Self-Build Requirements

Duke Energy Midwest
Transmission Interconnections

Revision 3
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Prepared By:

Transmission Engineering
Production Standards

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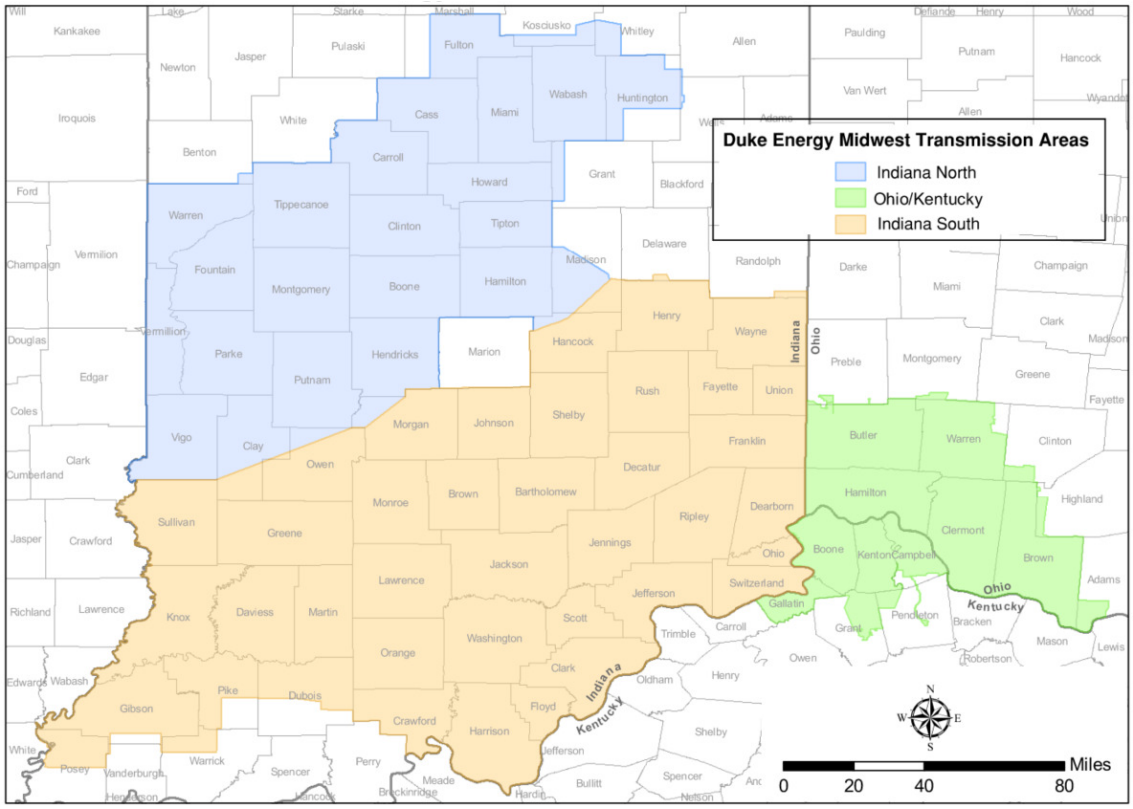
1.0 SUMMARY OF WORK

On April 19, 2018 the Federal Energy Regulatory Commission (FERC) issued its final rule of Order 845, addressing reform of generator interconnection procedures and agreements for generators of more than 20 megawatts (MW). To interconnect generation projects to the grid, developers and transmission providers must coordinate the construction and ownership of new transmission line facilities, a substation at the point where the generation will interconnect with the grid, and, if necessary, any additional upgrades to the transmission providers transmission system required to handle the increased generation capacity.

The purpose of this document is to identify and define all necessary standards, specifications, processes, and procedures required to install transmission facilities that meet Duke Energy Midwest Transmission specifications, should the developer elect to self-build these facilities, that will ultimately be owned and operated by Duke Energy (Project). The standards set forth within this document pertain to facilities that Duke Energy will own and operate in the future. These specifications are not required for facilities that will remain owned, operated, and constructed by the developer. Specifications may vary by geographical operating location, so care should be taken to ensure the developer is applying the correct area specifications. Below is an illustration of Duke Energy Midwest's transmission system:

Figure 1: Duke Energy Midwest Electric Service Territories



The information and specifications noted within this document is to be utilized for engineering, procurement, and construction of the scope of work for the individual project, which may include the following transmission facilities:

1.1 Transmission Interconnection Switching Station

The substation portion of the Project shall consist of a three-breaker ring bus configuration, two of which terminals will bifurcate an existing transmission line circuit, and the third will connect to the developer's collector substation. To support the construction of a new substation, all construction activities must satisfy the following specifications:

- All required site preparation, fencing, foundations, grounding, support structures, termination structures, cabling, bus work, station service, DC supplies, Control Enclosure, yard lightning, signage, protection, controls, SCADA and Telecommunications equipment, in accordance with state and local codes as well as Duke Energy Midwest standards and specifications.
- All bus work shall be constructed with the appropriate structural and electrical properties to accommodate the ultimate fault levels provided by Duke Energy Midwest.
- Contractor shall be required to coordinate with Duke Energy Midwest for device number assignments as required. This will be further addressed during project kick-off meeting.
- Clearing and grading will be required to facilitate construction of the proposed substation.
- The following permits have been identified as required for expansion, but not limited to:
    - General Permit
    - Driveway Access Permit
    - Local building permits
    - Construction SWPPP
    - County Zoning
    - Flood zone use or wetlands modification (as required)

Refer to Section 1 Appendices of this document for conceptual drawings for each station voltage rating.

1.2 Transmission Loop-in/out

All interconnection scopes will also require buildout of new transmission line facilities. An existing transmission line circuit will be split into two new segments and loop in and out of the new substation. Duke Energy Midwest will be responsible for making final connections; Contractor may be responsible for

new construction, excluding the final span to connect to existing infrastructure. Contact Duke Energy Midwest for reference information as it pertains to existing system information.

To support the construction of a new transmission line loop, all engineering, procurement, and construction activities will be required per the following specifications:

- All design, procurement, construction, and commissioning required for the project based on the scope of work, including required drawings, permits, project book(s), and information for submission to Duke Energy Midwest Transmission as noted in Section 3.3.
- All required site preparation, temporary construction permits, regulatory and local permits, fencing, sediment and erosion control, foundations, structures, grounding, structures, for the project in accordance with the standards and specifications noted in Section 4.0.
- For an overview of the project on a map, please contact Duke Energy for KMZ files and MyWorld screen captures.
- Plan and profile drawings are considered record documents within the Duke Energy document management system. Existing or provided PLS CADD files are viewed as conceptual design support information to be vetted by Contractor for use in Contractor's design.

1.3 General Project Requirements and Deliverables

The Contractor will be responsible for the entire project development including the design, required studies, procurement, construction, and commissioning of all the civil, structural, electrical, protection, control, isolation and grounding systems; required drawings and information for submission to Duke Energy Midwest Transmission; as well as final construction project documentation and "as built drawings" associated with all components of the Project. Specific requirements of each discipline (Substation, P&C, Transmission Line) are noted throughout Section 3.

1.3.1 Site Selection

Avoid floodway sites where feasible. If this is not practical, the site shall be filled to the minimum site elevation as specified below. Also, avoid sites in erosion-prone, mudslide-prone, subsidence-prone, and ice jam and debris areas, including areas subject to extreme storm surge flooding.

Selection of minimum site elevation shall be the highest of the following:

- 100-year base flood elevation (BFE) + either 2 feet (freeboard) if not considered as critical facility by the community or 3 feet (freeboard) if determined to be a critical facility by the community
- Design flood elevation (DFE) adopted by the community
- 500-year flood elevation + 1 foot (freeboard)

1.3.2 Submittals

The following are the minimum required submittals to be provided by Contractor for review and approval by Duke Energy Midwest Transmission:

A. Calculations, studies, reports, and analyses
B. Engineering Design Drawings
C. Material, shop/manufacture drawings and equipment cut sheets
D. Construction submittals
E. Submittals shall include native files and PDF copies

1.3.3 General Requirements

A. All deliverables shall be prepared in accordance with Duke Energy Midwest Transmission and industry standards. Developer must request a copy of all pertinent standards and specifications prior to each project as standards may change from time to time.
B. Acceptable electronic formats will be Microsoft Word, Microsoft Excel, Microsoft Power Point, Primavera, Adobe PDF, MathCAD, LPile, RAM Elements, WinIGS, Inventor, Civil3D, and AutoCAD. AutoCAD drawings shall be prepared in accordance with Duke Energy Design and Drawing standards.
C. All designs, drawings and documents produced for this project are to be considered confidential and the property of Duke Energy Midwest Transmission and shall be provided in electronic format. Any other use is strictly prohibited without written permission from Duke Energy Midwest Transmission.
D. All design drawings produced for the Project and submitted as “Issued for Bid”, “Issued for Permitting”, or “Issued for Construction” and as part of the licensing submittal package shall be signed and sealed by a professional engineer licensed in the appropriate state.
E. Material entry is to occur within Duke Energy asset management system. A meeting is to be set by Duke Energy Midwest Transmission to review methodology for entering material into these systems to trigger Duke Energy Midwest Transmission’s maintenance tracking but bypass their procurement. Duke Energy Midwest Transmission has provided forms for

Contractor to enter pertinent project (i.e. material, drawings, item setup etc.) information. Refer to Appendix 1-E "Asset Management Forms".

1.3.4 Engineering Milestones and Design Review Meetings

The following deliverables shall be provided to Duke Energy Midwest Transmission during the design process and shall be provided for each facility identified in Section 1.0, Overview and Description of Project. All deliverables shall be submitted for review, comments and **APPROVAL**. Work on any task that depends on a submittal that is pending review by Duke Energy Midwest Transmission shall not be performed until Duke Energy Midwest Transmission comments are returned. Time for reviewing the drawings shall be included in the work schedule (Contractor shall assume a minimum of 4-week review period by Duke Energy Midwest Transmission for each compliance submittal prior to any scheduled design review meeting). The Contractor shall provide Duke Energy Midwest Transmission with five (5) sets of hardcopies, as well as electronic versions, for each design deliverable in accordance with the project schedule. Design documents and drawings shall be submitted in both PDF and native formats (to verify adherence to Duke Energy Midwest Transmission drafting or design standards). In addition, the Contractor shall follow the guidelines as described on the Duke Energy Midwest Transmittal Letter when submitting Preliminary and Final design packages.

The Contractor will be required to participate, at a minimum, in the following review meetings to discuss Project deliverables (project manager and designated leads). In addition, discipline-specific bi-weekly meetings will be held during the design phase as the design develops. It shall be assumed for the following meetings to take place at a mutually agreed upon location:

- Project Kick-off/Scope Review Meeting
- LiDAR and Boundary Surveys (including Topographic survey)
- Preliminary Design Review Meeting
- Geotechnical Investigations
- Intermediate Design Review Meeting
- Final Design Review Meeting
- Pre-Construction & Post-Construction Walkdowns
- Permit Acquisition/Package Review Meeting

2.0 TRANSMISSION PLANNING REQUIREMENTS

This section of the document defines the facility connection requirements as defined by Duke Energy Midwest Transmission Planning. As the transmission assets will be transferred to Duke Energy Midwest Transmission and operated and maintained by Duke Energy Midwest Transmission in the future, all equipment must meet the design criteria put forth by Duke Energy Midwest Transmission Planning.

2.1 Facility Ratings Requirements

The information below describes the operating requirements of the transmission interconnection facilities:

2.1.1 Operating Voltage and Basic Impulse Level (BIL) Voltage

Nominal Voltage Classification (RMS)	**69kV**	**138kV**	**230kV**	**345kV**
Maximum Continuous Voltage	72.5kV	145kV	245kV	362kV
Basic Impulse Level f/Station Post Insulators and Airbreak Switches	350kV BIL	550kV BIL	900kV BIL	1300kV BIL
Basic Impulse Level f/Circuit Breakers	350kV BIL	650kV BIL	900kV BIL	1300kV BIL
Basic Impulse Level f/CTs	350kV BIL	650kV BIL	1050kV BIL	1300kV BIL
Basic Impulse Level f/CCVTs	350kV BIL	650kV BIL	1050kV BIL	1550kV BIL

2.1.2 Minimum Component Ratings in the Substation

Category/Component	**69kV**	**138kV**	**230kV**	**345kV**
Main Bus	2000A	2000A	2000A	3000A
Transmission Terminal (motor-operated isolating switches, jumpers, connectors)	2000A	2000A	2000A	3000A
Circuit Breakers (Operating)	2000A	3000A	3000A	3000A
Circuit Breakers (Interrupting)	40kA	40kA	40kA	50kA

2.1.3 Short Circuit Levels Before Construction

Contact Duke Energy Midwest Transmission to obtain this information prior to start of design:

Base Voltage (kV)	**Pre-Fault Voltage (p.u.)**	**3-Ø Fault (A)**	**Positive Sequence Impedance**	**1- Ø Fault (A)**	**Zero Sequence Impedance**	**3Ø X/R**	**1Ø X/R**
kV	1		__ @ __° Ω		__@ __° Ω		

2.2 Interconnection Metering Requirements

All metering, remote terminal unit (RTU), and communication requirements are provided in Appendix 2-A: Duke Energy Midwest Engineering Guide – Interconnection Metering.

3.0 ENGINEERING DESIGN REQUIREMENTS

This section of the document defines the facility design requirements as defined by Duke Energy Transmission Engineering. As the Project transmission assets will be transferred to Duke Energy Midwest Transmission and operated and maintained by Duke Energy Midwest Transmission in the future, all designs must comply with Duke Energy Midwest Transmission system standards.

3.1 Substation Engineering Requirements

Design for a switching station implementing a ring-bus configuration with equipment layout composed of rigid tubular conductors supported on post insulators. The design will be based upon the applicable industry and Duke Energy Midwest Transmission standards below. Refer to *IEEE 1127 IEEE Guide for the Design, Construction, and Operation of Electric Power Substations for Community Acceptance and Environmental Compatibility* for a more detailed look into this section.

This portion of the document addresses all requirements of the substation physical design elements of the interconnection. All designs must be approved by Duke Energy Substation Engineering prior to construction.

3.1.1 Applicable Industry Standards

Use the most current industry standards and codes applicable to the Project. The standards applicable to this Project include but are not limited to:

- National Electrical Safety Code (NESC) C2-2017
- IEEE Std. 525 Guide for the Design and Installation of Cable Systems in Substations
- IEEE Std. 605 Guide for Bus Design in Air Insulated Substations
- IEEE Std. 980 Guide for Containment and Control of Oil Spills in Substations
- IEEE Std. 998 Guide for Direct Lightning Stroke Shielding of Substations
- IEEE Std. 1402 Guide for Electric Power Substation Physical and Electronic Security
- IEEE Std. 1427 Guide for Recommended Electrical Clearances and Insulation Levels in Air-Insulated Electrical Power Substations
- ASCE Manuals and Reports on Engineering Practice No. 113 - Substation Structure Design Guide
- ANSI/IEEE Std. C37.30 - American National Standard Definitions and Requirements for High-Voltage Air Switches, Insulators, And Bus Supports
- C62.82.1 - IEEE Standard for Insulation Coordination – Definitions, Principles and Rules
- IEEE 1313.2 - IEEE Guide for the Application of Insulation Coordination

- IEEE Std. 80 - Guide for Safety in AC Substation Grounding
- IEEE Std. 81 – Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System
- IEEE Std. 367 - Recommended Practice for Determining the Electric Power Station Ground Potential Rise and Induced Voltage from a Power Fault
- IEEE Std. 837 - Guide for Qualifying Permanent Connections in Substation Grounding
- ASTM B241 Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube
- ANSI C93.1 Requirements for Power-Line Carrier Coupling Capacitors and Coupling Capacitor Voltage Transformers (CCVT)
- ANSI C93.3 Requirements for Power-Line Carrier Line Traps
- IEEE C93.4 IEEE Standard for Power-Line Carrier Line-Tuning Equipment (30 kHz to 500 kHz) Associated with Power Transmission Lines
- ANSI C93.5 Requirements for Single Function Power-Line Carrier Xmit/Rcv Equipment

3.1.2 Duke Energy Substation Standards, Guides, and Equipment

Substation engineering design shall be in accordance with the following list of referenced standards. Any deviations from Duke Energy Midwest Transmission standards, or use of subsequently released standards, require written authorization by Duke Energy Midwest Transmission. In the event of a discrepancy in any of the referenced standards, the Contractor shall contact Duke Energy Midwest Transmission for clarification. The results shall be documented accordingly. All files are included as appendices to this document.

Appendix	Document	Date	Rev	STD or DOC No.
3-1A	DEM Substation Signage Catalog	3/15/2017	-	-
3-1B	Transmission Engineering AutoCAD Standards for Substation and P&C	2/2019	0	STDP-STD-TRM-00178
3-1C	Greenfield Secondary Oil Containment	3/2018	0	STDP-STD-TRM-00169
3-1D	Storm Water Drain Labeling	12/2016	0	TSS-SUB-SRM-EW-0045
3-1E	Substation Site Elevation Selection Guide	11/2017	0	TSS-SUB-SRM-EW-0048
3-1F	Signage Quantities and Placement	9/21/2018	0.1	
3-1G	Steel Lattice Substation Structures	Apr 2015	001	33 72 00L
3-1H	Transmission Spill Prevention, Control and Countermeasure (SPCC) Plan Process	09/2017	001	TECP-MNT-TRM-00024
3-1J	SPS: Substation Ground Grid System	04/2017	002	STDP-STD-TRM-00098
3-1K	SPS: Substation Grounding Connectors	12/2015	000	STDP-STD-TRM-00095

3-1L	Substation Equipment/Structure Grounding	04/2017	001	STDP-STD-TRM-00097
3-1M	Substation Ground Grid Testing Spec	1/31/2020	002	

3.1.3 Site-Specific Studies

The studies identified in the table below will help to ensure the substation is safe, reliable, and will meet its intended service life:

Study	Purpose
Site Survey	Develop a Site Plan and Stormwater Management Plan
Geotechnical Investigation	Determine size and depth of foundations
Audible Noise Study	Determine if noise screening measures will be needed
AC Load Study	Size station service transformer needs based on major equipment and control house AC needs
Soil Resistivity	Use in a grounding study to create a grounding grid
Lightning Study	Determine the number of lightning masts and overhead shield wires

3.1.4 Site Grading

Site grading design will differ at various sites based on the region's topology and results from the site survey. A Stormwater Management Plan will be developed per state requirements for each site. This plan will specify detention pond requirements (if needed) for stormwater runoff.

3.1.5 Foundations

The foundation layout will follow a standardized station layout. Detailed engineering for foundations will be site specific based on the geotechnical investigation. Depending on a site's size and grade, foundations may be required to be at different top-of-concrete elevations, to maintain continuity of the bus and structure heights.

3.1.6 Fences and Screening

NESC regulations and guidelines stipulate that all power substations be protected by a chain-link fence with warning signs. If the site is located near a public area, then please contact Duke Energy Midwest Transmission to discuss options. The permitting process will trigger any additional requirements, as dictated by the local municipality. All local municipal requirements must be met and incorporated into the design. The fence shall be located away from energized equipment and conductors in accordance with NESC requirements (refer to Appendix 5-F for permanent fencing and Appendix 5-G for temporary fencing).

3.1.7 Access Roads

The substation standard design will allow for vehicular access around the interior perimeter of the substation fence. To facilitate maintenance, additional access drives will be built to allow vehicle access to each structure. Access roads will connect to existing roadways.

3.1.8 Grounding Design

The Grounding Design section covers the design aspects as well as materials, parameters, and considerations. Without a properly designed grounding system, large potential differences can exist between different points within the substation itself. Under normal circumstances, it is the current flow through the grounding grid from line-to-ground faults that constitutes the main threat to personnel. An effective substation grounding system consists of the following components:

- driven ground rods,
- buried interconnecting grounding cables or grid,
- equipment ground mats,
- cables from the buried grounding grid to metallic parts of structures and equipment,
- connections to grounded system neutrals, and
- the ground surface insulating cover material.

Soil resistivity is site specific and will be measured before commencing grounding design. Resistivity values shall be obtained in accordance with IEEE 81. The grounding grid design will be based heavily upon the site's soil resistivity tests and short circuit currents. WinIGS Integrated Grounding System Analysis & Design software shall be used to model soil layers, step potential, and touch potential for ground grid design. Refer to appendices 3-1J, 3-1K and 3-1L for specific information related to ground grid analysis and design, including soil resistivity minimum specification requirements.

Soil testing shall be conducted a minimum of three days since the last rainfall at the site. All adjacent property owners shall be notified testing will take place. "Traverse lines" shall be defined as two perpendicular lines as it pertains to Appendix 3-1M.

3.1.9 Lightning Protection

The designer shall verify adequate shielding with the actual station layout. The lighting protection system will be designed using the "Rolling Sphere Method" as established in IEEE 998. Protection is provided with a combination of shield masts and high transmission line shield wires.

3.1.10 Substation Cable Trench

In ground cable trench shall be Trenwa Inc. or Concast one-piece multi-duty sized for the immediate cable requirements with 100% additional capacity for future cables. Trench lids shall be fiberglass lightweight composite material; lifting tools shall be provided and kept at the station. Road crossings shall be provided where necessary and rated for H20 Heavy Traffic (32,000#/axle). Road crossing lids shall also be fiberglass lightweight composite material, but suitable for traffic.

3.1.11 Substation Outdoor Cabinets and Boxes

Outdoor cabinets and boxes shall be aluminum or stainless steel NEMA 3R or 4X. Painted steel cabinets and boxes are not allowed. Outdoor safety switches shall have stainless steel enclosures. Outdoor AC power cabinets shall be standard indoor panels mounted inside separate aluminum or stainless-steel cabinets.

3.1.12 Substation Preliminary Design Deliverables

The following section details all requirements of a preliminary substation design, to be submitted to Duke Energy Midwest Transmission when engineering design is approximately 30 percent complete:

- Listing of all Major Materials
- Conceptual Single Line and Three Line Diagrams (three-line to be physically arranged)
- Drawing List
- Geotechnical Testing Requirements and Soil Boring Locations
- Standard and Non-Standard Structures Identified
- Scope Document Revisions
- Equipment Removal Plan (as required)
- Substation Plan View with Section Cut Callouts
- Misc. Section Cuts (if concerns with clearances or tight spaces exist)
- Trench Plan Sketch
- Switch Order Package
- Polysided Tubular Steel Design Drawing
- Foundation Plan
- Structure Setting Plan
- Site Development Plan
- Stormwater Drainage Requirements

- Flood Mapping
- Equipment Rating Notification Form
- Permitting Requirements
- Conceptual Construction Sequence Drawings (as required)
- Conceptual Commissioning Plan

3.1.13 Substation Intermediate Design Deliverables

The Contractor shall provide Intermediate Design Submittal Packages that will include all drawings and submittals listed in the preliminary design submittal, which have incorporated all Duke Energy Midwest Transmission preliminary design review comments, and advanced in design to approximately 60 percent complete. Contractor shall also include the following additional submittals for intermediate review:

- Conduit and Raceway
- Circuit Schedule (Coordinate with P&C)
- Foundation Plan and Details with Calculations
- Oil Containment Plan with Calculations
- Steel Details / Loading Diagrams with Calculations
- Bus Design Calculations
- Material List
- Shop/Manufacture Drawings
- Control Enclosure Construction Drawings
- Soil Resistivity Data
- WinIGS Ground Grid Design with Calculations
- Grounding Plan
- Lightning Protection Plan with Calculations
- Landscaping Plan
- Drainage Plan
- Site Development Calculations
- Irrigation Plan
- Lighting Plan (designed to minimum 2 foot-candles across yard surface)
- Permit Package
- Drawing Index

3.1.14 Substation Final Design Deliverables

The Contractor shall provide Final Design Submittal Packages and shall include all drawings and submittals listed in the preliminary and intermediate design submittal, which have incorporated all Duke Energy Midwest Transmission preliminary and intermediate design review comments, and advanced in design to 100 percent complete. Contractor shall also include the following additional submittals for final review:

- Site Development Plan & Details
- Stormwater Drainage Requirements
- Permitting Package
- Flood Mapping Plan & Details
- Drainage Plan & Details
- Irrigation Plan & Details
- Landscaping Plan & Details
- Geotechnical Reports
- Foundation Plan & Details (with final calculations)
- Grounding Plan & Details (with ground grid design report)
- Oil Containment/SPCC (as required)
- Substation Plan View and Elevations
- Lightning Protection Design Report
- Equipment Removal Plan (as required)
- Construction Sequence Drawings (as required)
- Commissioning Plan
- Conduit and Raceway Plan & Details
- Circuit Schedule (Coordinate with Protection and Control [P&C])
- Steel Details / Loading Diagrams (with final calculations)
- Final Bus Design Calculations
- Material List
- Shop/Manufacture Drawings
- Control Enclosure Construction Drawings
- Single Line and Three Line Diagrams (three-line to be physically arranged)
- Drawing Index

3.1.15 Substation Issued for Construction Submittal Packages

The Contractor shall provide Final Issued for Construction Packages which have incorporated all Duke Energy Midwest Transmission final design review comments. Substation construction packages will be distributed as outlined on the transmittal document.

3.1.16 Substation As-built Deliverables

The Contractor shall provide a Final As-built Packages for the completed Project. For Substation As-Built packages, the Contractor shall set up a meeting with Duke Energy two weeks before the energization day to review the field marks. The Contractor shall also provide all equipment documentation, including drawings, instruction books, test manuals, etc. as part of this submittal. As part of the As-Built process, the Contractor is responsible for reviewing the integrity of the final product and rectifying in the field any non-conformities to Engineer-of-Record's intent. As-built deliverables include the following:

- Drawing Index (Substation)
- As-Built Plan & Profiles (Auto-CAD)
- General Arrangement Drawings including Section Views and Plates
- Foundation Plan and Foundation Detail
- Final Bill of Material
- Equipment Manufacturer Drawings
- Grounding and Lightning Drawings
- Final Topo Survey
- Lighting Plan
- Drainage Plan
- Conduit and Raceway Drawings
- Trench Drawings
- Ground Grid Verification (As-built Fall of Potential Test)
- Connection Details Drawings
- All the final Study Reports (if any changes from the Final Submittal)
- Revised Calculations (if applicable)
- Four (4) sets of signed & sealed SPCC Plans (if applicable)
- Construction photos from start to finish

3.1.17 Document Control

Duke Energy Midwest Transmission will be responsible for all document control in their Engineering Document Management System. Additional procedures for drawing and document control are to be established upon the project kick-off meeting as necessary.

3.2 Protection & Controls Engineering Requirements

This portion of the document addresses all requirements of the P&C design elements of the interconnection. All designs must be approved by Duke Energy Midwest Transmission P&C Engineering prior to construction. Designs shall adhere to the P&C Design Standards as listed below:

3.2.1 P&C Engineering Standards, Guides, and Equipment

P&C engineering design shall be in accordance with the list of referenced standards included in Appendix 3-2. Any deviations from Duke Energy Midwest Transmission standards, or use of subsequently released standards, require written authorization by Duke Energy. In the event of a discrepancy in any of the referenced standards, the Contractor shall contact Duke Energy Midwest Transmission for clarification. The results shall be documented accordingly. All files are included as appendices to this document.

Appendix	Drawing Number	Purpose
3-2A	ST-S-RTU-1001	DC schematic for Primary RTU
3-2B	BACKUP RTU	DC schematic for Backup Metering RTU
3-2C	ST-S-BUS-4	Revenue metering potential connections
3-2D	ST-S-CB-10A	DC schematic for circuit breaker relay and lockout
3-2E	ST-S-CB-10B	DC schematic for circuit breaker trip and close coils
3-2F	ST-S-CB-10C	DC schematic for circuit breaker user notes and options
3-2G	ST-S-COMM-GPS-1	DC schematic for satellite clock
3-2H	ST-S-L-11A	DC schematic for Duke Energy Line Relay-A
3-2J	ST-S-L-11B	DC schematic for Duke Energy Line Relay-B
3-2K	ST-S-L-10	AC schematic for Duke Energy Line
3-2L	ST-S-L-13B	AC schematic for Interconnection Line
3-2M	ST-S-L-14A	DC schematic for Interconnection Line Relay-A
3-2N	ST-S-L-14B	DC schematic for Interconnection Line Relay-B
3-2P	ST-S-TT-2	DC schematic for transfer trip transceiver
3-2R	ST-S-SW-2	Line switch controller and motor operator
3-2S	ST-S-SW-5	Transformer high side switch controller and motor operator
3-2T	ST-S-AUX-1010	Substation DC System Guide

3-2U	STA-AC-AUX	Substation AC System Guide
3-2V	000-PNL-XX-103A	Secondary Voltage Disconnect Panel f/3-Phase CCVT w/o Metering
3-2W	000-PNL-XX-103B	Secondary Voltage Disconnect Panel f/1-Phase CCVT
3-2X	000-PNL-XX-103C	Secondary Voltage Disconnect Panel f/3-Phase CCVT w/Metering
3-2Y	METER BOARD	Control Enclosure Metering Board Layout and Wiring

3.2.2 Control Enclosure

The Contractor will supply a pre-manufactured control enclosure for this project. Subject to the specification included in Appendix 4-B, the control enclosure shall include:

- Transmission Line Relay Panels
- Circuit Breaker Control Panels
- RTU and Telecommunications Panels
- Interconnection Metering Equipment
- Station Battery & Charger
- AC & DC Distribution Panels and Station Service Transfer Equipment
- HVAC Equipment

The Duke Energy Midwest Transmission P&C equipment is listed in the Control Enclosure specification in Appendix 4-B. The Contractor shall design schematic and wiring drawings using the example drawings provided in the table above. The Contractor shall be responsible for confirming that they have the latest standard drawings available. Duke Energy reserves the right to require the Contractor to use an alternative standard up until the Preliminary Design Review. The only exception to this shall be if the Owner believes there is a safety concern or if the project scope changes. Note that these are typical drawings; Contractor drawings shall be formatted and presented similar to these standard drawings with the correct options included. The drawing files are included as an attachment in Appendix 4-B. Telecom equipment shall not be shown on any P&C drawings. Rather, room will be reserved for telecom equipment in the panels. In addition, (1) 30A DC breaker will be provided for powering telecom equipment, with cable run to the appropriate panel for installation. The Contractor shall be responsible for following Duke Energy Midwest Transmission's CAD standards and plot styles. The Contractor shall use Duke Energy Midwest Transmission's standard drawings as well as the P&C Blocks for creating and/or modifying all drawings the Contractor is responsible for.

3.2.2.1 AC and DC Auxiliary Requirements

Battery system, AC and DC load centers requirements are included in the Control Enclosure specification and example drawing attached as Appendix 4-B.

3.2.2.2 Communication Requirements

Communication hardware requirements are listed in the Control Enclosure specification. Additional requirements will depend on the type of primary communications specified by Duke Energy Midwest Transmission. The following is the order of preference:

A. Direct fiber-optic connection to Duke Energy private network:

- Install (1) 2" conduit from inside the Control Enclosure to the outside fence (extend 10' beyond fence and cap conduit).

B. Cambium pole/radio installation:

- Install a cambium dish on top of a steel pole inside the substation (to be determined by site information).
- Install (1) 2" conduit between the pole and the Control Enclosure. Verify pole height, embedment, and location with Telecom group prior to design.

C. Leased line copper T1 service from Local Telco w/Positron copper type isolation (the copper T1 from the telco is terminated in the Positron box and converted to fiber which then connects to the control enclosure):

- Install fence bump out 10'x10' area for positron equipment (accessible by telecom company)
- Install 10' x 10' standalone fence for telecom equipment ("Dog Pen")
- Install 36" x 60" Outdoor NEMA 4X Hoffman box (aka Positron Cabinet) for demarcation point of entry
- Install (1) 3" conduit between control enclosure and Positron Cabinet
- Install (1) 4" conduit from the Positron Cabinet to 10' beyond the fence toward the street and cap
- Install fiber distribution panel in control enclosure and Positron Cabinet
- Install 12/12 single mode/multimode 50-micron hybrid fiber optic cable from control enclosure to Positron Cabinet
- Install outdoor rated CAT5 cable from control enclosure to Positron Cabinet
- Install DC power cable from control enclosure to Positron Cabinet

- Terminate DC in flip out dual fuse holder with properly sized fuses

D. Leased line copper T1 service from local telco w/RLH copper type isolation (the copper T1 from the telco is terminated in the RLH box then converted to fiber which then connects to the control enclosure):

- Install 2" conduit from an agreed upon pole outside of Substation to the Control Enclosure. Install fiber from RLH cabinet to communications panel. RLH copper type isolation will need to be installed inside and outside the Substation.

3.2.2.3 Protection Communication Hardware

Two (2) separate single-mode fiber paths shall be provided for communication between Owner relays and Contractor relays. These paths shall be physically separated. Either overhead optical ground wire (OPGW) or an underground path utilizing 2" conduit shall be used.

3.2.2.4 Revenue Metering

The Owner has identified the required interconnection metering in the Control Enclosure Specification. Upon delivery to the site, Jemstar meters are to be sent to Duke Energy Metering Department for acceptance testing and configuration prior to installation. The meters shall be installed per the schematics and key protection diagram provided. The primary meter shall be connected to metering class CT's and CCVT's.

3.2.2.5 Electrical Studies and Calculations

- AC and DC Station Load Calculations
- Control Enclosure HVAC Calculations
- Battery Ventilation Calculations
- Voltage Drop Calculations to substation equipment operating coils greater than 500 feet from Control Enclosure.
- Battery Sizing Calculations (**This calculation shall be performed for both new substations and existing substations**. **The worst-case scenario shall be coordinated with Duke Energy Midwest Transmission)**

3.2.3 Protection Settings

Duke Energy Midwest Transmission will provide a relay writeup and all the protective relay settings for this project. Duke Energy Midwest Transmission will schedule regular meetings as

needed between the Contractor and Duke Energy settings engineers. The Contractor shall submit the Preliminary Design Package to Duke Energy Midwest Transmission's settings engineers at least two weeks before the Preliminary Design Review Meeting.

3.2.4 P&C Preliminary Design Deliverables

The following section details all requirements of a preliminary P&C design, to be submitted to Duke Energy Midwest Transmission when engineering design is approximately 30 percent complete:

- Drawing Index (P&C drawings only)
- BOM/Panel Arrangement
- Control Enclosure Layout
- Relay One-Line Diagram
- DC System Arrangement/layout (Fuse Panels, safety switches, batteries, charger, etc.)
- Construction Description Letter
- Preliminary Cable Tabulation
- SCADA Point Assignment List
- Battery Calculation Results (spreadsheet)
- Telecom Services Request Form
- P&C Scope Review documents, notes and drawings

3.2.5 P&C Intermediate Design Deliverables

The Contractor shall provide Intermediate Design Submittal Packages that will include all drawings and submittals listed in the preliminary design submittal, which have incorporated all Duke Energy Midwest Transmission preliminary design review comments, and advanced in design to approximately 60 percent complete. Contractor shall also include the following additional submittals for intermediate review:

- Latest version of ALL drawings submitted in the Preliminary Submittal Package
- AC Schematics
- DC Schematics
- Partial Relay Panel and Equipment Wiring Diagrams

3.2.6 P&C Final Design Deliverables

The Contractor shall provide Final Design Submittal Packages that will include all drawings and submittals listed above, which have incorporated all Duke Energy Midwest Transmission design

review comments and completed all design. P&C Design Package will be considered 90% complete at this time. This submittal package shall include:

- Latest version of ALL drawings submitted in the Intermediate Submittal Package
- Drawing Index (P&C)
- Cable Tabulation
- Relay Panel and Equipment Wiring Diagrams

3.2.7 P&C Issued for Construction Submittal Packages

The Contractor shall provide Final Issued for Construction Packages which have incorporated all Duke Energy Midwest Transmission final design review comments. P&C construction packages will be distributed as outlined on the transmittal document.

3.2.8 P&C As-Built Deliverables

The Contractor shall provide Final As-built Packages for the completed Project. The Contractor shall also provide all equipment documentation, including drawings, instruction books, test manuals, etc. as part of this submittal. As part of the As-Built process, the Contractor is responsible for reviewing the integrity of the final product and rectifying in the field any non-conformities to Engineer-of-Record's intent. P&C As-built deliverables shall include the following:

- Drawing Index (P&C drawings only)
- BOM/Panel Arrangement
- Relay Settings Files
- Control Enclosure Layout
- DC System Arrangement/layout (Fuse Panels, safety switches, batteries, charger, etc.)
- Cable Tabulations
- AC & DC Schematics
- Relay Panel and Equipment Wiring Diagrams
- Relay One-Line

3.3 Transmission Line Engineering Requirements

This portion of the document addresses all requirements of the transmission line design elements of the interconnection. All designs must be approved by Duke Energy Midwest Transmission Line Engineering prior to construction. Designs shall adhere to the Line Design Standards as listed below:

3.3.1 Transmission Line Industry Standards, Guides, and Equipment

Use the most current industry standards and codes applicable to the project. The standards applicable to this project include but are not limited to:

- National Electrical Safety Code (NESC) C2-2017
- IEEE Std. 1048 – IEEE Guide for Protective Grounding of Power Lines
- IEEE C62.82.1 – IEEE Standard for Insulation Coordination – Definitions, Principles and Rules
- IEEE 1313.2 – IEEE Guide for the Application of Insulation Coordination
- ASCE 48 – Design of Steel Transmission Pole Structures
- ASCE 10 – Design of Latticed Steel Transmission Structures
- ASCE MOP 74 – Guidelines for Electrical Transmission Line Structural Loading
- IEEE 524 – IEEE Guide for the Installation of Overhead Transmission Line Conductors
- IEEE 516 – IEEE Guide for Maintenance Methods on Energized Power Lines
- IEEE 691 – IEEE Guide for Transmission Structure Foundation Design and Testing

3.3.2 Duke Energy Transmission Line Standards, Guides, and Equipment

Transmission line engineering design shall be in accordance with the following list of referenced standards. Any deviations from Duke Energy Midwest Transmission standards, or use of subsequently released standards, require written authorization by Duke Energy Midwest Transmission. In the event of a discrepancy in any of the referenced standards, the Contractor shall contact Duke Energy Midwest Transmission for clarification. The results shall be documented accordingly. All files are included as appendices to this document.

Appendix	Document	Date	Revision	Standard or Document No.
3-3A	Transmission Pole Design	11/2018	2	MWPS-TL-STD-001
3-3B	Guying and Anchoring	12/2018	3	MWPS-TL-STD-002
3-3C	Hardware	12/2018	1	MWPS-TL-STD-003
3-3D	OPGW	1/2019	3	MWPS-TL-STD-004
3-3E	Marking and Labeling	3/2019	2	MWPS-TL-STD-005
3-3F	Long Span Framing	4/2019	0	MWPS-TL-STD-006
3-3G	Insulator	4/2019	2	MWPS-TL-STD-007
3-3H	Motion Control	6/2019	1	MWPS-TL-STD-008
3-3J	Short Span Framing	1/2020	3	MWPS-TL-STD-009
3-3K	T-Line Switch Design	5/2020	0	MWPS-TL-STD-010
3-3L	Medium Span Framing	12/2020	0	MWPS-TL-STD-011
3-3M	Transmission Line Design Guide	9/2020	2	MWPS-TL-DG
3-3N	Geotechnical Specification	1/2020	000	TECP-EGR-TRM-00066

3-3P	Specification for Standard Series Steel Pole Structures	1/17/2014	-	DJ-A
3-3Q	Specification for Engineered Steel Pole Structures	1/31/2014	-	DJ-B
3-3R	LiDAR and As-Built Survey Stds	5/2016	1.0	DE XMSN LIDAR SPEC
3-3S	MW T-Line Survey Feature Code and Coordinate System	3/2021	0	MWPS-TL-DG-004
3-3T	MW T-Line Feature Code List	3/2021	0	MW FC LIST

3.3.3 Surveys and Geotechnical Investigation

The studies and reports identified below are required to verify an accurate and safe design:

- Topographic and Boundary Surveys
- LiDAR Surveys
- Geotechnical Reports
- Electric and Magnetic Field (EMF) Analysis [if applicable]

3.3.4 Transmission Line Preliminary Design Deliverables

The following section details all requirements of a preliminary transmission line design, to be submitted to Duke Energy Midwest Transmission when engineering design is approximately 30 percent complete:

- Project Drawing List
- Routing Plan Drawing
- One-Line Drawing
- Design Criteria
- Permitting Matrix [Coordinate with Duke Energy as required]
- Equipment Rating Notification Form, If Applicable
- Conceptual Plan and Profile Drawings
- Conceptual Structure Framing Drawings
- Conceptual Construction Sequence Drawings as required
- Conceptual Commissioning Plan
- Geotechnical Scope of Work and Boring Plan
- Survey Package (LiDAR, Boundary Survey, Utility Survey, Environmental and Cultural) [Coordinate with Duke Energy as required]

3.3.5 Transmission Line Intermediate Design Deliverables

The Contractor shall provide Intermediate Design Submittal Packages that will include all drawings and submittals listed in the preliminary design submittal, which have incorporated all Duke Energy Midwest Transmission preliminary design review comments, and advanced in design to approximately 60 percent complete. Contractor shall also include the following additional submittals for intermediate review:

- Project Drawing List
- Routing Plan Drawing
- One-Line Drawing
- Design Criteria
- Equipment Rating Notification Form, If Applicable
- EMF Calculations, If Applicable
- EMF Package, If Applicable
- FAA Notice Submission
- Environmental Permits and Drawings [Coordinate with Duke Energy as required)
- Clearing Plan
- PLS CADD Backup file (uncompressed)
- Plan and Profile Drawings
- Structure Framing Drawings
- Construction Sequence Drawings
- Commissioning Plan

3.3.6 Transmission Line Final Design Deliverables

The Contractor shall provide Final Design Submittal Packages and shall include all drawings and submittals listed in the preliminary and intermediate design submittal, which have incorporated all Duke Energy Midwest Transmission preliminary and intermediate design review comments, and advanced in design to 100 percent complete. Contractor shall also include the following additional submittals for final design review:

- Auto-CAD Plan & Profiles (version 2009)
- PLS-CADD Backup files (uncompressed)
- PLS-Pole Backup files (uncompressed)
- Design Criteria

- Phasing Diagrams Eng Field Reports
- Clearing Project Book:
    - State Location Map
    - Detailed Location Map
    - Material List (if applicable)
    - Work Instructions
    - Easement List
    - Notification & Permits (including approved drawings)
    - Plan & Profile Drawings (in indicated clearing info)
    - Standards & Assemblies (if applicable)
    - Field Reports
- Foundation Project Book:
    - State Location Map
    - Detailed Location Map
    - Material
    - Work Details
        - List of Structures – Construction
        - Foundation Instructions
        - Foundation Construction Schedule
        - Soil Borings
        - Excavation/Subsurface Engineering Reports
        - Easement List
        - Notification & Permits (including approved drawings)
        - Structure Delivery Notification
        - Plan & Profile Drawings
        - Foundation Installation Drawings
        - Steel Pole Manufacturer Drawings
        - Structure Orientation Drawings
        - Standards & Assemblies (if applicable)
        - Field Reports
- Electrical Project Book:
    - State Location Map
    - Detailed Location Map
    - Preliminary (Construction) One-Line

- Existing One-Line
- Switch Location Map
- Switch Number Information Drawing
- Phasing Details
- Bill of Material – Construction
- Site Bill of Material – Construction
- Work Details:
  - List of Structures – Construction
  - Foundation Construction Schedule
  - Soil Borings
  - Excavation/Subsurface Engineering Reports
  - Wire Installation Instructions
  - Table of Wire Installation Charts
  - Wire Installation Charts
  - List of Structures – Removal
  - Wire Removal Instructions
  - Table of Wire Removal Charts
  - Wire Removal Charts
  - Orientation Drawings (Auto-CAD)
  - Survey Reports

- Easement List
- Pole Delivery Notification & Permit Drawings
  - Pole Delivery Notification
  - Permit Drawing Index
  - Permits (with Approved Drawings)
- Drawings
  - Plan & Profile Drawings (Proposed and Referenced)
  - Concrete Manufacturer Drawings
  - Foundation Installation Drawings
  - Steel Pole Manufacturer Drawings
  - Structure Orientation Drawings
- Standards and Assemblies
- Field Reports
  - Transmission Design/Construction Project Summary

- Sag Reports
- Line Data Forms (filled out)
- Steel Pole Jacking Report
- Capital Project Close-out Checklist - Line Construction Projects

3.3.7 Transmission Line Issued for Construction Submittal Packages

The Contractor shall provide Final Issued for Construction Packages which have incorporated all Duke Energy Midwest Transmission final design review comments. Transmission Line construction packages will be distributed as outlined on the transmittal document.

3.3.8 Transmission Line As-Built Submittals

The Contractor shall provide a Final As-built Packages for the completed Project. As part of the As-Built process, the Contractor is responsible for reviewing the integrity of the final product and rectifying in the field any non-conformities to Engineer-of-Record's intent. As-built deliverables include the following:

- As-Built Plan & Profiles (Auto-CAD)
- Other Reference Plan & Profile Drawings (Auto-CAD)
- PLS-CADD Backup files with As-Built LiDAR incorporated (uncompressed)
- PLS-Pole Backup files with As-Built information incorporated (uncompressed)
- Grounding Resistance Report
- Pole Installation Report
- Rock and Screw Anchor Reports
- Wire Sag Report
- Project Books (Clearing, Foundation, & Electrical) including field revisions as PDF
- Construction photos from start to finish
- Post-Construction Lidar (as required)

3.4 Owner's Engineer

Duke Energy Midwest Transmission will, at the contractor's expense, employ an Owner's Engineering team to verify all engineering deliverables are in accordance with Duke Energy Midwest Transmission standards and specifications.

4.0 MATERIAL & EQUIPMENT REQUIREMENTS

This section of the document defines the facility equipment requirements as defined by Duke Energy Midwest Transmission Engineering. As the transmission assets will be transferred to Duke Energy Midwest Transmission and operated and maintained by Duke Energy Midwest Transmission in the future, all material and equipment must comply with Duke Energy Midwest Transmission specifications. The Contractor must procure all equipment for this project. The Contractor shall acquire required equipment for the project based on the standard equipment list provided. The project schedule shall identify all the equipment and the lead times to acquire. All major equipment drawings must be approved by Duke Energy Midwest Transmission prior to construction. Refer to Section 3 regarding submittals to Duke Energy Midwest Transmission engineering departments. Refer to Appendix 4-A for preliminary material lists.

4.1 Substation Equipment Specifications

The following sections contain detailed material specifications for various substation major equipment. Refer to these documents when purchasing major equipment for transmission substation projects.

4.1.1 Control Enclosure

The detailed control enclosure specification is included as Appendix 4-B. All enclosures will be prefabricated off site with panels pre-wired in the factory. The enclosure shall be delivered to the site assembled as completely as possible.

4.1.2 High-Voltage Circuit Breakers

The circuit breakers shall be as listed in Appendix 4-A Major Equipment List. Reference Duke Energy Midwest Transmission Item Number when ordering.

4.1.3 Polysided Tubular Steel (Substation Dead-End) Structures

The detailed steel specification is included as Appendix 4-C. Contact substation engineering for a current list of preferred steel manufacturers.

4.1.4 Standard Shape Steel (Substation General) Structures

The detailed steel specification is included as Appendix 4-D. Contact substation engineering for a current list of preferred steel manufacturers.

4.1.5 Transmission Disconnect Switches

High voltage switches shall be as listed in Appendix 4-A Major Equipment List.

4.1.6 Station Service Voltage Transformers (SSVTs)

SSVTs shall be as listed in Appendix 4-A Major Equipment List.

4.1.7 Coupling Capacitor Voltage Transformers (CCVTs)

Relay and meter accuracy CCVTs shall be as listed in Appendix 4-A Major Equipment List. All CCVTs should include carrier accessories (except 69kV).

4.1.8 Control and Instrumentation Cables

The detailed control cable specification is included as Appendix 4-E. The detailed instrumentation cable specification is included as Appendix 4-F. Contact substation engineering for a current list of preferred control cable manufacturers.

4.1.9 Substation Yard Lighting

Substation lighting shall be designed to provide 2 horizontal foot-candles across the surface of the substation. Yard lighting shall be provided by LED luminaires and include reflector shields, Eaton UFLD-X40-D-U-66-T-BZ-4N7-10K-U0037 or approved equal.

4.1.10 Current Transformers

Interconnection Metering Current Transformers shall be as listed in Appendix 4-A Major Equipment List, 0.15 B1.8 accuracy with Rating Factor of 2.0.

4.1.11 Surge Arresters

Surge arresters shall be as listed in Appendix 4-A Major Equipment List.

4.1.12 Wave Traps

Wave traps and line tuners shall be as listed in Appendix 4-A Major Equipment List. Contact Duke Energy Midwest Transmission system protection for final tuning frequencies.

4.2 Transmission Line Equipment Specifications

The following sections contain detailed material specifications for transmission line major equipment.

4.2.1 Standard Series Steel Pole Structures

The detailed specification is included as Appendix 4-G. Typical fabrication drawings are included as Appendix 4-H. Contact Duke Energy Midwest Transmission line engineering for a current list of preferred suppliers.

4.2.2 Engineered Steel Pole Structures

The detailed specification is included as Appendix 4-J. Sample drawings are included as Appendix 4-K. Contact Duke Energy Midwest Transmission line engineering for a current list of preferred suppliers.

5.0 CONSTRUCTION REQUIREMENTS

This section of the document defines the facility construction requirements as defined by Duke Energy Midwest Transmission Construction. As the transmission assets will be transferred to Duke Energy Midwest Transmission and operated and maintained by Duke Energy Midwest Transmission in the future, all construction must meet the requirements put forth by Duke Energy Midwest Transmission.

Appendix	Document	Date	Revision	Standard or Document No.
5-A	Concrete Installation Specification for Transmission Line & Substation Foundations	05/2020	000	TECP-EGR-TRM-00069
5-B	MW Earthwork Construction Specification		1	31 00 00
5-C	MW Seeding and Mulching Construction Specification		1	32 92 00
5-D	General instructions for welded bus connections	2/26/2016	03	000-BUS-AL-100
5-E	MW Station Grounding Construction Specification	1/15/2020	1	33 79 00
5-F	MW Station Fence Construction Specification		4	32 31 00
5-G	Substation Temporary Fencing		0	TSS-SUB-SRM-EW-0051
5-H	MW Overhead Wire Construction Specification		1	MWPS-TL-SPEC-002
5-J	Substation Aggregate Surfacing	9/6/2013	2	STDP-STD-TRM-00099
5-K	Underground Raceways & Conduits Specification	3/26/2010	0	33 72 33.33
5-L	S-Culvert Aggregate	1/15/2020	1	S-AGG-CULV-01.00

5.1 Siting, Permits, Land or Land-Use Acquisition, Regulatory and Outreach

Contractor to perform all siting under supervision of Duke Energy Midwest Transmission. Contractor will perform environmental studies to prepare the required application, permit and license for authorization of the work. The Contractor will be required to support this work by providing surveys, preliminary engineering, estimates of alternatives, information, drawings, schedules, etc. Contractor will develop a strategic Communication Plan with coordination and input from the Duke Energy Midwest Transmission for engaging local authorities, stakeholders, and agencies. The Communication Plan will detail who will be contacted and when and how to respond to stakeholder's questions and concerns, agency questions and/or hearing proceedings.

The Contractor will obtain all work permits, development permits, and other local approvals specific to the construction.

The Contractor will consult with Duke Energy Midwest Transmission's Land Agent to discuss project needs for temporary, revised or supplemental easements as well as any greenfield easements necessary for the project. In addition, a review of potential encroachments along the proposed transmission line will be completed and an action plan developed with Duke Energy Midwest Transmission's Asset Protection Specialist. Contractor will provide the necessary plats, drawings, and property descriptions for inclusion into the final easement document.

5.2 Commissioning, Acceptance and Energization

Duke Energy Midwest Transmission, or a Duke Energy-provided contractor, shall be responsible for all the testing, commissioning, acceptance and energization of all new facilities. The Contractor shall also be responsible for the planning and consideration of any outages required to integrate the new facilities to the existing system. The Contractor must coordinate with Duke Energy Midwest Transmission to meet the necessary requirements for the design, communication, and protection. The Contractor shall be required to submit to Duke Energy Midwest Transmission the following deliverables:

5.2.1 Model Data Information (Impedance & Ratings)

- Model / System Configuration Changes
    - Nomenclature – new lines/breaker/switch – comes from Owner
    - Preliminary system configuration information needed 4 Months prior to completion of outage
    - Major system changes / new substations / lines need to be incorporated into ECC/FRCC Seasonal Assessment, approximately six (6) month out submittal

5.3 Outage Constraints

Contractor shall design and construct in a manner that limits reliability risks to Duke Energy Midwest Transmission.

5.4 Construction Oversight

Duke Energy Midwest Transmission will, at the contractor's expense, provide a construction oversight individual to monitor construction activity.

5.5 Construction Testing

Duke Energy Midwest Transmission will, at the contractor's expense, request testing and inspections including but not limited to concrete testing, reinforcing steel inspection, steel inspections, welding inspections, compaction testing on fill, foundation observations, drilled pier observations.