide professional cleaning service for the O&M Building at the conclusion of the Work, including, but not limited to, cleaning light fixtures, mirrors, sinks, toilets, cabinets, and lockers; washing floors; washing windows; and waxing VCT.

All civil works, structures, foundations, assemblies, components, and electrical works shall comply with the applicable specifications in the Wind BOT Scope Book.

- All exterior doors shall be equipped with key card readers.

8,000 sq ft minimum footprint (7,500 sq ft min warehouse space) – an additional 1,000 sq ft for each 10 MWac over 180 MWac.

Concrete slab shall be a minimum of 6 inches thick with #4 rebar spaced at 12-inch O.C. each way and sealed.

1. Requirements for fire protection system:

All areas of the building shall be provided with smoke and heat detectors as the form of fire detection.

- The fire protection system shall receive the approval of Buyer's insurance carrier.
- Portable CO_2 and dry chemical fire extinguishers shall be furnished and installed in the building, in a quantity and type sufficient to ensure compliance with the Applicable Standards and other Requirements. At a minimum, one (1) 10-pound ABC-type fire extinguisher (including mounting device / cabinet) shall be installed at every exit door, break room, and utility room, respectively.
- All local alarm, detection, and suppression panels shall report status to the main fire alarm panel located in the control room.
- Seller shall ensure that fire-rated seals in all openings and penetrations in all rated barriers for the Project are supplied and incorporated into the Project and that the fire-rating of such seals are commensurate with the fire rating of the barrier. The following walls and doors shall be fire rated for the minimum times shown, or as required by the authority having jurisdiction, whichever is greater:
  - Interior wall between warehouse and office areas: 60 minutes.
  - Interior doors between warehouse and office area: 60 minutes.
  - Interior SCADA / communications room walls: 60 minutes
  - Interior door to SCADA / communications room: 60 minutes
- Seller shall provide and incorporate non-combustible or fire-rated sealing materials for all cable penetrations entering from below a raised electrical structure at the Project Site (BESS, Power Distribution Center, etc.).

2. Requirements for heating, ventilation, and air conditioning system:

- The heating, ventilating, and air conditioning systems shall satisfy the workspace environmental requirements for personnel occupancy and equipment operation.
- Heating elements shall be propane or natural gas-fired. Cooling elements shall be electric.

- Minimum ventilation rates shall be provided in normally-occupied areas in accordance with the Applicable Standards and other Requirements. In the absence of local codes, ASHRAE Standard 62 requirements shall be met. A minimum of five (5) air changes per hour of ventilation or recirculation air shall be provided for effective mixing during heat removal ventilation or air conditioning of normally occupied spaces.
- The air conditioning for control and electrical equipment shall be designed to meet the filtration levels as defined by ASHRAE Standard 52.
- Interior cooling loads for the SCADA room shall be based upon actual equipment to be installed and ASHRAE Standard requirements. This air conditioning unit shall be ceiling mounted.
- Air velocities in ducts and from louvers and grills shall be sufficiently low to maintain acceptable noise levels in areas where personnel are normally located.
- Thermal insulation with vapor barrier shall be provided on ductwork surfaces with a temperature below the dew point of the surrounding atmosphere to prevent vapor condensation. All ductwork used for air conditioning purposes shall be insulated; ductwork used for ventilation purposes shall not require insulation.
- Exhaust fans for bathrooms and locker room shall be furnished and installed. Exhaust systems shall be provided above the roof for toilet, shower and locker room areas and shall be controlled by occupancy sensors. Outdoor ventilation air shall be based on normal room occupancy or local codes, whichever is more stringent.
- Functional louvers at building workshop area shall be provided.

3. Requirements for fencing:

- The O&M Building perimeter shall be fenced.
- At least one (1) vehicle Electric slide gate shall be installed at the O&M Building. The vehicle gate shall be a double-hung, 20-foot-wide (minimum), motorized, rolling gate. At least 10 remote-entry devices shall be supplied and programmed by Seller for Buyer's use.
- At least one (1) walk gate shall be installed at the O&M Building. The walk gate shall be a lockable, single-hung, 4-foot-wide, swing-gate for personnel access.
- All fencing and gates shall comply with the minimum specifications in the Wind BOT Scope Book.

4. Requirements for O&M building signage:

- A 6-inch plastic vinyl building address and numbers on the front of the building shall be furnished and installed.
- Men's and women's restroom signs shall be furnished and installed.
- ADA-compliant and visitor parking sign(s) on steel posts in front of the handicap stalls shall be furnished and installed.
- Interior signage, as required by the Applicable Standards and other Requirements, shall be furnished and installed.
- A permanent sign at the O&M Building entrance shall be furnished and installed. This sign shall include Project name, Project address, and Owner name/logo, each subject to Owner approval. This sign shall be lit, including permanent power (with conduit) from the O&M Building.

5. Requirements for lighting:

- Interior
  - Lighting levels shall meet the intensities indicated in the IES handbook and NFPA 70/NEC.
- Exterior
  - Exterior lighting shall be provided by building-mounted, metal-halide or LED light fixtures at facility personnel and overhead doors. Additional building-mounted lights shall be provided to illuminate walkway and parking area. LED lights are preferred if minimum required illumination levels can be met. In lieu of LED lights, metal halide lights may be used, with Buyer approval. Lighting levels shall meet the intensities indicated in the IES handbook and NFPA 70/NEC.

- Exterior lighting shall be controlled by lighting contactors with hands-off auto selector switches and photocells and should be equipped with vandal-resistant lenses.
  - Lighting shall be provided to cover the building faces evenly and shall be directed inward from the property line.
  - Area lighting shall supplement existing street lighting (if any) to provide a maximum level of illumination from a minimum number of fixtures. The system shall be designed to illuminate the entire area evenly, including doorways, structures, and all opening into the structures.
  - Pedestrian and vehicle entrances that are actively used are to be provided with sufficient illumination to permit recognition of individuals and examination of credentials. All vehicle entrances must be lit so that the entire vehicle, occupants, and contents can be adequately viewed. Doorways and other recesses must be lit to eliminate shadows.
  - Alternate circuitry must be used in the power circuits so that the failure of any one lamp does not leave a large portion of either (a) the site perimeter or (b) critical or vulnerable areas in darkness.
- Emergency
  - Emergency lighting shall be provided by integral battery packs and shall automatically energize on loss of AC power to provide for safe egress and to light occupied control rooms and other critical areas. Illumination levels shall satisfy OSHA standards for their given service and location. Luminaires shall be standardized as much as practicable to reduce the number of components the Project must stock.
  - The facility shall use LED fixtures with internal battery backup ballast for emergency egress locations such as corridors, hallways, and fire exits.
  - Exit signs shall be illuminated LED type located at fire exits and required locations.

6. Roof Requirements:

- 14-foot minimum eave height. Deluxe eaves which match the rake of the building shall be included.
- Roof pitch will be a minimum of 1½:12.
  - Dektite boot flashings at 4-inch to 12-inch pipe penetrations shall be provided.
- Gutters/downspouts with simple trim shall be installed. Splash blocks shall be included at all downspouts. Downspouts shall not drain onto sidewalks or aprons.

7. Exterior Door Requirements:

- Overhead doors shall have vinyl seal on both sides of track, hood baffle, reversing "Feather Edge", and take-up reel. Each door shall be motor operated, and openers shall come with three-stage (open/stop/close) push button.
- Min (2) insulated overhead roll-up doors of at least 12 ft x 16 ft.
  - Exterior doors shall be 3-foot by 7-foot commercial-grade, insulated-steel service doors with ball-bearing hinges, hydraulic closer, latch guard, weather-stripping, self-sealing sweep, ADA-compliant aluminum threshold, and keyed lockset. One (1) lite kit shall be included per door, approximate size will be half lite (8-inch by 24-inch).
- Min (3) doors (one at each roll up door and one inside office area).
  - All door jambs shall be completely flashed to give door opening a finished appearance.
  - All exterior doors shall be equipped with a SCADA-integrated intrusion alarm. Such alarms shall be programmed to provide immediate silent notifications in the event of after-hours and/or non-card-reader access.
  - Panic hardware shall be provided for exterior shop / warehouse doors and the front entry door, along with any door where local fire codes require they be installed.
  - All exterior steel doors shall be painted.
  - Door bumpers shall be provided on every door.
  - Door keying shall be provided on every door. Bathroom doors shall include dead bolt.

8. Interior Door Requirements:

- Interior doors shall be 3-foot by 7-foot by 1.75-inch-thick flush solid-core commercial-grade birch wood doors. All interior doors shall be installed in primed hollow metal frames with three (3) 4.5-inch by 4.5-inch commercial hinges. The frames shall be painted and the doors shall be stained and varnished.
- Push/pull hardware shall be installed on all bathroom and break room doors.
- Kick-plates shall be installed on all bathroom, break room, shop/warehouse, and front entry doors (note: applies to interior and exterior shop/entry doors).
- All doors with push/pull hardware shall include kick-plates installed on push sides.
- All interior doors shall have medium-duty commercial lever locksets.
- All interior doors and woodwork shall be stained and varnished. All interior hollow metal doors and door frames shall be painted.
- Doors shall be fire rated as set forth herein.
- Door bumpers shall be provided on every door.
- Door keying shall be provided on every door. Bathroom doors shall include dead bolt.

9. Miscellaneous Requirements:

- All utilities including phone/fiber, electricity, water, sewer, and gas if applicable.
- Air-conditioned space to include at a minimum:
  - Minimum 8 ft ceilings.
  - Minimum 2 inch x 4 inch x 8 ft studs with 2 inch x 6 inch ceiling joist.
  - Two offices.
  - Bathroom
  - One hot water heater.
- Common area with room for fridge, counter space, meeting table, and 6 chairs.
  - Receptacles shall be properly placed to code, 2 data drops, A/C and water heater drops (if applicable) and minimum 200 Amp single phase overhead service.
  - 8 ft x 10 ft locked storage room for climate controlled stored items.
  - One direct to outside man door.
  - Insulation and finished/painted drywall interior and exterior walls (minimum ½" drywall complete with molding).

10. Metal Building Requirements:

- The main frames shall be clear span.
- The sidewall columns shall be tapered with inset girts.
- The bay spacings shall be 25 feet on center.
- Primer color shall be standard red.
- Concrete slab shall have minimum 2 ft x 2 ft x 2 ft pier footings at each metal building column and 1 ft x 1 ft perimeter footing.
- Roof panels shall be a minimum of 26 ga. PBR Galvalume finish w/Zac screws.
- Wall panels shall be minimum of 26 ga. PBR ACI 2000 color finish w/standard screws.
- 3" VR metal building insulation in walls and roof.
- Gutters and downspouts shall be a minimum 26 ga. and ACI 2000 color finish.
- Closure strips, sealing tape, and joint sealants shall be furnished and utilized as needed to complete the metal building erection per Prudent Wind Industry Practices.
- To ensure weather tightness and rodent control, a finished base angle at the bottom of each wall sheet shall be included.
- Provision for thermal expansion movement of the standing seam panels shall be accomplished by the use of clips with a movable tab.

11. Window Requirements:

- 4-foot by 5-foot aluminum horizontal slider windows, equal to Plyco Model M3025, shall be provided in the following quantities:
  - Offices: 1 per interior office, 2 per corner office.
  - Meeting room: 2.
  - Break room: 1.
  - Warehouse: 2.
- Window frames shall be thermally broken with standard color.
- Operable units shall include screens.
- Exterior windows shall be glazed with tinted insulated glass and argon gas filled.
- Windowsills:

12. Room Finishes:

- Each room in the O&M Building shall include the minimum finishes set forth in the following table and as further described below. Ceiling heights are noted to be nominal heights.

Room(s)	Floor	Base	Walls	Ceiling Height	Ceiling Type
Common area Offices Break room Meeting room	Vinyl composition tile	4-inch vinyl	Painted drywall	8'0"	2x4 acoustical tiles
Comm / SCADA	Anti-static vinyl composition tile	4-inch vinyl	Painted drywall	8'0"	2x4 acoustical tiles
Bathrooms	Glazed ceramic/ porcelain tile, with floor drain	4-inch glazed ceramic/ porcelain tile	Ceramic tile/ painted drywall	8'0"	2x4 vinyl covered sheetrock
Shop	Sealed concrete, with floor drain	Not applicable	29 ga. white liner (steel)	17'0"	Exposed structure

- Flooring:
- All tile shall be waxed. All tile and grout shall be sealed.
  - Vinyl composition floor tile shall be 12-inch by 12-inch by 1/8-inch tile adhesive applied to concrete floors. Wall base shall be 4-inch high, vinyl base adhesive applied to walls with covered profile.
  - Porcelain tile shall be set by the thin-set method. Anti-fracture membrane at control joints in floors for bathroom areas shall be provided.
  - Porcelain wall tile in bathrooms shall be 5-foot high on all sides, with painted drywall above.
- Vapor retarder: see Structural Works section herein.
- Walls:
- All drywall shall be 5/8-inch, taped, sanded, and textured.
  - All bathroom walls shall have 5/8-inch moisture-resistant drywall with at least two (2) coats of semi-gloss latex applied.
  - Three (3)-foot wainscot shall be applied along all exterior walls.
  - A 29-gauge steel liner panel to approximately 8-feet high shall be used along the exposed shop wall. A 2-inch by 2-inch galvanized base angle to attach liner panel at the concrete floor shall be provided.
  - Walls shall be fire rated as set forth herein.
  - Retractable wall: not used.
- Ceilings:
  - All ceiling tile shall be Armstrong Cortega or Buyer-approved equal.
  - The ceiling over the electrical storage, storage, and shared workshop shall be covered with 2-inch by 8-foot beams at 16 feet on center with one (1) layer of 7/16-inch OSB over the top. This shall be designed as a dust cover and not a mezzanine.

13. O&M Building Accessories:

- Cabinets shall be installed in the break room. Wall cabinets and hardware shall be wood veneer MDF-type, Buyer approved. Cabinets shall be both counter height and overhead.
- Countertops shall be installed in the break room. Countertops shall be Corian, or Buyer-approved equal.
- The following appliances shall be installed in the kitchen / break room. All appliances shall be new, unused, white, and Maytag (or Buyer-approved equal).
  - Microwave.
  - Refrigerator with ice maker.
  - Oven.
  - Dishwasher.
- The following items shall be provided in the quantities shown:
  - Men's bathroom:
    - Wall-mounted toilet: 2 (including 1 ADA toilet stall)
    - Urinal: 1
    - Floating sink: 1
    - Shower: 0
  - Women's bathroom:
    - Wall-mounted toilet: 1 (including 1 ADA toilet stall)
    - Urinal: 0
    - Floating sink: 1
    - Shower: 0
    - Kitchen:
    - Sink with faucet: 1
    - Ice maker connection: 0
  - Shop / warehouse area:
    - Floor sink: 1
    - Wash sink: 1
    - Eye wash station: 1
    - Propane or natural gas hot water heater, of sufficient size to satisfy the facility's needs: 1
- Toilet partitions shall be installed between each toilet and urinal. Partitions shall be wall- and ceiling-mounted with baked enamel finish complete with door, latch, rubber stop, and coat hook at each stall. At least one (1) toilet partition shall conform to ADA standards.
- Standard mirrors (approximately 36 inches by 40 inches) shall be furnished and installed in each bathroom.
- Paper towel dispensers and toilet paper holders shall be furnished and installed in each bathroom.
- Handicap grab-bar hardware shall be furnished and installed in each bathroom stall.
- Liquid soap dispensers shall be furnished and installed in each bathroom
- At least eight (8) lockers shall be furnished and installed. Each locker shall measure at least 8 feet by 12 inches by 12 inches and each in standard manufacturer's colors. One (1) movable hardwood bench shall be furnished and installed in front of each set of lockers.

14. Bollards:

- Bollards shall be installed (a) on each side of the overhead door(s) of the O&M Building; (b) on each side of the oil storage building doors; (c) around the outer four corners of the oil storage building; (d) around each propane tank, backup generator, and HVAC pad, respectively, although if such equipment is adjacent to each other then bollards may not be required around every unit; (e) around the septic tank; (f) around the perimeter of the septic leach field; (g) around the exterior dumpster; and (g) around the storm shelter
- Bollards shall be a minimum 3-inch-diameter steel pipe, concrete filled for equipment protection, painted safety yellow, and extend four (4) feet above grade. Bollards shall be installed no closer than two (2) feet from equipment.

15. Aprons & Sidewalks:

- HVAC pads shall have minimum dimensions of 4 feet by 4 feet by 4 inches.
- A concrete slab shall be installed along the length of the O&M Building near the exterior shop door and roll-up doors. Such slab shall be designed to accommodate AASHTO HS44-20 loading.
- All aprons and sidewalks shall be reinforced concrete with a broom finish. Minimum thickness shall be 4 inches.
- Sidewalk and curb at handicap stall shall be sloped per ADA requirements for handicap access.
- Sidewalks and aprons shall have 4-inch ABS sleeve under the structure every 15 feet, at a minimum.

16. Parking & Driveways:

- The parking area shall be sufficient to simultaneously accommodate parking for at least 10 vehicles and allow deliveries to the O&M Building front entry and warehouse.
- All car parking areas shall be shaped and graded for drainage away from the building.
- Wheel stops and lighting shall be provided for the parking area.
- A concrete slab shall be poured in the parking lot to accommodate ADA parking requirements. Parking lot striping and handicap symbol shall be painted on the concrete paving.

17. Electronic Security System:

- For all access control components, the subcontractor must be "Software House" certified.
- Vehicle access control system: not used.
- Personnel access control system:
- This system shall be installed for all man doors and vehicular gates. The system shall consist of stand-alone distributed smart panels that make the access decision and must have a stand-alone storage database capability that is downloaded routinely to the central computer database. The master computer or any other computer unit that has the proper password must be able to query it. The unit must have different levels of password control to access the data or program the unit.
    - The card system must use a proximity or RFID card.
- This system must have anti-passback capabilities to prevent multiple use of the card in a short time frame. This can be accomplished through read-in and read-out card readers with a timeout feature that prevents multiple uses at the same reader with in a user-defined time frame.
    - This system must be able to work in a local area network and/or wide area network environment and allow access from other computers on the network.
- The software must be capable of providing an audit trail of all who have accessed the database and all changes made by an individual.

18. Potable Water System:

- The potable water system shall be designed to provide potable water, both hot and cold, at the proper pressure, temperature, and flow rate to all plumbing fixtures and equipment.
- The potable water system shall include chlorination, charcoal filters, or other treatment as required.
- All internal water piping shall be PVC, copper, or pex.
- All potable water piping shall be insulated as required and sterilized in accordance with AWWA standards for disinfecting purposes prior to filling.
- At least two (2) insulated exterior hose bibs shall be installed.
- Water well requirements: Not used.

19. Sanitary Wastewater:

- Sanitary wastewater shall be collected from the various points of origin in the facility and diverted to a septic tank, and discharge from the septic tank shall be routed to a leach field.
- A pumped sanitary wastewater system shall only be used if a gravity system is impractical.

- Floor drains shall be installed in the break room, shop area, and each bathroom.

20. Insulation Systems / Thermal and Moisture Protection:

- Caulking and backer board, as recommended by the manufacturer and to seal exterior and interior joints at expansion joints, frames of doors, windows, and other wall openings, shall be furnished and installed.
- Roof insulation shall be such that an R value of at least 30 is achieved. Thermal blocks shall be included within the roof system.
- All building walls shall be insulated. Wall insulation shall be such that an R value of at least 19 is achieved. All interior office walls shall be insulated with 3.5-inch fiberglass batt insulation for sound control.
- Miscellaneous insulation for filling voids at roof eave, roof peak, door frames, window frames, and other similar areas shall be furnished and installed.

21. Electrical Service:

- All convenience outlets shall be on 20A circuits.
- All equipment and materials shall bear UL label.
- Underground conduit shall be PVC and shall conform to the specifications for conduit set forth herein.
- All transformers shall be installed exterior to the building.
- Install receptacle outlets as specified in accordance with NFPA 70/NEC.
- Grounding:
- Grounding shall be in accordance with NFPA 70/NEC. All feeder and branch circuits shall have a green-colored insulated equipment ground conductor in addition to any metallic conduit being bonded to the equipment grounding system.
    - Ground fault protection shall be installed in receptacles in warehouse and workshop where power tools are used, and in restrooms and other locations as required by NFPA 70/NEC.
    - The facility shall have a #4/0 AWG bare copper ground counterpoise with 0.75-inch by 10-foot copper-clad steel ground rods. The counterpoise will be connected to service entrance equipment, derived source transformer secondary neutrals, telecommunications main ground bus bar, and all building columns.
- The building shall have an array of air terminals, roof conductors, and down conductors. The lightning protection system shall be interconnected to the ground counterpoise system. Requirements for the building's lightning protection system shall be as determined and recommended by NFPA 780.
- Power Distribution System:
    - Service entrance conductors shall be installed to tie into the main distribution panel and terminated and tested by Seller. The main distribution panel in the building shall be service entrance rated.
    - Feeders shall extend from the main distribution panel to serve general power panel boards.
    - Panel boards and associated feeders shall be sized for twenty percent (20%) spare capacity. Panel boards shall contain space for twenty percent (20%) additional spare circuit breakers.
    - Building electrical service shall include a manual transfer switch and pad-mounted generator. The backup service shall be sized equal to the utility service and provided with sufficient fuel to operate for a minimum of two (2) days without refueling. A propane generator is preferred over diesel.
- Wiring and Conduit:
    - Each length of PVC conduit furnished with coupling on one end and metal or plastic thread protector on the other end. Sizes of conduit, fittings and accessories as indicated, specified or as required by Applicable Standards or in accordance with NFPA 70/NEC requirements.
    - Terminate all conduit runs with insulated bushings.
    - Provide all fittings necessary for a complete installation.
    - Lighting branch circuits, telephone circuits, fiber optic cables and intercommunications circuits shall be routed in separate conduit systems. Lighting circuits shall be routed in electrical metallic

  - tubing for indoor concealed areas, rigid conduit for outdoor areas, and PVC tubing or Schedule 40 PVC conduit for underground.
- Threaded, galvanized, rigid steel conduit or intermediate metal conduit shall be PVC tape wrapped or coated for underground use and will be used in all exposed, outdoor and hazardous locations.
  - All conductors shall be copper.
  - All conductors #10 AWG and smaller shall be solid conductor. All conductors #8 AWG and larger shall be stranded conductor.
  - All feeder and branch circuit wire shall be single conductor and have THWN/THHN insulation.
  - All electrical enclosures mounted outdoors shall be NEMA 4X.
  - Isolate emergency lighting circuit conductors from all other wiring.
- Communications:
  - A complete telephone and data network system shall be provided including all distribution jacks, cable, and wireless systems.
  - Internet service shall include (a) high-speed internet service (Wi-Fi) throughout the building and (b) broadband internet service up to the wall jacks. T1 service shall be provided (or the fastest available speed from the local service provider).
  - Phone service shall include four-line phone system up to the wall jacks.

22. Requirements for O&M Building garbage enclosure:

- The O&M Building shall include a separate, detached garbage enclosure. The enclosure shall be installed at an Owner-approved location.
- The enclosure shall be constructed of treated wood.
- The enclosure shall be 10-feet high on all sides and shall include at least 12 inches of clear space between the dumpster and enclosure in all directions.
- The front of the enclosure shall include a solid screening gate on a metal frame with hinges and a center latch. Such gate shall swing out to an angle greater than 90 degrees and create an opening wide enough to allow a truck to easily access the dumpster. Pins shall not be required to hold gates open while the dumpster is being accessed.

23. Requirements for O&M Building oil storage building:

- The O&M Building shall include a separate, detached building for oil storage. The building shall be installed at an Owner-approved location
- The oil storage building shall have dimensions of at least 12-feet by 32-feet, with a minimum interior area sufficient for the storage and convenient access of up to ten (10) 55-gallon drums of oil.
- The oil storage building shall be constructed using metal studs.
- The oil storage building shall include solid walls on three (3) sides, with one (1) roll-up door on the final side.
  - The door shall be sliding type or roll-up type.
  - The door shall be furnished with a keyed lockset.
  - The door shall be wide enough to permit the safe and comfortable entry by a standard, loaded fork lift.
  - Bollards shall be installed around the door.
- The oil storage building shall have a ramped entry on the door side, sufficient to allow forklift access and with a minimum 5-foot concrete slab extension.
- A concrete floor shall be installed throughout the interior of the oil storage building.
  - The floor shall include concrete curbs on all sides, each at least 6-inches high.
  - A non-skid steel grate shall be furnished and installed above the concrete floor. The grating shall be elevated approximately six (6) inches above the concrete floor.
  - The concrete floor shall be safely sloped towards a Contractor-installed sump pit in the rear corner of the building, which shall include a Contractor-furnished and Contractor-installed sump pump. The pump shall be used to manually remove effluent as needed; automatic discharge is not expected.

  - The concrete floor (including the elevated grating) shall be designed with sufficient structural capacity to simultaneously support the load of a standard, loaded fork lift and other stored materials. At least 15,000 pounds of floor load capacity shall be provided.
- The oil storage building shall have a metal roof which shall be slanted away from the door side and which shall be designed with similar loading criteria as was used for the O&M Building. The roof pitch for the oil storage building shall match the roof pitch utilized on the O&M Building.
- The oil storage building shall have power, heating, and lighting installed and operable.
- The oil storage building shall include ventilation for chemical storage.
- The interior of the building shall have at least 10 feet of clearance from floor to ceiling, or more if necessary to permit safe forklift access and use.
- One (1) eye wash station shall be furnished and installed in the oil storage building. Eye wash bottles may be substituted where they satisfy local regulations.
- Portable CO_2 and dry chemical fire extinguishers shall be furnished and installed in the oil storage building, in a quantity and type sufficient to ensure compliance with the Applicable Standards and other requirements. At a minimum, one (1) 10-pound ABC-type fire extinguisher (including mounting device / cabinet) shall be installed in the building.
- Minimum signage, exterior of oil storage building:
  - No smoking.
  - No open flames.
  - Maximum floor capacity (including loaded forklift).
  - Personal protective equipment requirements.
  - Authorized personnel only.
- Minimum signage, interior of oil storage building:
  - Eye wash station.
  - Fire extinguisher location.

24. Requirements for O&M Building storm shelter:

- The storm shelter shall be (a) ventilated; (b) compliant with FEMA 320, FEMA 361, and ICC 500; and (c) sufficient in size to safely and comfortably accommodate up to 20 adults.
- The storm shelter shall be installed at an Owner-approved location.
- Grading shall divert water flow away from the storm shelter.

25. Submittals

Seller shall prepare the O&M Building design documents per the submittal schedule in Wind BOT Scope Book and containing the following information, at a minimum: (a) electrical works, including grounding and lighting plans, one-line diagrams, electrical load list, power distribution board, communications, and construction specifications; (b) civil works, including site plan, subgrade preparation, grading/drainage, paving plan/design, and laydown area; (c) structural works, including structural steel drawings, foundation and equipment pads (locations and details), rebar, design calculations, and construction specifications; (d) mechanical works, including equipment arrangements/locations, equipment list, HVAC layout, fire protection and monitoring, piping and plumbing, vendor drawings (as applicable), and construction specifications; (e) architectural works, including building layout/plans/elevations, finishes, schedules for windows and doors, and hardware; (f) drawing index; (g) bill of materials; and (h) inspection, testing, and quality control requirements.

Seller shall provide a water quality test report for the O&M Building water supply.

Seller shall submit material and color (interior/exterior) samples for Buyer approval.

Seller shall submit copies of manufacturer warranties and operation manuals for all permanent-installed equipment and materials.

Seller shall submit manufacturer's approval drawings or product sheets (material cut sheets) for all permanently-installed equipment and materials. This shall include, but is not limited to, generators, transformer, electrical panels, signage, fixtures, appliances, and other similar items.

***** END OF APPENDIX 13 *****

APPENDIX 14: ENVIRONMENTAL GUIDELINES FOR WIND BOT AGREEMENTS

1. Overview

This document is a guide to environmental requirements and issues related to site work activities associated with the construction of a wind energy facility. The Contractor who signs a contract with Entergy is stating he or she has read the Contractor Environmental Guidelines and that the Contractor, his employees, and his or her subcontractors shall abide by job specifications and these guidelines.

The local, state, and federal environmental rules and regulations that most commonly apply during construction projects are addressed in this appendix. Any activity not identified in this section should be conducted in accordance with applicable local, state, and federal requirements, and in consultation with Entergy's Environmental Services (ES) Team.

Seller is responsible for preparing permit applications, studies/evaluations, and obtaining authorizations necessary for complying with applicable local, county, state, and federal requirements for the construction of the wind energy project. A Project/Project Site-specific health, safety, and environmental policy and associated procedures (HSE Plan) for the performance of the work outlined in Section 7 of the Wind Scope Book (i.e., Scope Book) shall be in alignment with Entergy's Environmental Guidelines contained in this document. Documentation of ongoing compliance activities is required to be maintained during construction of the project and provided to ES as outlined in the Scope Book.

1.1. Oversight

The Buyer's Environmental Specialist in conjunction with the Project Manager and/or ES will have ability to provide recommendations and oversight for environmental issues.

The Buyer's Environmental Specialist in conjunction with the Project Manager will have the authority to stop work if there is a violation of environmental requirements, or there is an observed immediate hazard to health or the environment.

The following sections outline Entergy's environmental guidelines for the rules and regulations applicable to wind energy construction projects.

2. Phase I/II Site Evaluation

Seller shall cause the Environmental Consultant to conduct Environmental Assessments (EA) on behalf of Seller and Buyer in compliance with Good Industry Practices and the then-current requirements and Laws reasonably in advance of the FNTP Date and within 180 days prior to the Closing.

Seller shall provide to Buyer reasonable advance notice of any EA conducted by the Environmental Consultant. Buyer shall have to the right to witness the performance of the EA and to communicate directly and in real time with the Environmental Consultant regarding the inclusion or exclusion of any recognized environmental conditions (RECs) within any EA.

The accuracy of any identified REC, or the determination of "no RECs" within an EA will be assessed by the Buyer's Environmental Team prior to finalizing the EA.

The following should be considered when an EA identifies a REC on the property:

Eliminate risk by avoiding the area(s) with the identified REC(s)

Assess risk by completing a Phase II of the areas in question to better assess actual contamination.

Mitigate risk by remediation

Each EA should be closely reviewed with the Environmental Team to understand and assess potential risk to the Buyer and to accurately report the conditions at the site. Any decision to complete a Phase II will be on a case-by-case basis.

3. Natural Resource Permitting

3.1. Wetland Delineation and T&E Survey

A wetland delineation is required to identify potential wetland areas within the footprint of the Project and associated construction activities for submittal to the U.S. Army Corps of Engineers (USACE) for a determination on potential wetlands impact to be made. Compensatory mitigation will be required by the USACE and State Department of Natural Resources for impacts to wetlands. It is Entergy's position that jurisdictional wetlands are to be avoided to the extent possible without inhibiting a successful project execution.

A wetlands delineation and JD is required to determine if construction activities will impact wetlands or waters of the U.S., and a T&E species survey be performed. These are typically conducted concurrently.

As part of the T&E Survey, a habitat assessment will be performed and will focus on and offsite (adjacent properties) to determine if the proposed Project contains habitat for identified species. The habitat assessment will provide a characterization of the quality and quantity of habitat available to support the T&E species, if they exist. Habitats and sightings identified will be documented on a composite drawing. The assessment will be provided to the Entergy ES team for review. Actions that result from any sighting documentations (e.g., Agency notifications/discussions/subsequent communications, monitoring) shall be communicated as outlined in the Scope Book.

3.2. Wildlife Onsite

The Contractor shall evaluate the anticipated effects of the Project to protected species, and determine the need for an Incidental Take Permit and mitigation of impacts, or redesign to avoid impacts.

The Contractor and/or employees of the Contractor shall not take or possess any Endangered or Threatened Species as identified 50 CFR Part 10 under the authority of the U.S. Department of the Interior Fish and Wildlife Service. "Take" means to pursue, hunt, shoot, wound, kill, trap, capture, harass, harm or collect or attempt to collect these species. As this refers to animals, this is any part, product, egg, offspring, or the dead body or parts. Possession of feathers of these species will be construed as "take", even if found on the ground. Included are "Migratory Birds", whatever their origin, protected by the Migratory Bird Treaty Act, 16 U.S.C. 703711. The Entergy Environmental Specialist must approve any exceptions only after the Contractor has obtained a permit from the U.S. Fish and Wildlife Service for such activities.

The Contractor and/or employees of the Contractor shall not take or possess any species as identified by the State in which the Contractor offers service. Each State may have their own list of Endangered or Threatened Species, as well as their own prohibitions on other species as well. It is likely that nearly all animal species will be protected in some form. Any exceptions must be approved by the Entergy Environmental Specialist, including a permit from the State in which the activity will require the disturbance of protected species.

3.3. Prepare Wetlands Jurisdictional Determination

Seller will prepare a JD/Wetland Delineation report for submittal to the appropriate District of the USACE with a request for a JD. The report will contain a description of field activities, figures, Routine Wetland

Determination Data Forms, and site photographs. This report is required for the USACE to determine the limits of their jurisdiction for any wetlands or waters of the U.S. identified in the delineation.

4. Water Permitting and Compliance

4.1. Acquire NPDES Construction Storm Water Permit

Any Contractor that performs construction activities on one or more acres, must comply with Federal, state, and local environmental regulations, including, but not limited to, EPA NPDES General Permit for Storm Water Discharges From Construction Activities (40 CFR Part 122). The state issued Construction General Permit, authorizes stormwater discharges from large and small construction activities.

Projects with a state issued Construction General Permit, including construction activity clearing, grading and excavation that result in land disturbance must develop, implement, and maintain a Storm Water Pollution Prevention Plan (SWPPP) until stabilization of the project is complete.

Construction sites discharging stormwater must obtain coverage under the general construction permit and submit the following items to the permitting authority at least 2 weeks prior to commencement of construction:

1. A Notice of Intent (NOI) in accordance with the requirements of the construction permit
2. A complete Stormwater Pollution Prevention Plan (SWPPP) in accordance with the requirements of the construction permit
3. An initial permit fee (amounts vary by state) must accompany the NOI

The Contractor shall maintain and, if requested, provide the Entergy Environmental Specialist and Contract Manager with the documents listed below (as applicable) if construction activities will be equal to or greater than 5 contiguous acres:

A Storm Water Pollution Prevention Plan (SWPPP)
A subcontractor Certification to abide by the Contractor's SWPPP
The Contractor's Storm Water Permit number and other pertinent information

Contractor must designate Best Management Practices (BMPs) to optimize erosion and sediment control during construction. BMPs can be a combination of non-structural controls such as good housekeeping inspections and emergency action planning and structural controls.

The Contractor shall conduct inspections at least once every 7 calendar days.

Inspections must include all areas of the site disturbed by construction activity and areas used for storage of materials that are exposed to precipitation. Inspectors must look for evidence of, or the potential for, pollutants entering the stormwater conveyance system. Contractor shall maintain copies of these inspections onsite.

The Contractor is responsible for proper management of all waste water on construction site as directed by applicable regulations. No un-permitted discharges are allowed. The Contractor shall maintain "good housekeeping," i.e., proper storage of materials, proper disposal of trash and construction waste, and clean up and report spills appropriately.

4.2. Site Revegetation

Adequate streamside vegetation buffers should be established based on project needs and site-specific conditions identified in the U.S. Army Corps of Engineers Jurisdictional Determination of wetlands and waters of the U.S. Considerations to soil type, slope, vegetation type, root structure, mean high water mark and average annual rain fall should be appropriately reviewed during development of buffers; where feasible, root structures should be left intact and undisturbed in close proximity to water features. If a streamside buffer cannot be feasibly established, adequate BMPs should be utilized for soil stabilization.

Low growth seed mix shall be planted on all ground inside the fence line. Where feasible, non-invasive, native seed mixes should be utilized for stabilization of disturbed soils outside the fence line. Seed mix shall be recommended by the local state extension agency, and consultation with local, regional, or state NGOs, universities, co-ops, and/or ag-business professionals should be taken into account as part of the seed selection process. Areas inside and outside the fence line disturbed during construction or site remediation shall be reseeded with low growth seed mix prior to closure of the construction stormwater permit.

Seller shall consult with the local state extension agency on recommended application timing offering successful seed germination in the project area. Consideration should be given to a late spring seeding when warmer soil temperatures will favor warm-season grasses. Planting after mid-July (i.e., July 15th) is not recommended as hot and dry weather conditions increase during summer months, limiting germination and seedling survival. When a project requires a summer or fall seeding to meet regulatory requirements, consider using a cover crop and wait to plant the final seed mix in a spring seeding. Drilling, broadcast seeding and hydroseeding are planting techniques that can be utilized during spring months.

4.3. Develop a Spill Prevention, Control, and Countermeasures (SPCC) Plan for Construction

A spill prevention, control and countermeasures plan is required to be prepared and implemented prior to construction work if there will be more than 1,320 gallons on oil onsite. The SPCC plan shall include the applicable components specified under 40 CFR 112.7.

The Contractor must evaluate the site for spill prevention and control prior to beginning work.

Careful planning and consideration of placement of liquid material equipment must take into account the location of nearby water bodies, such as lakes, rivers, streams, and wetlands. In the event of a spill the contractor must immediately take action to contain the spill and remove contaminated soil. Buyer shall be notified of any spills.

Liquid material storage containers with a potential to discharge liquids into nearby waters must have some form of containment and or diversionary structures that would prevent a discharge from reaching nearby waters. At a minimum, one of the following discharge prevention systems must be used (40 CFR 112.7(c)):

- Dikes, berms, or retaining walls sufficiently impervious to contain oil or spilled material.
- Curbing
- Culverting, gutters, or other drainage systems to retain spillage on-site
- Weirs, booms, or other barriers
- Spill diversion ponds
- Retention ponds
- Sorbent materials

The Contractor shall immediately report any instances where oil or hazardous substances are spilled, leaking, or improperly stored or released. If an oily sheen is observed in nearby ditches or other bodies of water or if there are signs of a chemical release, the Contractor shall immediately take action to respond to the incident. Buyer shall be notified of any spills or releases.

Any Contractor who refuels, repairs, replaces, or dismantles petroleum filled, or other hazardous material containers, shall meet the applicable Federal, state, and local regulations. This includes, but is not limited to EPA Spill Prevention, Control and Countermeasures (SPCC) (40 CFR Part 112), RCRA, DOT Loading and Unloading Procedures (49 CFR Parts 171, 173, 174, 177, and 179).

4.4. On-site Wastewater Disposal System

Onsite Wastewater Systems and their authorizations required are discussed in further detail in Section 7.4 of these Contractor Environmental Guidelines.

5. Hazard Communication and Chemical Approval

The Contractor shall comply with hazard communication requirements found in 29 CFR 1910.1200, (OSHA) Hazard Communication Standard for all hazardous chemicals used on site during the course of the job whether supplied by Entergy or the Contractor.

The Contractors shall label in accordance with 29 CFR 1910.1200 all portable containers into which hazardous chemicals are transferred that are not intended for immediate use by the employee who performs the transfer. Labeling shall indicate the hazardous material contained in the container and provide hazard warnings.

5.1. Storage and Use of Chemicals

The Contractor shall employ best management practices (BMPs) to help reduce stormwater pollution from the use and storage of chemicals. BMPs must meet the requirements of the appropriate construction storm water general permit at a minimum, in addition to any site specific BMPs included in the Spill Prevention, Control, and Countermeasures (SPCC) plan and Storm Water Pollution Prevention Plan (SWPPP). The Contractor will be required to review and acknowledge the requirements of the plans prior to beginning work on site. As required, a copy of the SWPPP and SPCC plan and records will be maintained on site in the Contractor's site office.

The Contractor shall ensure all containers of chemical products including but not limited to lubricants, grease, cutting fluids, oils, solvents, degreasers, cleaners, paints, coatings, paint thinners, glues, adhesives, resins, desiccants, or any water-soluble material shall be kept closed at all times except when adding or removing materials.

Container lids, bungs, rings, gaskets, bands, vents and caps shall be adequate and properly secured to prevent the intrusion of rainfall into the container and spillage or evaporation of the container contents.

All containers shall be adequately labeled as to contents and hazards in compliance with the OSHA Hazard Communications Standard and with the name of the Contractor who either owns the container or is responsible for its use.

The Contractor shall maintain and not remove or deface warning labels and markings on any container of DOT hazardous materials.

The Contractor shall store all chemicals and liquid fluid materials in temporary storage facilities.

Temporary storage facilities shall provide spill containment volume for stored material equal to the volume of the largest liquid filled container stored plus 10 percent allowance for rainfall for uncovered containers.

Covered containers spill containment volume area must contain the largest container's volume released into the containment area.

All chemicals stored in a temporary storage facility shall be elevated by use of pallets or similar devices to prevent contact with any accumulated rainfall or spilled material within the containment area and to facilitate leak detection.

Temporary storage facilities shall be impervious to the materials stored there for a minimum contact time of 72 hours.

Temporary storage facilities shall be maintained free of accumulated rainwater and spills. In the event of spills or leaks, contaminated rainwater and spill material shall be placed into drums after each rainfall event. These drums shall be handled as hazardous waste unless testing determines them to be non-hazardous. Non-hazardous waste shall be disposed in accordance with the requirements of the EPC Contract.

Temporary storage facilities shall provide sufficient separation between stored containers to allow for inspection, spill cleanup, and emergency response. Drums shall not be double stacked.

Incompatible chemicals shall not be stored in the same temporary storage facility unless properly segregated.

Temporary storage facilities shall be covered during non-working days and prior to rain events. Covered facilities may include use of properly secured plastic tarps or constructed roofs with overhangs. Container labels should remain clearly visible.

The Contractor shall employ appropriate signage at temporary storage facilities to indicate any hazards present, precautions or prohibitions (i.e., "no smoking or open flame") required to ensure the safe storage of the chemicals present and to prevent accidental release

6. Waste Management

All waste generated by the Contractor or his or her subcontractors while performing task under contract to or authorized by Entergy shall be managed or disposed in accordance with the requirements of the EPC Contract.

The Contractor shall be responsible for ensuring that all wastes which he/she is herein required or authorized to dispose are disposed at a vendor approved by Entergy.

The Contractor is responsible for proper management of waste on site as directed by applicable regulations, and as directed herein.

6.1. Solid Waste Registration ID

A solid waste registration ID is required if more than 220 lbs of Class 1 waste, 220 lbs of hazardous waste, or 2.2 lbs of acutely hazardous waste is generated in a single month and more than once per year. The Contractor shall obtain a solid waste registration ID from the TCEQ, LDEQ, MDEQ, or ADEQ prior to shipping the waste offsite for disposal.

Seller is responsible for completing the required annual waste summaries and paying the associated hazardous waste generation fees.

6.2. Episodic Waste Generation

The generation of more than 220 lbs of hazardous waste, or 2.2 lbs of acutely hazardous waste, in a single month can qualify as Episodic Waste Generation as outlined under 40 CFR §262.232. Unregistered/inactive and registered generators can have either one planned or one unplanned episodic event per calendar year.

Episodic waste generators must ship the episodic waste off-site within 60 days of the start date of the episodic event. The 60-day limit for a planned episodic event starts on the first day of any activities affiliated with the event. For an unplanned episodic event, the event begins on the first day the hazardous waste is generated, regardless of whether the generator has completed analysis confirming that the waste is hazardous.

6.3. General Requirements

The Contractor shall be able to properly profile waste to waste vendors including but not limited to samples, waste analysis, SDS, origin, quantity, weight, amount, composition, characteristics, intent and type of use, reason for disposal, and other required data.

The Contractor shall employ best management practices (BMPs) to help reduce stormwater pollution from the use and storage of waste.

The Contractor shall store all hazardous waste in temporary accumulation facilities or in a permanent hazardous waste accumulation area.

The Contractor shall manage waste and maintain records of waste accumulation and disposal in accordance with the appropriate state regulations and EPA (40 CFR Part 262) hazardous waste generator accumulation rules.

Temporary hazardous waste accumulation facilities shall provide spill containment volume for stored material equal to the volume of the largest liquid filled container stored plus 10 percent allowance for rainfall for uncovered containers. Covered containers spill containment volume area must contain the largest container's volume released into the containment area.

Temporary hazardous waste accumulation facilities shall be impervious to the materials stored there for a minimum contact time of 72 hours.

Temporary hazardous waste accumulation facilities shall be maintained free of accumulated rainwater and spills. In the event of spills or leaks, contaminated rainwater and spill material shall be placed into drums after each rainfall. These drums shall be handled as hazardous waste until a waste characterization is completed.

Temporary hazardous waste accumulation facilities shall provide sufficient separation between stored containers to allow for inspection, spill cleanup, and emergency response. Container labels shall also be clearly visible and faced into the aisles if they are formed.

Incompatible waste shall not be stored in the same temporary hazardous waste accumulation facility.

Temporary hazardous waste accumulation facilities shall be covered during non-working days and prior to rain events. Covered facilities may include use of properly secured plastic tarps or constructed roofs with overhangs.

Temporary hazardous waste accumulation facilities shall be inspected weekly for the presence of rainwater inside the containment, open or damaged containers, container closure, correct labeling and marking, spills, leaks, container integrity and general housekeeping. The Contractor shall maintain copies of these weekly inspections.

6.4. Oily Absorbent Pads and Cleaning Rags

The Contractor shall dispose of all oily absorbent pads or rags in trash receptacles and ensuring the following conditions are met:

Pads and rags, once appropriately rung, do not contain any free liquids (liquids drip from waste at a rate of > 1 drop in 5 minutes).

Pads and rags do not contain any hazardous waste such as ignitable or combustible solvents or chlorinated organic compounds such as but not limited to degreasers and cleaning compounds.

Disposal of any absorbent pads and rags that do not meet these conditions shall not be disposed. Pads and rags that contain free liquid must be rung dry prior to disposal or be contained in sufficient adsorbent to bind free liquids prior to disposal.

6.5. Aerosol Cans

All spent aerosol cans that have no propellant or chemical remaining can be disposed of as non-regulated trash or recycled. This means that no liquid is felt or heard when the can is shaken by hand, and no gas or liquid is released when the spray/discharge valve is activated and the container is rotated through all directions, and the valve is not observably or known to be clogged. Non spent aerosol cans may be punctured and drained. The remaining propellent or chemical drippings must be disposed of as hazardous waste.

All aerosol cans that have propellant or chemical remaining shall be considered a “Hazardous Waste” in Louisiana and Mississippi and “Universal Waste” in Texas and Arkansas and disposed accordingly. These aerosol cans must be placed in a drum in the waste storage area. The drum must be labeled with the words “Universal Waste Aerosol Cans” or “Hazardous Waste Aerosol Cans” as applicable. All container markings must be weatherproof and clearly visible. Containers must also be marked with the site’s name. Containers must be kept closed except when adding or removing cans. When the container is full, a waste shipping paper or manifest must be completed and shipped with the container.

6.6. Antifreeze/Ethylene Glycol

The Contractor shall collect and place all waste antifreeze or ethylene glycol in a closed head 55-gallon drum appropriately labeled with a Waste Liquid Label as shown in Appendix II or alternately with the identity of the contents, Contractor’s name, and date. The Contractor shall keep the drums closed at all times except when adding or removing waste.

6.7. Batteries

Rechargeable batteries must be managed as Universal Waste. Other small, non-rechargeable, single-use batteries may be disposed of as non-hazardous office waste. The Contractor shall collect and place all alkaline, dry cell, button, spent rechargeable and non-leaking sealed small lead acid batteries in 5-gallon plastic pails appropriately labeled with the words “Used Batteries” and the date or alternately the words or label “Universal Waste”. The container must be marked with the date the first battery is placed in the container. The Contractor shall cover the terminals of all used batteries with electrical or duct tape to prevent electrical discharge or arcing prior to placing in the container. For larger batteries, terminals can be taped instead of putting the batteries in plastic bags. When the container is full but NO LATER THAN ONE YEAR from the date on the container, close up the container, and ship to the appropriate recycler.

Larger lead acid batteries must be placed in containers and labeled “Lead-Acid Batteries for Recycling” and stored in a designated accumulation area at the site. Batteries should be stored on a level surface in an upright position and secured as appropriate to prevent tipping. Batteries designated for transport must be appropriately secured and prevented from electrical short-circuit.

6.8. Truck Wash Out and Excess Concrete Waste Management

The Contractor shall perform washout of concrete trucks offsite or in designated areas. The Contractor shall wash out concrete truck waste and excess concrete into a temporary pit where the concrete can be set, be broken up, and then disposed properly. Wash waters generated during this activity should be properly disposed of according to the applicable State construction storm water general permit. BMP’s shall be established to prevent the concrete wash out water from contributing to groundwater contamination or entering the waters of the state.

6.9. Empty Containers

The Contractor shall ensure that all discarded containers (i.e., drums, buckets, cans, pails) meet the EPA’s definition of empty (the entire residue has been removed that can be removed using normal means and no more than 1” of residue remains in the bottom of the container) prior to recycle or disposal. The Contractor may crush, flatten, or otherwise render useless metallic containers > 5 gallon capacity and dispose in a scrap metal receptacle.

6.10. Filters

The Contractor shall puncture and hot drain all used fuel, lubricating oil, and hydraulic oil filters into a labeled filter collection drum containing adsorbent media.

Once the filters are drained, the Contractor shall manage them as scrap metal. The absorbent media shall be disposed.

Alternatively, the entire filter may be placed into a container provided by a used oil recycle vendor for management at a recycle facility.

The Contractor shall place used air filters in receptacles.

6.11. Lighting Waste

All spent lamps which have bright green end caps, green paint on the end, a green “dimple” on the end or green writing on the lamp can be disposed of as non-regulated trash. All others must be recycled. For Mississippi, if the facility generates less than 220 pounds/month of hazardous waste including the lamps, the facility would be conditionally exempt and may dispose of the lamps as normal solid waste.

6.12. Arkansas, Louisiana, Mississippi (if small or large generator) and Texas

The Contractor shall place all used unbroken lighting waste (fluorescent bulbs, high intensity discharge lamps, and incandescent lamps) in containers designed to prevent breakage. The containers shall be labeled or marked with the words or label, “Universal Waste”, date, and identity of the contents (i.e., HID Lamps). Containers must be marked with the site’s name and must be kept closed except when adding or removing lamps. When the container is full, but no later than 1 year from the date on the container, send the container to the waste vendor. All container markings must be weatherproof and clearly visible. The Contractor shall store and manage lighting waste to prevent breakage.

The Contractor shall place all broken lighting waste (fluorescent bulbs, high intensity discharge lamps, and incandescent lamps) in secure containers such as a 5 5-gallon bucket.

6.13. Louisiana, Mississippi (if small or large generator) and Texas

The containers shall be labeled or marked with the words or label, "Universal Waste Lamps for Recycling", with "Broken" added to the label in an indelible marker and with the date the first broken bulb is placed in the container and the site's name. Containers must be kept closed except when adding or removing lamps. When the container is full, but no later than 1 year from the date on the container, send the container to the waste vendor.

6.14. Arkansas

The containers shall be labeled or marked with the words or label, "Hazardous Waste – Broken Lamps". The container must be labeled using an indelible marker and with the date the first broken bulb is placed in the container and the site's name. Containers must be kept closed except when adding or removing lamps. When the container is full, send the container to the waste vendor for proper disposal.

6.15. Mercury Wastes

Any mercury containing wastes such as, switches, thermometers, etc., shall be double bagged by the contractor in sealed plastic zip-lock type bags, and appropriately labeled with the words or label, "Hazardous Waste", the date, and description of contents and disposed in accordance with the requirements of the EPC Contract.

6.16. Waste Paint Management

The Contractor shall ensure that wastes generated during painting operations are managed in a manner that is in compliance with applicable environmental regulations. (More info available if needed)

6.17. Sanitary/Septic, Personnel Waste Management

The Contractor shall arrange for regular sanitary/septic waste collection and off-site disposal by reputable, licensed sanitary/septic waste haulers.

The Contractor shall not dispose of wastewater from personnel washing stations, laundry or food service facilities into site stormwater drains, sanitary sewers, watercourses, conveyances, and surface impoundments.

Personnel washing station, laundry and/or food service wastewaters shall be collected, managed, and be disposed off-site by reputable, licensed sanitary/septic waste haulers.

6.18. Scrap Metal

The Contractor shall collect and place all scrap metals, metal turnings, and metal shavings in labeled scrap metal receptacles. The Contractor will ensure that no electronic or generally licensed radioactive devices are allowed to be placed into the scrap metal receptacles.

6.19. Storage Requirements

Hazardous waste must be stored in a designated waste storage area and in covered containers or be off the ground and covered so as not to be exposed to rainwater.

Each container used for on-site waste accumulation must be labeled or marked in accordance with the appropriate label (non-hazardous, hazardous, solid waste) compliant with the waste characterization. The label shall include an indication of the hazards of the contents, and the date on which accumulation began (sections 262.16(b)(6) and 262.17(a)(5)). Containers must be marked with the site's name. All container markings must be weatherproof and clearly visible.

Containers can also be labeled as "Hazardous Waste Pending Analysis" while analytical testing is being conducted, the hazard that is being analyzed, along with the date upon which accumulation began. If the waste is determined to be non-hazardous, the generator can remove the hazardous waste label at that point.

6.20. Spill Cleanup/Petroleum Contaminated Soils

The Contractor shall at all times perform his work in a manner to eliminate spills and take necessary precautions to prevent their occurrence especially around fuel and oil storage tanks, reservoirs, and containers.

The Contractor shall promptly notify the Buyer as outlined in Section 8 of all spills. The Contractor is responsible to cleanup and manage the spill material.

The Contractor shall immediately clean up and containerize petroleum contaminated soils resulting from spills in and around storage tanks, reservoirs, and containers of virgin or used fuels, oils, hydraulic fluids or used oil. The containers shall be labeled with a Waste Solid Label or with wording or labels identifying the contents, the Contractor's name and the date. Containers shall be kept closed at all times except when adding or removing waste.

6.21. Trash

The Contractor shall place all nonhazardous solid waste (trash) in labeled containers. The Contractor shall ensure that his employees do not dispose of any hazardous, universal, industrial solid, Class I, or Class II waste in trash containers. (Examples of prohibited waste include but are not limited to batteries, solvents, aerosol cans, used blasting media, contaminated rags, etc.).

6.22. Used Oil

The Contractor must label all tanks, drums, and containers that contain used oil with a Waste Liquid Label or the words "Used Oil", including the type of oil. Maintain good records of used oil shipments from the facility.

The Contractor shall keep all tanks and containers of used oil securely closed with bungs. Vents should also be in place except when adding or removing oil. Oil must never be put in open top drums.

The Contractor shall not mix used oil with other substances, such as, but not limited to antifreeze, brake fluid, gasoline, paint thinner, solvents, because doing so may render the entire mixture as a hazardous waste.

The Contractor shall immediately report any instances where oil has spilled, leaked or been improperly disposed, or improperly stored. If an oily sheen is observed in nearby ditches or other bodies of water, the Contractor shall immediately take action to eliminate the source of the oil and remove and manage the spilled material. The Contractor shall promptly notify the Buyer as outlined in Section 8 of all spills

Only use permitted used oil processors/refiners for recycling and only use permitted transporters for the transport of used oil in quantities greater than 55 gallons. For quantities greater than 55 gallons, used oil shipments must be accompanied by the DOT used oil shipping document and the transporter must keep a record of the shipment.

The Contractor shall comply with the applicable oil spill prevention, control and countermeasure regulations.

7. Other Environmental Permitting

7.1. Aboveground Storage Tanks

The Contractor shall immediately notify the Entergy Environmental Specialist or Contract Manager should there be accidental contact with underground or aboveground storage tanks, piping and/or associated equipment that results in, or is anticipated to result in, a release of contents, or if they notice any leaks or spills.

Any Contractor who removes, repairs, replaces, or refuels/refills underground or aboveground storage tanks and/or associated equipment must meet all Federal, state, and local environmental regulations governing these tanks and equipment. This includes, but is not limited to, EPA Underground Storage Tanks (40 CFR Parts 280 and 281), EPA SPCC regulation (40 CFR 112), DOT Transportation of Hazardous Materials (49 CFR), and RCRA hazardous waste regulations (40 CFR 240281), and State specific requirements.

7.2. On-Site Sewage Facilities (Septic Systems)

7.2.1. Texas Requirements

An on-site sewage facility (OSSF) permit and an approved plan are required to construct, alter, repair, extend, or operate an OSSF per 30 TAC Chapter 285, Subchapters A and D. Seller must construct and operate the wastewater system in accordance with all permit conditions and requirements per 30 TAC Chapter 285, Subchapters A and D.

Seller shall contact the TCEQ prior to construction of the OSSF to determine applicability of a TPDES permit. Seller shall comply with all reporting, testing, record keeping and maintenance requirements associated with the TPDES permit, if required.

7.2.2. Arkansas Requirements

An Onsite Wastewater System construction permit and operating permit are required from the Arkansas Division of Health or its authorized agent, prior to construction or operation of an on-site wastewater system.

An NPDES Individual No-Discharge Permit from the ADEQ is required prior to construction of an on-site wastewater system with a spray-field application of effluent. Seller shall contact ADEQ prior to construction to determine applicability of the NPDES permit. Seller shall comply with all reporting, testing, recordkeeping and maintenance requirements in the NPDES permit.

7.2.3. Mississippi Requirements

A notice of intent (NOI) and Permit/Recommendation for water service connection must be filed with the Mississippi State Department of Health (MSDH) for approval of an on-site sewage treatment and disposal system per MSDH, Part 18, Subpart 77.

7.2.4. Louisiana Requirements

Approval of the on-site sewage treatment system must be granted by the Louisiana Department of Health, Office of Public Health and the Louisiana DEQ. LDEQ authorizes wastewater discharges for General Sanitary Permits under the Louisiana Water Discharge Permit System in LAC 33: Part IX Chapters 3 and 7.

8. Project Environmental Considerations

For projects located in Texas, Buyer is required to submit a Certificate of Convenience and Necessity (CCN) application to the Public Utility Commission (PUC) for a new generating facility. In Arkansas, Buyer is required to submit a Certificate of Environmental Compatibility and Public Need to the Arkansas Public Service Commission for a new generating facility.

Texas (see Rule 16 Texas Administrative Code [TAC] § 25.101(b)2).
Arkansas: See Ark. Code Ann. § 23-18-501, et. Seq. (the "Utility Facility and Economic Production Act")
The Buyer must be prepared to address its environmental considerations made while designing the proposed project. In Arkansas, Buyer shall prepare an Environmental Impact Statement to address the Project purpose and necessity, the existing environment, evaluation of alternatives, environmental impacts, unavoidable effects, irreversible/irretrievable commitments of resources, and recommended mitigation measures.

In Texas, an Environmental Assessment (EA) shall be prepared to address the CCN considerations provided below from the Public Utility Regulatory Act:

Sec. 37.056. GRANT OR DENIAL OF CERTIFICATE.

(c) The commission shall grant each certificate on a nondiscriminatory basis after considering:
(4) other factors, such as:
(A) community values;
(B) recreational and park areas;
(C) historical and aesthetic values;
(D) environmental integrity;

The content and format of the EA should be guided by the Texas Parks and Wildlife Department Suggested Guidelines for Preparation of Environmental Assessment Documents.

9. Site Conditions

Contractor shall have the sole responsibility of satisfying itself by personal inspection or otherwise concerning the nature and location of Work and the general and local conditions.

If in the performance of the work at the project the Contractor encounters any Hazardous Substance, pollution or contamination, Contractor will notify the Entergy Environmental Specialist or Contract Manager immediately, and before such conditions are disturbed. Handling or removal of any hazardous substance, pollution or contamination will be in accordance with Contractor's agreement or contractual provisions.

***** END OF APPENDIX 14 *****