Document title

Transmission Line Material Condition Assessment Procedure; Ground Patrols

Document number

MNT-TRMX-00053

Applies to: Transmission Operations and Planning Department – Carolinas and Florida

Keywords: maintenance; transmission – maintenance line

1.0 Purpose

The material condition of the transmission line structures must be periodically assessed to ensure the assets are in optimum condition. The primary goal of the line assessment is to inspect transmission line structures and associated hardware on a routine basis with the purpose of finding and documenting any required material repairs or replacements. A secondary goal is to periodically inspect the general condition of the right-of-way including emergency type danger trees, ditches, access locations, and encroachments.

2.0 Determining Risk

The State Code for any line component is intended to reflect the risk of continuing to operate the asset in its present condition. Unacceptable risks are those that have high probabilities of degrading service to the customer, negatively impacting reliability, or incurring increased future O&M or capital costs to the company. Lines that are not patrolled within 125% of the established preventive maintenance due date present an unknown risk to the system and shall be ranked a State 5.

3.0 Terms and Definitions

3.1 Ground Patrol: The ground patrol is a detailed assessment of a line's poles, crossarms, insulators, guys, anchors, static wires, and conductors. The overall condition of the right-of-way, including access, ditches, encroachments, and off right-of-way trees is also inspected.

3.2 Climbing Inspections: A key component of the ground patrol is evaluating the condition of insulators & wood crossarms. These components cannot always be properly evaluated from the ground, even with binoculars. Therefore, when the condition of components up the structure appears suspect, poles & towers should be climbed or assessed with a bucket. This may expose line deficiencies that may be more widespread, such as penciled porcelain insulators on multiple structures.

3.3 High Risk Areas: These are defined as locations where line structures are directly adjacent to or in an industrial area, a plant with caustic type emissions, or near ocean or salt spray.

3.4 Patrol versus Repairs: Repairs to poles during a patrol should be limited. Generally, found deficiencies should have work orders written and later scheduled for completion based on prioritization. This methodology insures all lines receive an appropriate amount of inspection and the most critical of work is completed first.

4.0 Roles and Responsibilities

4.1 Line Technician: The Line Technician is tasked with completing the line assessment. Specific responsibilities include:

4.1.1 Utilize the guidance contained in this document to accurately classify and assess the condition of transmission line components.

4.1.2 Write work orders for all O&M and capital work.

4.1.3 Complete the Transmission Line Condition Assessment form within 30 days of completion of a Ground Patrol and forwarding the completed form to the Component Engineering Unit Line Engineer.

4.2 Line Supervisor: The Line Supervisor is tasked with providing oversight and planning for the assessment process. Specific responsibilities include:

4.2.1 Provide input to the prioritization of when lines are patrolled.

4.2.2 Ensure Ground Patrol Assessments are conducted at intervals identified in the Transmission Line Equipment Maintenance Schedules Procedure (MNT-TRMX-00051), to be completed within 125% of the established due date.

4.2.3 Ensure supplemental Assessments are conducted for pending construction projects or in reaction to significant line operations.

4.2.4 Ensure poles and towers are properly inspected & climbed.

4.2.5 Ensure all O&M and capital work orders are written to the data management tool in a timely manner.

4.2.6 Ensure the Transmission Line Condition Assessment form is completed within 30 days of a Ground Patrol.

5.0 Precautions and Limitations

Ground patrol assessments will be conducted in accordance with all applicable Company safety rules; OSHA regulations; work practices; and federal, state, and local regulations and ordinances.

6.0 Material and Special Equipment

Image stabilizer type binoculars are required for assessing structure hardware, particularly the underside of porcelain insulators or the end fittings on polymer insulators. Binoculars are needed to inspect for signs of hardware, insulator, conductor, or ground wire connection corrosion. A thorough inspection of all structures is expected.

7.0 Inspection and Climbing Requirements

In certain situations, a climbing inspection is to be performed in addition to the ground patrol. During the climbing patrol, all insulators, pole attachments, hardware, and connections are to be inspected. Crews are to document which structures are climbed so different structures are inspected during subsequent patrols.

Poles with distribution underbuild cannot be climbed. These locations should be noted and should be followed up later with a more detailed helicopter assessment or by utilizing a bucket in cases where crossarm or insulator integrity is suspicious.

7.1 Lattice Tower Lines shall have a detailed climbing inspection performed on at least every 15th tower, more often if any component deterioration is found.

7.2 Wood Pole Lines do **not** require a detailed climbing unless the line is located in a High Risk Area or if component deterioration is found.

7.3 Concrete and Steel Pole Lines do **not** require a detailed climbing inspection unless the line is located in a High Risk Area or if component deterioration is found.

7.4 Structures located adjacent to or in an industrial area or plant with caustic type emissions are required to have a detailed climbing inspection performed on **all** potentially affected structures.

7.5 Lines located adjacent to or in an area with known salt contamination and constructed with porcelain insulators are to have a detailed climbing inspection performed on every 5th structure, more often if any component deterioration is found.

8.0 Simplified Assessment Definitions

8.1 Components rated a **STATE 1** meet the following criteria:

8.1.1 The component is new or less than 10 years old & is in excellent condition.

8.1.2 All preventative maintenance is completed within 125% of the established due date.

8.2 Components rated a **STATE 2** meet the following criteria:

8.2.1 The component is greater than 10 years old & is in excellent condition.

8.2.2 All preventative maintenance is completed within 125% of the established due date.

8.3 Components rated a **STATE 3** meet the following criteria:

8.3.1 Line has some maintenance issues, primarily consisting of a few pole repairs & replacements, or other non-critical maintenance items.

8.3.2 Less than two preventative maintenance activities are overdue by more than 125% of the established completion date.

8.3.3 Painting and labeling is required.

8.4 Components rated a **STATE 4** meet the following criteria:

8.4.1 Line has numerous and significant maintenance issues, including disproportionate numbers of poles needing replacement or repair compared to the total number of poles on the line. Significant insulator deterioration or steel tower/pole corrosion are also examples of applicable issues.

8.4.2 Several preventative maintenance activities are overdue by more than 150% of the established completion date.

8.5 Components rated a **STATE 5** meet the following criteria:

8.5.1 Require IMMEDIATE attention.

9.0 Critical/Major System Components & State Codes

9.1 Transmission Wood Poles

9.1.1 **State 1** is described as meeting the criteria listed below:

- New wood poles up to 10 years of age & in excellent condition.

9.1.2 **State 2** is described as meeting all of the criteria listed below:

- No woodpecker holes or woodpecker holes have been repaired
- A pole that has been successfully cut and capped
- Checks/cracks show no decay or insect damage
- Inspected/treated by Osmose with no data in the remarks field of the report and no noted reduction in effective pole diameter
- Hammer test indicates a hard pole
- No pole top deflection noted

9.1.3 **State 3** is described as meeting one or more of the criteria listed below:

- Woodpecker holes are present
- Checks/cracks show decay or insect damage, or the presence of minimal shell cracking
- Inspected/treated by Osmose with decay noted in the remarks field of the report and a noted reduction in effective pole diameter
- Hammer test indicates a minimal amount of groundline decay
- Pole has been repaired or C-trussed
- Poles with a wood bayonet or a pole that needs to be cut and capped
- Pole can be partially hollow but with no less than 3 – 4 inches of shell thickness and cannot be caved during a hammer test
- Pole top has deflection but is less than 3 feet

9.1.4 **State 4** does not meet NESC Code and is described as meeting one or more of the criteria listed below and should be scheduled to be replaced:

- Woodpecker holes which have deep cavities and are not repairable
- Checks/cracks show significant decay or insect damage, or the presence of substantial shell cracking
- Decay in the pole top is extensive such that the pole cannot be cut and capped
- Inspected/treated by Osmose and identified as rejected/restorable or rejected/non-restorable
- When hammer tested, groundline decay pockets are found and are greater than 5 inches wide and 2 inches deep
- Pole is hollow with less than 3 – 4 inches of shell thickness extending over more than one-quarter of the pole circumference
- Pole top deflection is between 3 to 5 feet



Typical State 4 Pole

9.1.5 **State 5** does not meet NESC Code and is described as meeting one or more of the criteria listed below. (This pole should be scheduled to be replaced as soon as possible but no later than the next 3 months):

- Woodpecker holes which have deep cavities and are not repairable, severely affecting the integrity of the pole
- Osmose indicates the pole as “priority”
- When hammer tested, groundline decay pockets are found and are greater than 8 inches wide by 3 inches deep
- Pole is hollow with less than 2 inches of shell thickness extending over more than one-third of the pole circumference
- Pole deflection exceeds 5 feet



Typical State 5 Pole

9.2 Transmission Line Cross-Arms, Cross-Braces, & Knee-braces

9.2.1 **State 1** is described as meeting the criteria listed below:

- Crossarms, Cross-braces, or Knee-braces are steel

9.2.2 **State 2** is described as meeting all of the criteria listed below:

- Wood; when hammer tested, member is hard
- No Woodpecker holes or rot present
- Galvanized or painted steel members have minimal rust
- There is no loose hardware

9.2.3 **State 4** is described as meeting one or more of the criteria listed below and should be scheduled to be restored or replaced:

- When hammer tested, member can be caved
- Separation exists between laminates sections of cross-braces
- Member has wide (> 1 inch) cracks that can hold water
- Woodpecker holes are present
- There is missing hardware

9.2.3 **State 5** is described as needing immediate attention

9.3 Transmission Line Lattice Towers, Steel & Concrete Poles

9.3.1 **State 1** is described as meeting all of the criteria listed below:

- Poles are new, less than 10 years old
- No visible signs of deterioration

9.3.2 **State 2** is described as meeting all of the criteria listed below:

- Galvanized or painted steel pole or towers have minimal surface rust
- No pack-out on tower bracing at member connections to tower legs
- Groundline treatment on steel pole or tower is totally intact & has not deteriorated
- Grout on top of concrete pole is intact
- Concrete surface may have hairline cracks, but less than 1/8 inch wide

9.3.3 **State 3** is described as meeting one or more of the criteria listed below:

- Galvanized or painted steel pole or towers have rust and needs painting
- Weathering steel poles or tower members exhibit minimal pitting
- Aluminum towers exhibit minimal surface deterioration.
- Light pack-out on tower bracing at member connections to tower legs
- Groundline treatment on steel pole or tower is cracked, or peeled, but rusting has not yet occurred
- Grout on top of concrete pole is cracked
- Concrete surface may have hairline cracks, but less than 1/8 inch wide

9.3.4 **State 4** is described as meeting one or more of the criteria listed below:

- Galvanized or painted steel pole or towers have deep rust, needs cleaning, priming, & painting.
- Weathering steel poles or towers exhibit heavy pack-out including deformed or missing members or bolts
- Aluminum towers exhibit deformed or missing members or bolts
- Concrete poles has rust stains originating from inside the crack from the reinforcing steel or cracks more that ¼ inch wide

9.3.5 **State 5** is described as needing immediate attention

9.4 Transmission Line Porcelain Insulators

9.4.1 **State 1** is described as meeting the criteria listed below:

- No visible signs of deterioration, cracking, chipping, or pin rust



Typical State 1 “Ball & Socket” Insulator

9.4.2 **State 3** is described as meeting one or more of the criteria listed below:

- Displays initial signs of pin rust
- Up to two individual insulator units within a string with cracked or broken skirts at 69/115 kV, or up to three at 230/500 kV
- Any individual insulator unit within a string with signs of electrical flashing
- Insulator units with bird contamination



Typical State 3 “Ball & Socket” Insulator

9.4.3 **State 4** is described as meeting one or more of the criteria listed below and should be replaced:

- These insulators have advanced pin erosion
- Three or more individual insulator units within a string with cracked or broken skirts at 69/115 kV, or four or more for 230/500 kV
- Three of more individual insulator units within a string with signs of electrical flashing



Typical State 4 “Ball & Socket” Insulator

9.4.4 **State 5** is described as needing immediate attention

9.5 Transmission Line Polymer Insulators

9.5.1 **State 1** is described as meeting the criteria listed below:

- Insulator with no visible signs of deterioration

9.5.2 **State 3** is described as meeting the criteria listed below:

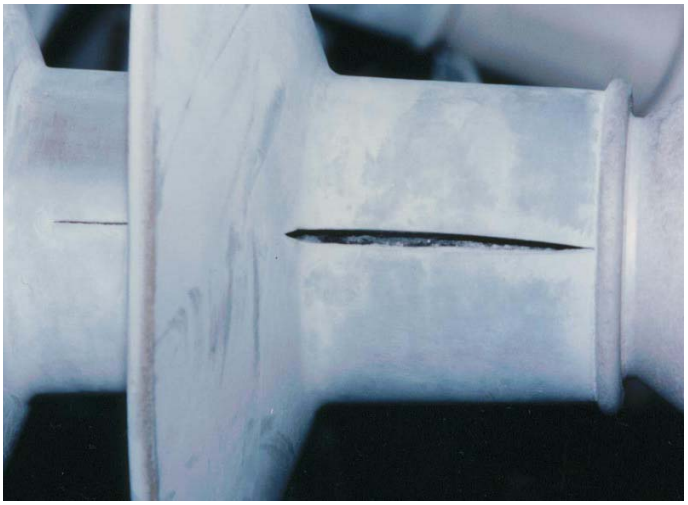
- Insulator with moderate amounts of chalking

9.5.3 **State 4** is described as meeting one or more of the criteria listed below and should be replaced:

- Insulator with an exposed fiberglass rod
- Insulator with open splits or gaps in the rubber housing
- Insulator with signs of electrical tracking or leaking interface compound
- 230 kV insulators with missing corona rings



Exposed Fiberglass Rod



Split Housing

9.5.4 **State 5** is described as needing immediate attention

9.6 Transmission Line Conductors

9.6.1 **State 2** is described as meeting the criteria listed below:

- Conductor with no visible wear

9.6.2 **State 3** is described as meeting one or more of the criteria listed below and should be repaired:

- Minor core rusting or corrosion
- Minor “Birdcage” of any conductor
- Conductor aluminum strands are unraveled
- Ohm-stick” conductor splice resistance readings indicating a recommended recheck in one year

9.6.3 **State 4** is described as needing immediate attention and meets one or more of the criteria listed below and should be repaired or replaced:

- Conductor steel core has severe corrosion.
- Severe “Birdcage” of any conductor
- “Ohm-stick” conductor splice resistance readings indicating a recommendation to immediately replace

9.6.4 **State 5** is described as needing immediate attention

9.7 Transmission Line Overhead Ground Wires (Statics, OHGW, OHG, OPGW)

9.7.1 **State 2** is described as meeting the criteria listed below:

- Static has no visible wear

9.7.2 **State 3** is described as meeting one or more of the criteria listed below:

- Static has minor rusting, corrosion, or visible pitting
- Mechanical static splices present
- Statics including 5/16”, 3#6, & 7#10
- “Ohm-stick” conductor splice resistance readings indicating a recommended recheck in one year

9.7.3 **State 4** is described as meeting one or more of the criteria listed below and should be repaired or replaced:

- Any broken strands
- “Ohm-stick” conductor splice resistance readings indicating a recommendation to immediately replace.
- Static is severely rusted and or has become brittle. This condition can also be supported with lab testing of static samples.

9.7.4 **State 5** is described as needing immediate attention

9.8 Transmission Line Anchors and Guy Wires

9.8.1 **State 2** is described as meeting all the criteria listed below:

- Anchors & Guys have no visible wear
- Guy Grips & anchor heads are all above groundline
- Guys are tight.

9.8.2 **State 3** is described as meeting one or more of the criteria listed below:

- Guys have been damaged
- Guy Grips & anchor heads are at or below groundline
- Grade modifications have exposed the top portion of the anchor
- Guys are loose and can be swayed

9.8.3 **State 5** is described as needing immediate attention

9.9 Transmission Line Switches

9.9.1 **State 1** is described as meeting all of the criteria listed below:

- The switch is new or less than 10 years old & is in excellent condition.
- All preventative maintenance is completed within 125% of the established due date
- No know material defects
- Infrared readings are normal

9.9.2 **State 2** is described as meeting all of the criteria listed below:

- The switch is greater than 10 years old & is in excellent condition
- All preventative maintenance is completed within 125% of the established due date
- No know material defects
- Infrared readings are normal

9.9.3 **State 3** is described as meeting one or more of the criteria listed below:

- Preventative maintenance activities are overdue by more than 125% of the established completion date
- Switch has mechanical issues that require attention whenever it is operated
- Infrared readings are normal

9.9.4 **State 4** is described as meeting one or more of the criteria listed below:

- Preventative maintenance activities are overdue by more than 150% of the established completion date.
- Switch has mechanical issues that require attention whenever it is operated
- Infrared readings are high and require adjustment of blade/jaw interface or replacement

9.9.5 **State 5** is described as needing immediate attention, or:

- Infrared readings indicate immediate action is required
- The switch is tagged out of service with the ECC due to mechanical or operational problems
- Interrupter has lost dielectric strength, i.e. no vacuum or gas is present.

9.10 Transmission Minor Components

9.10.1 **Aerial Markers**; Inspect for faded, partially detached, or missing markers.

9.10.2 **Arrestors;** Inspect for loose hardware, detached jumpers, cracks, or signs of being burnt.

9.10.3 **Bird Contamination;** Inspect for bird droppings on crossarms, the ground, and stains on porcelain insulator strings. Significant activity may warrant the installation of protective bird guards.

9.10.4 **Connections;** Inspect for bent, cracked, or missing hardware, and loose or missing bolts.

9.10.5 **U-bolts used on steel crossarms;** Inspect for loose hardware. Particular attention should be given to rusting nuts and washers on 5/8" diameter weathering U-bolts.

9.10.6 **Dampers;** Inspect for bent, cracked, or missing nuts. Look for signs of being broken loose and sliding away from the insulator.

9.10.7 **Encroachments;** Inspect for buildings, deer stands, ditches, fences, and elevation changes including ditches affecting access and mounds.

9.10.8 **Grounding;** Inspect for broken or deteriorated pole grounds and for unattached flying taps.

9.10.9 **Guy Strain Insulators;** Inspect coatings for cracking and chipping as they protect the fiberglass insulator rod from ultraviolet radiation. Inspect end fittings for deterioration. Insulators with significantly frayed glass or splintering should be replaced.

9.10.10 **Line Traps;** Inspect for bent, cracked, or missing hardware.

9.10.11 **Pole Bands;** Inspect for broken thru bolts and pulled out lag screws, particularly on conductor deadends.

9.10.12 **ROW Condition;** Inspect for burn or dirt piles, trees that may affect the reliability of the line, vines, and any change in grade due to earthmoving activities.

9.10.13 **Warning Signs;** Inspect for faded, detached or missing signs. Insure signs used for helicopter patrols are present at all crossings.

10.0 References

10.1 Ground Patrol Assessments shall be followed in accordance with the Transmission Maintenance Program Policy (MNT-TRMX-00000).

10.2 Ground Patrol Assessments will be conducted at intervals identified in the Transmission Line Equipment Maintenance Schedules Procedure (MNT-TRMX-00051).

11.0 Attachments/Forms

11.1 Ground Patrol Assessments shall be completed utilizing Transmission Line Condition Assessment Form (FRM-TRMX-01030).