Appendix B-2
Scope Book

for

2021 Request for Proposals
for
Build-Own-Transfer
Solar Photovoltaic Resources

Entergy Texas, Inc.

July 15, 2021

APPENDIX B-2

FORM OF SCOPE BOOK

(Exhibit A to BOT Agreement)

TABLE OF CONTENTS

1 GENERAL DATA[1]

This Exhibit A, including its attachments, is the Scope Book. This Scope Book describes certain requirements with respect to the Work. 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. In performing the Work, Seller shall comply with the requirements specified in this Scope Book, all Laws and applicable Permits, and the other elements of the Performance Standard.

This Scope Book provides the minimum functional specification (MFS) for the Project, including scope and design requirements. In addition to the requirements set forth in the Agreement (including this Scope Book), the high voltage (HV) substations and the HV transmission lines shall comply with all requirements specified in the GIA or any other Required Deliverability Arrangement.

This Scope Book is part of the B-O-T 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.

Without limiting the other provisions of this Exhibit A and the Agreement, this Scope Book includes elements that apply to the work contemplated by and the provisions set forth in Appendix 9 - Collector Substation and Appendix 10 - High Voltage Overhead Transmission Line. These elements include, among others, project controls; cyber security; 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:

- PV Modules
- Trackers
- Inverters

[1] **NTD:** 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. ELL reserves the right to issue an updated version of the Scope Book at a later date.

- Battery Energy Storage System (BESS)
- Transformers
- Switchgear
- High Voltage (HV) Substation
- Control System (including charge controllers and battery energy management system)
- Balance of System (BOS) and Auxiliary Equipment
- Backup Power Supply/Emergency Generator, if required for equipment protection or personnel safety (i.e., Container/Enclosure HVAC and emergency lighting)
- Access and internal roads
- Water, fuel, power and all other utilities.

Seller shall provide all other ancillary equipment, systems, materials, and components necessary to deliver to Buyer a fully functional and operational Project meeting the Performance Standard. Among other things, the Project will be designed to comply with at least the following principles: allow safe, reliable, long-term operations; provide maintenance access for all equipment according to the Performance Standard (including OSHA); achieve at least a thirty (30)-year life (recognizing that the theoretical design life of the PV modules and inverters used in the Project will be twenty-five (25) years; 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 power to the interconnected electric grid; minimize adverse local community impacts; minimize impact of fire and natural hazards on site equipment and otherwise adhere to the Performance Standard.

The Project design shall provide for, and the completed Project shall allow, the free and unimpeded access of individuals and vehicles, equipment, and items that will perform vegetation management and related maintenance activities down and along any rows to maximize the efficiency of such activities; that is, to allow entry from either end of each row, free and unimpeded passage down the entire length of that row, and free and unimpeded exit from the other end of that row. Splice boxes may not be placed between rows in the Project. Combiner boxes and/or string inverters for panels in a row must be placed in direct line with the relevant row, and not to either side of the row, and must not be more than 3 feet from the end of the row.

1.2 Site Description

1.2.1 General

The Project Site is located in ______________, as further identified on Appendix 6.

1.2.2 Climatic Conditions

The Project shall be designed taking into account, in accordance with the Performance Standard, the climatic conditions set forth in Appendix 3 and any other climactic or environmental conditions that would reasonably be expected to be encountered or occur at the Project Site during the expected Project life. The Project equipment, materials, and components incorporated into the Project shall be suitable and, to the extent applicable, rated for such climatic conditions. The Project shall be capable of sustaining minimal damage and operating properly at such conditions.

Performance modeling for the Project shall utilize the Typical Meteorological Year (TMY) file set forth in Appendix 5, which is based on the solar resource assessment report provided to Buyer by Seller.

1.3 Codes and Standards

Without limiting the other requirements applicable thereto, 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 and standards. Without limiting Section 2.1 of the Agreement, in the event of a conflict between the requirements of different codes and standards (or other Laws) applicable to the Project or the Work, the most stringent requirement shall govern and control. In the event a code or standard (or other Law) applicable to the Project (including any code or standard (or other Law) expressly referenced in this Scope Book or other provision of the Agreement) is superseded by another code or standard (or other Law), the more stringent standard or code (or other Law) shall apply and be complied with.

Despite language in NFPA 850 suggesting that compliance with NFPA 850 is “advised, but not required,” for the purposes of this Agreement and the Project, compliance with the recommendations in NFPA 850 is required except to the extent a deviation from a recommendation (i) is supported and documented in writing by an engineering justification prepared by a qualified individual with direct knowledge of the matter and (ii) has been accepted by the Authority Having Jurisdiction. For purposes of the Project and NFPA 850, Entergy Risk Engineering is the Authority Having Jurisdiction on behalf of Entergy’s multiple insurance underwriters.

Seller shall perform the Work and otherwise cause the Project to comply with the applicable standards set forth in Table 1 below.

Table 1. Applicable Standards	
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
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
IBC	International Building Code
ICE	Institution of Civil Engineers
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
ISO	International Standardization Organization
NEC	National Electrical Code
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
UL	Underwriters Laboratories

The PV Modules included in the Project must be certified to UL 1703, IEC 61215, and IEC 61730 by a nationally recognized testing laboratory (NRTL). UL, CSA, Intertek, MET Laboratories, TUV America, and TUV Rheinland of North America are recognized NRTLs.

The PCUs included in the Project must be certified to UL 1741 SA and IEEE 1547 by an NRTL.

The BESS used in the Project must be certified to UL 9540, UL 1741 SA and IEEE 1547 by an NRTL.

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 the milestones set forth in Table 2 below.

Table 2. Project Milestones	
Milestone	**Date**
Full Notice to Proceed	
Begin Construction	
Mechanical Completion	
Closing	
Performance Testing Completed	
Substantial Completion	
Final Completion	

1.5 Project Controls

1.5.1 Project Execution Plan

Seller shall submit a Project Execution Plan (PEP), which will include:

- Health, Safety, and Environmental Plan
- Quality Assurance/Quality Control Plan
- Project Custody Plan
- Project Organization Plan
- Engineering Plan
- Contracting Plan
- Procurement Plan
- Construction Plan
- Document Control Plan
- Project Risk Register
- Schedule Management Plan
- Preliminary Baseline Level I and Level II Project Schedules and WBS
- Performance Measure Baseline
- Site-Specific Fire Protection Design Basis Document.

1.5.2 Project Schedule and Schedule Management

Seller shall develop a Project Schedule in accordance with the requirements of this Scope Book. The Project Schedule shall be a linked network of time-phased, project-planned discrete activities keyed to the Project's scope of Work and the requirements of the Agreement and any applicable Ancillary Agreement. The Project Schedule shall contain critical target dates, project milestones, contractual events, deadlines, Project decision points, deliverables, and related activities to plan, coordinate, check the status of, and monitor the progress of the Project. The Project Schedule shall be developed in a version compatible with Primavera Version 6.2 or Microsoft Project in native format.

Seller shall provide three (3) levels of the Project Schedule as follows:

- The Level I Schedule shall be an integrated Project summary schedule showing major activities and milestones in a Gantt chart format with network features to show major constraints and shall be provided within the first (1st) monthly report. Level I Schedule activities will be work breakdown structure (WBS) summary tasks that are driven by the Level II WBS summary tasks. The Level I Schedule shall be an executive management tool used to monitor overall Project status and shall align with the Project's WBS.

- Like the Level I Schedule, the Level II Schedule shall be deliverable-based and aligns with the Project's WBS. When summarized, the Level II Schedule shall also be used to validate the Level I Schedule. A key objective of the Level II Schedule is to bring all Project functions together to identify critical activity sequences and risks and resolve conflicts and restraints. 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 the critical path method (CPM) precedence diagram form. Seller shall clearly identify and define the critical path of the Work and the Project in the Level II Project Schedule. The preliminary baseline Level II Schedule will be provided by Seller within forty-five (45) days after the Effective Date. Seller shall provide to Buyer the final Project baseline Level II Schedule with the first (1st) monthly report.

- The Level III Schedule shall consist of a CPM network that clearly defines the sequences and restraints between activities at a detailed level. The Level III Project Schedule will be a fully integrated schedule with activities initially developed based on the Level I and Level II Project Schedules. Like the Level I and Level II Project Schedules, each activity in the Level III Schedule shall be of sufficient detail to assure adequate planning and execution of the Work throughout its duration. In addition, each Level III Schedule shall include a basis of schedule. Within sixty (60) days after the FNTP Date, Seller shall provide to Buyer the baseline Level III Schedule including the associated basis of schedule. The initial Level III Schedule will be frequently updated during Project execution utilizing the rolling wave planning methodology.

Seller shall provide a Schedule Management Plan, as part of the PEP, which sets forth the required schedule development approach, schedule content, update process, baseline management practices, and change management procedures. Seller shall prepare, maintain, and update the Project Schedule according to the Schedule Management Plan and the Performance Standard.

Each of the following requirements shall apply to each level of the Project Schedule (including any updates thereto):

- The logical network thereof shall be constructed primarily using the finish-to-start relationship type
- Seller shall prepare each level of the Project Schedule submitted to Buyer such that it describes a complete, realistic Work plan demonstrating completion of the Work in advance of the Guaranteed Substantial Completion Date
- Seller shall use CPM scheduling techniques in scheduling software
- The schedule option for retained logic must be used
- All calendars and activity codes assigned within the schedule must be assigned at the "Project" level and not at the "global" level
- Excluding procurement activities, Seller shall schedule Work activities in days with any Work activity requiring more than fourteen (14) days to complete being broken down further into shorter duration activities, unless Owner otherwise approves a single Work activity including a duration of more than fourteen (14) days. Each activity included in the Project Schedule shall be of sufficient detail to assure adequate planning and execution of the Work.

The Project Schedule shall not include any open-ended schedule logic, unless otherwise agreed by Buyer, except that the Final Completion milestone shall not have a successor.

1.5.3 Project Controls Reporting

Without limiting Seller's obligation to provide other documents required to be delivered under this Scope Book or the Agreement, Seller shall submit monthly reports in accordance with Section 6.2 of the main body of the Agreement (in PDF and in native file), which shall include:

- Updated Project Schedule
- Updated schedule narrative including descriptions of the following:

- Progress narrative
- 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

- Updated commodity reporting matrix breaking down key scopes of work
- Updated cumulative and monthly planned vs. actual physical progress s-curve (physical percent complete).

Beginning with mobilization to site and continuing until Substantial Completion, the Seller shall submit, in addition to the monthly report, a weekly report of the status of work completed for the prior week. The weekly report for the prior week shall be submitted to Buyer by no later than 5:00 p.m. of each Tuesday. The weekly report shall include: Safety Statistics (to be agreed to by Seller and Buyer), key Commodity reporting (including Budgeted Quantity, Baseline Planned Installed Quantity for the prior week, Baseline Planned Cumulative Installed Quantity thought the prior week, Actual Installed Quantity for the prior week, and Actual installed quantity Cumulative through the prior week), Four Week Schedule (Including prior week actual activities worked and completed, and the upcoming three week forecast of activities to be worked), Equipment and Material receiving summary, Construction Status Narrative, Prior Week Weather Summary, and Construction Manpower Forecasting (including weekly Baseline Planned and Actual FTEs onsite). Beginning with mobilization the Buyer shall be provided all weekly and monthly reporting provided to Seller by Seller's Contractors or Subcontractors. Nothing herein shall limit Seller's obligation to provide to Buyer other reports and information in accordance with the other terms of this Agreement.

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 3 below.

Table 3. Units for Calculation	
Measurement	**Units**
Area	Acre
Dimensions	Ft
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

1.6.2 Language

Seller shall provide all information in the English language.

2 SCOPE OF WORK

2.1 General

Without in any way limiting the definition thereof or the other terms of the Agreement, the Work shall include:

- The survey and assessment of the Project Site
- The 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 the PV Plant, the BESS, the HV substation and the HV transmission line(s)
- Onsite quality control assurance and control programs, which shall include torqueing of electrical connections and mechanical mounting fasteners
- The works and services related to preparation, civil, mechanical, electrical, I&C, and communication
- The security of the Project Site
- The utilities and interconnections needed for construction, commissioning and testing such as potable/non-potable water, temporary power, telecommunications and internet, and fuel.

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, including Exhibits 2, 3, and 4 and the accompanying text, and the remainder of the Performance Standard. Seller shall cause all design and engineering Work to be performed in accordance with all Laws (including codes and standards), applicable Permits, and the other elements of the Performance Standard. The design shall meet the interface requirements of the ETI Transmission System, including communications and battery limits.

The energy and other products delivered to the grid shall comply with the requirements of the GIA and all other elements of the Performance Standard.

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. As a general principle, the latest/most modern, commercially proven, and up-to-date technologies shall be utilized, with the objective of maximizing value to Buyer.

The Project shall include a well-established classification and identification ("tagging") system in all phases. Seller shall use a consistent tagging system across the Project and obtain Buyer approval prior to implementation of the tagging system.

Appendix 7 sets forth the list of Approved Vendors for the equipment specified therein. Pursuant to Section 5.8 of the Agreement, Seller may only procure the equipment specified in Appendix 7 from an Approved Vendor.

Seller shall provide documentation, as further detailed in Section 9.1 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 issuance for construction

Seller may deliver documents for a given system as it reaches a design milestone instead of delivering all documents in a single package. Buyer shall have ten (10) Business Days to review and provide comments to each set of design documents provided by Seller. Seller shall consider in good faith 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 design documents, Seller shall promptly notify Buyer in writing of, document (for Buyer's review), and describe with reasonable particularity any changes made thereto, as a result of Buyer's comments or otherwise, and provide Buyer a reasonable opportunity (specified to Buyer in writing in the corresponding transmittal notice), but under no circumstance less than five (5) Business Days, to review and comment on the modified design documents. This process shall continue until Seller proposes no additional changes to Buyer or Buyer provides no additional comments to Seller. Seller's continuation to the next phase of the Project without Seller first obtaining Buyer's acceptance of each set of preliminary designs will be at the sole risk of Seller. Without limiting the Change Order restrictions in Article VIII of the Agreement and other Change Order-related terms, no Change Order will be issued by Buyer for any additional Work or rework performed by Seller or required due to such continuation of work without Buyer's prior approval. Seller shall notify Buyer in writing upon each achievement of the design milestones set forth above and upon the issuance for construction of the detailed design documents for the Project.

The basis of the Project design shall be a thirty (30)-year design life (Design Life) and the requirements of the Agreement (including the Performance Standard), the Project Site, meteorological and environmental conditions, technical requirements and specifications (including the specifications for Goods and services set forth in the Scope Book), and other elements of the Performance Standard. The preliminary Project Site layout in Appendix 6 to the Scope Book (Preliminary Project Site Layout) sets forth the preliminary layout of the Project, including certain Project design parameters, such as, for example, ground cover ratio, selected DC:AC ratio, tracker, rack configuration, PV Module specification sheet and watt class, inverter specification sheet and selection, PCS (inverter station/skid) configuration, Electrical Interconnection Facilities voltage and substation location, access road specifications, to include width, internal turning radii, and surfacing cross section, Project Site ingress/egress, confirmation of stringing (1500Vdc), Project generation tie lines and the Electrical Interconnection Point in accordance with the GIA and other requirements of the Agreement, and other items. The basic Project design is based on or derived from the proposal submitted in the RFP that led to the Agreement. The detailed design of the Project will be finalized, in accordance with and subject to the terms of the Agreement, following the FNTP Date. Notwithstanding anything to the contrary, the final detailed design and the design changes permitted by the Agreement (see, e.g., Appendices 2, 3, and 4 hereto and the classifications therein) may not reduce the Design Life, decrease the Expected Energy Yield (defined below), adversely affect the Base Case Reliability (defined below), or increase the costs to Buyer of ownership, use, operation, or maintenance of the Project or products therefrom, including the levelized costs of energy. The "Expected Energy Yield" for the Project is the one-year P50 Project PV system energy performance calculated by the Energy Model in accordance with Section 4 below. The reliability of the Project is based on the specifications for the Goods set forth in the Scope Book and the original equipment manufacturers warranties (the Base Case Reliability).

2.3 Civil and Structural

The civil and structural Work includes:

2.3.1 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)

- 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. Roads shall be designed of sufficient bearing capacity and in accordance with the Performance Standard. The following shall be included as a minimum:

    - Main access road(s)

    - Internal roads

    - HV Substation access road(s)

    - Transmission line maintenance road(s)

- Security fence and surveillance system and lighting system

- Access gate

- All civil works for the solar arrays, including:

    - Complete civil works for the solar field, including foundations for the Tracker structure and equipment

    - Trenches

    - Service roads

    - Onsite infrastructure

- All civil works for the HV Substation

- All civil works for routing and installation of the transmission line

- Any other outdoor civil works required inside the Project Site or as needed for interconnection of the Project to the ETI Transmission System.

2.3.2 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 MV and LV system cables, perimeter lighting, surveillance, I&C system, etc.

- Civil works for equipment such as PCUs, transformers, switchgear, and enclosures, including their corresponding foundations

- Civil works for power evacuation lines from the Project's solar arrays to the HV Substation
- Civil works within the HV Substation area for power evacuation
- Civil works for the power transmission line from the HV Substation to the Electrical Interconnection Point, including tower foundations, if required
- Civil works for the Electrical Interconnection Point, if required
- Underground cable for MV and data connections inside of the PV array
- Connecting MV and I&C cables to the agreed interface points
- Power and control cabling
- Transformer foundation(s)
- PCU foundations
- Switchgear foundation(s)
- Enclosure foundation(s)
- Metering (operational meters, see Section 3.6 below)
- Any other outdoor civil works related to the electrical and I&C systems.

2.3.3 [Reserved]

2.3.4 Storage

A storage area on the Project Site that will be located, sized, and secured in accordance with the Performance Standard 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.

2.4 Mechanical

Each Tracker shall include the following systems and components:

- Supply and assembly of a suitable main racking/tracking structure and anchor to structure foundations for the specified site conditions
- Supply and assembly of suitable substructure (racking system and/or tracking system) and attachment to PV Modules for the specified conditions

- Corrosion protection.

2.5 Electrical

2.5.1 Solar Array and DC Distribution

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

- PV Modules
- PV Module string connectors
- PV Module mounting clamps
- Solar cabling
- Grounding system and connection
- Fused DC combiner boxes
- DC disconnect switches
- Surge arrestors and lightning protection

2.5.2 Power Conversion Stations and PV Collection System

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

- Power conversion system(s)
    - PV DC to AC power inverter(s)
    - AC disconnect switches
    - Transformer(s)
    - Switchgear
    - Auxiliary equipment and systems (including HVAC or other cooling systems)
- Backup power supply and uninterruptible power supply (UPS), if applicable
- Grounding
- Lightning protection system, if applicable
- Conduits and cable trays

- Cables
- Relay protection
- Lighting systems (including emergency lighting)

2.5.3 MV Distribution and HV Substation

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

- HV switchgear, if applicable
- MV switchgear
- MV/HV transformer(s)
- Switchyard buses
- Revenue metering
- Circuit breakers
- Disconnect switches
- Overhead line
- Backup power supply/emergency generator
- UPS
- HVAC
- Grounding
- Lightning protection system, if applicable
- Conduits and cable trays
- Cables
- Relay Protection
- Lighting systems (including emergency lighting)
- I&C system (including fire alarm system).

2.5.4 Auxiliary Supply System

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

- Auxiliary transformer(s)
- LV switchgear
- LV panelboard
- Busducts and cables
- Conduits and cable trays
- Protective devices for inverters, transformers, MV and main LV switchgears
- Required protection systems
- Lighting System (including emergency lighting)
- Grounding
- Electrical workshop equipment
- Backup power supply/emergency generator (including UPS)
- Lightning protection system, where applicable
- Fire suppression for high value or potentially dangerous equipment and other items stored on the Project Site (e.g., spares in the storage warehouse), unless the exclusion of fire suppression for such equipment and items is approved in writing in advance by the Entergy Risk Engineering group.

2.5.5 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
- Human Machine Interface (HMI) to operate and monitor the Project from the control room

[2] A distribution 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.

- Meteorological, or “met”, weather stations as described in Section 3.5.3 below
- Revenue metering systems at the HV 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 HV Substation control system
- 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

2.5.6 Battery Energy Storage System[3]

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

- Battery container(s)/enclosure(s)
- BESS power conversion system(s)
  - BESS bidirectional power inverter(s)/converter(s);
  - Transformer(s)
  - Switchgear
  - Auxiliary equipment and systems
- Grounding
- Conduits and cable trays
- Cables
- Relay Protection
- Metering System

[3] **NTD:** To be included for Projects with a battery component.

- HVAC System, fully redundant
- UPS System
- Instrumentation and Control System (including firefighting system)
- Explosion/deflagration (thermal runaway) mitigation equipment.

2.6 Environmental Requirements

Without limiting the other terms of the Agreement, including the other elements of the Performance Standard, Seller shall design, build, operate, and maintain the Project to meet all applicable Environmental Laws and Permits. 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 Permits. Applicable standards for Environmental protection must be fulfilled without any restriction.

Without limiting the other terms of the Agreement, including the other elements of the Performance Standard, 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 Environmental Assessment conducted by the Environmental Consultant. Buyer shall have to the right to witness the performance of the Environmental Assessment and to communicate directly and in real time with the Environmental Consultant regarding any Environmental Assessment.

2.7 Site Fire Protection

Seller shall provide to Buyer a complete set of the fire protection design basis documentation for the Project Site for Buyer's review and approval and shall not release equipment and material purchase orders for the Project prior to obtaining such Buyer's approval. NFPA 850, Chapter 14 (Paragraphs 14.2 and 14.4), and applicable sections in Chapters 4-10 is the current standard by which Buyer and Buyer's insurers measure property and asset protection and actions taken to mitigate fire risks to Buyer's insured assets. Buyer intends to utilize Chapter 14 and other applicable sections of NFPA 850 as a basis for Buyer's review of the fire protection design basis documentation provided by Seller. This set of documentation will be updated from time to time to include and record all fire protection design decisions as the Project progresses.

2.8 Site Security - Construction

The Project Custody Plan to be developed in accordance with Section 12.1(b) of the main body of the Agreement shall include the following:

- Surveillance equipment to detect unauthorized access to the Project SitePerimeter security fence
- Project Site access gate with interface for manual key entry
- Locks on any building on the Project Site that contains microprocessor-based relays

Seller shall ensure that the security systems comply with all requirements of Law, applicable Permits, and the other requirements of the Performance Standard.

2.9 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 provide safe, secure, weatherproof, and functional offices on the Project Site, complete with electrical, telephone, water supply, air conditioning/heating, drainage, and sewage disposal services for Buyer's use during the construction of the Project.

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.

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.

2.10 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, approximately 16 weeks prior to Substantial Completion, a list of recommended spare parts and Consumables, including the list price of each item. The recommended spare parts and Consumables should be classified in such list 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 during construction, commissioning, and testing without charge to Buyer.

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.

2.11 <u>Project Utilities</u>

In accordance with Section 5.4 of the main body of the Agreement, Seller shall procure, and provide the necessary means of transportation and delivery to the Project Site of, each commodity, utility, utility product, and service necessary or desirable for the performance of the Work.

2.12 <u>Redundancy Concepts</u>

Seller shall cause the Project to satisfy the following general redundancy requirements:

- If a failure in an instrument or in a control component can directly or indirectly cause the failure of the whole system, redundant instrumentation shall be provided.

- The trip or outage of any single equipment or any single piece of auxiliary equipment shall not affect the operation of the Project.

Elements that shall be provided with full redundancy include:

- Communication links between LCS and the remote-control facilities

- Battery Container(s)/Enclosure(s) HVAC systems

- Backbone IT switches

3 TECHNICAL REQUIREMENTS

3.1 General System Requirements

The Project and all equipment, systems, materials, and components included as part of the Project shall be designed for at least a thirty (30)-year useful life expectancy.

The rated power of the Project, as included in of this Scope Book is sustained throughout the Project and the redundancy requirements in Section 2.12 of this Scope Book are satisfied.

Seller shall perform and complete the Work in a thorough, professional manner utilizing personnel skilled, competent, and appropriately licensed in their various trades, notwithstanding any omission from this Scope Book or the Agreement. All parts shall be made accurately to standard gauge when possible so that renewals and repairs may be made when necessary with the least possible expense.

The Project design shall be effective in engineering characteristics and comply with the requirements stated herein. All equipment, materials, and components shall comply with the requirements of this Scope Book.

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.

Without limiting the foregoing, 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 ETI Transmission System. The Project shall be designed to suppress EMI effects and must meet the specifications of the latest revision of IEEE 519.

Seller shall take necessary precautions to ensure that the panels installed at the Project or included in Inventory do not degrade or experience diminished performance as a result of micro-cracking, micro-fracturing, or similar damage to the panels.

The system shall be of 1500Vdc design.

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 and, without limiting Section 3.4.2 below, the economical performance of vegetation/real property management services. 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.

PCU and other high-profile electrical equipment shall be placed on the Project Site in a manner to prevent or, if not possible, minimize shading on the PV Modules.

3.2.2 Accessibility

3.2.2.1 Vertical Clearances at the Project Site

Without limiting the requirements of the Performance Standard, the following minimum vertical clearances shall be used in the design and construction of the Project:

- Walkways and platforms: 7 feet, 6 inches
- Work areas and aisles for forklifts: 10 feet
- Work areas and access routes at grade: 10 feet.

Appendix 9 - Collector Substation and Appendix 10 - High Voltage Overhead Transmission Line have additional constraints.

3.2.2.2 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.

Appendix 9 - Collector Substation and Appendix 10 - High Voltage Overhead Transmission Line have additional constraints.

3.2.2.3 Row Spacing

Row spacing must provide a minimum of 10 feet clear space between Trackers to allow access for vegetation control or other plant maintenance. Distance shall be measured as the minimum distance at any time during operation.

Special consideration shall be given to minimize vegetation control efforts (e.g., grass mowing, trimming) at the Project Site, including providing ample row spacing for maneuvering of equipment and sufficient elevation to permit ease of vegetation removal below the PV Modules.

3.2.3 Geotechnical Investigation

Seller shall conduct geotechnical investigations on the Project Site in accordance with the Performance Standard. Without limiting Section 2.3 of the main body of the Agreement or the other requirements of the Performance Standard, 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.

3.2.4 Site Clearing, Grading, and Soil Improvement

Seller shall design the general grading of the Project Site taking into account the requirements of the selected Trackers and 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 in accordance with the Performance Standard. Seller shall ensure that all Project grading and drainage and access roads are designed to the requirements of all Laws and applicable Permits.

Without limiting Section 2.3 of the main body of the Agreement or the other requirements of the Performance Standard, 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.

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.

Backfill for trenches shall be selected to prevent physical damage to raceways or cables. If existing soils contain large rocks, paving materials, cinders, large or sharply angular substances, or corrosive materials, then protection shall be provided in the form of granular or selected material. The backfill of trenches shall be tested for design compaction requirements.

Any debris or unsuitable material shall be removed from the site and properly disposed of in accordance with local Laws, applicable Permits, and the Performance Standard. If necessary, any surplus soil shall be transported to another suitable area inside or outside the Project Site.

Seller shall obtain all required Project Work Permits and Project Operational Permits from applicable Governmental Authorities. Seller shall locate the Work from horizontal and vertical control monuments. Seller shall locate, identify, protect, and flag as necessary or appropriate all utilities, structures, facilities, sidewalk, curbs, fences, paving, vegetation, and other features that exist on the Project Site. If the removal or relocation of utilities is required, Seller shall notify utility companies.

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 Project 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 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 latest version of the codes and standards, as per Section 1.3 of this Scope Book, and the other requirements of the Performance Standard.

3.2.6 Drainage and Stormwater Management

Without limiting the Performance Standard, the Project shall have, and Seller shall be responsible for developing, constructing, and maintaining through the Substantial Completion Date a Project Site stormwater management plan that meets all 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, channels, manholes, stormwater swales, surface flow, outlets, or other components for collecting, directing, and disposing of storm water from the Project Site. 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.

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 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.

When culverts are utilized, the culvert inlets and outlets shall be provided with end sections and permanent erosion protection.

Areas of the Project Site not included in or affected by the Project shall be left in their existing condition.

The Parties acknowledge that an offsite fire department response to a fire at or threatening the Project Site likely will include the spraying or use of significant quantities of water or fire retardant material to protect the Project and reduce the risk of property damage, personal injury, or other harm or casualty. Seller shall design, engineer, and construct the Project to direct water introduced to the Project Site to suppress fire or mitigate fire risk to an approved safe location and contain such water within such location in accordance with the Performance Standard.

- Spill containment for Project transformers shall be as addressed in the SPCC Plan. Where applicable, the equipment, systems, structures, and other means for containment of firefighting water used for transformer fires or incidents shall be designed, engineered, and sized to accommodate, provide, or include, at a minimum, each of the following without uncontrolled flooding on the Project Site or off-site discharge:The spill of the largest single container of any flammable or combustible liquid in the area
- The maximum expected manual hose streams (below) for ten minutes
- Where open pits are used for transformer containment, a 12-inch layer of rock between steel gratings should be provided at the top of the pit.

The Project's equipment and systems affecting fire hose flow from the local fire department response for containment and runoff considerations shall provide at least the following capacity flow volumes:

- 500 GPM for all lube oil and liquid fuel hazards on the Project Site regardless of quantity
- 500 GPM for all outdoor transformers on the Project Site containing > 1,000 gallons mineral oil
- 250 GPM for all outdoor transformers on the Project Site containing < 1,000 gallons mineral oil.

3.2.7 Erosion Control

An erosion and sediment control plan shall be developed by Seller's professional engineer licensed 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. 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, 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).

3.2.8 Foundations

Foundations shall be designed, constructed, and completed in accordance with the applicable codes and standards listed in Section 1.3 of this Scope Book and the other elements of the Performance Standard.

Foundations shall be designed, constructed, and completed to take into account the site climatic conditions (including, heat, cold, rain, wind (including maximum wind speeds recorded in the region)), soil conditions, and seismic loads, and thermal loads caused by expected fluctuations of materials and ambient temperatures.

Foundations for outdoor electrical equipment shall be elevated above ground to prevent any equipment, parts, systems, or other items (excluding the foundation) from coming in contact with surface water or runoff. The minimum height of the above-ground portion of any such foundation (measured from the top of ground level) shall be the greater of (i) the height required by the Performance Standard based on the results of the hydrological study for the Project/Project Site conducted in accordance with the Performance Standard plus an additional six inches (6") of safety margin and (ii) twelve inches (12").

3.2.9 Corrosion Protection

Seller shall be aware of and take into account the corrosion problems that would reasonably be expected to be encountered on the Project Site, especially with outdoor equipment. Seller shall provide corrosion protection for concrete and steel structures in accordance with the Performance Standard. Without limiting the foregoing, and for the avoidance of doubt, non-galvanized steel shall not be used for piles.

3.2.10 Roads

Roads and bridges shall be designed in accordance with the requirements of Law, applicable Permits, and the other elements of the Performance Standard. 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.

Without limiting the Performance Standard, new roadway lanes shall have widths of no less than twelve (12) feet. Where a new road meets an existing road, the width of the new road shall smoothly transition back to the width of the existing road.

Access roads to each PCU shall have a minimum width of sixteen (16) feet with a minimum shoulder width of two (2) feet on each side of the road (at least twenty (20) feet in total).

If determined by Seller to be necessary for the Project, perimeter roads shall have a minimum width of twenty (20) feet with a minimum shoulder width of two (2) feet on each side of the road (at least twenty-four (24) feet in total).

At road intersections within the Project Site, the minimum turn radius shall be twenty-five (25) feet.

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.

The existing grade of any road shall be compacted to an acceptable level meeting the Performance Standard or replaced and compacted with suitable material, if necessary, and the sub-base, base, and pavement layers selected so as to provide sufficient bearing capacity to withstand the intended traffic and use. Roads shall comply with AASHTO requirements. Road surfaces for the Project Site shall be designed based on the recommendations from the final geotechnical report and the engineer of record.

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.

3.2.11 Fencing and Gates

Seller shall ensure that the perimeter of the Project Site is completely fenced, utilizing either an eight (8) foot tall “farm style” or “deer style” fence or a six (6) foot tall chain link fencing topped with a three-strand barbed wire (creating a total fence height of seven (7) feet), with no ground gaps greater than two (2) inches, and secure.

All posts, rails, fabric, wire, and gates shall be galvanized. Road gates shall be sliding gates of the same design as the fence and have a width at least four (4) feet wider than the paved width of the ingress and egress road.

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

Seller may consider the possibility of installing a wind fence around the solar field (in whole or in part), if necessary and beneficial for the Tracker and the Project. In the event determines to install such a wind fence, Seller shall demonstrate to Buyer's satisfaction that the installation of such wind fence is necessary and beneficial for the Tracker and the Project reasonably prior to installation, including providing to Buyer the documents considered in Seller's determination and any information reasonably requested by Buyer.

If the Project or a portion thereof (including any ancillary structure) is exposed to known or reasonably foreseeable woodland, forest, or grassland fire hazards (as determined by industry accepted natural hazard modeling software), Seller shall establish and maintain sufficient separation to prevent the spread of offsite fire to onsite structures or the spread of fire from onsite structures to adjacent woodland or forest areas. For woodland and forest hazards, the separation between the nearest row of Project solar panels and the closest wood line shall be evaluated based on the typical maximum growth of neighboring trees but shall never be less than 150 feet. For grassland fire hazards, the separation from the nearest row of Project solar panels to the closest edge of the fire hazard shall be a minimum of 100 feet.

3.2.12 Parking and Access at the Project Site

Seller shall be responsible for assuring that parking areas are included next to all buildings and enclosures required for the Project based on Seller's final design. The quantity of parking spaces shall be sufficient for the Project's operation and maintenance staff, with five (5) or more additional parking spaces for Buyer's staff and visitors.

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. Surfacing requirements for parking areas shall conform to the requirements for roads.

Appendix 9 - Collector Substation and Appendix 10 - High Voltage Overhead Transmission Line have additional constraints.

3.2.13 Buildings on the Project Site

Buildings on the Project Site shall be designed in accordance with the requirements of all Laws, applicable Permits, and the other elements of the Performance Standard. 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.

Separate site support structures from solar collector panels and other site support structures shall be in accordance with NFPA 80A.

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 (BESS, 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.

Appendix 9 - Collector Substation and Appendix 10 - High Voltage Overhead Transmission Line have additional constraints.

3.3 Electrical Requirements of the Project Site

3.3.1 General Requirements

Power shall be generated by the solar arrays through the solar inverters and stepped up through medium voltage, pad-mounted transformers to the Project medium voltage level. The medium voltage shall be stepped up through the GSU to the utility high voltage system. The following general criteria shall be used to design the electrical system.

Protective relaying, metering, and controls for all electrical equipment shall be according to industry standard metering and relaying, including NERC compliance, applicable codes and standards, and other requirements of the Performance Standard.

Appendix 9 - Collector Substation and Appendix 10 - High Voltage Overhead Transmission Line have additional constraints.

3.3.2 Cables

Cables shall be designed in accordance with the proposed voltage levels of the Project. All cables shall be halogen-free, fire-retardant, and self-extinguishing, with XLPE isolation where required. For buried cable, anti-rodent and anti-termite additives shall be included for cable protection.

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

3.3.2.1 DC Source Circuit Cable

All free air and conduit string source circuit cabling shall be minimum #12 AWG, multi strand, PV-Wire/RHH/RHW-2, 1000V-2000V rated, sunlight and UV resistant, with XLPE insulation.

All DC source circuit cabling shall be sized according to the operating and short-circuit current, multi strand, PV-Wire/RHH/RHW-2, 1000V-2000V rated.

All DC source circuit cabling shall be minimum 194°F temperature rated.

Conductors shall be sized to ensure the total peak losses of the DC System are below 2% and to avoid excessive voltage drop.

All DC source circuit cabling shall be listed and comply with UL 44 and UL 854.

3.3.2.2 AC Cables

AC cables shall be rated for the correct maximum voltage and sized according to the operating and short-circuit currents.

Conductors shall be sized to ensure that peak losses are below 2% 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.

AC cables shall adhere to local AHJ and applicable standards, including IEEE and UL, for the voltage class.

AC cables shall be aluminum with bare copper ground, 100% insulated TR-XLPE, and shall meet the following specifications and construction requirements. Alternative cables shall not be substituted without approval from Buyer.

1. Specifications:

    a. ASTM B231 Standard Specification for Concentric-Lay-Stranded Aluminum 1350 Conductors

    b. ASTM B609 Standard Specification for Aluminum 1350 Round Wire, Annealed and Intermediate Tempers, for Electrical Purposes

    c. ICEA S-94-649 Standard for Concentric Neutral Cables Rated 5 – 46 kV

    d. AEIC CS-8 Specification for extruded dielectric shielded power cables rated for 5 through 46 kV

2. Construction:

a. Conductor: Moisture blocked class B compressed Aluminum ASTM B231 1350 ¾ hard H16/H26

b. 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

c. Insulation: 345 Mils Tree Retardant Cross Linked Polyethylene 100% insulation level

d. Insulation Shield: Strippable semi-conducting cross-linked copolymer

e. Concentric Neutral: Helically applied soft drawn bare copper one-third concentric neutral

f. Overall Jacket: Linear Low Density Polyethylene (LLDPE) Jacket, black with red extruded stripes;

3.3.2.3 Cable Management

All of the Project's AC cables shall be direct buried. All direct buried cables (whether AC or DC) must be installed in compliance with NEC 300 requirements and guidelines (including NEC 300.5), be buried at a minimum depth of 36 inches below the ground surface above the cable and at a distance of at least four (4) inches from rocks or stones that are 3/4 inch or more in size, and otherwise be built and installed in accordance with the Performance Standard. Without limiting the foregoing, underground cables must be spatially separated based on the thermal resistance specified in or derived from the geotechnical report for the Project Site and the Performance Standard.

Subject to the foregoing, the Project's DC cables running the length of the torque tube above ground, such as module cables and string cables, shall be routed and secured to the Tracker, either using dedicated cable trays or weather-resistant Nylon 12 or better cable ties or zip ties as near as reasonably possible to the underside of the applicable racking structure and to the applicable torque tube. Cables shall be protected from direct sun exposure, standing, or dripping water, and abrasion by any edges of the Tracker.

All field-installed DC quick connectors shall be of the same manufacturer and type as the PV Module. Connectors shall be touch-proof.

3.3.2.4 DC and AC Circuit Conduit

All above-ground DC circuit conduit within the array shall be rigid PVC conduit, schedule 80, with screw adapters. The cable runs between rows and to the combiner boxes shall be direct buried, as provided in Section 3.3.2, including Section 3.3.2.3, and transition directly from the row to the combiner box at the end of the row. The combiner box at the end of a row may be no more than three (3) feet from the end of the row, and must be directly in line with the row. Plastic bushings with locking nuts shall be used for all exposed threads. All sweeps and transitions from below ground to above ground shall be rigid PVC conduit, schedule 80. All sections of conduit shall have an inside chamfer at both ends.

Non-metallic liquid tight (NMLT) flexible conduit may be used to protect RHH/RHW-2 cable (or equivalent) from abrasion or damage. The conduit shall have an inside chamfer at both ends and may not exceed 3 feet. All NMLT fittings shall be metallic with locking nuts with plastic bushings on exposed threads.

Electrical Metallic Tubing (EMT) or compression type fittings shall not be used for any DC circuit.

AC conduit shall be rigid galvanized steel conforming to ANSI C80.1 & UL 6.

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

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

3.3.2.5 Intentionally left blank

3.3.3 Lighting

At a minimum, lighting shall be provided in the following areas:

- Building interior equipment (as applicable)
- Building exterior entrances (as applicable)
- Outdoor equipment within the high voltage area
- Entrance gate

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.

3.3.4 Grounding

A comprehensive soil resistivity measurement shall be performed in accordance with IEEE Standard 81 and the Performance Standard. 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.

Solar arrays shall be installed in accordance with the original equipment manufacturer’s recommendations for grounding and bonding.

Every PV Module within a string shall be bonded together (a) with a bonding procedure that is approved by the module manufacturer and complies with applicable codes and standards and (b) otherwise according to all manufacturer specifications.

Each PV Module string shall be bonded to the DC combiner box or harness assembly. Each combiner box output shall have an equipment grounding bond terminated at a ground ring or mat that is designed in accordance with the applicable standards listed in Section 1.3.

All low voltage and medium voltage 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.

3.3.5 Lightning Protection

Lightning protection for buildings shall be provided in accordance with NFPA 780, IEEE Std. 998-2012, and UL 96A. Lightning protection shall also be provided for major electrical equipment where applicable. Master labels shall be provided for structures that require lightning protection.

3.3.6 Interconnection Requirements

Without limiting Section 20.16 of the main body of the Agreement, Seller shall cause the Project to comply with the interconnection requirements set forth in the GIA.

3.4 <u>Main Equipment Requirements</u>

All equipment described in this Section shall be supplied by one of the Approved Vendors listed in Appendix 7, subject to the other terms of the Agreement. Appendix 4 of this Scope Book sets forth the complete datasheets for the Project’s key equipment. The design, materials, manufacturing, construction, testing, cleaning, coating, and packaging of all equipment and components shall comply with the applicable standards listed in Section 1.3 and the other elements of the Performance Standard. Hot bolting of Project components is not allowed.

3.4.1 PV Modules

The PV Modules incorporated into the Project shall have a proven track-record in terms of technology performance, durability, and quality and shall comply with the Performance Standard.

PV Modules shall be suitable for installation at the Project Site with climatic conditions described Appendix 3.

PV Modules shall be UL 1703 Type 1, Type 2, Type 3, Type 10, or Type 13. Use of any other UL 1703 Type will require the prior written approval of an authorized representative of Buyer prior to use.

The PV Module manufacturer shall provide a recommended procedure for disposal of the PV Modules at the end of their useful life.

PV Modules shall have a power tolerance of +5W/-0W or better.

PV Modules shall be designed to minimize the loosening of fasteners over time. Self-tapping screws shall not be used unless designed and documented for a 30-year life. Nyloc or equivalent nut shall be used to prevent loosening.

PV Module frames shall be bolted and secured in accordance with the design windspeed using clamps that hold the modules individually or independently. Module "T" clamps or similar binders that depend on adjacent panels for tightness are permitted within a given module string only to minimize successive failure and each string must begin and end with an independent clamp design that isolates each string from the next. If such "T" clamps design is implemented, all strings must be capable of withstanding the Project Site climatic conditions as specified in Appendix 3 with an adjacent string or any string from a neighboring tracker/rack missing to ensure that the failure of a given string will not cause successive failures.

3.4.2 Trackers

Seller shall utilize a single axis tracking4 system for the Trackers.[5] The tracking system shall be designed, built, and maintained to minimize interference with the free movement of equipment, including vegetation management equipment, or personnel between any rows of the Project. Each Tracker shall be designed to resist all imposed loads in all possible working conditions as per the applicable standards and the conditions listed in Section 1[4]. Each Tracker shall be installed in accordance with the Performance Standard.

Tracking systems (including Trackers, PV Modules, panel loading devices, and attachments) must be designed to withstand the Project Site climatic conditions described in Appendix 3. Wind tunnel tests can be used to determine the design lateral and vertical loads. Any reduction in the loads stipulated in the codes due to such approach shall be kept within the limits established in the applicable standards. A written report describing the test(s), including the relevant conditions under which the test(s) were performed, and the test results shall be provided to Buyer promptly after the performance of the test(s). The conditions under which the test(s) were performed must be representative of the ones encountered at the Project Site. If wind tunnel tests are not performed as part of the Project, Seller shall provide Buyer recent wind tunnel test results previously conducted for the proposed Trackers. Such review shall not alleviate or diminish Seller's

---

[4] The defined term "Tracker" contemplates a single axis tracking system.

[5] **NTD:** Any limitation on the normal operation of the PV Plant arising out of wind speed, snow load, or other climatic or Environmental condition being above a certain threshold value applicable to the Tracker must be properly incorporated into the inputs to and reflected in the outputs of the Energy Model. The loss of power generation or performance arising out of such limitation shall be based on the meteorological data provided in Appendix 3 and determined in accordance with the Performance Standard.

responsibility to provide Trackers that are suitable for the Project Site climatic conditions provided in Appendix[3].

Seller shall perform a load analysis and verify the foundation type and embedment depth for the Trackers based upon, without limitation, the geotechnical and climatic conditions specific to the Project Site. If bored or rammed pile foundations are selected for the structure, Seller shall carry out a sufficient number of load tests in order to refine and/or validate the preliminary design before the Construction Commencement Date.

Seller shall confirm that the PV Module attachment methods are approved by the PV Module manufacturer. The Trackers shall incorporate integrated NEC/UL required grounding. The integrated grounding method shall be approved for use by the PV Module manufacturer.

The leading front edge of the PV Module shall be a minimum of two (2) feet clear of the ground measured from the ground to the lower edge of the PV Module. The Tracker shall allow for any undulation of the ground and sloping as per the final proposed grade of the Project Site.

All structural elements of the racking system shall be designed according to the relevant material design codes. Factors of safety other than those required by the relevant codes shall not be used.

Structural steel – AISC 360. Torque Tubes, Torque Tube connection to foundations, and foundation piles shall be fabricated from steel designed per the AISE 360.

Black steel shall not be used for piles. A minimum of 3 mil galvanization is required for piles. Black steel shall not be used for major structural elements of the tracking system.

The PV Plant must include tracking systems that have the functionality to move the PV Plant's solar arrays expeditiously to a stow or safe position in preparation for, or during unexpected, extreme weather events (such as, for purpose of illustration only, hail, high wind, snow, and ice) to mitigate the potential adverse effects of such events on the PV Plant. This functionality must be able to be provided (i) with power generated from a generating resource located on the Project Site and (ii) without causing Project components, systems, equipment, or items to become damaged or impaired during the transition to or from, or while in, a stow or safe position.

3.4.3 Power Conversion Unit (PCU)

The PCU will be the integration of inverters, LV (Aux) and MV transformers, MV switchgear (if applicable), and auxiliary components such as the LV auxiliary panel, the communication system, and LCS panel.

Where applicable, the PCU shall be provided with all necessary auxiliary equipment, including current transformers, voltage transformers, protective relays, grounding systems, breakers, and a fully integrated climate control system to ensure proper operation through all possible operating conditions at the Project Site. A lockable and visible disconnect switch shall be provided between the batteries and the PCU.

PCU enclosures shall be rated for the prescribed site conditions in Section 1.2 of this Scope Book and for the intended PCU configuration (indoor or outdoor).

3.4.3.1 Inverters

Seller shall select a suitable technology to achieve the Guaranteed PV Plant Capacity (and associated energy) level for the Project. The inverters selected by Seller shall have proven track-records for performance, durability, and quality.

Inverters shall be selected and equipped to operate at rated capacity with respect to the local climatic and Environmental conditions in Appendix 3. The inverters shall be designed, among other things, for reliability and to avoid significant power loss in case of failure.

Each inverter shall meet the following requirements:

- Designed in accordance with UL 1741 SA
- Includes an output AC circuit breaker or load interrupting disconnect switch
- DC inputs rated for continuous duty, including overcurrent protection devices
- DC inputs with ground fault protection, isolation monitoring, and instrumentation to measure current to an accuracy of 1% or lower
- Self-consumption less than 0.4% of its own rated power
- Efficiency minimum of 97%
- Trip limits set per local Governmental Authority inverter protection settings
- Capable of operating at a power factor as required in the GIA
- Capable of providing full VAR support without the use of capacitors
- Meets the local electrical connection requirements
- Equipped with communication capabilities and able to control the main parameters (DC power, AC power, and auxiliary consumptions at a minimum) from the LCS
- Allows for remote operation utilizing read/write commands from the LCS and include interface protocol support, an alarm and command points list, remote connection, operation, and linkage

- Limits noise emissions to eighty-five (85) dB or less at three (3) feet from the source.

Grid forming capabilities shall be available at initial start-up of the inverters with the ability to activate this attribute provided to Buyer regardless of the need for this attribute at initial Project operation such that future costs are not incurred for such activation.

3.4.3.2 AC Disconnect Switches

An AC disconnect switch shall be located within the inverter transformer. If installed externally and in addition to the AC disconnect switch associated with the inverter, AC disconnect switches shall be visual air-gap type designed to provide a manual means of electronically isolating inverters allowing for disconnection of all three phases of output wiring from the inverter(s). AC switches shall be rated for AC operation and capable of breaking under full load.

3.4.3.3 AC Panelboards

Where string inverters are utilized in the Project, an AC panelboard shall be mounted near the inverters. Each AC panelboard shall be equipped with circuit breakers for each inverter or aggregated output from another panelboard. Each AC panelboard shall meet the following criteria:

a. Rated 480/277 VAC, 3-phase, 4 wire, solid neutral, with main breaker.

b. Rated 208/120 VAC, 3-phase, 4 wire, solid neutral, with main breaker.

c. Provides 100 ampere frame size bolt-on thermal-magnetic breakers with non-interchangeable trip units with an interrupting capacity compatible with the available fault current at the panelboard.

d. Branch breakers have a minimum interrupting capacity of 10,000 rms amperes symmetrical at 208 VAC and 18,000 rms amperes symmetrical series rated with the panelboard main breaker.

e. Installed with the top of panelboard approximately 6 feet above the base of the skid and spaced away from walls or columns at least 1/4 inch to prevent surface moisture from rusting the enclosure.

Provides a typed circuit directory indicating branch circuit loads. LV(Aux) and MV Transformers

Transformers shall be either dry or liquid-filled.

Attributes of Project LV(Aux) Transformers shall include:

a. 3 winding transformer with 25 kVA 480/277 VAC rating and 10 kVA 208/120 VAC rating.

b. Suitable for outdoor installation.

c. Encapsulated core and coils.

d. Noise level not to exceed NEMA ST1 standards.

e. Class H insulation with 80°C maximum temperature rise in 40°C ambient temperature under continuous full load operation.

f. High side voltage, as required by inverter output voltage; low side, 480/277 VAC and 208/120 VAC, 3-phase, 60 hertz, delta-wye connected.

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

Transformers shall be rated for inverter source operation of this type of generation and the Project Site climactic conditions listed in Appendix 3.

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.

Transformers shall be equipped with dedicated relays for oil level, pressure, and temperature.

PCUs with oil-filled transformers shall be separated from other equipment and structures as outlined below in Section 3.4.6.

3.4.3.4 MV Switchgear

The complete switchgear assembly shall consist of fully compartmentalized cubicles complete with circuit breaker, instrument current and voltage transformers, primary/main bus, secondary/transfer bus, power cable terminations, and relays, switches, meters for protection, control and indication, preferably on a per bay basis. The transfer bus shall be in its own compartment. All switchgear compartments shall be easily accessible. Compartment covers may be bolted or hinged and secured.

The switchgear design and construction shall comply with IEEE Std C37.20.2. Switchgear control, protection, and instrumentation wiring shall comply with the requirements of IEEE Std C37.20.2 and IEEE Std C37.21.

The switchgear cubicle layout design shall provide that all incoming circuit breakers and the bus tie circuit breakers are of the one-high arrangement with the circuit breaker in the bottom compartment and the associated control and instrumentation in the top compartment.

The mechanical protection class of all MV and LV switchgear, as well as of all control and protection panels, shall be NEMA 4X or greater for outdoor equipment.

The MV switchgear shall be internal arc certified IAC=AFRL in accordance with ANSI/IEEE C37.20.7. Any arc that may be initiated in a compartment shall be contained in that compartment. The switchgear shall be designed to that overpressure in one cell shall not damage the adjacent cells. The switchgear construction shall be arc-resistant at the front, back, sides, and between compartments within the same cell or adjacent cells. All compartments of the switchgear assembly, including outgoing power cable termination compartments, shall be suitably designed and constructed to withstand safely the transient pressure and thermal effects of an internal arcing fault. Any instruments or low voltage control cable connections in or routed through the power cable compartment shall be made arc resistant by provision of suitable protective covers. Pressure relief vents, when provided, shall discharge hot ionized gases generated by an arcing fault in such a manner that the direction of discharge is not hazardous to personnel and does not create a fire hazard. A metal plenum duct with risers or flanges to collect hot ionized gasses shall be fitted to the top or to the rear of the switchgear assembly. The plenum duct or duct risers shall be securely attached over all pressure relief vents to capture all vented gasses and debris. Plenum exterior vent openings shall be provided and fitted with a hood for rain, self-closing louvers, and insect/animal proof screens.

All MV switchgear for indoor and outdoor installation shall be metal-clad. The switching element connected to the MV transformer will be vacuum or SF6 type circuit breakers.

Each cubicle shall be provided with thermostatically controlled space heaters to prevent condensation in the cubicle.

A minimum clearance of six (6) feet shall be provided in front of the cubicles to permit withdrawal and or insertion of removable elements. Adequate working clearance shall be provided above and behind the switchgear.

All wiring shall be continuous from terminal to terminal and shall be without splices.

Switchgear buses and power carrying conductors shall be copper with silver plated joints. Aluminum conductors shall be supplied only with the prior approval of Buyer. Each primary bus bar and conductor shall be fully insulated with a non-flammable insulating material. All joints in the buswork shall be bolted and use bolts, nuts, flat washers, and Belleville washers and suitable inhibitors. Tin plating of aluminum is not acceptable.

All terminal blocks with voltage above 120V shall be fitted with insulating covers to prevent accidental contact, for greater safety. A minimum 20% spare terminal blocks shall be provided. The switchgear shall be suitable for mounting on an aggregate base, a concrete foundation, or on discrete piers or piles.

a. MV Switchgear Power Circuit Breakers

a) The circuit breaker shall be of a horizontal draw-out design with interlocks as per IEEE Std C37.20.2. Removal of the breaker from the cell shall not require ramps, channels, rails, lifting device, or transport dolly.

b) Unless specified otherwise the circuit breaker operating voltage shall be 125 Vdc. Circuit breaker control switches and indicating lights shall be located on the door of the instrument compartment. Operating handles shall not be more than 6 feet above the switchgear base. All auxiliary relays, terminal blocks, fuse blocks, etc. required for circuit breaker control shall be located in the instrument compartment above the circuit breaker compartment.

c) The circuit breaker draw-out mechanism shall allow the breaker to be racked from Service to Test position with the cell door closed. The circuit breaker shall have three operating positions as follows:

   i. Service: In this position the circuit breaker is fully connected and is in operation.

   ii. Disconnected/Test: In this position the circuit breaker is partially drawn out, disengaged from the bus, shutters are closed, and the controls are operational.

   iii. Removed: In this position the circuit breaker is completely withdrawn from the cubicle.

d) The circuit breaker shall be electrically operable from the controls in the instrumentation compartment. Wiring from the circuit breaker to the control compartment shall utilize flexible multi-conductor cable with plug and socket. The length of the flexible cable shall be sufficient to withdraw and operate the circuit breaker in the “Removed” position. It shall not be possible to disconnect this plug when the circuit breaker is in the “Service” or in the “Test” position.

e) The circuit breaker compartment shall be provided with a hinged pad-lockable door. This door shall not be used for mounting any device. It shall be possible to close and padlock the door with the circuit breaker withdrawn to “Disconnected/Test” position.

f) The bus bar and load bus protective shutters provided in the circuit breaker compartment shall be identified and shall have provision for padlocking in the closed position.

g) In addition to the circuit breaker mechanism operated auxiliary contacts, four auxiliary contacts actuated by the draw-out racking mechanism shall be supplied to indicate when the breaker is in the "Connected" position and when the breaker is in "Test" position. These contacts shall be wired to terminals in the instrument compartment. These contacts shall be rated 2 A continuous and 0.2 A interrupting at 125 Volts DC.

b. MV Switchgear Current Transformers

a) Quantity, rating, and location of the current transformer shall be as specified on the equipment single line diagram.

b) The current transformer shall be dry cast epoxy insulated and shall be fully rated for the appropriate voltage class.

c) The current transformers shall be readily and directly accessible for maintenance or replacement from either the front or rear of the switchgear. Current transformers may be mounted in the cable compartment.

d) All current transformers shall be multi-ratio with ratios in accordance with IEEE Std C57.13. All secondary leads shall be brought to the instrumentation compartment. All secondary leads shall be terminated at individual short circuiting terminal blocks for each CT and individually identified.

c. MV Switchgear Voltage Transformers

a) Quantity, rating, and location of the voltage transformers shall be as specified the equipment single line diagram.

b) The voltage transformer shall be dry cast epoxy insulated.

c) The voltage transformers shall have primary current limiting fuses. Each voltage transformer including its associated fuse shall be of a draw-out design for disconnection from the power bus and maintenance. Alternatively, the voltage transformers may be stationary, and only fuses may be of a draw-out design. In the withdrawn position the voltage transformer primary terminals and the fuses shall be automatically grounded. A visible indication of positive ground shall be provided.

d. MV Switchgear Distribution/Power Transformer

a) Any distribution transformers shall be dry type.

b) Any quantity and rating of distribution transformers shall be as determined from a system study. Any distribution transformers shall be two plus and two minus 2½% taps in the high voltage winding.

c) Any distribution transformers shall be provided with primary current limiting fuses. The primary fuses shall be of a draw-out design. In the withdrawn position the power transformer primary terminals and the fuses shall be automatically grounded. A visible indication of positive ground shall be provided.

d) Any distribution transformer shall be provided with a molded case circuit breaker of adequate rating. The circuit breaker shall be interlocked with the draw-out assembly so that the load is disconnected prior to draw-out.

3.4.4 Auxiliary Equipment and Systems

3.4.4.1 AC Auxiliary System

The LV electrical panel for indoor applications shall be a fixed-mounted design in accordance with NEC standards. For outdoor applications, the panel shall be NEMA 4X or greater.

3.4.4.2 DC Auxiliary System

The DC auxiliary system shall consist of at least one (1) 100% capacity battery bank, two (2) 100% capacity battery chargers connected in a load sharing configuration, battery management system, a DC switchboard, and LV auxiliary panel board. The DC auxiliary system shall supply DC power for critical DC loads, including the UPS system, MV and LV switchgear, and HV equipment. The DC auxiliary system shall be sized to supply emergency loads for a minimum of two (2) hours or as necessary for safe equipment shutdown, whichever is longer.

The entire DC auxiliary system shall be designed in accordance with NEC requirements. For outdoor applications, the panel shall be NEMA 4X or greater.

3.4.5 Battery Energy Storage System (BESS)

3.4.5.1 General

The BESS shall be designed in accordance with the Project Site climactic conditions listed in Appendix 3.

The BESS shall meet the requirements of NFPA 855.

The BESS and all equipment, materials, and components incorporated therein shall be designed and installed to operate as a complete, fully integrated system. The system configuration may be either AC or DC coupled with the PV Plant. To assure compliance with investment tax credit (ITC) requirements, the BESS shall be designed and integrated with the PV Plant and the ETI Transmission System such that 100% of any energy used to charge the BESS is provided directly by the PV Plant (with no energy provided by the ETI Transmission System). The Project shall be designed, constructed, and completed in a manner to permit Buyer to change this control requirement at a later date to allow energy to be provided by the ETI Transmission System to charge the BESS once all of the ITC for the Project has vested.

The BESS shall be designed and constructed with sufficient redundancy such that the availability required as per this Scope Book is sustained throughout the Project and to comply with the redundancy requirements in Section 2.12 of this Scope Book.

3.4.5.2 Voltage

Reactive power capabilities for voltage control shall be 0.0 pF lead/lag to 1.0pF for full four quadrant operation. The BESS shall not cause excessive voltage flicker or introduce excessive distortion to the sinusoidal voltage or current waves as defined by ANSI (American National Standards Institute) Standard C84.1-1989, in accordance with IEEE Standard 519.

3.4.5.3 Frequency

The continuous and momentary low and high frequency ride-through capabilities shall meet the requirements of UL 1741 SA.

3.4.5.4 Electrical Losses

Without limiting the Guaranteed LD Performance Test Requirements, the estimated acceptable overall losses of the BESS system based on equipment specific data is set forth in Appendix 4.

3.4.5.5 Functionality and Use

The BESS shall be capable of performing all functions in accordance with this Scope Book.

3.4.5.6 Primary Function

The primary use of the BESS shall be demand response and load shifting. The BESS shall be able to perform daily peak shifting of the distribution network requiring a minimum of one deep full cycle per day, 365 full deep cycles per year, each consisting of the full energy capacity discharge and subsequent recharge to full capacity. The Project shall autonomously manage charging and discharging to follow for the distribution network demand curve.

3.4.5.7 Secondary Functions

Additionally, the Project shall be capable of providing the following secondary functions:

- Extended Solar Production: The BESS shall be capable of extending the hours of solar production by collecting energy during peak generation periods and discharging energy after end of day shutdown.

- Solar Smoothing: The BESS shall be capable of simulating, collecting, storing, and discharging as dynamic real power support when necessary to provide a stable energy profile.

- Grid Stability: The BESS shall be capable of providing at least the following functions to maintain grid stability:

    - Volt-VAR
    - Voltage Control
    - Frequency-Watt
    - Volt-Watt (standard and dynamic)
    - Power Factor
    - Dynamic Reactive Power Support
    - Connect/Disconnect

The BESS's reactive power control functions shall be available independent of battery availability.

3.4.5.8 Available Functions

Appendix 4 sets forth the minimum available functions that the BESS shall be able to perform.

3.4.5.9 Battery

Seller shall take all necessary precautions to ensure that the BESS (and any component thereof) is protected from physical damage during transportation, unpacking, inspection, handling, storage, and installation. Battery cells shall be comprised of proven Lithium-Ion chemistry and shall utilize proven technology designed for the type of service described herein. The BESS may include only cells that are commercially available or for which suitable (though not necessarily identical) replacement cells can be supplied on short notice throughout the life of the BESS. Seller shall guarantee cell availability and replacement time to maintain the required availability as provided in

Batteries shall be connected using string orientations and provided in modular, climate-controlled enclosures. Batteries shall be installed in a configuration that enables easy maintenance and replacement thereof and easy future battery expansion or additions.

Battery enclosures shall be stacked in a manner to ensure safe operation and shall not be stacked higher than recommended by the manufacturer or in a manner that would make maintenance and replacement difficult.

If changes to, or periodic replacements or overhauls of the components of, the BESS are necessary or contemplated throughout the life of the BESS to maintain the required functionality and proper operability of the BESS as required by this Scope Book and the Agreement, Seller shall provide a schedule for implementation of such changes and replacements over the life of the BESS as part of the documentation required to be delivered by Substantial Completion under the Agreement. The BESS design shall ensure that any such future changes to the BESS will require only installation of additional batteries and no other upgrades or modifications required.

The BESS, including the batteries, shall not release toxic gases or other emissions during normal charging, discharging, or use in excess of, or that create conditions that exceed, the permissible level(s) for such gas or gases (or combinations thereof) within the room or space in which the batteries are located or do not meet the Performance Standard.

The battery module manufacturer shall provide a recommended procedure for disposal of the battery modules at the end of their useful life and Seller shall provide such procedure and any related documentation to Buyer at the Closing.

3.4.5.10 BESS Enclosures

The BESS enclosure(s) shall be in accordance with the International Building Code (IBC) and all Laws, applicable Permits, codes, and standards, including NFPA 855.

The edge of the BESS enclosure(s) shall be located at least 150 ft. from the closest perimeter property fence accessible to the public.

The enclosure(s) shall have the appropriate rating for the Project Site conditions specified in Appendix 3 of this Scope Book and shall be thermally insulated with a fully integrated heating, ventilating and air conditioning (HVAC) system to satisfy the climate requirements of all equipment, materials, components, and occupants housed in the enclosure(s). The HVAC system shall be provided with full redundancy (2 x 100%) to prevent system outage and damage.

In order to prevent unacceptable hazards to adjacent BESS units or equipment, dedicated use buildings/containers housing battery assemblies shall meet one or more of the following separation criteria:

- The batteries in their installed configuration shall be listed in accordance with UL 9540, including size, capacity, and, if part of the listing, presence of required fire suppression, OR

- In order to demonstrate that a fire in a battery container will not affect other adjacent battery containers or equipment, full-scale fire tests are performed in accordance with UL 9540A and the Performance Standard and are installed taking into account the test conditions, OR

- Individual containers (e.g., Sealand container) are separated from other battery containers, inverters, transformers, or other site equipment by a minimum of 25 feet or a 3-hour fire wall.

Seller shall ensure that the OEM/battery integrator submits to Entergy Risk Engineering a hazard mitigation analysis for Buyer's review and approval at least 90 days prior to any implementation of the battery design work for the Project. Buyer shall approve or provide to Seller any comments on the proposed analysis within 30 days after receipt. Seller shall consider and cause the OEM/battery integrator to consider in good faith any such comments made by Buyer and to issue a new or revised hazard mitigation analysis promptly after receipt of Buyer's comments. Buyer shall approve or provide to Seller any comments on the new or revised proposed analysis within 10 days after receipt. The foregoing process shall continue until Buyer's approval has been obtained. The hazard mitigation analysis shall document the UL 9540 listing and compliance with the conditions of the listing or provide the test results of the full-scale fire tests performed in accordance with UL 9540A or evidence compliance with the required separation distance or fire wall, as applicable. If no UL 9540A testing was performed, provide separation of buildings/containers housing batteries in accordance with the paragraph above.

The following protection against thermal runaway shall be provided to preclude, detect, and minimize the impact of thermal runaway:

- Installed HVAC systems shall be designed to remove the required heat load from the batteries during normal use to prevent thermal stresses

- A Battery Management System (BMS) shall be supplied that, among other things, controls the charging and discharging of the batteries in the Project, monitors the condition of each battery, and isolates the Project's battery system from exterior connections in emergencies.

- Installation of pre-emptive technologies (e.g., the Li-Ion Tamer system by Nexceris) shall be included as part of the BESS and the Project. Other pre-emptive technologies that act on signs of battery cell deterioration and are precursors to thermal runaway may be used with the prior written approval of Entergy Risk Engineering. E-Stop circuits shall be connected into the circuitry to automatically trip the BESS unit upon detection of thermal runaway precursors.

- E-Stop circuitry shall not prevent the operation of pre-emptive technology or other post-incident monitoring technologies.

Explosion controls shall be included in the BESS and the Project to preclude catastrophic deflagrations or explosions in the event of failures such as thermal runaway.

- The internal automatic suppression system may extinguish flames but does not remove the heat or generation of explosive gases typical of thermal runaway.

- Detection shall be provided for accumulated quantities of combustible and explosive gases and the BESS shall be designed, engineered, and installed to transmit interior concentrations of these gases to a remote safe location in accordance with the Performance Standard.

- Remote manually actuated emergency ventilation shall be provided with the BESS and the Project. Ventilation shall be sized in accordance with NFPA 68 and NFPA 69 as applicable and located to direct any potential deflagration or explosion energy in a safe direction without jeopardizing nearby personnel or the structural integrity of the container or other property.

Seller shall provide a fire suppression, smoke detection, and alarm (FASS) system for each enclosure. The FASS system shall include local and remote audible and visual alarms and a gaseous extinguishing system designed to prevent damage of or residue on the equipment housed in the enclosure(s). All FASS system alarms shall be relayed to the LCS. Protocols shall be included to extinguish fires inside the enclosure(s) without the need to open the enclosure doors.

Outdoor battery containers shall be protected internally with a self-contained automatic suppression system. The system may be Hybrid Water Mist (i.e. Victaulic Vortex) or clean agent gaseous (e.g. NOVEC-1230). Suppression system shall not utilize aerosol (Stat-X) agent or any other agent that leaves a residue.

The enclosure(s) shall be equipped with a minimum of two (2) grounding lugs per device within the container to enable proper grounding of the overall enclosure(s).

A lockable visible air gap disconnect switch is required between the batteries and the first inversion device (either DC/DC converter or DC/AC inverter)

All wiring and cables shall be sized and selected per IEEE, NEC, and any other applicable code or standard as provided in Section 1.3 of this Scope Book. Internal wiring shall be pre-installed where possible. Any wiring that must be shipped separate for field installation shall be pre-terminated in the manufacturer's factory, labelled, and shipped with the enclosure for easy field installation.

3.4.5.11 BESS Power Conversion System

The BESS shall be provided with a PCU designed to match the DC voltage of the batteries and the transformers.

For an AC-coupled system, the BESS shall be provided with a PCU in accordance with the requirements of Section 3.4.3 of this Scope Book.

In the case of a DC-coupled system, appropriate metering must be applied to ensure that BESS RT Efficiency, BESS Availability, and BESS Storage Capacity Project Performance Tests are accurately implemented in accordance with the Agreement and this Scope Book.

3.4.5.12 MV Transformers

The MV transformers shall conform to the requirements set forth in Section 3.4.3.4 of this Scope Book.

3.4.6 Generator Step-Up (GSU) Transformer

Please see Appendix 9 - Collector Substation.

3.4.7 [Reserved]

3.5 <u>Control System and Communication Requirements</u>

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 stations, 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 inverter parameters
- Real-time 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 (Trackers, including inverters)
- 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 and the other elements of the Performance Standard.

3.5.1 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 3.5.4.1 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.

3.5.2 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:

- 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 1547 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
SunSpec Modbus	TCP/IP	Ethernet
	N/A	RS-485

3.5.3 Meteorological Station

Subject to the other terms hereof, Seller shall provide a minimum of two (2) met stations for the Project and a Soiling Measurement Station (SMS). One (1) main met station shall be located near the Project Site control building. Additional met stations shall be distributed throughout the solar arrays of the Project such that there is one (1) additional met station per 50 MW of installed capacity. The stations shall be arranged to allow for the determination of, and provide an accurate weather profile for, the overall solar field and the Project.

Met stations shall be provided with NEMA 3R or greater enclosures. Instruments and sensors associated with the met stations shall be calibrated by a reputable, certified laboratory.

[The main met station shall contain or meet, among other things, the following requirements:

- One (1) global horizontal pyranometer with a minimum secondary standard according to ISO 9060

- One (1) plane of array (POA) pyranometer with a minimum secondary standard installed in the plane of the PV Modules

- One (1) unobstructed wind speed and wind direction sensor at a minimum 3-meter height and location representative of array conditions, at a radial distance of 10 times the nearest obstacle height differential

- Three (3) platinum RTD temperature sensors with a range of -40°C to +70°C and an accuracy of +/-0.5°C, installed as per IEC 61724 and manufacturer recommendations

- One (1) louvered housing, aspirated thermal sensor to measure ambient temperature with a measurement range of -40°C to +70°C and an accuracy of 0.3°C at 25°C, installed at a height representative of array conditions

- One (1) relative humidity (RH) sensor

- One (1) Soiling Measurement Station (SMS)

- One (1) precipitation sensor

- A data logger for local saving of data and for remote data transfer through available telecommunication infrastructure; the data logger shall be capable of accommodating all sensors and be protected against direct sunlight; irradiation data should be collected every second and stored as ten (10)-min averages (in W/m2) and as the sum total for any defined time period (in Wh/m2)

- Minimum twelve (12)-hour backup battery.

The additional met stations located in the solar field shall meet the following requirements:

- One (1) global horizontal pyranometer with a minimum secondary standard according to ISO 9060

- One (1) plane of array (POA) pyranometer with a minimum secondary standard installed in the plane of the PV Modules

- One (1) unobstructed anemometer and vane at a minimum height of three (3) meters

- Three (3) platinum RTD temperature sensors with a range of -40°C to +70°C and an accuracy of +/-0.5°C, installed as per IEC 61724 and manufacturer recommendations

- One (1) louvered housing, aspirated thermal sensor to measure ambient temperature with a measurement range of 40°C to +70°C and an accuracy of 0.3°C at 25°C, installed at a height representative of array conditions

- Data logger for local saving of data and for remote data transfer through available telecommunication infrastructure and capable of accommodating all sensors. The data logger should be protected against direct sunlight. All readings should be sampled at three (3) second intervals and include a one minute and hourly average and standard deviation of all readings. Rainfall shall be totalized.

- Minimum twelve (12)-hour backup battery.]

The met stations shall be powered either by:

- PV Modules and batteries (sizing of the system shall ensure complete autonomy throughout the year and avoidance of power shortage); or

- Direct LV connection to the nearest building or inverter/transformer block. Seller shall design a backup system to ensure a minimum of three (3) days of autonomy to the Project in case of a grid failure.

Data can be directly transferred to the unit or block equipped with communication capacities and available in the monitoring system.

Batteries and all electronics shall be installed in a protected area away from direct heat and protected against the elements by a sunshade.

3.5.4 Control System Security

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 cyber security controls for low impact and Non-CIP Solar Sites testing NERC CIP Standards in development of 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 in accordance with the Performance Standard 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.

3.6 **<u>Metering Requirements</u>**

Please see Appendix 9 - Collector Substation.

3.7 <u>Interconnection of Utilities</u>

Pursuant to Section 5.4 of the main body of the Agreement, 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, waste water, sanitation (including sewage), temporary power, telecommunications, internet, and fuel.

Seller shall provide adequate means for PV Module washing either via permanent water connection or on-site storage.

3.8 <u>IT Infrastructure</u>.

Seller shall provide the IT Infrastructure for the Project as provided in this Section 3.8 and otherwise in accordance with the Performance Standard. All equipment and materials described in this Section 3.8 to be provided by Seller shall be the "***IT Infrastructure***".

Sellers design shall be subject to Buyer approval at Buyer's sole discretion.

Seller shall provide DC plant systems, ladder rack structures, equipment racks, and associated cabling installations for the Project to Buyer installed systems. This is to include Firewall, Network components, CCTV, and Access Control Systems.

3.8.1 Telecom/Transport

The IT Infrastructure serving as the basis of connectivity from the ETI/Buyer control house at the ETI Transmission System Interconnection Facilities (the ETI ***Control House***) to the Project collector substation control house (as described in Appendix 9 (the ***Project Control House***) will be laid out in a linear route between these two points.

3.8.1.1 Purchasing/Ownership and Configuration

Seller shall provide DC plant systems, ladder rack structures, equipment racks, and associated cabling installations for the Project to Buyer installed systems. This is to include Firewall, Network components, CCTV, and Access Control Systems.

Seller shall coordinate the acquisition and installation of these systems, including purchases, shipping, storage, and installation, with Buyer's IT Infrastructure Project Manager.

3.8.1.2 Fiber constructions

Seller shall determine cable types based on specific site conditions and the Performance Standard. Standard cable shall be 48-strand, single mode fiber optic cable. Standard cable will be utilized to deliver network communications from Buyer and its Affiliates to the Project Site at the Project Control House.

Seller shall use optical ground wire fiber optic cable (**OPGW**) for overhead fiber optic cable installations and ADSS for underground fiber optic cable installations, as applicable. Subject to the following paragraph, the installation environment and other Performance standard considerations shall determine whether the fiber optic cable installations for the Project are overhead or underground. Such installations, regardless whether overhead or underground, shall be routed linearly to the project site.

Whenever practicable and in accordance with the Performance Standard, Seller shall install all fiber optic cable for the Project underground, to limit the risks associated with an above-ground installation, such as continuous exposure to the elements and the potential for incidental contact with overhead structures by human or other intervention.

3.8.1.3 Transmission Line Design

For any given OPGW project that is part of the Work, Seller shall select splice locations to minimize the number of splices required to construct a new OPGW route from [substation to substation] and with the best-case accessibility for the performance of maintenance and/or restoration work. The quantity and location of splices shall be subject to review and written acceptance by Buyer. Seller's choice of splice locations requires receipt of such acceptance prior to Seller's final route design, the creation of the material specification, and Seller's acquisition of such material. Buyer may specify "extra" splice points to provide access to the fiber optic cable for Buyer and Affiliate assets not directly located on the new OPGW path, such as service centers. Any Seller deviations from agreed splice locations will require written approval from Buyer's Telecom Engineering and Operations group (Entergy Telecom.

3.8.1.4 Construction of Fiber

Seller shall procure and install all OPGW and all-dielectric self-supporting (ADSS) fiber optic cables as required to establish end-to-end connectivity from the Project Control House to the ETI Control House. All fiber optic cable installation Seller shall be coordinated in advance with Buyer (through Entergy Telecom) and Buyer shall be entitled to witness and review of all such installations. Buyer (through Entergy Telecom) shall be responsible for all OPGW splices and the OPGW/ADSS transition splice on first transmission pole outside of any substation.

3.8.1.4.1 Pre-Installation Fiber Reel Testing

Whenever OPGW cable for the Project has been delivered to the construction laydown yard, Seller shall arrange for Buyer to conduct optical time-domain reflectometer (OTDR) testing on each OPGW reel prior to transportation of the reel to the installation site. Each fiber in each cable will be tested at the 1550 nm wavelength to verify that the tested fiber parameters agree with those in the factory-provided fiber optic test sheet data shipped with each reel. Upon completion of the fiber reel testing, Buyer will mark the reel as tested and whether the reel has conformed to the factory-provided fiber optic test sheet data shipped with the reel. If the reel so conforms, Seller will then be cleared to take that reel to the job site for installation.

All pre-installation reel test OTDR data gathered by Seller shall be presented, in standard “SOR” file format, to Buyer prior to installation for Buyer’s review and acceptance before Buyer marks on the reel whether the reel has conformed to the factory-provided fiber optic test sheet data shipped with the reel. Each OTDR file provided by Seller shall be named according to project name, reel number, and fiber number, e.g., “PT-project-xx-yy.sor,” where “PT” indicates “pre-test,” “project” is the common, plain-text name of the Project, “xx” is the reel number, and “yy” is the fiber number. The file extension “.sor” is added automatically by the OTDR when saving the test data.

Seller shall perform OTDR traces promptly after installation to detect any damage to fibers during installation. Seller shall promptly notify Buyer of any such damage, consider in good faith any related input from Buyer regarding next steps and cure, and Remedy any installation-related cable damage to Buyer’s reasonable satisfaction at Seller’s sole cost and expense.

All elements of a transmission line splice point, including fiber optic cable slack coils, must be installed a minimum of fifteen feet (15’) above ground level or the structure base (whichever is higher). At each splice location (OPGW or ADSS or both), enough slack fiber optic cable shall be left to reach the ground plus at least one hundred feet (100’). Splicing crews shall use only the first 10-15 feet of each fiber optic cable tail for splicing. The remainder of each fiber optic cable tail shall be mounted to the coil bracket to accommodate future splicing or repairs.

Seller shall be responsible for training the fiber optic cable down the structure and securing it to the structure at all splice locations. All fiber optic cable must be trained and secured, and structure electrical grounds must be established, before any splicing may be performed.

Seller shall be responsible for the handling of all fiber optic splice boxes mounted to structures, including lowering such boxes to ground level prior to splicing and permanently hanging such boxes after splicing has been completed to Buyer’s satisfaction.

Seller will install ADSS fiber from the OPGW/ADSS transition splice point to the fiber optic patch panel in the Project Control House, leaving at least one hundred feet (100’) of slack fiber optic cable installed on the OPGW/ADSS transition splice coil bracket. At least one hundred feet (100’) of slack fiber cable shall be left on the ADSS coil bracket inside the Project Control House, with at least a twenty-five foot (25’) tail at the patch panel location. The project name and location of the cable shall be clearly labeled at the far end of the cable. If wall space is insufficient for the inside ADSS coil bracket, Seller shall install an additional bracket.

All fiber optic cable shall be installed in fiber innerduct within any trough/pull box/control house riser/control house cable tray, etc. Seller shall provide conduit from the OPGW/ADSS transition splice location into the Project Control House or into the substation trough system. Outside the substation fence, conduit shall extend up the splice structure to a height of at least fifteen feet (15') above ground level or the structure base (whichever is higher). Conduit shall be Schedule 40 PVC for all below grade installations. Rigid galvanized steel conduit shall be used for all above-grade installations. The size of the conduit shall be two inch (2") inner diameter (ID). Conduit elbows shall be thirty-six (36") long sweep. All buried conduit must be installed a minimum of eighteen inches (18") below grade and encased in concrete to ensure CIP 6 compliance. Any required pull boxes, etc. shall be installed per manufacturer's instructions except where these instructions are superseded herein.

Seller shall schedule construction work such that, prior to installing/splicing the T-Line OPGW, it first installs the ADSS fiber cables at each substation between the OPGW/ADSS transition splice outside the substation and the fiber optic patch panel inside the P Control House. This work should be considered "critical path" and delivered as early as possible in the project schedule. Buyer expects Seller to install new OPGW spans in sequential order, starting at one substation transition splice point, then progressing to the next splice point in order, and so on, until reaching the opposite end substation transition splice. This approach will enable Buyer and Seller to identify noncompliant splice losses, crossed fibers, cable problems, fiber anomalies, etc., by testing from the starting substation patch panel.

Seller shall provide and terminate fiber into an approved Fiber Patch Panels with sufficient quantity to support delivered fiber count in agreed upon locations where Buyer can connect patch fiber to fiber patch panels. This covers both transport from Buyer Substation to Collector Substation and fiber runs to support connection to PV Yard.

Seller shall design and install appropriate routing (conduit, cable tray) from patch panels to Buyer equipment installed.

Seller shall design and provide patch fibers to terminate from Fiber Patch Panel to specified equipment.

3.8.1.5 OPGW Support Material

TABLE 1: Fiber Optic Cable Materials Supplied by Seller		
Description	**Manufacturer**	**Part/Kit Number**
High-Count Fiber Optic Cable Material		
OPGW Fiber Optic Cable, 96-fiber, "CentraCore"	Alcoa-Fujikura, Ltd.	DNO-12160
ADSS Fiber Optic Cable, 96-fiber	Alcoa-Fujikura, Ltd.	DNA-33465

High-count Splice Enclosure Kit, includes the following individual items (one each, unless otherwise noted): • OPTI-Guard Splice Enclosure (OG03) • Bullet Shield (OGBGS-01) • Two (2) each, Splice Trays (OGST01-96) • Ten (10) each, Fusion Splice Sleeve Ten-pack (SPS-60) • Two (2) each, Furcation Kits (OGFK01) • Coil Bracket (CB-44-3AL)	Alcoa-Fujikura, Ltd.	OGO3SP17
Low-Count Fiber Optic Cable Material		
OPGW Fiber Optic Cable, 48-fiber, "AlumaCore"	Alcoa-Fujikura, Ltd.	DNO-8161
ADSS Fiber Optic Cable, 48-fiber	Alcoa-Fujikura, Ltd.	DNA-28262
Low-count Splice Enclosure with Splice Tray • For projects featuring 48-count fiber cables ONLY	Alcoa-Fujikura, Ltd.	SB01-72
Parts Common to All Projects		
ADSS/OPGW Slack Cable Coil Bracket • For use on any line structures • For use with SB01 and OG03 Splice Enclosures	Alcoa-Fujikura, Ltd.	CB-44-3AL
ADSS Coil Bracket Option 1 • For use inside Substation Control House	Allen Tel	GB13C
ADSS Coil Bracket Option 2 – "Custom" • For use inside Substation Control House	DJM Welding and Fabrication	Special order
Innerduct • HDPE, orange, corrugated, non-split tube, one-inch (1") inside diameter, with pull tape and footage markings on exterior	Varies	Varies, must meet or exceed Description
Parts Common to All Projects		
ADSS/OPGW Slack Cable Coil Bracket • For use on any line structures • For use with SB01 and OG03 Splice Enclosures	Alcoa-Fujikura, Ltd.	CB-44-3AL
ADSS Coil Bracket Option 1 • For use inside Substation Control House	Allen Tel	GB13C
ADSS Coil Bracket Option 2 – "Custom" • For use inside Substation Control House	DJM Welding and Fabrication	Special order
Innerduct • HDPE, orange, corrugated, non-split tube, one-inch (1") inside diameter, with pull tape and footage markings on exterior	Varies	Varies, must meet or exceed Description

Material detailed in **Table 2** will be provided and installed by the party responsible for fiber optic splicing.

TABLE 2: Fiber Optic Cable Materials

Description	Manufacturer	Part/Kit Number
High-Count Fiber Optic Cable Material		
Connector Kit for DNO-12160 (96-fiber OPGW)	Alcoa-Fujikura, Ltd.	APCKC522/537
Connector Kit for DNA-33465 (96-fiber ADSS)	Alcoa-Fujikura, Ltd.	BCK554/568
Connector Kit for DNA-33465 (96-fiber ADSS) • Includes adapter for 1” flex conduit attachment • Used for substation entry cable assemblies	Alcoa-Fujikura, Ltd.	BCK554/568F
Low-Count Fiber Optic Cable Material		
Connector Kit for DNO-8161 (48-fiber OPGW)	Alcoa-Fujikura, Ltd.	APCKD522/537
Connector Kit for DNA-28262 (48-fiber ADSS)	Alcoa-Fujikura, Ltd.	ACK512
Connector Kit for DNA-28262 (48-fiber ADSS) • Includes adapter for 1” flex conduit attachment • Used for substation entry cable assemblies	Alcoa-Fujikura, Ltd.	ACK512F
Parts Common to All Projects		
Heat-shrink Fiber Optic Fusion Splice Sleeves w/ Strength Member, pack of fifty (50) • For use in Fiber Optic Patch/Splice Panel applications and SB01 applications	Corning	2806031-01
Fiber Optic Patch Panel, type to be specified by Buyer	Varies	Site specific

3.8.1.6 Optical Fiber Splice Technique and Performance Requirements

Splicing for OPGW-to-OPGW and OPGW-to-ADSS splice points shall be “straight-through,” that is, one-for-one in terms of the color code of the tube and fiber (blue tube-blue fiber spliced to blue tube-blue fiber, orange tube-blue fiber to orange tube-blue fiber, etc.) unless otherwise directed by Buyer. Buyer expects to provide to Seller a detailed fiber splicing diagram to address any atypical splice requirements.

Preparation of fiber optic cable for splicing and fiber optic cable entry into and routing within fiber optic splice enclosures shall conform to manufacturer’s specifications and written directions. Optical fibers shall be spliced using fusion splicing technique, and splice performance shall conform to the details written below and presented in Table 3.

The bi-directional average splice loss, as measured with an OTDR at the 1550 nm wavelength, should not exceed 0.1 dB for any splice; the target loss shall be less than 0.05 dB at 1550 nm. If the estimated splice loss as measured by the fusion splicer is greater than 0.1 dB, the non-conforming splice shall be cut out and the fibers re-spliced. This process shall be followed no less than three (3) times prior to accepting a substandard splice. All substandard splices must be documented for later analysis and made available to Buyer upon request. Seller shall provide OTDR trace data in electronic format per the standard practice detailed in Section 5. All OTDR trace data shall be provided to Buyer in SOR format for review and acceptance.

TABLE 3: Summarized Fiber Optic Splice Performance Grid (all measurements to be recorded at 1550 nm)		
Parameter	**Measured Value**	**Action Required**
Splice Loss as estimated by Fusion Splicer:	$loss \leq 0.05$ dB	TARGET
	0.05 dB $< loss <$ 0.10 dB	Acceptable
	$loss \geq 0.10$ dB	Break and re-splice up to three times; if no improvement, note the splice location and the fiber number for further analysis
Splice Loss as measured by OTDR:	$loss \leq 0.05$ dB	TARGET
	0.05 dB $< loss <$ 0.10 dB	Acceptable
	$loss \geq 0.10$ dB	Work with Entergy Telecom Engineering to analyze and re-splice as necessary

All optical fiber splices shall be supported and protected using heat shrink tubes. No part of any optical fiber shall be left bare, anywhere.

Buyer will perform end-to-end acceptance testing of the complete OPGW fiber optic cable route. Any further issues identified with any fiber optic cable after full fiber route testing shall be the responsibility of Seller to assist in resolving to the satisfaction of Buyer.

3.8.1.7 OTDR Trace Data Requirements

Seller shall provide to Buyer the bi-directional OTDR trace data on all fibers installed as part of the Project. This data may be gathered when all field and patch panel splicing is complete. OTDR trace data shall be provided to Buyer in electronic format for Buyer's analysis and acceptance. OTDR testing shall conform to all requirements below:

- OTDR files shall be delivered to Buyer in SOR ("Standard OTDR Record") data format conforming to Telcordia SR-4731.
- OTDR testing shall be performed at the1550 nm wavelength from the substation fiber patch panel using a launch fiber that is 500 meters to 1000 meters in length.
- OTDR traces completed at 1310 nm wavelength shall not be utilized in support of acceptance testing requirements.
- PDF representations of OTDR traces will not be accepted.

- OTDR equipment and OTDR settings shall be approved by Buyer to ensure accurate measurements.

Required OTDR settings:

- Test range shall be set between 1 and 2 times the actual length of fiber optic table to be tested.
- Test pulse width shall be set for the length of the fiber optic cable being tested. The preferred test pulse width setting is 300 ns or shorter.
- Each trace shall be averaged for a minimum of 60 seconds.
- Traces shall be performed at High Resolution.

Any Seller questions regarding fiber optic cable acceptance testing shall be directed to Buyer (through Entergy Telecom Engineering).

3.8.1.8 Optical Power Loss and Continuity Testing

Seller shall perform bidirectional optical power loss testing for each optical fiber in the new cable. Bidirectional optical power loss testing shall be conducted at the 1550 nm wavelength using a light source and a power meter approved by Buyer. The optical power loss test will accurately measure actual end-to-end optical loss between optical patch panels at substation "A" and substation "B."

This test will also show whether any fibers have been cross-spliced at any splice point (i.e., "frogged"). All cross-spliced fibers shall be Remedied at Seller's sole expense.

Seller provide optical power loss test data to Buyer, in a spreadsheet format, with each spreadsheet line listing:

1. Route Name
2. Source Optical Patch Panel Identifier
3. Source Optical Patch Panel position of the fiber under test
4. Destination Optical Patch Panel Identifier
5. Destination Optical Patch Panel position of the fiber under test
6. Transmitted optical power at 1550 nm
7. Received optical power at 1550 nm
8. Notes associated with any anomalous finding on any fiber

3.8.2 Data Network Engineering/Data Network Operations (DNE/DNO)

3.8.2.1 DNE

3.8.2.2 Design

Buyer will provide to seller the DNE design including address space of the affected zones. Zones to include the collector substation, PV Yard, Physical security (CCTV and ACCESS control), and Entergy 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 Entergy DNE and filtered by Entergy onsite firewall to ensure separation of separately managed network and in compliance with applicable Buyer and Regulatory requirements.

Seller is responsible for ensuring that 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.

Sellers design shall be subject to Buyer approval at Buyer's sole discretion.

Network segmentation of Seller provided network shall meet the following requirements

- Logical segments shall be filtered by Buyer onsite Firewall. Seller shall provide necessary rules for FW configuration between segments.
- Collector substation equipment (RTU, Breaker Relays, etc.) shall be on its own segment.
- PV Yard equipment (Inverters, Metrology, PPC, etc.) shall be on its own segment. All equipment in collector substation shall be on separate VLAN than equipment in PV Yard.
- PV Access Control and Camera system shall be on its own segment
- 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.

3.8.2.3 Procurement/Ownership

Seller shall procure equipment with a minimum 5-year manufacturing and support warranty with SLA 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 Entergy 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.

3.8.3 Desktop Equipment

As required by Buyer for the functionality of the site and in support of Entergy 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 Entergy field services to install and configure equipment. Desktop includes laptops, desktop computing boxes, printers, and peripheral devices.

3.8.4 Voice/VOIP Communications

3.8.5 Voice Configurations

3.8.5.1 Design

Buyer will designate placement of standard voice over internet protocol equipment throughout site. Typical locations include relay house and other habitable structure.

Seller shall incorporate the designated placement of VOIP equipment into appropriate network and mechanical design drawings. Design to include all necessary conduit, wiring, and fixturing for VOIP equipment installation.

3.8.5.2 Procurement/Installations

Upon agreement to final design Seller will be responsible for installing fixtures and wiring terminated on appropriate breaker or patch panels to allow Entergy field services to install and configure equipment. Voice engineering will specify the phone sets, configurations, and mapping to the call center for each site. As these sites are remote and unmanned, there will be generic programming across the devices placed.

Buyer IT project management will procure and arrange installation of all VOIP equipment upon notification of Seller installing fixturing and wiring. Entergy retains the sole responsibility for operation and maintenance thereof.

3.8.6 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.

3.8.6.1 CCTV Installations

An NVR appliance will be installed in the structure containing Buyer's primary firewall/network switches. 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 by an 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 in accordance with the Performance Standard 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-ganged, ceiling-mounted junction box.

Locations to be recorded:

- The CCTV installation site
- All gates and any other point of ingress and/or egress at the Project Site (and with coverage and clarity sufficient to identify any Representative of the Parties and their respective contractors and subcontractors and any other Person and markings and license plates of any vehicle entering the Project Site through the gates), with the CCTV system utilizing infrared illuminators and supporting systems as needed to ensure the required images are captured in dark or near-dark conditions (as well as in daylight conditions).
- Either side of any human passable door into or inside any building that includes such doors, including the control house.

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

Seller shall install necessary mounting camera system hardware, conduit, and wiring to Buyer patch panels per the relevant approved drawings.

Buyer is responsible for contracting with Buyer-approved vendors to install NVR, cameras, and make final connections from patch panels to the equipment to be installed.

3.8.6.2 Access Control Installations

Seller shall design infrastructure to allow the use of use Buyer provided access control systems.

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

Seller shall install conduit and identified wiring to allow Entergy selected vendor to install control equipment and devices.

Buyer to contract with approved vendor to install Control Panel, Door strike/Mag locks, badge sensors, and make final connection from patch panels to equipment to be installed.

3.9 Locks

The site will be a mix of Buyers Access Control System for Control houses and Battery storage. All other points of egress to site or equipment will be managed utilizing the CyberLock family of locks where technically feasible and economical. This allows Entergy to manage a virtual keyset versus a brass key system. The Cyber Lock family of locks has form factors to meet the various needs of the project and shall be selected from in implementation of Lock Strategy.

Seller shall design CyberLock lock or Cylinder that is appropriate for project execution for all equipment to be locked. This includes but is not limited to gates, doors, and NEMA cabinets. General guidance is to comply best practice and with regulatory requirements paying specific attention to equipment that contains IP connected equipment or can affect the function of the site.

Seller shall provide overall plan of execution locks of site including Bill of Material prior to procurement and installation.

Seller shall include CyberLock products to cover Padlocks for gates and equipment requiring padlocks, Inverters, Network gear containing cabinets, and other high value equipment identified by Buyer and/or Seller.

Seller shall procure all onsite CyberLock equipment including locks, cylinders, Visitor keybox, Initial Key inventory for site

Seller shall coordinate with Entergy Security to intake and being management of CyberLock equipment using the CyberLock system managed by buyer.

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.

3.10 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.

Lock Locations

Without limiting its obligations under the Agreement, including this Scope Book, Seller shall consider, at minimum, the following locations for inclusion of the CyberLock product

3.11 Gates

Seller shall design Primary Gate to Collector Substation to include Buyer Approved Gate Operator including on board power and local solar power cell with safety and loops(obstruction and exit) installed.

In cases of singular PV yard with continuous fence Seller shall design Primary Gate to PV yard to be sliding gate to include Buyer Approved Gate Operator including on board power and local solar power cell with safety and loops(obstruction and exit) installed.

Where appropriate Seller shall install conduit and wiring/fiber to support power of gate, External Card Reader (egress and ingress) and Pin Pad Access Control, and camera installation. This is to include NEMA enclosure that includes a 4 plex outlet and fiber. NEMA Enclosure to measure.

All other gates shall be secured with a High Security Chain and a High Security Padlock.

3.12 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

- Inverter
- Met stations
- Tracking station

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 ENERGY MODEL AND ENERGY YIELD VERIFICATION

The Energy Model shall calculate mathematically and accurately model the Project PV system's theoretical energy output (i.e., the energy yield) over a continuous thirty (30)-year period based on measured ambient conditions, with no deduction factors other than degradation, line losses to the point of Electrical Interconnection Point, and transformer losses. Any Energy Model for the Project provided to Buyer after the Effective Date shall be compliant and function in accordance with the terms of this Agreement, including the Performance Standard.

The Energy Model requires a PVsyst software program and PVsyst input files to run the PVsyst simulation in the Energy Model. The version of the PVsyst software program for the Energy Model shall be as specified in item 3.5 of Appendix 2 to this Scope Book. The PVsyst input files for the Energy Model shall consist of .PAN, .OND, .PRJ, .VC#, and .MET files.[6]

The Energy Model also requires inputs and assumptions to generate projections of PV Plant output. These inputs and assumptions are based on or include discrete design parameters, physical characteristics, equipment capabilities, and similar attributes of the Project, Project layout and location, relevant meteorological and environmental conditions, and other factors. The inputs and assumptions for the Effective Date Energy Model are reflected in the documentation included in Attachment Y to the main body of the Agreement. Appendix 2 and, to the extent applicable, Appendices 3 and 4 to this Scope Book set forth certain inputs for the PV Plant used in the Effective Date Energy Model. The inputs to the Effective Date Energy Model are based on or derived from the proposal submitted in the RFP that led to the Agreement.

In addition, the Energy Model requires the application of losses (post-process losses) not captured by the underlying PVsyst model. Such losses shall be presented and modeled as a singular loss value shown in Appendix 2. The inputs and assumptions for such losses in the Effective Date Energy Model are based on assumed values and reflected in the documentation included in Attachment Y to the main body of the Agreement.

The Effective Date Energy Model shall establish and be considered the final form of the Energy Model. The Effective Date Energy Model version of the PVsyst program, the types and versions of the PVsyst program files, the types of inputs and assumptions used in the PVsyst program input files, the types of post-process loss adjustments, and the form of the Energy Model report created after a run of the PVsyst program shall not be changed after the Effective Date without Buyer's prior approval, which may be provided in Buyer's sole and absolute discretion. Subject to the remainder of this paragraph, the inputs and assumptions to the Energy Model shall be updated after the Effective Date to cause the Energy Model to correctly reflect the Project design and/or physical attributes or characteristics of the Project as of 100% Project design completion or Substantial Completion. Appendix 2 and, to the extent applicable, Appendices 3 and 4 identify which of the characteristics listed therein are subject to limitations that restrict Seller's ability when designing, procuring items for, or building the Project to deviate from the value or data entry for a particular characteristic specified for the Project in the applicable Appendix. Other provisions of the Scope Book or the Agreement may include similar restrictions. Seller is not authorized to update any input or assumption used in the Effective Date Energy Model to the extent the updated input or assumption fails to comply with the limitations or requirements of this Scope Book or the Agreement applicable to such input or assumption. Permitted updates to the inputs or assumptions used in the Energy Model could include, for example, changes reflecting certain supplier

[6] **NTD:** Depending on the Energy Model used and accepted as the Effective Date Energy Model, .SIT, .SHD, and/or .HOR files could also be included.

data obtained after final equipment selection and overall refinements to the physical PV Plant during the design phase that do not deviate from the basic design of the Project and that Seller is permitted to make under the terms of the Agreement. For the avoidance of doubt, the inputs and assumptions used in the .MET input file for the Energy Model shall be final as of the Effective Date and may not be updated or otherwise changed.

The Energy Model shall be rerun on each of the following dates (each, an "**Energy Model Delivery Date**"):

- On or before ten (10) days after the delivery by Seller to Buyer of written notice that the issued-for-construction design package prepared following 100% completion of the detailed design of the Project (see Section 2.2 above) (the "**Design Completion Energy Model**")

- On or before the delivery by Seller to Buyer of the Substantial Completion Certificate (reflecting the Project as then built and tested) pursuant to Section 7.4(a) of the main body of the Agreement (the "**Substantial Completion Energy Model**").

Seller shall maintain an up-to-date, accurate log recording the date and basis for, and a reasonable description of, each change, if any, to the Energy Model from the Effective Date through the Substantial Completion Payment Date, including changes to any input or assumption used in the Energy Model, and shall provide the then-current log of all such changes (and associated documentation reasonably requested by Buyer) to Buyer upon Buyer's request or at intervals or times as the Parties may otherwise agree. Such log may include versions of Appendices 2, 3, and 4 that have been updated in accordance with, and subject to the limitations set forth, herein and therein. Seller shall notify Buyer in writing reasonably in advance of any running of the Energy Model and consider in good faith any Buyer comments made to Seller regarding the Energy Model, including any objections to inputs or assumptions proposed to be used in the Energy Model.

The Energy Model shall be prepared and run by [the Project Performance Test Contractor], and the Energy Model report (along with the associated Energy Model files, inputs, assumptions, and documentation, including any supporting calculations prepared by the Project Performance Test Contractor) shall be provided to Buyer within one (1) day after completion of each required model run specified above. For an Energy Model to be final and the results thereof given effect, the associated test report (including the contents thereof) must be completed in accordance with the requirements of this Scope Book and be free from any errors, omissions, or other defects.

The Parties agree that the Effective Date Energy Model establishes the Expected Energy Yield for the PV portion of the Project as of the Effective Date (specified in item 1.4 of Appendix 1) as the Project's "**Base Case Expected Energy Yield**." Seller guarantees that the Expected Energy Yield in each subsequent Energy Model delivered to Buyer under this Scope Book will equal or exceed the Base Case Expected Energy Yield (the "**Energy Yield Guaranty**"). If the Design Completion Energy Model does not demonstrate that the Energy Yield Guaranty has been satisfied, Seller shall undertake to diagnose and cure the cause(s) of the Energy Yield Guaranty deficiency, which cure could include Seller making permitted modifications to the Project design to ensure the Energy Yield Guaranty will be satisfied at Substantial Completion. Without limiting the other terms of this Scope Book, Seller shall update the inputs and assumptions to and re-run the Energy Model, in accordance with and subject to the terms of this Scope Book, after completion of such cure until the Energy Yield Guaranty has been satisfied. If the Substantial Completion Energy Model does not demonstrate that the Energy Yield Guaranty has been satisfied, Seller may either (i) cure the cause(s) of the Energy Yield Guaranty deficiency, which cure could include Seller making permitted modifications to the Project and shall update the inputs and assumptions to and re-run the Energy Model, in accordance with and subject to the terms of this Scope Book, after completion of such cure until the Energy Yield Guaranty has been satisfied or (ii) pay Energy Yield Liquidated Damages in accordance with Section 9.4 of the main body of the Agreement.

5 COMMISSIONING AND TESTING

Seller shall develop a commissioning plan and process (Commissioning Plan) that ensures all Project components meet the requirements of the Agreement, this Scope Book, and the other elements of the Performance Standard, including BESS Availability, BESS Power Rating, BESS RT Efficiency, BESS Storage Capacity, PV Plant Availability, and PV Plant Capacity. The Commissioning Plan shall conform to and include, without limitation, the components set out in Appendix 5, Project Performance Test Procedures. 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 perform a random pile/pull testing campaign in accordance with ISO-2859-1, and subject to general inspection level II and an acceptance quality limit of 0.10.

Seller shall provide the Commissioning Plan to Buyer reasonably 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 and when 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, this Scope Book, and the other elements of the Performance Standard.

Where manufacturing or finishing is performed at the Project Site, reviews, inspections, studies, and tests shall be conducted in accordance with the Performance Standard 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.

5.1 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 (DC and AC)
- PV Modules and inverter – manufacturer, model, and quantity
- Commissioning date
- System designers’ information
- System installer/contractor information
- Detailed single-line diagram of the Project

- Array general specifications
- PV Module type
- PV Module number
- Number of PV Modules per string
- Number of strings
- PV string information
- String cable type, size, and length
- Specification (current and voltage rating) of overvoltage protection device
- Array electrical characteristics
- Array junction box location
- Array main cable specification
- Location, type, and rating of over voltage protective devices
- Earthing and over voltage protections
- Single-line diagram(s) showing 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 PV Modules and PCUs with the information of starting date of warranty and period of warranty
- Mechanical design information/data sheet of array mounting structure (static report)
- Documentation of all required Permits
- Documentation and stock of spare parts and Consumables
- Documentation of PV Module flash test data
- 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

Without limiting its other NERC-related obligations under the Agreement, Seller shall cause the Project to be compliant with, and the Work to be performed in accordance with, as applicable, the more stringent of the applicable NERC reliability standards and the applicable Seller NERC program (collectively, the "NERC Standards"), including the NERC Standards in effect as of the Effective Date. The applicable NERC Standards in effect as of the Effective Date include those set forth in Appendix 8 to the Scope Book. Seller shall be responsible for causing the Project to comply with, and the Work to be performed in compliance with, all "Generator Owner," or "GO," obligations in Appendix 8, to the extent applicable to the Project or the Work, and any other applicable NERC Standards through the Closing Date (and to the extent requested by Buyer and on Buyer's behalf, through the Substantial Completion Payment Date). Seller shall be responsible for causing the Project to comply with, and the Work to be performed in compliance with, all "Generator Operator," or "GOP," obligations in Appendix 8, to the extent applicable to the Project or the Work, and any other applicable NERC Standards through the Substantial Completion Payment Date. Seller's GOP obligations shall transfer to Buyer on the Substantial Completion Payment Date unless Seller or an Affiliate or Contractor or Subcontractor thereof is performing term operation and maintenance services for the Project pursuant to an operation and maintenance agreement with Buyer or an Affiliate thereof. The NERC Standards that Seller shall cause the Project to be compliant with, and the Work to be performed in accordance with, as applicable, include all applicable NERC Standards that, as of the Effective Date, (i) are not in effect but are approved to take effect after the Effective Date or (ii) are neither in effect nor approved to take effect after the Effective Date, but, subsequent to the Effective Date, are approved to take effect on or before one (1) year after the Substantial Completion Payment Date. The implementation of and compliance with any NERC Standard described in clause (i) or (ii) above shall occur by the earlier of (a) the time specified in such NERC Standard for such implementation and compliance and (b) the Closing Date. Seller provide to Buyer, within 120 days but no earlier than 90 days prior to initial synchronization of the Project, reasonable evidence of Seller's implementation of, and Seller's or the Work's compliance with, the NERC Standards and any other NERC-related documentation reasonably requested by Buyer or required by NERC.

5.2 Factory Acceptance Tests

All equipment, materials, and components specified in Section 3.4 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 and the other elements of the Performance Standard. 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.

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

- PV Modules
- Inverters
- Trackers
- Step-Up transformers

- Inverter power transformers
- HV switchgear, if applicable
- MV switchgear
- LCS
- Batteries
- BESS PCU
- BESS container(s)/enclosure(s).

5.3 <u>Project Performance Tests</u>

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.

Appendix 5 sets forth certain requirements, standards, and procedures for the performance of the Project Performance Tests, which shall be conducted in accordance with the Commissioning Plan under Section 5 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

5.3.1 PV Plant Capacity Test

Seller shall cause a Project Performance Test to be performed to determine PV Plant Capacity in accordance with the requirements, standards, and procedures set forth in Article 9 of the main body of the Agreement, Appendix 5, and the other elements of the Performance Standard. The PV Plant Capacity shall be measured at the Electrical Interconnection Point.

The Project Performance Test conducted to determine the PV Plant Capacity may not be interrupted or suspended and then resumed without Buyer's prior written approval. Among other things, and without limiting the other terms of the Agreement, the PV Plant must have operated and performed as designed (and must have achieved the Minimum PV Plant Availability) during such Project Performance Test in order for such Project Performance Test to be considered valid for purposes of determining the PV Plant Capacity.

5.3.2 PV Plant Availability Test

Seller shall cause a Project Performance Test to be performed to measure PV Plant Availability in accordance with the requirements, standards, and procedures set forth in Article 9 of the main body of the Agreement, Appendix 5 of this Scope Book, and the other elements of the Performance Standard.

The Project Performance Test conducted to determine the PV Plant Availability may not be interrupted or suspended and then resumed without Buyer's prior written approval. Among other things, and without limiting the other terms of the Agreement, the PV Plant must have operated and performed as designed (and must have achieved the Minimum PV Plant Capacity) during such Project Performance Test in order for such Project Performance Test to be considered valid for purposes of determining the PV Plant Availability.

5.3.3 Battery Energy Storage System Performance Tests

5.3.3.1 BESS Storage Capacity and BESS Power Rating Tests

Seller shall cause Project Performance Tests to be performed to determine the BESS Power Rating and the BESS Storage Capacity in accordance with the requirements, standards, and procedures set forth in Article 9 of the main body of the Agreement, Appendix 5, and the other elements of the Performance Standard. Such Project Performance Tests may be run simultaneously or separately. The BESS Power Rating and the BESS Storage Capacity shall be measured at the Electrical Interconnection Point. Among other things, and without limiting the other terms of the Agreement (including Section 9.2 of the main body of the Agreement), (i) the BESS and PV Plant must have operated and performed as designed (and must have achieved Minimum BESS Power Rating and the Minimum BESS RT Efficiency) during such Project Performance Test in order for such Project Performance Test to be considered valid for purposes of determining the BESS Storage Capacity, and (ii) the BESS and PV Plant must have operated and performed as designed (and must have achieved the Minimum BESS Storage Capacity and the Minimum BESS RT Efficiency) during such Project Performance Test in order for such Project Performance Test to be considered valid for purposes of determining the BESS Power Rating.

5.3.3.2 BESS Round Trip (RT) Efficiency Test

Seller shall cause a Project Performance Test to be performed to determine the BESS RT Efficiency in accordance with the requirements, standards, and procedures set forth in Article 9 of the main body of the Agreement, Appendix 5, and the other elements of the Performance Standard. The BESS RT Efficiency shall be measured at the input/output meter(s) to the BESS and shall be measured in AC for an AC-coupled system and DC for a DC-coupled system. Among other things, and without limiting the other terms of the Agreement (including Section 9.2 of the main body of the Agreement), (i) the BESS and PV Plant must have operated and performed as designed (and must have achieved the Minimum BESS Storage Capacity and Minimum BESS Power Rating) during such Project Performance Test in order for such Project Performance Test to be considered valid for purposes of determining the BESS Storage RT Efficiency, and (ii) the BESS and PV Plant must have operated and performed as designed (and must have achieved the Minimum BESS Storage Capacity and the Minimum BESS Power Rating) during such Project Performance Test in order for such Project Performance Test to be considered valid for purposes of determining the BESS RT Efficiency Test.

5.3.3.3 BESS Availability Test

Seller shall cause a Project Performance Test to be performed to measure BESS Availability in accordance with the requirements, standards, and procedures set forth in Article 9 of the main body of the Agreement, Appendix 5, and the other elements of the Performance Standard.

5.3.3.4 BESS Functional Tests

Seller shall conduct functional tests to confirm that the BESS is capable of operation of each primary and secondary function required per Sections 3.4.5.6 and 3.4.5.7 of this Scope Book, and for all available functions provided per Section 3.4.5.8 of this Scope Book.

6 WARRANTY

In addition to the Project Warranty, and without limiting the requirements or obligations of Seller set forth in Section 5.2 or Article X of the main body of the Agreement or the other elements of the Performance Standard, Seller shall procure warranties from original equipment manufacturers that satisfy the requirements set forth in this Scope Book, including this Section 6, and the other elements of the Performance Standard. Without limiting the foregoing, Seller shall obtain and have in effect as of the Closing the Major Warranties on terms and conditions that comply with the warranty requirements set forth in this Agreement. 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.

6.1 PV Module Warranty

The PV Modules shall be provided with original equipment manufacturer warranties, including the following (which may commence no sooner than the earlier of (i) the date of completion of installation of the PV Modules or (ii) ninety (90) days after delivery of the PV Modules to the Project Site):

- The product warranty for PV Modules shall warrant that the PV Modules are free from defects in materials, manufacture, workmanship, and design for at least ten (10) years from the warranty commencement date. The PV Module manufacturer shall be required to repair or replace any PV Module in breach of the PV Module product warranty.

- The power output warranty for PV Modules shall warrant the power output of the PV Modules relative to the labeled nameplate power output of the PV Modules, as adjusted only for degradation (with no additional exclusions or other conditionality on coverage), for at least twenty-five (25) years from the warranty commencement date. The annual linear degradation included in the power output warranty shall have a maximum power output degradation of 2.0% within the first year and 0.5% in each year thereafter when measured using Standard Test Conditions. In the event of a breach of the power output warranty, the PV Module manufacturer shall take corrective action at its cost to repair or replace and prevent in subsequent years breaches of the power output warranty.

6.2 <u>Inverter Warranty</u>

The Project inverters shall be provided with an original equipment manufacturer's warranty that the inverters are free from defects in material, manufacture, workmanship, and design, which warranty may commence no sooner than delivery of the inverters to the Project Site and continue for a minimum of five (5) years from the warranty commencement date. The inverter manufacturer shall be required to repair or replace at its cost any inverter (or any component thereof) in breach of such warranty. The inverter 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.

6.3 <u>Transformer Warranty</u>

Without limiting Section 5.6 of Appendix 9 to this Scope Book, 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.

6.4 Intentionally left blank

6.5 Tracker Warranty

The Trackers shall be provided with an original equipment manufacturer's warranty that the Trackers are free from defects in material, manufacture, workmanship, and design for a period of (i) for structural components of the Trackers, at least twenty (20) years from the date of completion of the installation thereof and (ii) for motor, gear, battery, and controller components of the Trackers, at least five (5) years from the date of completion of the installation thereof. The Tracker manufacturer shall be required to repair or replace any Tracker (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.

6.6 Balance of Plant Warranties

All combiner boxes shall be provided with an original equipment manufacturer's warranty that such combiner boxes are free from defects in material, manufacture, workmanship, and design for a period of at least five (5) years from the date of completion of the installation thereof. The combiner box manufacturer shall be required to repair or replace any combiner box (or component thereof) in breach of such warranty. The combiner box 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 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.

6.7 Battery Energy Storage System Warranty

The BESS shall be provided with an original equipment manufacturers or BESS contractor's, as applicable, warranty that all equipment, systems, and components included in the BESS are free from defects in material, manufacture, workmanship, and design for a period of at least ten (10) years from the date the Project achieves Substantial Completion. The original equipment manufacturer or BESS contractor, as applicable, shall repair or replace any equipment, system, or component of the BESS in breach of such warranty.

The BESS shall also be provided with an original equipment manufacturers or the BESS contractor's, as applicable, warranty covering the BESS RT Efficiency, the BESS Power Rating, and the BESS Capacity for a period of ten (10) years from the date the Project achieves Substantial Completion with an option to extend such performance warranty for a twenty (20) years from Substantial Completion. The original equipment manufacturer or the BESS contractor, as applicable, shall repair or replace any equipment, system, or component of the BESS causing the BESS to not meet the requirements of such performance warranty.

The BESS 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.

7 <u>TRAINING</u>

Buyer will identify a project team to be trained by Seller during the design, construction, commissioning, and testing of the Project.

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. Each individual shall be assigned a qualification plan and schedule according to his or her designated position within the project team.

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.

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 and auxiliary equipment and systems included in the Project.

All presented lectures shall be conducted by personnel having extensive experience both in PV solar plant start-up, operations and maintenance, 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.

Scheduling of the training program shall be subject to mutual agreement between Seller and Buyer.

Training shall include:

- Solar resource basics
- Introduction to PV and solar
- Performance modeling basics and software operation
- BESS basics
- Introduction to Project equipment (PV Modules, PCUs, Trackers, the BESS, transformers, switchgear, etc.)
- Plant installation basics
- Inspection and testing basics
- Control system basics
- Interconnection basics.

Without limiting the other terms of this Section 7, training will be provided with respect to the following Project equipment/systems, at a minimum:

- PCUs
- Trackers
- BESS
- LCS
- Met stations
- HV/MV switchgear.

7.1 <u>Training Goals</u>

The goal of the training program is to ensure that Project personnel acquire and maintain the knowledge and skills required to fulfil their responsibilities such that the Project is operated safely, efficiently, and in accordance with the Performance Standard.

7.2 Program Description

Seller shall ensure that 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 training program shall make up the majority of all training at the Project Site. 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.

The training plan shall include the following minimum training:

- Overview of the Project and Technology
  - The training will be attended by trainees assigned by Buyer
  - The training will be delivered at the Project Site
  - The training shall cover, at a minimum, the following topics: introduction to PV and BESS, basics of electricity, PCU, rectifiers, transformers, switchgear, Project installation and testing, HSE, control system, measurement of input/output energy, transmission lines (underground and overhead as applicable), etc.
  - Training shall cover all normal and off-normal operating procedures, which Seller shall provide to Buyer
- O&M training during the construction, commissioning, and testing phases
  - The training will be attended by trainees assigned by Buyer
  - The training will be delivered at Project Site
  - The training shall include at least the following topics: Plant operation, O&M philosophy, preventive and corrective maintenance, HSE, quality assurance and control, spare parts philosophy, etc.

Seller shall be responsible for the attendance of all instructors needed to provide proper training for each piece of equipment and system.

8 HEALTH AND SAFETY REQUIREMENTS

8.1 General Requirements

Seller shall prepare and implement a comprehensive Project/Project Site-specific health, safety, and environment policy and associated procedures (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 and the other elements of the Performance Standard. 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. Without limiting Section 4.1(c) of the main body of the Agreement or the other elements of the Performance Standard, 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 Project Custody 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.

8.1.1 Fire Protection and Firefighting Systems

The fire alarm and detection systems and the fire protection and firefighting systems for the Project shall include the systems required to meet local and National Fire Protection Association (NFPA) Standards.

- All fire alarms shall be arranged to annunciate at a constantly attended location on a main fire alarm control panel. Local panels may be installed in addition to the main panel as required or appropriate.

- If the Project's local panels and main fire alarm panel are installed by multiple Contractors or Subcontractors, one of the Contractors or Subcontractors shall be designated in writing as responsible for the integration of all remote alarms to the main fire alarm panel and such record shall be transferred to Buyer at the Closing

- Each fire alarm shall be readily accessible for inspection, testing, maintenance, repair, and replacement and installed in accordance with the Performance Standard

- All communications (network) wiring shall be Class A; individual detection circuits may be Class B

- The main fire alarm control panel shall have the capability to serve a minimum of 500 fire alarms and to create and store an accurate, comprehensible, electronically retrievable historical record of the activation and performance of such alarms.

Smoke and/or heat detection systems at the Project shall be provided in accordance with NFPA 72 and where recommended by NFPA 850, specifically, but not limited to, the following areas as applicable:

- Air aspirating early warning smoke detection (e.g., VESDA) shall be provided in areas with critical electronic equipment (e.g., computer rooms/DCS servers, BESS)

- Control rooms shall have smoke detection installed throughout the control room in the spaces that may contain humans, below raised floor systems, and above suspended ceilings
- In control rooms that are or may be occupied 24/7, the detection in the operating spaces may be omitted
- Control room break areas
- In-duct detectors shall be used for ventilation systems in occupied buildings
- Switchgear rooms and relay rooms
- Battery rooms
- Warehouses and buildings.

The Project shall be designed and built with a safe operating environment for equipment and personnel. Seller shall select and install equipment and systems for the Project in accordance with such obligation and separate equipment and systems at the Project Site with sufficient distance, clearance, and other safeguards to mitigate hazards and risks, including fire. The Project shall comply with all fire protection, fire alarm, firefighting, and similar Laws (including codes and standards), applicable Permits, the NFPA (including NFPA 850 and NFPA 855), and the other elements of the Performance Standard.

Miscellaneous site support structures such as warehouses, oil storage buildings, vehicle maintenance facilities, bulk compressed gas storage, or other facilities not specifically mentioned above in this Section 8.1.1shall be evaluated for the need for or appropriateness of automatic fire, smoke, and heat detection systems and equipment and for water-based fire suppression systems in accordance with applicable codes and standards and the other elements of the Performance Standard.

Miscellaneous site structures shall be separated from other important plant structures and equipment in accordance with NFPA 80A.

Different firefighting systems shall be adopted according to the operational characteristics of the particular areas and improvements on and near the Project Site to be protected.

Seller shall coordinate the firefighting plan, system, and solutions for the Project and the Project Site with the local fire department, and shall obtain approval of the same from Buyer.

Portable fire extinguishers shall be provided at strategic locations in accordance with NFPA 10 and the Performance Standard.

- Sensitive electronic equipment areas (BESS, control room/DCS servers/computer room, etc.) shall have an ABC-rated clean agent, Halotron, water mist, or other effective agent that does not leave a residue after use. Dry chemical extinguishers shall not be used in these areas.

- General electrical hazard areas shall utilize CO_2 or a clean agent extinguisher sized appropriately for the hazard. Dry chemical extinguishers shall not be used for general electrical hazards

- General areas and oil hazard areas may use any suitable ABC-rated extinguisher, including dry chemical

- Extinguishers shall be located as follows:

    - Near entrances and/or exits to an area

    - Extinguishers in occupied buildings (warehouse, control room, DCS server/computer room, electrical distribution, etc.), if applicable, shall be located, at a minimum, at each exit door, with additional extinguishers in the interior spaces if required to meet NFPA 10 travel distances.

8.1.2 Safety Rules and Procedures

Without limiting the Performance Standard, 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.

8.2 Arc Flash Hazard Analysis Study/Calculation

Seller shall perform in accordance with IEEE Standard 1584 an arc flash hazard analysis study/calculation for all equipment installed pursuant to the Agreement. Arc flash hazard incident energy levels shall be limited to 8 cal/sq.cm. Arc flash hazard reduction maintenance systems may be utilized to achieve the required levels. Where 8 cal/sq.cm levels cannot be achieved, site-specific operation and maintenance procedures shall be required to address Project equipment clearance requirements.

Labeling that lists arc flash incident energy exposure levels, including instructions on disconnecting devices required for the replacement of battery modules, shall be provided in accordance with the Performance Standard.

8.3 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 in accordance with the Performance Standard on the fencing, each building, and any other enclosure at the Project Site.

8.4 <u>Community Relations</u>

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 its Contractors' or Subcontractors' acts or omissions, thereafter.

9 <u>DOCUMENTATION TO BE SUBMITTED PRIOR TO COMPLETION OF THE DESIGN AND ENGINEERING PHASE</u>

9.1 <u>Documentation to be Submitted During Project Design (Documents Issued for Construction)</u>

Without limiting Seller's obligation to provide other documents required to be delivered under this Scope Book or the Agreement, Seller shall prepare and submit to Buyer the following documents during the design and engineering phase of the Project:

- Monthly progress reports in accordance with Section 6.2 of the main body of the Agreement
- Drawings and documents provided with Permit applications in accordance with Section 5.5(c) of the main body of the Agreement 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
- Subject to Appendix 2 below, the final Energy Model, including
    - All PVsyst project files, inputs, parameters, and reports
    - 30-year estimates
    - P50 and P90 estimates
- Project documents, including:
    - General arrangement and layout drawings
    - Plans, sections, and details for each system

        - Underground arrangement drawings (mechanical, electrical, and civil)
        - Electrical Diagrams for each system (single line diagrams, three-line diagrams and elementary diagrams)
        - Cable layouts
        - Grading and drainage drawings
        - Foundation drawings
        - Structural Calculations
            - PV racking and foundations, including all wind tunnel test reports, load derivations, corrosion calculations, detailed structural steel code checks, soil/structural embedment and deflections calculations using LPILE or equivalent and pile load test data, and connection calculations
            - Inverter and battery/BESS foundation calculations
            - Battery/BESS enclosure structural calculations
            - Substation structure and foundation calculations
        - Specifications and datasheets
    - Site studies (geotechnical, hydrological, etc.)
    - Construction Pile Installation QA/QC Procedure
        - Pile installation tolerances
        - Out of tolerance remediation plan
        - Pile rejection criteria
            - Damage to pile
            - Extreme out of tolerance
        - Pile testing campaign
            - Sampling population and acceptance criteria
            - Pile load test procedure
    - The initial, baseline Environmental Assessment (subject to Section 7.1 or Section 7.2, as applicable, of the main body of the Agreement)

- System description of the main systems for the Project
- Start-up and shut-down diagrams
- 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
- Preliminary Commissioning Program with procedures for respective tests and activities
- The Project Performance Test procedures
- Preliminary O&M philosophy
- The site-specific fire protection design basis in accordance with NFPA 850, Chapter 4, including:

    1. Plant name/location information
    2. Plant location
    3. Responsible fire protection engineer
    4. Table of Contents
    5. Stakeholders
    6. General fire protection philosophies
    7. Assumptions
    8. Site-specific information
    9. Source documents
    10. Plant layout (description of fire areas)
    11. Water supply (fire protection water storage, fire pumps, mains, hydrants, etc.)
    12. Hazards
    13. Administrative controls.

9.2 <u>Documentation to be Submitted During Project Construction</u>

Without limiting any other documents required to be delivered under the Agreement or this Scope Book, Seller shall prepare and submit to Buyer the following documents from and after the Construction Commencement Date through Substantial Completion:

- Monthly progress reports in accordance with Section 6.2 of the main body of the Agreement, including:
  - Engineering, procurement and construction activities
  - HSE information (near misses, incidents, accidents, training, etc.)
  - Updated Project schedule including lookahead for coming month
  - Visual report of completed activities using layout drawings and photographs
- Copy of all Project Work Permits and Project Operational Permits when obtained
- Final Commissioning Program
- Final Performance Test Procedure
- Final O&M Philosophy
- Construction Test Reports
  - Compaction test results and related documents for roads, substation pads, and at non-pile supported foundations and structures
  - In situ pile test results and related documents.

9.3 Documentation to be Submitted at Substantial Completion Payment Date

Without limiting any other documents required to be delivered under the Agreement or this Scope Book, Seller shall prepare and submit to Buyer the following documents prior to Substantial Completion:

- Draft As-Builts for all drawings and documents submitted during the engineering and design phase and during Project construction as described above with final As-Builts to be delivered as a condition to Final Completion
- Test Results
  - Factory Acceptance Test Results and Certificates for key equipment, including those listed in Section 5.2 of this Scope Book
  - Arch/Flash Test Results and Certificates

    - Project Performance Test Results and Certificate

- A Project operation and maintenance manual, including all OEM manuals and related documentation

- Reports and Other Documents

    - All Permits

    - All signed and approved design change requests

    - All site study reports (geotechnical, hydrological, EIA, etc.)

    - Training manuals

    - Punchlist in accordance with Section 7.5(b) of the main body of the Agreement, including the agreed Punchlist Holdback Amount

    - Invoices

    - Records.

9.4 **<u>Supplemental Appendix Information</u>**

For each of Appendices 1 through 6 attached hereto, and in accordance with the other terms of this Agreement, including the applicable Appendix, the Scope Book, and the remainder of this Section 9.4, Seller shall update all cells left blank, if applicable, as of the Effective Date in such Appendix with accurate data, content, and/or information contemplated for such cell by the applicable row and heading in such Appendix. Subject to the other provisions of this Section 9.4 and the applicable Appendices, and without limiting the other terms the Agreement, Seller shall provide to Buyer, using the best information reasonably available to Seller at the time, periodic updates to each such Appendix at the intervals specified in the Agreement for Seller updates to the Schedules, provided that no cells may be updated after the date that is 90 days prior to the Closing without the prior written agreement of Buyer and Seller.

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

Appendix 1: Performance Guarantees

PERFORMANCE GUARANTEES				
Nº	**CHARACTERISTICS**	**UNITS**	**DATA**	**NOTES**
1	**MINIMUM CRITERIA**			
1.1	Guaranteed PV Plant Capacity (@ Electrical Interconnection Point (EIP))	MWac		Final
1.2	Minimum PV Plant Capacity (@Electrical Interconnection Point (EIP))	MWac		Final. 95% of Guaranteed PV Plant Capacity
1.3	Guaranteed Run Requirement	Duration		Uninterrupted operation during the Project Performance Test for PV Plant Capacity subject to the Failure Mode Guidelines as set forth in Appendix 5 of this Scope Book
1.4	Project Net Electricity Production (P50) in Year 1 (starting at the Substantial Completion Payment Date) @ Electrical Interconnection Point (EIP))	MWh		Final
1.5	Guaranteed BESS Power Rating (@Electrical Interconnection Point (EIP))	MWac		Final
1.6	Minimum BESS Power Rating (@Electrical Interconnection Point (EIP))	MWac		Final 95% of Guaranteed BESS Power Rating
1.7	Guaranteed BESS Energy Storage Capacity (@Electrical Interconnection Point (EIP))	MWh ac		Final

PERFORMANCE GUARANTEES				
Nº	CHARACTERISTICS	UNITS	DATA	NOTES
1.8	Minimum BESS Storage Capacity Electrical Interconnection Point (EIP))	MWh ac		Final 95% of Guaranteed BESS Storage Capacity
1.9	BESS RT Efficiency (@ BESS)	%		Final
1.10	Minimum BESS RT Efficiency (@ BESS)	%		Final 95% of Guaranteed BESS RT Efficiency
1.11	Minimum BESS Availability (Required / As Bid)	%	99% /	Final
1.12	Long-Term BESS Availability (Required / As Bid)	%	97% /	Final

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.

This Appendix is subject to, without limitation, the terms of Section 9.4 of the Scope Book.

***** END OF APPENDIX 1 *****

Appendix 2: Energy Model

The following table sets forth certain inputs to and results from the Energy Model (PVsyst). Seller shall update information in Appendix 2according to the table below, Appendix 5- Energy Yield Verification hereto, and Section 9.4 of the Scope Book.

CERTAIN ENERGY MODEL INPUTS				
Nº	**CHARACTERISTICS**	**UNITS**	**DATA**	**CLASSIFICATION; NOTES**
1	**REFERENCE SITE CONDITIONS**	-		
1.1	Global Horizontal Irradiation (GHI) @ ground level	kWh/m²		Final
1.2	Diffuse Horizontal Irradiation (DHI) @ ground level	kWh/m²		Final
1.3	Ambient temperature	°C		Final
1.4	Altitude (above sea level)	Ft		Final
2	**WEATHER DATA**	-		
2.1	Data source	-		Final
2.2	Period of data collection	Months		Final
2.3	Distance from site or spatial resolution	Km		Final
2.4	Uncertainty	%		Final
3	**MODEL PARAMETERS**	-		
3.1	Installed Capacity (DC)	MWp		2
3.2	Nominal Power (AC)	MW		2
3.3	Nominal Power at Electrical POI (AC)	MW		Final
3.4	DC/AC ratio	-		2
3.5	PVsyst Software Version (should be as bid)	-		Final
3.6	Transposition Model	-		Final

CERTAIN ENERGY MODEL INPUTS				
Nº	CHARACTERISTICS	UNITS	DATA	CLASSIFICATION; NOTES
3.7	Meteorological File Parameters (should be as bid)	-		Interval end is preferred
3.8	Post Processed Losses	%		2
3.9	**PV Modules**	-		
3.9.1	PV module manufacturer and model	-		1
3.9.2	PV module power at STC	Wp		1
3.9.3	Technology	-		Final
3.9.4	Number of PV Modules per string	-		1
3.9.5	Total number of PV Modules installed	-		1
3.9.6	Total number of strings	-		1
3.10	**Inverters**	-		
3.10.1	Inverter manufacturer and model	-		1
3.10.2	Input voltage rating	VDC		2
3.10.3	Number of strings per inverter	-		1
3.10.4	Number of inverters	-		1
3.11	**Mounting System**	-		
3.11.1	Tilt angle of rotation limits of tracking system	°		2
3.11.2	Backtracking	Yes / No		2
3.11.3	Orientation of PV Modules (azimuth)	°		1
3.11.4	Installation type (portrait / landscape)	-		1

CERTAIN ENERGY MODEL INPUTS				
Nº	**CHARACTERISTICS**	**UNITS**	**DATA**	**CLASSIFICATION; NOTES**
3.11.5	Rows and columns per mounting structure	- x -		1
3.11.6	Ground Coverage Ratio	%		1
3.12	**Array losses**	-		
3.12.1	Module quality loss	%		2
3.12.2	Module mismatch losses	%		2
3.12.3	String mismatch losses	%		2
3.12.4	Light induced degradation losses	%		2
3.12.5	IAM losses defined by manufacturer	Yes / No		2
3.12.6	Constant thermal loss factor	$W/m^2/k$		1
3.12.7	Wind loss factor	$W/m^2/k/m/s$		1
3.12.8	Soiling losses January February March April May June July August September October November December	%		2 Average Annual and Monthly
3.12.9	Ground Albedo January February March April May June July			2 Average Annual and Monthly

CERTAIN ENERGY MODEL INPUTS				
Nº	**CHARACTERISTICS**	**UNITS**	**DATA**	**CLASSIFICATION; NOTES**
	August September October November December			
3.12.10	Spectral correction applied	Yes / No		Final
3.13	**Cabling**	-		
3.13.1	DC ohmic losses @STC (Max/Calculated)	%		2
3.13.2	AC ohmic losses @STC (Max/Calculated)	%		2
3.14	**Transformers**	-		
3.14.1	Transformer type	-		1
3.14.2	Number of transformers	-		1
3.14.3	Constant Loss	W		1
3.14.4	Peak Power Loss	W		1
3.15	**System losses**	-		
3.15.1	Year 1 (starting at the Substantial Completion Payment Date) degradation	%		2
3.15.2	Annual degradation	%		2
3.15.3	Light soaking effect	%		2
3.15.4	Inverter losses	%		2
3.15.5	Auxiliary losses	%		2
3.15.6	Unavailability	%		2
3.15.7	Combined Uncertainty	%		2

CERTAIN ENERGY MODEL INPUTS					
Nº	**CHARACTERISTICS**	**UNITS**	**DATA**		**CLASSIFICATION; NOTES**
4	**ANNUAL PERFORMANCE RESULTS**	-	**PVsyst Results**	**Final Results**	Final Results include all post-processing work
4.1	Net electricity production	MWh/yr			2
4.1.1	Year 1 (starting at the Substantial Completion Payment Date), P50	MWh/yr			2
4.1.2	Year 1 (starting at the Substantial Completion Payment Date), P90	MWh/yr			2
4.1.3	30-year average, P50	MWh/yr			2
4.2	Specific Yield (Year 1, starting at the Substantial Completion Date, P50)	kWh/kWp/yr			2
4.3	Performance Ratio (Year 1, starting at the Substantial Completion Date, P50)	%			2

CLASSIFICATION LEGEND:

"1" – Subject to the other terms of the Agreement (including the Scope Book), Seller may update data or other information for the specified characteristic until 90 days prior to the Closing.

"2" - Subject to the other terms of the Agreement (including the Scope Book), Seller may update data or other information for the specified characteristic until 90 days prior to the Closing if the update constitutes an improvement to the specified characteristic's performance capabilities. The net effect of all updates classified as category 2 updates under Appendices 2, 3, and 4 may not be to increase the levelized cost of energy from the Project.

"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.

This Appendix is subject to, without limitation, the terms of Section 9.4 of the Scope Book.

***** END OF APPENDIX 2 *****

Appendix 3: Design and Operational Data

The following table sets forth certain design and operational requirements for the overall Project. Seller shall update items in Appendix 3 as noted below.

DESIGN AND OPERATIONAL DATA				
Nº	**CHARACTERISTICS**	**UNITS**	**DATA**	**CLASSIFICATION; NOTES**
1	**DESIGN CONDITIONS**	-		
1.1	Design lifetime of the plant (Required / As Bid)	years	30/	Final
1.2	Average elevation	ft a.s.l.		Final
1.3	Ambient Temperature Recorded (Minimum/Average/Maximum)	°F		Final
1.4	Design Temperature for Operation (Minimum/Maximum)	°F		Final
1.5	Design Humidity Ratio (Minimum/Maximum)	Grams of water vapor / Grams of dry air		Final
1.6	Design wind speed (per ASCE 7, Risk Category III)	Mph		2
1.7	Rainfall (Annual Avg/Annual Max/1-day Max/Design Basis Rainfall Event)	In		Final
1.8	Typical meteorological year (GHI)	kWh/m²		2
1.9	Seismic Zone	-		2 Zone and ground acceleration values shall be confirmed by the Project's geotechnical study
1.10	Available Area required (approx.)	Acres		2

DESIGN AND OPERATIONAL DATA				
Nº	**CHARACTERISTICS**	**UNITS**	**DATA**	**CLASSIFICATION; NOTES**
2	**GENERAL PLANT DATA**			
2.1	PV technology type			2
2.2	Installed Capacity (total DC peak power)	MWp		2
2.3	Nominal Power (AC) (total nominal inverter output)	MW		2
2.4	Nominal Power at Electrical POI (AC)	MW		2
2.5	DC/AC ratio			2
2.6	Nighttime Auxiliary Power (Average/Peak)	MW		2
2.7	Annual Nighttime Auxiliary Power	MWh		2 Year 1 (starting at the Substantial Completion Payment Date) based on TMY
2.8	Total area covered by PV arrays	acres		2
2.9	Total area of Project	acres		2
2.10	Row to row spacing	Ft		1
2.11	Ground Coverage Ratio	%		1
2.12	Shading losses due to internal row spacing	%		1
2.13	Total number of PV panels	Qty		1
2.14	Total number of strings	Qty		1
2.15	Total number of racking system tables	Qty		1
2.16	Total number of combiner boxes	Qty		1
2.17	Total number of inverters	Qty		1
2.18	Total number of LV/MV transformers	Qty		1

DESIGN AND OPERATIONAL DATA				
Nº	**CHARACTERISTICS**	**UNITS**	**DATA**	**CLASSIFICATION; NOTES**
3	**MONTHLY PERFORMANCE RATIOS**	-		
3.1	January	%		1
3.2	February	%		1
3.3	March	%		1
3.4	April	%		1
3.5	May	%		1
3.6	June	%		1
3.7	July	%		1
3.8	August	%		1
3.9	September	%		1
3.10	October	%		1
3.11	November	%		1
3.12	December	%		1
3.13	PR Base	%		1
4	**YEARLY PERFORMANCE RATIOS**	-		
4.1	Year 1 (starting at the Substantial Completion Payment Date)	%		1
4.2	Year 2	%		1
4.3	Year 3	%		1
4.4	Year 4	%		1
4.5	Year 5	%		1
4.6	Year 6	%		1
4.7	Year 7	%		1
4.8	Year 8	%		1
4.9	Year 9	%		1

DESIGN AND OPERATIONAL DATA				
Nº	**CHARACTERISTICS**	**UNITS**	**DATA**	**CLASSIFICATION; NOTES**
4.10	Year 10	%		1
4.11	Year 11	%		1
4.12	Year 12	%		1
4.13	Year 13	%		1
4.14	Year 14	%		1
4.15	Year 15	%		1
4.16	Year 16	%		1
4.17	Year 17	%		1
4.18	Year 18	%		1
4.19	Year 19	%		1
4.20	Year 20	%		1
4.21	Year 21	%		1
4.22	Year 22	%		1
4.23	Year 23	%		1
4.24	Year 24	%		1
4.25	Year 25	%		1
4.26	Year 26	%		1
4.27	Year 27	%		1
4.28	Year 28	%		1
4.29	Year 29	%		1
4.30	Year 30	%		1
5	**ANNUAL DEGRADATION FACTOR**	-		
5.1	Year 1 (starting at the Substantial Completion Payment Date)	%		Final Maximum 2% allowed
5.2	Year 2	%		Final Maximum 0.5%

DESIGN AND OPERATIONAL DATA				
Nº	**CHARACTERISTICS**	**UNITS**	**DATA**	**CLASSIFICATION; NOTES**
				allowed for Year 2 and afterward
5.3	Year 3	%		Final
5.4	Year 4	%		Final
5.5	Year 5	%		Final
5.6	Year 6	%		Final
5.7	Year 7	%		Final
5.8	Year 8	%		Final
5.9	Year 9	%		Final
5.10	Year 10	%		Final
5.11	Year 11	%		Final
5.12	Year 12	%		Final
5.13	Year 13	%		Final
5.14	Year 14	%		Final
5.15	Year 15	%		Final
5.16	Year 16	%		Final
5.17	Year 17	%		Final
5.18	Year 18	%		Final
5.19	Year 19	%		Final
5.20	Year 20	%		Final
5.21	Year 21	%		Final
5.22	Year 22	%		Final
5.23	Year 23	%		Final
5.24	Year 24	%		Final
5.25	Year 25	%		Final

DESIGN AND OPERATIONAL DATA				
Nº	**CHARACTERISTICS**	**UNITS**	**DATA**	**CLASSIFICATION; NOTES**
5.26	Year 26	%		Final
5.27	Year 27	%		Final
5.28	Year 28	%		Final
5.29	Year 29	%		Final
5.30	Year 30	%		Final
6	**YEARLY PRODUCTION**	-		
6.1	Year 1 (starting at the Substantial Completion Payment Date)	MWh/yr		Final
6.2	Year 2	MWh/yr		Final
6.3	Year 3	MWh/yr		Final
6.4	Year 4	MWh/yr		Final
6.5	Year 5	MWh/yr		Final
6.6	Year 6	MWh/yr		Final
6.7	Year 7	MWh/yr		Final
6.8	Year 8	MWh/yr		Final
6.9	Year 9	MWh/yr		Final
6.10	Year 10	MWh/yr		Final
6.11	Year 11	MWh/yr		Final
6.12	Year 12	MWh/yr		Final
6.13	Year 13	MWh/yr		Final
6.14	Year 14	MWh/yr		Final
6.15	Year 15	MWh/yr		Final
6.16	Year 16	MWh/yr		Final
6.17	Year 17	MWh/yr		Final
6.18	Year 18	MWh/yr		Final
6.19	Year 19	MWh/yr		Final
6.20	Year 20	MWh/yr		Final
6.21	Year 21	MWh/yr		Final

DESIGN AND OPERATIONAL DATA				
Nº	CHARACTERISTICS	UNITS	DATA	CLASSIFICATION; NOTES
6.22	Year 22	MWh/yr		Final
6.23	Year 23	MWh/yr		Final
6.24	Year 24	MWh/yr		Final
6.25	Year 25	MWh/yr		Final
6.26	Year 26	MWh/yr		Final
6.27	Year 27	MWh/yr		Final
6.28	Year 28	MWh/yr		Final
6.29	Year 29	MWh/yr		Final
6.30	Year 30	MWh/yr		Final

CLASSIFICATION LEGEND:

"1" – Subject to the other terms of the Agreement (including the Scope Book), Seller may update data or other information for the specified characteristic until 90 days prior to the Closing.

"2" - Subject to the other terms of the Agreement (including the Scope Book), Seller may update data or other information for the specified characteristic until 90 days prior to the Closing if the update constitutes an improvement to the specified characteristic's performance capabilities. The net effect of all updates classified as category 2 updates under Appendices 2, 3, and 4 may not be to increase the levelized cost of energy from the Project.

"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.

This Appendix is subject to, without limitation, the terms of Section 9.4 of the Scope Book.

***** END OF APPENDIX 3 *****

Appendix 4: Key Equipment Datasheets

The following tables detail the design requirements for the designated Project equipment.

PV MODULE				
Nº	**CHARACTERISTICS**	**UNITS**	**DATA**	**CLASSIFICATION; NOTES**
1	**GENERAL**			
1.1	Manufacturer			1
1.2	Type/Model			1
1.3	Cell type			Final
1.4	Cell configuration			1
2	**ELECTRICAL DATA**			
2.1	Nominal maximum power	W		1
2.2	Power tolerance	W		1
2.4	Module efficiency	%		1
2.5	Rated voltage (Vmp)	V		1
2.6	Rated current (Imp)	A		1
2.7	Open-Circuit voltage	V		1
2.8	Short-Circuit voltage	V		1
2.9	Maximum system voltage	VDC		2
2.10	Series fuse rating	A		1
2.11	Annual degradation factor	%		2
2.12	Grounding requirements			1
3	**TEMPERATURE CHARACTERISTICS**			
3.1	Power	%/K		1
3.2	Voltage	%/K		1
3.3	Current	%/K		1
4	**MECHANICAL DATA**			
4.1	Cell type			2
4.2	Cell arrangement			1
4.3	Dimensions	Mm		1

PV MODULE				
Nº	**CHARACTERISTICS**	**UNITS**	**DATA**	**CLASSIFICATION; NOTES**
4.4	Front cover			1
4.5	Frame material, if applicable			1
4.6	Junction box			1
4.7	Cable			1
4.8	Weight	Kg		1
5	**TESTED OPERATION CONDITIONS**			
5.1	Operating temperature	ºC		1
5.2	Max load	Pa		2
5.3	Impact resistance			2
6	**WARRANTIES**			
6.1	Product warranty period (Required / As Bid)	Yrs	10 /	Final
6.2	Power warranty (Required / As Bid)	Yrs	25 /	Final
6.3	Certifications			2

CLASSIFICATION LEGEND:

"1" – Subject to the other terms of the Agreement (including the Scope Book), Seller may update data or other information for the specified characteristic until 90 days prior to the Closing.

"2" - Subject to the other terms of the Agreement (including the Scope Book), Seller may update data or other information for the specified characteristic until 90 days prior to the Closing if the update constitutes an improvement to the specified characteristic's performance capabilities. The net effect of all updates classified as category 2 updates under Appendices 2, 3, and 4 may not be to increase the levelized cost of energy from the Project.

"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.

This Appendix is subject to, without limitation, the terms of Section 9.4 of the Scope Book.

PV MODULE				
Nº	**CHARACTERISTICS**	**UNITS**	**DATA**	**CLASSIFICATION; NOTES**
Electrical Data in Standard Test Conditions (STC).				

INVERTER				
Nº	**CHARACTERISTICS**	**UNITS**	**DATA**	**CLASSIFICATION; NOTES**
1	**GENERAL**			
1.1	Manufacturer			1
1.2	Type/Model			1
1.3	Nº machines			1
2	**INPUT RATING**			
2.1	Rated power	kW		1
2.2	Max. DC Input voltage	V		2
2.3	MPP voltage range	V		1
2.7	Nº of MPP trackers			1
2.8	Input overvoltage protection			1
3	**OUTPUT RATING**			
3.1	Rated output power	kW		1
3.2	Rated grid voltage	V		1
3.3	Voltage range	V		1
3.4	Max. output current	A		1
3.5	Contributory fault current	A		1
3.6	Rated frequency	Hz		2
3.7	Nominal power factor and adjustable range	%		
3.8	THD (rated power)	%		2
3.9	Output fuse rating	A		1
3.10	Output overvoltage protection			1
4	**OPERATING PERFORMANCE**			
4.1	Maximum efficiency	%		1

INVERTER				
Nº	**CHARACTERISTICS**	**UNITS**	**DATA**	**CLASSIFICATION; NOTES**
4.3	CEC weighted efficiency	%		1
4.4	Max. standby consumption	W		2
4.5	Max. self-consumption (operation)	W		2
5	**ENVIRONMENT**			
5.1	Operating temperature range	ºC		2
5.2	Noise level	dBA		2
5.3	Maximum installation altitude without derating	m a.s.l.		1
5.4	Maximum acceptable temperature at Pn	ºC		1
5.5	Installation type	indoor / outdoor		Final
5.6	Dimensions/machine (width/height/depth)			1
5.7	Weight/machine	Kgs		1
5.8	Galvanic isolation			1
6	**COOLING**			
6.1	Cooling method			1
6.2	Cooling air requirement	Cfm		1
6.3	Heating system			1
7	**OTHERS**			
7.1	Communication			1 DNP3 is a preferred alternative
7.2	Emergency stop			2
7.3	Positive earth soft connection			1
7.4	External auxiliary power for inverter machine			1
7.5	Additional circuits for tracker motors			1

INVERTER				
Nº	**CHARACTERISTICS**	**UNITS**	**DATA**	**CLASSIFICATION; NOTES**
7.6	Disconnect parameter adjustable			1
7.7	All pole sensitive RCB			1
7.8	Isolation monitoring			1
7.9	Overload behavior			1
7.10	Internal DC switch			2
8	**WARRANTIES**			
8.1	Product warranty period (Required / As Bid)	Yrs	5	Final
8.2	Certifications			2

CLASSIFICATION LEGEND:

“1” - Subject to the other terms of the Agreement (including the Scope Book), Seller may update data or other information for the specified characteristic until 90 days prior to the Closing.

“2” - Subject to the other terms of the Agreement (including the Scope Book), Seller may update data or other information for the specified characteristic until 90 days prior to the Closing if the update constitutes an improvement to the specified characteristic’s performance capabilities. The net effect of all updates classified as category 2 updates under Appendices 2, 3, and 4 may not be to increase the levelized cost of energy from the Project.

“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.

This Appendix is subject to, without limitation, the terms of Section 9.4 of the Scope Book.

TRACKER				
Nº	**CHARACTERISTICS**	**UNITS**	**DATA**	**CLASSIFICATION; NOTES**
1	**GENERAL**			
1.1	Manufacturer			1
1.2	Type	Tracking		Final

TRACKER				
Nº	**CHARACTERISTICS**	**UNITS**	**DATA**	**CLASSIFICATION; NOTES**
2	**BASIC DATA**			
2.1	Ground Coverage Ratio	%		1
2.2	Type of foundations			1
2.3	Corrosion protection	Yes / No		Dependent on final geotechnical studies
2.4	Type of corrosion protection			Dependent on final geotechnical studies
2.5	Design wind speed (per ASCE 7, Risk Category III)	Mph		Final
2.6	Tilt	º		2
2.7	Module positions	landscape / portrait		1
2.8	Module arrangement			1
2.9	kWp per table	kWp		1
2.10	Number or tables			1
2.11	Dimensions (length/width/height)	M		1
3	**TRACKER SYSTEM**			
3.1	Maximum slope			2
3.2	Type of tracking system			2
3.3	Tracking range			2
3.4	Backtracking	Yes / No		2
3.5	Rows per tracker actuator			1
3.6	Strings per row			1
3.7	Power per tracker	kWp		1
3.8	Drive type			1

TRACKER				
Nº	**CHARACTERISTICS**	**UNITS**	**DATA**	**CLASSIFICATION; NOTES**
3.9	Power consumption	kWh/MWp/yr		1
3.10	Stow Wind Speed	Mph		1
3.11	Motors per MWp			1
4	**WARRANTIES**			
4.1	Manufacturer's material & workmanship (Required / As Bid)	Yrs	10 /	Final
4.2	Motor, gear, battery, controller (Required / As Bid)	yrs	5 /	Final
4.3	Certifications			2

CLASSIFICATION LEGEND:

"1" - Subject to the other terms of the Agreement (including the Scope Book), Seller may update data or other information for the specified characteristic until 90 days prior to the Closing.

"2" - Subject to the other terms of the Agreement (including the Scope Book), Seller may update data or other information for the specified characteristic until 90 days prior to the Closing if the update constitutes an improvement to the specified characteristic's performance capabilities. The net effect of all updates classified as category 2 updates under Appendices 2, 3, and 4 may not be to increase the levelized cost of energy from the Project.

"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.

This Appendix is subject to, without limitation, the terms of Section 9.4 of the Scope Book.

LV/MV TRANSFORMER				
Nº	**CHARACTERISTICS**	**UNITS**	**DATA**	**CLASSIFICATION; NOTES**
1	**GENERAL**			

LV/MV TRANSFORMER				
Nº	**CHARACTERISTICS**	**UNITS**	**DATA**	**CLASSIFICATION; NOTES**
1.1	Manufacturer			1
1.2	Type/Model			1
1.3	Nº of units			1
1.4	Intellectual Properties			1
1.5	Design - manufacture standards			1
1.6	Name of datasheet attached			1
2	**TRANSFORMER CHARACTERISTICS**			
2.1	Type of Transformer			1
2.2	3 x single phase or three-phase			1
2.3	Core or shell			1
2.4	Type of tank			1
2.5	Type of cooling			1
2.6	Vector group			1
2.7	Winding material LV/HV	Al/Cu		1
2.8	Rated frequency	hz		Final
2.9	Transformer life value at IEC conditions			1
2.10	Rated power based @ 20ºC	kW		1
2.11	Higher grid voltage	kV		1
2.12	Insulation voltage level	kV		1
2.13	Short duration withstand voltage	kV		1
2.14	Test voltage (60 hz 1min)	kV		1
2.15	Transformation ratio			1

LV/MV TRANSFORMER				
Nº	**CHARACTERISTICS**	**UNITS**	**DATA**	**CLASSIFICATION; NOTES**
2.16	Primary rated current	A		1
2.17	First Secondary rated current	A		1
2.18	Second Secondary rated current	A		1
2.19	Primary no load current	A		1
2.20	Excitation current (rated V/110% rated V)	A		1
2.21	Maximum inrush current HV	A		1
2.22	Maximum withstand short-circuit current	kA		1
2.23	Duration of short-circuit current	S		1
2.24	Tappings			1
2.25	Load losses at 75ºC	W		1
2.26	No-load losses	W		1
2.27	Short-circuit impedance	%		1
2.28	Environmental class			1
2.29	Climatic class			1
2.30	Fire behavior class			1
2.31	Thermal class			1
2.32	Dimensions (width/height/depth)	In		1
2.33	Weight of complete transformer	lbs		1
3	**accessories**			
3.1	Accessories oil type			1
3.2	Shock tightness degree			1
3.3	Salt-fogtight			1

LV/MV TRANSFORMER				
Nº	**CHARACTERISTICS**	**UNITS**	**DATA**	**CLASSIFICATION; NOTES**
3.4	Tª resistance			1
3.5	Max. Rated pressure			1
3.6	Pressure range			1
3.7	Oil level			1
3.8	Tª range			1
3.9	PT 100, Dry type			1
3.10	Tª range			1
3.11	Output signal			1
3.12	Other technical characteristics			1
4	**OTHERS**			
4.1	Temperature rising windings	ºF		1
4.2	Terminals (location)			1
4.3	LV			1
4.4	MV			1
4.8	Accessories			1
5	**WARRANTIES**			
5.1	Product Warranty Period (Required / As Bid)	mo	18-36 /	See Section 6.3 Final

CLASSIFICATION LEGEND:

"1" - Subject to the other terms of the Agreement (including the Scope Book), Seller may update data or other information for the specified characteristic until 90 days prior to the Closing.

"2" - Subject to the other terms of the Agreement (including the Scope Book), Seller may update data or other information for the specified characteristic until 90 days prior to the Closing if the update constitutes an improvement to the specified characteristic's performance capabilities. The net effect of all updates classified as category 2 updates under Appendices 2, 3, and 4 may not be to increase the levelized cost of energy from the Project.

LV/MV TRANSFORMER				
Nº	**CHARACTERISTICS**	**UNITS**	**DATA**	**CLASSIFICATION; 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.

Subject to the other terms of the Agreement (including the Scope Book), Seller to complete each type of LV/MV transformer used on the Project, including inverter station transformers, at least 90 days prior to Closing.

This Appendix is subject to, without limitation, the terms of Section 9.4 of the Scope Book.

BATTERY				
Nº	**CHARACTERISTICS**	**UNITS**	**DATA**	**CLASSIFICATION; NOTES**
1	**GENERAL**	**-**		
1.1	Manufacturer	-		1
1.2	Type/Model	-		1
1.3	Quantity required	Qty		1
1.4	Design - Manufacture standards	-		Final
2	**RATINGS**	**-**		
2.1	Continuous Real Power - Discharge (Rated/Maximum)	MW		2
2.2	Continuous Real Power - Charge (Rated/Maximum)	MW		2
2.3	Continuous Apparent Power - Charge (leading and lagging) (Rated/Maximum)	MVA		2
2.4	Continuous Apparent Power - Discharge (leading and lagging) (Rated/Maximum)	MVA		2
2.5	Continuous Reactive Power (Rated/Maximum)	MVARs		2

BATTERY				
Nº	**CHARACTERISTICS**	**UNITS**	**DATA**	**CLASSIFICATION; NOTES**
2.6	Rated Discharge Energy (BOL)	MWh		2
2.7	Rated Continuous AC Current	A		2
2.8	Output Voltage Range (AC grid voltage)	kV		2
2.9	Output Frequency Range	Hz		2
2.10	Maximum Ramp Rate (charging/discharging)	MW/min		2 Specify any associated parameters such as SOC
2.11	Charge Time (Minimum/Typical/Maximum)	Hr		2 From minimum to rated maximum SOC
2.12	Recommended Charge Power	MW		2
2.13	Typical Charge Time (include any rest period between charge and discharge cycle)	Hr		2
2.14	Expected Availability of System	%		Final
2.15	Typical Start Up Time / Shut Down Time	S		2
3	**EFFICIENCY AND CYCLE LIFE**	**-**		
3.1	Cycle Life @ Full rated power.	Qty		2
3.2	Total Round Trip Efficiency, 100% DOD Cycles, Full rated power (BOL and EOL)	%		2
3.3	Total Round Trip Efficiency, 100% DOD Cycles, 50% rated power (BOL and EOL)	%		2
3.4	Total Round Trip Efficiency, 50% DOD Cycles, Full rated power (BOL and EOL)	%		2

BATTERY				
Nº	**CHARACTERISTICS**	**UNITS**	**DATA**	**CLASSIFICATION; NOTES**
3.5	Total Round Trip Efficiency, 50% DOD Cycles, 50% rated power (BOL and EOL)	%		2
3.6	Total Round Trip Efficiency, 25% DOD Cycles, Full rated power (BOL and EOL)	%		2
3.7	Total Round Trip Efficiency, 25% DOD Cycles, 50% rated power (BOL and EOL)	%		2
4	**AUXILIARY POWER**	**-**		
4.1	Average Auxiliary Power Required (continuous/peak)	kW		2
4.2	Auxiliary Nominal Voltage	VAC		1
5	**ENVIRONMENT**	**-**		
5.1	Rate Operating Temperature Range (Minimum-Maximum)	ºF		2
5.2	Noise Level (@ 3ft)	dBA		2
5.3	Rated Operating Relative Humidity Range (Minimum-Maximum)	%		2
5.4	Maximum Installation Altitude Without Derating	ft a.s.l		2
5.5	Installation Type	indoor/ outdoor		Final
5.6	Battery Container/Enclosure Dimension (length/width/height)	In		1
5.7	Weight per Battery Container/Enclosure	Lbs		1
5.8	Galvanic Isolation	-		Final
6	**BATTERY CONTAINER/ENCLOSURE THERMAL MANAGEMENT**	**-**		

BATTERY				
Nº	**CHARACTERISTICS**	**UNITS**	**DATA**	**CLASSIFICATION; NOTES**
6.1	Startup Time (Typical/Maximum)	S		2
6.2	Shutdown Time (Typical/Maximum)	S		2
6.3	Estimated Planned Outages	hr/yr		2
7	**BATTERY CONTAINER/ENCLOSURE THERMAL MANAGEMENT**	**-**		
7.1	Cooling Method	-		1
7.2	Configuration (i.e. 2 x 100%)	-		2
7.3	Cooling Air Requirement	Cfm		1
7.4	Heating System	-		1
8	**WARRANTIES**	**-**		
8.1	BESS Product Warranty Period (Required / As Bid)	Yrs	10 /	Final
8.2	BESS Performance Warranty Period (Required / As Bid)	Yrs	20 /	Final

CLASSIFICATION LEGEND:

"1" - Subject to the other terms of the Agreement (including the Scope Book), Seller may update data or other information for the specified characteristic until 90 days prior to the Closing.

"2" - Subject to the other terms of the Agreement (including the Scope Book), Seller may update data or other information for the specified characteristic until 90 days prior to the Closing if the update constitutes an improvement to the specified characteristic's performance capabilities. The net effect of all updates classified as category 2 updates under Appendices 2, 3, and 4 may not be to increase the levelized cost of energy from the Project.

"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.

This Appendix is subject to, without limitation, the terms of Section 9.4 of the Scope Book.

BALANCE OF PLANT				
Nº	**CHARACTERISTICS**	**UNITS**	**DATA**	**CLASSIFICATION; NOTES**
1	**COMBINER BOXES**			
3.1	Rated output current	A		1
3.2	Number of strings			1
3.3	Permissible DC voltage	Vdc		2
3.4	Protection level, according to IS Codes			2
3.5	UV proof	Yes / No		Final
3.6	String voltage, temperature and surge protection monitoring	Yes / No		1
3.7	String current monitoring	Yes / No		1
3.8	Output DC switch	Yes / No		2
3.9	Surge protection on DC side			2
3.10	Design Ambient Temperature (min/max)	°F		2
3.11	Halogen-free and self-extinguishing housing	Yes / No		1
3.12	Cooling system	Yes / No		1
3.13	Earthing	Yes / No		1
3.14	Warranties (Required / As Bid)	Yrs	2 /	Final
3.15	Enclosure Rating			
2	**CABLES**			
2.1	Solar String Cable Voltage (rated/max)			1
2.2	Solar String Cable Material (conductor/insulator)			1
2.3	Solar String Cable Insulator Class			1
2.4	LV Cable Voltage (rated/max)			1

BALANCE OF PLANT				
Nº	**CHARACTERISTICS**	**UNITS**	**DATA**	**CLASSIFICATION; NOTES**
2.5	LV Cable Material (conductor/insulator)			1
2.6	LV Cable Insulator Class			1
2.7	MV Cable Voltage (rated/max)			1
2.8	MV Cable Material (conductor/insulator)			1
2.9	MV Cable Insulator Class			1
2.10	HV Cable Voltage (rated/max)			1
2.11	HV Cable Material (conductor/insulator)			1
2.12	HV Cable Insulator Class			1
3	**POWER CONVERSION AUXILIARY EQUIPMENT**			
3.1	**General**			
3.1.1	Total number of step-up transformers per station			1
3.1.2	Total number of auxiliary transformers per station			1
3.1.3	Temperature range	°F		1
3.1.4	Cooling System			1
3.1.5	Energy consumption	W		1
3.1.6	Dimensions (length/width/height)	In		1
3.4	**UPS**			
3.4.1	Manufacturer			1
3.4.2	Type/Model			1
3.4.3	Rated Voltage	V		1
3.4.4	Rated capacity	kVA		1
3.4.5	Time Backup	Hr		1

BALANCE OF PLANT				
Nº	**CHARACTERISTICS**	**UNITS**	**DATA**	**CLASSIFICATION; NOTES**
3.4.6	Inverters and by pass switch redundant (2 x 100%)	Yes / No		1
3.4.7	Protection class			1
4	**INSTRUMENTATION AND CONTROL**			
4.1	Number of operator stations	Qty		
4.2	**Meteorological Stations**	Qty		2
4.2.1	GHI Pyranometer	Qty		Per met station
4.2.2	POA Pyranometer	Qty		Per met station
4.2.3	Ambient temperature	Qty		Per met station
4.2.4	Module temperature	Qty		Per met station
4.2.5	Wind speed (anemometer)	Qty		Per met station
4.2.6	Relative Humidity Sensor	Qty		Per met station
4.2.7	Soiling Monitoring System/Sensor	Qty		Per met station
4.2.8	Data Logger	Qty		Per met station
4.2.9	Battery Backup (required/as bid)	Hr	12/	Per met station
4.2.10	Cloud sensor	Qty		Per met station
4.2.11	Other			List and provide quantity per met station
5	**SPARE PARTS**			
5.1	List all recommended initial spare parts for 25 years operation			To be provided 60 days prior to Closing

CLASSIFICATION LEGEND:

“1” - Subject to the other terms of the Agreement (including the Scope Book), Seller may update data or other information for the specified characteristic until 90 days prior to the Closing.

“2” - Subject to the other terms of the Agreement (including the Scope Book), Seller may update data or other information for the specified characteristic until 90 days prior to the Closing if the update constitutes an improvement to the specified characteristic’s performance capabilities. The net effect of all updates classified as category 2 updates under Appendices 2, 3, and 4 may not be to increase the levelized cost of energy from the Project.

“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.

This Appendix is subject to, without limitation, the terms of Section 9.4 of the Scope Book.

***** END OF APPENDIX 4 *****

Appendix 5: Project Performance Test Procedures[7]

[Attached]

***** END OF APPENDIX 5 *****

[7] **NTD:** To be provided by Seller and approved by Buyer prior to the Effective Date. The procedures are expected to include, among other things, pre-test meetings, checks, and other requirements, test procedures and protocols, notice and engineering, equipment, instrumentation, monitoring, control system and other document deliverables, and data collection and filtering.

Appendix 6: Project Site Map[8]

*** **END OF APPENDIX 6** ***

[8] Appendix 6 cannot be updated without approval of Buyer.

Appendix 7: 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 7 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 – Excludes major equipment covered in Appendix 9 - Collector Substation and Appendix 10 - High Voltage Overhead Transmission Line					
PV Modules	Jinko	Trina	LG	Hanwha Q CELLS	Canadian Solar
	FirstSolar	Astronergy	Talesun	LONGi	Phono Solar (SUMEC)
	Yingli	JA Solar	Suntech	SunPower	REC Solar
	Risen	HT Solar			
Inverters	GE	TMEIC	Schneider	Power Electronics	SMA
	Chint	Ingeteam	ABB		
Racking System	Array Technologies Inc.	NexTracker	Game Change	SunLink	Shoals
	RBI	Schletter	TerraSmart	Ideematec	Unirac
	SunPower	Soltec	Nclave		

Approved Manufacturers List					
Major Equipment – Excludes major equipment covered in Appendix 9 - Collector Substation and Appendix 10 - High Voltage Overhead Transmission Line					
LV/MV Transformer	ABB	Central Maloney	ERCOM		
	Virginia Transformer with external surge arrestor	Cooper/ Eaton			
Switchgear	ABB	Cutler-Hammer	GE	Powell	
Balance of Plant					
Combiner / Recombiner Boxes	SolarBOS	Shoals	Bentek		
Disconnects	Square D	Siemens	Eaton	ABB	SMA
Data Logger	Campbell Scientific	Kipp and Zonen			
Pyranometer	Kipp and Zonen	Eppley Laboratory	EKO		
Temperature Sensor (cell)	Aros Solar Technology				
Anemometer	Gill Instruments				
Power Distribution Center	Powell	Zachry	PACS	Alstom	
Battery Energy Storage System					
Batteries	Samsung	LG Chem	BYD	Panasonic	Tesla
	CATL				
Power Conversion System	SMA	TMEIC	Schneider	Power Electronics	Ingeteam
	ABB	Chint			

EPC Contractors: [Seller to provide a list of EPC Contractors for Buyer's approval]

***** END OF APPENDIX 7 *****

APPENDIX 8: NERC Requirements - Effective Date[9]

NERC Standard	Title	Requirement(s)	NERC Responsibility
EOP-004-4	Event Reporting	R1, R2	GO/GOP
FAC-001-3	Facility Interconnection Requirements	R2, R4	GO
FAC-002-2	Facility Interconnection Studies	R2, R5	GO
FAC-003-4	Vegetation Management	R1, R2, R3, R4, R5, R6, R7	GO
FAC-008-3	Facility Ratings	R1, R2, R6, R7, R8	GO
IRO-010-2	Reliability Coordinator Data Specification and Collection	R3	GO/GOP
MOD-025	Verification and Data Reporting of Generator Real and Reactive Power Capability and Synchronous Condenser Reactive Power Capability	R1, R2	GO
MOD-026	Verification of Models and Data for Generator Excitation Control System or Plant Volt/Var Control Functions	R2, R3, R4, R5	GO
MOD-027	Verification of Models and Data for Turbine/Governor and Load Control or Active Power/Frequency Control Functions	R2, R3, R4	GO
MOD-032-1	Data for Power System Modeling and Analysis	R2, R3	GO
PRC-002-2	Disturbance Monitoring and Reporting Requirements	R2, R3, R4, R7, R8, R9, R10, R11, R12	GO
PRC-004-5(i)	Protection System Misoperation Identification and Correction	R1, R2, R3, R4, R5, R6	GO
PRC-005-1.1b	Transmission and Generation Protection System Maintenance and Testing	R1, R2	GO

[9] **NTD**: Items to be updated and current as of the Effective Date of the Agreement and as required thereafter pursuant to Sections 5 and 9.4 of the Scope Book.

NERC Standard	Title	Requirement(s)	NERC Responsibility
PRC-005-6	Protection System, Automatic Reclosing, and Sudden Pressure Relaying Maintenance	R1, R2, R3, R4, R5	GO
PRC-006-SERC-02	Automatic Underfrequency Load Shedding Requirements	R8	GO
PRC-012-2	Remedial Action Schemes	R1, R3, R5, R6, R7, R8	GO
PRC-015-1	Remedial Action Scheme Data and Documentation	R1, R2, R3	GO
PRC-016-1	Remedial Action Scheme Misoperations	R1, R2, R3	GO
PRC-017-1	Remedial Action Scheme Maintenance and Testing	R1, R2	GO
PRC-018-1	Disturbance Monitoring Equipment Installation and Data Reporting	R1, R2, R3, R4, R5, R6	GO
PRC-019-2	Coordination of Generating Unit or Plant Capabilities, Voltage Regulating Controls, and Protection	R1, R2	GO
PRC-023-4	Transmission Relay Loadability	R1, R2, R3, R4, R5	GO
PRC-024-2	Generator Frequency and Voltage Protective Relay Settings	R1, R2, R3, R4	GO
PRC-025-2	Generator Relay Loadability	R1	GO
PRC-026-1	Relay Performance During Stable Power Swings	R2, R3, R4	GO
PRC-027-1	Coordination of Protection Systems for Performance during Faults	R1, R2, R3	GO
TOP-003-3	Operational Reliability Data	R5	GO/GOP
TPL-007-3	Transmission System Planned Performance for Geomagnetic Disturbance	R6, R10	GO
VAR-002-4.1	Generator Operation for Maintaining Network Voltage Schedules	R5, R6	GO
COM-001-3	Communications	R8, R11, R12	GOP

NERC Standard	Title	Requirement(s)	NERC Responsibility
COM-002-4	Operating Personnel Communications Protocols	R3, R6	GOP
EOP-005-3	System Restoration from Blackstart Resources	R11, R12, R13, R14, R15, R16	GOP
IRO-001-4	Reliability Coordination - Responsibilities	R2, R3	GOP
PER-005-2	Operations Personnel Training	R6	GOP
PER-006-1	Specific Training for Personnel	R1	GOP
PRC-001-1.1(ii)	System Protection Coordination	R1, R3	GOP
TOP-001-4	Transmission Operations	R3, R4, R5, R6	GOP
TPL-007-3	Transmission System Planned Performance for Geomagnetic Disturbance Events	R6	GOP
VAR-002-4.1	Generator Operation for Maintaining Network Voltage Schedules	R1, R2, R3, R4	GOP

***** END OF APPENDIX 8 *****

APPENDIX 9: Collector Substation

Attached.

Appendix 9
Collector Substation

to

Scope Book (Exhibit A)

for

Build-Own-Transfer Acquisition Agreement

for

[Name of Project]

TABLE OF CONTENTS

1. INTRODUCTION

1.1 Purpose

This Appendix 9 to the Scope Book (this "Appendix 9") 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 9 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 9 applies to all new Collector Substations.

This Appendix 9 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 9.

1.3 General Data[10]

This Appendix 9 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. Without limiting the other terms of the Agreement or any Ancillary Agreement, in performing the Work relating to Collector Substations, Seller shall comply with, any cause its Contractors and Subcontractors to comply with, the terms of this Appendix 9, the Scope Book, all Laws (including codes) and applicable Permits, and the other elements of the Performance Standard.

This Appendix 9 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

[10]**NTD:** The document remains subject in all respects to Buyer's continued due diligence and internal review (including by Buyer's subject matter experts). On occasion, this draft includes certain provisions on the basis that the drafters were unaware of information that might cause those provisions to be drafted in a materially different way or eliminated altogether. 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. ELL reserves the right to issue an updated version of this document at a later date.

comply with all requirements specified in the GIA or any other Required Deliverability Arrangement.

This Appendix 9 is part of the Scope Book.

Article, Section, Table, Figure, and Attachment references in this Appendix are to this Appendix 9 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 Changes in this Revision

[Reserved]

1.6 Deviations

Any deviations from the MFS for the Collector Substations or the terms of this Appendix 9 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 Substations 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:

- American National Standards Institute (ANSI)
- Institute of Electrical and Electronics Engineers (IEEE)
- Insulated Cable Engineers Association (ICEA)
- American Society of Mechanical Engineers (ASME)
- National Electrical Code (NEC)
- National Electrical Safety Code (NESC)
- National Electrical Manufacturers Association (NEMA)
- North American Electric Reliability Corporation (NERC)
- National Fire Protection Association (NFPA)
- Uniform Plumbing Code (UPC)
- Underwriters Laboratories (UL)
- American Concrete Institute (ACI)
- American Iron and Steel Institute (AISI)
- Federal Occupational Safety and Health Administration (OSHA)
- Avian Power Line Interaction Committee (APLIC)
- ANSI/TIA-568-C.0-2009 Generic Telecommunications Cabling for Customer Premises
- 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
- Underwriters Laboratories, Inc. (UL)

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 9.

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 5.

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 3. 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 3: 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 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 4, Table 5, Table 6, 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 4: 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 5: 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 6: 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 7: 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.

5.3.4.1 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.

5.3.5 Load Combinations:

Case 1 – Extreme Wind:	2.5 D + 2.5 W I_{FW} + 1.0 SC
Case 2 – Ice with Concurrent Wind:	2.5 D + 2.5 $I_W I_{FI}$ + 2.5 $W_I I_{FI}$ + 1.0 SC
Case 3 – Seismic:	2.5 D + 2.5 E (or E_{FS})I_{FE} + 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.

5.3.6 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 8 and dimensions shall be as shown in Table 9.

Table 8: 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
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 9: 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”

Rated Duty- Cycle Voltage	Creepage Distance	Height
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”

5.3.7 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 10 and Table 11.

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 10: 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 3	
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 11: 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 studs 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.

5.3.8 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.

5.3.9 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.

5.3.10 Line Tuners

Communication using carrier equipment (line traps and tuners) shall not be used.

5.3.11 Metering Devices

5.3.11.1 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.

5.3.11.2 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 ETI 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) and the other elements of the Performance Standard.

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.

5.3.11.3 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)

5.3.12 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 12 and Table 13 for required CCVT and PT ratings, respectively.

Table 12: 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 13: 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

5.3.12.1 Free Standing CTs

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 Section 5.3.11.2 for Revenue Metering Requirements.

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 14 and Table 15 for required minimum CT ratios and CT accuracy, respectively.

Table 14: CT Ratios

Fault Current	Minimum CT Ratio
48 – 64kA	4000/5
32 – 48kA	3000/5
20 – 32kA	2000/5
0 - 20kA	1200/5

Table 15: CT Accuracy

Metering Accuracy Class	Accuracy			
	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 16: 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

5.3.12.2 CT/PT Combo Units

CT/PT Combo units are not allowed. Exceptions must be approved by Buyer in writing.

5.3.13 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 in accordance with the Performance Standard.

5.3.13.1 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 17. Circuit breakers shall conform to IEEE C37. Circuit breaker ratings shall be as shown in Table 17.

Table 17: 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.

5.3.13.2 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.

5.3.13.3 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 18.

Table 18: 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)	
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 developed or procured and used in accordance with the Performance Standard shall dictate the final rating.

5.3.14 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 delta-wye configuration (low side to high side) with a neutral grounding bushing on the high side (wye winding).

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 19 below provide some recommended transformer specifications to consider.

Table 19: 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)

5.3.14.1 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 20: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 21 below (for 345 kV and 500 kV, requirements will be provided under separate cover);

Table 21: 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 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 / mm^2 (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 22: 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 23

Table 23: 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 24

Table 24: 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”

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 25. 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 25: GSU Bushing Typical CT Ratios

	kV	**600:5**	**1200:5**	**2000:5**	**3000:5**	**5000:5**	
BUSHING VOLTAGE (kV L–L)	**13.8**	**12-14 MVA**	**19-28 MVA**	**28-47 MVA**	**47-71 MVA**	**71-100 MVA**	**XFMR WINDING MVA RATING: 3Ph @65C**
	14.4	**12-14 MVA**	**19-29 MVA**	**29-49 MVA**	**49-74 MVA**	**74-100 MVA**	
	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

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 26: 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.

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.

5.5 <u>Provisions for a fall protection system</u>

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.

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, thermo wells, 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 ^{0}C to +150 ^{0}C, and shall have a display resolution of ± 1 ^{0}C 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.

5.6 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.

5.7 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 X_0 Neutral Grounding Reactor is required. The requirement of the NGR shall be evaluated during planning phases.

5.8 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:

a) Control house lighting, heating, and air conditioning,

b) Power transformer cooling fans, pumps, LTC and control cabinet space heaters,

c) Circuit breaker control cabinet heaters, and operating mechanism charging motors,

d) Substation lighting,

e) Battery chargers.

f) Maintenance equipment, including gas cart, and oil filter truck if feasible

g) Future Loads

Approved sources of ac station service include the following:

a) Distribution line(s) area feeder

b) Distribution transformer connected to a substation bus

c) 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.

a) Inverter system

b) Solar panels

c) Autotransformer tertiary

d) 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.

5.9 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.)

5.9.1 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.

5.9.2 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).

5.9.2.1 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).

5.10 <u>Control House</u>

5.10.1 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.

5.10.2 Roof

All roof panels in all locations shall have a U.L. wind uplift classification of class 90 (minimum).

5.10.3 Ceiling

Insulation shall be R-19 minimum and shall have a U.L. Flame Spread Rating of 25 (minimum).

5.10.4 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).

5.10.5 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.

5.10.6 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.

5.10.6.1 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

5.10.7 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.

5.10.8 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.

5.10.9 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.

5.10.10 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.

5.11 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 9, 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.).

5.11.1 Siting and Civil

5.11.1.1 Floodplain

5.11.1.2 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.

5.11.1.3 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.

5.11.1.4 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.

5.11.1.5 Erosion Control

The design shall comply with the Storm Water Pollution Prevention Plan (SWPPP) and Environmental Management Plan (EMP).

5.11.1.6 Wetland Delineation and Mitigation

Seller shall comply with all wetland requirements specified by Laws, applicable Permits, and the Performance Standards. Wetlands shall be confirmed by a qualified third party.

5.11.1.7 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

5.11.1.8 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.

5.11.1.9 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.

5.11.2 Oil Containment

5.11.2.1 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.

5.11.2.2 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.

5.11.2.3 Containment System

5.11.2.4 Secondary oil containment type shall be an above grade containment pit.

5.11.2.5 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.

5.11.2.6 All designed water removal systems shall incorporate a method of monitoring discharged water quality. Monitors shall be connected to alarm systems.

5.11.2.7 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.

5.11.2.8 Pits using drainpipes shall assure that the drainpipe material shall be capable of withstanding the higher temperatures associated with an oil fire.

5.11.2.9 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:

5.11.2.10 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.

5.11.2.11 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

5.11.2.12 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.

5.11.2.13 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.

5.11.2.14 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.

5.11.2.15 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. Structures and Foundations

6. <u>CODE AND STANDARDS</u>

The structural design of the substation shall be in accordance with the latest revision of industry codes, standards, and design guides unless stated otherwise. Applicable federal, state and local codes and standards shall also be observed. The following industry codes and standards shall be observed for civil/structural design.

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 9.

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. This risk is borne by Seller.

American Concrete Institute (ACI)

ACI 318: Building Code Requirements for Structural Concrete

American Institute of Steel Construction (AISC)

AISC 360: Specification for Structural Steel Buildings

American National Standards Institute (ANSI) standards

American Society for Testing and Materials (ASTM) standards

American Society of Civil Engineers (ASCE)

ASCE 113: Design of Substation Structures

ASCE 48: Design of Steel Transmission Pole Structures

American Welding Society (AWS) D1.1

International Building Code

Concrete Reinforcing Steel Institute (CRSI) standards

Institute of Electrical and Electronics Engineers (IEEE)

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

Other recognized standards and ordinances shall be used where required, to serve as guidelines for the design, when not in conflict with the above listed standards.

7. EQUIPMENT SUPPORT STRUCTURE LOADING

7.1 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 27, Table 28, Table 29, or Table 30 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 27, Table 28, Table 29, or Table 30 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 27, Table 28, Table 29, or Table 30: 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 27: 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

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
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 28: Load Districts by Parish – Louisiana

State	Parish	Extreme Wind mph	NESC District			Concurrent Ice & Wind Case Ice Thickness inches
			Light	Medium	Heavy	
LA	Acadia	140	L			0.5
LA	Allen	110	L			0.5
LA	Ascension	140	L			0.5
LA	Assumption	140	L			0.5
LA	Avoyelles	110	L			0.5
LA	Beauregard	110	L			0.5
LA	Bienville	100		M		0.75
LA	Bossier	100		M		0.75
LA	Calcasieu	140	L			0.5
LA	Caldwell	100		M		0.75
LA	Cameron	140	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	140	L			0.5
LA	East Carrol	100		M		0.75
LA	East Feliciana	110	L			0.5
LA	Evangeline	110	L			0.5
LA	Franklin	100		M		0.75
LA	Grant	100	L			0.75
LA	Iberia	140	L			0.5
LA	Iberville	140	L			0.5
LA	Jackson	100		M		0.75
LA	Jefferson	150	L			0.5
LA	Jefferson Davis	140	L			0.5
LA	Lafayette	140	L			0.5
LA	Lafourche	150	L			0.5
LA	Lasalle	100	L			0.75
LA	Lincoln	100		M		0.75
LA	Livingston	125	L			0.5
LA	Madison	100	L			0.75
LA	Morehouse	100		M		0.75
LA	Natchitoches	100		M		0.75

LA	Orleans	140	L			0.5
LA	Ouachita	100		M		0.75
LA	Plaquemines	150	L			0.5
LA	Point Coupee	110	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	140	L			0.5
LA	St. Helena	110	L			0.5
LA	St. James	140	L			0. 5
LA	St. John the Baptist	140	L			0.5
LA	St. Landry	110	L			0.5
LA	St. Martin, North	140	L			0.5
LA	St. Martin, South	140	L			0.5
LA	St. Mary	140	L			0.5
LA	St. Tammany	140	L			0.5
LA	Tangipahoa	125	L			0.5
LA	Tensas	100	L			0.5
LA	Terrebonne	150	L			0.5
LA	Union	100		M		0.75
LA	Vermillion	140	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	140	L			0.5
LA	West Carrol	100		M		0.75
LA	West Feliciana	110	L			0.5
LA	Winn	100		M		0.75

Table 29: 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
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 30: 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	140	L			0.5
TX	Galveston	140	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
TX	Jasper	125		M		0.5
TX	Jefferson	140	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	140	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

7.2 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.

7.3 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.).

7.4 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.

7.5 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

8. 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), and the Performance Standard. 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.

8.1 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.

8.2 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.

8.3 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.

8.4 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.

9. 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 Piling fc = 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.

9.1 <u>Foundation Deflection and Rotation</u>

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.

9.2 <u>Materials</u>

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.

9.3 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.

10. 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.

10.1 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.

10.2 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.

11. SUBSTATION PHYSICAL DESIGN CRITERIA

11.1 Substation Bus System

11.1.1 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.

11.1.2 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.

11.1.3 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.

11.2 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.

11.3 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.

11.4 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.

11.5 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.

11.6 Grounding System Components

11.6.1 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.

11.6.2 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.

11.6.3 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.

11.6.4 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.

11.6.5 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).

11.6.6 Crushed Rock

The site will be covered with a layer of crushed rock as defined in Section 5.11.1.8. 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.

11.6.7 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.

11.7 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.

11.7.1 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.

11.7.2 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.

11.7.3 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.

11.7.4 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.

11.8 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.

11.8.1 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.

11.9 <u>Substation Security/Safety (CODE)</u>

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.

11.10 <u>Animal Deterrents</u>

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.

11.11 <u>Substation Protection & Control Design Criteria</u>

11.11.1 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.

11.11.2 Backup and Transfer Trip

Breaker Failure Backup and/or transfer trip circuits to interface with other stations shall always be provided.

11.11.3 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.

11.11.4 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.

11.11.5 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.

11.11.6 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.

11.11.7 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.

11.11.8 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).

11.11.9 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.

11.11.10 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.

11.12 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).

12. 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 5.10. 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.

12.1 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.

12.2 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.

12.3 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.

12.4 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.

12.5 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.

12.6 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.

12.7 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.

13. 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.

14. 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 or the Performance Standard:

- 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.

15. ATTACHMENTS

1. ATTACHMENT 1: APPROVED MANUFACTURERS LIST*

**Attachment 1 to Appendix 9 (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 7 of the Scope Book.*

2. <u>ATTACHMENT 2: SITE ENVIRONMENTAL CHARACTERISTICS</u>

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
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	

Purchase Spec.	Class	Description	Qualifier	Approved Manufacturer(s) - (Preferred)	Preferred Supplier	Type	Notes
	Conductor	Copper (Not Control cable)		Copperweld/Alcoa	Stuart Irby	Substation	Grounding conductor
	Conductor	Cable, Fiber	OPT-GW	AFL	Preferred Sales	T-Line	
	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	
	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	

Purchase Spec.	Class	Description	Qualifier	Approved Manufacturer(s) - (Preferred)	Preferred Supplier	Type	Notes
	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
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	
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

Purchase Spec.	Class	Description	Qualifier	Approved Manufacturer(s) - (Preferred)	Preferred Supplier	Type	Notes
							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	
	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
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	

Purchase Spec.	Class	Description	Qualifier	Approved Manufacturer(s) - (Preferred)	Preferred Supplier	Type	Notes
	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;	Qualified	1000 (Aus, Ger), 750 (Br), 200 (Col)	500 (Aus, Ger, Br), 230 (Col)	2000 (Aus), 1100 (Ger), 1000	765 (Aus), 1000+ (Ger), 765 (Br), 345 (Col)

Bogota, Colombia				(Br), 250 (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

Descriptions	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	
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 9 *****

APPENDIX 10: High Voltage Overhead Transmission

Attached.

Appendix 10
High Voltage Overhead Transmission

to

Scope Book (Exhibit A)

for

Build-Own-Transfer Acquisition Agreement

for

[Name of Project]

TABLE OF CONTENTS

1. INTRODUCTION[11]

1.1 Purpose

This Appendix 10 to the Scope Book (this "Appendix 10") 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 line 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 10 applies to all Transmission Lines.

This Appendix 10 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 10.

1.3 General Data

This Appendix 10 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 10, all Laws (including codes) and applicable Permits, and the other elements of the Performance Standard.

This Appendix 10 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

[11] **NTD:** The document 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. ELL reserves the right to issue an updated version of this document.

Lines shall comply with all requirements specified in the GIA or any other Required Deliverability Arrangement.

This Appendix 10 is part of the Scope Book.

Article, Section, Table, Figure, and Attachment references in this Appendix 10 are to this Appendix 10 unless otherwise provided or the context otherwise requires.

1.4 Changes in this Revision

Document created 03/26/2021.

1.5 Deviations

Any deviations from the MFS for the Transmission Lines or the terms of this Appendix 10 shall require Buyer's prior approval and will be subject to the terms of the Agreement.

2. DEFINITIONS

2.1 Definitions

2.1.1 BIL - Basic Lightning Impulse Insulation Level is a reference insulation level in terms of the crest voltage of a standard lightning impulse.

2.1.2 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 (W_{CD}) in Figure 6.3.4.1-3.

2.1.3 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.

2.1.4 Designer – Individual (in-house or contractor) responsible for analyzing and selecting transmission line components, structures, or foundations.

2.1.5 **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.

2.1.6 **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.

2.1.7 **Meridian –** Electronic document management system used to archive transmission standards and documents and track revisions.

2.1.8 **PLS-CADD –** A software package used during optimization of pole spotting, design analysis, and the development of material lists.

2.1.9 **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 10:

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 10.

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. <u>SAFETY AND ENVIRONMENT</u>

4.1 <u>Safety</u>

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 140 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 Attachment 6 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

Description	Wind Loading	Ice Loading	Temp.	NESC Ref.	Condition	Clearance Check
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 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 5.2 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)

6.2.2 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.

6.2.3 Substations

Transmission line vertical clearances inside substations shall meet the vertical clearance requirements shown in Attachment 2.

6.2.4 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 5.2. 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 5.2. 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 5.2. Minimum clearance shall be that associated for the higher voltage for the 100 mph swing clearance given in Table 8.1.2.

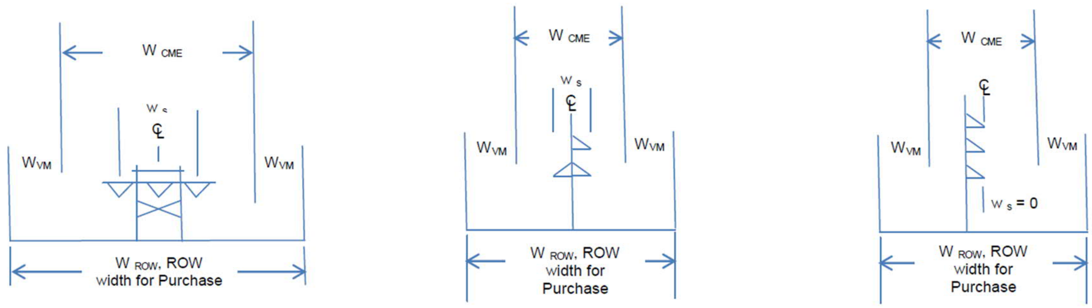
6.3.4 Right of Way Requirements

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.

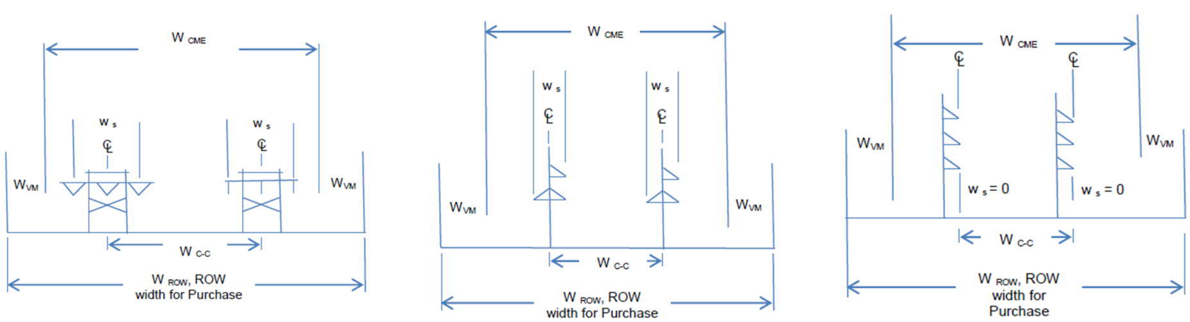
Figure 6.3.4.1-1 – Typical Single Structure ROW



(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})

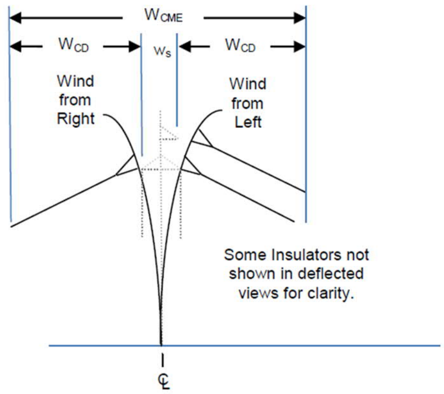
		Single Pole	
Voltage	H-frames (ft.)	Delta/ Vert. Double Circuit (ft.)	Single Circuit Vertical (ft.)
500kV	140	96	70
345kV	120	65	45
230kV	75	50	35
161/138/115 kV	60	40	30
69kV	45	30	20

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

Line Voltage (kV)	ROW Widths (ft.) assuming two identical lines								
	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
	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

Type	Size	Stranding	Code Word	Area (in^2)	Dia. (in.)	Weight (lb/ft)	Strength (lbs)
ACSS	1590	45/7	LAPWING	1.34	1.50	1.79	27,900
	1272	45/7	BITTERN	1.07	1.35	1.43	22,300
	954	54/7	CARDINAL	0.85	1.20	1.23	26,000
	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
	1590	45/7	LAPWING	1.34	1.50	1.79	42,200
	1272	45/7	BITTERN	1.07	1.35	1.43	34,100
	1033.5	45/7	ORTOLAN (1)	0.87	1.21	1.163	27,700
	954	54/7	CARDINAL	0.85	1.20	1.23	33,800
	954	45/7	RAIL (2)	0.80	1.165	1.075	25,290
	666.6	24/7	FLAMINGO	0.59	1.00	0.86	23,700
	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
	649.5	18/19	N/A	0.51	0.93	0.61	17,100
	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	-	-
	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 tension	35% UBS
Final unloaded tension	25% 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
	LAPWING	0-0-0 (F)	8431	30.2
	BITTERN	0-0-0 (I)	8580	38.5
	BITTERN	0-0-0 (F)	6735	30.2
	CARDINAL	0-0-0 (I)	7380	28.4
	CARDINAL	0-0-0 (F)	5793	22.3
	FLAMINGO	0-0-0 (I)	5160	28.4
	FLAMINGO	0-0-0 (F)	4051	22.3
ACSR	CHUKAR	0-0-0 (I)	12480	24.5
	CHUKAR	0-0-0 (F)	9796	19.2
	LAPWING	0-0-0 (I)	10740	25.5
	LAPWING	0-0-0 (F)	8431	20.0
	BITTERN	0-0-0 (I)	8580	25.2
	BITTERN	0-0-0 (F)	6735	19.8
	ORTOLAN	0-0-0 (I)	6978	25.2
	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
ACA	649.5 ACAR	0-0-0 (I)	3660	21.4

Type	Conductor Name	Load Case	Max Tension (pounds)	% of Ultimate Strength
	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
	* 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 <u>Conductor and Shield Wire Marking</u>

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 10, 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.
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 and11/2" 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

8.3.2 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.

8.3.3 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.

8.3.4 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.

8.3.5 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.

8.3.6 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

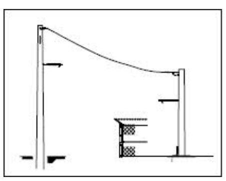
There are two acceptable methods to achieve these requirements: (1) driving additional rods and (2) installing a counterpoise that consists of 100 feet of conductor buried 18” deep parallel to the line.

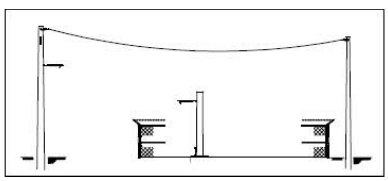
8.3.7 Grounding at Substations

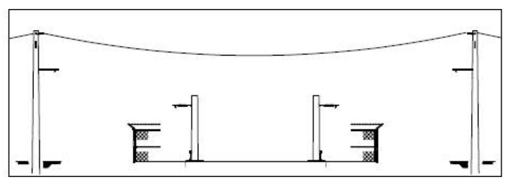
Bonding of Transmission Line Shield Wire to Substation Ground Grid

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.

8.3.8 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.
Soil Investigations

The soil investigation shall include soil corrosion recommendations to determine the need for anodes and the number required for each structure.

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

8.3.9 Structure Protection

Steel poles, steel piles and steel guy anchors shall be protected as described below.

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.

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 <u>Concrete Poles</u>

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
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

Assembly Part	**Ultimate Strength**	**NESC Strength Factor**	**Allowable Load**	**Line Tension Guy Slope 1.5:1**	**Line Tension Guy Slope 1:1**
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 (140 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 <u>Spacing of Dead-End Structures</u>

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 10.

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 List1

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.)

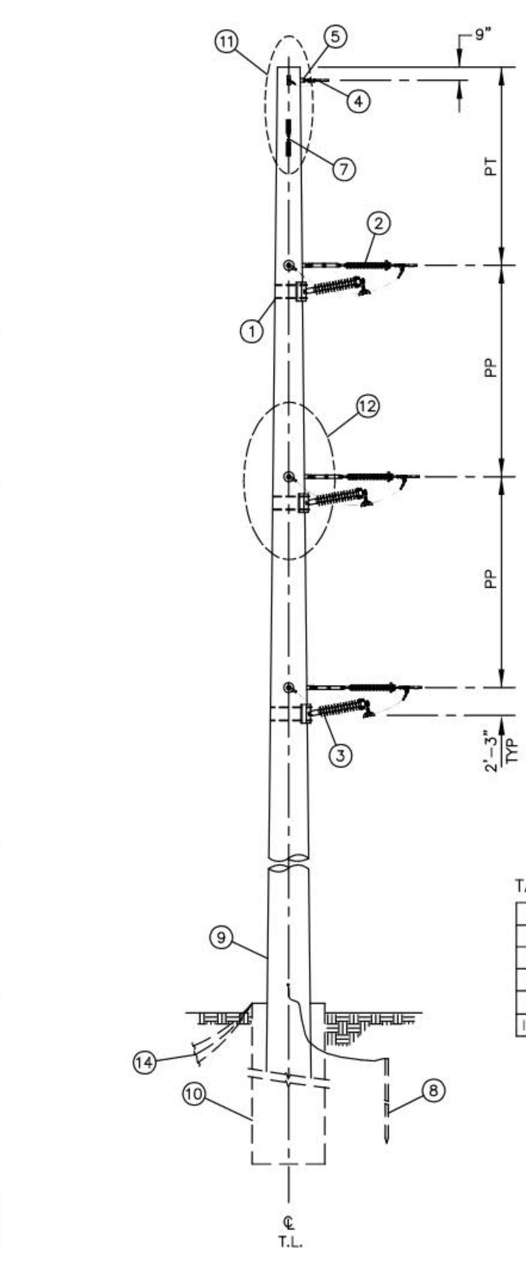


TABLE 1

	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

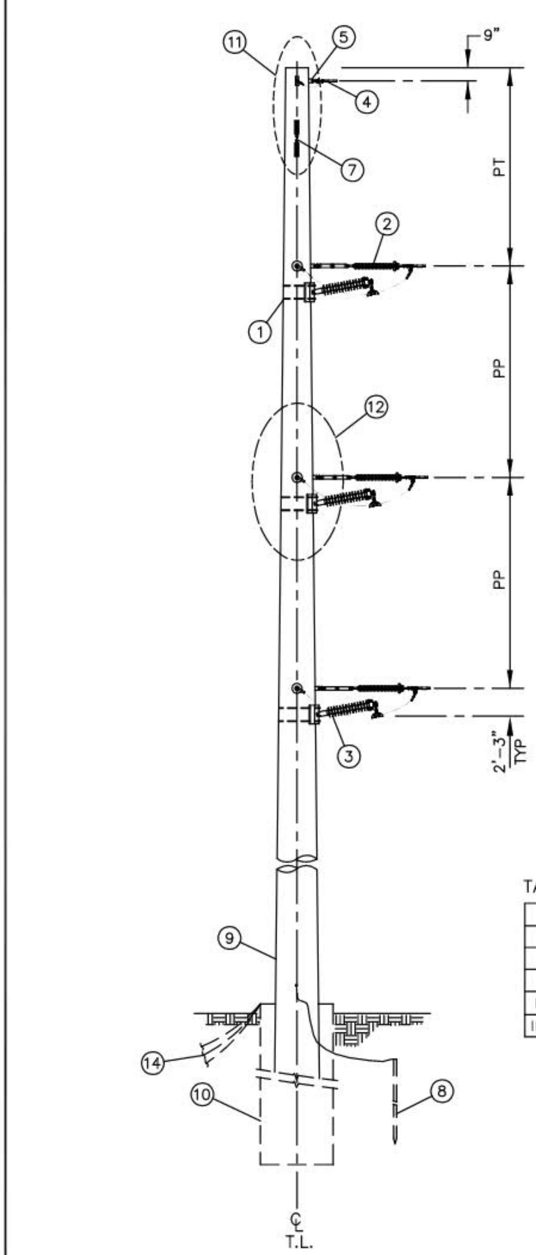
Entergy | No. TMS627A0

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

0	01–02–16	REPLACES DWS TAS286A2, TCS298A3, & TDS298A3	WRK	KC	ECW	STD NO. SCALE: NONE
NO.	DATE:	REVISION	BY:	CHK:	APPR	No. TMS626A0

Entergy

PLOT 1=1 SH. 1 OF 1

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.)

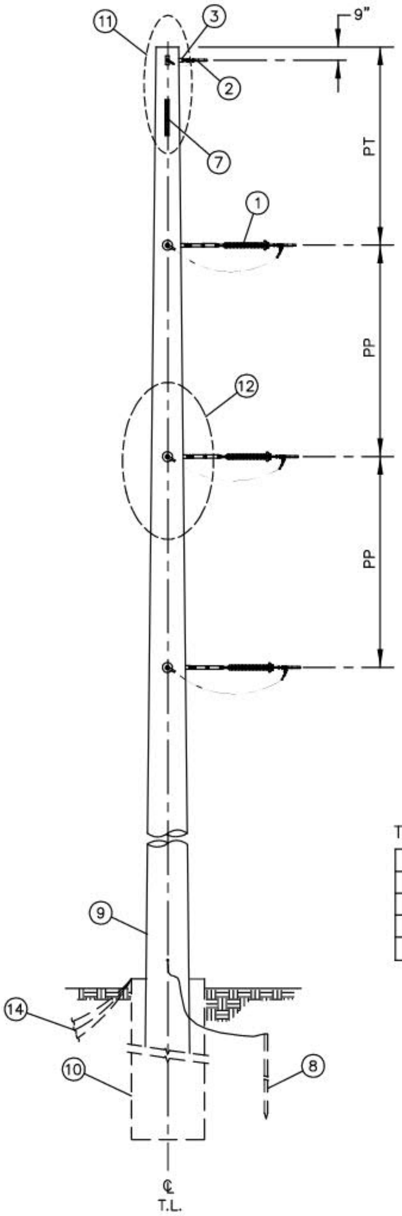


TABLE 1

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

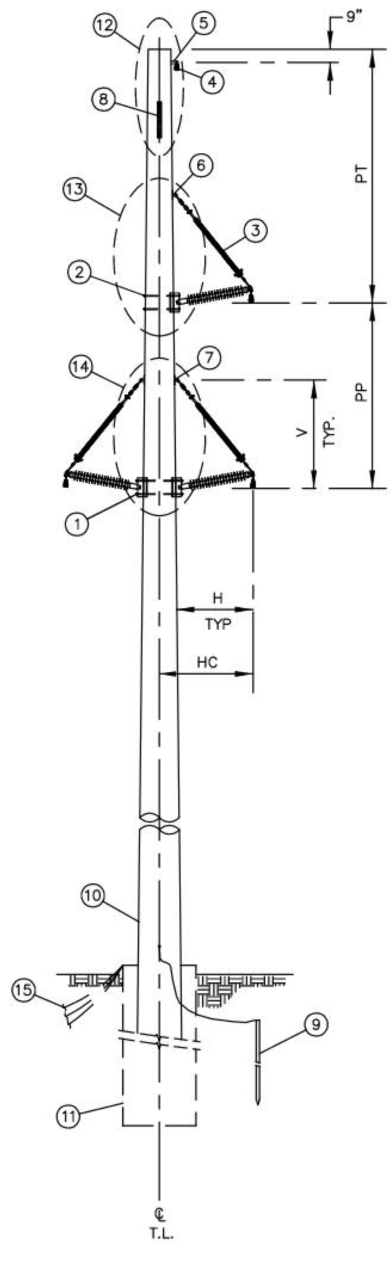
STD NO.	SCALE: NONE
Entergy	No. TMS625A0
	PLOT 1=1	SH. 1 OF 1

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.

ITEM	QTY.	ASSEMBLY/DRAWING
ASSEMBLY LIST		
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"

No. TMS236A0

Entergy

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.)

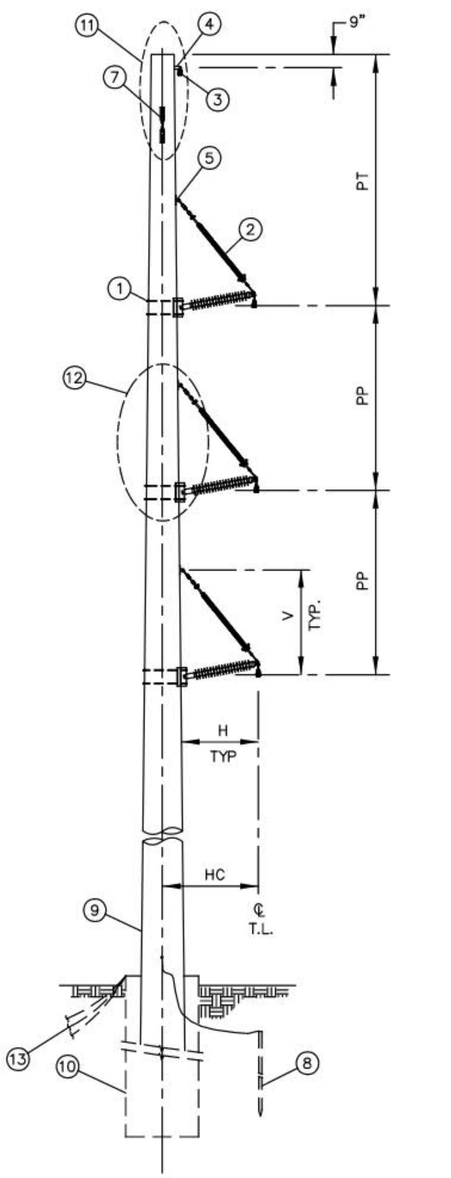


TABLE 1

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.

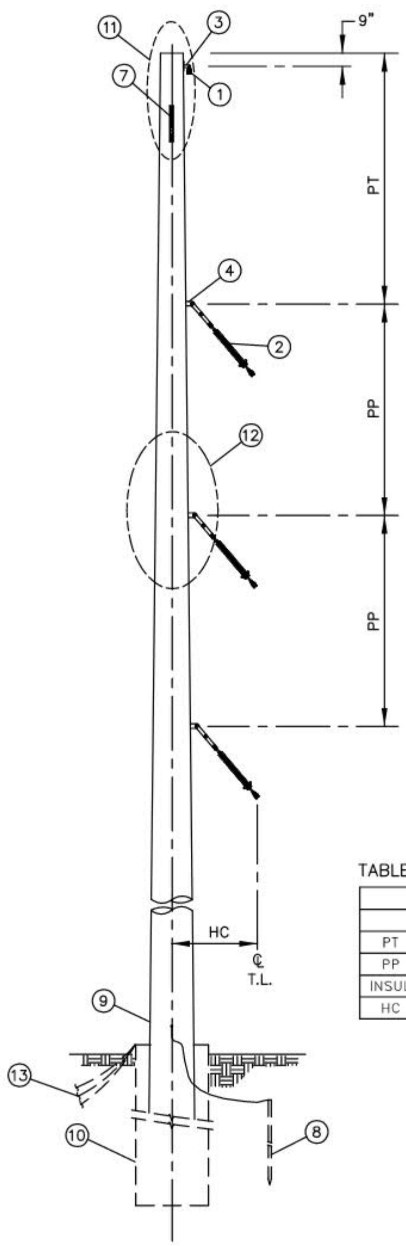
Transmission LineDesign Standard
6-20' SC VERT, BP2, CONC
STRUCTURE DRAWING & DETAIL

STD NO.	SCALE: NONE
Entergy	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
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.)

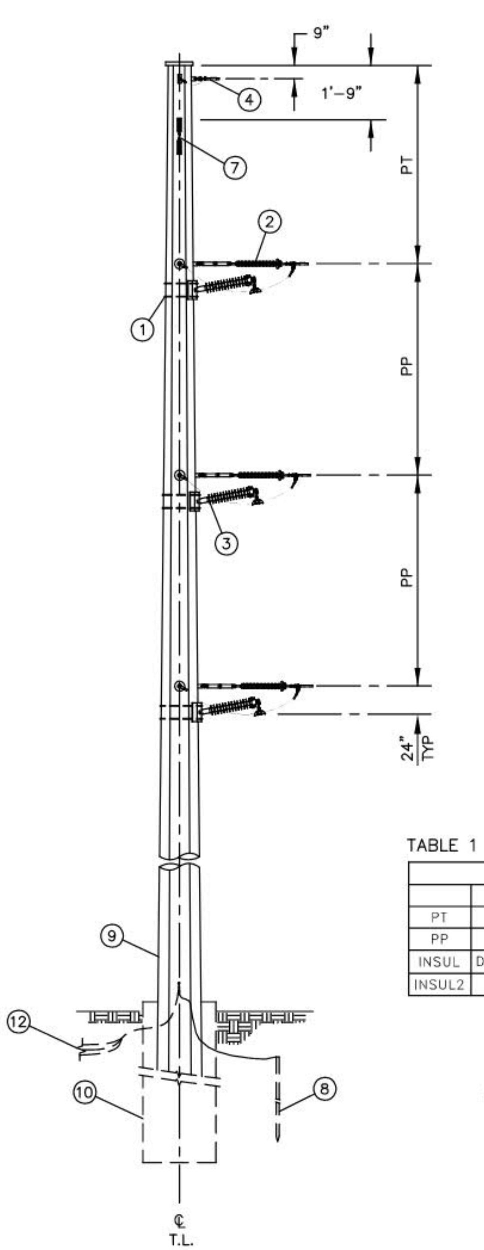


TABLE 1

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		
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.)

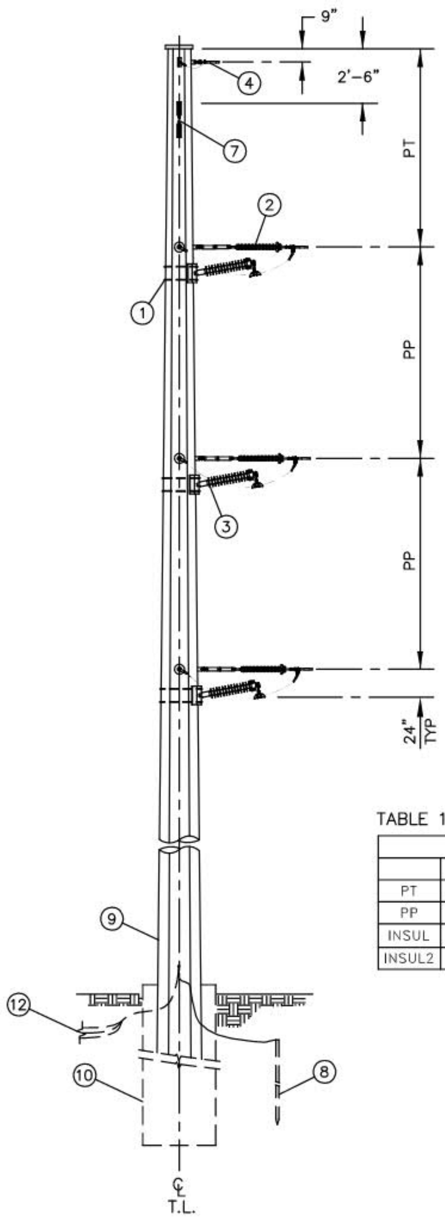


TABLE 1

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

0	01–02–16	REPLACES DWS TAS387A3, TCS444A4, & TDS417A4	WRK	KC	ECW	
NO.	DATE:	REVISION	BY:	CHK:	APPR	

STD NO. | SCALE: NONE
Entergy | No. TMS641A0
PLOT 1=1 | SH. 1 OF 1

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.)

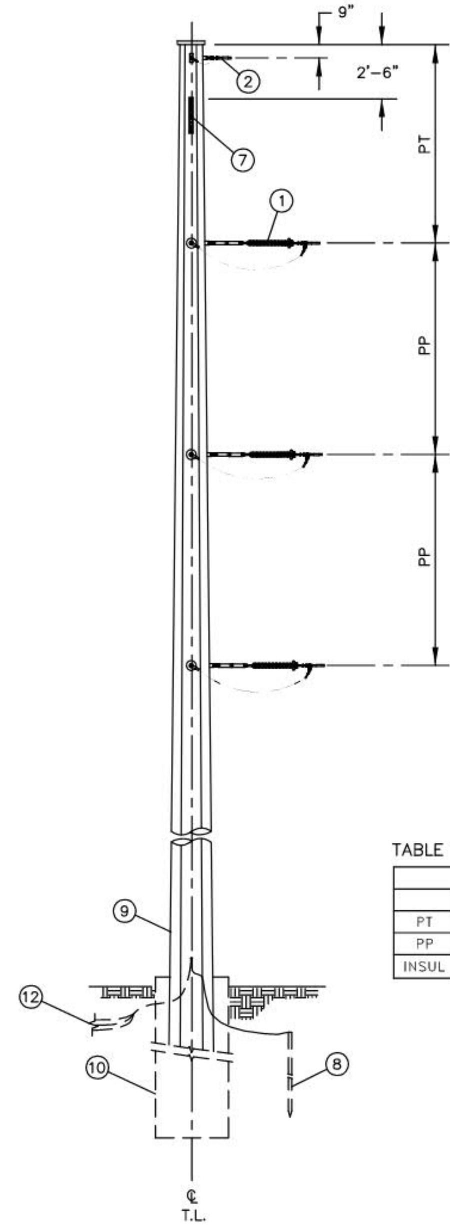


TABLE 1

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

STD NO. | SCALE: NONE

No. TMS640A0

Entergy

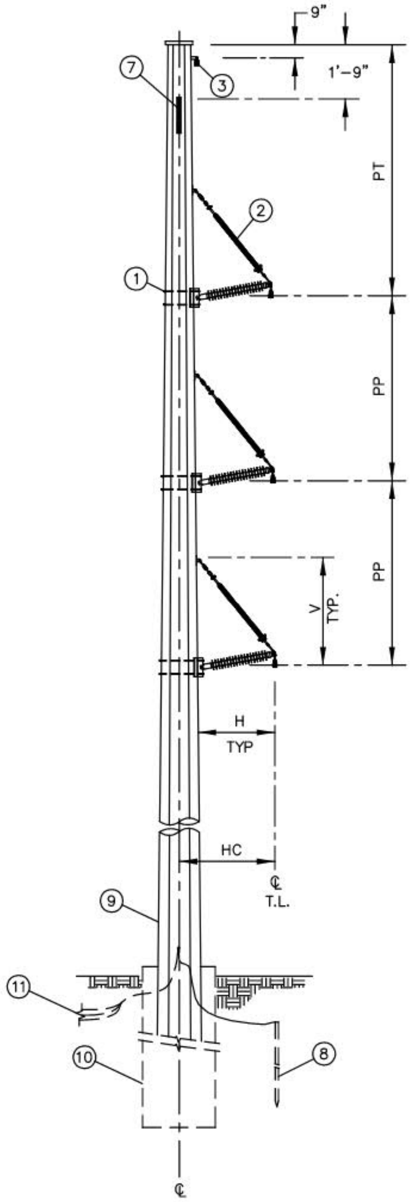
PLOT 1=1 | SH. 1 OF 1

NO.	DATE:	REVISION	BY:	CHK:	APPR
0	01–02–16	REPLACES DWS TAS389A2, TCS446A3, & TDS419A3	WRK	KC	ECW

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

NO.	DATE:	REVISION	BY:	CHK:	APPR
0	01-02-16	Replaces Dws TAS411A1, TCS335A2, & TDS323A2	WRK	KC	ECW

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.)

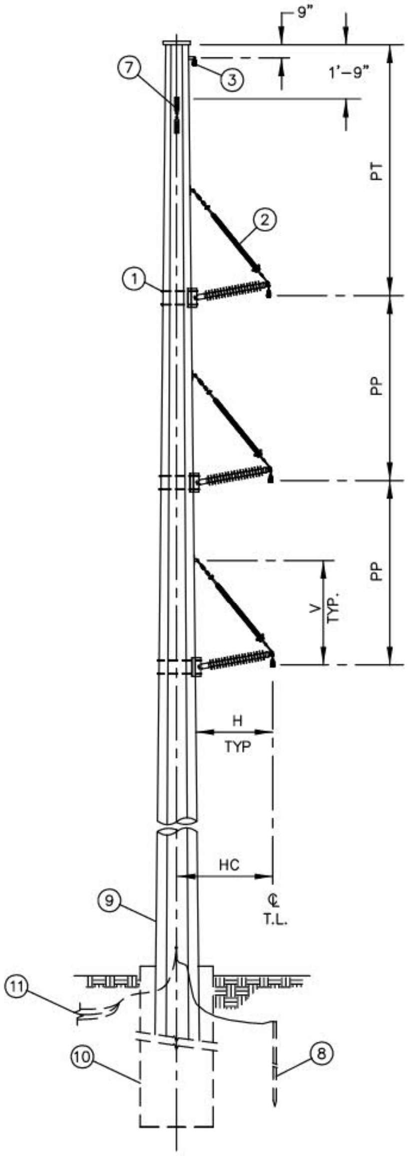


TABLE 1

	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 hardward 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

NO.	DATE:	REVISION	BY:	CHK:	APPR
0	01–02–16	REPLACES DWS TAS465A0, TCS431A2, & TDS402A2	WRK	KC	ECW

STD NO. | SCALE: NONE

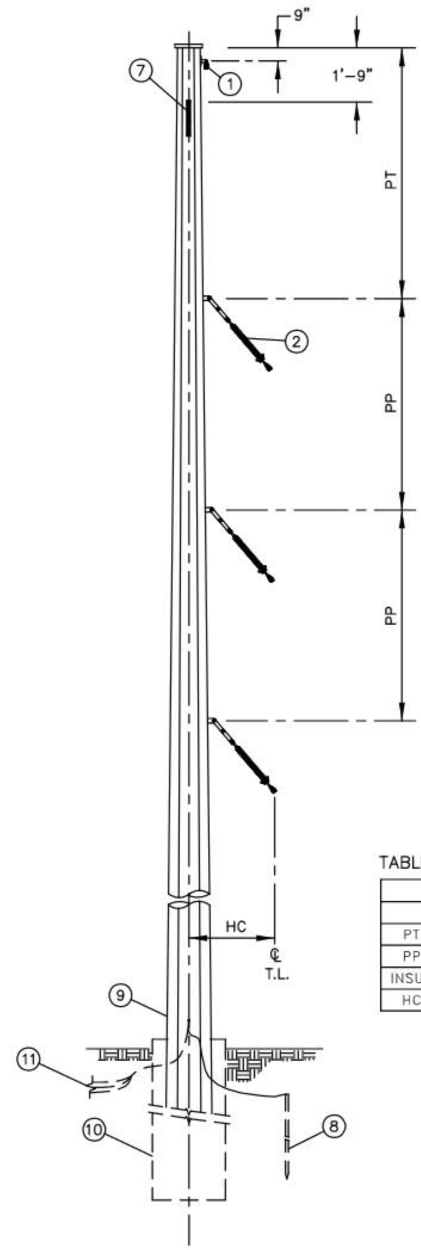
No. TMS606A0

Entergy

PLOT 1=1 | SH. 1 OF 1

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		
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

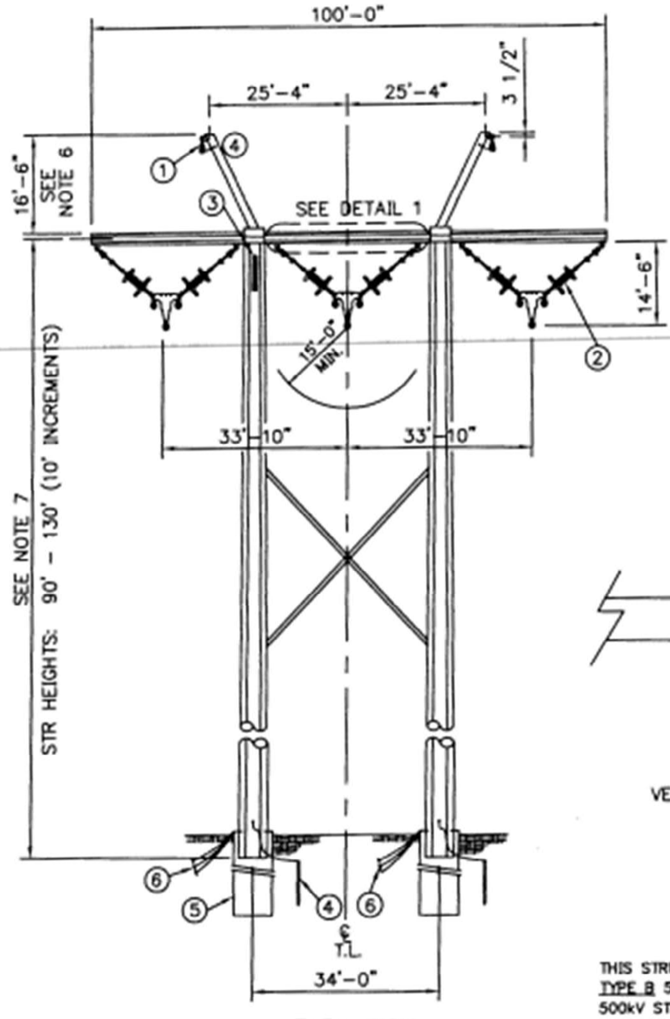
Entergy | PLOT 1=1 | SH. 1 OF 1

NO.	DATE:	REVISION	BY:	CHK:	APPR
0	01–02–16	REPLACES DWS TAS393A1, TCS450A2, & TDS423A2	WRK	KC	ECW

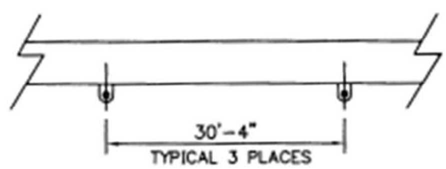
rkugl90 12/2/2015 SF–V–SHR–S

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)



ELEVATION



DETAIL 1
VEE STRING ATTACHMENT SPACING

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

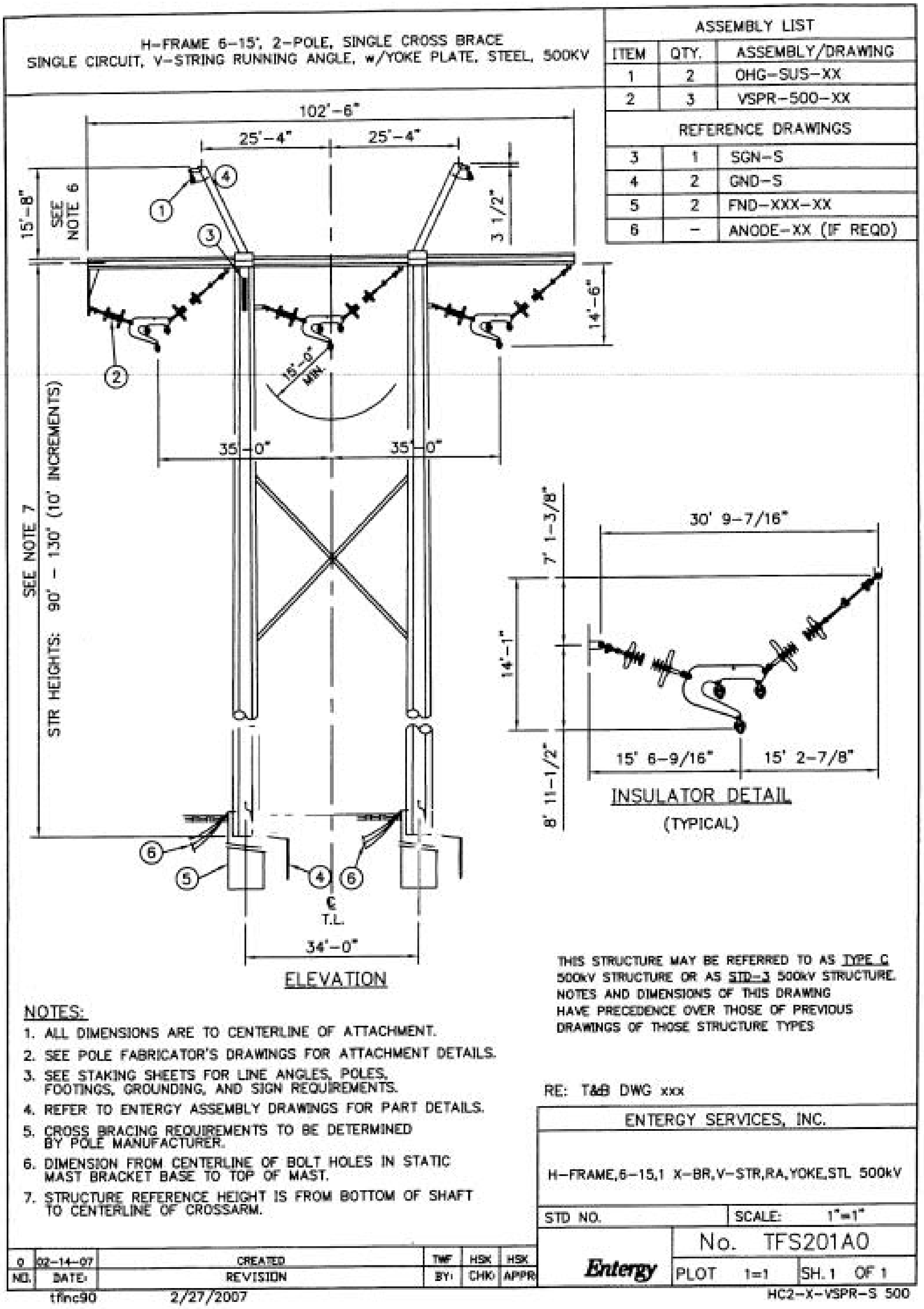
ENTERGY SERVICES, INC.

H-FRAME,0-6,1 X-BR, V-STR, YOKE, STL 500KV

0	02-14-07	CREATED	TWF	HSK	HSK
NO.	DATE:	REVISION	BY:	CHK:	APPR

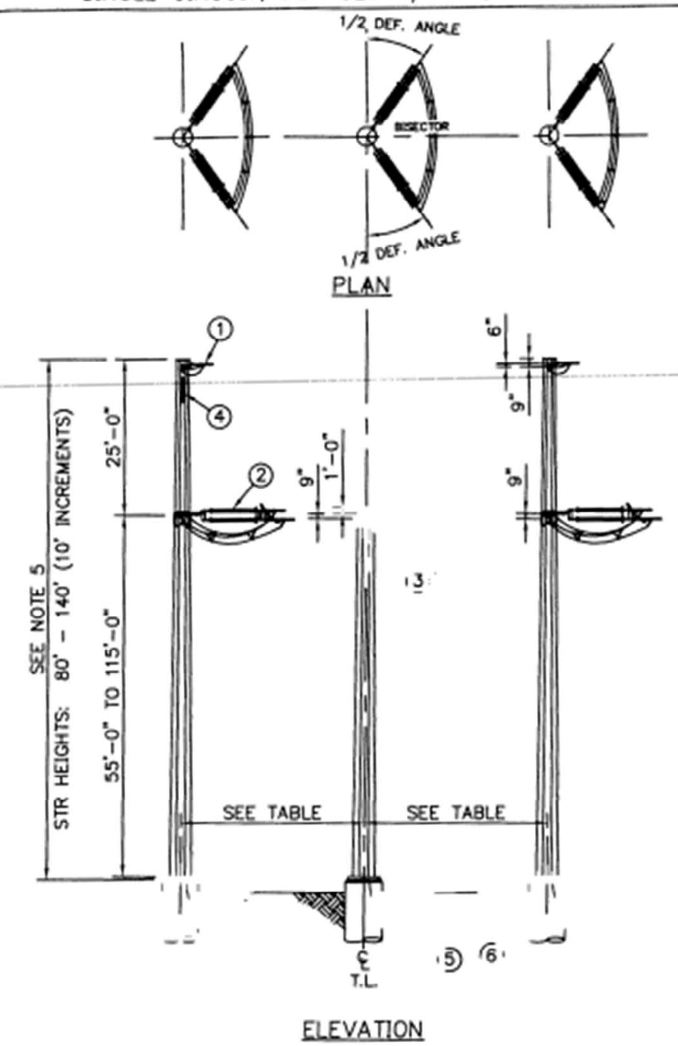
STD NO. SCALE: 1"=1"
Entergy No. TFS200A0
PLOT 1=1 SH. 1 OF 1

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)
102'-6"
25'-4"
25'-4"
15'-8"
SEE NOTE 6
3 1/2"
14'-6"
15'-0" MIN.
35'-0"
35'-0"
SEE NOTE 7
STR HEIGHTS: 90' - 130' (10' INCREMENTS)
T.L.
34'-0"
ELEVATION
30' 9-7/16"
7' 1-3/8"
14'-1"
8' 11-1/2"
15' 6-9/16"
15' 2-7/8"
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
0 | 02-14-07 | CREATED | TWF | HSK | HSK
NO. | DATE: | REVISION | BY: | CHK: | APPR
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

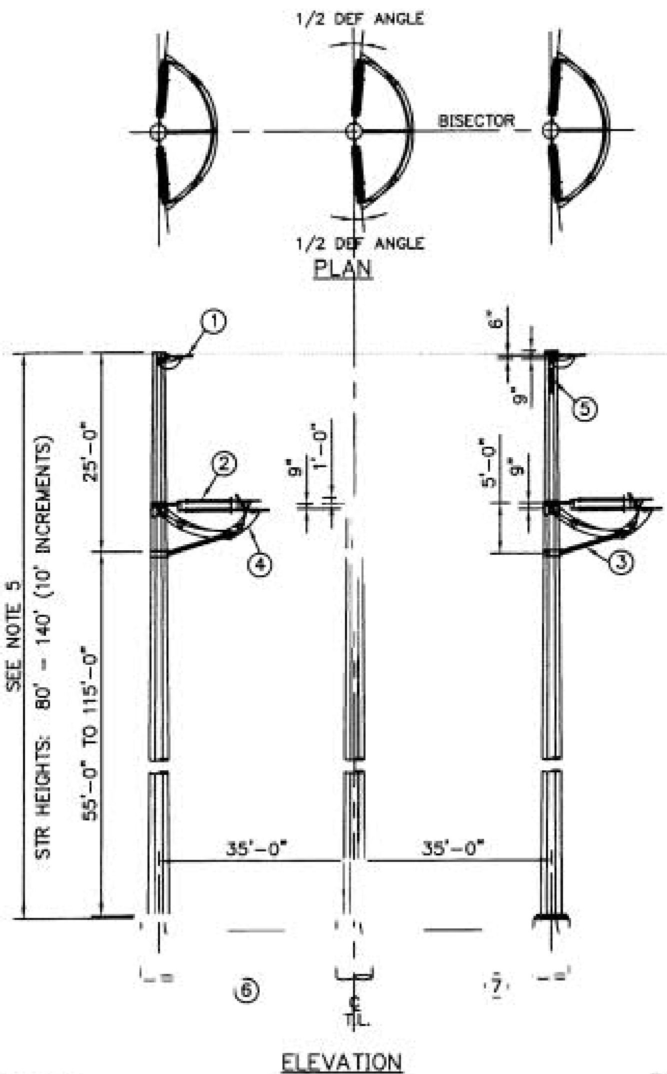
STD NO.	SCALE: 1"=1"
Entergy	No. TFS202A0
	PLOT 1=1 — SH. 1 OF 1

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"

No. TFS203A0

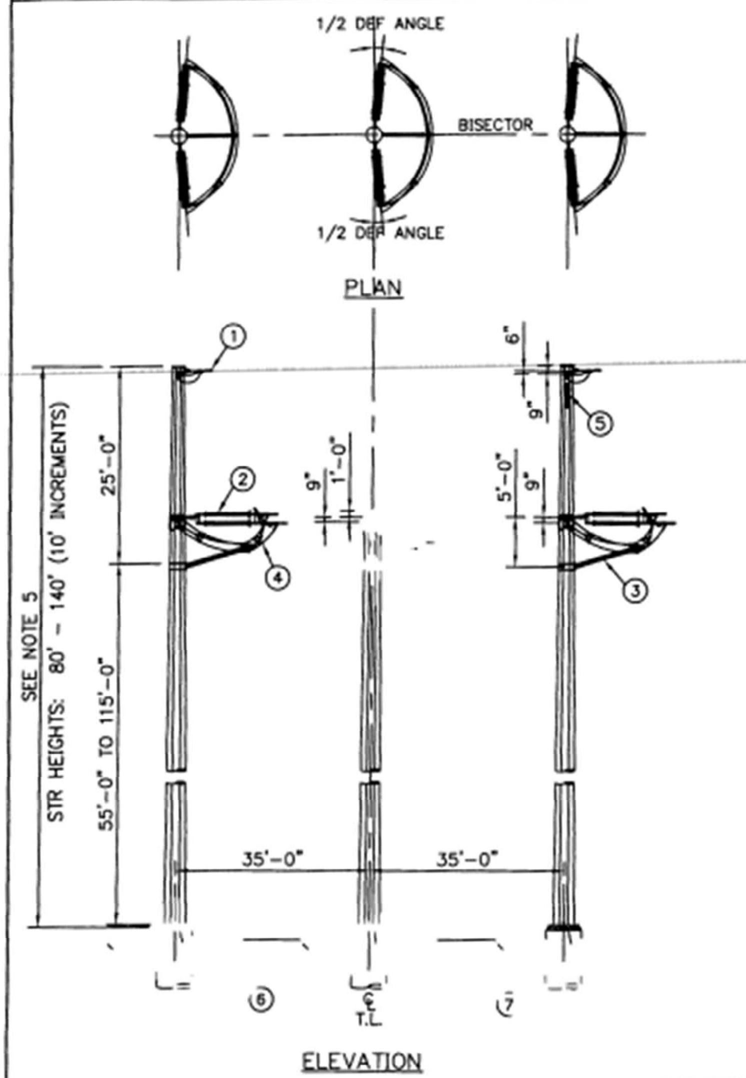
Entergy | PLOT 1=1 | SH. 1 OF 1

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



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 E 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.

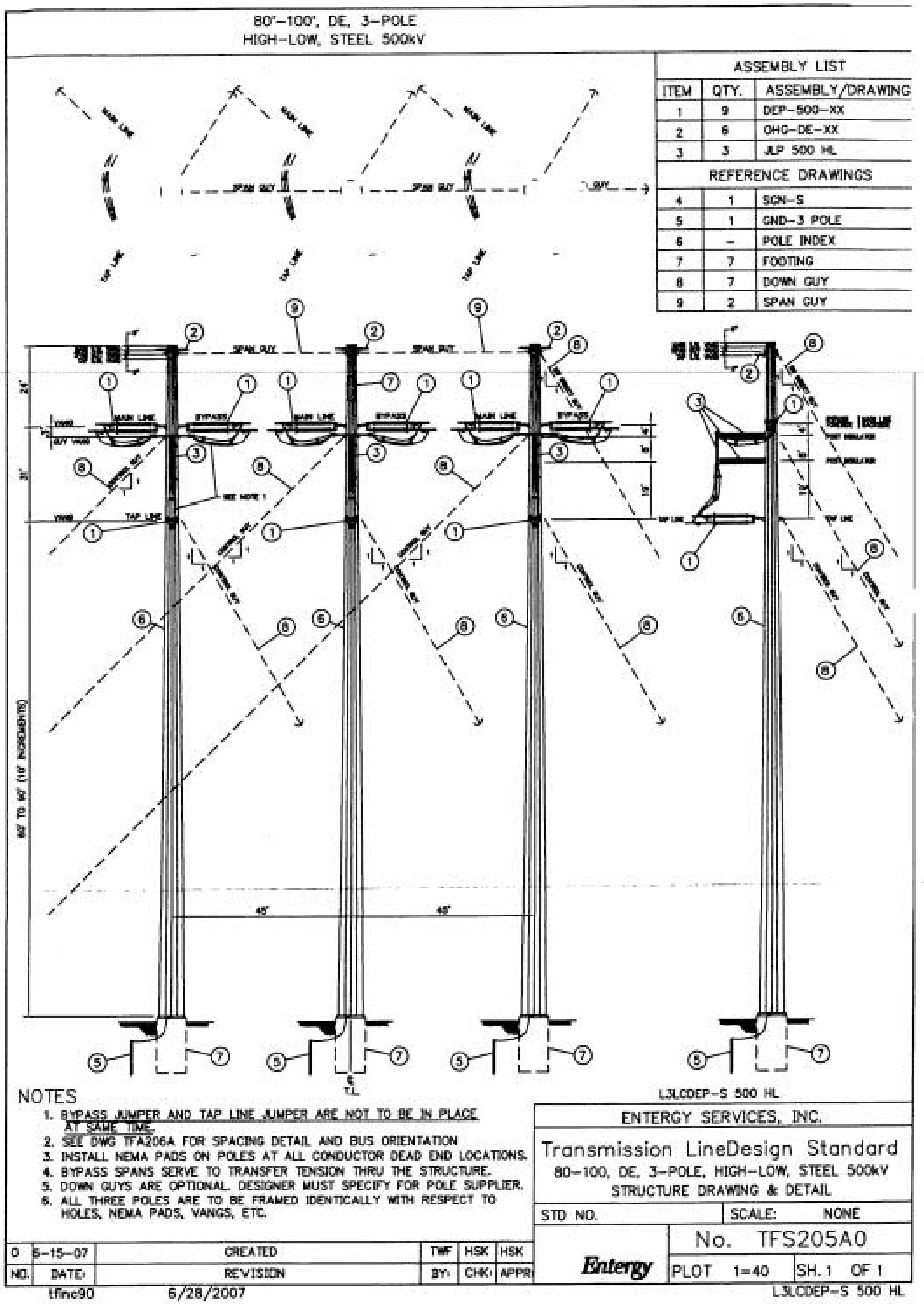
DE 0-10 SS, JUMPER, 3-POLE, POLY, STL 500kV

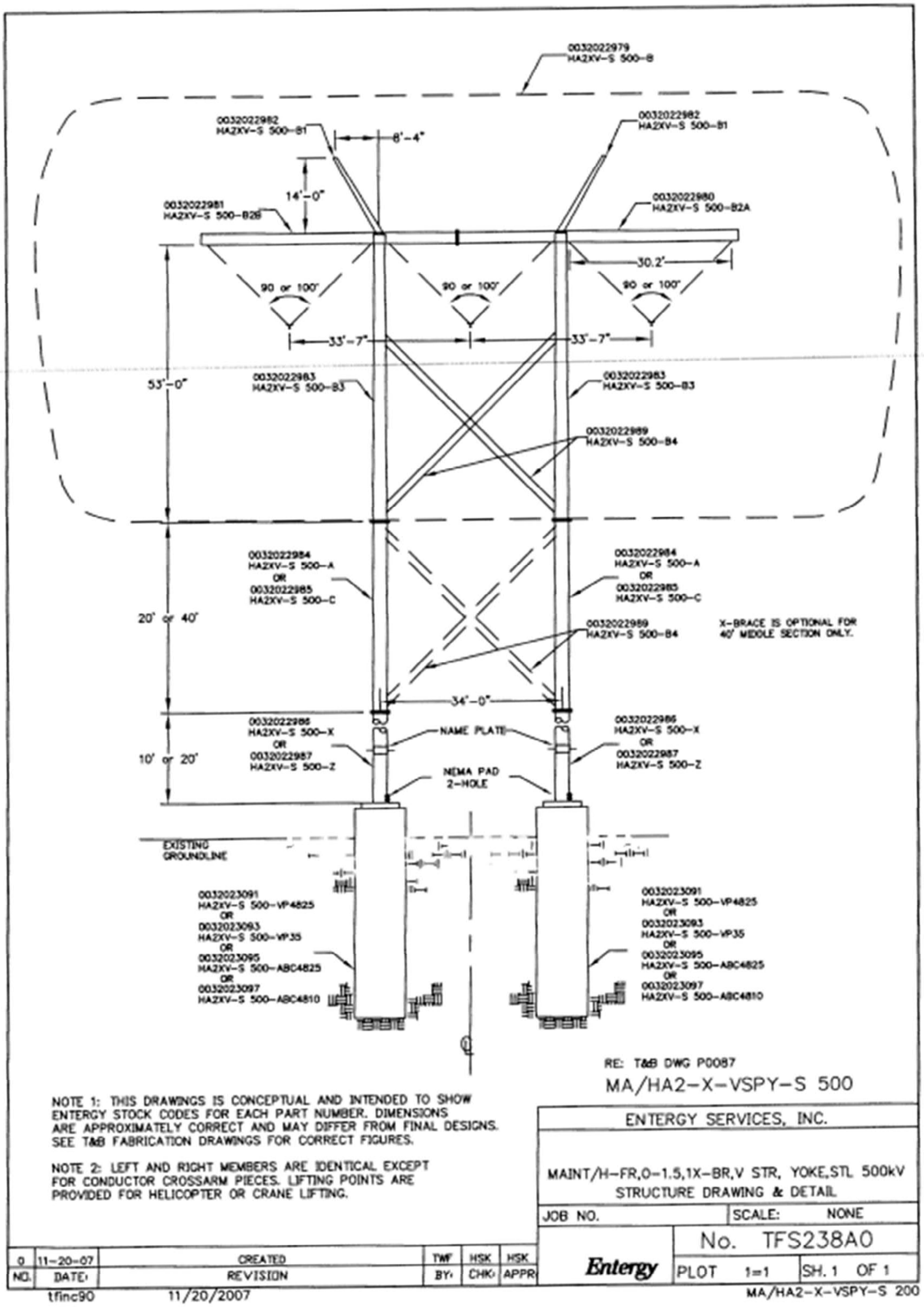
0	02-14-07	CREATED	TWF	HSK	HSK	
NO.	DATE	REVISION	BY	CHK	APPR	

STD NO. | SCALE: 1"=1"

Entergy | No. TFS204A0 | PLOT 1=1 | SH. 1 OF 1

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
MAIN LINE
BYPASS
TAP LINE
SPAN GUY
45'
45'
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.
L3LCDEP-S 500 HL
ENTERGY SERVICES, INC.
Transmission LineDesign Standard
80-100, DE, 3-POLE, HIGH-LOW, STEEL 500kV
STRUCTURE DRAWING & DETAIL
STD NO.
SCALE: NONE
No. TFS205A0
Entergy
PLOT 1=40
SH. 1 OF 1
0 | 6-15-07 | CREATED | TWF | HSK | HSK
NO. | DATE | REVISION | BY | CHK | APPR
tfinc90
6/28/2007
L3LCDEP-S 500 HL


0032022979
HA2XV-S 500-B
0032022982
HA2XV-S 500-B1
8'-4"
0032022982
HA2XV-S 500-B1
14'-0"
0032022981
HA2XV-S 500-B2B
0032022980
HA2XV-S 500-B2A
30.2'
90 or 100'
90 or 100'
90 or 100'
33'-7"
33'-7"
53'-0"
0032022983
HA2XV-S 500-B3
0032022983
HA2XV-S 500-B3
0032022989
HA2XV-S 500-B4
0032022984
HA2XV-S 500-A
OR
0032022985
HA2XV-S 500-C
0032022984
HA2XV-S 500-A
OR
0032022985
HA2XV-S 500-C
20' or 40'
0032022989
HA2XV-S 500-B4
X-BRACE IS OPTIONAL FOR 40' MIDDLE SECTION ONLY.
34'-0"
0032022986
HA2XV-S 500-X
OR
0032022987
HA2XV-S 500-Z
NAME PLATE
0032022986
HA2XV-S 500-X
OR
0032022987
HA2XV-S 500-Z
10' or 20'
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
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
0 11-20-07 CREATED TWF HSK HSK
NO. DATE REVISION BY CHK APPR
Entergy
PLOT 1=1
SH. 1 OF 1
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

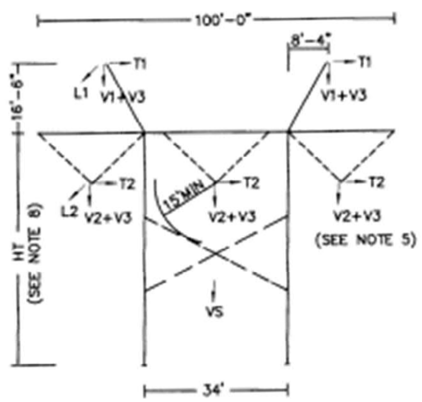
CASE 3 – HIGH WIND: 25.6 PSF WIND ON WIRES AND STRUCTURE, NO ICE, 60° F, OLF=1.00.

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

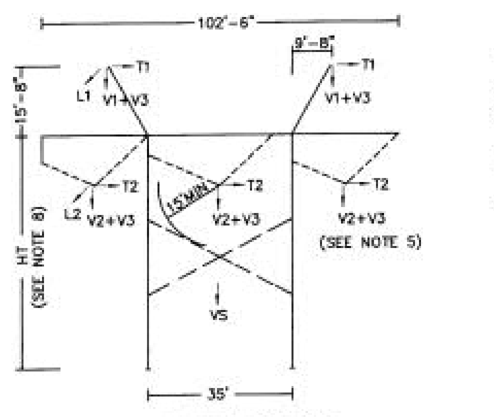
CASE 3 – HIGH WIND: 25.6 PSF WIND ON WIRES AND STRUCTURE, NO ICE, 60° F, OLF=1.00.

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

No. TFS240A0

Entergy 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.

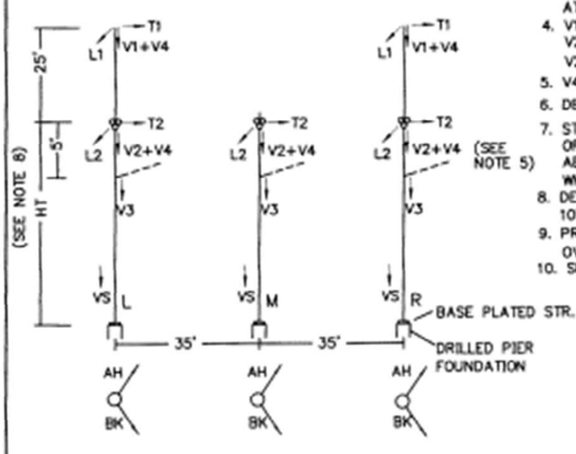
CASE 2 – HEAVY ICE: 1" RADIAL ICE, NO WIND,15° F. OLF=1.0

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 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 (15)

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
LOAD TREE, DEADEND, 15°, SS, 55'–115'
STRUCTURE DRAWING & DETAIL

STD NO.	SCALE: NONE
Entergy	No. TFS241A0
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 (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)

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.

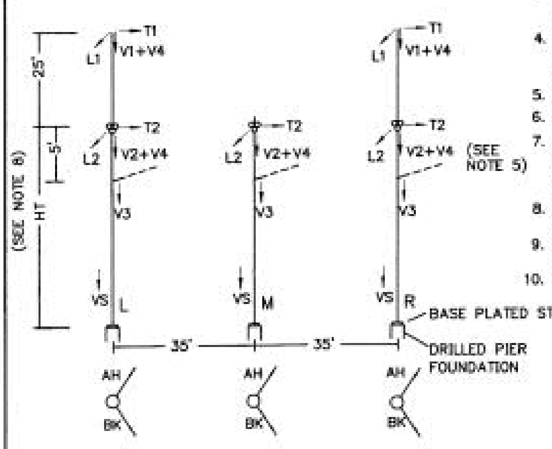
CASE 2 – HEAVY ICE: 1" RADIAL ICE, NO WIND,15' F. OLF=1.0

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 (25)

0	11–21–07	CREATED	TWF	HSK	HSK
NO.	DATE	REVISION	BY	CHK	APPR

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

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.

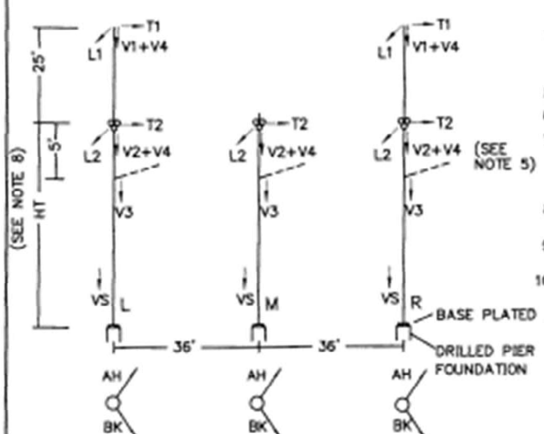
CASE 2 – HEAVY ICE: 1" RADIAL ICE, NO WIND,15' F. OLF=1.0

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.

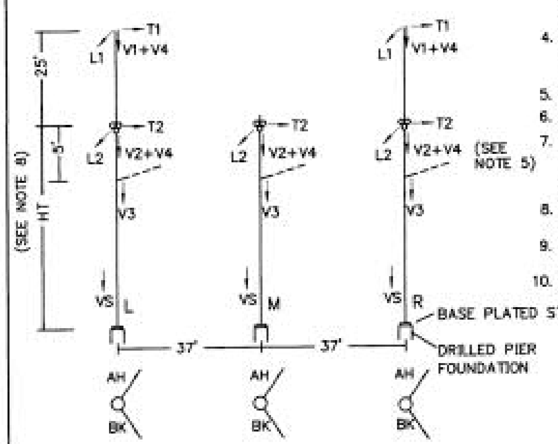
CASE 2 – HEAVY ICE: 1" RADIAL ICE, NO WIND,15° F. OLF=1.0

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)

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.

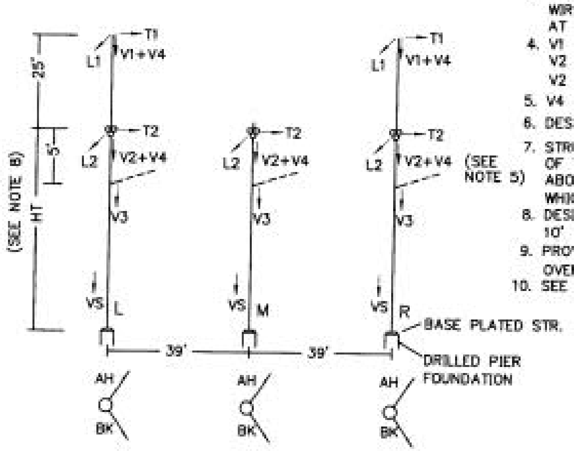
CASE 2 – HEAVY ICE: 1" RADIAL ICE, NO WIND, 15' F. OLF=1.0

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 (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)

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.

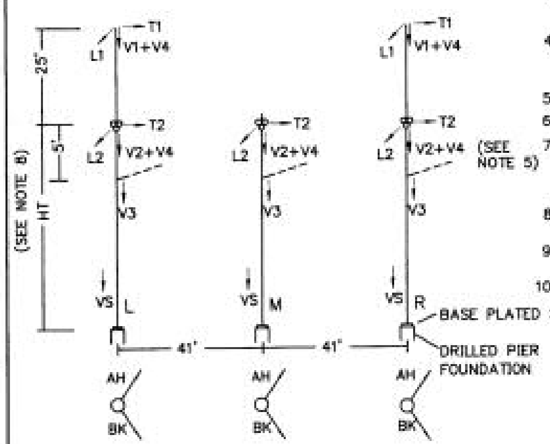
CASE 2 – HEAVY ICE: 1" RADIAL ICE, NO WIND,15° F. OLF=1.0

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 (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.

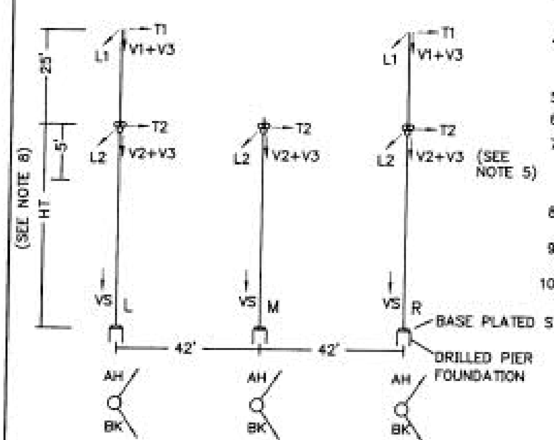
CASE 4 – EVERYDAY: NO WIND, NO ICE, 60° F. OLF=1.0

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)

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.

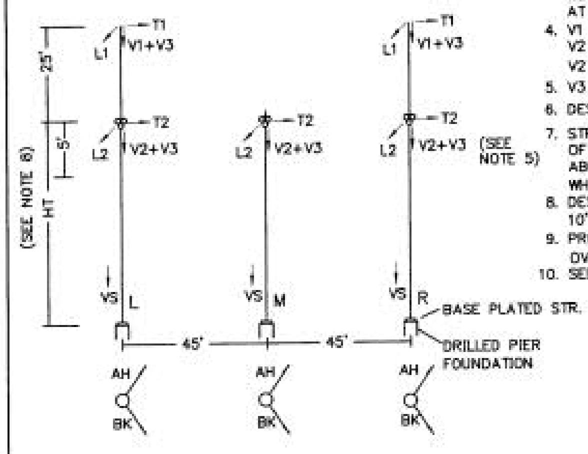
CASE 4 – EVERYDAY: NO WIND, NO ICE, 60' F. OLF=1.0

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 (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

SLE3–DEPY–S 500; SK5 (80)

tfinc90 12/7/2007

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.

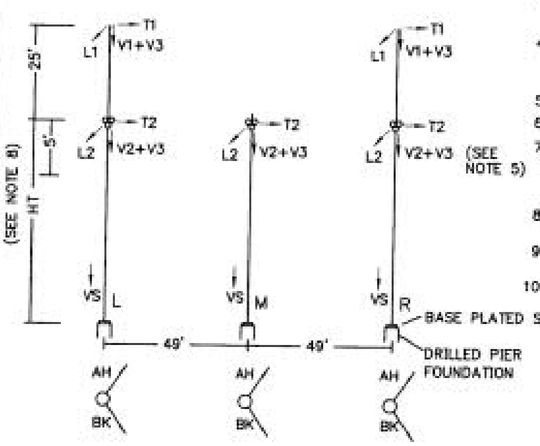
CASE 4 – EVERYDAY: NO WIND, NO ICE, 60° F. OLF=1.0

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)

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.

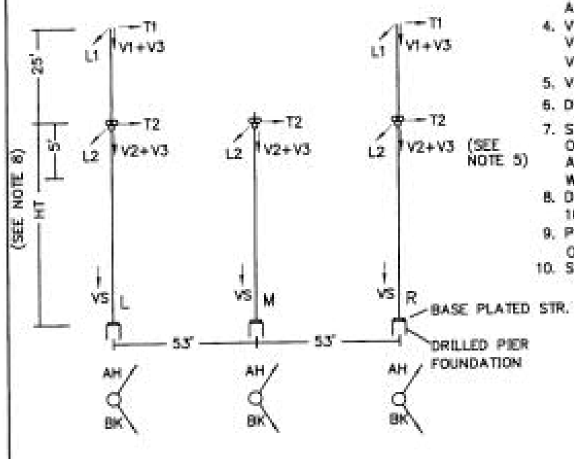
CASE 2 – HEAVY ICE: 1" RADIAL ICE, NO WIND, 15° F. OLF=1.0

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 (100)

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
LOAD TREE, DEADEND, 100°, SS, 55'-115'
STRUCTURE DRAWING & DETAIL

STD NO.	SCALE: NONE
Entergy	No. TFS250A0
	PLOT 1=1 SH. 1 OF 1

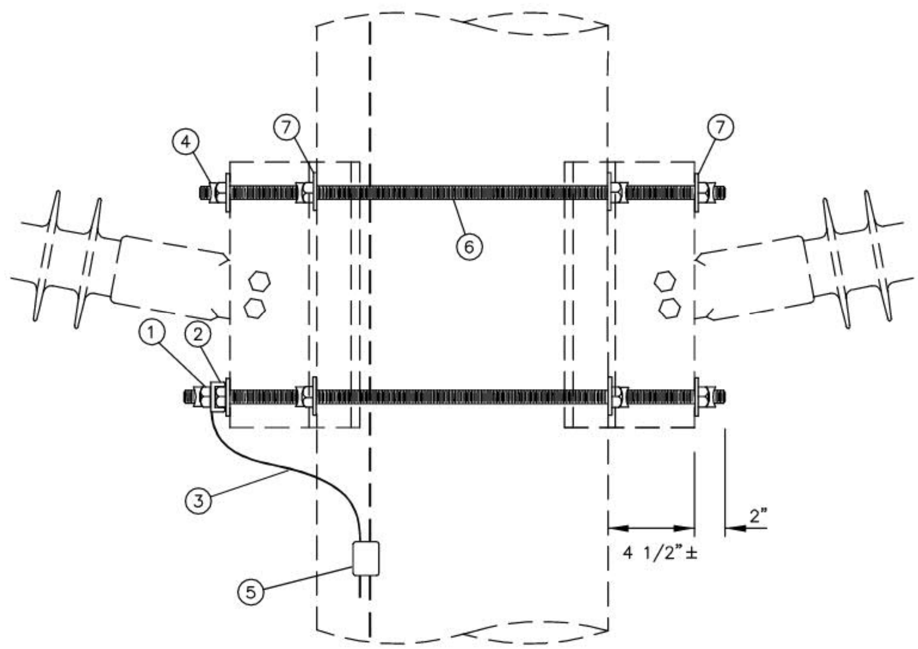
NO.	DATE:	REVISION	BY:	CHK:	APPR
0	11-21-07	CREATED	TWF	HSK	HSK

tfinc90 12/7/2007 SLE3-DEPY-S 500; SK5 (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		

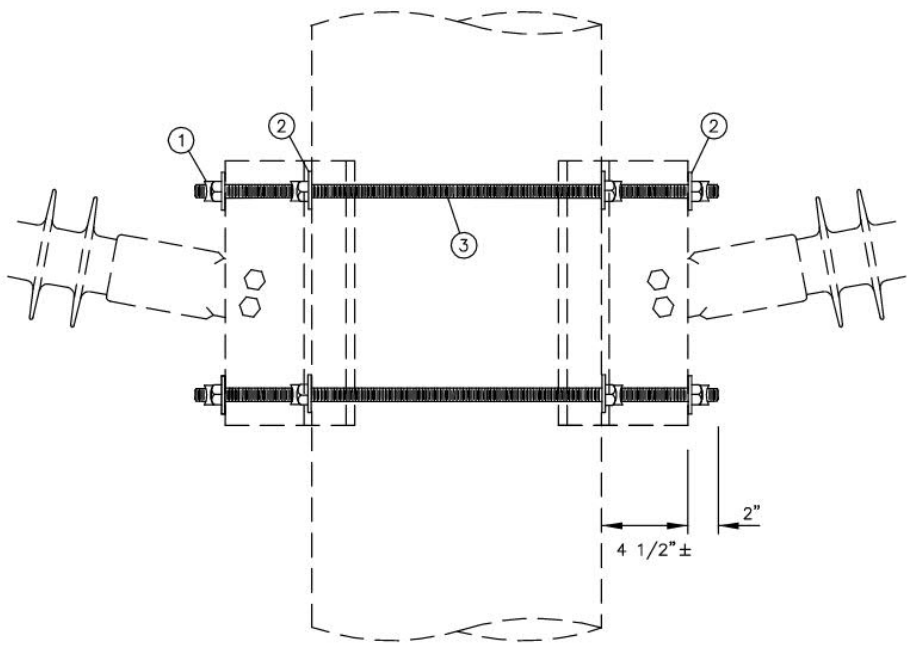
NO.	DATE:	REVISION	BY:	APPR:
1	5–28–03	REV. DIM., CHANGE WASHER FROM SQ. TO FLAT ROUND	ITRON	

TEMP\AM-Work\ewilli2\M-LITAPETSP047,D-TDocs,S-Template\ESI\STANDARDS\Transmission\AMISC\TMD207A1.DWG, 5/20/2010 5:26:50 PM, ewilli2

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	STANDARDS APPROVAL
SIGNED / DATE	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

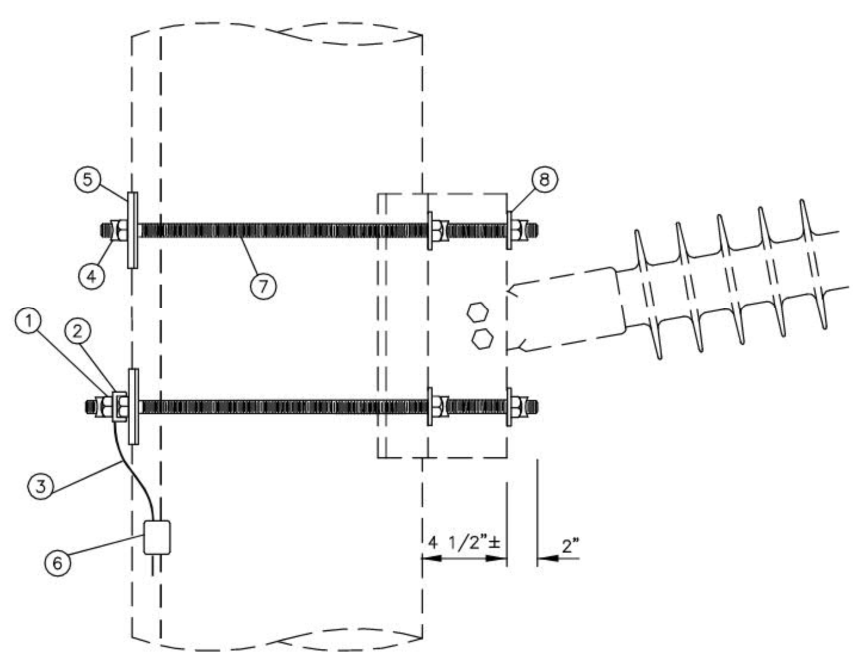
Entergy | No. BLT2PS | PLOT 1=8 | SH. 1 OF 1

TEMP\AM-Work\ewilli2\M-LITAPETSP047,D-TDocs,S-Template\ESI\STANDARDS\Transmission\AMISC\TMD208A1.DWG, 5/20/2010 5:31:01 PM, ewilli2

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

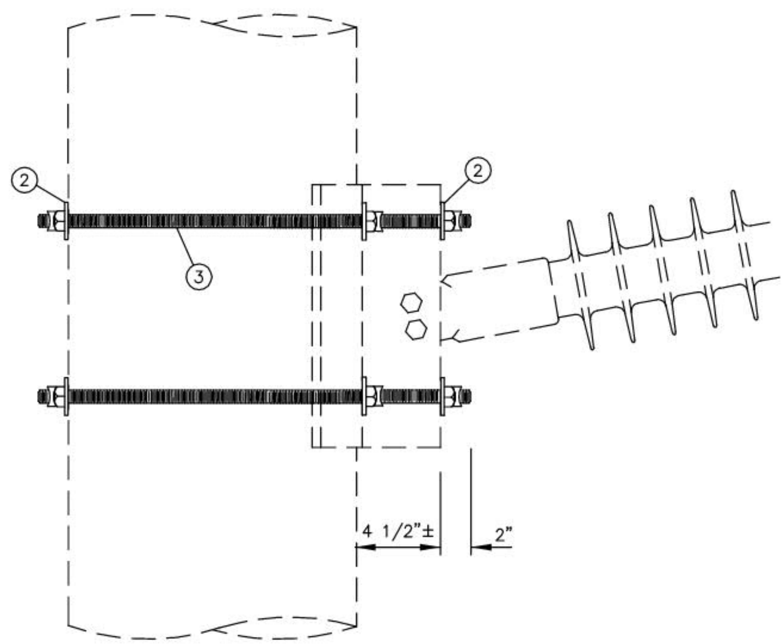
NO.	DATE:	REVISION	BY:	APPR:
1	5–30–03	CHANGE WASHER, DIM.	ITRON	

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 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

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		

STD NO. SCALE:

No. TMD212A3

Entergy

PLOT SH. OF

cmcgr91 8/11/2010 BLT–P–S

:TEMP\AM-Work\ewilli2\M-LITAPETSP047,D-TDocs,S-Template\ESI\STANDARDS\Transmission\AMISC\TMD212A3.DWG, 12/3/2010 4:15:45 PM, ewilli2

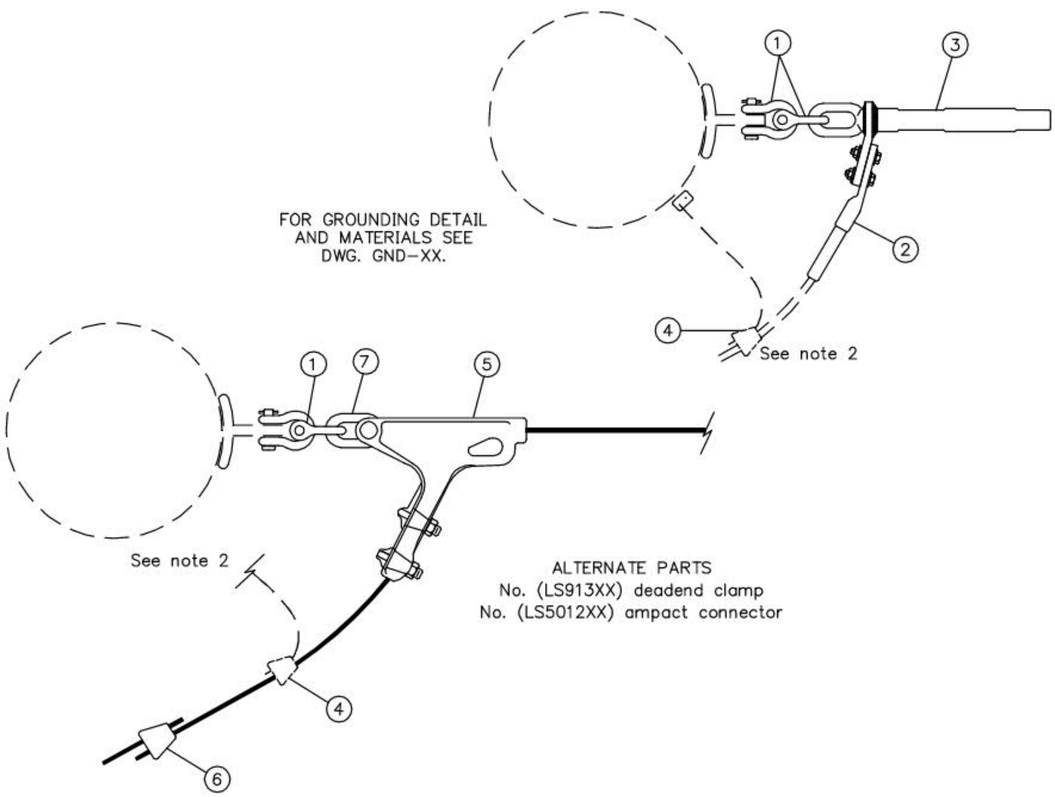
BILL OF MATERIALS

OHGW DEADEND

ITEM	QTY.	STOCK NO.	DESCRIPTION
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	REVISED 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

No. TMD222A6

Entergy | PLOT 1=8 | SH. 1 OF 1

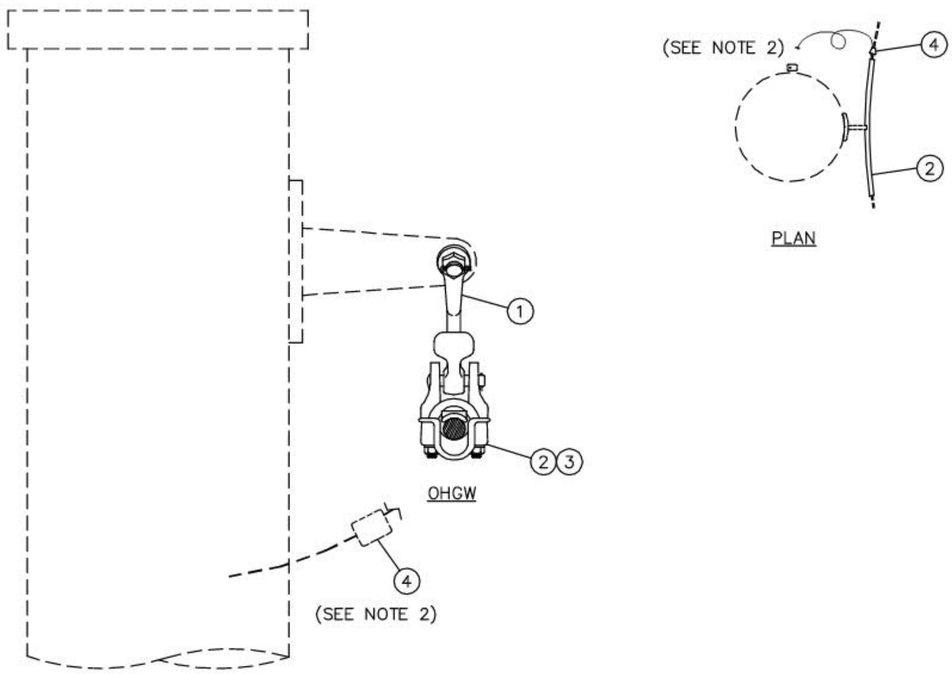
rlafon 8/15/2006 OHG–DE–XX

:TEMP\AM-Work\ewilli2\M-LITAPETSP047,D-TDocs,S-Template\ESI\STANDARDS\Transmission\AMISC\TMD222A6.DWG, 12/3/2010 4:32:05 PM, ewilli2

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

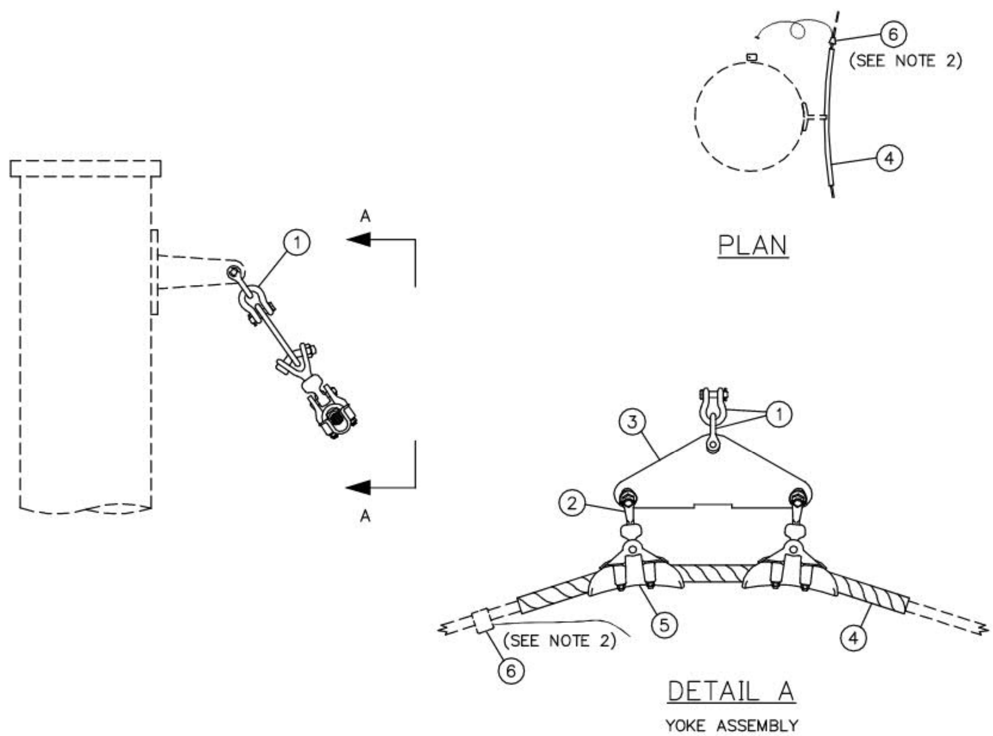
OVERHEAD GROUNDWIRE SUSPENSION ASSY

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

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



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	STANDARDS APPROVAL
SIGNED / DATE	SIGNED / DATE

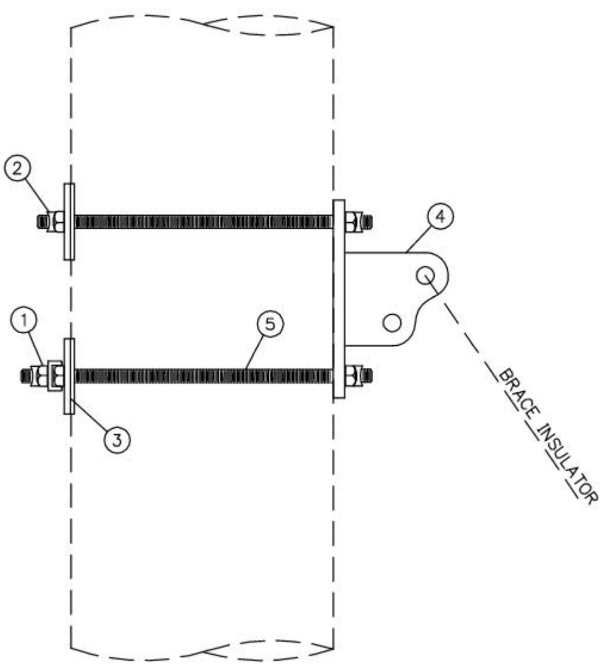
OVERHEAD GROUNDWIRE HEAVY ANGLE ASSY

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		STANDARDS APPROVAL	
SIGNED / DATE		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

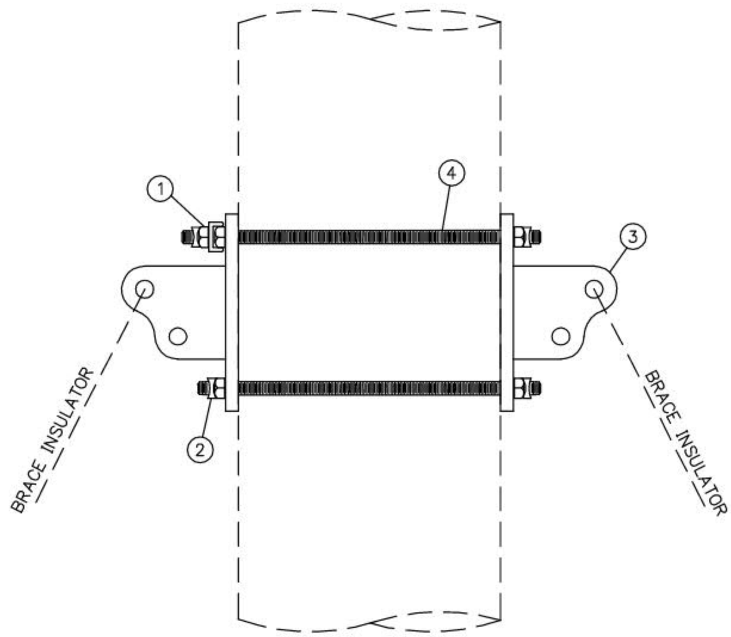
NO.	DATE:	REVISION	BY:	APPR:

TEMP\AM-Work\ewilli2\M-LITAPETSP047,D-TDocs,S-Template\ESI\STANDARDS\Transmission\AMISC\TMD279A0.DWG, 6/10/2010 5:04:20 PM, ewilli2

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		STANDARDS APPROVAL	
SIGNED / DATE		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:

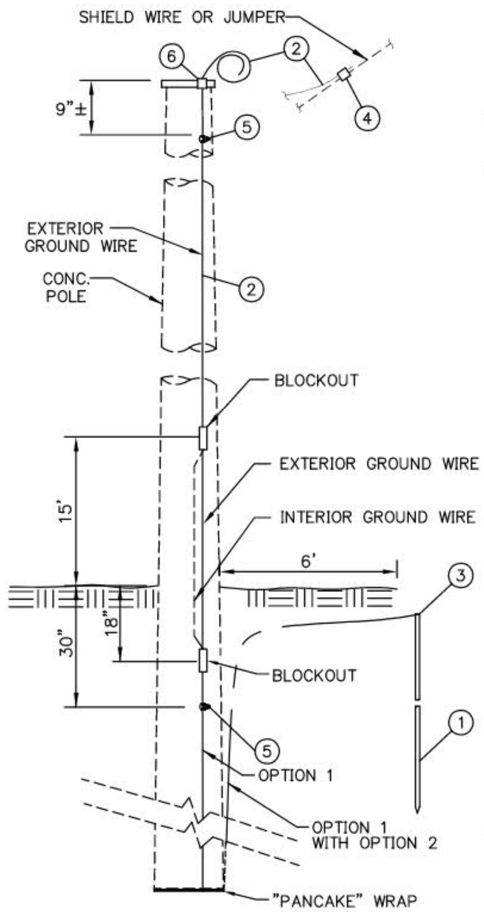
BILL OF MATERIALS – GROUNDING

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

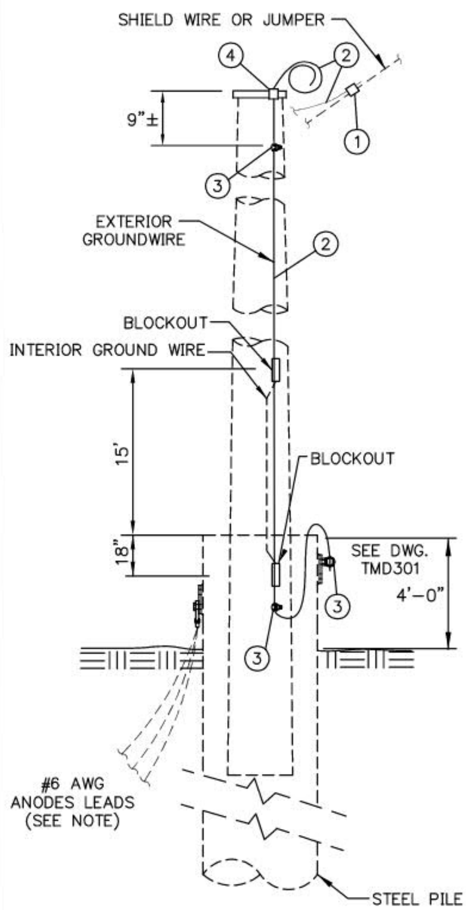
ewilli2 9/6/2017 GNDCEMB

BILL OF MATERIALS – GROUNDING

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	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

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		

ENTERGY SERVICES, INC.

Transmission LineDesign Standard

Grounding, Concrete Pole, Steel Pile

STRUCTURAL ASSEMBLY DETAIL

STD NO. SCALE:

Entergy No. TMD294A3

PLOT SH. OF

ewilli2 9/6/2017 GND-C-PILE

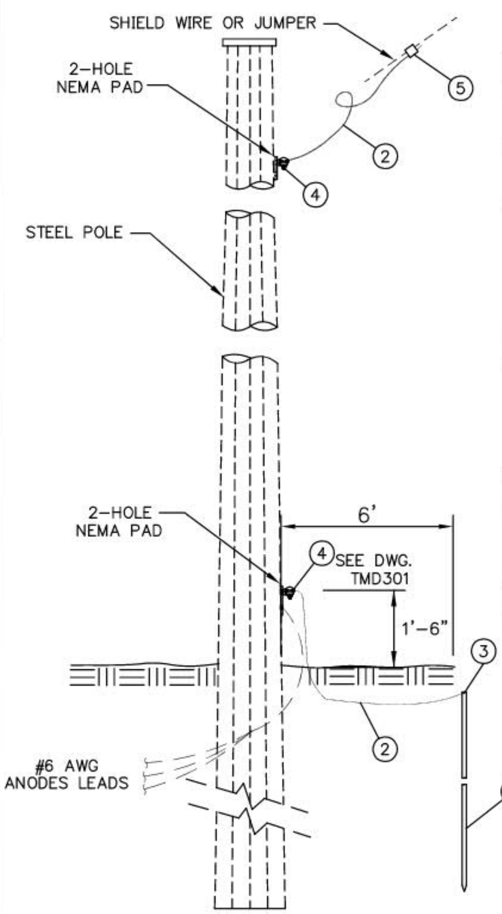
BILL OF MATERIALS – GROUNDING

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

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		

ENTERGY SERVICES, INC.

Transmission LineDesign Standard

GROUNDING, STEEL POLE, DIRECT EMBED STRUCTURAL ASSEMBLY DETAIL

STD NO. | SCALE: NONE

No. TMD295A4

Entergy

PLOT 1=32 | SH. 1 OF 1

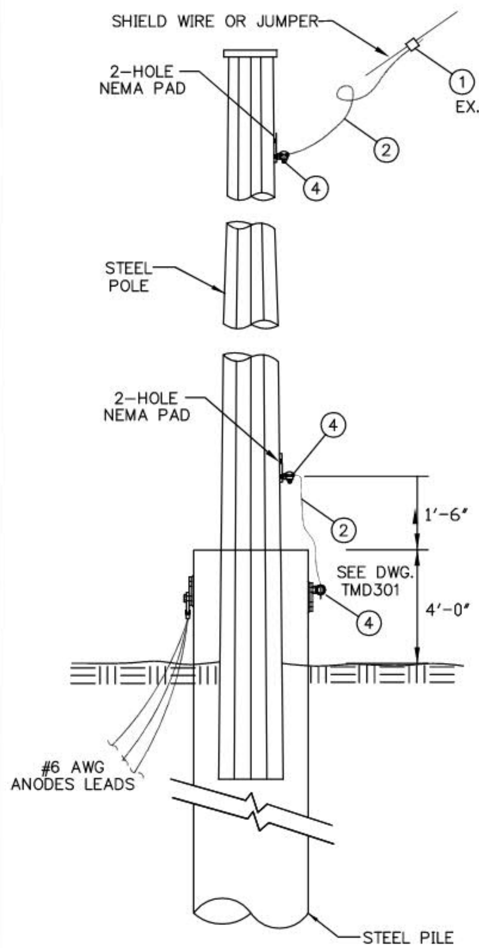
ewilli2 9/6/2017 GNDSEMB

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.



EX. EN010109 USED FOR #4 TO 7#7 CONNECTION

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. 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

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
Grounding, Steel Pole, Steel Pile
STRUCTURAL ASSEMBLY DETAIL

STD NO. SCALE:

No. TMD296A4

Entergy

PLOT SH. OF

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		

ewilli2 9/6/2017 GND–S–PILE

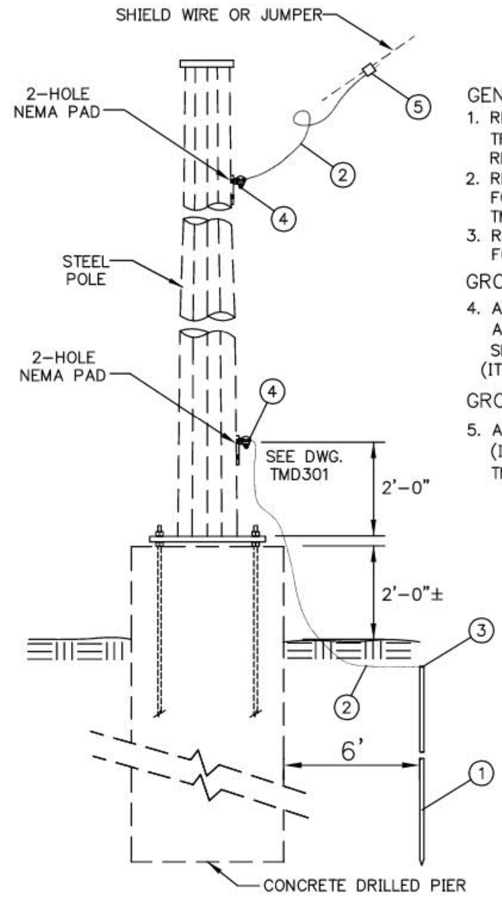
BILL OF MATERIALS – GROUNDING

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

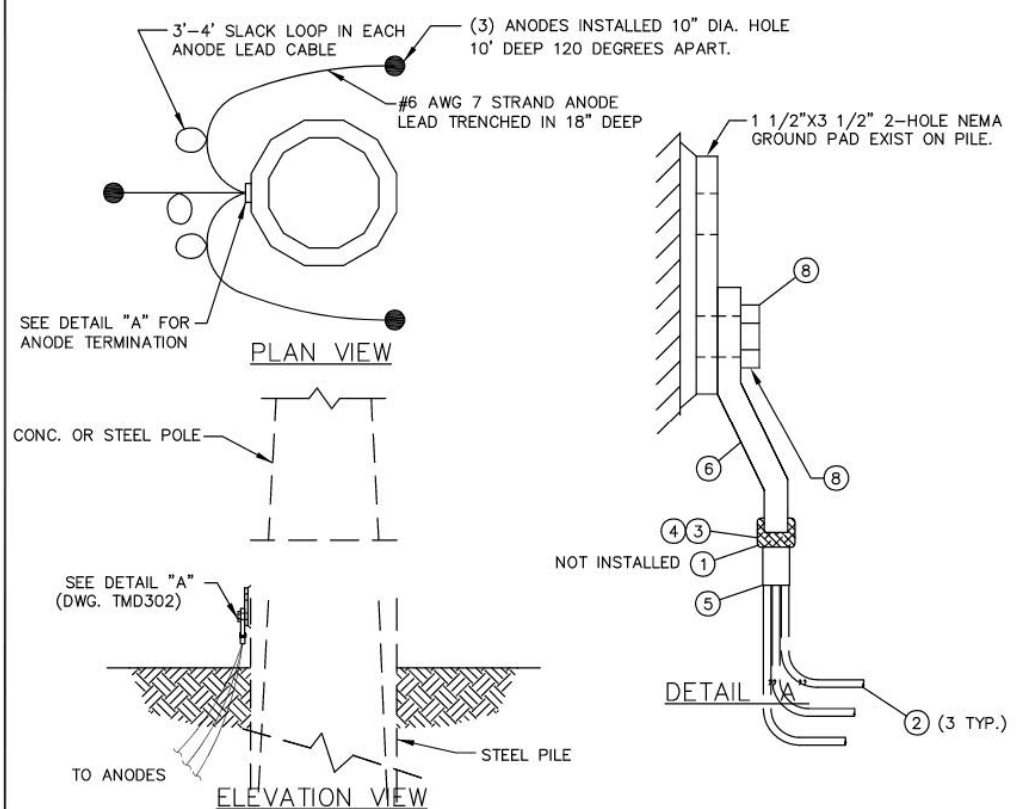
Entergy PLOT 1=32 SH. 1 OF 1

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		

EWILLI2 8-21-14

ANODE-S-PILE

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
ANODE INSTALLATION DETAILS FOR STEEL PILES
STRUCTURAL ASSEMBLY DETAIL

STD NO. T00109 | SCALE: NONE

No. TMD299A3

Entergy

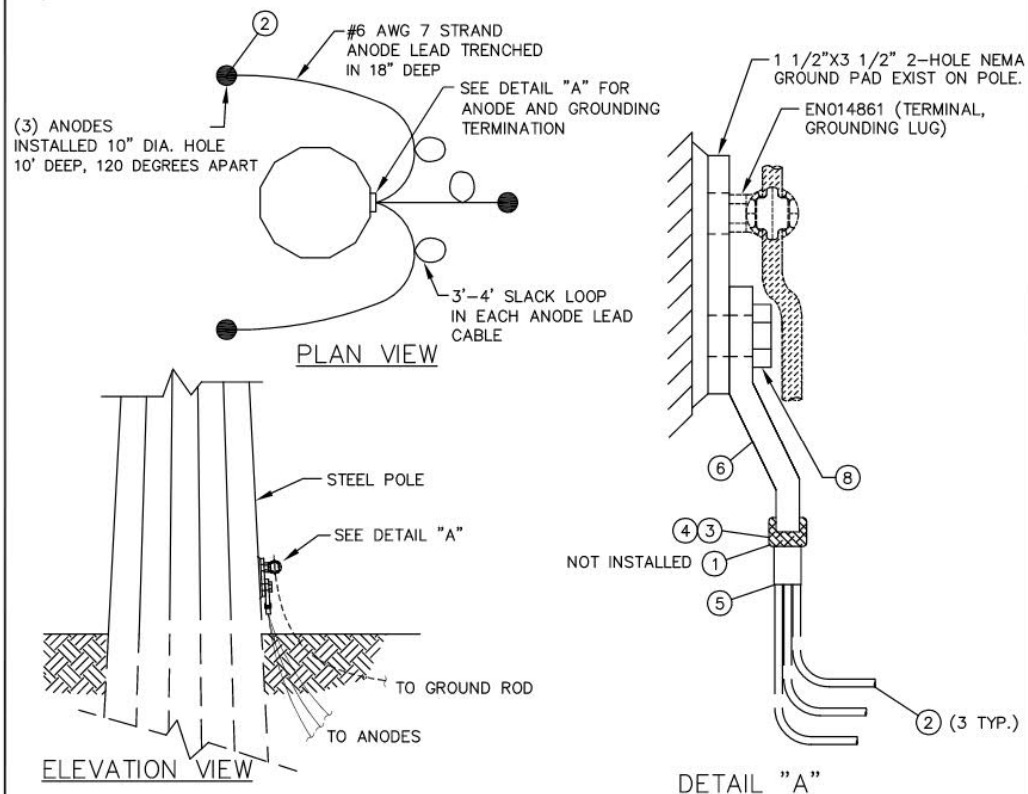
PLOT 1=32 | SH. 1 OF 1

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 ENOI9331 IF REQUIRED.
5) ITEM 8 HAS 1 NUT & 1 WASHER THAT WILL NOT BE USED.

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

ENTERGY SERVICES, INC.

Transmission LineDesign Standard

ANODE INSTALLATION DETAILS FOR STEEL POLES

STRUCTURAL ASSEMBLY DETAIL

STD NO. T00109 SCALE: NONE

Entergy No. TMD300A4

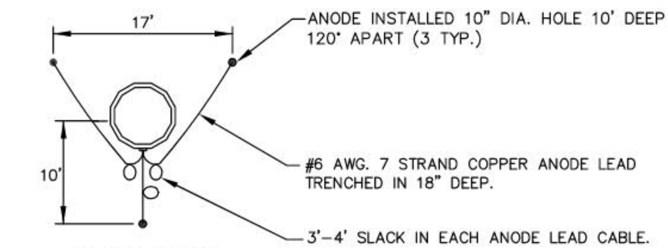
PLOT 1=32 SH. 1 OF 1

ANODE-S-EMBED/PIER

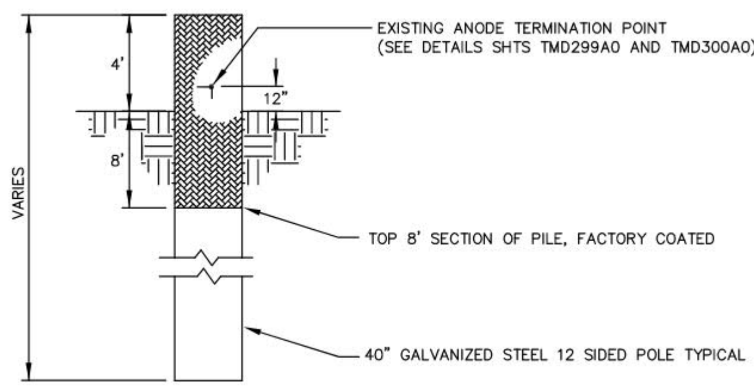
TYPICAL APPLICATION OF ANODE MATERIALS

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

STD NO. T00109 | SCALE: NONE

No. TMD302A1

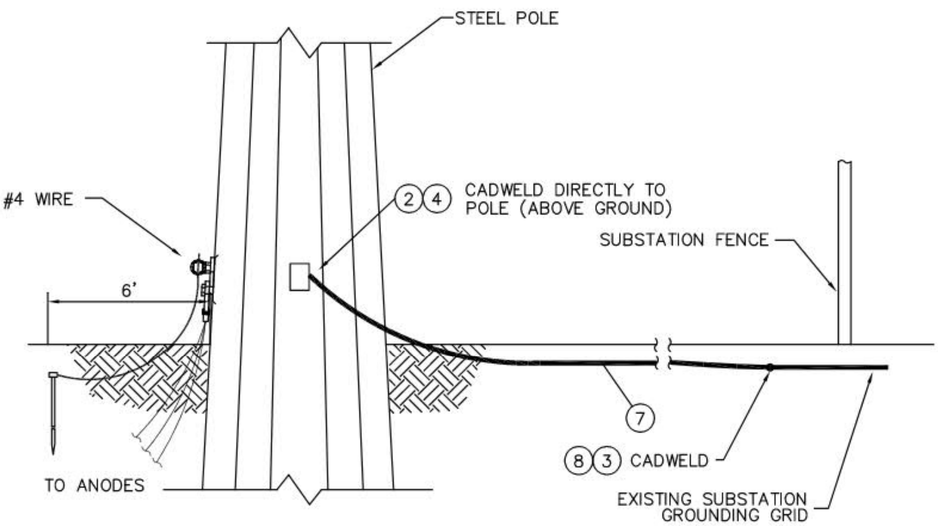
Entergy | PLOT 1=32 | SH. 1 OF 1

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		

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.

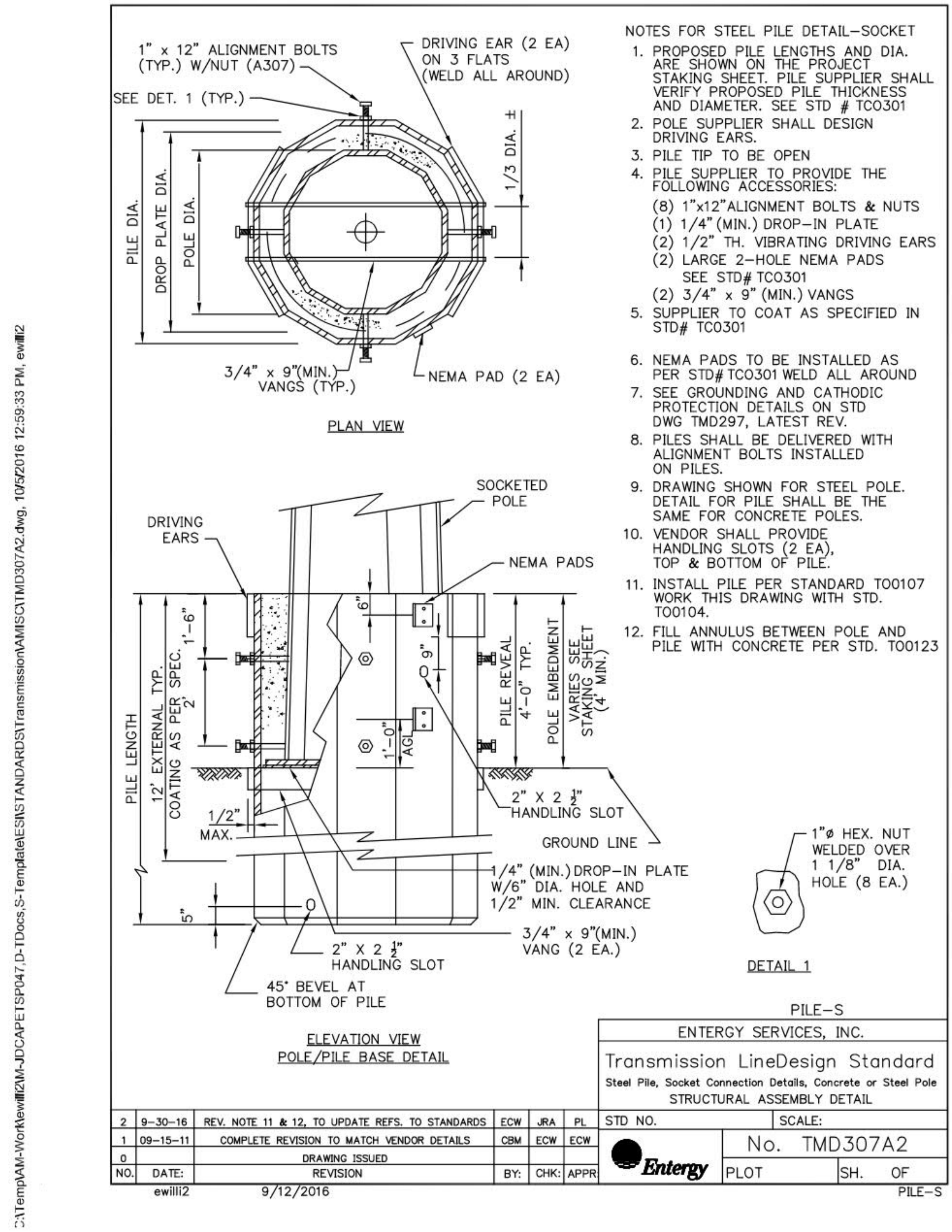
Transmission LineDesign Standard
GROUNDING, STEEL POLE TO SUBSTATION GRID
STRUCTURAL ASSEMBLY DETAIL

STD NO. | SCALE: NONE

Entergy | No. TMD303A5

PLOT 1=1 | SH. 1 OF 1

EWILLI2 12-15-2014 GNDSPSUB


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
1" x 12" ALIGNMENT BOLTS (TYP.) W/NUT (A307)
DRIVING EAR (2 EA) ON 3 FLATS (WELD ALL AROUND)
SEE DET. 1 (TYP.)
1/3 DIA. ±
PILE DIA.
DROP PLATE DIA.
POLE DIA.
3/4" x 9"(MIN.) VANGS (TYP.)
NEMA PAD (2 EA)
PLAN VIEW
SOCKETED POLE
DRIVING EARS
NEMA PADS
6"
9"
1'-6"
2'
1'-0"
AGL
PILE REVEAL 4'-0" TYP.
POLE EMBEDMENT VARIES SEE STAKING SHEET (4' MIN.)
PILE LENGTH
12' EXTERNAL TYP. COATING AS PER SPEC.
1/2" MAX.
2" X 2 1/2" HANDLING SLOT
GROUND LINE
1/4" (MIN.) DROP–IN PLATE W/6" DIA. HOLE AND 1/2" MIN. CLEARANCE
5"
3/4" x 9"(MIN.) VANG (2 EA.)
2" X 2 1/2" HANDLING SLOT
45° BEVEL AT BOTTOM OF PILE
ELEVATION VIEW
POLE/PILE BASE DETAIL
1"ø HEX. NUT WELDED OVER 1 1/8" DIA. HOLE (8 EA.)
DETAIL 1
PILE–S
ENTERGY SERVICES, INC.
Transmission LineDesign Standard
Steel Pile, Socket Connection Details, Concrete or Steel Pole
STRUCTURAL ASSEMBLY DETAIL
STD NO.
SCALE:
No. TMD307A2
Entergy
PLOT
SH. OF
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
NO. | DATE: | REVISION | BY: | CHK: | APPR
ewilli2
9/12/2016
PILE–S
C:\Temp\AM-Work\ewilli2\M-JDCAPETSP047,D-TDocs,S-Template\ES\STANDARDS\Transmission\AMISC\TMD307A2.dwg, 10/5/2016 12:59:33 PM, ewilli2

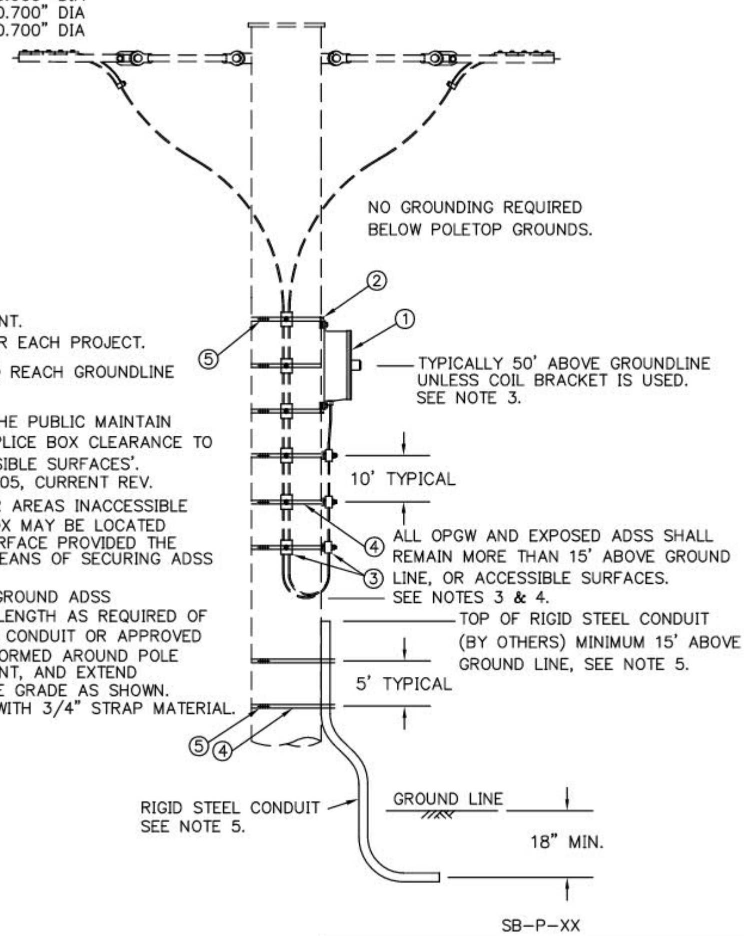
BILL OF MATERIALS

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.

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

No. TMD337A5

Entergy

PLOT 1=1 | SH. 1 OF 1

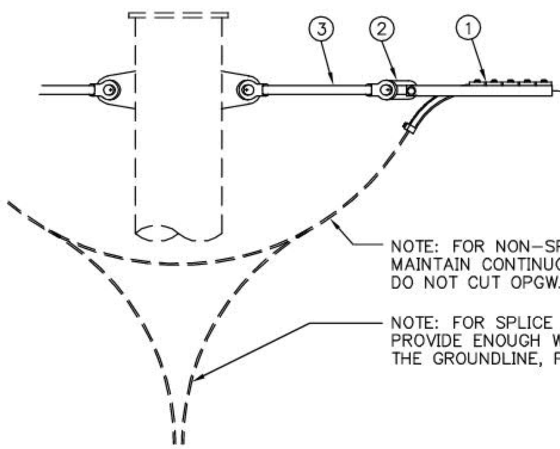
ewilli2 9/6/2017 SB–P–XX

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.



NOTE: FOR NON-SPLICE BOX LOCATIONS, MAINTAIN CONTINUOUS LOOP AND DO NOT CUT OPGW.

NOTE: FOR SPLICE BOX LOCATIONS, PROVIDE ENOUGH WIRE TO REACH THE GROUNDLINE, PLUS 15 FEET.

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

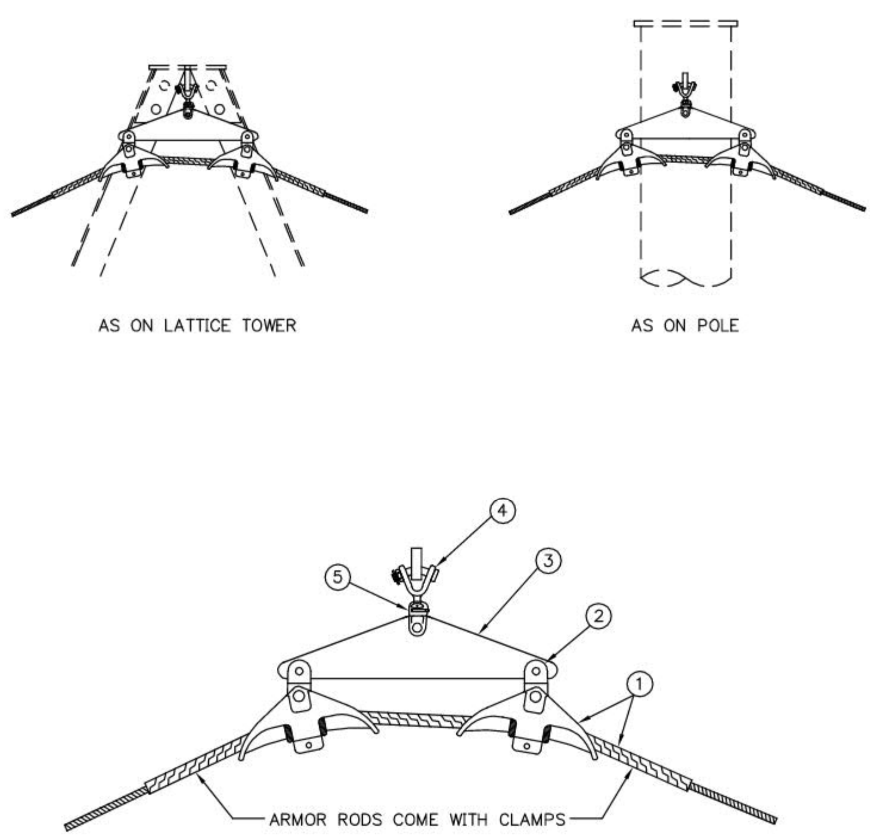
PLOT 1=1 | SH. 1 OF 1

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



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

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

STD NO. | SCALE: NONE
Entergy | No. TMD341A2
PLOT 1=1 | SH. 1 OF 1

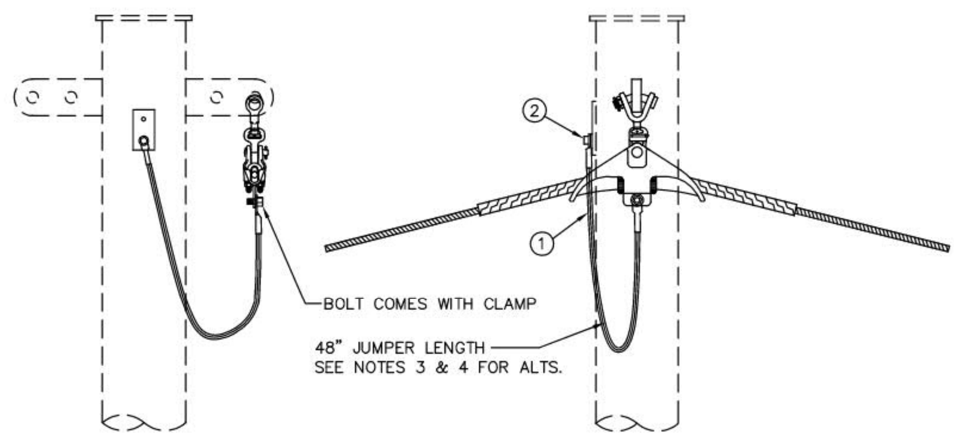
tfinc90 6/25/2007 OHG-SUY-OP-XX

TEMP\AM-Work\ewilli2\M-LITAPETSP047,D-TDocs,S-Template\ESI\STANDARDS\Transmission\MISC\TMD341A2.dwg, 5/28/2010 5:16:29 PM, ewilli2

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

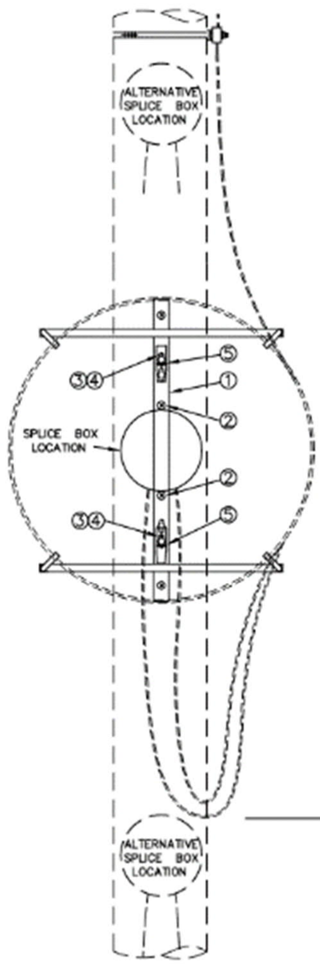
PLOT 1=1 SH. 1 OF 1

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

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
COIL BRACKET, OPGW, STEEL POLE
STRUCTURAL ASSEMBLY DETAIL

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

STD NO. SCALE: NONE

Entergy No. TMD386A3

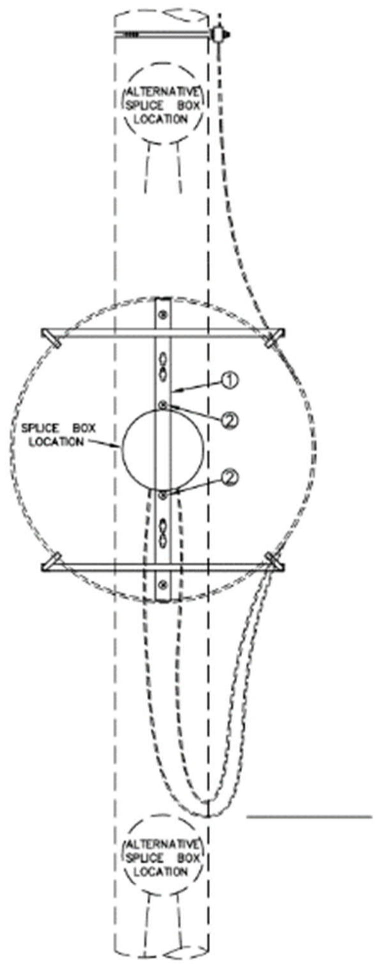
PLOT 1=1 SH. 1 OF 1

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

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

STD NO. | SCALE: NONE
No. TMD387A3
Entergy
PLOT 1=1 | SH. 1 OF 1

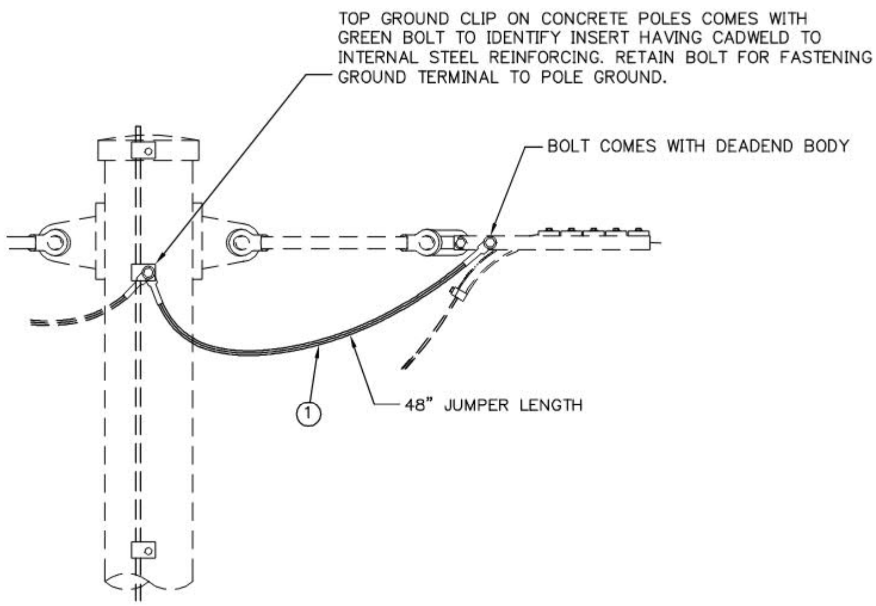
EWILLI2 8/24/15 CB–OP–C

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

NO.	DATE	REVISION	BY	CHK	APPR
0	5–15–07	CREATED	TWF	HSK	HSK

STD NO. | SCALE: NONE

Entergy | No. TMD398A0

PLOT 1=1 | SH. 1 OF 1

tfinc90 5/31/2007 GND–DE–OP–C

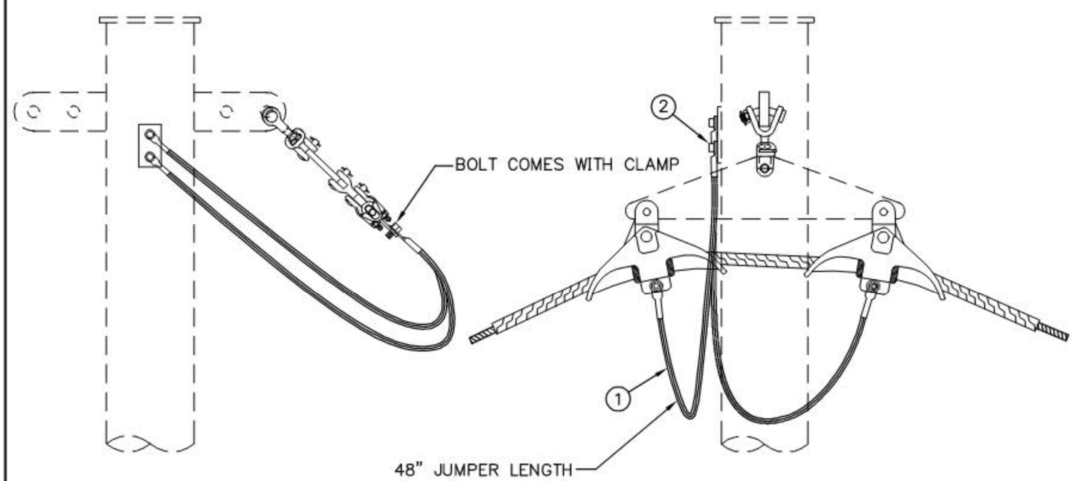
TEMP\AM-Work\ewilli2\M-LITAPETSP047,D-TDocs,S-Template\ESI\STANDARDS\Transmission\AMISC\TMD398A0.dwg, 5/25/2010 1:22:27 PM, ewilli2

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.



THIS DRAWING REPLACES: TMD343B1

GND–SUY–OP–S

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
GROUND, SUSP, 30–50, W/YOKE, OPGW, STEEL POLE
STRUCTURAL ASSEMBLY DETAIL

0	5–15–07	CREATED	TWF	HSK	HSK	
NO.	DATE:	REVISION	BY:	CHK:	APPR:	

STD NO. | SCALE: NONE
Entergy | No. TMD399A0
PLOT 1=1 | SH. 1 OF 1

tfinc90 5/31/2007 GND–SUY–OP–S

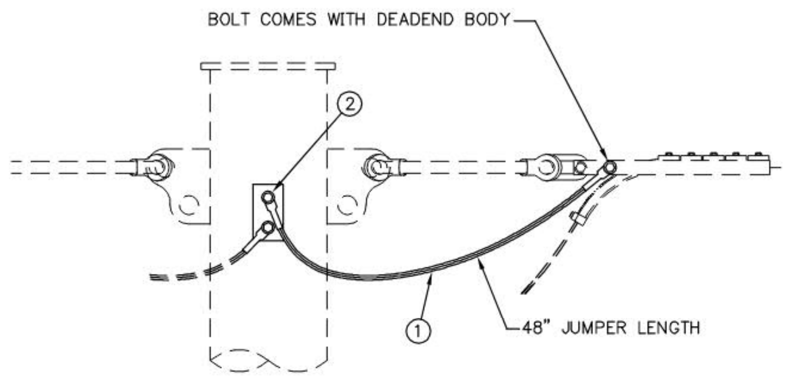
TEMP\AM-Work\ewilli2\M-LITAPETSP047,D-TDocs,S-Template\ESI\STANDARDS\Transmission\AMISC\TMD399A0.dwg, 5/28/2010 3:09:52 PM, ewilli2

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.



THIS DRAWING REPLACES: TMD343C1

GND-DE-OP-S

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
GROUND, DEADEND, OPGW, STEEL POLE
STRUCTURAL ASSEMBLY DETAIL

STD NO. | SCALE: NONE

No. TMD402A0

0	5-15-07	CREATED	TWF	HSK	HSK
NO.	DATE:	REVISION	BY:	CHK:	APPR:

Entergy | PLOT 1=1 | SH. 1 OF 1

tfinc90 5/31/2007 GND-DE-OP-S

·TEMP\AM-Work\ewilli2\M-LITAPETSP047,D-TDocs,S-Template\ESI\STANDARDS\Transmission\AMISC\TMD402A0.dwg, 5/25/2010 1:27:23 PM, ewilli2

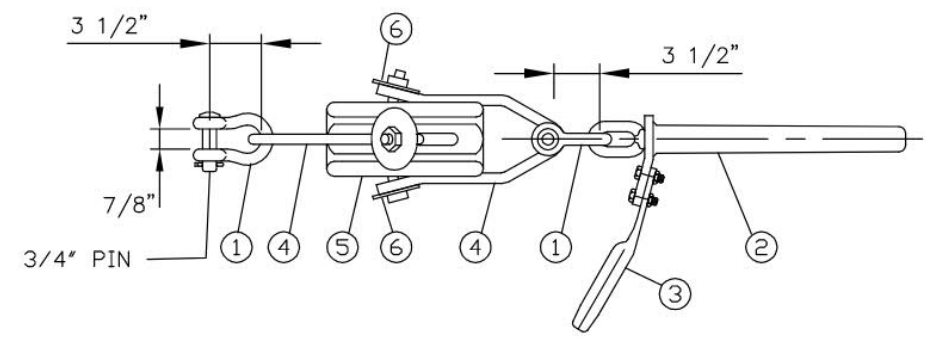
LIST OF COMPONENTS

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

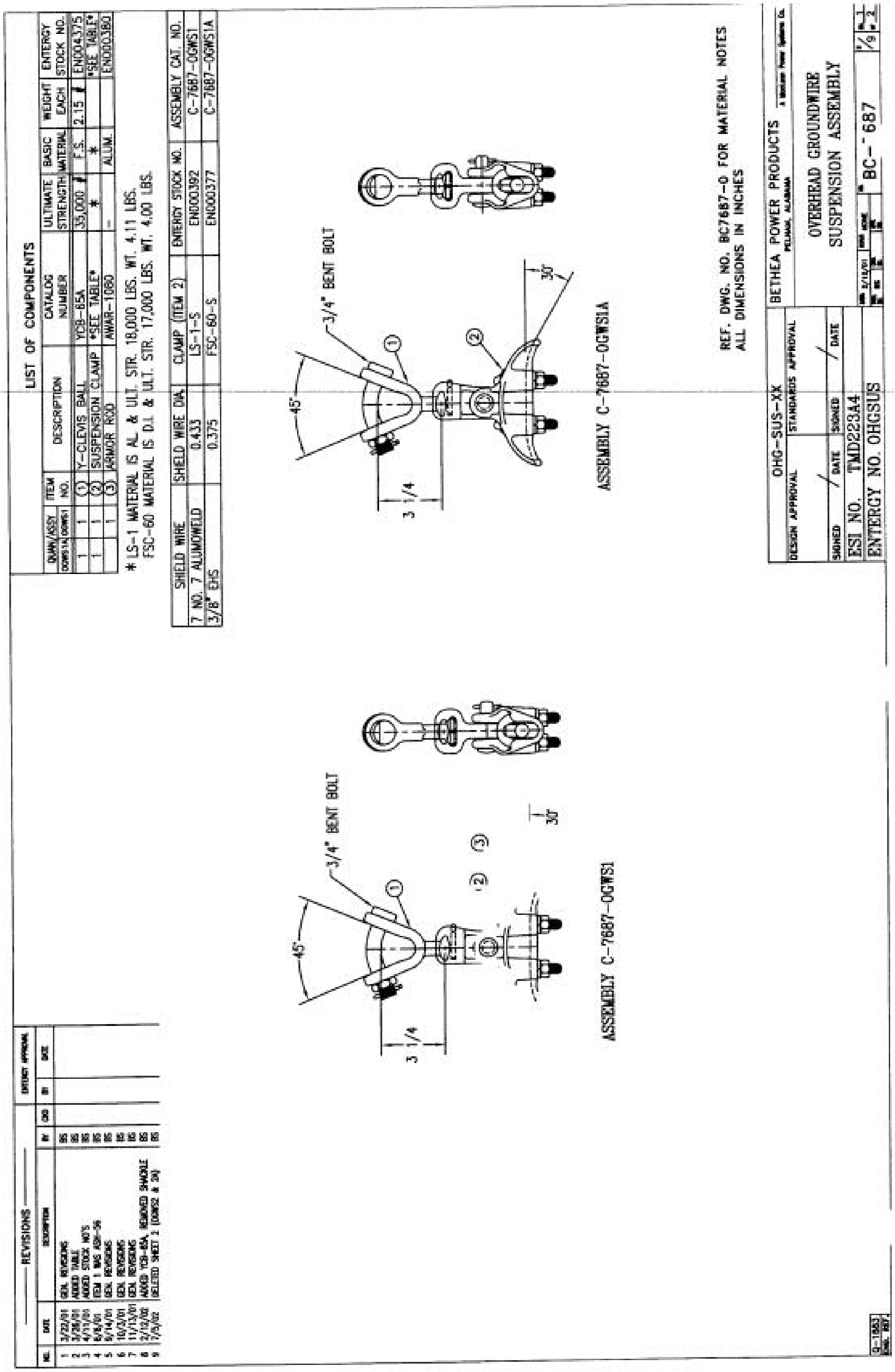
STD NO. | SCALE: NONE

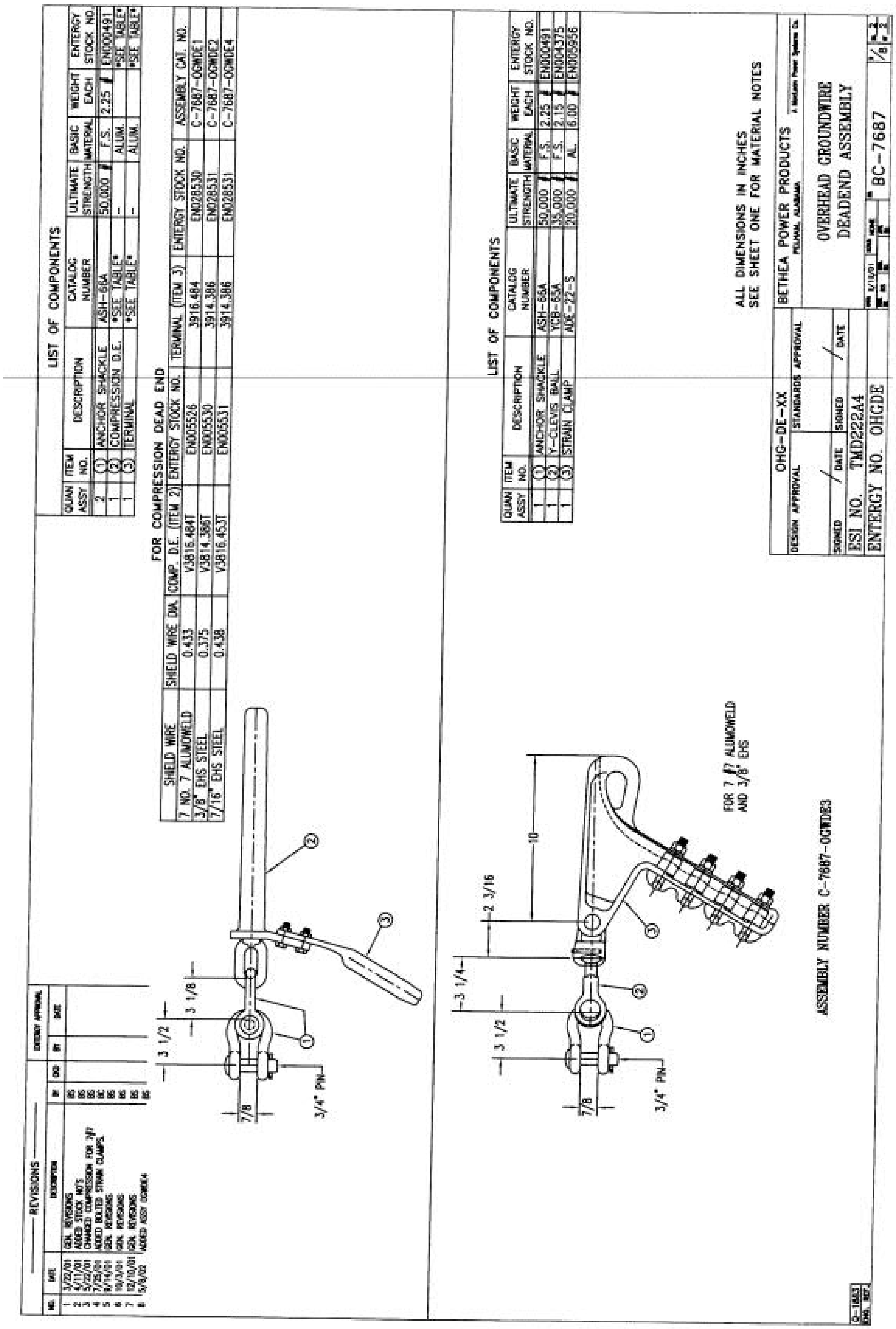
Entergy | No. TMD403A0 | PLOT 1=1 | SH. 1 OF 1

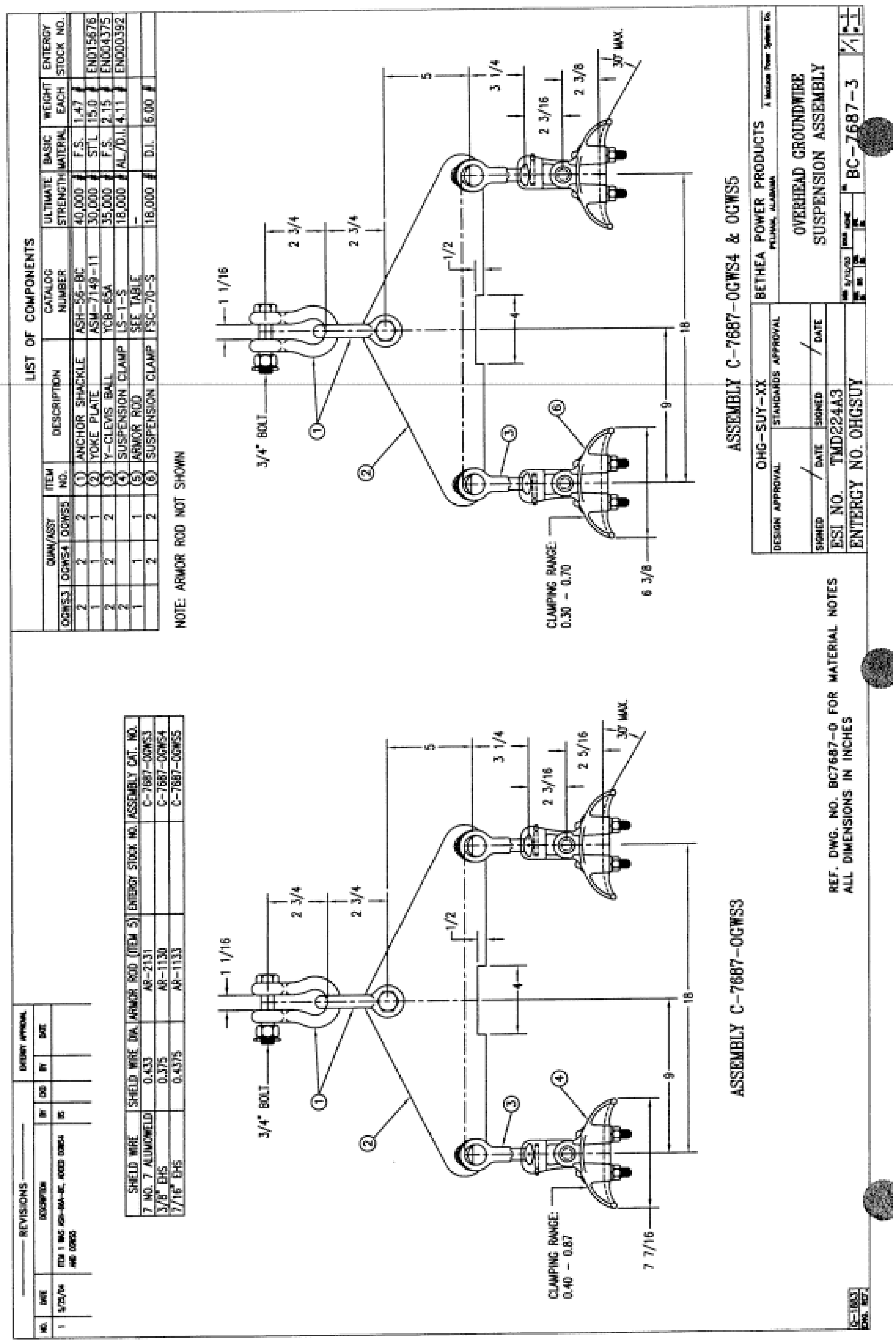
NO.	DATE:	REVISION	BY:	CHK:	APPR
0	12-13-07	CREATED	TWF	HSK	HSK

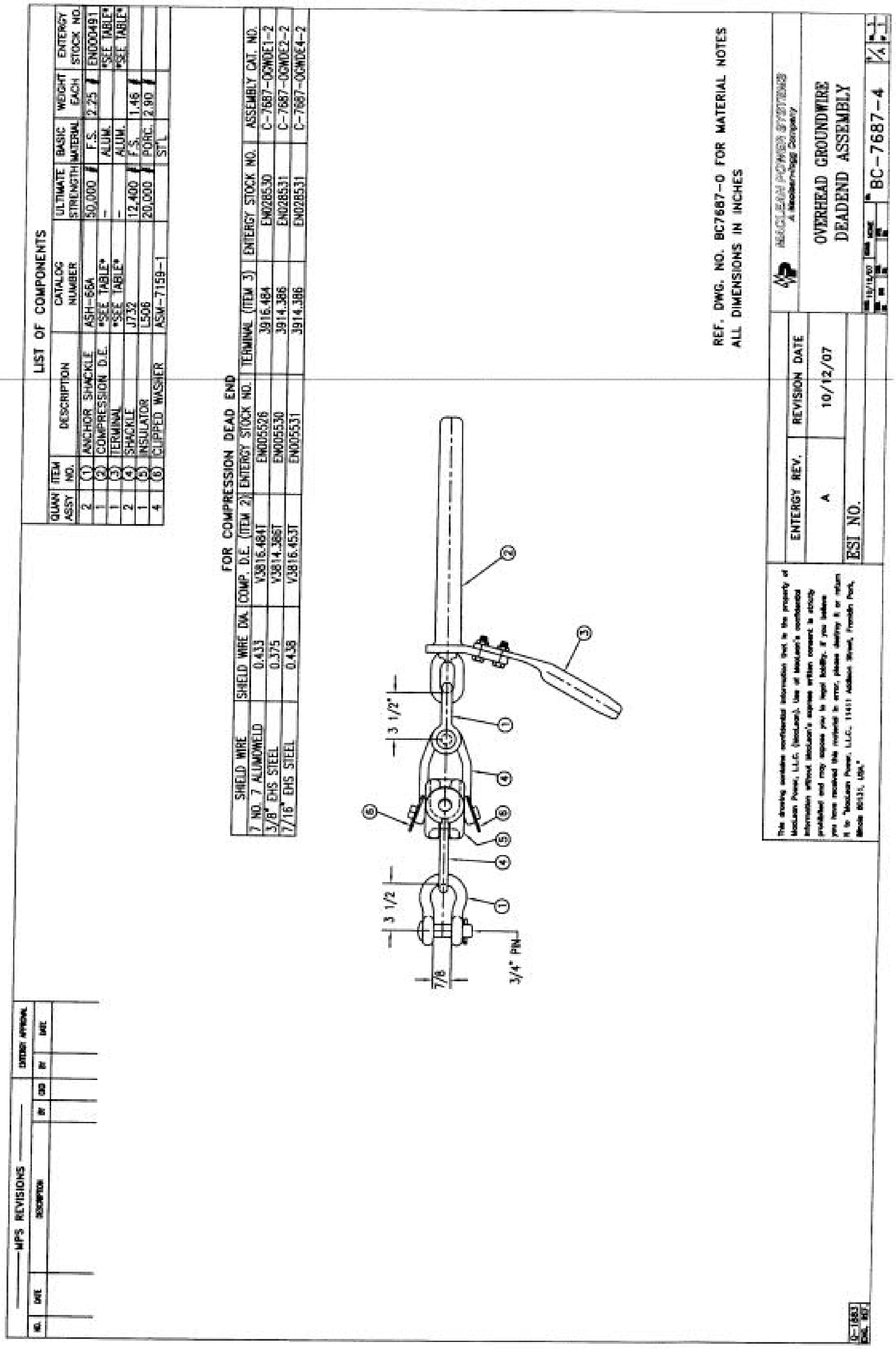
tfinc90 12/20/2007 OHG-DEJB-XX

TEMP\AM-Work\ewilli2\M-LITAPETSP047,D-TDocs,S-Template\ESI\STANDARDS\Transmission\AMISC\TMD403A0.dwg, 5/28/2010 5:05:01 PM, ewilli2


LIST OF COMPONENTS
QUAN/ASSY OGWS1A OGWS1
ITEM NO.
DESCRIPTION
CATALOG NUMBER
ULTIMATE STRENGTH
BASIC MATERIAL
WEIGHT EACH
ENTERGY STOCK NO.
(1) Y-CLEVIS BALL YCB-65A 35,000 # F.S. 2.15 # EN004375
(2) SUSPENSION CLAMP *SEE TABLE* * * *SEE TABLE*
(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
SHIELD 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
3/4" BENT BOLT
45°
30°
3 1/4
ASSEMBLY C-7687-OGWS1A
ASSEMBLY C-7687-OGWS1
REF. DWG. NO. BC7687-0 FOR MATERIAL NOTES
ALL DIMENSIONS IN INCHES
OHG-SUS-XX
BETHEA POWER PRODUCTS
PELHAM, ALABAMA
OVERHEAD GROUNDWIRE
SUSPENSION ASSEMBLY
DESIGN APPROVAL
STANDARDS APPROVAL
SIGNED
DATE
ESI NO. TMD223A4
ENTERGY NO. OHGSUS
BC-7687
REVISIONS


LIST OF COMPONENTS
FOR COMPRESSION DEAD END
LIST OF COMPONENTS
ALL DIMENSIONS IN INCHES
SEE SHEET ONE FOR MATERIAL NOTES
BETHEA POWER PRODUCTS
OVERHEAD GROUNDWIRE
DEADEND ASSEMBLY
BC-7687
OHG-DE-XX
ESI NO. TMD222A4
ENTERGY NO. OHGDE
FOR 7 #7 ALUMOWELD
AND 3/8" EHS
ASSEMBLY NUMBER C-7687-OGWDE3
3/4" PIN
REVISIONS


LIST OF COMPONENTS
QUAN/ASSY OGWS3	OGWS4	OGWS5	ITEM NO.	DESCRIPTION	CATALOG NUMBER	ULTIMATE STRENGTH	BASIC MATERIAL	WEIGHT EACH	ENTERGY STOCK NO.
2	2	2	(1)	ANCHOR SHACKLE	ASH-56-BC	40,000 #	F.S.	1.47 #	EN015676
1	1	1	(2)	YOKE PLATE	ASM-7149-11	30,000 #	STL	15.0 #	EN004375
2	2	2	(3)	Y-CLEVIS BALL	YCB-65A	35,000 #	F.S.	2.15 #	EN000392
2			(4)	SUSPENSION CLAMP	IS-1-S	18,000 #	AL./D.I.	4.11 #	EN000392
1	1	1	(5)	ARMOR ROD	SEE TABLE	-			
	2	2	(6)	SUSPENSION CLAMP	FSC-70-S	18,000 #	D.I.	6.00 #	
NOTE: ARMOR ROD NOT SHOWN
SHIELD WIRE	SHIELD WIRE DIA.	ARMOR ROD (ITEM 5)	ENTERGY STOCK NO.	ASSEMBLY CAT. NO.
7 NO. 7 ALUMOWELD	0.433	AR-2131		C-7687-OGWS3
3/8" EHS	0.375	AR-1130		C-7687-OGWS4
7/16" EHS	0.4375	AR-1133		C-7687-OGWS5
REVISIONS
3/4" BOLT
1 1/16
2 3/4
1/2
5
3 1/4
2 3/16
2 3/8
2 5/16
30° MAX.
18
9
4
CLAMPING RANGE: 0.30 - 0.70
CLAMPING RANGE: 0.40 - 0.87
6 3/8
7 7/16
ASSEMBLY C-7687-OGWS4 & OGWS5
ASSEMBLY C-7687-OGWS3
REF. DWG. NO. BC7687-0 FOR MATERIAL NOTES
ALL DIMENSIONS IN INCHES
OHG-SUY-XX
BETHEA POWER PRODUCTS
PELHAM, ALABAMA
OVERHEAD GROUNDWIRE SUSPENSION ASSEMBLY
ESI NO. TMD224A3
ENTERGY NO. OHGSUY
BC-7687-3



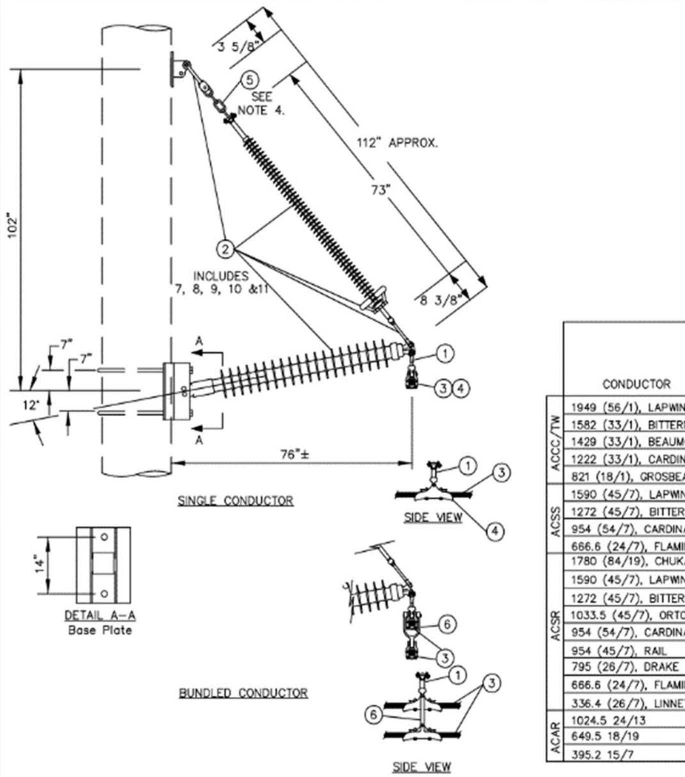
LIST OF COMPONENTS

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

This drawing contains confidential information that is the property of MacLean Power, L.L.C. (MacLean). Use of MacLean's confidential information without MacLean's express written consent is strictly prohibited and may expose you to legal liability. If you believe you have received this material in error, please destroy it or return it to "MacLean Power, L.L.C., 11411 Addison Street, Franklin Park, Illinois 60131, USA."



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
ACCC/TW	1582 (33/1), BITTERN	INCL.	w/ ITEM 4	–	–	TLS–0115SE **	32068992	NOT YET ASSIGNED	N/A	N/A	N/A
ACCC/TW	1429 (33/1), BEAUMONT	INCL.	w/ ITEM 4	–	–	AGS–5138	32082067	NOT YET ASSIGNED	N/A	N/A	N/A
ACCC/TW	1222 (33/1), CARDINAL	INCL.	w/ ITEM 4	–	–	TLS–0111SE	32068988	NOT YET ASSIGNED	N/A	N/A	N/A
ACCC/TW	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
ACSS	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
ACSS	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
ACSS	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
ACSR	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
ACSR	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
ACSR	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
ACSR	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
ACSR	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
ACSR	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
ACSR	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
ACSR	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
ACAR	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
ACAR	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	W.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

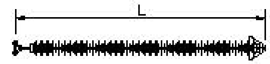
PLOT 1:24 | SH. 1 OF 1

BP2–161–XX

10–15–2014

ewilli2

INSULATOR, SUSPENSION, 25,000 LBS.



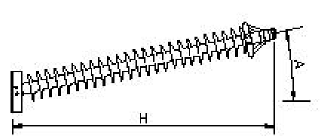
S1. SPECIFIED MECHANICAL LOAD (SML) = 25,000 LBS. ROUTINE TEST LOAD (RTL) = 12,500 LBS

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.

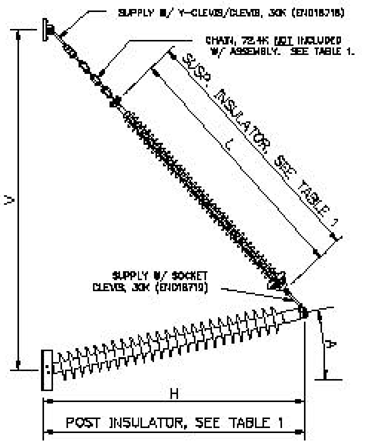


TABLE 1

	V (kV)	ENTERGY STOCK CODE BP ASSY	SUSP.	POST	CHAIN
BP2	115	EN016144	EN014860	EN014788	32103533
BP2	138	EN016146	EN014859	EN014852	32103536
BP2	161	EN016149	EN014858	EN014853	32103543
BP2	230	EN016150	EN014884	EN014789	32103548
BP3	115	EN016145	EN014860	EN014794	32103531
BP3	138	EN016148	EN014859	EN014795	32103533
BP3	161	EN016151	EN014858	EN014797	32103539
BP3	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	36	380	330	640	660	–	–
	115	EN014860	–	–	60"	–	8	120	46	485	410	780	835	–	–
	138	EN014859	–	–	66"	–	9	130	56	540	480	865	955	–	–
	161	EN014858	–	–	75"	–	10	140	60	590	510	960	1020	8" HORZ.	–
	230	EN014884	–	–	90"	–	13	200	77	735	840	1240	1270	8" HORZ.	–
POST INSULATOR, 2.5" ROD DIA.	69	EN014787	45"	–	–	12"	8	90	36	380	330	640	660	–	–
	115	EN014788	60"	–	–	12"	8	120	48	485	410	780	835	–	–
	138	EN014852	66"	–	–	12"	8	130	56	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" HORZ.	–
	230	32084119	84"	–	–	12"	13	200	77	735	840	1240	1270	6" HORZ.	–
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	EN014795	66"	–	–	17"	8	130	56	540	480	865	955	–	–
	161	EN014797	78"	–	–	17"	10	140	80	590	510	960	1020	–	–
	230	EN014803	84"	–	–	17"	13	200	77	735	840	1240	1270	–	–
	161	32084118	78"	–	–	17"	10	140	80	590	510	960	1020	6" HORZ.	–
	230	32084116	84"	–	–	17"	13	200	77	735	840	1240	1270	6" HORZ.	–
DEADEND INSULATOR 50,000 LB.	69	EN014886	–	–	64"	–	8	120	49	485	430	830	880	–	–
	115	EN014887	–	–	75"	–	10	136	61	590	510	870	1025	–	–
	138	EN014809	–	–	80"	–	11	170	88	640	560	1045	1105	–	–
	161	EN014810	–	–	92"	–	12	185	76	890	828	1215	1275	8" HORZ.	–
	230	EN016124	–	–	104"	–	16	220	88	830	708	1380	1440	8" HORZ.	–
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	56	540	480	865	935	–	–
	161	EN016149	78"	102"	73"	12"	10	140	80	590	510	980	1029	6" HORZ.	–
	230	EN016150	84"	120"	90"	12"	13	200	77	735	840	1240	1270	6" HORZ.	–
BRACED POST INSULATOR 3" ROD DIA.	115	EN016145	60"	80"	60"	17"	8	120	48	485	410	780	835	–	–
	138	EN016148	66"	90"	66"	17"	8	130	56	540	460	865	955	–	–
	161	EN016151	78"	102"	73"	17"	10	140	80	590	510	860	1020	6" HORZ.	–
	230	EN016152	84"	120"	90"	17"	13	200	77	735	840	1240	1270	8" HORZ.	–

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.	DATED	REVISION	BY:	CHK:	APPR:
5	10-12-11	DEL. NOTE 8, REV. ELECTRICAL VALUES, REV. CHAIN	ECW		
4	10-13-11	COMPLETE REVISION	ECW	HSK	RLR
3	02-28-11	ADD CORONA SHIELDS TO 161 kV, REV. NOTES 1 & 3		ECW	RLR
2	03-05-07	CORRECTED DRAFTING STANDARD ERRORS	TWF	HSK	
1	3-30-06	REPLACED TURNBUCKLES WITH CHAIN LINKS	RMB		

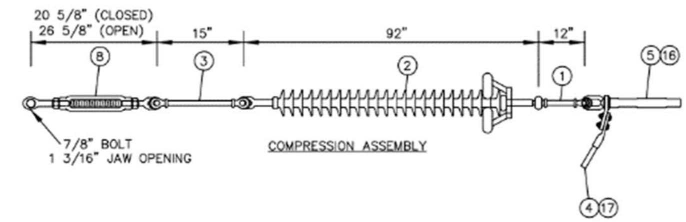
ENTERGY SERVICES, INC.
Transmission Standard
POLYMER INSULATOR STANDARD, 69-230kV
INSULATOR ASSEMBLY DETAIL
STD NO. SCALE: NONE
Entergy
No. TMC007A5
PLOT 1=1 SH. 1 OF 1

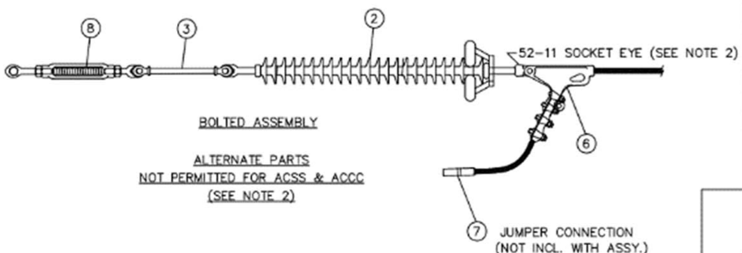
TD020 Attachment 5, Polymer Insulator Standard Drawing

ewill2 8/10/2012

C:\TEMP\AM-Work\ewill2\M-JDCAPETSP047,D-TDocs,S-Template\ES\STANDARDS\Transmission\TMC007A1.DWG, 8/10/2012 4:17:35 PM, ewill2

Attachment 1: Applicable Standard Framing and Assembly Drawings





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.

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.

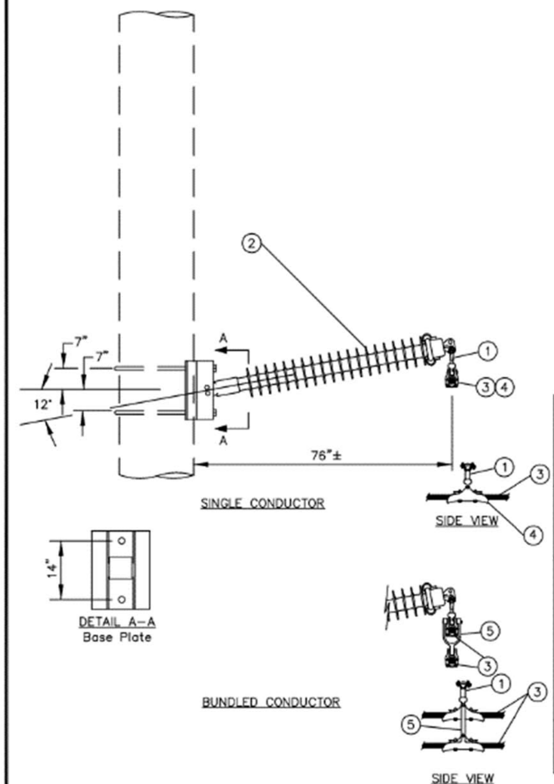
Entergy | No. TCA205A5

PLOT 1:24 | SH. 1 OF 1

DEP-TRB-161-XX (1 WIRE)

11-17-2014

ewill2



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
ACCC/TW	1582 (33/1), BITTERN	INCL. w/ ITEM 4		–	–	TLS–0115SE ***	32068992	NOT YET ASSIGNED	N/A	N/A	N/A
ACCC/TW	1429 (33/1), BEAUMONT	INCL. w/ ITEM 4		–	–	AGS–5138	32082067	NOT YET ASSIGNED	N/A	N/A	N/A
ACCC/TW	1222 (33/1), CARDINAL	INCL. w/ ITEM 4		–	–	TLS–0111SE	32068988	NOT YET ASSIGNED	N/A	N/A	N/A
ACCC/TW	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
ACSS	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
ACSS	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
ACSS	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
ACSR	1590 (45/7), LAPWING	–	–	1.504	30	LS–7–S	EN000386	C–7648–JLP–4	VBLS–12–77–S	EN027824	C–7648–JLPB–4
ACSR	1272 (45/7), BITTERN	–	–	1.345	30	LS–6–S	EN000158	C–7648–JLP–3	VBLS–12–66–S	EN027823	C–7648–JLPB–3
ACSR	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
ACSR	954 (54/7), CARDINAL	–	–	1.196	30	LS–6–S	EN000158	C–7648–JLP–3	VBLS–12–66–S	EN027823	C–7648–JLPB–3
ACSR	954 (45/7), RAIL	–	–	1.165	30	LS–6–S	EN000158	C–7648–JLP–3	VBLS–12–66–S	EN027823	C–7648–JLPB–3
ACSR	795 (26/7), DRAKE	–	–	1.108	30	LS–6–S	EN000158	C–7648–JLP–6	VBLS–12–66–S	EN027823	C–7648–JLPB–6
ACSR	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
ACSR	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
ACAR	649.5 18/19	–	–	0.928	30	LS–2–S	EN000387	C–7648–JLP–2	VBLS–12–22–S	EN027822	C–7648–JLPB–2
ACAR	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.

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			

JLP–161–XX

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.

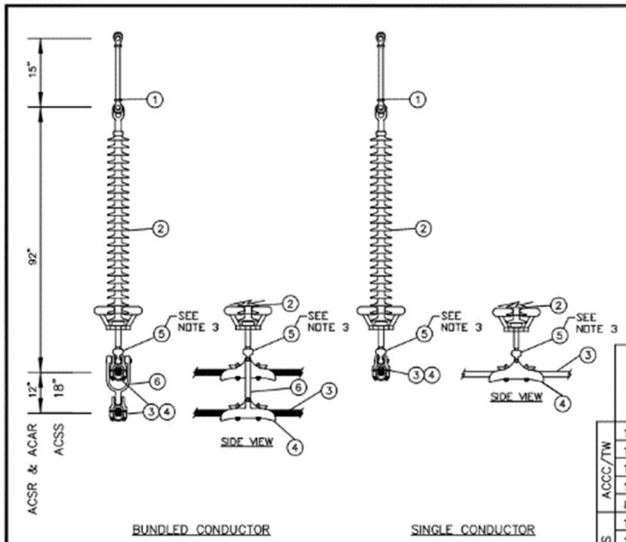
Entergy | No. TCA207A5

PLOT 1:24 | SH. 1 OF 1

JLP–161–XX

11–7–2014

ewill2



BILL OF MATERIALS

INSULATOR LINE SUSPENSION HEAVY POLYMER WITH LINK 161kV

ITEM	QUANTITY SHL	QUANTITY 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
ACCC/TW	1582 (33/1), BITTERN	INCL.	w/ ITEM 4	–	–	TLS-0115SE **	32068992	NOT YET ASSIGNED	N/A	N/A	N/A
ACCC/TW	1429 (33/1), BEAUMONT	INCL.	w/ ITEM 4	–	–	AGS-5138	32082067	NOT YET ASSIGNED	N/A	N/A	N/A
ACCC/TW	1222 (33/1), CARDINAL	INCL.	w/ ITEM 4	–	–	TLS-0111SE	32068988	NOT YET ASSIGNED	N/A	N/A	N/A
ACCC/TW	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
ACSS	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
ACSS	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
ACSS	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
ACSR	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
ACSR	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
ACSR	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
ACSR	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
ACSR	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
ACSR	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
ACSR	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
ACSR	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
ACAR	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
ACAR	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.

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		

SHR-LINK-161-XX

ENTERGY SERVICES, INC.

TRANSMISSION LINE STANDARD
POLYMER ASSY., HEAVY SUSPENSION
161 kV INSULATOR ASSEMBLY DETAIL

STD NO. TA0504 | SCALE: N. T. S.

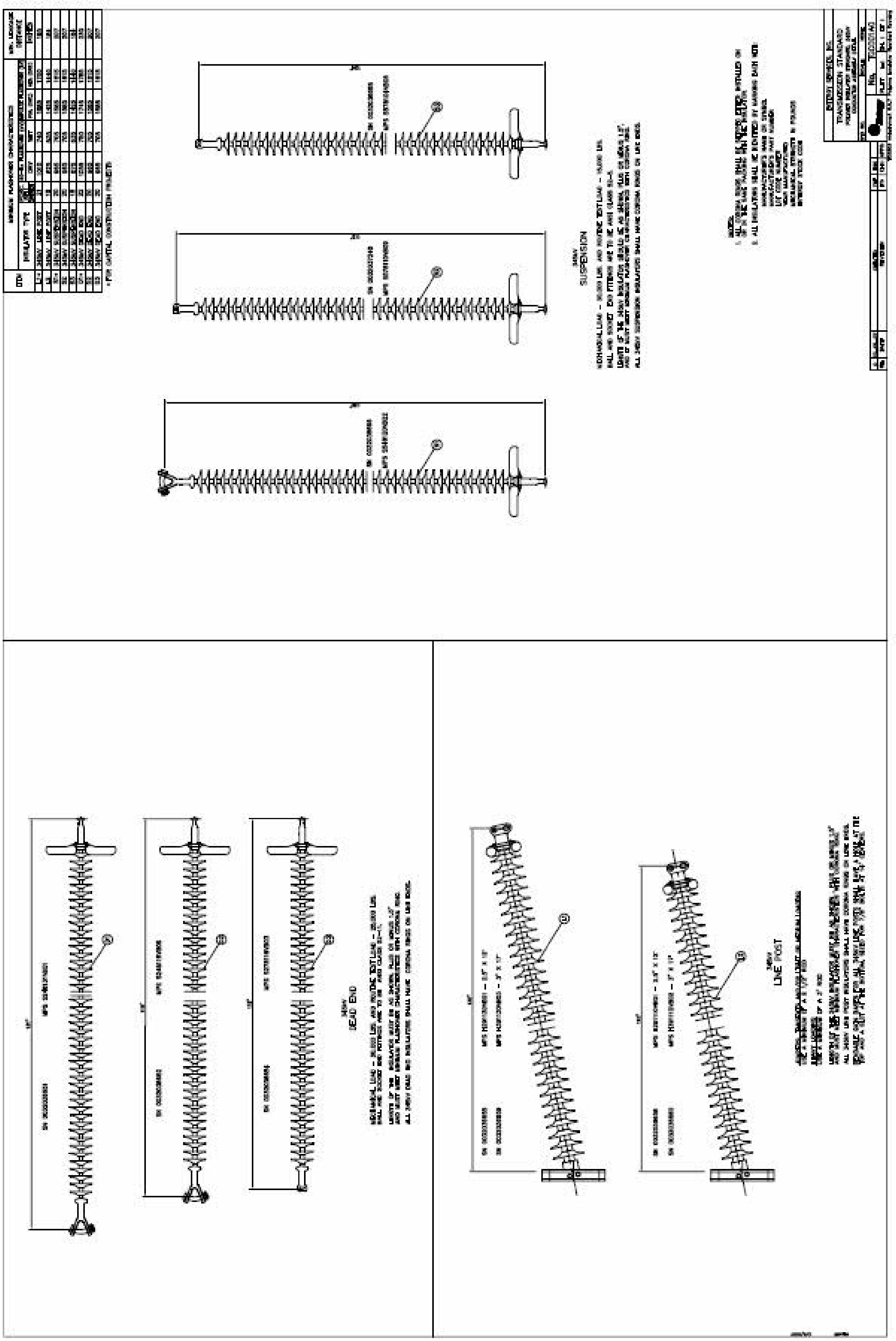
Entergy | No. TCA214A6

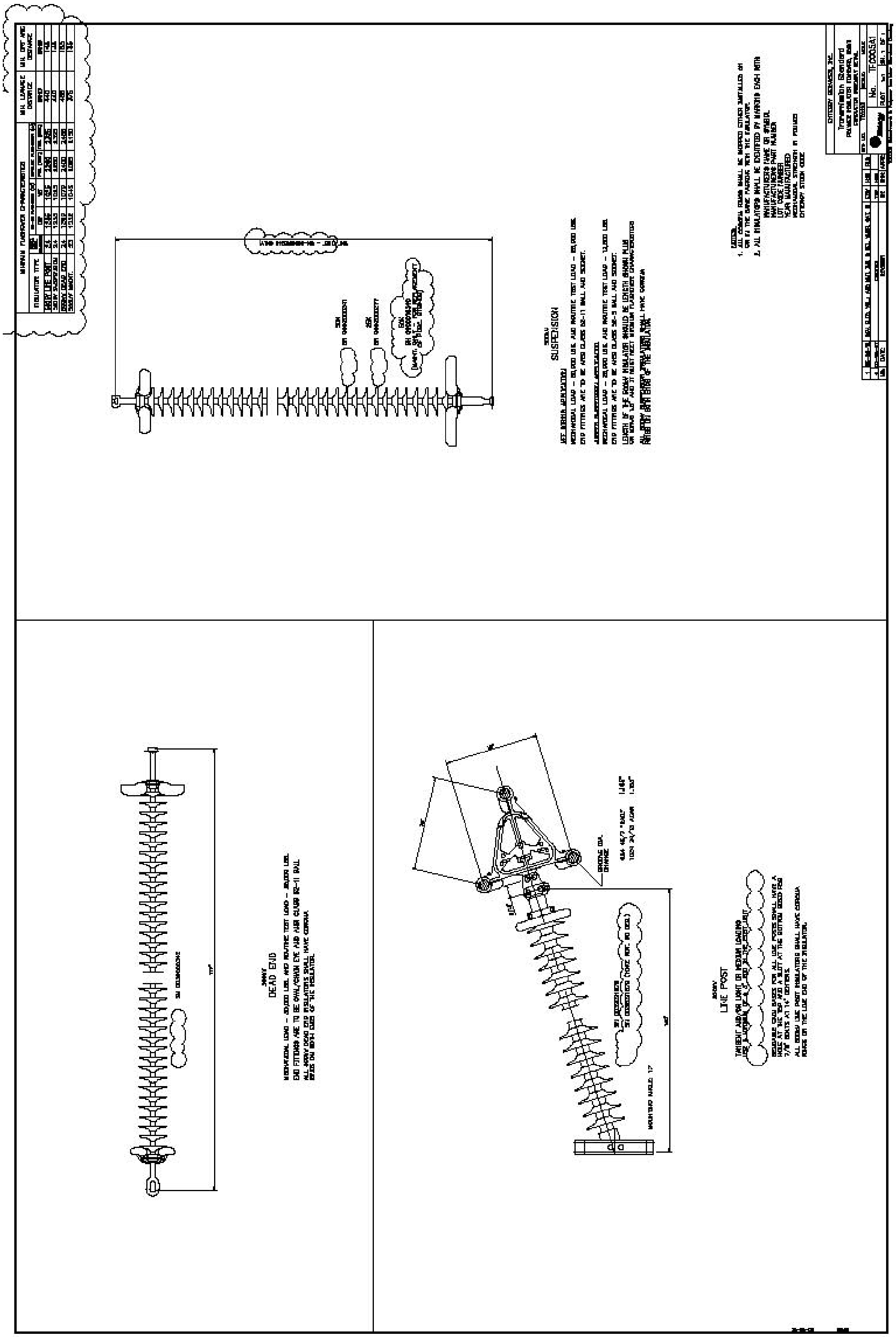
PLOT 1:24 | SH. 1 OF 1

SHRLINK-161-XX

06-11-15

ewilli2





C:\TEMP\AM-Workfile\IZM-JDCAPETSP047_D-TDocs_S-Template\ES\STANDARDS\Transmission\TF-C005A1.DWG, 9/17/2012 3:59:45 PM, ewill2

BILL OF MATERIALS

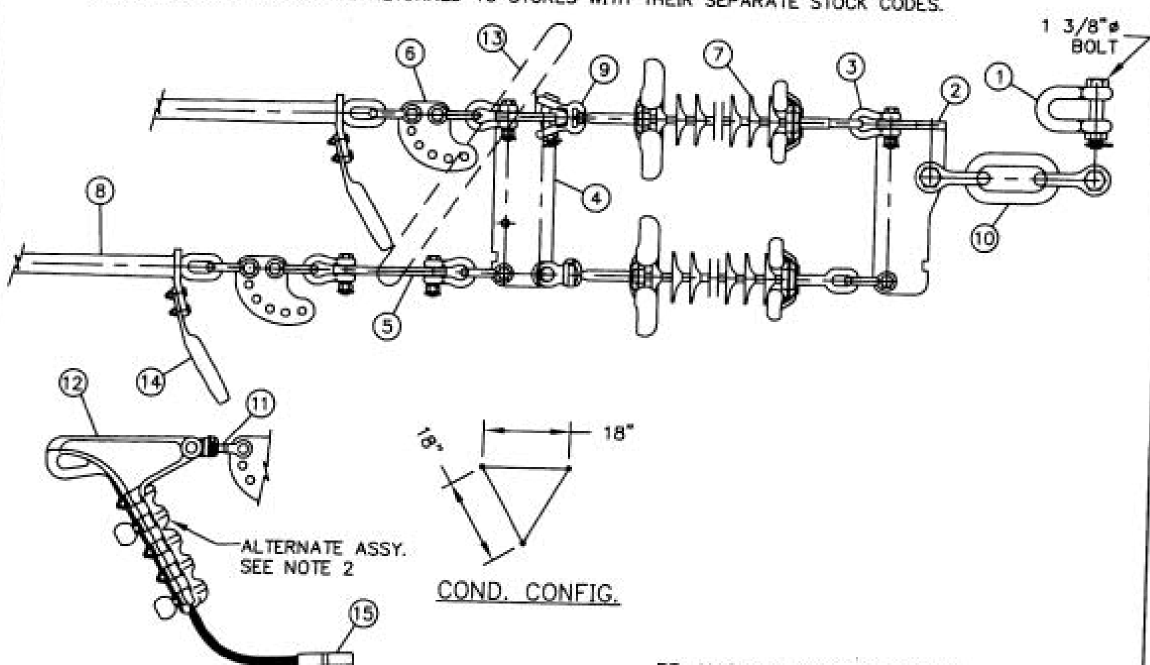
DEADEND, POLYMER, WITH BUNDLING YOKE, 500KV

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

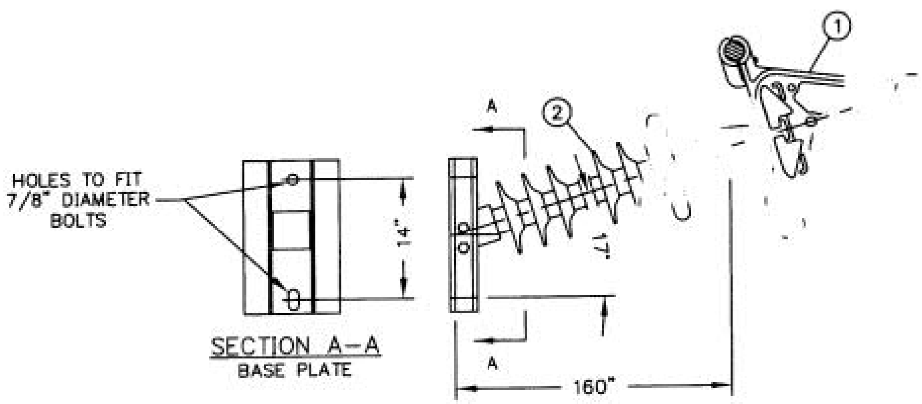
DEPY-500-XX; BC-7686-1

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

0	03-05-07	CREATED	TWF	HSK		
NO.	DATE:	REVISION	BY:	CHK:	APPR	

STD NO. SCALE: NONE

No. TFA201A0

Entergy PLOT 1=1 SH. 1 OF 1

JLPB-HJ-500-XX; BC-7686-4

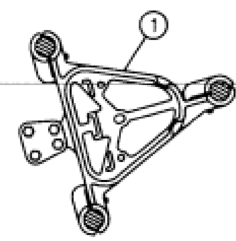
tfinc90 3/19/2007

BILL OF MATERIALS

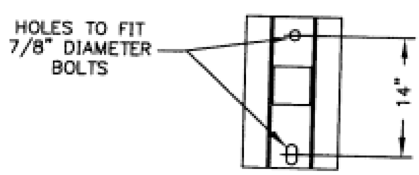
JUMPER LINE POST, POLYMER, w/BUNDLING YOKE, VERTICAL, 500kV

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.

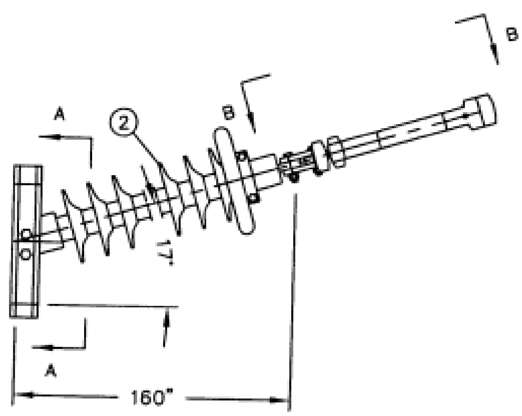
CONDUCTOR	CONDUCTOR DIA.	JMPR. YOKE (ITEM 1)	ENTERGY STOCK NO.	ASSEMBLY CAT. NO.	ENTERGY STOCK NO.
1024 ACAR	1.165	C-7686-4	0032021850	C-7686-J3	NA
954.0 45/7 "RAIL"	1.165	C-7686-4	0032021850	C-7686-J3	NA
954 54/7 "CARDINAL"	1.196	C-7686-4A	0032021860	C-7686-J3A	NA



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

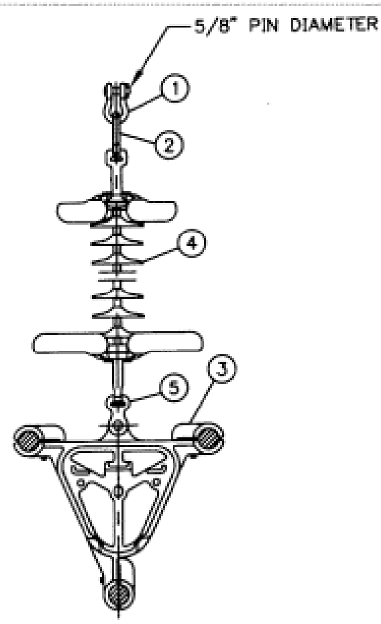
JLPB-VJ-500-XX; BC-7686-5

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

-05-07	CREATED	TWF	HSK		
DATE:	REVISION	BY:	CHK:	APP	

STD NO. | SCALE: NONE

No. TFA203A0

Entergy | PLOT 1=1 | SH. 1 OF 1

JSPB-500-XX; BC-7686-2

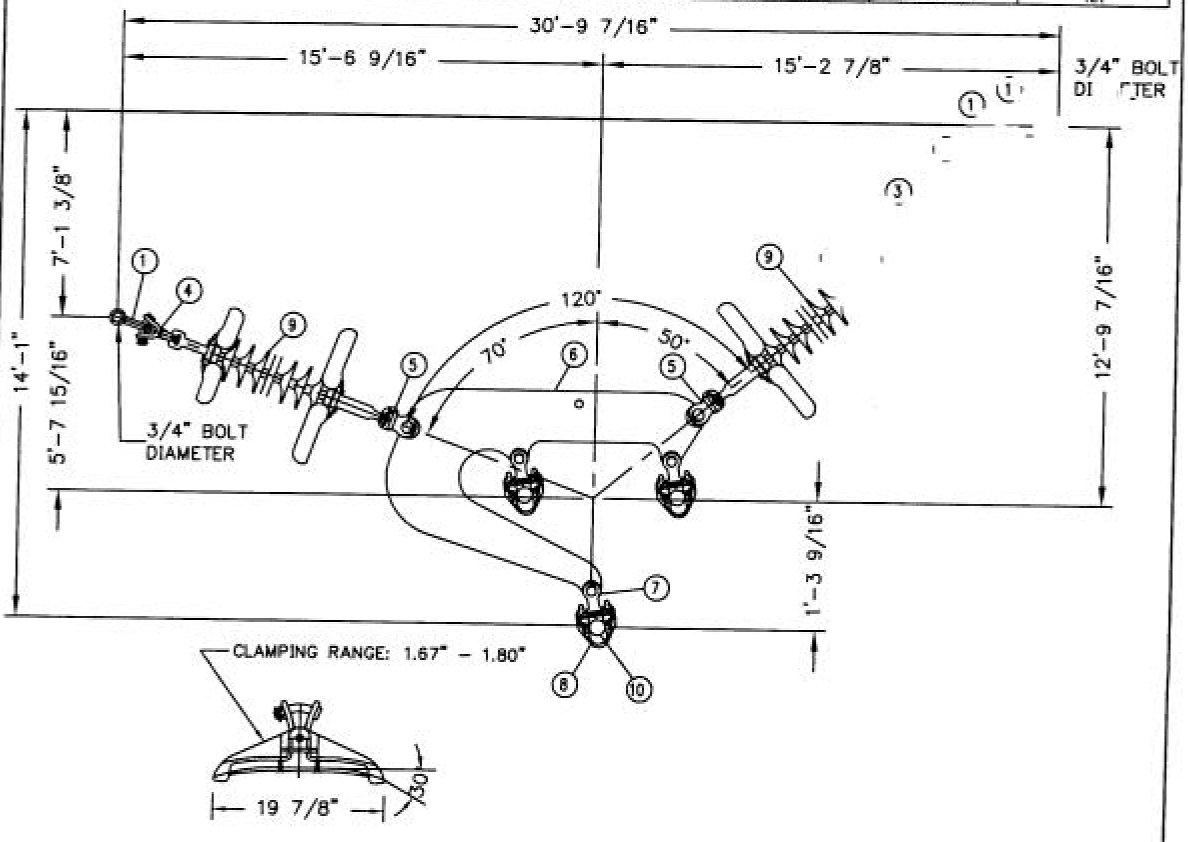
tfinc90 3 5 2007

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



SIDE VIEW OF CLAMP

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

Entergy | No. TFA204A0 | PLOT 1=1 | SH. 1 OF 1

NO.	DATE	REVISION	BY	CHK	APPR
0	03-05-07	CREATED	TWF	HSK	

tfinc90 3/5/2007

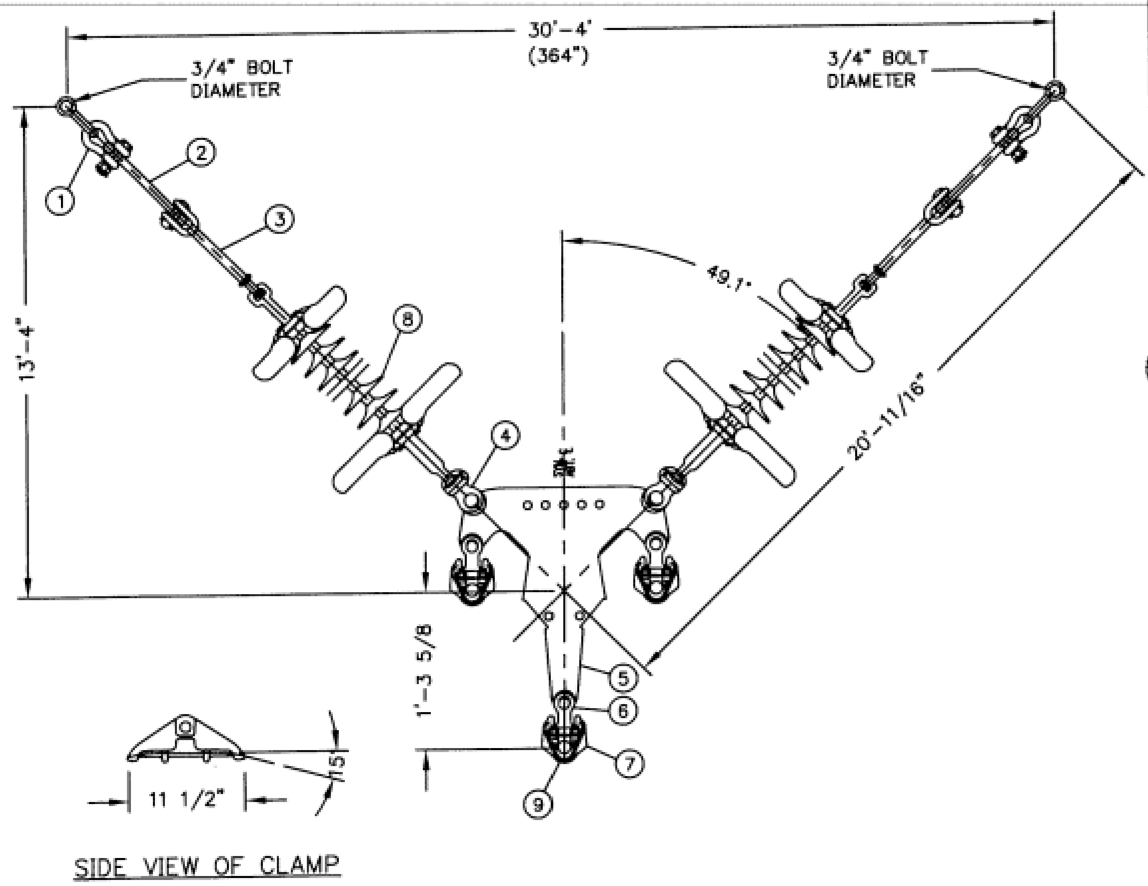
VSPR-500-XX; BC-7686-7

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



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.

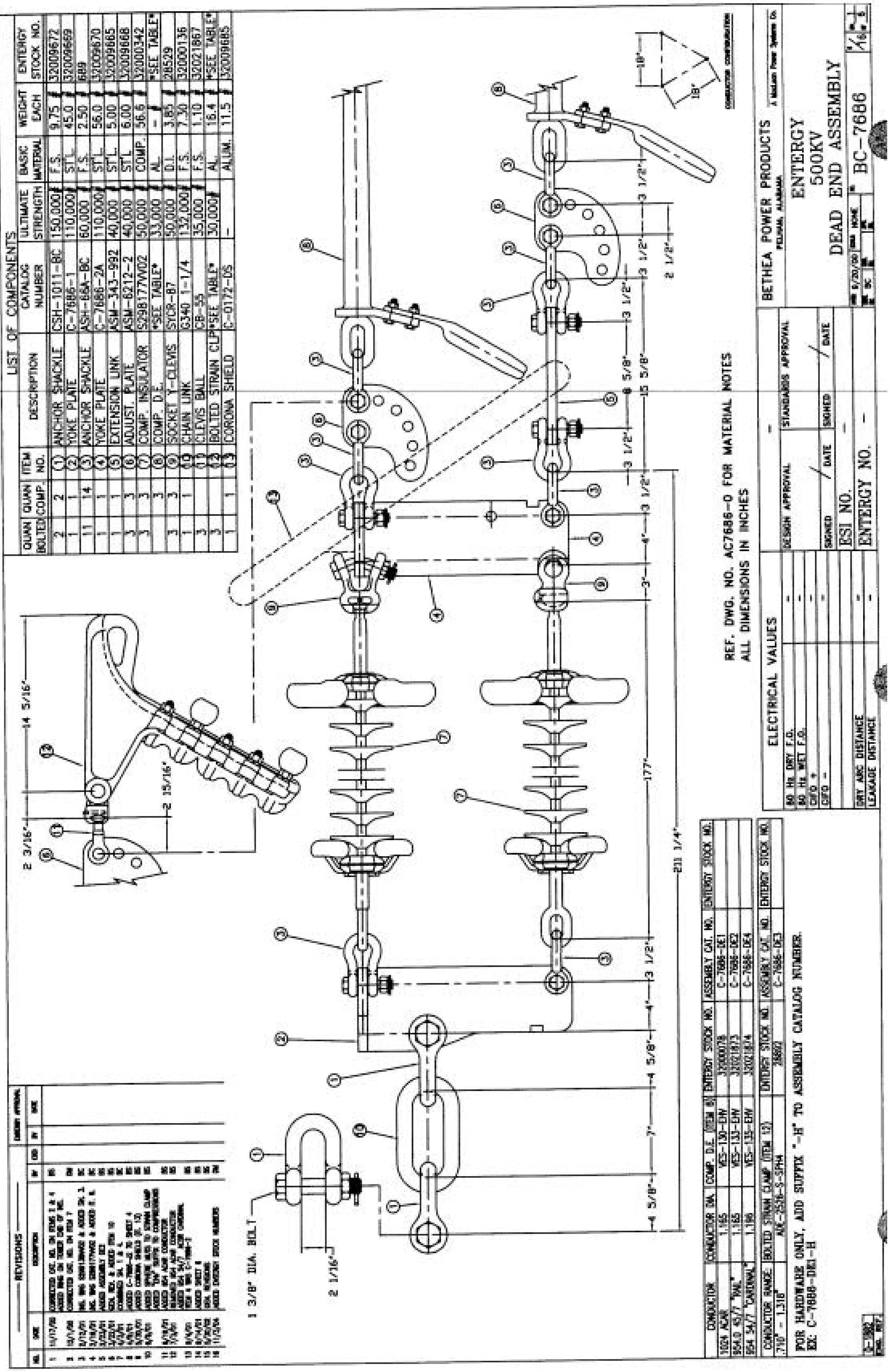
VEE-STRING, POLYMER, W/BUNDLING YOKE, 500kV

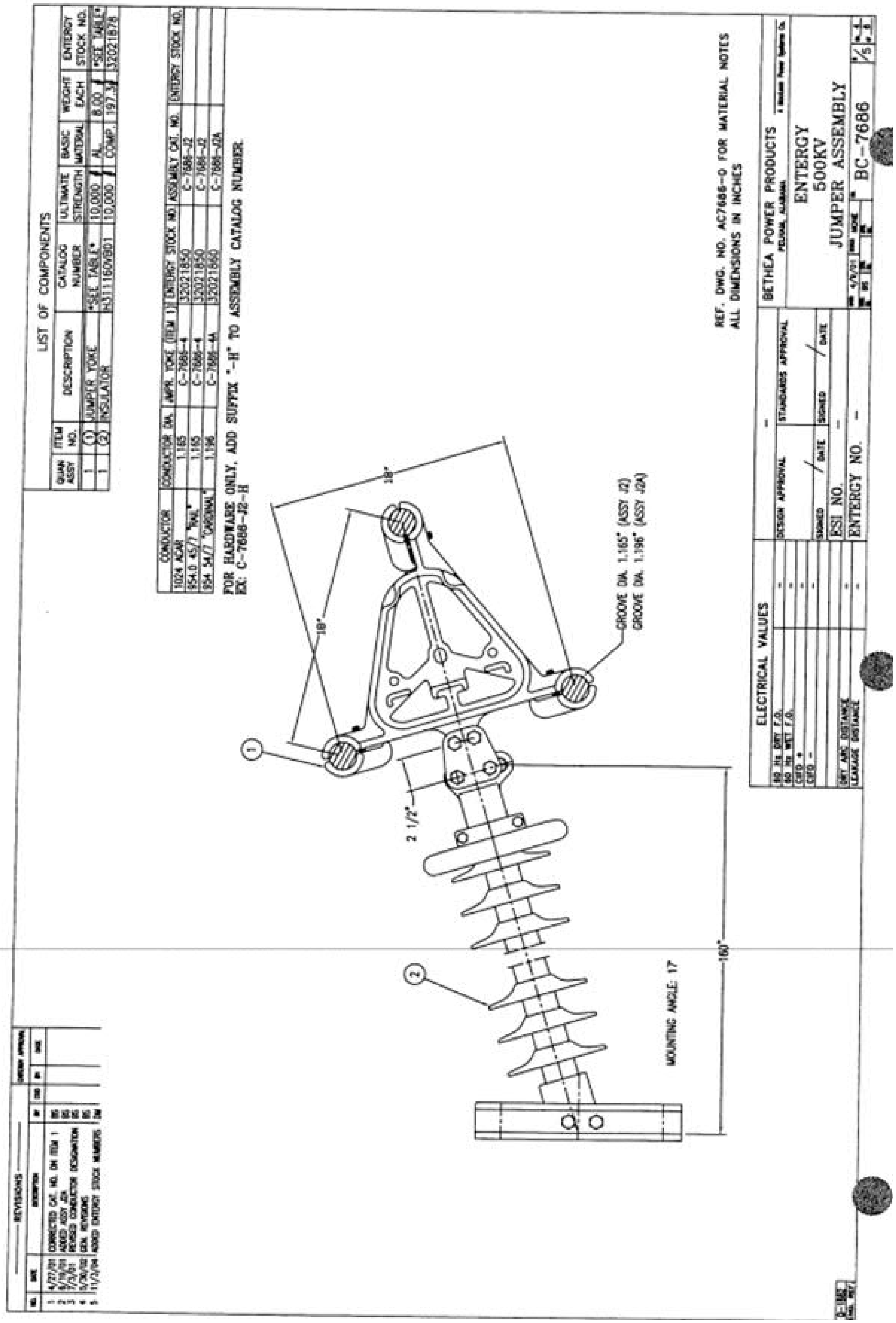
STD NO.	SCALE: NONE
Entergy	No. TFA205A0
PLOT 1=1	SH. 1 OF 1

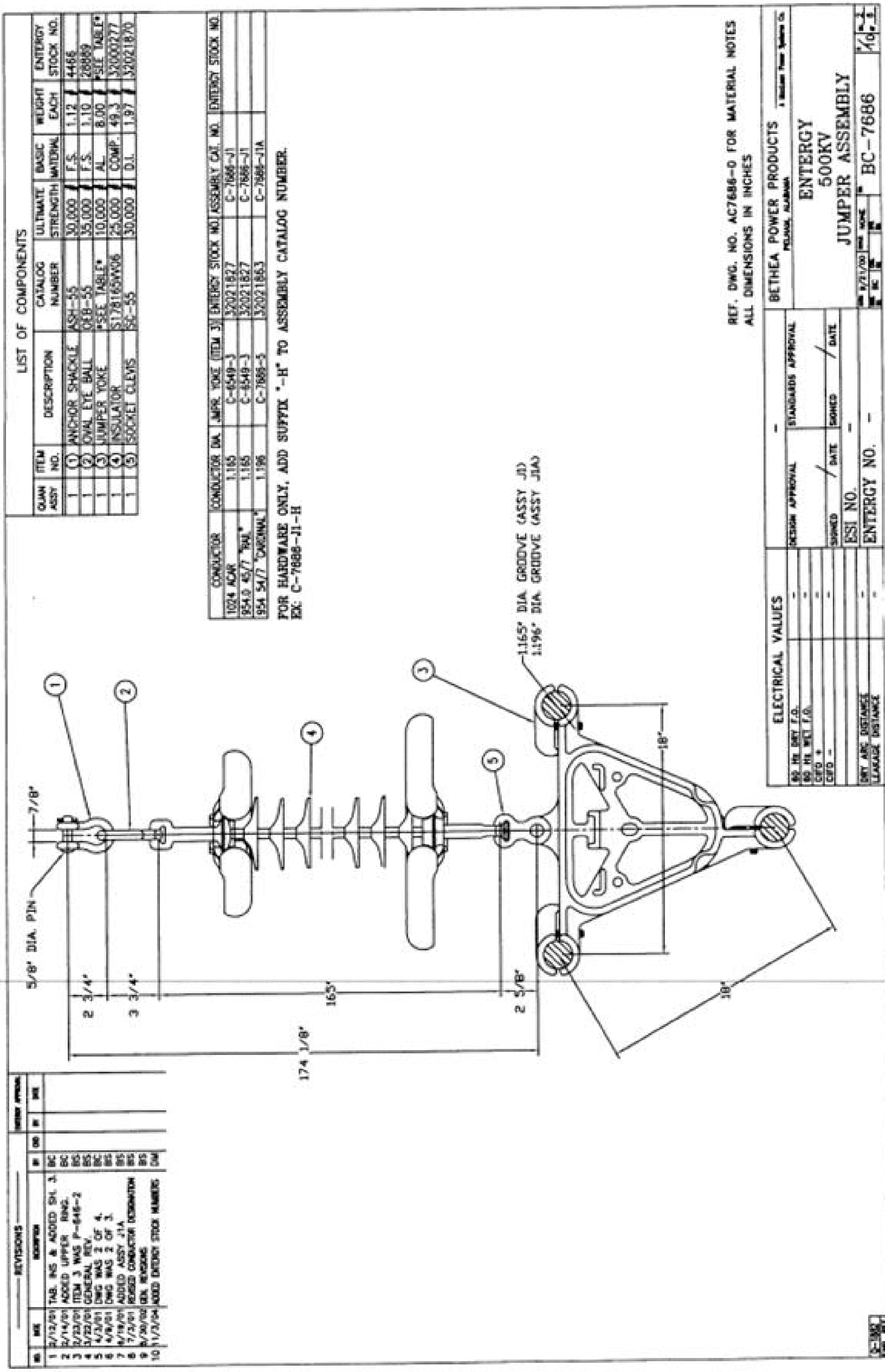
NO.	DATE	REVISION	BY	CHK	APPR
0	03-05-07	CREATED	TWF	HSK	

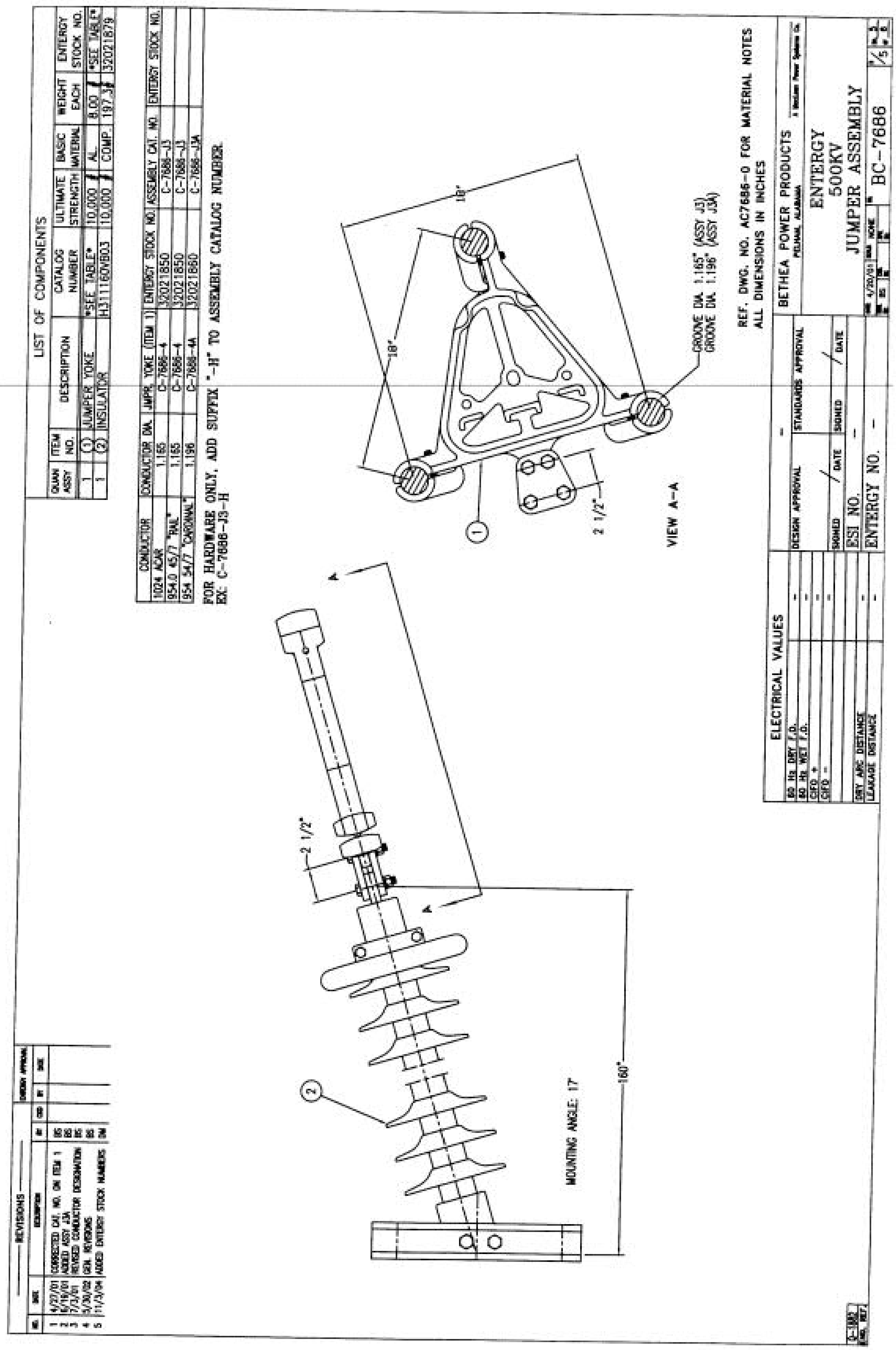
tfinc90 3/5/2007

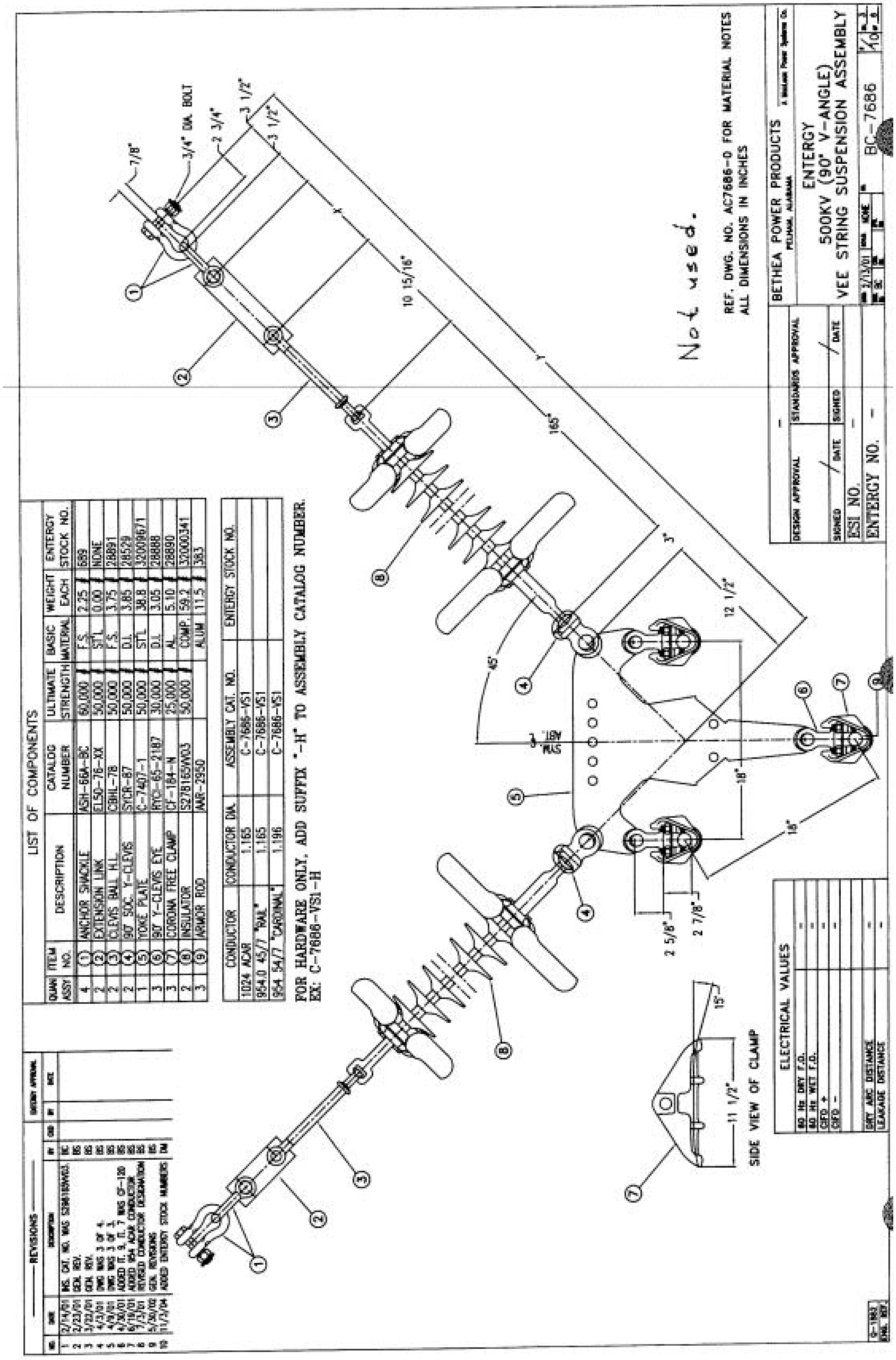
VSPY-500-XX; BC-8098-1

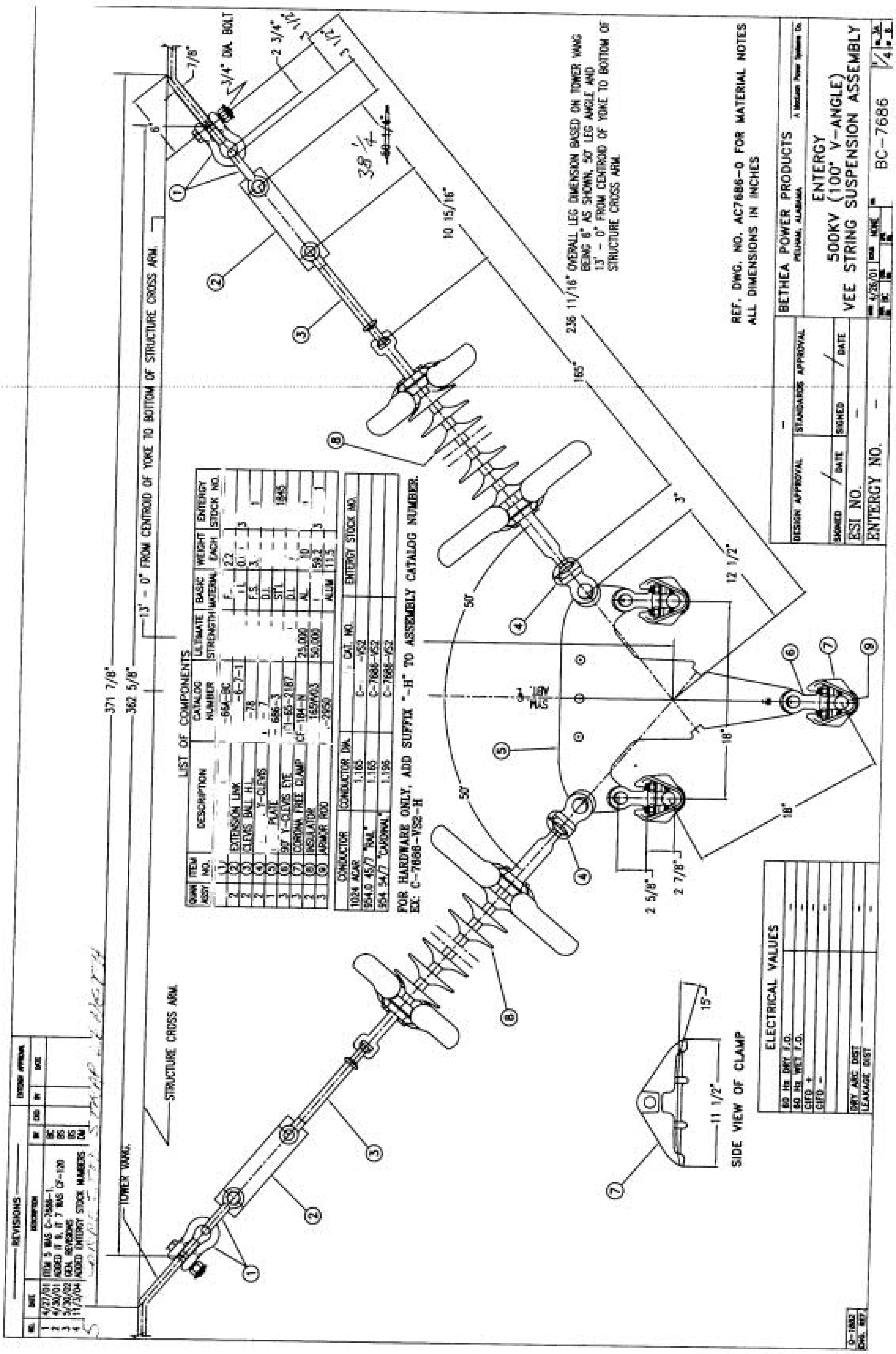

REF. DWG. NO. AC7686-0 FOR MATERIAL NOTES
ALL DIMENSIONS IN INCHES
LIST OF COMPONENTS
ELECTRICAL VALUES
BETHEA POWER PRODUCTS
ENTERGY
500KV
DEAD END ASSEMBLY
BC-7686
FOR HARDWARE ONLY, ADD SUFFIX "-H" TO ASSEMBLY CATALOG NUMBER.
1 3/8" DIA. BOLT

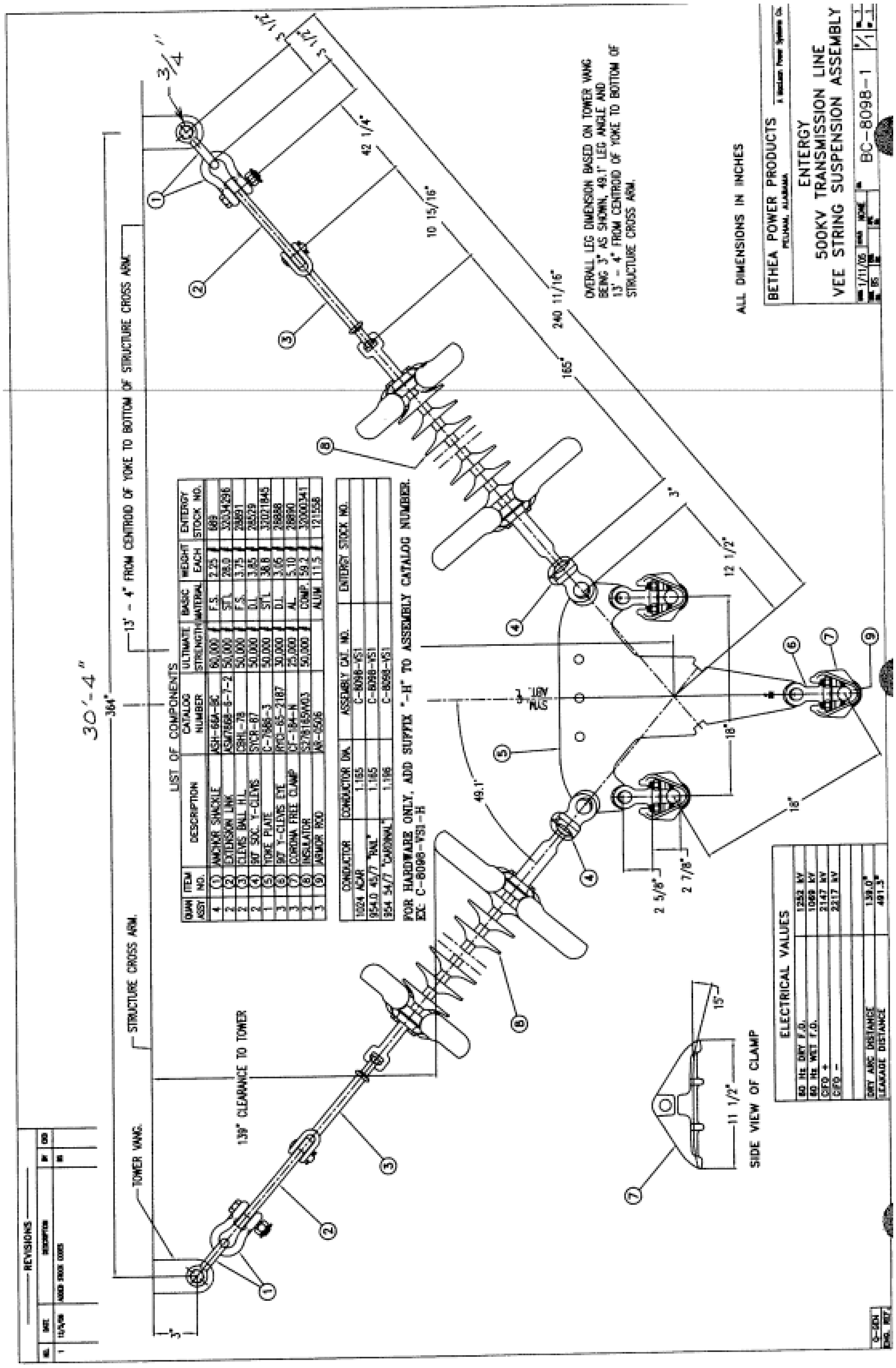

LIST OF COMPONENTS
JUMPER YOKE
INSULATOR
FOR HARDWARE ONLY, ADD SUFFIX "-H" TO ASSEMBLY CATALOG NUMBER
EX: C-7686-J2-H
GROOVE DIA. 1.165" (ASSY J2)
GROOVE DIA. 1.196" (ASSY J2A)
18"
18"
2 1/2"
160"
MOUNTING ANGLE: 17°
REF. DWG. NO. AC7686-0 FOR MATERIAL NOTES
ALL DIMENSIONS IN INCHES
ELECTRICAL VALUES
BETHEA POWER PRODUCTS
ENTERGY
500KV
JUMPER ASSEMBLY
BC-7686
ENTERGY NO.
ESI NO.


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
REVISIONS
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 8/30/02 GEN. REVISIONS BS
10 11/3/04 ADDED ENTERGY STOCK NUMBERS DM
5/8" DIA. PIN
7/8"
2 3/4"
3 3/4"
174 1/8"
165"
2 5/8"
1.165" DIA. GROOVE (ASSY J1)
1.196" DIA. GROOVE (ASSY J1A)
18"
18"
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
ESI NO. -
ENTERGY NO. -
BETHEA POWER PRODUCTS
PELHAM, ALABAMA
ENTERGY
500KV
JUMPER ASSEMBLY
BC-7686


REVISIONS
1 4/27/01 CORRECTED CAT. NO. ON ITEM 1 BS
2 6/19/01 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"
A
MOUNTING ANGLE: 17°
160"
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
SIGNED DATE
ESI NO. -
ENTERGY NO. -
BETHEA POWER PRODUCTS
PELHAM, ALABAMA
ENTERGY
500KV
JUMPER ASSEMBLY
4/20/01 NONE
BC-7686


REVISIONS
1 2/14/01 INS. CAT. NO. WAS S278165W03. 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
7/8"
3/4" DIA. BOLT
2 3/4"
3 1/2"
3 1/2"
X
10 15/16"
165"
Y
45°
SYM. ℄ ADJ.
3"
12 1/2"
2 5/8"
2 7/8"
18"
18"
15°
11 1/2"
SIDE VIEW OF CLAMP
ELECTRICAL VALUES
60 Hz DRY F.O. -
60 Hz WET F.O. -
CIFO + -
CIFO - -
DRY ARC DISTANCE -
LEAKAGE DISTANCE -
Not used.
REF. DWG. NO. AC7686-0 FOR MATERIAL NOTES
ALL DIMENSIONS IN INCHES
DESIGN APPROVAL
STANDARDS APPROVAL
SIGNED / DATE
ESI NO. -
ENTERGY NO. -
BETHEA POWER PRODUCTS
PELHAM, ALABAMA
ENTERGY
500KV (90° V-ANGLE)
VEE STRING SUSPENSION ASSEMBLY
2/13/01
NONE
BC-7686
G-1982
ENG. REF.


REF. DWG. NO. AC7686-0 FOR MATERIAL NOTES
ALL DIMENSIONS IN INCHES
236 11/16" OVERALL LEG DIMENSION BASED ON TOWER VANG BEING 6" AS SHOWN, 50' LEG ANGLE AND 13' - 0" FROM CENTROID OF YOKE TO BOTTOM OF STRUCTURE CROSS ARM.
BETHEA POWER PRODUCTS
PELHAM, ALABAMA
ENTERGY
500KV (100° V-ANGLE)
VEE STRING SUSPENSION ASSEMBLY
BC-7686
ESI NO.
ENTERGY NO.
DESIGN APPROVAL
STANDARDS APPROVAL
LIST OF COMPONENTS
FOR HARDWARE ONLY, ADD SUFFIX "-H" TO ASSEMBLY CATALOG NUMBER.
EX: C-7686-VS2-H
ELECTRICAL VALUES
SIDE VIEW OF CLAMP
STRUCTURE CROSS ARM
TOWER VANG
13' - 0" FROM CENTROID OF YOKE TO BOTTOM OF STRUCTURE CROSS ARM
371 7/8"
362 5/8"
3/4" DIA. BOLT
10 15/16"
REVISIONS


30'-4"
364"
13' - 4" FROM CENTROID OF YOKE TO BOTTOM OF STRUCTURE CROSS ARM.
STRUCTURE CROSS ARM.
TOWER VANG.
139" CLEARANCE TO TOWER
3/4"
42 1/4"
10 15/16"
240 11/16"
165"
3"
12 1/2"
18"
49.1°
2 5/8"
2 7/8"
SYM. ℄ ABT.
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-SC | 60,000 | F.S. | 2.25 | 889
2 | (2) | EXTENSION LINK | ASW7868-6-7-2 | 50,000 | STL | 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-7888-3 | 50,000 | STL | 38.8 | 32021845
3 | (6) | 90° Y-CLEVIS EYE | RYC-65-2187 | 30,000 | D.I. | 3.05 | 28888
3 | (7) | CORONA FREE CLAMP | CF-184-H | 25,000 | AL | 5.10 | 28890
3 | (8) | INSULATOR | S2818SW03 | 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
OVERALL LEG DIMENSION BASED ON TOWER VANG BEING 3" AS SHOWN, 49.1° LEG ANGLE AND 13' - 4" FROM CENTROID OF YOKE TO BOTTOM OF STRUCTURE CROSS ARM.
ALL DIMENSIONS IN INCHES
15°
11 1/2"
SIDE VIEW OF CLAMP
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 | 491.5"
BETHEA POWER PRODUCTS
PELHAM, ALABAMA
ENTERGY
500KV TRANSMISSION LINE
VEE STRING SUSPENSION ASSEMBLY
1/11/05
BC-8098-1
REVISIONS

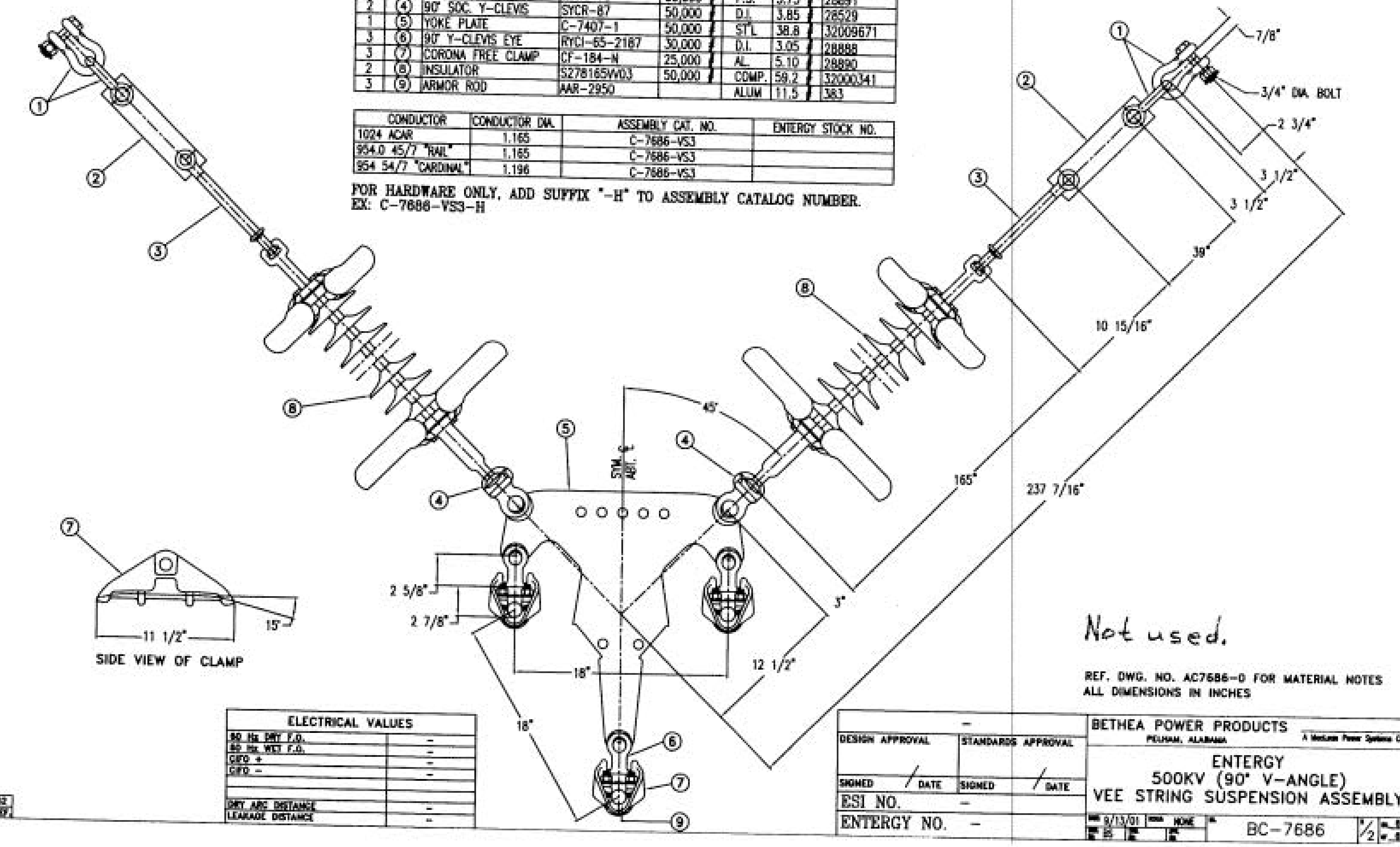
REVISIONS					ENTERGY APPROVAL	
NO.	DATE	DESCRIPTION	BY	CKD	BY	DATE
1	5/30/02	GEN. REVISIONS	BS			
2	11/3/04	ADDED ENTERGY STOCK NUMBERS	DW			

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	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-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

ELECTRICAL VALUES	
60 Hz DRY F.O.	-
60 Hz WET F.O.	-
CIFO +	-
CIFO -	-
DRY ARC DISTANCE	-
LEAKAGE DISTANCE	-

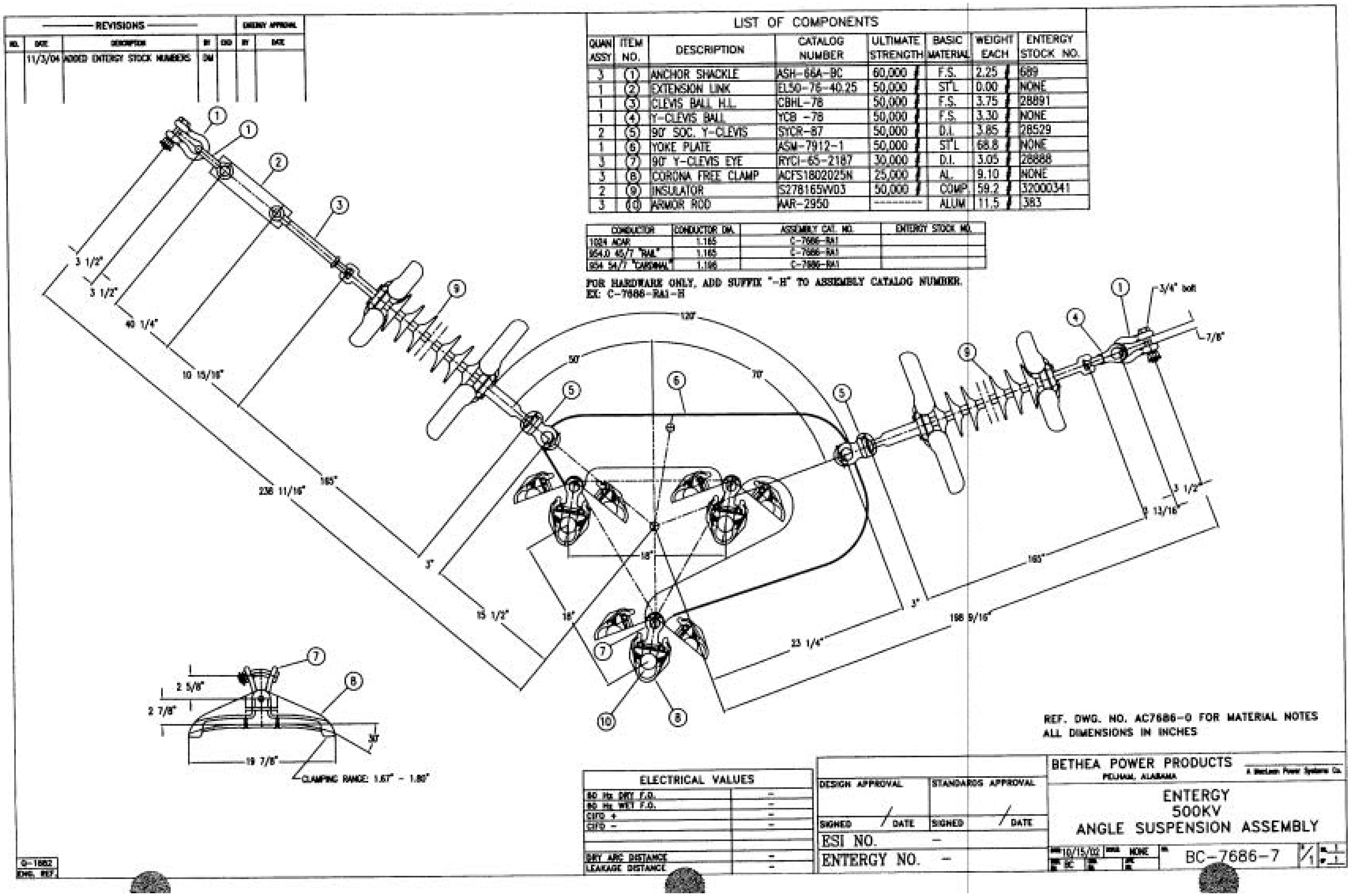
C-1882
DWG. REF.

	-	
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

9/13/01 NONE BC-7686 1/2



REVISIONS					ENTERGY APPROVAL	
NO.	DATE	DESCRIPTION	BY	CKD	BY	DATE
	11/3/04	ADDED ENTERGY STOCK NUMBERS	DM			

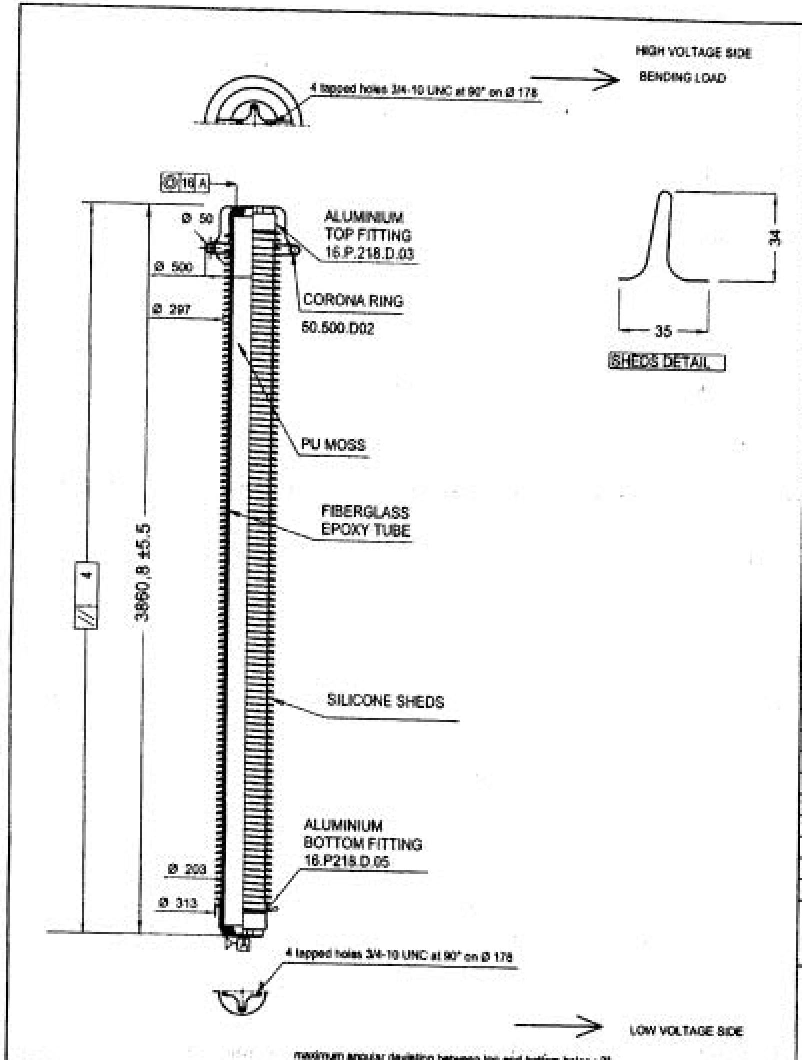
LIST OF COMPONENTS

QUAN ASSY	ITEM NO.	DESCRIPTION	CATALOG NUMBER	ULTIMATE STRENGTH	BASIC MATERIAL	WEIGHT EACH	ENTERGY STOCK NO.
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	

FOR HARDWARE ONLY, ADD SUFFIX "-H" TO ASSEMBLY CATALOG NUMBER.
EX: C-7686-RA1-H

ELECTRICAL VALUES	
60 Hz DRY F.O.	-
60 Hz WET F.O.	-
CITO +	-
CITO -	-
DRY ARC DISTANCE	-
LEAKAGE DISTANCE	-



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	206 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

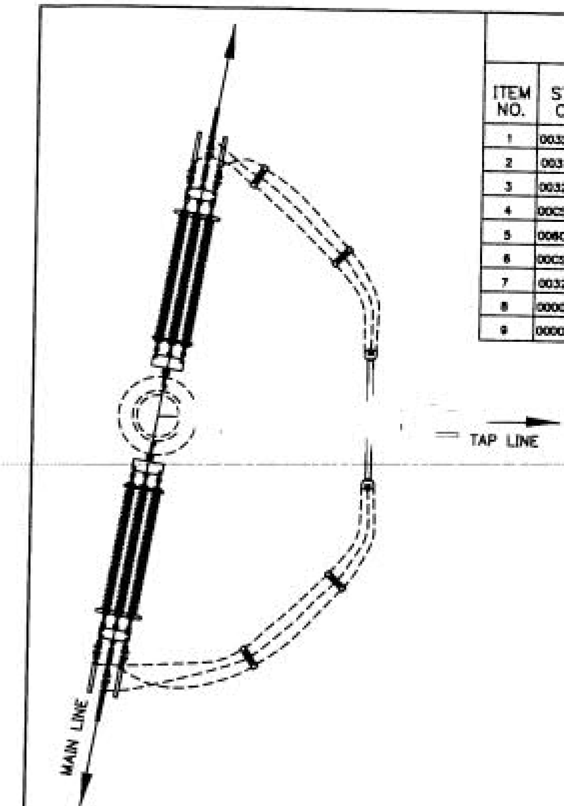
DESSINE :	23/10/2000	RV
VERIFIE :	13.11.03	
APPROUVE :	23/01/03	
DATE du TIRAGE :		
ECHELLE :		
ECH. SEC. :		

COMMERCIAL DRAWING

T-04684

N° T-04684

500KV STATION POST - ENTERGY STOCK CODE 0032034655



BILL OF MATERIAL

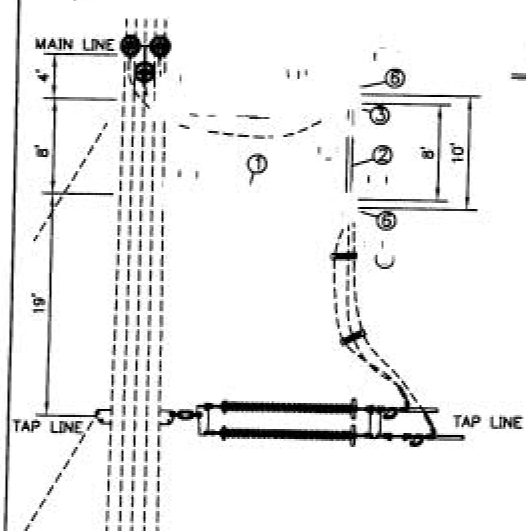
ITEM NO.	STOCK CODE	QTY.	UNIT	DESCRIPTION	MFR.	PART NO.
1	0032034655	2	EA.	STATION POST INSULATOR 500kV, 7" B.C.	MPS	T-04884
2	0032040241	20	FT.	TUBING, COND, ALUM, 5", SCH 40, EHV, 40' LG	AFL	500S40YTBE
3	0032040322	2	EA.	SUPPORT, BUS, 5" TUBE TO 7" B.C., W/ MTG HDWR	SEFCOR	WCTI-67-7-EHV
4	00CSPERCPD	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"

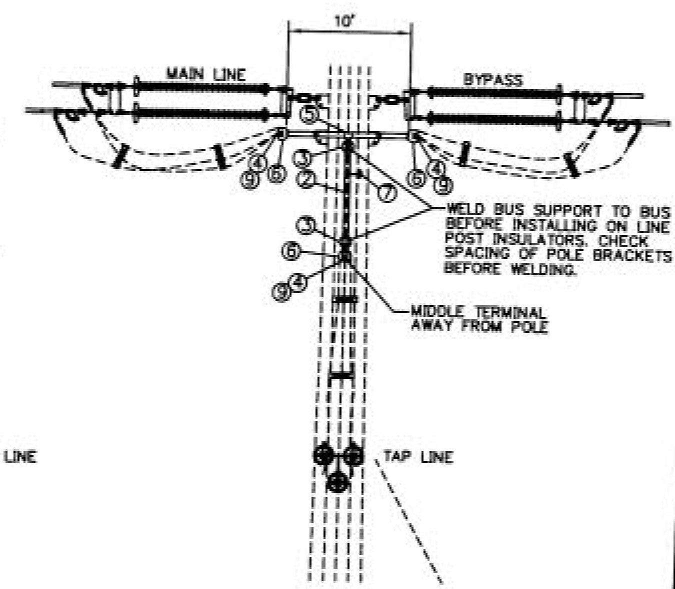
REFERENCE DRAWINGS:

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

No. TFA206A0

Entergy | 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

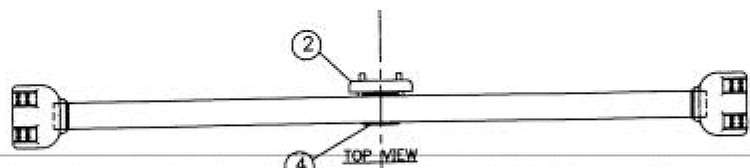
JLP-500-HL

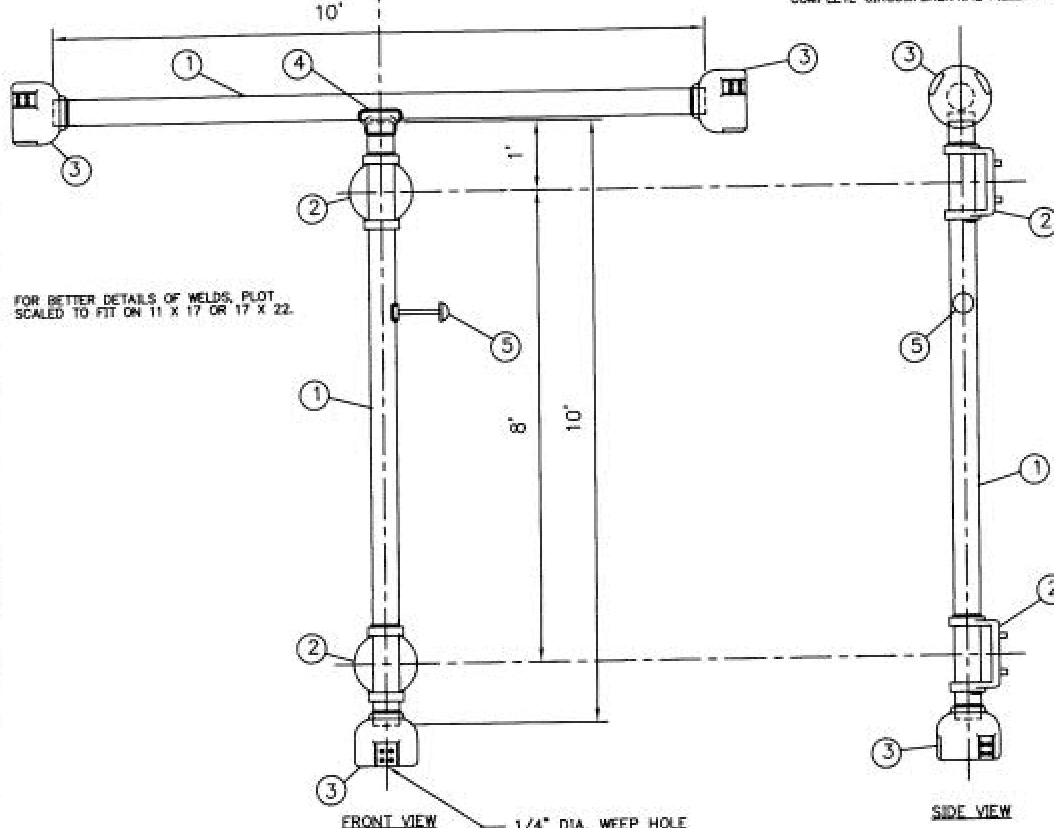
BILL OF MATERIAL

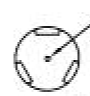
ITEM NO.	STOCK CODE	QTY	UNIT	DESCRIPTION	MFR.	PART NO.
1	0032040241	20	FT.	TUBING, COND, ALUM, 5", SCH 40, EHV, 40' LG	AFL	500S40YTBE
2	0032040322	2	EA.	SUPPORT, BUS, 5" TUBE TO 7" B.C., W/ MTG HDWR	SEFCOR	WCTI-67-7-EHV
3	00CSPERCPD	3	EA.	EHV BUS COUPLER, 5" TUBING , 3-TERMINAL, 500KV	SEFCOR	WSTC3-67-4B
4	00607-6810	1	EA.	CONNECTOR, TEE, 5" RUN/5" TAP, 90 DEGREE, EHV	SEFCOR	WFTT-6767
5	0032031610	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.







BOTTOM VIEW OF CONNECTOR

ENTERGY SERVICES, INC.

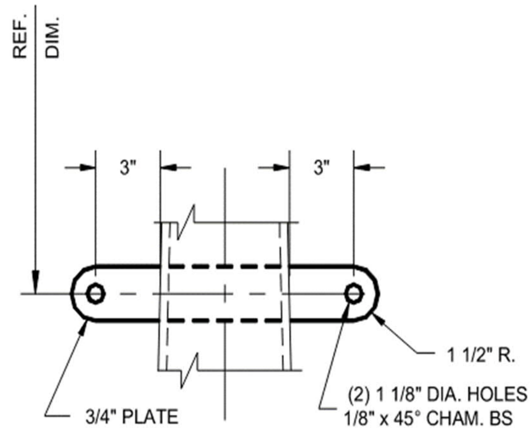
TRANSMISSION STANDARD
BUS ASSY FOR 500KV HIGH-LOW STRUCTURE
MATERIAL ITEM DRAWING

0	12-15-07	CREATED	TWF	HSK	HSK	
NO.	DATE:	REVISION	BY:	CHK:	APPR	

STD NO. SL0206 — SCALE: NONE

Entergy — No. TFM001A0 — PLOT 1=1 — SH. 1 OF 1

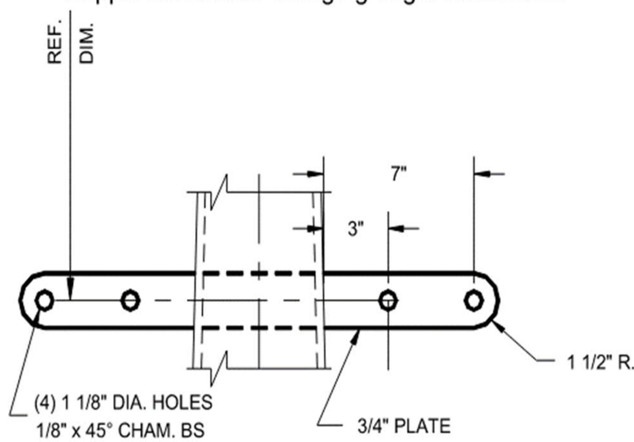
Vang Details for Steel Poles



LIGHT-DUTY 2-HOLE VANG

Primary uses:

Support shield wire span guys
Support top of braced-post insulator assemblies
Support conductor swinging angle assemblies

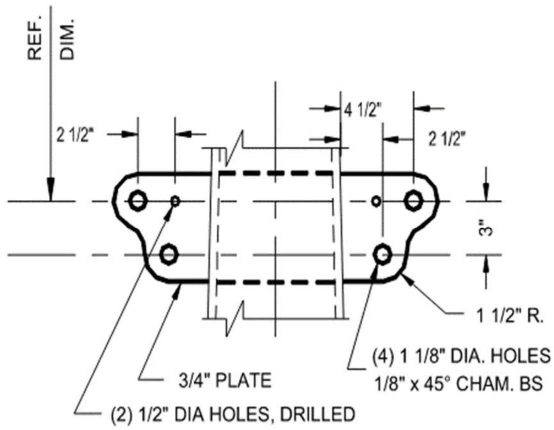


LIGHT-DUTY 4-HOLE VANG

Primary use:

Support shield wire suspension

Vang Details for Steel Poles

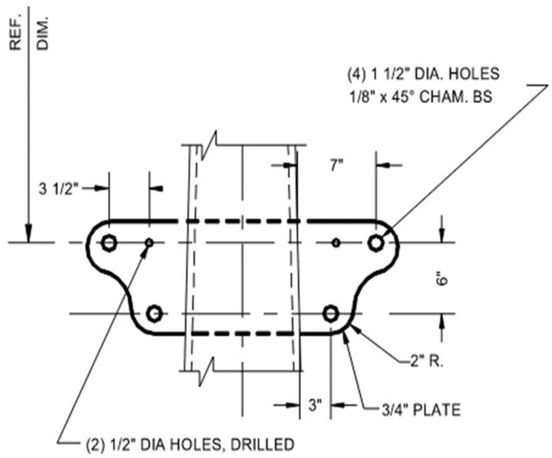


HEAVY-DUTY 4-HOLE VANG

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)

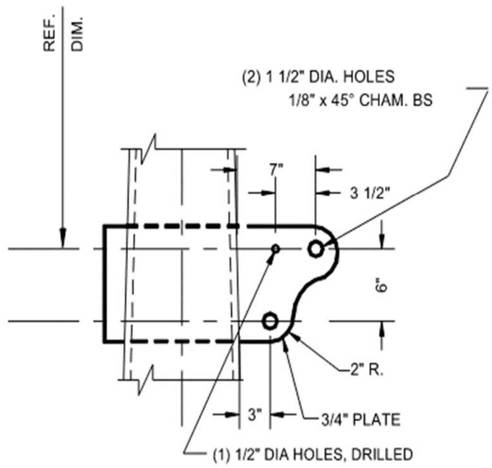
Vang Details for Steel Poles



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.

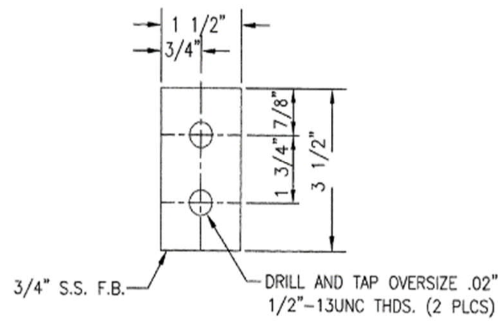


HEAVY-DUTY 2-HOLE VANG FOR TRIPLE BUNDLE SINGLE POINT DEAD ENDS

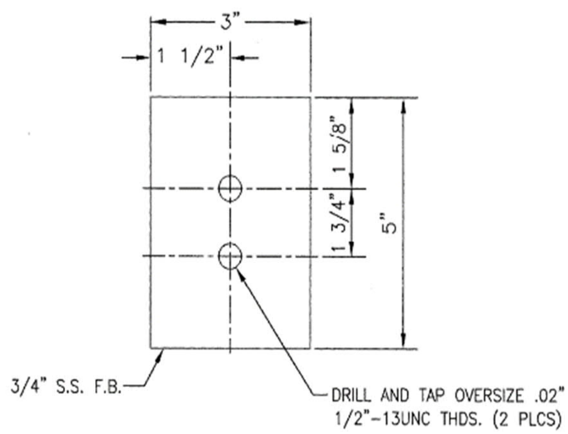
Primary use:

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



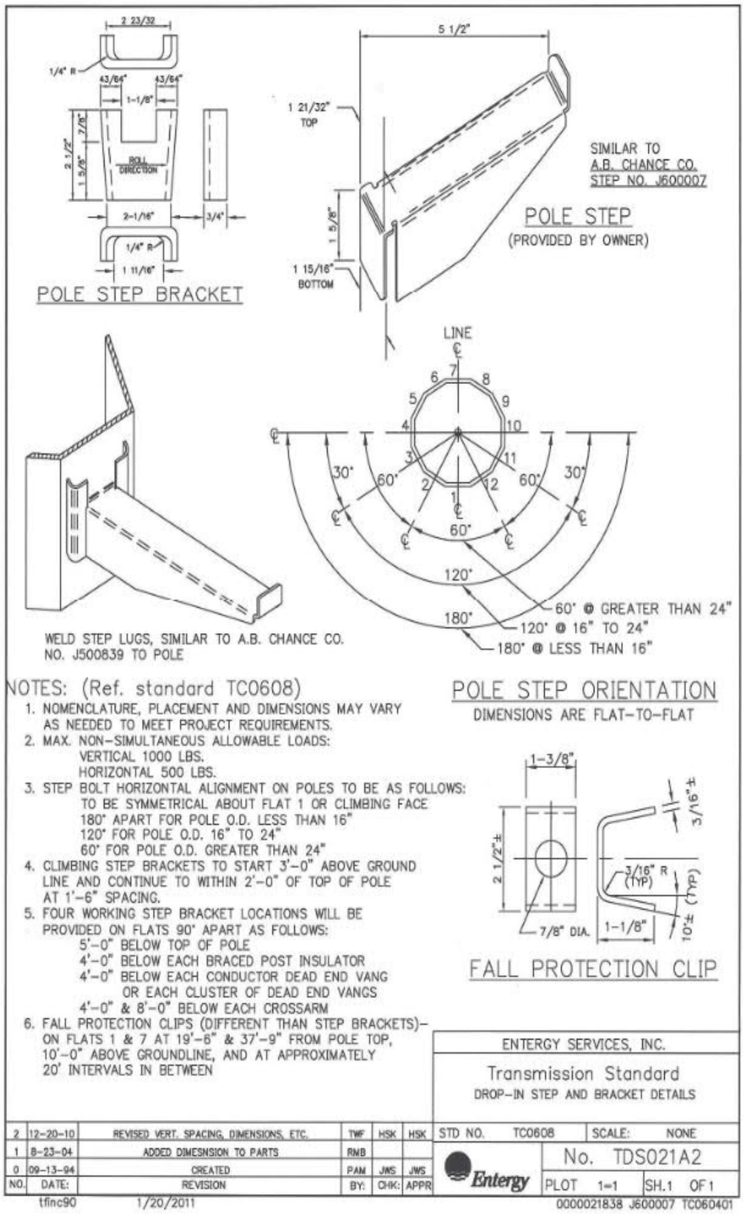
SMALL NEMA 2-HOLE PAD



LARGE NEMA 2-HOLE PAD

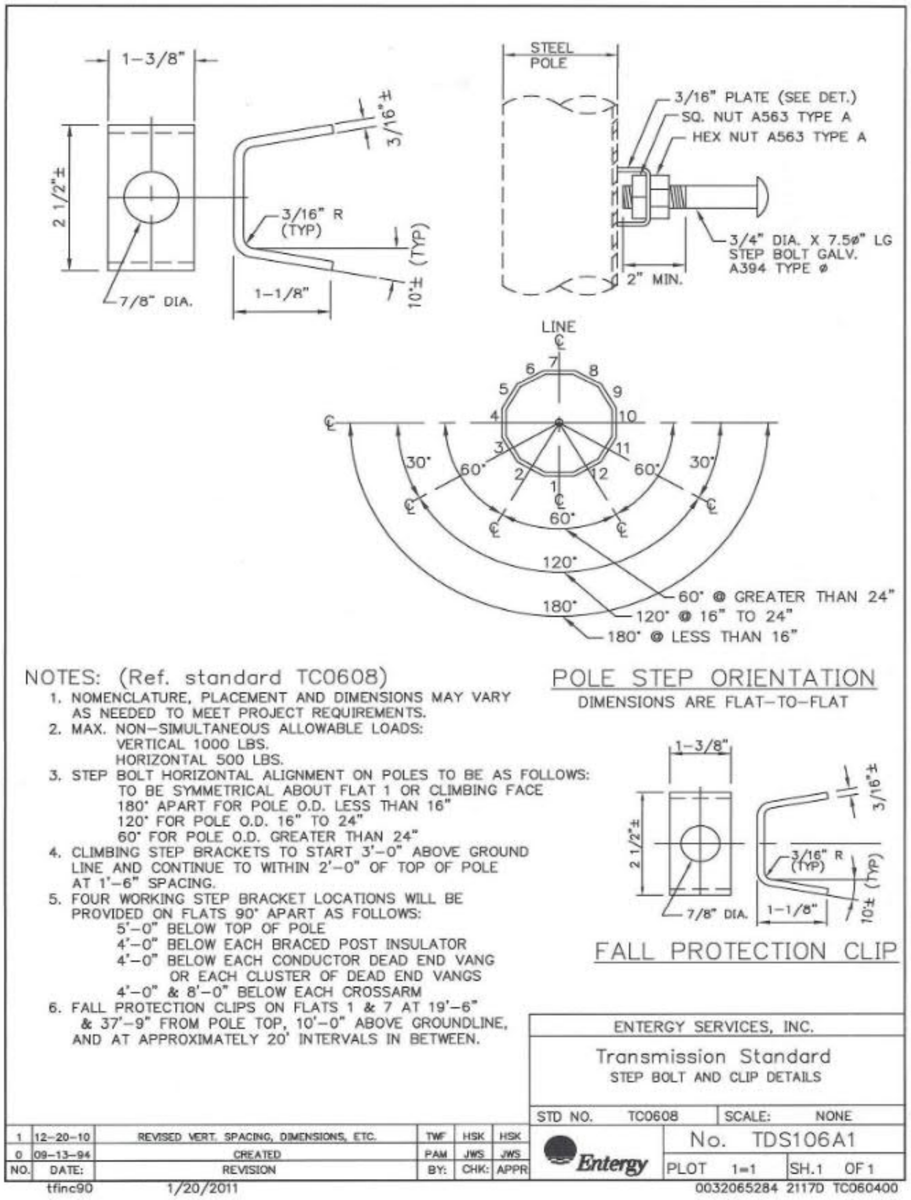
Climbing Details

TDS021A1, Step and Bracket Details, represents the Entergy specifications for drop-in steps.



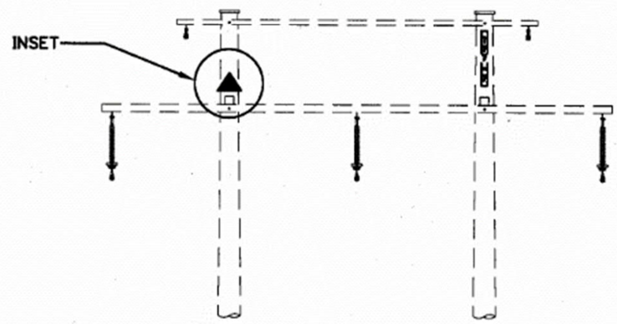
Climbing Details

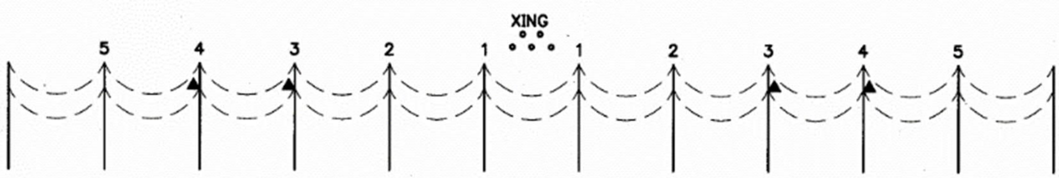
TDS106A1, Step Bolt Details, represents the Entergy specifications for pole steps.

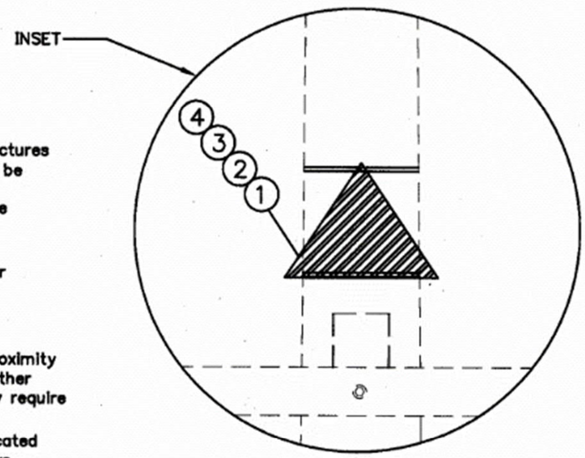


BILL OF MATERIAL

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 third & fourth 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

0	12-10-08	CREATED	TWF	HSK	HSK	
NO.	DATE:	REVISION	BY:	CHK:	APPR	

STD NO. | SCALE: NONE

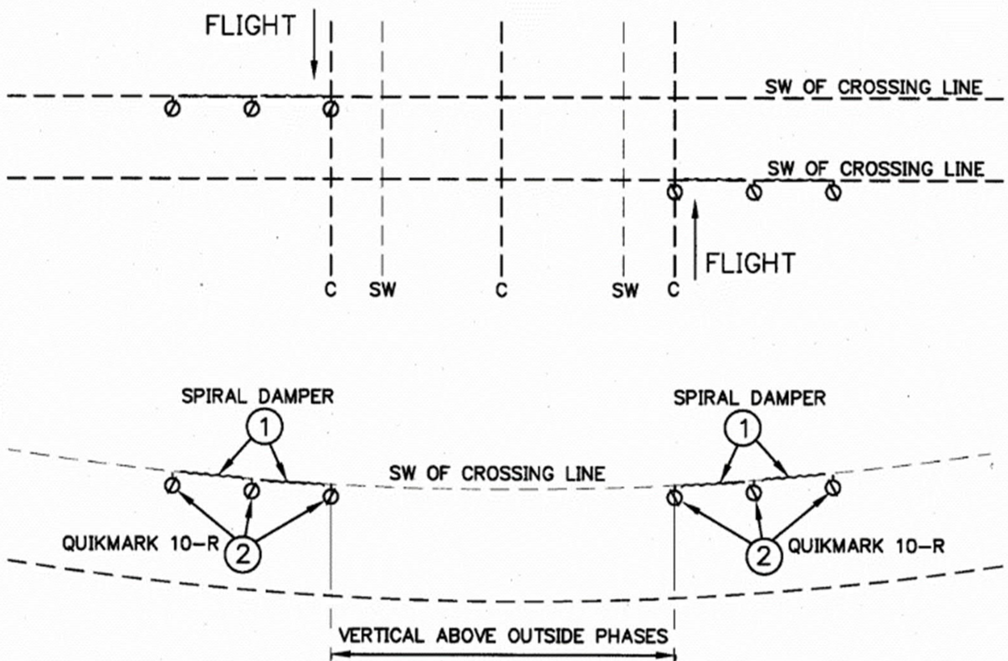
Entergy | No. TMD407A0

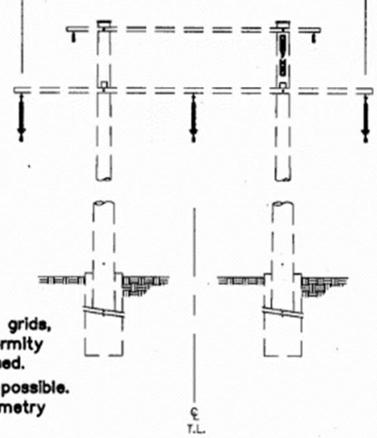
PLOT 1=1 | SH. 1 OF 1

tfinc90 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

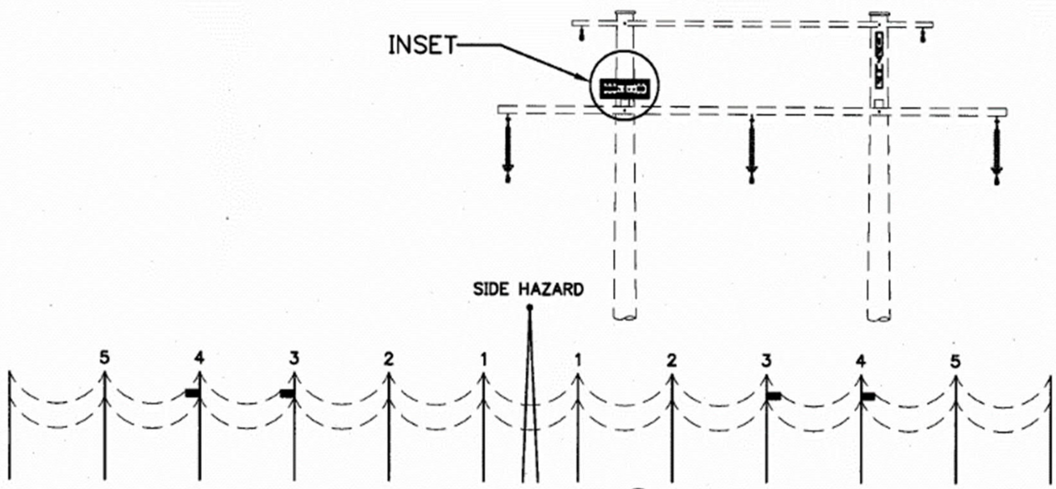
STD NO.	SCALE: NONE
Entergy	No. TMD406A0
	PLOT 1=1 SH. 1 OF 1

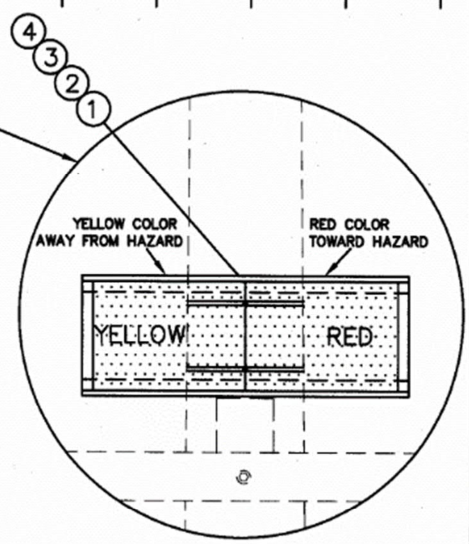
NO.	DATE:	REVISION	BY:	CHK:	APPR
0	12-10-08	CREATED	TWF	HSK	HSK

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 <u>third & fourth</u> 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

ENTERGY SERVICES, INC.

Transmission LineDesign Standard
ADJACENT HAZARD MARKING
STRUCTURAL ASSEMBLY DETAIL

0	12-10-08	CREATED	TWF	HSK	HSK
NO.	DATE:	REVISION	BY:	CHK:	APPR

STD NO. | SCALE: NONE

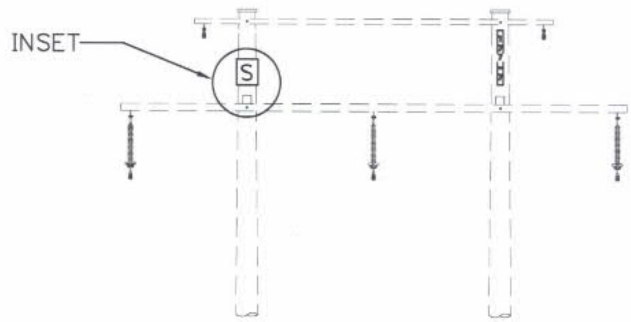
Entergy | No. TMD408A0

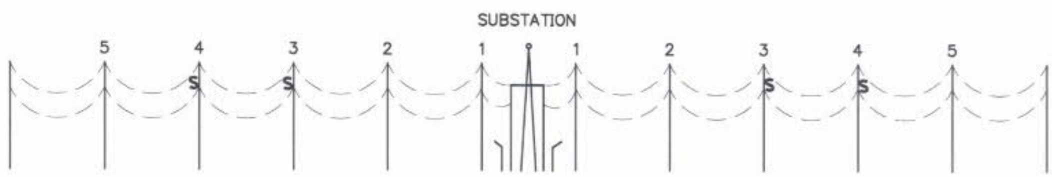
PLOT 1=1 | SH. 1 OF 1

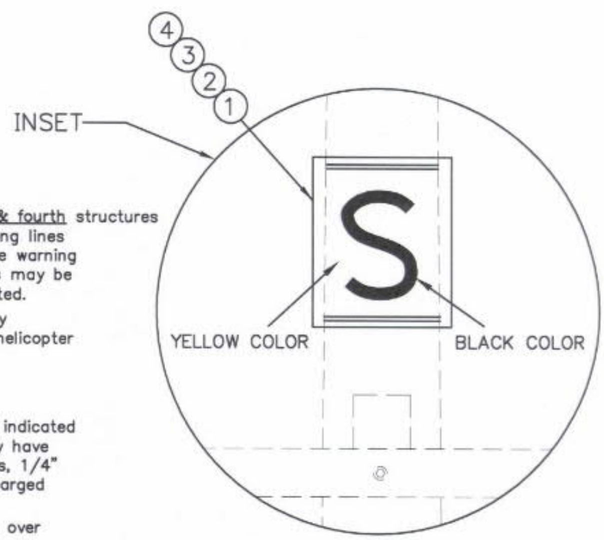
tfinc90 12/11/2008 SGN-HAZ-ADJ

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 third & fourth 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

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
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 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

Chapter 8 — Characteristics of Aerial Lines — 61

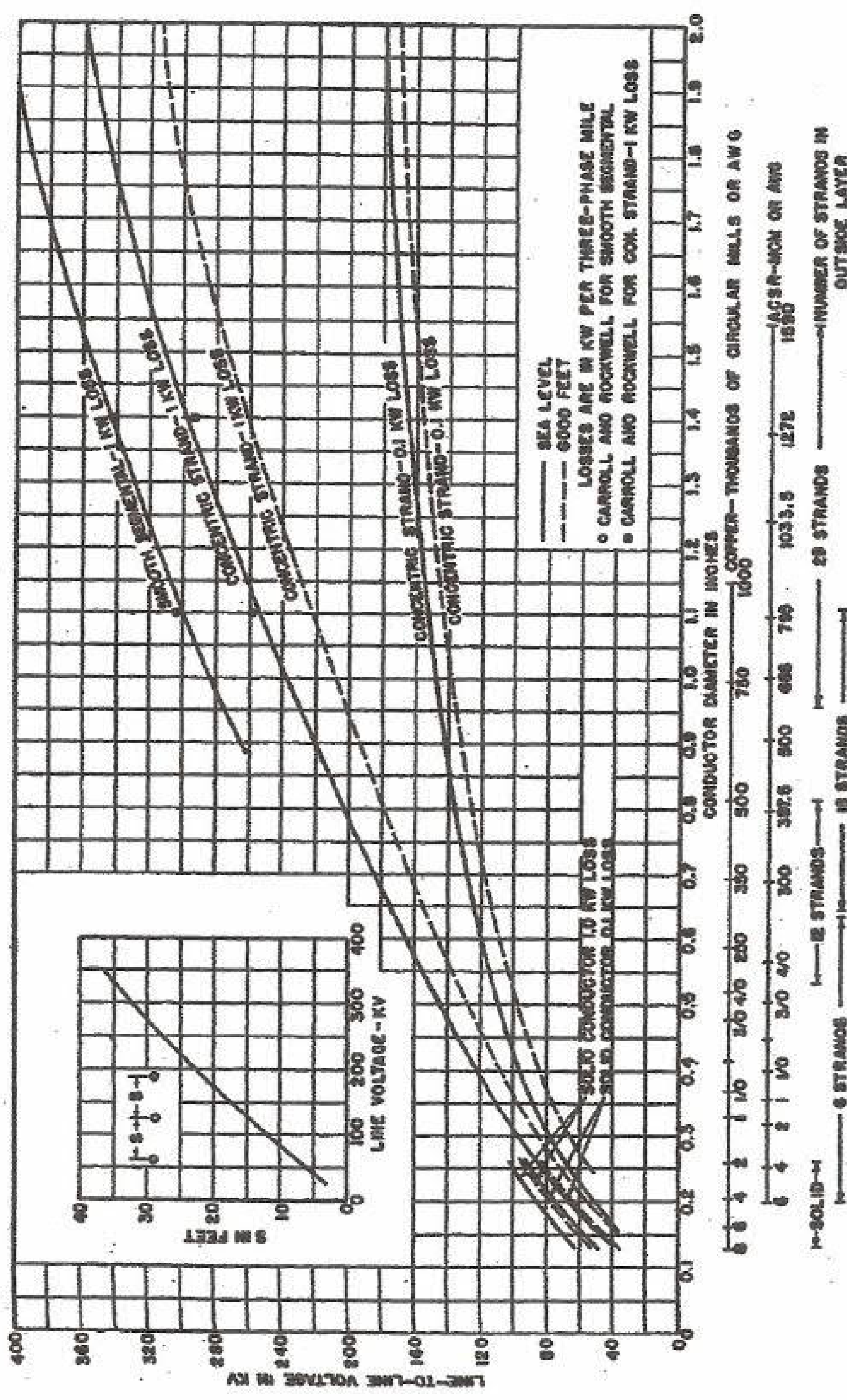
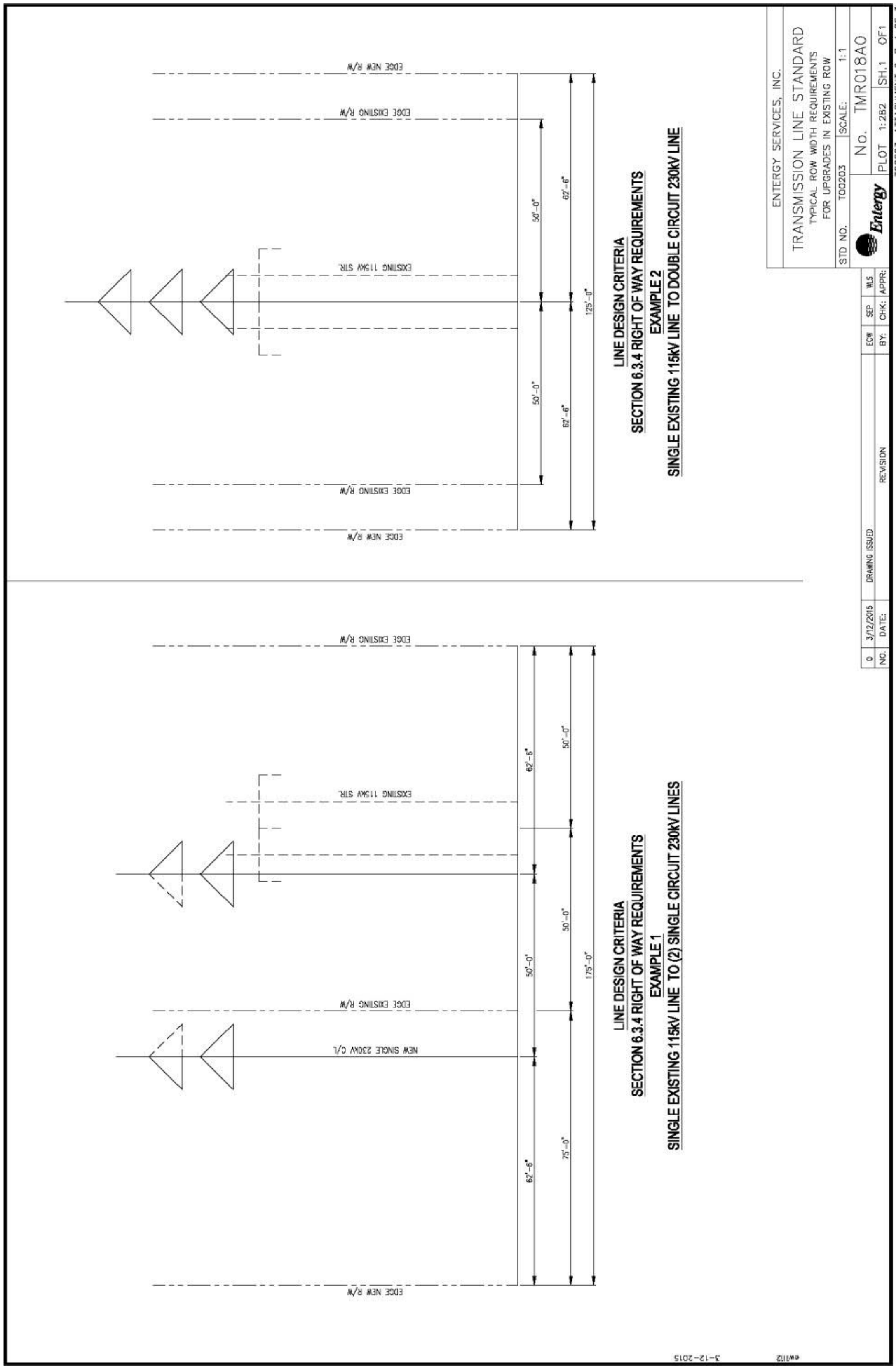
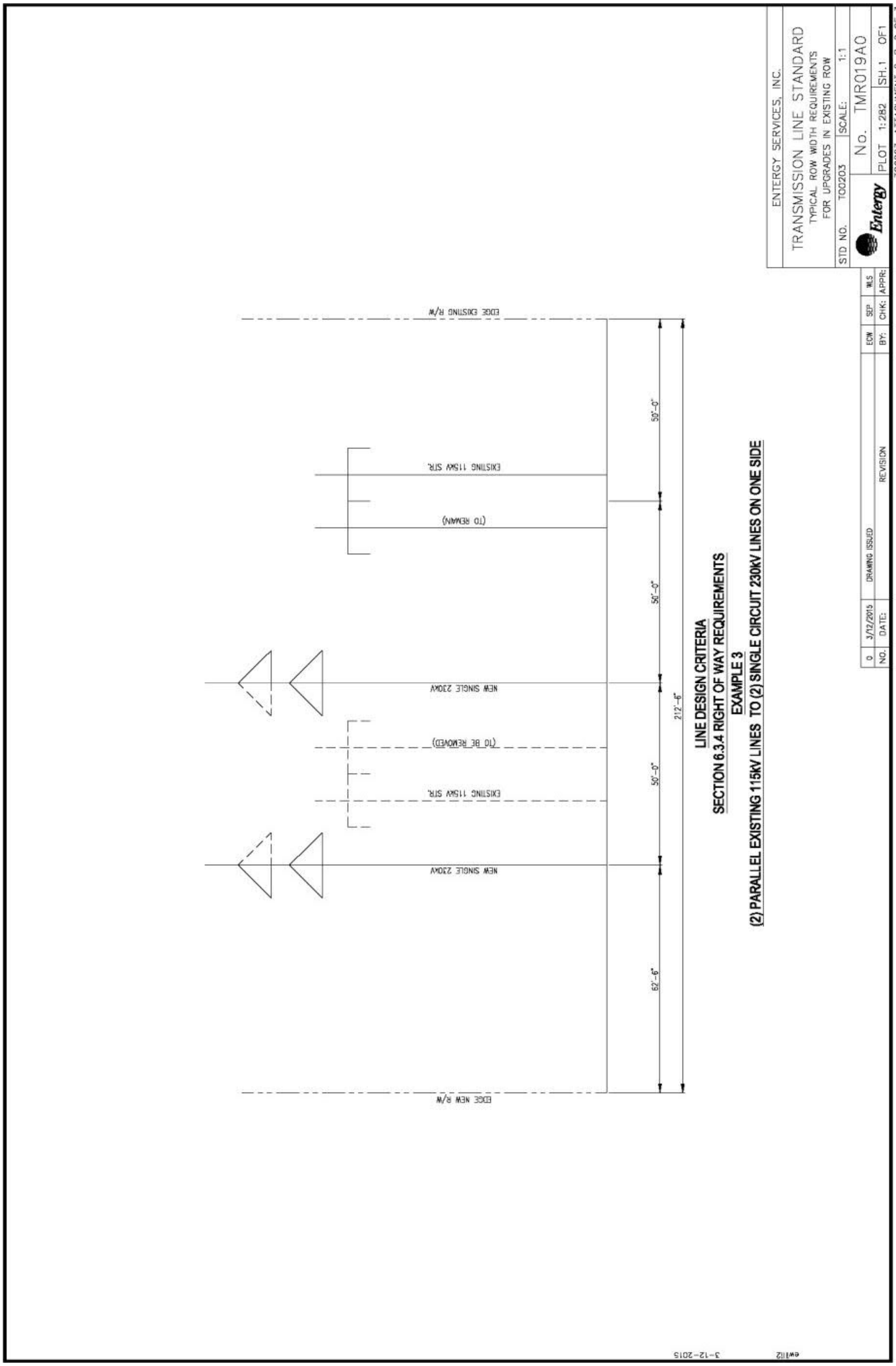


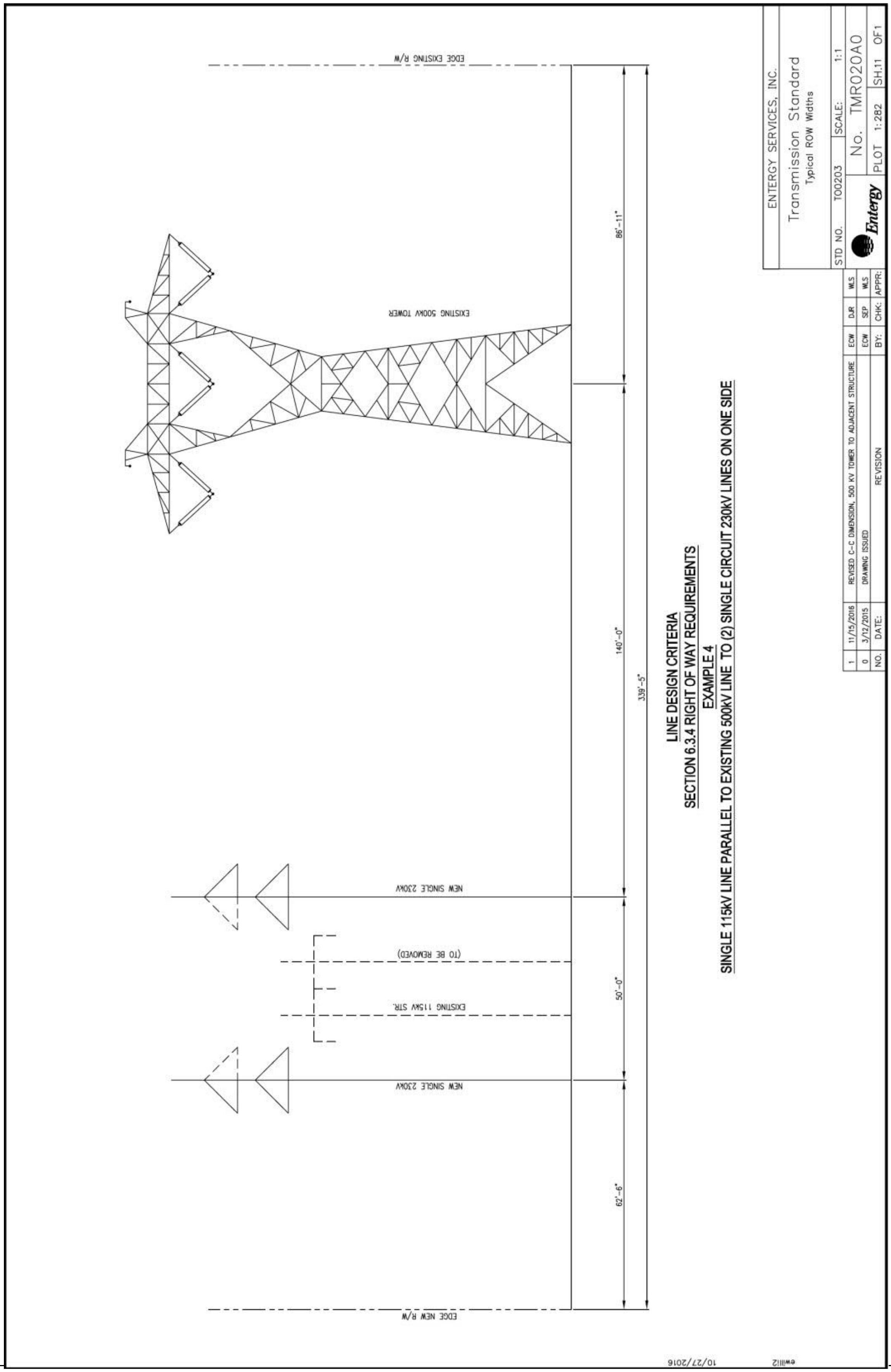
Fig. 31—Quick-Estimating Corona-Loss Curves. Curves based on Peterson's formula with a few check points from the Carrol and Rockwell paper for comparison.

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
LINE DESIGN CRITERIA
SECTION 6.3.4 RIGHT OF WAY REQUIREMENTS
EXAMPLE 1
SINGLE EXISTING 115KV LINE TO (2) SINGLE CIRCUIT 230KV LINES
EDGE NEW R/W
EDGE EXISTING R/W
EXISTING 115KV STR.
NEW SINGLE 230KV C/L
50'-0"
62'-6"
125'-0"
175'-0"
75'-0"
ENTERGY SERVICES, INC.
TRANSMISSION LINE STANDARD
TYPICAL ROW WIDTH REQUIREMENTS FOR UPGRADES IN EXISTING ROW
STD NO. TD0203
SCALE: 1:1
No. TMR018AO
PLOT 1:282
SH.1 OF1
TD0203, 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
Entergy
0 3/12/2015 DRAWING ISSUED
NO. DATE: REVISION
BY: CHK: APPR:
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
EDGE EXISTING R/W
EXISTING 115KV STR.
(TO REMAIN)
NEW SINGLE 230KV
(TO BE REMOVED)
EXISTING 115KV STR.
NEW SINGLE 230KV
EDGE NEW R/W
50'-0"
50'-0"
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
EDGE EXISTING R/W
EXISTING 500KV TOWER
NEW SINGLE 230KV
(TO BE REMOVED)
EXISTING 115KV STR.
NEW SINGLE 230KV
EDGE NEW R/W
86'-11"
140'-0"
339'-5"
50'-0"
62'-6"
ENTERGY SERVICES, INC.
Transmission Standard
Typical ROW Widths
STD NO. T00203
SCALE: 1:1
No. TMR020A0
PLOT 1:282
SH.11 OF1
Entergy
1 11/15/2016 REVISED C-C DIMENSION, 500 KV TOWER TO ADJACENT STRUCTURE ECW DJR W.S
0 3/12/2015 DRAWING ISSUED ECW SEP W.S
NO. DATE: REVISION BY: CHK: APPR:
10/27/2016

ATTACHMENT 5
APPROVED VENDOR LIST

Last update 7/2/2020

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
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		(W illiams 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	
	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	
	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
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	
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	

Last update 7/2/2020

Purchase Spec.	Class	Description	Qualifier	Approved Manufacturer(s) ( )-Preferred	Preferred Supplier	Type	Notes
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	
	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, MEPPI, Siemens, SMIT, SPX-W aukesha Electric		Substation	See chart below
SN0102	Transformer	Transformer, Small Auto	below 230kV and 100MVA	(SPX-W aukesha Electric), ABB, Howard	Aertker Co.	Substation	See chart below
SN0801	Transformer	Power Transformers	230kV and below	(SPX-W aukesha Electric), ABB	Aertker Co.		See chart below
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
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), 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 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
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

State	County	Extreme Wind mph	NESC District			Extreme Ice inches	Entergy Load Case
			Light	Medium	Heavy		
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

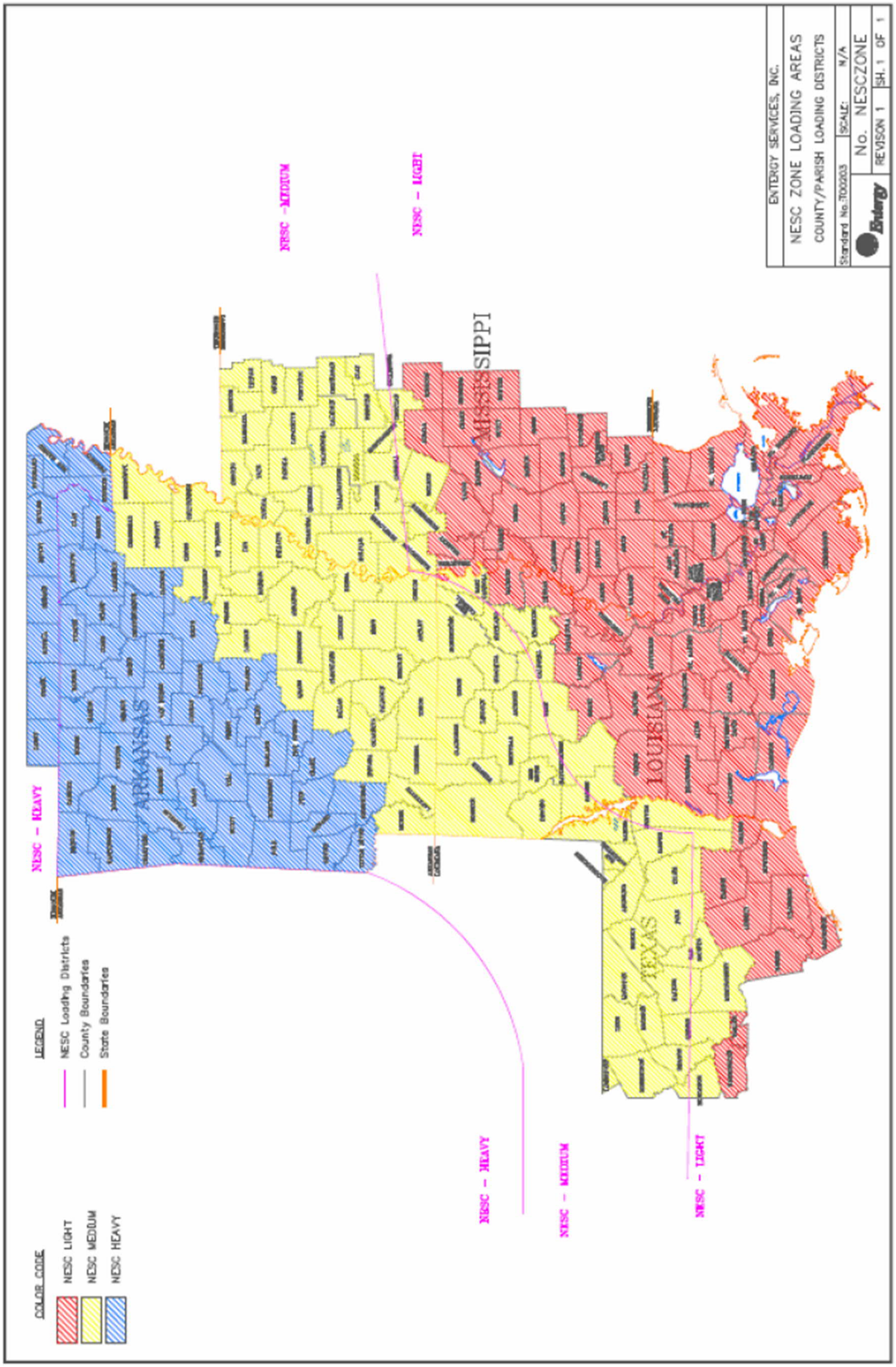
State	Parish	Extreme Wind mph	NESC District Light	NESC District Medium	NESC District Heavy	Extreme Ice inches	Entergy Load Case
LA	Acadia	140	L			0.5	LC-3
LA	Allen	110	L			0.5	LC-3F
LA	Ascension	140	L			0.5	LC-3
LA	Assumption	140	L			0.5	LC-3
LA	Avoyelles	110	L			0.5	LC-3F
LA	Beauregard	110	L			0.5	LC-3F
LA	Bienville	100		M		0.75	LC-2D
LA	Bossier	100		M		0.75	LC-2D
LA	Calcasieu	140	L			0.5	LC-3
LA	Caldwell	100		M		0.75	LC-2D
LA	Cameron	140	L			0.5	LC-3
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	140	L			0.5	LC-3
LA	East Carrol	100		M		0.75	LC-2D
LA	East Feliciana	110	L			0.5	LC-3F
LA	Evangeline	110	L			0.5	LC-3F
LA	Franklin	100		M		0.75	LC-2D
LA	Grant	100	L			0.75	LC-2C
LA	Iberia	140	L			0.5	LC-3
LA	Iberville	140	L			0.5	LC-3
LA	Jackson	100		M		0.75	LC-2D
LA	Jefferson	150	L			0.5	LC-3D
LA	Jefferson Davis	140	L			0.5	LC-3
LA	Lafayette	140	L			0.5	LC-3
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	125	L			0.5	LC-3B
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	140	L			0.5	LC-3
LA	Ouachita	100		M		0.75	LC-2D
LA	Plaquemines	150	L			0.5	LC-3D
LA	Point Coupee	110	L			0.5	LC-3F
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	140	L			0.5	LC-3

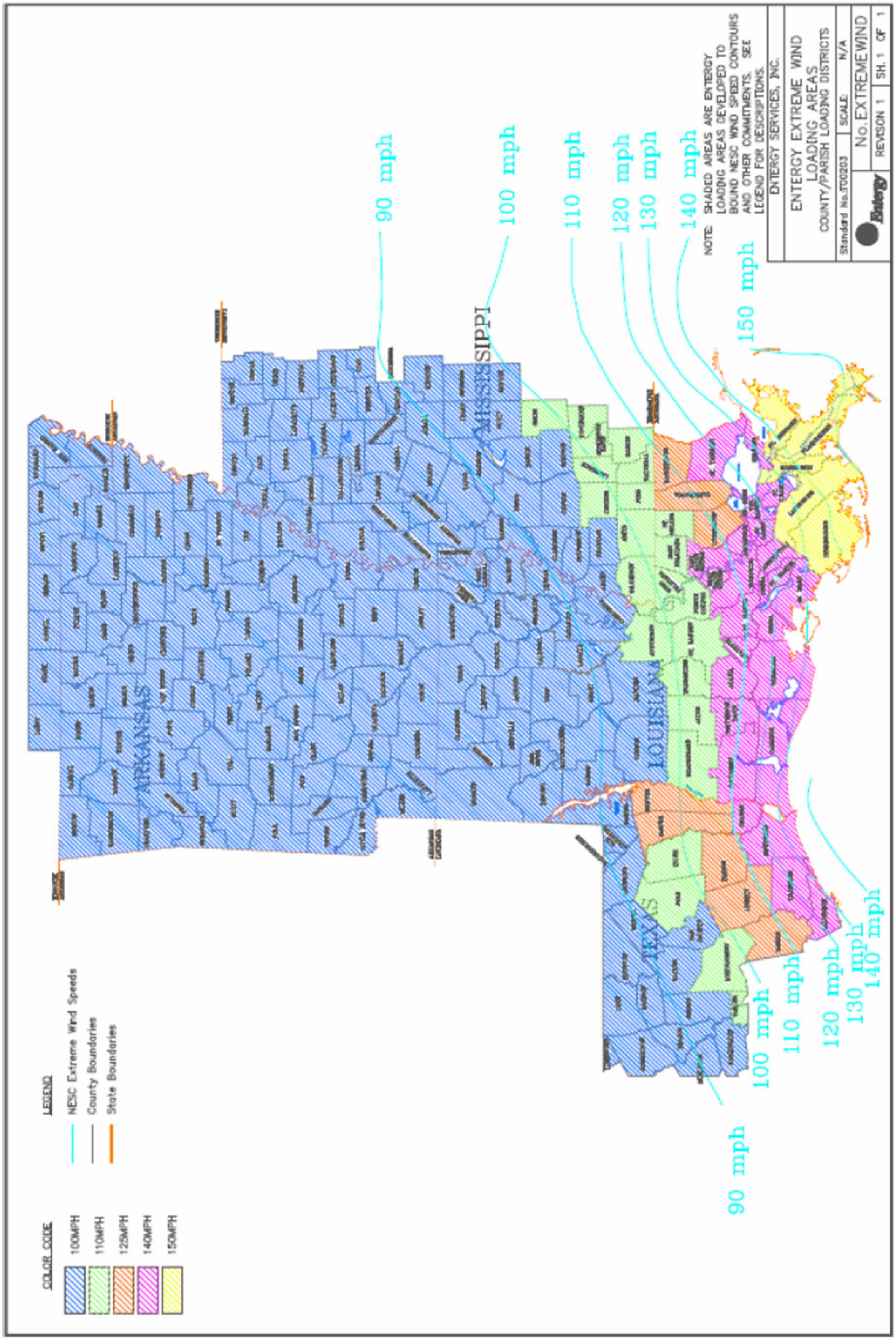
State	Parish	Extreme Wind mph	NESC District			Extreme Ice inches	Entergy Load Case
			Light	Medium	Heavy		
LA	St. Helena	110	L			0.5	LC-3F
LA	St. James	140	L			0. 5	LC-3
LA	St. John the Baptist	140	L			0.5	LC-3
LA	St. Landry	110	L			0.5	LC-3F
LA	St. Martin, North	140	L			0.5	LC-3
LA	St. Martin, South	140	L			0.5	LC-3
LA	St. Mary	140	L			0.5	LC-3
LA	St. Tammany	140	L			0.5	LC-3
LA	Tangipahoa	125	L			0.5	LC-3B
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	140	L			0.5	LC-3
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	140	L			0.5	LC-3
LA	West Carrol	100		M		0.75	LC-2D
LA	West Feliciana	110	L			0.5	LC-3F
LA	Winn	100		M		0.75	LC-2D

State	County	Extreme Wind mph	NESC District Light	NESC District Medium	NESC District Heavy	Extreme Ice inches	Entergy Load Case
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 Light	NESC District Medium	NESC District Heavy	Extreme Ice inches	Entergy Load Case
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 Light	NESC District Medium	NESC District Heavy	Extreme Ice inches	Entergy Load Case
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	140	L			0.5	LC-3
TX	Galveston	140	L			0.5	LC-3
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	140	L			0.5	LC-3
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	Nacogdoches	100		M		0.75	LC-2D
TX	Newton	125		M		0.5	LC-2C
TX	Orange	140	L			0.5	LC-3
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
LEGEND
NESC Loading Districts
County Boundaries
State Boundaries
COLOR CODE
NESC LIGHT
NESC MEDIUM
NESC HEAVY
NESC - HEAVY
NESC - MEDIUM
NESC - LIGHT
ARKANSAS
MISSISSIPPI
LOUISIANA
TEXAS



90 mph
100 mph
110 mph
120 mph
130 mph
140 mph
150 mph
ARKANSAS
MISSISSIPPI
LOUISIANA
TEXAS
NOTE: SHADED AREAS ARE ENTERGY LOADING AREAS DEVELOPED TO BOUND NESC WIND SPEED CONTOURS AND OTHER COMMITMENTS. SEE LEGEND FOR DESCRIPTIONS.
ENTERGY SERVICES, INC.
ENTERGY EXTREME WIND LOADING AREAS
COUNTY/PARISH LOADING DISTRICTS
Standard No.JT00203
SCALE: N/A
No.EXTREMEWIND
REVISON 1
SH. 1 OF 1
COLOR CODE
100MPH
110MPH
125MPH
140MPH
150MPH
LEGEND
NESC Extreme Wind Speeds
County Boundaries
State Boundaries

Attachment 6: Entergy Loading Districts

***** END OF APPENDIX 10 *****