BASIN ELECTRIC POWER COOPERATIVE
A Touchstone Energy® Cooperative

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JUN 22 2017
NORTH DAKOTA
PUBLIC SERVICE COMMISSION

June 22, 2017

Darrell Nitschke
Executive Director
North Dakota Public Service Commission
600 East Boulevard; Dept. 408
Bismarck, ND 58505-0480

Re: Basin Electric Power Cooperative
AVS to Neset 345-kV Transmission Project Case No. PU-11-696
NKL Phase I 345-kV Transmission Project Case No. PU-14-813

Dear Mr. Nitschke:

Basin Electric Power Cooperative (Basin Electric) requests a change to the North Dakota Public Service Commission's (Commission) previously approved Orders for Case No. PU-11-696 and Case No. PU-14-813. Specifically Paragraph 8 of the Tree and Shrub Mitigation Specifications within the respective FINDINGS OF FACT, CONCLUSIONS OF LAW AND ORDER states, "The maximum width of clear cuts through windbreaks, shelterbelts and all other wooded areas is 50 feet, unless otherwise approved by the Commission."

Basin Electric respectfully requests that the Commission increasing the allowed vegetation clearance size from 50 feet to both Project's Right-of-Way (ROW) width of 150 feet. Vegetation clearing of the entire ROW would be consistent with Basin Electric's recent transmission facilities commission orders. Both the Williston to Tioga 230-kV Transmission line Project (PU-07-671) and the Rhame to Belfield 230-kV Project (PU-07-169) Orders had specific language that allowed the clear cut for the width of their respective ROWs. We believe the corresponding statement was inadvertently omitted in the Order for Case No. PU-11-671 and Case No. PU-14-813.

The purpose of allowing vegetation clearing from the entire ROW is to allow Basin Electric, as an owner of Bulk Electric System (BES) facilities, the ability to comply with the North American Electric Reliability Corporation's (NERC) Reliability Standard FAC-003-4 (Attachment 1). This "Transmission Vegetation Management" standard requires management of vegetation to prevent encroachments into the Minimum Vegetation Clearance Distance (MVCD) of applicable transmission lines. Basin Electric's compliance strategy with the NERC requirements is outlined in Basin Electric's "Transmission Line Vegetation Management Program" (TLVMP) (Attachment 2) which is enclosed for reference.

105 **PU-14-813** Filed: 6/22/2017 Pages: 67
Request for 150-foot vegetation clear-cuts
Basin Electric Power Cooperative
Cris Miller

296 **PU-11-696** Filed: 6/22/2017 Pages: 67
Request for 150-foot vegetation clear-cuts
Basin Electric Power Cooperative
Cris Miller

A 150 foot wide clear cut area within our ROW, will better position Basin Electric to ensure the reliability of the transmission system. As the Commission knows, Basin Electric purchased 150 foot ROW easements from landowners, a distance established thru an engineering evaluation, including factoring in the height and span distance of the structures and the conductor characteristics in the project's initial design stage. This 150 foot easement ensures that Basin Electric has the appropriate width of ROW in order to provide adequate clearances in order to maintain system reliability. For reference, clearance obstructions can come from encroachment within the ROW of man-made buildings (farm out-buildings, grain bins, grain augers, antennas; etc.) as well as from natural objects such as trees. Basin Electric's Transmission System Maintenance Division performs aerial and ground surveys annually to verify the integrity of the transmission system, identify the presence of ROW encroachments and perform vegetation clearance inspections. Any clearance violations are reported internally and the appropriate corrective steps are undertaken.

Further, the 150 foot wide vegetation clearance area requested is consistent with Basin Electric's ROW management practices with our other 345-kv transmission lines. Currently, if Basin Electric was only allowed to clear vegetation for 50 feet, it would be very difficult, if not impossible to maintain adequate clearance, thus jeopardizing the integrity of the transmission system and placing Basin Electric in a potential non-compliance situation should the failure to maintain the MVCD be the cause of a transmission line outage.

In summary and for the reasons outlined above, we respectfully request the Commission insert the appropriate language in the Order for Case NO. PU-11-696 and Case No. PU-14-813, to allow for vegetation clearance area of 150 feet.

For questions or inquiries regarding this request, please contact me directly at your convenience at (701) 557-5635.

Sincerely,

Cris Miller
Senior Environmental Services Administrator

/ser

cc: Casey Jacobson-electronic
Amanda Wangler -electronic

Transmission Line Vegetation Management Program (TLVMP)				
Effective Date:	10/01/2016	Next Review & Approval Date:		10/01/2019
Predecessor Document(s):	*Transmission_Line_Vegetation_Management_Program_V0.0_2014-07-01.pdf*			
NERC ID:	MRO	NCR00102	NERC Links:	FAC-003-4
	WECC	NCR05023		

REVIEWED & APPROVED BY:	
Document Owner:	Mike Risan
Title:	Senior VP Transmission
Electronic Signature & Date	Mike Risan Mike Risan (Sep 26, 2016)
Document Owner:	Bryan Keller
Title:	VP of Transmission System Maintenance
Electronic Signature & Date	Bryan L. Keller Bryan L. Keller (Sep 23, 2016)

DOCUMENT OWNER REVIEW & APPROVAL:			
Department:	Name:	Title:	Electronic Signature & Date:
Transmission	Vince Smith	Transmission Line Superintendent	Vince Smith Vince Smith (Sep 19, 2016)

TABLE OF CONTENTS:

1.0 PURPOSE **3**

2.0 SCOPE **3**

3.0 RESPONSIBILITIES **3**

4.0 APPLICABILITY **4**

4.1 Transmission Facilities 4

4.2 Generation Facilities 4

5.0 DEFINITIONS **5**

6.0 TRANSMISSION LINE VEGETATION MANAGEMENT PROCESS **6**

7.0 MAINTENANCE STRATEGY **7**

7.1 Cycle Maintenance 7

7.2 Minimum Vegetation–to–Conductor Distance 7

7.3 Border-Wire Zone Method 8

8.0 WORK METHODS **9**

8.1 Control Methods 9

8.2 Safety Considerations 10

8.3 Controlling Hazard Trees 10

9.0 SPECIAL CIRCUMSTANCES **11**

9.1 Handling Imminent Threats 11

9.2 Vegetation Management Constraints 11

10.0 INSPECTIONS **12**

11.0 ANNUAL WORK PLAN **12**

12.0 TRAINING **13**

13.0 REPORTING **13**

14.0 REVIEW & APPROVAL INTERVALS **13**

15.0 DOCUMENT CONTROL **13**

16.0 RETENTION PERIOD **13**

17.0 REFERENCE DOCUMENTS **14**

REVISION HISTORY **15**

1.0 PURPOSE

This *Transmission Line Vegetation Management Program* (Program) is used to maintain a reliable electric transmission system by using a defense-in-depth strategy to manage vegetation located in and adjacent to transmission rights of way (ROW) and prevent encroachments into the Minimum Vegetation Clearance Distance (MVCD) from vegetation located in and adjacent to the ROW, of Basin Electrics transmission lines, and thus preventing the risk of those vegetation-related outages that could lead to Cascading.

2.0 SCOPE

This Program is essential to preventing vegetation-related outages that could lead to Cascading of transmission lines. The scope of this document is to manage vegetation to prevent encroachments into the Minimum Vegetation Clearance Distance (MVCD) of any type for all of Basin Electric's applicable lines, which are to be operating within their Rating and for all Rated Electrical Operating Conditions.

This Program includes managing vegetation to prevent an encroachment into the MVCD, observed in Real-time, absent a Sustained Outage, an encroachment due to a fall-in from inside the ROW that caused a vegetation-related Sustained Outage, an encroachment due to the blowing together of applicable lines and vegetation located inside the ROW that caused a vegetation-related Sustained Outage, or an encroachment due to vegetation growth into the MVCD that caused a vegetation-related Sustained Outage.

This Program has also defined a maintenance strategy and work methods in order to achieve the desired outcome of managing vegetation to prevent encroachments into the MVCD. These maintenance strategies and work methods take into consideration the movement of applicable line conductors under their Rating and for all Rated Electric Operating Conditions and the inter-relationships between vegetation growth rates, vegetation control methods, and inspection frequency.

3.0 RESPONSIBILITIES

Senior Vice President Transmission: Provides the necessary Senior Management knowledge, expertise, and authority to make sure that the Program is being implemented.

Vice President of Transmission System Maintenance: Oversees the implementation of the Program and provides the support needed to make sure it is being fully implemented and adhered to.

Transmission Line (TL) Superintendent: Responsible for applying the Program to the work practices that are performed for the Transmission Line division within Basin Electric. It is also the Transmission Line Superintendent's responsibility to provide resolution of any vegetation management problems by clarifying and enforcing the practices provided and detailed in the Program. The TL Superintendent is also responsible for enforcing the correct work safety practices that are to be adhered to when performing any function associated with vegetation management.

Transmission Line section: Responsible for performing the duties and functions associated with the management of vegetation following this Program as approved practices that Basin Electric employs to maintain compatible plant growth in and around the transmission ROW's while removing the non-compatible vegetation.

General Council: Provides any legal advice, counsel, or representation that may be needed in the advent of any landowner disputes, ROW issues, or other legal matters that may come about while performing vegetation management.

Property and Right-of-Way division: Assists the transmission line personnel who may have any related questions, comments, or concerns with the Right-of-Way for all Basin Electric Transmission Facilities.

Transmission Compliance division: Responsible for providing insight on the regulatory requirements related to vegetation management. Also responsible for providing the regular reporting to the Regional Entities as required.

4.0 APPLICABILITY

4.1 Transmission Facilities

- Each overhead transmission line operated at 200 kV or higher that is an element of an IROL or an element of a Major WECC Transfer Path.
- Each overhead transmission line operated at 200 kV or higher that is not an element of an IROL or an element of a Major WECC Transfer Path.
- Each overhead transmission line operated below 200 kV identified as an element of an IROL under NERC Standard FAC-014 by the Planning Coordinator.
- Each overhead transmission line operated below 200 kV identified as an element of a Major WECC Transfer Path in the Bulk Electric System by WECC.
- Each overhead transmission line identified above located outside the fenced area of the switchyard, station or substation and any portion of the span of the transmission line that is crossing the substation fence.

4.2 Generation Facilities

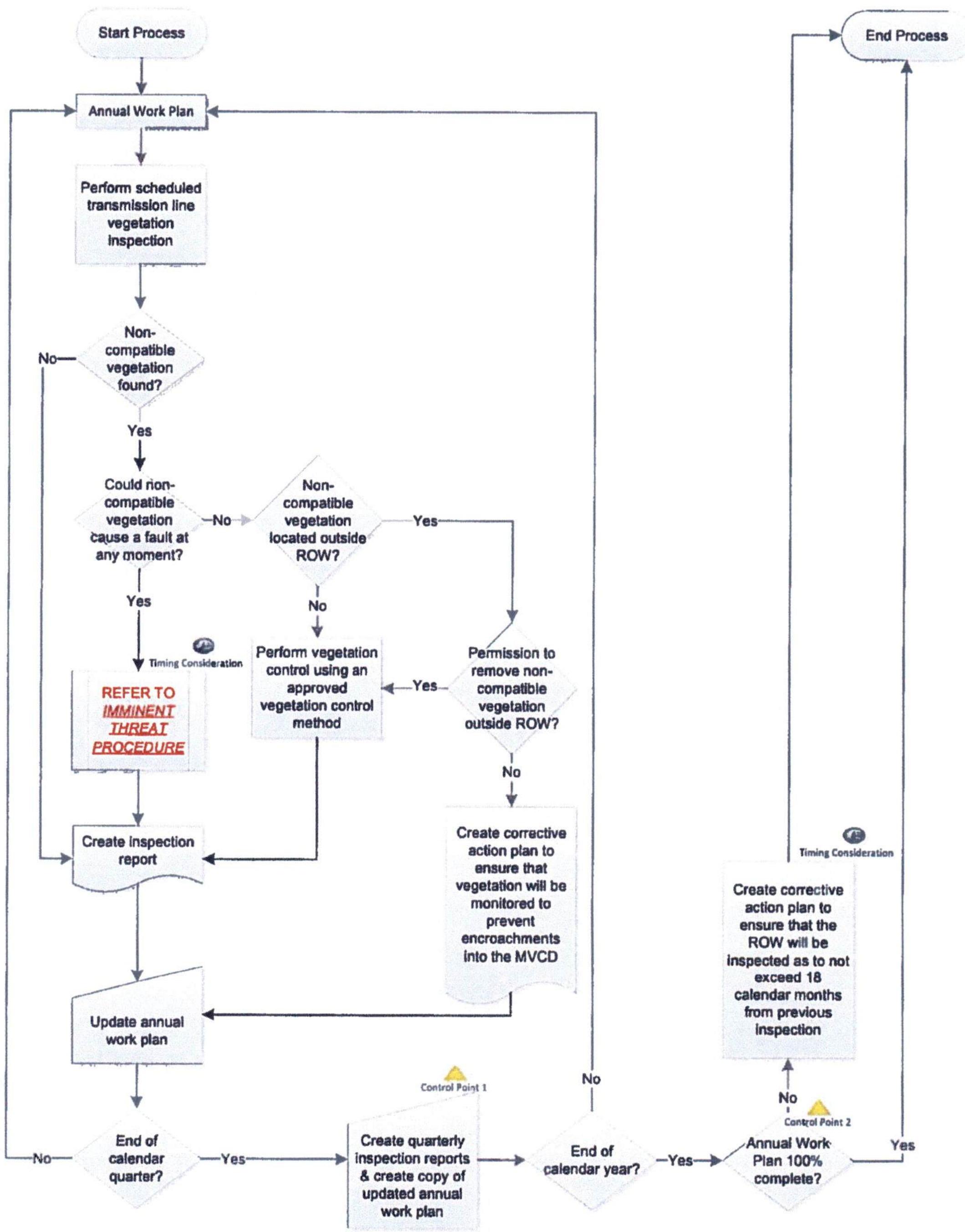
- Overhead transmission lines that (1) extend greater than one mile or 1.609 kilometers beyond the fenced area of the generating station switchyard to the point of interconnection with a Transmission Owner's Facility or (2) do not have a clear line of sight from the generating station switchyard fence to the point of interconnection with a Transmission Owner's Facility and are:
  - Operated at 200 kV or higher; or
  - Operated below 200 kV identified as an element of an IROL under NERC Standard FAC-014 by the Planning Coordinator; or
  - Operated below 200 kV identified as an element of a Major WECC Transfer Path in the Bulk Electric System by WECC.

5.0 DEFINITIONS

For purposes of this document, Basin Electric will use the following definitions:

Term (Acronym):	Definition:	Source:
Annual	Occurring within 12 months, but not to exceed 15 months.	BEPC Defined
Bulk Electric System (BES)	All Transmission Elements operated at 100 kV or higher and Real Power and Reactive Power resources connected at 100 kV or higher. This does not include facilities used in the local distribution of electric energy. **See NERCs Glossary of Terms Used in NERC Reliability Standards for Inclusions and Exclusions to the BES definition.*	NERC Glossary of Terms
Cascading	The uncontrolled successive loss of System Elements triggered by an incident at any location. Cascading results in widespread electric service interruption that cannot be restrained from sequentially spreading beyond an area predetermined by studies.	NERC Glossary of Terms
Interconnection Reliability Operating Limt	A System Operating Limit that, if violated, could lead to instability, uncontrolled separation, or Cascading outages4 that adversely impact the reliability of the Bulk Electric System.	NERC Glossary of Terms
Minimum Vegetation Clearance Distance (MVCD)	The calculated minimum distance stated in feet (meters) to prevent flash-over between conductors and vegetation, for various altitudes and operating voltages.	NERC Glossary of Terms
Right-of-Way (ROW)	The corridor of land under a transmission line(s) needed to operate the line(s). The width of the corridor is established by engineering or construction standards as documented in either construction documents, pre-2007 vegetation maintenance records, or by the blowout standard in effect when the line was built. The ROW width in no case exceeds the applicable Transmission Owner's or applicable Generator Owner's legal rights but may be less based on the aforementioned criteria.	NERC Glossary of Terms
Transmission Line	A system of structures, wires, insulators and associated hardware that carry electric energy from one point to another in an electric power system. Lines are operated at relatively high voltages varying from 69 kV up to 765 kV, and are capable of transmitting large quantities of electricity over long distances.	NERC Glossary of Terms
Unresolved Maintenance Issue (UMI)	A deficiency identified during a maintenance activity that causes the component to not meet the intended performance, cannot be corrected during the maintenance interval, and requires follow-up corrective action.	NERC Glossary of Terms
Vegetation Inspection	The systematic examination of vegetation conditions on a Right-of-Way and those vegetation conditions under the applicable Transmission Owner's or applicable Generator Owner's control that are likely to pose a hazard to the line(s) prior to the next planned maintenance or inspection. This may be combined with a general line inspection.	NERC Glossary of Terms

6.0 TRANSMISSION LINE VEGETATION MANAGEMENT PROCESS



7.0 MAINTENANCE STRATEGY

In applying a Maintenance Strategy, Basin Electric provides guidance for employees making decisions as to which vegetation should be in the annual work plan by using a standard vegetation-to-conductor clearance method for the vegetation in and adjacent to the ROW.

The basic philosophy that Basin Electric employs is consistent with ANSI A300 Part 7, which may be used for additional guidance and reference. The philosophy is to target only those plants that are incompatible with Basin Electric's use of the land. This allows for natural competition from desired species to reduce influx and growth of the target species. Right-of-ways take on a natural appearance encouraging wildlife and native plants. Intensive practices are the exception rather than the norm; as a result cost is reduced. This requires more time and effort to be placed in planning and scheduling. Increased planning provides a better atmosphere to reduce environmental mistakes and further encourages cost reduction. Also, vegetation management is to reduce wildfire risk and enhance wildfire survivability. The density of vegetation after treatment and areas of regeneration will be managed to reduce the overall fire risk. Vegetation debris from intensive or repetitive treatments may also require mitigation to reduce wildfire risk and enhance the survivability of the transmission facility. Basin Electric also maintains vegetation to provide for adequate access routes to provide for efficient and cost effective vegetation treatment activities.

Compatible species will vary from location and terrain. Any species capable of growing into the pre-defined vegetation–to–conductor clearance distance would be considered incompatible. The annual work plan would target those species for removal at the most cost effective manner as long as they are not able to encroach into the MVCD under any conditions.

7.1 Cycle Maintenance

Basin Electric maintains vegetation using a cycle based system. The vegetation is mowed or cut with sufficient frequency to keep the vegetation–to–conductor clearance at the specified distance at all times as to not allow for vegetation to encroach into the Minimum Vegetation Clearance Distance (MVCD). Annual inspections of the ROW allow time for cycle buster trees to be caught and added into the annual work plan.

7.2 Minimum Vegetation–to–Conductor Distance

Basin Electric utilizes prescriptive management to maintain the vegetation in and adjacent to the ROW. In this process the condition of the vegetation, as determined by the annual inspections, is used to determine which vegetation belongs in the annual work plan to prevent vegetation encroachments into the Minimum Vegetation Clearance Distance (MVCD).

Where the Vegetation–to–Conductor clearance at time of maintenance is known, (laser, insulated measuring stick, or cable height meter) schedules can be determined to meet the distance between the conductor and the vegetation using the following table.

TRANSMISSION LINE ROW TARGET CLEARANCE DISTANCES FOR INCOMPATIBLE VEGETATION	
Conductor Voltage	**Clearance Between Conductor and Vegetation**
115 kV	15 feet
230 kV	20 feet
345 kV	25 feet

This target distance between the conductor and the vegetation takes into consideration the inter-relationships between vegetation growth rates, vegetation control methods, and inspection frequency as to not allow for the encroachment of vegetation into the MVCD under any circumstance.

The Minimum Vegetation Clearance distances (MVCD) that are applicable to Basin Electric's Facilities are indicated below.

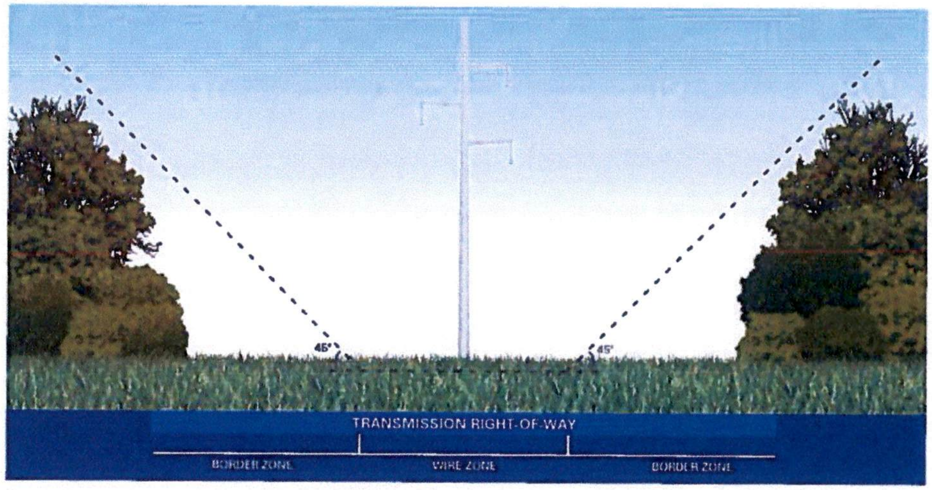
Minimum Vegetation Clearance Distances									
Nominal System Voltage (kV)	Maximum System Voltage (kV)	0 ft to 500 ft	500 ft up to 1000 ft	1000 ft up to 2000 ft	2000 ft up to 3000 ft	3000 ft up to 4000 ft	4000 ft up to 5000 ft	5000 ft up to 6000 ft	6000 ft up to 7000 ft
345	362	4.3	4.3	4.4	4.5	4.6	4.7	4.8	4.9
230	242	4.0	4.1	4.2	4.3	4.3	4.4	4.5	4.6
115	121	1.9	1.9	1.9	2.0	2.0	2.1	2.1	2.2

Minimum Vegetation Clearance Distances									
Nominal System Voltage (kV)	Maximum System Voltage (kV)	7000 ft up to 8000 ft	8000 ft up to 9000 ft	9000 ft up to 10000 ft	10000 ft up to 11000 ft	11000 ft up to 12000 ft	12000 ft up to 13000 ft	13000 ft up to 14000 ft	14000 ft up to 15000 ft
345	362	5.0	5.1	5.2	5.3	5.4	5.5	5.6	5.7
230	242	4.7	4.8	4.9	5.0	5.1	5.2	5.3	5.4
115	121	2.2	2.3	2.3	2.4	2.5	2.5	2.6	2.6

*Tables are taken directly from the FAC-003-4 Table 2 – Minimum Vegetation Clearance Distances (MVCD) For Alternating Current Voltages. It has been tailored to reflect only those voltage levels for which Basin Electric owns and maintains vegetation.

7.3 Border-Wire Zone Method

Vegetation cleared under the conductor will follow a border-wire-zone method to the designed ROW width. The border-wire zone method is eliminating risks of vegetation grow-in from any direction and also eliminating the risk of contact from conductor blowout. Conductor blowout is the movement of applicable line conductors under their Rating and for all Rated Electrical Operating Conditions. For vegetation growth directly under the conductor, the border-wire zone method will use a vegetation reference that is equal to the maximum vegetation height that was determined utilizing the vegetation–to–conductor clearance distance (identified in section 7.2) located under the conductor for any given span. For vegetation growth that is within the designed ROW width but not directly under the conductor, the vegetation will be cleared at a 45-degree angle away from the line (see diagram below).



Actual easement rights vary from location. The edge of the easement may or may not coincide with the ROW as designed and maintained. The vegetation specialist should recognize that Basin Electric may not have the necessary rights to remove or trim vegetation outside of the easement.

Vegetation outside of the ROW will be evaluated for the risk of fall-ins. If it deemed necessary to remove vegetation outside the ROW, landowners will be contacted and vegetation will be removed or pruned at a 45-degree angle away from the line. Examples that warrant action include but are not limited to:

- Height of tree;
- Species of tree;
- Species failure characteristics;
- Growth rates;
- Local climate & rainfall patterns;
- Terrain & elevation;
- Conditions of the tree (dead, damaged, leaning towards conductor, heavy growth on the side facing the conductor, split, and soil conditions).

8.0 WORK METHODS

Basin Electric utilizes different work methods to control vegetation in and around the ROW. Since a border-wire zone method is utilized, the non-compatible vegetation is determined across the entire ROW at time of inspection to determine which control methods to utilize for removing non-compatible vegetation.

8.1 Control Methods

The different methods in which Basin Electric will remove non-compatible vegetation are:

1. Manual Control: Physical method used to cut vegetation. Manual control uses hand labor to remove or control target plants.
    a. Cutting: Utilization of power saws to control vegetation

b. Pruning and Trimming: Cutting a tree at some height up the trunk to prevent it from encroaching into the MVCD.

2. Mechanical Control: Employ machines (blade, bucket, and backhoe equipment, grinders, and masticators) to remove or control target vegetation.

   a. Timber Harvest Technique: A technique used to remove large trees from the ROW.

   b. Mowing or Grinding Vegetation: Mechanized equipment with high-speed rotary blades (mowers) that are used to cut, chop, flail, or shred woody vegetation.

3. Chemical Control: Herbicide (type of pesticide) used to kill or suppress the growth of unwanted plans, including trees.

   a. Selective Herbicide: Certain vegetation species are killed but other desirable plants are not significantly injured.

   b. Nonselective Herbicide: Toxic to plants without regard to species.

***Note:** All Chemical Control is done by a nationally recognized entity that abides by all Federal, State, and Local Regulations including only utilizing chemicals approved for use on vegetation.*

8.2 Safety Considerations

When controlling vegetation using any one of the methods mentioned above, the laws, rules, and regulations regarding public and worker safety that are to be followed include:

- ANSI Z133
- OSHA 1910.269

8.3 Controlling Hazard Trees

Danger trees that exhibit an increased level of concern due to disease, damage, physical location, growth characteristics or environmental problems may result in these trees being considered a hazard tree. Hazard trees constitute a higher level of potential contact with the transmission lines and are considered as a high-priority risk that needs to be addressed and corrected.

Hazard Trees are identified by the following characteristics:

- Species
  - Typically, fast growing and/or structurally weak trees would constitute a higher level of hazard
  - Tree species that are highly susceptible to damage from insects or pathogens may also result in these species designated as potentially problematic species of concern.
- Decay or damage
  - Exhibition of outward signs of decay or structural damage that could result in failure and potential contact with transmission lines. Decay may be present when trees possess dead limbs, cavities, off color or dead foliage, cankers, fungus or loss of bark.

- Disease or insect problems
    - Trees that are prone to disease or insect damage that may raise the level of risk these trees pose when their location places them in close proximity to the transmission lines.
- Growth characteristics
    - Trees with unusually significant lean towards the line or trees that have lost large portions of their crown or have large leaders that are not in proportion with the rest of the crown present potential problems due to their current growth patterns.
- Location
    - Location of a tree with respect to the transmission lines is the first qualifier for any hazard tree assessment. The possible locations of the line under any and all operating conditions must be evaluated and considered when determining if a tree has the potential to contact the lines upon failure. Another possible location issue is the side of the line or right-of-way where the tree is located.
- Environmental factors
    - Trees located in or near wetlands and stream channels that may have been impacted by construction activities, any animal activity such as beaver or wood pecker, a fire damage tree may pose a higher risk of hazard, or any logging activity area would also provide a high risk of hazard trees.

9.0 SPECIAL CIRCUMSTANCES

9.1 Handling Imminent Threats

Basin Electric shall communicate vegetation conditions that are likely to cause a Fault at any moment to the appropriate control center switching authority (Transmission Operator) by utilizing the "*Vegetation Imminent Threat Procedure*".

9.2 Vegetation Management Constraints

In some circumstances, Basin Electric may be constrained from performing vegetation work on an applicable line. For this constraint, Basin Electric must always take corrective action to ensure continued vegetation management to prevent encroachments into the MVCD as the constraint may lead to a vegetation encroachment into the MVCD prior to the implementation of the next annual work plan.

The maintenance strategy section within this Program defines the expected extent of clearing. If the clearance specifications cannot be achieved at the time of scheduled maintenance, Basin Electric shall implement corrective action. This corrective action shall be documented and may include more frequent maintenance or more frequent inspections to monitor the risk to the system.

Restrictions on scheduled work may include refusals by property owners to access or perform work, orders to stop work by local authorities, or restrictions by federal and state agencies. These restrictions will be brought to management for action. While negotiations or legal action with governmental entities or landowners is under way, Basin Electric will manage the restriction to prevent encroachment into

MVCD. These actions will be documented as evidence that appropriate action was taken to prevent encroachment to the MVCD.

10.0 INSPECTIONS

Basin Electric performs annual vegetation inspections which includes inspecting and identifying all non-compatible vegetation within and/or adjacent to the ROW of all (100%) of Basin Electric applicable transmission facilities. The annual vegetation inspections are defined as one (1) calendar year and cannot exceed 18 calendar months from the last vegetation inspection date on the same ROW. The Annual Vegetation Inspections also include the review and identification of any hazard trees that may require a more thorough investigation to determine if it poses an imminent threat.

This annual vegetation inspection timing and number of inspections is flexible. Basin Electric may increase the number of inspections or adjust schedules based on changing conditions that could include storms, locally heavy rainfall or high winds, landowner intervention and tree mortality caused by disease outbreaks or insect infestations.

Basin Electric tracks inspections by transmission line pole (structure) for each applicable line. A work plan will be maintained to ensure inspections are on schedule and as evidence that Basin Electric completed 100% of its inspections.

11.0 ANNUAL WORK PLAN

Basin Electric is to complete 100% of the annual vegetation work plan of its applicable lines to ensure that no vegetation encroachments occur within the MVCD. The percent (%) completed calculation is based on the number of units actually completed divided by the number of units in the final amended plan measured in transmission line structures. All modifications to the work plan, whether in response to changing conditions or to findings from vegetation inspections may be made (provided they do not allow encroachment of vegetation into the MVCD) and must be documented.

Basin Electric's annual work plan takes into consideration and may be adjusted based on any one or a combination of the following:

- Change in expected growth rate/environmental factors;
- Circumstances that are beyond the control of an applicable Transmission Owner or applicable Generator Owner;
- Rescheduling work between growing seasons;
- Crew or contractor availability/mutual assistance agreements;
- Identified unanticipated high priority work;
- Weather conditions/accessibility;
- Permitting delays;
- Land ownership changes/change in land use by the landowner;
- Emerging technologies.

12.0 TRAINING

Basin Electric shall conduct annual training for all personnel who perform the functions and tasks related to this Program. The training shall include this Program, the Vegetation Imminent Threat Procedure, communication and coordination with the transmission operator and management, and the regulations that govern the safe working practices for utilities performing vegetation management around transmission facilities.

13.0 REPORTING

Basin Electric's transmission line personnel shall submit a quarterly report to the transmission compliance division identifying all sustained outages and all vegetation encroachments into the MVCD of applicable lines determined by Basin Electric to have been caused by vegetation. If no vegetation related sustained outages have occurred during the quarter, then the report shall indicate as such. Basin Electric transmission compliance division shall submit the completed quarterly report to the applicable regional entity.

14.0 REVIEW & APPROVAL INTERVALS

This document entitled "*Transmission Line Vegetation Management Program*" shall be updated, as necessary, by the Document Owner and any applicable Subject Matter Experts (SMEs). All updates to this document shall be reviewed & approved by the Document Owners(s) at least every three years or more frequently as required. If no changes to the document have been identified within the three year approval cycle, then Basin Electric shall re-approve the current version as is.

15.0 DOCUMENT CONTROL

To maintain document integrity, all formatting changes to the document will be the responsibility of the Transmission Compliance division. The Document Owner and any applicable Subject Matter Experts (SMEs) shall make changes, additions and updates to the content of this document, and the Transmission Compliance division will provide a "Final" version of this document for review and approval by the Document Owner.

16.0 RETENTION PERIOD

This document and all associated documents will be retained in a secure repository for a minimum of ten (10) years.

Basin Electric will keep data or evidence to show compliance for three calendar years unless directed by the Midwest Reliability Organization (MRO) and/or Western Electricity Coordinating Council (WECC) to retain specific evidence for a longer period of time as part of an investigation.

Basin Electric will retain data or evidence to show compliance with notifications to the control center holding switching authority for confirmed existence of a vegetation condition that is likely to cause a Fault at any moment for at least 12 months unless directed by the Midwest Reliability Organization (MRO) and/or Western Electricity Coordinating Council (WECC) to retain specific evidence for a longer period of time as part of an investigation.

17.0 REFERENCE DOCUMENTS

The following documents are referenced and may be considered as an extension of this document:

- Basin Electric's "*Reliability Standards Compliance Program*", Version 1.0, dated September 3, 2008;
- United States Department of Agriculture (USDA) Rural Utilities Service (RUS) Bulletin 1728F-811 *"Electric Transmission Specifications and Drawings, 115 kV Through 230kV"*, dated April 1998;
- ANSI A300 (Part 1) *"for Tree Care Operations – Tree, Shrub, and Other Woody Plant Management – Standard Practices (Pruning)"*, Revision of ANSI A300 (Part1) – 2001, dated 2008;
- ANSI A300 (Part 7) *"for Tree Care Operations – Tree, Shrub, and Other Wood Plant Maintenance – Standard Practices (Integrated Vegetation Management a. Electric Utility Rights-of-way"*, dated 2006;
- National Electrical Safety Code;
- Occupational Safety & Health Administration (OSHA) 1910.269 Standard – *"Electric Power Generation, Transmission, and Distribution"*;
- ANSI Z133.1 Standard – *"Pruning, Repairing, Maintaining, and Removing Trees, and Cutting Brush Safety Requirements"*;
- North American Electric Reliability Corporation (NERC) Reliability Standard FAC-003-4, "*Transmission Vegetation Management*", effective October 1, 2016

REVISION HISTORY

CURRENT REVISION		
Date	Initials	Description
09/02/2016	JV	Updated section 7.3 from a single zone method to a border-wire zone method of vegetation management
07/20/2016	JV	Updated the Minimum Vegetation Clearance Distance tables. Removed the Preface

REVISION HISTORY			
Revision	**Effective Date**	**Initials**	**Description:**
1.0	10/01/2016	JV	*See Current Revision
0.0	07/01/2014	JV	Renamed the document to Transmission Line Vegetation Management Program. Developed based upon the new FAC-003-3 NERC Reliability Standard, this is the reason for the name change as to not confuse it with the old information.
Transmission Vegetation Management Program (TVMP)			
5.2	06/17/2010	DR	Reviewed & updated TVMP prior to 2010 MRO Compliance Audit. Reference to MRO webCompliance CDMS. Appendix A – Belfield (BEF) – Rhame (RHA) 230kV.
5.1	09/25/2009	DR	Updated TVMP per USE recommendations on 08/07/2009.
5.0	07/16/2009	DR	Updated Transmission Vegetation Management Program document using new Utility System Efficiencies template as a guideline.
4.0	10/10/2007	TK	Added paragraph to Vegetation Management Strategy.
3.0	10/12/2006	TK	Added Section G – Planted Vegetation and Section H – Annual Work Plan
2.0	09/08/2006	TK	Revised Section F.
1.0	11/04/2005	N/A	Added "Compatible Vegetation definition.
0.0	09/01/2004	N/A	Informal Transmission Vegetation Management Program (TVMP)

NERC

NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Transmission Vegetation Management NERC Standard FAC-003-2 Technical Reference

Prepared by the North American Electric Reliability Corporation Vegetation Management Standard Drafting Team

to ensure the reliability of the bulk power system

September, 2009

116-390 Village Blvd., Princeton, NJ 08540
609.452.8060 | 609.452.9550 fax
www.nerc.com

Table of Contents

INTRODUCTION 3
DISCLAIMER 4
DEFINITION OF TERMS 5
APPLICABILITY OF THE STANDARD 8
TRANSMISSION VEGETATION MANAGEMENT PROGRAM 10
METHODS TO CONTROL VEGETATION 11
ANSI A300 – BEST MANAGEMENT PRACTICES FOR TREE CARE OPERATIONS 12
VEGETATION INSPECTION FREQUENCY 17
ANNUAL PLANS 18
VEGETATION IMMINENT THREAT PROCEDURE 20
IMPLEMENT IMMINENT THREAT PROCEDURE 28
CONDUCT VEGETATION INSPECTIONS 29
ENCROACHMENTS WITHIN THE "MINIMUM VEGETATION CLEARANCE DISTANCES" 30
SUSTAINED OUTAGES — VEGETATION GROWING INTO CONDUCTOR 32
SUSTAINED OUTAGES — VEGETATION AND CONDUCTOR BLOWING TOGETHER 35
SUSTAINED OUTAGES — VEGETATION FALLING INTO CONDUCTOR 37
IMPLEMENT ANNUAL WORK PLAN 39
DESIGNATING SUB-200KV LINES 40
DOCUMENTING METHOD OF IDENTIFYING SUB-200KV LINES 41
APPENDIX ONE: CLEARANCE DISTANCE DERIVATION BY THE GALLET EQUATION 42
LIST OF ACRONYMS AND ABBREVIATIONS 49
REFERENCES 50

Introduction

This document is intended to provide supplemental information and guidance for complying with the requirements of Reliability Standard FAC-003-2. It is a supporting document and provides explanatory background to the requirements of the Standard. The intentions of the Standard Drafting Team in developing many key areas of this Revision are also explained in this document.

The purpose of the Standard is to improve the reliability of the electric transmission system by preventing those vegetation related outages that could lead to Cascading.

Compliance with the Standard is mandatory and enforceable.

Disclaimer

This supporting document may explain or facilitate implementation of reliability standard FAC-003-2 — Transmission Vegetation Management but does not contain any additional mandatory requirements subject to compliance review.

Definition of Terms

Active Transmission Line Right of Way* — A strip of land that is occupied by active transmission facilities. This corridor does not include the inactive Right of Way or unused part of the Right of Way intended for other facilities.

Examples of inactive or unused portions of corridors include:

1) The portions of the right of way acquired to accommodate future facilities. Power plant exits are examples where large rights of way are obtained for maximum corridor utilization and may currently have fewer lines constructed.
2) The portion of the right of way where corridor edge zones (i.e., buffer zones) are provided for vegetation to exist.
3) The portions of the right of way where double-circuit structures are installed but only one circuit is currently strung with conductors.
4) Portions of the right of way with deactivated transmission lines that are unavailable for service.

Vegetation Inspection** — The systematic examination of vegetation conditions on an Active Transmission Line Right of Way. This inspection may be combined with a general line inspection. The inspection includes the documentation of any vegetation that may pose a threat to reliability prior to the next planned inspection or maintenance work, considering the current location of the conductor and other possible locations of the conductor due to sag and sway for rated conditions.

*To be added to the NERC glossary of terms with final approval of this standard revision
** This term is listed in the NERC glossary of terms, but has been modified for the purposes of this standard and is to be modified in the NERC glossary of terms with final approval of this standard revision

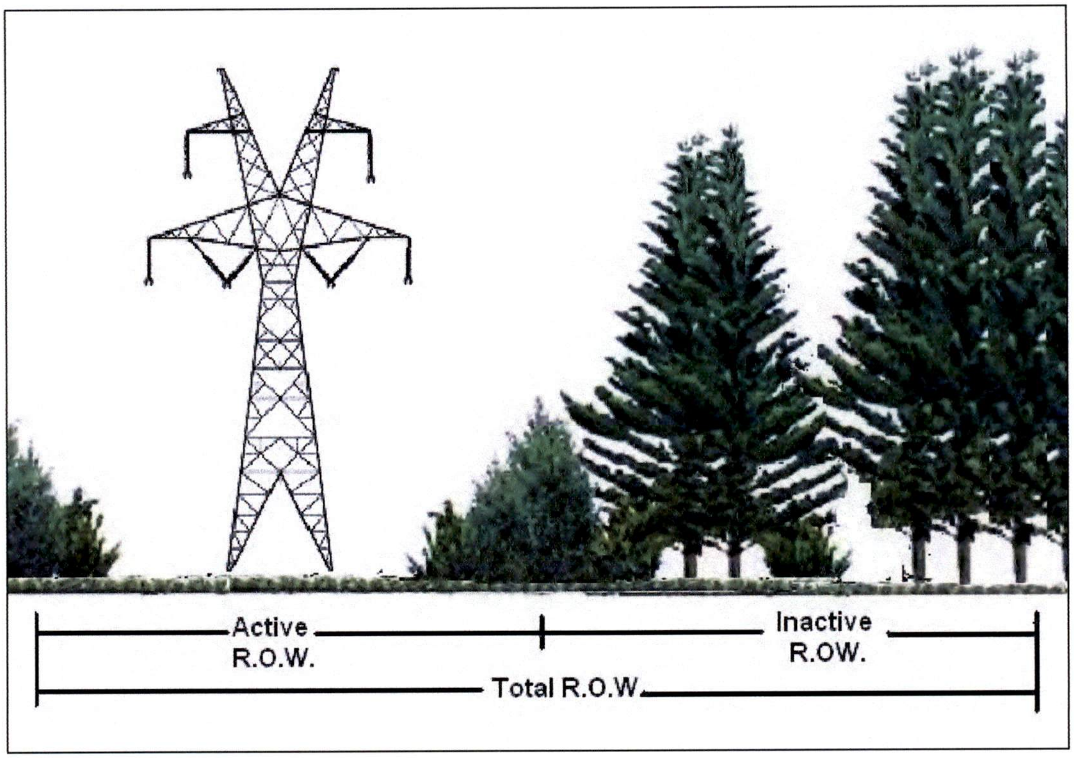


Figure 1

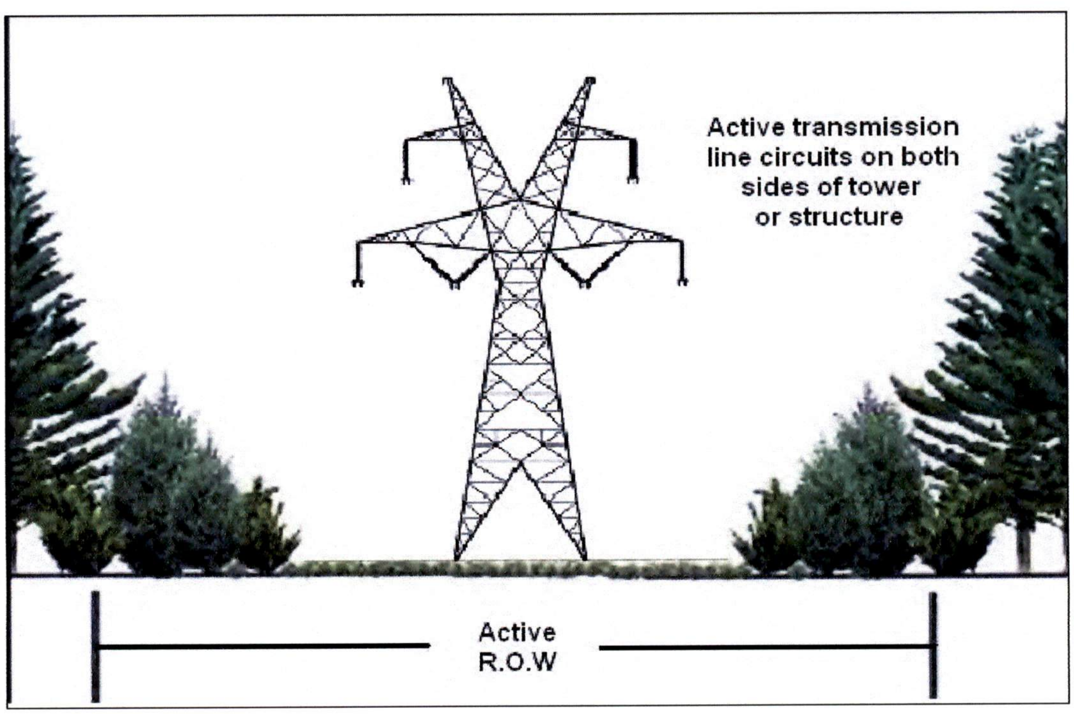


Figure 2

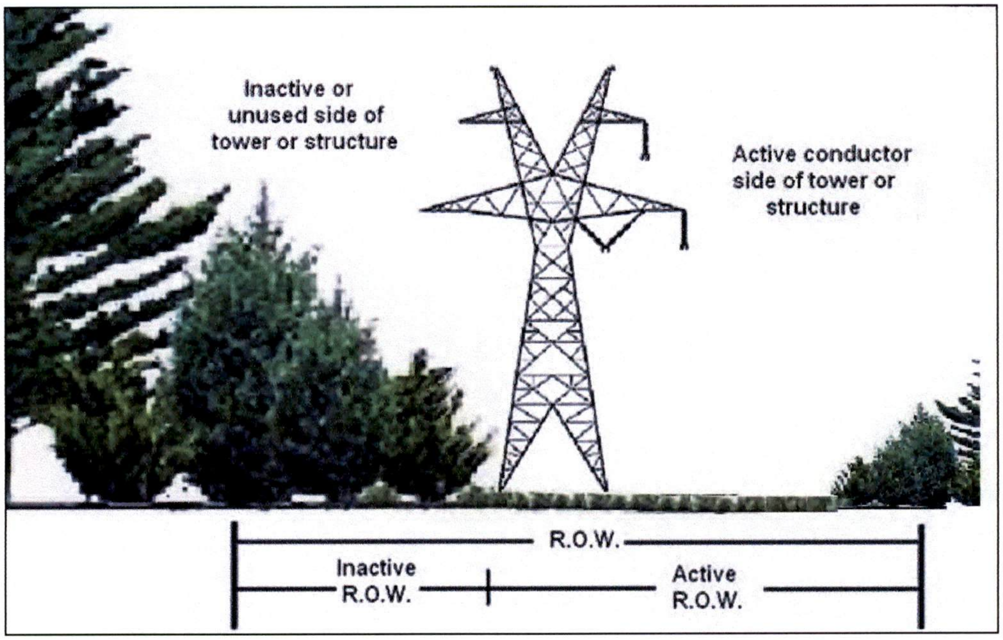

Inactive or
unused side of
tower or structure
Active conductor
side of tower or
structure
R.O.W.
Inactive
R.O.W.
Active
R.O.W.

Figure 3

Applicability of the Standard

4. ***Applicability:***

Functional Entities:

- *Transmission Owner*
- *Planning Coordinator*

Facilities:

- *Transmission lines ("applicable lines") operated at 200kV or higher, and transmission lines operated below 200kV designated by the Planning Coordinator as being subject to this standard including but not limited to those that cross lands owned by federal*[1]*, state, provincial, public, private, or tribal entities.*
- *Transmission lines operated below 200kV designated by the Planning Coordinator as being subject to this standard become subject to this standard 12 months after the date the Planning Coordinator initially designates the transmission line as being subject to this standard.*
- *Existing transmission lines operated at 200kV or higher which are newly acquired by a Transmission Owner and were not previously subject to this standard, become subject to this standard 12 months after the acquisition date of the transmissions lines.*

[1] EPAct 2005 section 1211c: *"Access approvals by Federal agencies"*

The reliability objective of this NERC Vegetation Management Standard ("Standard") is to prevent vegetation-related outages which could lead to Cascading by effective vegetation maintenance while recognizing that certain outages such as those due to vandalism, human errors and acts of nature are not preventable. Operating experience clearly indicates that trees that have grown out of specification could contribute to a cascading grid failure, especially under heavy electrical loading conditions.

Serious outages and operational problems have resulted from interference between overgrown vegetation and transmission lines located on many types of lands and ownership situations. To properly reduce and manage this risk, it is necessary to apply the Standard to applicable lines on any kind of land or easement, whether they are Federal Lands, state or provincial lands, public or private lands, franchises, easements or lands owned in fee. For the purposes of the Standard and this technical paper, the term "public lands" includes municipal lands, village lands, city lands, and a host of other governmental entities.

The Standard addresses vegetation management along applicable overhead lines that serve to connect one electric station to another. However, it is not intended to be applied to lines sections inside the electric station fence or other boundary of an electric station or underground lines.

The Standard is intended to reduce the risk of Cascading involving vegetation. It is not intended to prevent customer outages from occurring due to tree contact with all transmission lines and voltages. For example, localized customer service might be disrupted if vegetation were to make contact with a 69kV transmission line supplying power to a 12kV distribution station. However, this Standard is not written to address such isolated situations which have little impact on the overall Bulk Electric System. In fact, the inclusion of such a transmission line (which does not lead to the undesirable conditions listed in Requirement R11) on the Planning Coordinator's list of sub-200kV lines may constitute a violation of Requirement R11.

Vegetation growth is constant and always present. Unmanaged vegetation poses an increased outage risk when numerous transmission lines are operating at or near their Rating. This poses a significant risk of multiple line failures and Cascading. On the other hand, most other outage causes (such as trees falling into lines, lightning, animals, motor vehicles, etc.) are statistically intermittent. The probability of occurrence of these events is not dependent on heavy loads. There is no cause-effect relationship which creates the probability of simultaneous occurrence of other such events. Therefore these types of events are highly unlikely to cause large-scale grid failures.

In preparing the original vegetation management standard in 2005, industry stakeholders set the threshold for applicability of the standard at 200kV. This was because an unexpected loss of lines operating at above 200kV has a higher probability of initiating a widespread blackout or cascading outages compared with lines operating at less than 200kV. Thus, the 200kV threshold was an arbitrary proxy for those circuits whose Sustained Outage might lead to a Cascade.

The NERC vegetation management standard FAC-003-1 also allowed for application of the standard to "critical" circuits (critical from the perspective of initiating widespread blackouts or cascading outages) operating below 200kV. While the percentage of these circuits is relatively low, it remains a fact that there are sub-200kV circuits whose loss could contribute to a widespread outage. Given the very limited exposure and unlikelihood of a major event related to these lower-voltage lines, it would be an imprudent use of resources to apply the Standard to all sub-200kV lines. The drafting team, after evaluating several alternatives, selected the Planning Coordinator as the best entity to determine applicable lines below 200kV that are subject to this standard in a time horizon that best matches requirements for vegetation management methods.

Transmission Vegetation Management Program

R1. *Each Transmission Owner shall have a documented transmission vegetation management program that describes how it conducts work on its Active Transmission Line Rights of Way to prevent Sustained Outages due to vegetation, considering all possible locations the conductor may occupy under the effects of sag and sway throughout its operating range under rated conditions. The transmission vegetation management program shall: [Violation Risk Factor: Lower][Time Horizon: Long-term planning]*

M1. *The Transmission Owner has a documented transmission vegetation management program (paper or electronic copy of dated, current, in force document with specified elements) that describes how it conducts work on its Active Transmission Line Rights of Way to prevent Sustained Outages due to vegetation, considering all possible locations the conductor may occupy under the effects of sag and sway throughout its operating range under rated conditions. (R1)*

The purpose of the Standard is to prevent vegetation-related outages that can result in Cascading. Under Requirement R1, each Transmission Owner is required to have a transmission vegetation management program (TVMP) designed to control vegetation on the Active Transmission Line Right of Way. The TVMP is an important component of the Standard because it is the formal document that Transmission Owners use to manage vegetation to achieve the purpose of the Standard. An adequate TVMP formally establishes the guidelines that are used by the Transmission Owner to plan and perform vegetation work that is necessary to prevent transmission outages and minimize risk to the transmission system.

Requirement R1 is concerned with the content of the TVMP and supporting documents, but does not address implementation of the elements of the TVMP. Other requirements address implementation of the TVMP. For example, sub-part 1.2 requires Transmission Owners to specify a vegetation inspection frequency. However, sub-part 1.2 does not address implementation of the inspection. This is addressed in Requirement R3.

The numbered "Parts" of Requirement 1 are elements of Requirement 1 and, while these parts identify performance that is mandatory, these parts do not constitute separate Requirements. For assessing compliance, each requirement has a single Violation Risk Factor and a single set of Violation Severity Levels so that compliance is assessed with the requirement, "in total."

Methods to Control Vegetation

R1

1.1 The transmission vegetation management program shall specify the methods that the Transmission Owner may use to control vegetation.[2]

[2] *ANSI A300, Tree Care Operations — Tree, Shrub, and Other Woody Plant Maintenance – Standard Practices, while not a requirement of this standard, is considered to be an industry best practice.*

M1

1.1 The Transmission Owner's transmission vegetation management program documentation specifies the methods that the Transmission Owner may use to control vegetation.

Each Transmission Owner is required to specify the methods used to control vegetation on applicable lines in its transmission vegetation management program. The methods specified in the transmission vegetation management program under this requirement are the methods that will be applied to the development and implementation of the annual work plan (1.3 and R9).

The intent of Requirement R1, Part 1.1 is for the Transmission Owner to list and generally describe the vegetation management methods that are used on its Active Transmission Line Rights of Way. Transmission Owners are not required to deploy each of the methods listed in every situation. Nor are they required to provide a detailed description of each method, although these may exist in the Transmission Owner's specifications. Instead, the methods listed under this requirement are intended to provide a menu of vegetation management options that the Transmission Owner may deploy when developing and implementing its annual work plan based upon the many different circumstances that are typically encountered.

Pruning is an inefficient maintenance method. Removal is always superior to pruning in ensuring tree conflicts do not occur.

In general, the best management practice for the Transmission Owner is to exercise its maximum legal rights to achieve the objectives of the transmission vegetation management program. This minimizes the possibility of conflicts between energized conductors and vegetation. Since this is not always possible, the Transmission Owner's strategy should be to use its prescribed vegetation maintenance methods to work towards or achieve the maximum use of the Active Transmission Line Right of Way.

The following are several examples of how methods could be specified in the transmission vegetation management program under this requirement. These are offered as examples only and numerous other methods could be included in the transmission vegetation management program. More detailed descriptions would typically be included in the Transmission Owner's internal specifications and procedures. In summary, methods must be applied in a sound biological manner.

Mechanical Clearing — Remove all trees and brush in the Active Transmission Line Right of Way. Cut or mow all stumps to 3 inches or less above grade. De-limb and windrow on the edge of the right of way those larger trees that could be obstructive to other line maintenance activities.

Selective Mechanical Tree Removal — Selectively remove with chain saws or mechanized equipment all tall-growing species of trees, as listed in the specifications. Chemically treat the stumps of re-sprouting trees with the herbicide mixtures identified in the specification within one hour of making the cut. All low-growing species of shrubs and trees, as listed in the specification, will be preserved unless otherwise noted.

Low-Volume Foliar Selective Herbicide Treatment — Selectively treat with herbicide all tall-growing species of trees as listed in the specification which are less than ten feet in height, using the low-volume foliar herbicide mixture and application process listed in the specification. All low-growing species of shrubs and trees, as listed in the specification will be preserved unless otherwise noted.

Side Pruning — Prune trees adjacent to the Active Transmission Line Right of Way that have grown to an extent that they have encroached upon or will soon encroach upon the clearances listed in the specification. In cases where specified clearances can not be achieved due to Active Transmission Line Right of Way width restrictions, remove branches to prevent entry into the Active Transmission Line Right of Way.

ANSI A300 – Best Management Practices for Tree Care Operations

Transmission Owners have the option of adopting the procedures and practices contained in an industry-recognized ANSI Standard known as A300 for use as a central component of its vegetation management program. The following is a description of A300.

Introduction

Integrated Vegetation Management (IVM) is a best management practice conveyed in the American National Standard for Tree Care Operations, Part 7 (ANSI 2006) and the International Society of Arboriculture's *Best Management Practices: Integrated Vegetation Management* (Miller 2007). IVM is consistent with the requirements in FAC-003-02, and it provides practitioners with what industry experts consider to be the most appropriate techniques to apply to electric right of way projects in order to exceed those requirements.

IVM is a system of managing plant communities whereby managers set objectives, identify compatible and incompatible vegetation, consider action thresholds, and evaluate, select and implement the most appropriate control method or methods to achieve set objectives. The choice of control method or methods should be based on their environmental impact and anticipated effectiveness, along with site characteristics, security, economics, current land use and other factors.

Planning and Implementation

Best management practices provide a systematic way of planning and implementing a vegetation management program. While designed primarily with transmission systems in mind, it is also applicable to distribution projects. As presented in ANSI A300 part 7 and the ISA best management practices, IVM consists of 6 elements:

1) Set Objectives
2) Evaluate the Site
3) Define Action Thresholds
4) Evaluate and Select Control Methods
5) Implement IVM
6) Monitor Treatment and Quality Assurance

The setting of objectives, defining action thresholds, and evaluating and selecting control methods all require decisions. The planning and implementation process is cyclical and continuous, because vegetation is dynamic and managers must have the flexibility to adjust their plans. Adjustments may be made at each stage as new information becomes available and circumstances evolve.

Set Objectives

Objectives should be clearly defined and documented. Examples of objectives can include promoting safety, preventing outages caused by vegetation growing into electric facilities and minimizing them from trees growing outside the right of way, maintaining regulatory compliance, protecting structures and security, restoring electric service during emergencies, maintaining access and clear lines of sight, protecting the environment, and facilitating cost effectiveness.

Objectives should be based on site factors, such as workload and vegetation type, in addition to available human, equipment and financial resources. They will vary from utility to utility and project to project, depending on line voltage and criticality, as well as topographical, environmental, fiscal and political considerations. However, where it is appropriate, the overriding focus should be on environmentally-sound, cost effective control of species that potentially conflict with the electric facility, while promoting compatible, early successional, sustainable plant communities.

Work Load Evaluations

Work-load evaluations are inventories of vegetation that could have a bearing on management objectives. Work load assessments can capture a variety of vegetation characteristics, such as location, height, species, size and condition, hazard status, density and clearance from conductors. Assessments should be conducted considering voltage, conductor sag from ambient temperatures and loading, and the potential influence of wind on line sway.

Evaluations can be comprehensive or point sample, and can be done to obtain information on an entire program or an individual project. Comprehensive evaluations account for vegetation that could potentially affect management objectives, including hazard trees. Program-level comprehensive evaluations can be made of all target vegetation on a system, while project-level evaluations focus on vegetation relevant to a specific job. Comprehensive evaluations provide the advantage of supplying a complete set of data upon which to base management decisions. On the other hand, comprehensive surveys can be impractical for utilities with large numbers of trees, limited human and financial resources, or both.

Point sampling offers an alternative for utilities for which comprehensive inventories are impractical. Point sampling is cost effective, and has a proven track record for reasonable accuracy. A common method involves dividing a management area (a system or project) into equal-sized units and selecting a random sample sufficient to statistically represent the total work quantity. Random selection eliminates the chance of bias on the part of the investigator. Every plant or plant community of interest within each selected area is inventoried, with collected data used to forecast the total workload.

Evaluate and Select Control Methods

Control methods are the process through which managers achieve objectives. The most suitable control method best achieves management objectives at a particular site. Many cases call for a combination of methods. Managers have a variety of controls from which to choose, including manual, mechanical, herbicide and tree growth regulators, biological, and cultural options.

Manual Control Methods

Manual methods employ workers with hand-carried tools, including chainsaws, handsaws, pruning shears and other devices to control incompatible vegetation. The advantage of manual techniques is that they are selective and can be used where others may not be. On the other hand, manual techniques can be inefficient and expensive compared to other methods. If pruning is necessary, it should comply with ANSI A300 Part 1 (ANSI 2001) and ISA best management practices for utility pruning (Kempter 2004).

Mechanical Control Methods

Mechanical controls are done with machines. They are efficient and cost effective, particularly for clearing dense vegetation during initial establishment, or reclaiming neglected or overgrown rights of way. On the other hand, mechanical control methods can be non-selective and disturb sensitive sites.

Tree Growth Regulator and Herbicide Control Methods

Tree growth regulators and herbicides are essential for effective vegetation management. Tree growth regulators (TGRs) are designed to reduce growth rates by interfering with natural plant processes. TGRs can be helpful where removals are prohibited or impractical by reducing the growth rates of some fast-growing species.

Herbicides control plants by interfering with specific botanical biochemical pathways. Herbicide use can control individual plants that are prone to re-sprout or sucker after removal. When trees that re-sprout or sucker are removed without herbicide treatment, dense thickets develop, impeding access, swelling workloads, increasing costs, blocking lines-of-site, and deteriorating wildlife habitat. Treating suckering plants allows early successional, compatible species to dominate the right of way and out-compete incompatible species, ultimately reducing work.

Cultural Control Methods
Cultural methods modify habitat to discourage incompatible vegetation and establish and manage desirable, early successional plant communities. Cultural methods take advantage of seed banks of native, compatible species lying dormant on site. In the long run, cultural control is the most desirable method where it is applicable.

A cultural control known as cover-type conversion provides a competitive advantage to short-growing, early successional plants, allowing them to thrive and eventually out-compete unwanted tree species for sunlight, essential elements and water. The early successional plant community is relatively stable, tree-resistant and reduces the amount of work, including herbicide application, with each successive treatment.

Wire-Border Zone
The wire-border zone technique is a management philosophy that can be applied through cultural control. W.C. Bramble and W.R. Byrnes developed it in the mid-1980s out of research begun in 1952 on a transmission right of way in the Pennsylvania State Game Lands 33 Research and Demonstration project (Yahner and Hutnik (2004).

The wire zone is the section of a utility transmission right of way directly under the wires and extending outward about 10 feet on each side. The wire zone is managed to promote a low-growing plant community dominated by grasses, herbs and small shrubs (under 3 feet in height at maturity). The border zone is the remainder of the right of way. It is managed to establish small trees and tall shrubs (under 25 feet in height at maturity). When properly managed, diverse, tree-resistant plant communities develop in wire and border zones. The communities not only protect the electric facility and reduce long-term maintenance, but also enhance wildlife habitat, forest ecology and aesthetic values.

Although the wire-border zone is a best practice in many instances, it is not necessarily universally suitable. For example, standard wire-border zone prescriptions may be unnecessary where lines are high off the ground, such as across low valleys or canyons, so the technique can be modified without sacrificing reliability.

One way to accommodate variances in topography is to establish different regions based on wire height. For example, over canyon bottoms or other areas where conductors are 100 feet or more above the ground, only a few trees are likely to be tall enough to conflict with the lines. In those cases, trees that potentially interfere with the transmission lines can be removed selectively on a case-by-case basis.

In areas where the wire is lower, perhaps between 50-100 feet from the ground, a border zone community can be developed throughout the right of way. Note that in many cases, conductor attachment points are more than 50 feet off the ground, so a border zone community can be cultivated near structures. Where the line is less than 50 feet off the ground, managers could apply a full wire-border zone prescription.

An environmental advantage of this type of modification is stream protection. Streams often course through the valleys and canyons where lines are likely to be elevated. Leaving timber or border zone communities in canyon bottoms helps shelter this valuable habitat, enabling managers to achieve environmentally sensitive objectives.

Implement Integrated Vegetation Management (IVM)
All laws and regulations governing IVM practices and specifications written by qualified vegetation managers must be followed. IVM control methods should be implemented on regular work schedules, which are based on established objectives and completed assessments. Work should progress systematically, using control measures determined to be best for varying conditions at specific locations along a right of way. Some considerations used in developing schedules include the importance and type of line, vegetation clearances, work loads, growth rate of predominant vegetation, geography, accessibility, and in some cases, time lapsed since the last scheduled work.

Clearances Following Work
Clearances following work should be sufficient to meet management objectives, including preventing trees from entering the Minimum Vegetation Clearance Distance, electric safety risks, service-reliability threats and cost.

Monitor Treatment and Quality Assurance
An effective program includes documented processes to evaluate results. Evaluations can involve quality assurance while work is underway and after it is completed. Monitoring for quality assurance should begin early to correct any possible miscommunication or misunderstanding on the part of crewmembers. Early and consistent observation and evaluation also provides an opportunity to modify the plan, if need be, in time for a successful outcome.

Utility vegetation management programs should have systems and procedures in place for documenting and verifying that vegetation management work was completed to specifications. Post-control reviews can be comprehensive or based on a statistically representative sample. This final review points back to the first step and the planning process begins again.

Summary
IVM offers among others, a systematic way of planning and implementing a vegetation management program as presented in ANSI A300 Part 7. This methodology enables a program to comply with the NERC *Transmission Vegetation Management Program* standard (FAC-003-2). Managers should select control options to best promote management objectives.

Vegetation Inspection Frequency

R1

> ***1.2*** *The transmission vegetation management program shall specify a Vegetation Inspection frequency of at least once per calendar year that takes into account local*[4] *and environmental factors.*

M1

> ***1.2*** *The Transmission Owner's transmission vegetation management program documentation specifies a Vegetation Inspection frequency of at least once per calendar year that takes into account local and environmental factors.*

[4] Local factors include items such as treatment cycle, extent and type of treatment, and their relationship to the normal growth rate.

The Transmission Owner's Transmission Vegetation Management Program (TVMP) shall specify the frequency of vegetation inspections. The inspection frequency is required to be at least once per calendar year. Transmission Owners should consider local and environmental factors that could warrant more frequent inspections. Such factors may include anticipated growth rates of the local vegetation, length of the growing season for the geographical area, limited Active Transmission Line Right of Way widths, rainfall amounts, etc.

Annual Plans

R1

> ***1.3.*** *The transmission vegetation management program shall require an annual work plan. An annual work plan shall:*
>
> ***1.3.1*** *Identify the applicable lines to be maintained*
>
> ***1.3.2*** *Identify the work to be performed and methods to be used*
>
> ***1.3.3*** *Be flexible to adjust to changing conditions and to findings from Vegetation Inspections. Adjustments to the plan within the year are permissible.*
>
> ***1.3.4*** *Take into consideration permitting and scheduling requirements from landowners or regulatory authorities.*

M1

> ***1.3*** *The Transmission Owner's transmission vegetation management program contains an annual work plan which:*
>
> ***1.3.1*** *Identifies the applicable lines to be maintained*
>
> ***1.3.2*** *Identifies the work to be performed and the methods used*
>
> ***1.3.3*** *Shows flexibility to adjust to changing conditions and to findings from Vegetation Inspections*
>
> ***1.3.4*** *Considers permitting and scheduling requirements from landowners or regulatory authorities*

The work plan is not intended to be a "span-by-span" detailed description of all work to be performed. It is intended to require the Transmission Owner to annually plan and schedule vegetation work to prevent encroachment into the Minimum Vegetation Clearance Distance. Work plans can vary in their level of detail.

The flexibility to adjust the annual work plan in response to changing conditions must not be invoked in a manner that adversely impacts reliability. The intent of the standard drafting team was to allow adjustments for changing conditions of the vegetation on the Active Transmission Line ROW, emergencies, and other significant changing conditions, and not for budget constraints. Annual work plan adjustments must always ensure the reliability of the electric transmission system.

This Standard requires that the annual work plan be flexible to allow the Transmission Owner to change priorities during the year as conditions or situations dictate. For example, weather conditions (drought) could make herbicide application ineffective during the plan year. Another situational variance could be a major storm that redirects local resources away from planned maintenance. This situation may also include complying with mutual assistance agreements by moving resources off the Transmission Owner's system to work on another system. Examples of adjustments may include deferrals or additions to the annual work plan.

The drafting team cites the following conditions that may result in adjustments to the annual work plan: abnormal weather such as drought, major storms, excessive rainfall, other environmental conditions such as infestation, disease, fire, etc. These conditions may be found as part of a special or scheduled Vegetation Inspection. Examples of annual work plan adjustments that are permitted may include revising the work plan priorities, rescheduling work to another time or selecting alternate vegetation control methods. Changes in land usage made by a property owner, such as timber clearing, may be another condition that warrants an adjustment.

When developing the annual work plan the Transmission Owner should allow time for procedural requirements to obtain permits to work on federal, state, provincial, public, tribal lands. In some cases the lead time for obtaining permits may necessitate preparing work plans more than a year prior to work start dates. Transmission Owners may also need to consider those special landowner requirements as documented in easement instruments.

Vegetation Imminent Threat Procedure

R1.

1.4 *The transmission vegetation management program shall require a process or procedure for response to an imminent threat of a vegetation-related Sustained Outage. The process or procedure shall specify actions which shall include communication of the threat to the responsible control center.*

M1.

1.4 *The Transmission Owner's transmission vegetation management program documentation specifies an imminent threat process or procedure for responding to imminent threats of a vegetation-related Sustained Outage including communication of the threat to the responsible control center.*

The term "imminent threat" refers to a vegetation condition which is likely to cause a Sustained Outage at any moment. An imminent threat requires immediate action by the Transmission Owner to alert the responsible control center (usually the Transmission Operator) that there is an increased probability of the occurrence of a Sustained Outage.

Two key elements of an acceptable imminent threat process or procedure are outlined below:

- Specify the vegetation-related conditions that warrant a response:

  Examples of these vegetation-related conditions include vegetation that is near or encroaching into the MVCD (growth issue) or vegetation that presents an imminent danger of falling into the transmission conductor (fall-in issue).

- Notify the responsible control center:

  So that the responsible control center holds situational awareness of known risks to the power system, the Transmission Owner has the responsibility to ensure the proper communication between field personnel and the responsible control center. This will allow the responsible control center to take the appropriate action until the threat is relieved. Appropriate actions may include, but are not limited to, a temporary reduction in the line loading, or switching the line out of service.

  The protocol for contacting the responsible control center should be defined. For example, some Transmission Owners' processes may require a call directly to the responsible control center, while other Transmission Owners may require a call to a supervisor or field forester who will in turn notify the responsible control center .

The urgency of vegetation-related imminent threats may be contrasted with the longer time frames of interim corrective action plans which are developed from a corrective action process as defined in Requirement R1, Part 1.5.

The imminent threat process or procedure should be implemented in terms of minutes or hours as opposed to a longer time frame for interim corrective action plans.

All serious growth or fall-in vegetation-related conditions are not necessarily considered imminent threats under the Standard. For example, some Transmission Owners may have a danger tree identification program that identifies for removal trees with the potential to fall near the line. These trees are not necessarily considered imminent threats under the Standard unless they pose an immediate fall-in threat.

Also, there can be situations involving vegetation that are not considered vegetation-related imminent threats under the Standard. For example, a logging operation on or near the Active Transmission Line Right of Way can pose an immediate threat of a sustained outage and result in the initiation of an imminent threat process in the same manner as the presence of a nearby crane or the notification of a hot-spot on a conductor connector. Although the logging threat in this example tangentially involves vegetation, it is not considered a vegetation-related imminent threat under the Standard.

Interim Corrective Action Process

R1.

> ***1.5.*** *The transmission vegetation management program shall specify an interim corrective action process for use when the Transmission Owner is temporarily constrained from performing vegetation maintenance as planned.*

M1

> ***1.5*** *The Transmission Owner's transmission vegetation management program documentation specifies the interim corrective action process for use when the Transmission Owner is temporarily constrained from performing vegetation maintenance as planned.*

The intent of this requirement is to deal with situations that temporarily prevent the Transmission Owner from performing planned vegetation management work and, as a result, have the potential to put the transmission line at risk. This is not intended to address situations where an alternate work method can be substituted for the planned method. For example, a land owner may prevent the planned use of chemicals but allow the use of mechanical clearing. In this case the Transmission Owner can still perform work sufficient to eliminate the risk to the transmission line and does not need an interim corrective action plan. However, in situations where transmission line reliability is at risk due to a constraint and an alternate work method will not suffice, the Transmission Owner is required to develop a specific interim corrective action plan to mitigate the potential risk to the transmission line during the interim period.

The interim corrective action process should be flexible to provide a framework that can be applied over a wide range of situations to ensure line reliability.

Elements of the interim corrective action process include:

- Identifying locations where the Transmission Owner is constrained from performing planned vegetation maintenance work.
- Developing the specific plan to mitigate the risk associated with not performing the vegetation maintenance work as planned.
- Documenting and tracking the specific plan for each location.

Constraints to performing vegetation maintenance work as planned could result from legal injunctions filed by property owners, the discovery of easement stipulations which limit the Transmission Owner's rights, or other circumstances.

In developing a specific plan to mitigate the risk to the transmission line, the Transmission Owner could consider location-specific measures such as modifying inspection and/or maintenance intervals. Where a legal constraint would not allow any vegetation work, the interim corrective action plan could include limiting the loading on the transmission line.

The Transmission Owner should document and track each specific corrective action work plan by location. This location may be indicated as one span, one tree or a combination of spans on one property where the constraint is considered to be temporary.

Maintenance Strategies

R1.

1.6 *The transmission vegetation management program shall specify the maintenance strategies used (such as minimum vegetation-to-conductor distance or maximum vegetation height) to ensure that Table 1 clearances in FAC-003-2-Attachment 1 are never violated. The maintenance strategies shall consider the sag and sway of the conductor throughout its operating range under rated conditions.*

M1.

1.6 *The Transmission Owner's transmission vegetation management program documentation specifies the maintenance strategies used (such as minimum vegetation-to-conductor distance or maximum vegetation height) to ensure that Table 1 clearances in FAC-003-2-Attachment 1 are never violated. The maintenance strategies consider the sag and sway of the conductor throughout its operating range under rated conditions.*

For a Transmission Owner to develop a specific maintenance strategy, it is important to understand the dynamics of a line conductor's movement. First, the complexities inherent in observing and predicting conductor movement, particularly for field personnel, will be addressed. Then, some examples of maintenance strategies that take into account these complexities will be described.

The phrase in Requirement R1 Part 1.6 that reads ". . . ensure that Table 1 clearances in FAC-003-2-Attachment 1 are never violated." is intended to require the TO to design its maintenance strategies considering all possible locations of the conductor for rated design conditions, and not to suggest that a compliance violation exists merely by a possible future proximity of the conductor to vegetation. Requirement R4 indicates that a real-time MVCD encroachment will result in a compliance violation.

Understanding Conductor Position and Movement

The conductor's position in space at any point in time changes as a reaction to a number of different loading variables. Vertical and horizontal conductor movement results from variations in thermal and physical loads applied to the line. Thermal loading is a function of line current and the combination of numerous variables influencing ambient heat dissipation including wind velocity/direction, ambient air temperature and precipitation. Physical loading applied to the conductor affects sag and sway by combining physical factors such as ice and wind loading

When calculating the range of conductor positions, the Transmission Owner should use the same design criteria and assumptions that the Transmission Owner uses when establishing Ratings. Typically, the greatest conductor movement is at mid-span. As the conductor moves through various positions, a spark-over zone surrounding the conductor moves with it. The radius of the spark-over zone may be found by referring to Table 1 ("Minimum Vegetation Clearance Distances") in the standard. For illustrations of this zone and conductor movements, Figures 4 through 6 on the following pages demonstrate these concepts. At the time of making a field observation, however, it is very difficult to precisely know where the conductor is in relation to its wide range of all possible positions. Therefore, Transmission Owners must adopt maintenance strategies that account for this dynamic situation.

Selecting a Maintenance Strategy

To maintain adequate separation between vegetation and transmission line conductors, the Transmission Owner must craft a maintenance strategy that keeps vegetation well away from the spark-over zone mentioned above. In fact, it is generally necessary to incorporate a variety of maintenance strategies. For example, one Transmission Owner may utilize a combination of routine cycles, traditional Integrated Vegetation Management (IVM) techniques and long-term planning. Another Transmission Owner may place a higher reliance on frequent inspections and quick remediation as opposed to a cyclical approach. This variation of strategies is further warranted when factors, such as terrain, legal and other constraints, vegetation types, and climates, are considered in developing a Transmission Owner's specific strategy to satisfying this requirement.

The following is a sample description of one combination of strategies which may be utilized by a Transmission Owner.

A Transmission Owner's basic maintenance strategy could be to remove all incompatible vegetation from the right of way if it has the right to do so and has no constraints. In mountainous terrain, however, this strategy could change to one where the Transmission Owner manages vegetation based on vegetation-to-conductor clearances, since it might not be necessary to remove vegetation in a valley that is far below.

If faced with constraints and assuming a line design with sufficient ground clearance, the Transmission Owner 's strategy could then be to allow vegetation such as fruit trees, but perhaps only up to a given height at maturity (perhaps 10 feet from the ground). If constraints cannot be overcome and if design clearances are sufficient, an exception to the Transmission Owner's 10-foot guideline might be made. Finally, if the Transmission Owner has chosen to utilize vegetation-to-conductor clearance distance methods, the Transmission Owner could have an inspection regimen in place to regularly ensure that any impending clearance problems are identified early for rectification.

Additional information regarding proper maintenance strategies for achieving and ensuring Table I clearances can be found in the "Methods to Control Vegetation" and "Vegetation Inspection Frequency" sections of this document.

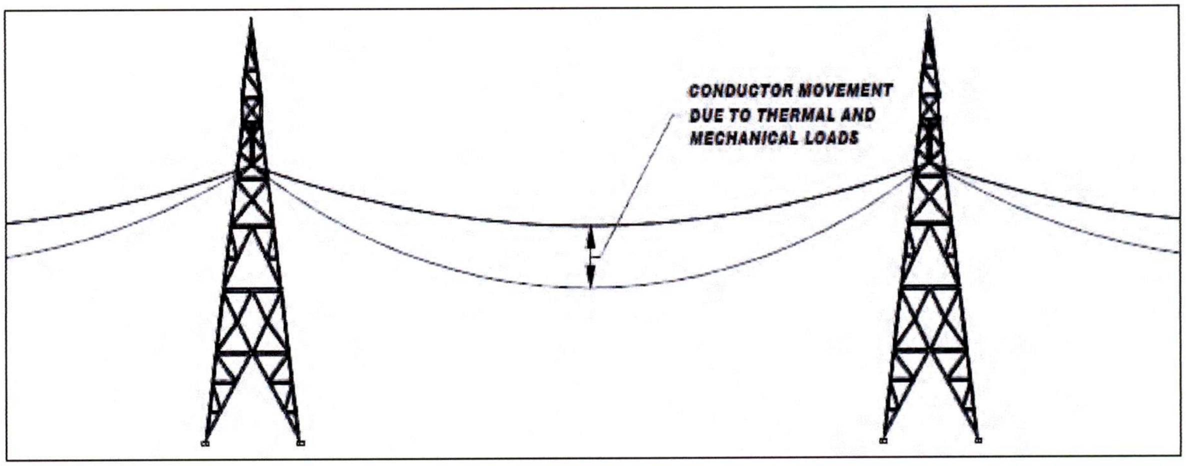


Figure 4

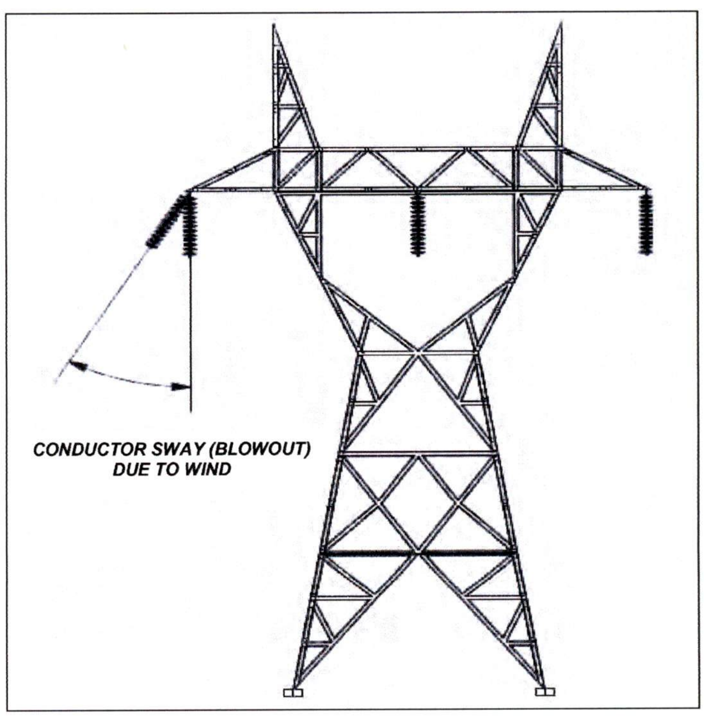


Figure 5

Cross-Section View of a Single Conductor
at a Given Point along the Span
Showing Six Possible Conductor Positions Due to Movement
Resulting from Thermal and Mechanical Loading
For Consideration in Developing a Maintenance Strategy

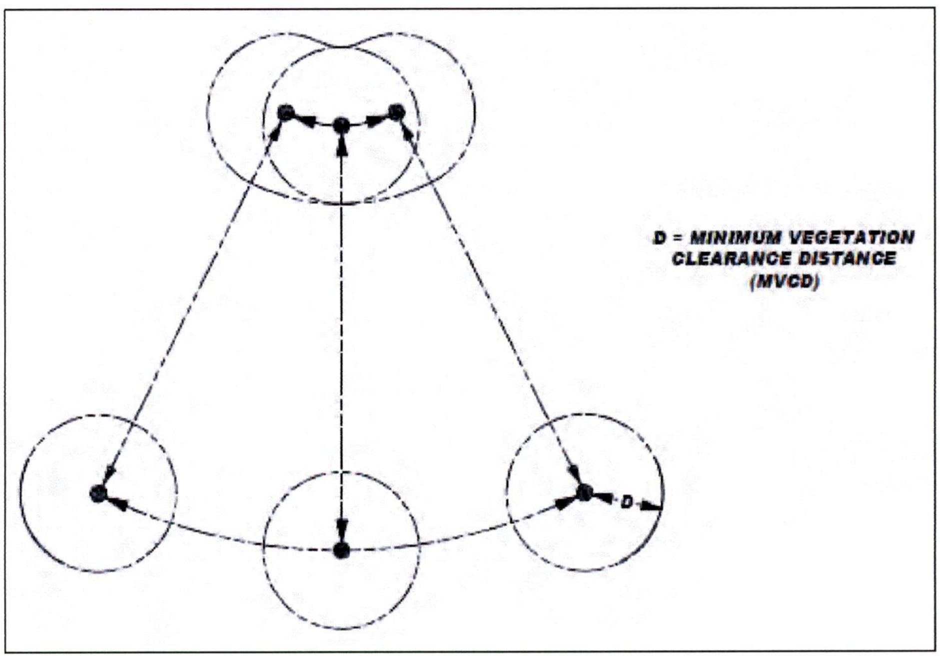


Figure 6

Implement Imminent Threat Procedure

R2. *Each Transmission Owner shall implement its imminent threat process or procedure when the Transmission Owner has actual knowledge of such a threat, obtained through normal operating practices. [Violation Risk Factor- Medium][Time Horizon – Real Time]*

M2. *The Transmission Owner has evidence of the implementation of its vegetation imminent threat process or procedure showing what was done with dates and activities accomplished. (R2)*

Each Transmission Owner must implement its imminent threat process or procedure when the Transmission Owner becomes aware of and confirms the existence of such a vegetation-related threat. The Transmission Owner could learn of the threat through a variety of normal operating practices, including routine line inspections, reports from landowners, observations made by public safety agencies or other utilities, etc. If a situation requires the Transmission Owner to implement its imminent threat process or procedure, it must retain some evidence of the threat and its response as outlined by Measure M2.

Conduct Vegetation Inspections

R3. *Each Transmission Owner shall conduct Vegetation Inspections of all applicable lines (as measured in line miles) in accordance with the frequency specified in its transmission vegetation management program, unless constrained by natural disasters[4]. When constrained by a natural disaster, the Transmission Owner shall conduct the Vegetation Inspection(s) within six months or a period agreed to by its Regional Entity, whichever is greater. [Violation Risk Factor: Medium][Time Horizon: Operations Planning]*

[4] Examples include, but are not limited to, earthquakes, fires, tornados, hurricanes, landslides, wind shear, fresh gale, major storms as defined either by the Transmission Owner or an applicable regulatory body, ice storms, and floods.

M3. *The Transmission Owner has evidence that it conducted Vegetation Inspections in accordance with Requirement R3.*

This requirement is the implementation requirement for the Vegetation Inspections identified in Requirement R1, Part 1.2. The Standard allows Vegetation Inspections to be performed in conjunction with general line inspections. The inspections will be measured in line miles based on the defined inspection frequency.

The measure of "line miles" was selected so that if a Transmission Owner were to fail to completely inspect its system according to its stated frequency, an appropriate Violation Severity Level would be determined based upon the percentage of the system that was actually inspected.

As an example, where a Transmission Owner operates 1,000 miles of 230kV transmission lines with a stated Vegetation Inspection frequency (Requirement R1, Part 1.2) of twice per year; this Transmission Owner will be responsible for inspecting all 1,000 miles of 230kV transmission lines two times during the calendar year. This would yield a "total line miles inspection plan" of 2,000 miles for that calendar year.

Continuing with this example, if the Transmission Owner completed inspections of more than 1900 miles or 95% of its 2,000-mile but not 100% of the full 2000 miles, then, a VSL of "Moderate" would be used in determining a sanction.

In the event that extensive resources are devoted to a lengthy service restoration following a natural disaster on its own system or by assisting another utility, the Transmission Owner is permitted to reasonably postpone its line inspections until the resource constraint is relieved.

Encroachments within the "Minimum Vegetation Clearance Distances"

R4. *Each Transmission Owner shall prevent encroachment of vegetation into the Minimum Vegetation Clearance Distances (MVCD) listed in FAC-003-2-Attachment 1 for its applicable lines as observed in real-time operating between no-load and their Rating, with the following exceptions: [Violation Risk Factor VRF= Medium][Time Horizon – Real Time]*

- *Encroachment into the MVCD listed in FAC-003-2-Attachment 1 resulting from natural disasters.*[4]
- *Encroachment into the MVCD listed in FAC-003-2-Attachment 1 resulting from human or animal activity.*[5]
- *Brief encroachment into the MVCD listed in FAC-003-2-Attachment 1 resulting from falling vegetation.*

[4] Examples include, but are not limited to, earthquakes, fires, tornados, hurricanes, landslides, wind shear, fresh gale, major storms as defined either by the Transmission Owner or an applicable regulatory body, ice storms, and floods.

[5] Examples include, but are not limited to, logging, animal severing tree, vehicle contact with tree, arboricultural activities or horticultural or agricultural activities, or removal or digging of vegetation.

M4. *The Transmission Owner has evidence from inspections that indicate there was no vegetation encroachment into the Minimum Vegetation Clearance Distances listed in FAC-003-2-Attachment 1 for its applicable lines as observed in real-time operating between no-load and their Rating, considering exceptions. (R4)*

This requirement indicates that if a Transmission Owner observes vegetation at a distance less than that prescribed in Table 1 of FAC-003-2-Attachment 1, it is in violation of this standard since sparkover is likely to occur. Requirement R4 refers to observation in "real time". This is an actual field observation or measurement of the conductor-to-vegetation distance and is not to be a calculated separation between the conductor and the vegetation

When possible encroachments of the MVCD are discovered through inspections or other means, the Transmission Owner must take appropriate action, which might include initiating vegetation management activities or implementation of its imminent threat process. If there is a confirmed clearance violation, the Transmission Owner must report to the Regional Entity as appropriate.

Certain exceptions are recognized in the Standard, including provisions for natural disasters and human or animal activity. Also, brief encroachments by falling vegetation are not considered to be a violation.

This requirement applies to transmission lines that are operating within their Rating. If a line is intentionally or inadvertently operated beyond its rating (potentially in violation of other standards), the occurrence of a clearance encroachment would not be a violation of this Standard. An encroachment of the MVCD that results from operation of a transmission line beyond its recognized Rating (for example emergency actions taken by an operator to protect an Interconnection) is beyond the scope of this standard.

Sustained Outages — Vegetation Growing Into Conductor

R5. *Each Transmission Owner shall prevent Sustained Outages[6] of applicable lines that are identified as an element of an Interconnection Reliability Operating Limit (IROL) (or Major WECC Transfer Path) due to vegetation growing into a conductor operating between no-load and its Rating, with the following exceptions: [Violation Risk Factor – High][Time Horizon – Real Time]*

- Sustained Outages of applicable lines that result from natural disasters.[4]
- Sustained Outages of applicable lines that result from human or animal activity.[5]

M5. *The Transmission Owner's self-certification reports are adequate evidence of no Sustained Outage of any applicable line that is identified as an element of an IROL (or Major WECC Transfer Path) due to vegetation growing into a conductor operating between no-load and its Rating. (R5)*

R6. *Each Transmission Owner shall prevent Sustained Outages[6] of applicable lines that are not an element of an IROL (or Major WECC Transfer Path) due to vegetation growing into a conductor operating between no-load and its Rating, with the following exceptions [Violation Risk Factor – High][Time Horizon – Real Time]*

- Sustained Outages of applicable lines that result from natural disasters.[4]
- Sustained Outages of applicable lines that result from human or animal activity.[5]

M6. *The Transmission Owner's self-certification reports are adequate evidence of no Sustained Outage of any applicable line that is not identified as an element of an IROL (or Major WECC Transfer Path) due to vegetation growing into a conductor operating between no-load and its Rating. (R6)*

[4] Examples include, but are not limited to, earthquakes, fires, tornados, hurricanes, landslides, wind shear, fresh gale, major storms as defined either by the Transmission Owner or an applicable regulatory body, ice storms, and floods.

[5] Examples include, but are not limited to, logging, animal severing tree, vehicle contact with tree, arboricultural activities or horticultural or agricultural activities, or removal or digging of vegetation.

[6] Multiple Sustained Outages on an individual line, if caused by the same vegetation, shall be considered as one outage regardless of the actual number of outages within a 24-hour period.

Vegetation grow-in events have contributed to several major blackouts and present a potential risk to the electric transmission system. Requirements R5 and R6 have been established to convey the seriousness of an outage caused by a vegetation grow-in and to distinguish between lines of differing impact to the system. Outages on certain lines are more likely to cause Cascading than on others. Accordingly, R5 applies to lines associated with IROLs (or major WECC transfer paths) and has been assigned a High Violation Risk Factor due to the higher probability of leading to a Cascading event. R6 applies to lines which are not associated with an

IROL (or major WECC transfer path) and has been assigned a Medium Violation Risk Factor, since outages on such lines are less likely to cause a Cascading event.

Planning Coordinators in planning time, and Reliability Coordinators in real time, determine operating limits for circuits or groups of circuits that may impact interconnected system reliability. The implication is that if these limits are exceeded; cascading, uncontrolled separation, instability, or voltage collapse might occur. Therefore these circuits or groups of circuits need to be protected from the risk of vegetation related outages. Planning Coordinators are required to identify circuits or groups of circuits that make up an IROL in NERC Standard FAC-010, Reliability Coordinators in FAC-011.

In the Western Interconnection there are some circuits or groups of circuits that do not meet the definition of an IROL, but nonetheless are very important to that Interconnection. Theses circuits or groups of circuits are classified as Major WECC Transfer Path(s) in the Western Interconnection. These are found in NERC Standard TOP-007-WECC-1.

It is important to note that for a Sustained Outage to be classified as a vegetation-related event, the conductor must be operating between no load and its Rating when the event occurs. Events that occur when the conductor is operating beyond its Rating would not be classified as vegetation-related Sustained Outages under the Standard.

Vegetation-related Sustained Outages that occur due to natural disasters are beyond the control of the Transmission Owner. These events are not classified as vegetation-related Sustained Outages and are therefore exempt from the Standard. Transmission lines are not designed to withstand the impacts of natural disasters such as tornadoes, hurricanes, severe ice loads, landslides, etc.

Sustained Outages due to human or animal activity are also beyond the control of the Transmission Owner are not classified as vegetation-related Sustained Outages and are therefore exempt from the Standard. Examples of these events may include new plantings of tall vegetation under the transmission line planted since the last Vegetation Inspection, tree contacts with line initiated by vehicles, logging activities, etc.)

Multiple Sustained Outages on an individual line can be caused by the same vegetation. Such events within a 24 hour period are considered to be a single vegetation-related Sustained Outage under the Standard. For example, a Sustained Outage caused by a tree could be mistakenly attributed to something else (e.g. contaminated insulator string, lightning, etc). After the apparent cause of the outage is addressed the line could be re-energized without the root cause being identified and removed. The transmission line could remain energized for a period of time while the thermal loading on the transmission line builds back to the point where the conductor contacts the same tree that caused the earlier Sustained Outage. These multiple outages resulting from the same tree would be considered as a single outage as long as all Sustained Outages occurred within a 24 hour period.

The Transmission Owner must self-certify each year that all vegetation-related Sustained Outages are documented and reported. If no vegetation-related Sustained Outages have occurred, a null report is sufficient documentation of compliance with these requirements.

Sustained Outages — Vegetation and Conductor Blowing Together

R7. *Each Transmission Owner shall prevent Sustained Outages[6] of applicable lines due to the blowing together of vegetation and a conductor within an Active Transmission Line Right of Way (operating within design blow-out conditions) with the following exception: [Violation Risk Factor - Medium][Time Horizon - Real Time]*

- Sustained Outages of applicable lines that result from natural disasters[4] or wind-blown debris.

[4] Examples include, but are not limited to, earthquakes, fires, tornados, hurricanes, landslides, wind shear, fresh gale, major storms as defined either by the Transmission Owner or an applicable regulatory body, ice storms, and floods.

[6] Multiple Sustained Outages on an individual line, if caused by the same vegetation, shall be considered as one outage regardless of the actual number of outages within a 24-hour period.

M7. *The Transmission Owner's self-certification reports are adequate evidence of no Sustained Outage of any applicable line due to the blowing together of vegetation and a conductor within the Active Transmission Line Right of Way. (R7)*

This requirement is intended to prevent vegetation-related risk of a Cascading event on the electric transmission system by requiring the Transmission Owner to manage vegetation such that a vegetation-related Sustained Outage due to blowing together of vegetation and conductor does not occur.

Again, for a Sustained Outage to be classified as a vegetation-related event, the conductor must be operating between no load and its Rating when the event occurs. Events that occur when the conductor is operating beyond its Rating are not classified as vegetation-related Sustained Outages under the Standard. Also, this requirement clarifies that the conductor and the vegetation must be within the Active Transmission Line Right of Way.

Vegetation-related Sustained Outages that occur due to natural disasters are beyond the control of the Transmission Owner. These events are not classified as vegetation-related Sustained Outages and are therefore exempt from the Standard. Transmission lines are not designed to withstand the impacts of natural disasters such as tornadoes, hurricanes, severe ice loads, landslides, etc. Additionally, Sustained Outages due to wind-blown debris, such as large limbs and branches, separated tree tops, etc., are exempt from the Standard.

Multiple Sustained Outages on an individual line can be caused by the same vegetation. Such events within a 24 hour period are considered to be a single vegetation-related Sustained Outage under the Standard. For example, a Sustained Outage caused by a tree could be mistakenly attributed to something else (e.g. contaminated insulator string, lightning, etc). After the apparent cause of the outage is addressed the line could be re-energized without the root cause being identified and removed. The transmission line could remain energized for a period of time while the thermal loading on the transmission line builds back to the point where the conductor contacts the same tree that caused the earlier Sustained Outage. These multiple outages resulting from the same tree would be considered as a single outage as long as all Sustained Outages occurred within a 24 hour period.

The Transmission Owner must self-certify each year that all vegetation-related Sustained Outages are documented and reported. If no vegetation-related Sustained Outages have occurred, a null report is sufficient documentation of compliance.

Sustained Outages — Vegetation Falling Into Conductor

R8. *Each Transmission Owner shall prevent Sustained Outages[6] of applicable lines due to vegetation falling into a conductor from within an Active Transmission Line Right of Way with the following exceptions: [Violation Risk Factor - Medium] [Time Horizon - Real Time]*

- *Sustained Outages of applicable lines that result from natural disasters[4] or wind-blown debris.*
- *Sustained Outages of applicable lines that result from human or animal activity.[5]*

[4] Examples include, but are not limited to, earthquakes, fires, tornados, hurricanes, landslides, wind shear, fresh gale, major storms as defined either by the Transmission Owner or an applicable regulatory body, ice storms, and floods.

[5] Examples include, but are not limited to, logging, animal severing tree, vehicle contact with tree, arboricultural activities or horticultural or agricultural activities, or removal or digging of vegetation.

[6] Multiple Sustained Outages on an individual line, if caused by the same vegetation, shall be considered as one outage regardless of the actual number of outages within a 24-hour period.

M8. *The Transmission Owner's self-certification reports are adequate evidence of no Sustained Outage of any applicable line due to vegetation falling into a conductor from within the Active Transmission Line Right of Way. (R8)*

This requirement is intended to prevent vegetation-related risk of a Cascading event on the electric transmission system by requiring the Transmission Owner to manage vegetation to prevent a vegetation-related Sustained Outage due to vegetation falling into a conductor from within the Active Transmission Line Right of Way.

Note that for a Sustained Outage to be classified as a vegetation-related event, the conductor must be operating between no load and its Rating when the event occurs. Events that occur when the conductor is operating beyond its Rating are not classified as vegetation-related Sustained Outages under the Standard. Also, this requirement clarifies that the conductor and the vegetation must be within the Active Transmission Line Right of Way.

Vegetation-related Sustained Outages that occur due to natural disasters are beyond the control of the Transmission Owner. These events are not classified as vegetation-related Sustained Outages and are therefore exempt from the Standard. Transmission lines are not designed to withstand the impacts of natural disasters such as tornadoes, hurricanes, severe ice loads, landslides, etc. Additionally, Sustained Outages due to wind-blown debris, such as large limbs and branches, separated tree tops, etc., are exempt from the Standard.

Sustained Outages due to human or animal activity are beyond the control of the Transmission Owner. These events would not be classified as vegetation-related Sustained Outages and are exempt from the Standard. Examples of these events may include new plantings of tall vegetation under the transmission line planted since the last Vegetation Inspection, tree contacts with line initiated by vehicles, logging activities, etc.

Multiple Sustained Outages on an individual line can be caused by the same vegetation. Such events are considered to be a single vegetation-related Sustained Outage under the Standard.

The Transmission Owner must self-certify each year that all vegetation-related Sustained Outages are documented and reported. If no vegetation-related Sustained Outages have occurred, a null report is sufficient documentation of compliance.

Implement Annual Work Plan

R9. *Each Transmission Owner shall implement its annual work plan for vegetation management to accomplish the purpose of this standard. [Violation Risk Factor: Medium] [Time Horizon: Operations Planning]*

M9. *The Transmission Owner has evidence that it is implementing, or has implemented, its annual work plan. An example of evidence is a paper or electronic copy of work plan and work records. (R9)*

This requirement sets the expectation that the work identified in the annual work plan (Requirement R1, Part 11.3) will be completed as planned.

Documentation or other evidence of the work performed typically consists of signed-off work orders, signed contracts, printouts from work management systems, spreadsheets of planned versus completed work, timesheets, work inspection reports, or paid invoices. Other evidence may include photographs, work inspection reports and walk-through reports.

Documentation is required when the annual work plan is adjusted or not completely implemented as originally planned. The reasons for the deferrals or changes and the expected completion date of postponed work should be documented.

The Transmission Owner's vegetation maintenance work necessary to implement the annual work plan is most effective when performed to the maximum extent allowed by any easement, fee simple and other legal rights. The Transmission Owner, therefore, should endeavor as a best practice to maintain its Active Transmission Line Right of Way to the full extent of its legal rights at all times and in all cases.

Designating Sub-200kV Lines

R10. *Each Planning Coordinator shall prepare and review annually, a list of lines that are operated below 200kV, if any, which are subject to this standard. Each Planning Coordinator shall consult with its Transmission Owner and neighboring Planning Coordinator to obtain to develop the list [Violation Risk Factor: Lower] [Time Horizon: Long-Term Planning]*

M10. *The Planning Coordinator has evidence that it consulted with its Transmission Owner(s) and neighboring Planning Coordinator(s), prepared and reviewed annually a list of designated sub-200kV transmission lines, if any, which are subject to this standard. (R10)*

Requirement R10 assigns to the Planning Coordinator the task of designating sub-200kV lines that are subject to this standard. The Planning Coordinator is appropriate because it operates within a time horizon that allows a vegetation manager to develop and implement the necessary vegetation management plan.

The Standard places the responsibility on the Planning Coordinator for the identification of specific sub-200kV circuits to which the Standard is to be applied. Identification of such sub-200kV circuits is to be done in consultation with the Planning Coordinator's Transmission Owners and neighboring Planning Coordinators. This is intended to ensure that the individual Transmission Owners at the two ends of interconnections will receive identical signals regarding applicability of the Standard to the line in question.

Planning Coordinators, using their methodologies described in R11, will need to conduct the necessary studies and identify candidate sub-200kV transmission lines for potential applicability under the Standard. The Planning Coordinators will next need to consult with its Transmission Owners and neighboring Planning Coordinators to resolve any differences in the selection of sub-200kV transmission lines of common interest. Finally, the Planning Coordinator will need to finalize, adopt, and issue the list of designated sub-200kV lines.

For audit purposes, Planning Coordinators can offer documentation that they have consulted with their Transmission Owners and neighboring Planning Coordinators and that they have reviewed annually the list of designated sub-200kV transmission lines that are subject to the Standard. Documentation may include dated letters, e-mails, spreadsheets, etc.

Documenting Method of Identifying Sub-200kV Lines

R11. *Each Planning Coordinator shall develop and document its method for assessing the reliability significance of sub-200kV transmission lines whose loss would place the grid at an unacceptable risk of instability, separation, or cascading failures. [Violation Risk Factor: Lower] [Time Horizon: Long-term Planning]*

M11. *The Planning Coordinator has documented evidence such as planning study criteria or other analysis used to develop its method for assessing the reliability significance of sub-200kV lines whose loss would place the grid at an unacceptable risk of instability, separation, or cascading failures. (R11)*

Requirement R11 assigns to the Planning Coordinator the task of documenting its methods for assessing the reliability significance of sub-200kV lines. The methods and requirements for assessing significance of transmission lines are complex and spelled out in other prevailing NERC standards. Essentially, however, these methods include activities such as load flow studies, contingency analyses, and transient and dynamic voltage stability studies. Through the use of such studies, the significance of each transmission line to the reliability of the system is determined. Because such activities are already being conducted by the Planning Coordinator(s) to meet other standards, the Planning Coordinator may choose to adopt the same methods for meeting Requirement R11.

Appendix One: Clearance Distance Derivation by the Gallet Equation

The Gallet Equation is a well-known method of computing the required strike distance for proper insulation coordination, and has the ability to take into account various air gap geometries, as well as non-standard atmospheric conditions. When the Gallet Equation and conservative probabilistic methods are combined, i.e. deterministic design, sparkover probabilities of 10^{-6} or less are achieved. This approach is well known for its conservatism and was used to design the first 500kV and 765kV lines in North America [1]. Thus, the deterministic design approach using the Gallet Equation is used for the standard to compute the minimum strike distance between transmission lines and the vegetation that may be present in or along the transmission corridor.

Method Explanation (Gallet Equation)

In 1975 G. Gallet published a benchmark paper that provided a method to compute the critical flashover (CFO) voltage of various air gap geometries [4]. The Gallet Equation uses various "gap factors" to take into account various air gap geometries. Various gap factor values are provided in [1]. If the vegetation in a transmission corridor, e.g. a tree, is assumed electrically to be a large structure then the CFO of such an air gap geometry can be computed for dry or wet conditions using a well established equation proposed by Gallet [1],[2],[4],

$$CFO_A = k_w \cdot k_g \cdot \delta^m \cdot \frac{3400}{1+\frac{8}{D}} \tag{1}$$

Where:

k_w is defined as the factor that takes into account wet or dry conditions (dry = 1.0 and wet = 0.96) and phase arrangement (multiply by 1.08 for outside phase), e.g. outside phase and wet conditions = (0.96)(1.08) = 1.037,

k_g is defined as the gap factor (1.3 for conductor to large structure),

D is the strike distance (m),

CFO_A is the CFO for the relative air density (kV).

δ is defined as the relative air density and is approximately equal to (2) where A is the altitude in km,

$$\delta = e^{-\frac{A}{8.6}} \tag{2}$$

$$m = 1.25G_0\left(G_0 - 0.2\right) \tag{3}$$

$$G_0 = \frac{CFO_s}{500 \cdot D} \tag{4}$$

$$CFO_s = k_w \cdot k_g \cdot \frac{3400}{1+\frac{8}{D}} \tag{5}$$

Where CFO_S is the CFO for standard atmospheric conditions (kV). Using (1)-(5), the required CFO_A can be computed using an iterative process.

Once the CFO_A is known, deterministic methods can be used to determine the required clearance distance. If we let the maximum switching overvoltage be equal to the withstand voltage of the air gap (CFO_A - 3σ) then the CFO_A can be written as (6).

$$CFO_A = \frac{V_m}{1-3\left(\frac{\sigma}{CFO_A}\right)} \qquad (6)$$

Where:

V_m is equal to the maximum switching overvoltage, i.e. the value that has a 0.135% chance of being exceeded,

σ is the standard deviation of the air gap insulation,

CFO_A is the critical flashover voltage of the air gap insulation under non-standard atmospheric conditions.

The ratio of σ to the CFO_A given in (6) can be assumed to be 0.05 (5%) [1]. Thus, (6) can be written as (7).

$$CFO_A = \frac{V_m}{0.85} \qquad (7)$$

Substituting (7) into (1) we arrive at (8).

$$V_m = 0.85 \cdot k_w \cdot k_g \cdot \delta^m \cdot \frac{3400}{1+\frac{8}{D}} \qquad (8)$$

Equation 8 relates the maximum transient overvoltage, V_m, to the air gap distance, D. Using (8) to compute the required clearance distance for the specified air gap geometry (conductor to large structure) results in a probability of flashover in the range of 10^{-6}.

Transient Overvoltage

In general, the worst case transient overvoltages occurring on a transmission line are caused by energizing or re-energizing the line with the latter being the extreme case if trapped charge is present. The intent of FAC-003 is to keep a transmission line that is *in service* from becoming de-energized (i.e. tripped out) due to sparkover from the line conductor to nearby vegetation. Thus, the worst case scenarios that are typically analyzed for insulation coordination purposes (e.g. line energization and re-energization) can be ignored. For the purposes of FAC-003-2, the worst case transient overvoltage then becomes the maximum value that can occur with the line energized. Determining a realistic value of transient overvoltage for this situation is difficult because the maximum transient overvoltage factors listed in the literature are based on a switching operation of the line in question. In other words, these maximum overvoltage values (e.g. the values listed in [2], [3] and [5]) are based on the assumption that the subject line is being energized, re-energized or de-energized. These operations, by their very nature, will create the largest transient overvoltages. Typical values of transient overvoltages of in-service lines, as such, are not readily available in the literature because the resulting level of overvoltage is negligible compared with the maximum (e.g. re-energizing a transmission line with trapped charge). A conservative value for the maximum transient overvoltage that can occur anywhere along the length of an in-service ac line is approximately 2.0 p.u.[2]. This value is a conservative estimate of the transient overvoltage that is created at the point of application (e.g. a substation) by switching a capacitor bank without a pre-insertion device (e.g. closing resistors). At voltage levels where capacitor banks are not very common (e.g. 362kV), the maximum transient overvoltage of an "in-service" ac line are created by fault initiation on adjacent ac lines and shunt reactor bank switching. These transient voltages are usually 1.5 p.u. or less [2]. It is well known that these theoretical transient overvoltages will not be experienced at locations remote from the bus at which they were created; however, in order to be conservative, it will be assumed that all nearby ac lines are subjected to this same level of overvoltage. Thus, a maximum transient overvoltage factor of 2.0 p.u. for 242 kV and below and 1.4 p.u. for ac transmission lines 362 kV and above is used to compute the required clearance distances for vegetation management purposes.

The overvoltage characteristics of dc transmission lines vary somewhat from their ac counterparts. The referenced empirically derived transient overvoltage factor used to calculate the minimum clearance distances from dc transmission lines to vegetation for the purpose of FAC-003-2 will be 1.8 p.u.[3].

Example Calculation

An example calculation is presented below using the proposed method of computing the vegetation clearance distances. It is assumed that the line in question has a maximum operating voltage of 550 kV_{rms} line-to-line. Using a per unit transient overvoltage factor of 1.4, the result is a peak transient voltage of 629 kV_{crest}. It is further assumed that the line in question operates at a maximum altitude of 7000 feet (2.134 km) above sea level.

The required withstand voltage of the air gap must be equal to or greater than 629 kV_{crest}. Since the altitude is above sea level, (1) - (5) have to be iterated on to achieve the desired result. Equation (9) can be used as an initial guess for the clearance distance.

$$D_i = \frac{8}{\frac{3400 \cdot k_w \cdot k_g}{\left(\frac{V_m}{0.85}\right)} - 1} \tag{9}$$

For our case here, V_m is equal to 629 kV, $k_w = 1.037$ and $k_g = 1.3$. Thus,

$$D_i = \frac{8}{\frac{3400 \cdot k_w \cdot k_g}{\left(\frac{V_m}{0.85}\right)} - 1} = \frac{8}{\frac{3400 \cdot 1.037 \cdot 1.3}{\left(\frac{629}{0.85}\right)} - 1} = 1.535m \tag{10}$$

Using (2)-(5) and (8) the withstand voltage of the air gap is next computed. This value will then be compared to the maximum transient overvoltage.

$$CFO_S = k_w \cdot k_g \cdot \frac{3400}{1 + \frac{8}{D}} = 1.037 \cdot 1.3 \cdot \frac{3400}{1 + \frac{8}{1.535}} = 737.7kV \tag{11}$$

$$\delta = e^{-\frac{A}{8.6}} = e^{-\frac{2.134}{8.6}} = 0.78 \tag{12}$$

$$G_O = \frac{CFO_S}{500 \cdot D} = \frac{737.7}{(500)\cdot(1.535)} = 0.961 \tag{13}$$

$$m = 1.25 \cdot G_O(G_O - 0.2) = 1.25 \cdot 0.961(0.961 - 0.2) = 0.915 \tag{14}$$

$$V_m = 0.85 \cdot k_w \cdot k_g \cdot \delta^m \cdot \frac{3400}{1 + \frac{8}{D}} = (0.85)(1.037)(1.3)(0.78)^{0.915}\left(\frac{3400}{1 + \frac{8}{1.535}}\right) = 499.8kV \tag{15}$$

The calculated V_m is less than 629 kV; thus, the clearance distance must be increased. A few iterations using (2)-(5) and (8) are required until the computed $V_m \geq 629$ kV. For this case it was found that D = 1.978 m (6.49 feet) yielded V_m = 629.3kV. Using this clearance distance the following values were computed for the final iteration.

$$CFO_S = k_w \cdot k_g \cdot \frac{3400}{1 + \frac{8}{D}} = 1.037 \cdot 1.3 \cdot \frac{3400}{1 + \frac{8}{1.978}} = 908.5kV \tag{16}$$

$$\delta = e^{-\frac{A}{8.6}} = e^{-\frac{2.134}{8.6}} = 0.78 \tag{17}$$

$$G_O = \frac{CFO_S}{500 \cdot D} = \frac{908.5}{(500)\cdot(1.978)} = 0.919 \tag{18}$$

$$m = 1.25 \cdot G_O(G_O - 0.2) = 1.25 \cdot 0.919(0.919 - 0.2) = 0.825 \tag{19}$$

$$V_m = 0.85 \cdot k_w \cdot k_g \cdot \delta^m \cdot \frac{3400}{1 + \frac{8}{D}} = (0.85)(1.037)(1.3)(0.78)^{0.825}\left(\frac{3400}{1 + \frac{8}{1.978}}\right) = 629.3kV \tag{20}$$

Therefore, the minimum vegetation clearance distance for a maximum line to line ac operating voltage of 550 kV at 7000 feet above sea level is 1.978 m (6.49 feet). Table 1 provides calculated distances for various altitudes and maximum system operating ac voltages.

TABLE 1 — Minimum Vegetation Clearance Distances (MVCD)
For **Alternating Current** Voltages

(AC) Nominal System Voltage (kV)	(AC) Maximum System Voltage (kV)	MVCD feet (meters) Sea level	MVCD feet (meters) 3,000ft (914.4m)	MVCD feet (meters) 4,000ft (1219.2m)	MVCD feet (meters) 5,000ft (1524m)	MVCD feet (meters) 6,000ft (1828.8m)	MVCD feet (meters) 7,000ft (2133.6m)	MVCD feet (meters) 8,000ft (2438.4m)	MVCD feet (meters) 9,000ft (2743.2m)	MVCD feet (meters) 10,000ft (3048m)	MVCD feet (meters) 11,000ft (3352.8m)
765	800	8.06ft (2.46m)	8.89ft (2.71m)	9.17ft (2.80m)	9.45ft (2.88m)	9.73ft (2.97m)	10.01ft (3.05m)	10.29ft (3.14m)	10.57ft (3.22m)	10.85ft (3.31m)	11.13ft (3.39m)
500	550	5.06ft (1.54m)	5.66ft (1.73m)	5.86ft (1.79m)	6.07ft (1.85m)	6.28ft (1.91m)	6.49ft (1.98m)	6.7ft (2.04m)	6.92ft (2.11m)	7.13ft (2.17m)	7.35ft (2.24m)
345	362	3.12ft (0.95m)	3.53ft (1.08m)	3.67ft (1.12m)	3.82ft (1.16m)	3.97ft (1.21m)	4.12ft (1.26m)	4.27ft (1.30m)	4.43ft (1.35m)	4.58ft (1.40m)	4.74ft (1.44m)
230	242	2.97ft (0.91m)	3.36ft (1.02m)	3.49ft (1.06m)	3.63ft (1.11m)	3.78ft (1.15m)	3.92ft (1.19m)	4.07ft (1.24m)	4.22ft (1.29m)	4.37ft (1.33m)	4.53ft (1.38m)
161*	169	2ft (0.61m)	2.28ft (0.69m)	2.38ft (0.73m)	2.48ft (0.76m)	2.58ft (0.79m)	2.69ft (0.82m)	2.8ft (0.85m)	2.91ft (0.89m)	3.03ft (0.92m)	3.14ft (0.96m)
138*	145	1.7ft (0.52m)	1.94ft (0.59m)	2.03ft (0.62m)	2.12ft (0.65m)	2.21ft (0.67m)	2.3ft (0.70m)	2.4ft (0.73m)	2.49ft (0.76m)	2.59ft (0.79m)	2.7ft (0.82m)
115*	121	1.41ft (0.43m)	1.61ft (0.49m)	1.68ft (0.51m)	1.75ft (0.53m)	1.83ft (0.56m)	1.91ft (0.58m)	1.99ft (0.61m)	2.07ft (0.63m)	2.16ft (0.66m)	2.25ft (0.69m)
88*	100	1.15ft (0.35m)	1.32ft (0.40m)	1.38ft (0.42m)	1.44ft (0.44m)	1.5ft (0.46m)	1.57ft (0.48m)	1.64ft (0.50m)	1.71ft (0.52m)	1.78ft (0.54m)	1.86ft (0.57m)
69*	72	0.82ft (0.25m)	0.94ft (0.29m)	0.99ft (0.30m)	1.03ft (0.31m)	1.08ft (0.33m)	1.13ft (0.34m)	1.18ft (0.36m)	1.23ft (0.37m)	1.28ft (0.39m)	1.34ft (0.41m)

*As designated by the Planning Coordinator

TABLE 1 (CONT.) — Minimum Vegetation Clearance Distances (MVCD)
For **Direct Current** Voltages

(DC) Nominal Pole to Ground Voltage (kV)	MVCD feet (meters) sea level	MVCD feet (meters) 3,000ft (914.4m) Alt.	MVCD feet (meters) 4,000ft (1219.2m) Alt.	MVCD feet (meters) 5,000ft (1524m) Alt.	MVCD feet (meters) 6,000ft (1828.8m) Alt.	MVCD feet (meters) 7,000ft (2133.6m) Alt.	MVCD feet (meters) (8,000ft (2438.4m) Alt.	MVCD feet (meters) 9,000ft (2743.2m) Alt.	MVCD feet (meters) 10,000ft (3048m) Alt.	MVCD feet (meters) 11,000ft (3352.8m) Alt.
±750	13.92ft (4.24m)	15.07ft (4.59m)	15.45ft (4.71m)	15.82ft (4.82m)	16.2ft (4.94m)	16.55ft (5.04m)	16.9ft (5.15m)	17.27ft (5.26m)	17.62ft (5.37m)	17.97ft (5.48m)
±600	10.07ft (3.07m)	11.04ft (3.36m)	11.35ft (3.46m)	11.66ft (3.55m)	11.98ft (3.65m)	12.3ft (3.75m)	12.62ft (3.85m)	12.92ft (3.94m)	13.24ft (4.04m)	(13.54ft 4.13m)
±500	7.89ft (2.40m)	8.71ft (2.65m)	8.99ft (2.74m)	9.25ft (2.82m)	9.55ft (2.91m)	9.82ft (2.99m)	10.1ft (3.08m)	10.38ft (3.16m)	10.65ft (3.25m)	10.92ft (3.33m)
±400	4.78ft (1.46m)	5.35ft (1.63m)	5.55ft (1.69m)	5.75ft (1.75m)	5.95ft (1.81m)	6.15ft (1.87m)	6.36ft (1.94m)	6.57ft (2.00m)	6.77ft (2.06m)	6.98ft (2.13m)
±250	3.43ft (1.05m)	4.02ft (1.23m)	4.02ft (1.23m)	4.18ft (1.27m)	4.34ft (1.32m)	4.5ft (1.37m)	4.66ft (1.42m)	4.83ft (1.47m)	5ft (1.52m)	5.17ft (1.58m)

List of Acronyms and Abbreviations

AC	Alternating Current
ANSI	American National Standards Institute
CFO	Critical Flashover
DC	Direct Current
IEEE	Institute of Electrical and Electronics Engineers
IROL	Interconnection Reliability Operating Limit
IVM	Integrated Vegetation Management
NERC	North American Electric Reliability Corporation
IROL	Interconnection Reliability Operating Limit
MVCD	Minimum Vegetation Clearance Distance
TGR	Tree Growth Regulator
TO	Transmission Owner
TVMP	Transmission Vegetation Management Program
WECC	Western Electricity Coordinating Council

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