ERO Enterprise-Endorsed Implementation Guidance
Standard Application Guide FAC-003-3

Reliability Standard and Requirement(s): FAC-003-3
Requirements R1, R2, R3, R4, R5, R6, and R7

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This document is Implementation Guidance that describes a possible method for complying with all or part of an inactive Reliability Standard. The ERO Enterprise endorsed this method for achieving compliance with the Reliability Standard version identified on this cover page. It is the responsibility of the registered entity to determine whether material changes have occurred between the inactive Reliability Standard and the currently-enforceable version of the Reliability Standard that would render any portion of this Implementation Guidance inapplicable to the currently-enforceable version.
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Subject Matter Experts in the field of vegetation management were brought together in 2012, to prepare a guide for complying with NERC Reliability Standard FAC-003. Participants include representatives from Generator Owner and Transmission Owner registration function.

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The materials have been reviewed by MRO staff and provide reasonable application guidance for the standard(s) addressed. Ultimately, demonstrating compliance depends on a number of factors including the precise language of the standard, the specific facts and circumstances, and quality of evidence.

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**Acknowledgement**

This publication was developed by a team of Subject Matter Experts (SME) from MRO member organizations within the MRO footprint. The development of SME teams is an ongoing effort to produce unified application guides for MRO and its Registered Entities.

The FAC-003 SME team chair, Pat Smith from Western Area Power Administration, wishes to acknowledge and thank those who dedicated efforts and contributed significantly to this publication. The MRO and the MRO Standards Committee, and their organizational affiliations include:

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INTRODUCTION
NERC Reliability Standard FAC-003-3, Transmission Vegetation Management is applicable to Transmission Owners (TO) and Generation Owners (GO). The new version of the standard helps to enhance reliability by (1) ensuring there are no reliability gaps related to vegetation management practices at applicable generation facilities, (2) expands the applicable transmission facilities to those facilities which are an element of an Interconnected Reliability Operating Limit, or an element of a Major WECC Transfer Path and (3) providing greater flexibility to NERC registered entities to address local vegetation management conditions.

FAC-003-3 allows more diverse approaches through the flexibility inherent in new results-based approach that focuses on what actions need to be taken, and to ensure key vegetation management issues are addressed.

Purpose: To maintain a reliable electric transmission system by using a defense-in-depth strategy to manage vegetation located on transmission rights of way (ROW) and minimize encroachments from vegetation located adjacent to the ROW, thus preventing the risk of those vegetation-related outages that could lead to cascading.

Applicability
The applicability of the Standard is listed below:

4.1 Functional Entities:
4.1.1 Applicable Transmission Owners
4.1.1.1 Transmission Owners that own Transmission Facilities defined in 4.2.

4.1.2 Applicable Generator Owners
4.1.2.1 Generator Owners that own Generation Facilities defined in 4.3

4.2 Transmission Facilities:
Defined below (referred to as “applicable lines”), including but not limited to those that cross lands owned by federal, state, provincial, public, private, or tribal entities:

4.2.1 Each overhead transmission line operated at 200kV or higher.
4.2.2 Each overhead transmission line operated below 200kV identified as an element of an IROL under NERC Standard FAC-014 by the Planning Coordinator.
4.2.3 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.
4.2.4 Each overhead transmission line identified above (4.2.1 through 4.2.3) 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.
4.3 Generation Facilities:
Defined below (referred to as “applicable lines”), including but not limited to those that cross lands owned by federal, state, provincial, public, private, or tribal entities:

4.3.1 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:

4.3.1.1 Operated at 200kV or higher; or
4.3.1.2 Operated below 200kV identified as an element of an IROL under NERC Standard FAC-014 by the Planning Coordinator; or
4.3.1.3 Operated below 200 kV identified as an element of a Major WECC Transfer Path in the Bulk Electric System by WECC.

The Background in FAC-003-3 states:

This standard uses three types of requirements to provide layers of protection to prevent vegetation related outages that could lead to cascading:

a) Performance-based - defines a particular reliability objective or outcome to be achieved. In its simplest form, a results-based requirement has four components: who, under what conditions (if any), shall perform what action, to achieve what particular bulk power system performance result or outcome?

b) Risk-based - preventive requirements to reduce the risks of failure to acceptable tolerance levels. A risk-based reliability requirement should be framed as: who, under what conditions (if any), shall perform what action, to achieve what particular result or outcome that reduces a stated risk to the reliability of the bulk power system?

c) Competency-based - defines a minimum set of capabilities an entity needs to have to demonstrate it is able to perform its designated reliability functions. A competency-based reliability requirement should be framed as: who, under what conditions (if any), shall have what capability, to achieve what particular result or outcome to perform an action to achieve a result or outcome or to reduce a risk to the reliability of the bulk power system?

The defense-in-depth strategy for reliability standards development recognizes that each requirement in a NERC reliability standard has a role in preventing system failures, and that these roles are complementary and reinforcing. Reliability standards should not be viewed as a body of unrelated requirements, but rather should be viewed as part of a portfolio of requirements designed to achieve an overall defense-in-depth strategy and comport with the quality objectives of a reliability standard.
This standard uses a defense-in-depth approach to improve the reliability of the electric Transmission system by:

- Requiring that vegetation be managed to prevent vegetation encroachment inside the flash-over clearance (R1 and R2);
- Requiring documentation of the maintenance strategies, procedures, processes and specifications used to manage vegetation to prevent potential flash-over conditions including consideration of 1) conductor dynamics and 2) the interrelationships between vegetation growth rates, control methods and the inspection frequency (R3);
- Requiring timely notification to the appropriate control center of vegetation conditions that could cause a flash-over at any moment (R4);
- Requiring corrective actions to ensure that flash-over distances will not be violated due to work constraints such as legal injunctions (R5);
- Requiring inspections of vegetation conditions to be performed annually (R6); and
- Requiring that the annual work needed to prevent flash-over is completed (R7).

OVERVIEW

Ineffective vegetation management was identified as a major contributor of the August 14, 2003 blackout, and has also been a causal factor in other large-scale North American outages such as those that occurred in the summer of 1996 in the western United States. Recommendation 16 of the Blackout Report suggests the establishment of enforceable standards for maintenance of electrical clearances in Right-of-Way areas. Unlike the FAC-003-1, which is primarily focused on the “Transmission Vegetation Management Program,” the new version of FAC-003-3 has a broader focus on Transmission Vegetation Management, including Generator Owners with qualifying interconnection facilities to perform vegetation management on applicable facilities.

The goals of this SME Project include the following:

- Provide vegetation management best practices
- Explain how requirements are interrelated
- Describe processes and outcomes that can be used for evidence of compliance.

METHODOLOGY

This section contains suggested methodologies to meet the requirements of NERC Standard FAC-003. These methods represent the intended practices of the members of the FAC-003 SME Team.
Common Terms and Definitions

**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.

**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.

**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.

Evaluating FAC-003-3 R1

*R1.* Each applicable Transmission Owner and applicable Generator Owner shall manage vegetation to prevent encroachments into the MVCD of its applicable line(s) which are either an element of an IROL, or an element of a Major WECC Transfer path: operating within their Rating and all Rated Electrical Operating Conditions of the types shown below

[Violation Risk Factor: High] [Time Horizon: Real-time]:

1. An encroachment into MVCD as shown in FAC-003 Table 2, observed in Real-time, absent a Sustained Outage.
2. An encroachment due to a fall-in from inside the ROW that caused a vegetation-related Sustained Outage.
3. An encroachment due to the blowing together of applicable lines and vegetation located inside the ROW that caused a vegetation-related Sustained Outage.
4. An encroachment due to vegetation growth into the MVCD that caused a vegetation-related Sustained Outage.

Analysis

R1 is a Performance-Based Requirement

R1 is applicable to Transmission Owners and Generator Owners who own transmission facilities which are a part of an IROL or an element of a major WECC Transfer Path regardless of its operating voltage. The reliability objective of R1 is to ensure there are no vegetation encroachments within the MVCD.
R1 and R2 are identical however they apply to different transmission facilities. Due to the greater risk associated with transmission facilities which are identified as elements of an IROL or WECC Transfer Path these facilities have a higher violation risk factor assigned to them.

R1 and R2 do not apply during events when transmission lines are operating outside of their designed Rating in such instances where as emergency actions have been taken to protect the integrity of the BES and have led to facilities operating beyond their designed limits causing excessive sagging or during ice loading.

**Recommended Application Guidance**

The following are examples of how each Transmission Owner and Generator Owner should reduce vegetation-related outages:

- Exercise the maximum legal rights as defined by the ROW agreements.
- Use multiple methods to manage vegetation to include: manual removal or pruning, mechanical mower and treatment with chemicals.
- Identify and remove or prune hazardous trees, where possible, outside the ROW that may enter the minimum vegetation clearance distance (MVCD).
- Perform quality control work evaluations on completed work to see that it meets requirements. Signed and dated Certification Letter.
- As a guideline use ANSI document ANSI Z133.1 – for Arboricultural Operations – Safety Requirements.
- Remove trees and brush within the ROW that at some time in the future could enter the MVCD.
- Cut all trees and brush as close to the ground as practical.
- Remove all second growth from stumps cut on previous pruning or clearance cycles.
- Treat all stumps with herbicide to prevent re-sprouting.

**Documentation**

Supporting documentation and evidence for R1 would include your current Maintenance Program including Annual Plan for Vegetation Management Work, utility specific strategies to prevent encroachment into the MVCD, annual training records, completed work orders, time/labor records documenting hours applied to vegetation management, and any internal orders or guidance on Vegetation or ROW Management. Develop records that show no sustained outages based on real-time observations.

**M1.** Each applicable Transmission Owner and applicable Generator Owner has evidence that it managed vegetation to prevent encroachment into the MVCD as described in R1. Examples of acceptable forms of evidence may include dated attestations, dated reports containing no Sustained Outages associated with encroachment types 2 through 4 above, or records confirming no Real-time observations of any MVCD encroachments. (R1)
Evaluating FAC-003-3 R2

**R2.** Each applicable Transmission Owner and applicable Generator Owner shall manage vegetation to prevent encroachments into the MVCD of its applicable line(s) which are not either an element of an IROL, or an element of a Major WECC Transfer Path; operating within its Rating and all Rated Electrical Operating Conditions of the types shown below [Violation Risk Factor: Medium] [Time Horizon: Real-time]:

1. An encroachment into the MVCD, observed in Real-time, absent a Sustained Outage,

2. An encroachment due to a fall-in from inside the ROW that caused a vegetation-related Sustained Outage,

3. An encroachment due to blowing together of applicable lines and vegetation located inside the ROW that caused a vegetation-related Sustained Outage,

4. An encroachment due to vegetation growth into the line MVCD that caused a vegetation-related Sustained Outage.

**Analysis**

**R2 is a Performance-Based Requirement**

R2 is applicable to Transmission Owners and Generator Owners who own Transmission Facilities which are operated at 200kV or higher. The reliability objective of R2 is to ensure there are no vegetation encroachments within the MVCD.

**Recommended Application Guidance**

*(See R1 Recommended Application Guidance)*

**Documentation**

*(See R1 Documentation)*

**M2.** Each applicable Transmission Owner and applicable Generator Owner has evidence that it managed vegetation to prevent encroachment into the MVCD as described in R2. Examples of acceptable forms of evidence may include dated attestations, dated reports containing no Sustained Outages associated with encroachment types 2 through 4 above, or records confirming no Real-time observations of any MVCD encroachments. *(R2)*
Evaluating FAC-003-3 R3

**R3.** Each applicable Transmission Owner and applicable Generator Owner shall have documented maintenance strategies or procedures or processes or specifications it uses to prevent the encroachment of vegetation into the MVCD of its applicable lines that accounts for the following:

1. **Movement of applicable line conductors under their Rating and all Rated Electrical Operating Conditions;**
2. **Inter-relationships between vegetation growth rates, vegetation control methods, and inspection frequency. [Violation Risk Factor: Lower] [Time Horizon: Long Term Planning]**

**Analysis**

**R3 is a Competency-Based Requirement**

Each applicable Transmission Owner and applicable Generator Owner must develop a transmission vegetation management program. The program may use engineering reviews of conductor dynamics including swing, vegetation species and growth rates, utility specific strategies to prevent encroachment into the MVCD, and consistent specifications or minimum clearance charts to demonstrate that encroachments can be prevented.

**Recommended Application Guidance**

- Determine MVCD from Table 2 of the Standard.
- Maintenance strategy used, such as minimum vegetation to conductor distance or maximum vegetation height to ensure that MVCD clearance are never violated.
- Tables that have been developed to determine sag and sway of conductor (conductor dynamics) for each span or worst case for each line.
- Tables or growth rates available for the most common vegetation species.
- The work methods used to control the vegetation.
- Frequency of vegetation inspections.
- Annual work plan.
- Implement integrated vegetation management.

**Documentation**

The Transmission Owner Generator Owner’s procedures, policies and specifications shall demonstrate the ability to manage the system at all rated conditions to maintain reliability.

Establish “Tree Report Guideline” as an internal policy description. Define “tree spans” and what constitutes a tree span, side growth criteria, exclusions, and priority guidelines including clearance charts.
M3. The maintenance strategies or procedures or processes or specifications provided demonstrate that the applicable Transmission Owner and applicable Generator Owner can prevent encroachment into the MVCD considering the factors identified in the requirement. (R3)

Evaluating FAC-003-3 R4

R4. Each applicable Transmission Owner and applicable Generator Owner, without any intentional time delay, shall notify the control center holding switching authority for the associated applicable line when the applicable Transmission Owner and applicable Generator Owner has confirmed the existence of a vegetation condition that is likely to cause a Fault at any moment [Violation Risk Factor: Medium] [Time Horizon: Real-time].

Analysis

R4 is a Risk-Based Requirement
R4 focuses on preventive actions to be taken by the Transmission Owner or applicable Generator Owner for the mitigation of fault risk when a vegetation threat is confirmed. The Transmission Owner or applicable Generator Owner has the responsibility to ensure the proper communication between field personnel and the control center to allow the control center to take the appropriate action until the vegetation threat is relieved.

Recommended Application Guidance
Develop a procedure or process to document vegetation conditions to be included in utility specific strategies listing the steps to be taken and who to contact to take the line out of service or derate the line in the event of a vegetation condition that is likely to cause a Fault at any moment. Identify:

- Who is to contact the switching authority
- Who is to be contacted to address the vegetation condition
- Who is to develop the plan of action to take care of the vegetation condition
- Who directs the crew to remove the vegetation
- Property owner notification
- Who reports to compliance
- Who reports to regulator authorities as needed

Documentation
Procedure or process should include forms or records that will be processed to document the event and any corrective action that was taken to eliminate the vegetation condition. Dispatch communications, work orders, and time sheets would help support the process. A regular record should also be developed to show that over a period of time no outages occurred or vegetation condition was encountered that could cause a fault on the system.
Evaluating FAC-003-3 R5

R5. When a applicable Transmission Owner and applicable Generator Owner is constrained from performing vegetation work on an applicable line operating within its Rating and all Rated Electrical Operating Conditions, and the constraint may lead to a vegetation encroachment into the MVCD prior to the implementation of the next annual work plan, then the applicable Transmission Owner or applicable Generator Owner shall take corrective action to ensure continued vegetation management to prevent encroachments [Violation Risk Factor: Medium] [Time Horizon: Operations Planning].

Analysis

R5 is a risk-based requirement
R5 focuses upon preventive actions to be taken by the Transmission Owner or applicable Generator Owner for the mitigation of Sustained Outage risk when temporarily constrained from performing vegetation maintenance.

Recommended Application Guidance

Develop a procedure or process including utility specific strategies listing the steps to be taken when Transmission Owner is temporarily constrained from performing vegetation maintenance.

- Mitigation measures should include potential risk and the steps that will be taken for each risk type.
- Steps should include patrols or site visits with level of risk identified on each patrol or site visit to assure that imminent threat has not occurred.

Documentation

Procedures or process should include forms or records that will be processed to document the mitigation, risk and the steps that are to be taken for each risk level. This should include patrol records or site visit documentation, landowner contacts and constraints, court records, initial and revised work orders, or documentation of derating or de-energization.

Evidence
M5. Each applicable Transmission Owner and applicable Generator Owner has evidence of the corrective action taken for each constraint where an applicable transmission line was put at potential risk. Examples of acceptable forms of evidence may include initially-planned work orders, documentation of constraints from landowners, court orders, inspection records of increased monitoring, documentation of the de-rating of lines, revised work orders, invoices, or evidence that the line was de-energized. (R5)
Evaluating FAC-003-3 R6

**R6.** Each applicable Transmission Owner and applicable Generator Owner shall perform a Vegetation Inspection of 100% of its applicable transmission lines (measured in units of choice - circuit, pole line, line miles or kilometers, etc.) at least once per calendar year and with no more than 18 calendar months between inspections on the same ROW [Violation Risk Factor: Medium] [Time Horizon: Operations Planning].

**Analysis**

**R6 is a Risk-Based Requirement**

Number and frequency of line inspections or patrols are included in utility specific strategies. Inspections are based on an anticipated growth of vegetation and changing environmental or operational factors that could impact the relationship of vegetation to transmission lines. Applicable entities are now required to conduct vegetation inspections on all applicable transmission lines at least once per calendar year with no more than 18 months between inspections.

**Recommended Application Guidance**

Each Transmission Owner and Generator Owner shall conduct inspections or patrol by a qualified vegetation management person. Such inspections or patrols may be done by, by foot, ATV, vehicle or by air. Selected Inspector or patrol person have knowledge of conductor dynamics and vegetation species growth rates.

**Documentation**

Each Transmission Owner or Generator Owner must keep the following documentation:

- Document to authorize the inspection or patrol.
- Record or field notes to include any vegetation that could cause an encroachment issue prior to the next maintenance cycle.
- Maintenance records generated for the records or field notes.

Assure your maintenance plan and your utility specific strategies accurately reflect your intentions. Assure that paperwork exists to “close-the-loop” from documentation of discrepancy to completing the work mitigating the hazard.

**M6.** Each applicable Transmission Owner and applicable Generator Owner has evidence that it conducted Vegetation Inspections of the transmission line ROW for all applicable lines at least once per calendar year but with no more than 18 calendar months between inspections on the same ROW. Examples of acceptable forms of evidence may include completed and dated work orders, dated invoices, or dated inspection records. (R6)
Evaluating FAC-003-3 R7

R7. Each applicable Transmission Owner and applicable Generator Owner shall complete 100% of its annual vegetation work plan of applicable lines to ensure no vegetation encroachments occur within the MVCD. Modifications to the work plan 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.

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 units of choice - circuit, pole line, line miles or kilometers, etc.)

Examples of reasons for modification to annual plan may include [Violation Risk Factor: Medium] [Time Horizon: Operations Planning]:

- 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

Analysis
R7 is a Risk-Based Requirement

Annual Vegetation Management Work Plan should be addressed in the utility specific strategies but the plan itself should be a separate document. The plan should list all lines that are regulated by the standard (200 kV and above or are part of an IROL or Major WECC Transmission Path). The plan is to ensure the reliability of the system. Included in the plan would be ROW maintenance or clearing methods to be used. The plan should have flexibility for changing conditions taking into consideration anticipated growth of vegetation, environmental factors and the time required to provide notification to land owners and regulatory authorities.

Recommended Application Guidance Summary

- The Transmission Vegetation Management Program (TVMP) can be summarized as removing all trees that have the potential to impact transmission line reliability, i.e. manage vegetation to prevent encroachments.
• Identify your SME’s, assuring knowledge of applicable current Regulatory Approved Reliability Standards, review or develop comprehensive, utility specific strategies to prevent encroachments. Review related Reliability Standard Audit Worksheets (RSAW), and develop or review industry and internal guidance documents utilizing Best Management Practices (BMP) in vegetation management.

• The strategies to prevent encroachments cannot be accomplished without the coordinated activities of the maintenance, lands, and operations functions.
  
  o The maintenance function will be responsible for inspecting, Rating and documenting vegetation concerns. Removal may be performed by maintenance personnel or contractors.

  o The lands function is responsible for landowner contacts and securing the necessary permissions for tree removal outside the ROW.

  o The Operations function is responsible for arranging any line outages that may be necessary for safe tree removal activities.

• Using a defense in depth approach, specify how to prevent MVCD encroachment.

• Use table 2 of Standard for MVCD plus distance calculations for sag and sway of conductor. Document maintenance strategies, procedures, processes and specifications to include conductor dynamics, growth rates, control methods, inspection frequency and train personnel.

• Develop procedures for timely notification to control center of vegetation that could cause flash-over.

• Develop procedures for corrective actions to ensure no flash-over distance will be violated due to work constraints.

• Conduct annual inspection or patrols of vegetation conditions.

• Complete an annual work plan to ensure no encroachment of MVCD. Plan can be modified provided no risk to the system.

• Establish records and reports to document processes.

**Mitigating Risk and Internal Controls**

Implementation of management practices is key to ensuring work practices are applied as designed and in accordance with Reliability Standards. These practices may be applied throughout the process starting with preventative controls. Examples of preventative controls are:

• Develop the annual plan for vegetation management

• Development of the Transmission Vegetation Management Program

• Implementation of a data base or spreadsheet which identifies:
  
  o All applicable facilities

  o The annual work plan
o Schedules for inspections
o Schedules for vegetation management
o Document storage

Controls designed to monitor the completion of vegetation management may include:

- Documented reviews of all or a sample of completed work orders.
  o Document the procedure for the review
    ▪ Who conducts the review
    ▪ When is the review conducted
    ▪ How is the review documented
    ▪ What is the process to be followed if work vegetation management work
      was not completed as expected

- Inspection of the vegetation management work
  o Identify who conducts the review
  o Identify when follow up inspections take place
  o Identify how many circuits are reviewed and how much:
    ▪ The entire circuit
    ▪ A portion of the circuit
  o Identify how the review is recorded
  o Identify the steps to be taken if work was not completed as expected

Regardless of the type of management practices implemented to monitor the application of
vegetation management practices ensure these steps are clearly identified and documentation is
retained to provide assurance vegetation management tasks have been applied as designed.

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