



United States Operations

Transmission: Vegetation Management Strategy (VMS)

Authorized by:

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Carol Sedewitz, Vice President
Asset Management
National Grid USA Service Company, Inc.

National Grid USA Service Company, Inc.
40 Sylvan Road
Waltham, MA 02451

1.0 Change Control

Version	Date	Modification	Author(s)	Reviews and Approvals by
Issue 1.0	Effective July 1, 2014	Initial	Teri Niedzielski and Mariclaire Rigby	John Gavin
Issue 2.0	Effective October 26, 2015	Minor revisions; adjusted MVCD; added 7.1.5 – Notification to Company FERC Compliance	Teri Niedzielski and Mariclaire Rigby	John Gavin
Issue 3.0	Effective December 31, 2016	Updates for implementation of FAC 003-4; new MVCDs	Teri Niedzielski and Mariclaire Rigby	Carol Sedewitz

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2.0 Introduction

2.1 Purpose

The purpose of this Right-of-Way (ROW) Vegetation Management Strategy (VMS) is to document the strategy for managing vegetation on transmission and certain distribution assets for National Grid. This VMS defines:

- Strategies for all phases of vegetation management on electric ROWs;
- Clearance requirements between conductors and vegetation acceptable to National Grid for maintaining reliable electric transmission service;
- Responsibilities of Company personnel;

2.2 Scope

The strategies of the VMS apply to all National Grid electric ROWs.

2.3 Objectives

The primary objective of National Grid's VMS is to minimize service interruptions due to vegetation. Other objectives include providing a clear and safe work space and access for maintenance activities.

3.0 Definitions:

Annual Work Plan – Identifies the vegetation management field work that will be carried out in a specified year.

Capable Species – Tree, shrub and vine species that have the ability to grow into the National Grid Clearance Distance (NGMVCD) from conductors.

Compatible Species- woody shrub and herbaceous species that do not have the ability to grow into the National Grid Clearance Distances (NGMVCD).

Clearance Distances – 1) the At Time of Vegetation Management (ATVM) Clearance Distance from vegetation, in a radius around the conductor, to be achieved at the time of vegetation management and 2) National Grid Minimum Clearance Distance (NGMVCD), is a radius around the conductor, maintained at all times to prevent flashover between vegetation and conductors 3) Minimum Vegetation Clearance Distance (MVCD) is a regulatory definition (FAC 003-4) of clearance between conductors and vegetation to be maintained under all rated electrical operating conditions. Clearance distances are provided in Section 6.

Danger Tree – A tree on or off the ROWs that if were cut or failed could contact electric lines.

Hand Cutting – Vegetation management method in which woody vegetation is felled via the use of hand tools, including chainsaws and brush saws.

Hazard Tree – Danger trees which due to species and/or structural defect are likely to fail and fall onto the electric facility.

Herbicide – Chemical used to control, suppress or kill plants or severely interrupt their normal growth processes.

Imminent Threat –a vegetation condition that poses an increased risk to the reliable operation of a particular transmission circuit and therefore requires 1) mitigation of that vegetation condition typically within 24 hours, and 2) notification to the system operator.

Integrated Vegetation Management – an adaptation of Integrated Pest Management (IPM) where the pest is tall growing, capable vegetation. IPM/IVM is a system of controlling pests in which pests are identified, action thresholds considered, all possible control options evaluated and selective, physical, biological and chemical controls are considered. When chemical controls become necessary to control and prevent the growth of capable, tall growing woody species, the Company is committed to employing selective, targeted applications. These treatments shall use approved herbicide products and mixtures that target specific plants or plant communities in a manner calculated to control and eliminate the tall-growing, capable woody species, while preserving as much of the small, compatible woody shrub and herbaceous vegetation as is practical.

IROL - Interconnection Reliability Operating Limit

ISO – Independent System Operator

MA DAR – Massachusetts Department of Agricultural Resources

Minimum Vegetation Clearance Distance (MVCD) – The calculated minimum distance stated in feet to prevent flash-over between conductors and vegetation, for various altitudes and operating voltages (FAC 003-4).

NERC – North American Electric Reliability Council

NH PES – New Hampshire Pesticide Bureau

NPCC – Northeast Power Coordinating Council

NY DPS – New York Department of Public Service

NY Part 84- The New York Long-Range Transmission ROW Management Program required by the NY Public Service Commission

Pruning – the cutting and removal of tree branches to provide specified clearance distance between vegetation and the conductors. See A.N.S.I. A300 for additional detail.

RI DEM – Rhode Island Department of Environmental Management

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 guidance 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 (FAC 003-4).

Transmission – includes all electric lines 115kV and higher in New York and 69kV and higher in New England, used to transport electricity between various generation, switching, and distribution substations.

Vegetation Inspection – The systematic examination of vegetation conditions on a ROW and those vegetation conditions under the 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 (FAC 003-4).

VIPER – (Vegetation Inspection Planning Evaluation and Reporting) National Grid's vegetation management system; a combination of databases, GIS and mobile applications.

VMP –Vegetation Management Procedures

VMS – Vegetation Management Strategy

VMSpec –Vegetation Management Specification

VT AAFM – Vermont Agency of Agriculture, Food and Markets

YOP – Yearly Operational Plan, Massachusetts

4.0 Strategy Overview:

National Grid's strategic approach to vegetation management within the ROW is to establish and maintain ROWs that are largely clear of all capable vegetation while maintaining a stable low-growing plant community that is beneficial to wildlife. National Grid's strategic approach to managing vegetation adjacent to the ROW is to prune and/or remove danger trees and/or hazard trees where property rights allow vegetation management work.

ROWs that are largely clear of capable vegetation present a very low risk of vegetation-caused interruptions. Vegetation adjacent to ROWs (danger and hazard trees) presents a greater risk of interruptions. The risk from danger trees is primarily related to two non-biotic variables: 1) distance from conductor to the adjacent tree line, and 2) conductor distance above the ground; and three biotic factors: 1) height of trees, 2) tree species, and 3) tree health and condition. National Grid seeks to mitigate risk of interruptions from trees adjacent to the ROW that are within the Company's control through site specific management of these variables.

Vegetation management work on transmission and distribution ROW is organized into two programs:

- ROW Floor Program – management of vegetation within the ROW corridor, and
- Sideline Tree Program – management of vegetation adjacent to the ROW corridor.

5.0 Strategy Elements

- 5.1 **Cycles:** Vegetation is managed by a combination of cycle maintenance and off-cycle maintenance. The maintenance cycle (interval) for all ROWs shall be set by Vegetation Strategy with input from Vegetation Operations: The ROW Floor cycles range from three to eight years and Off-ROW Sideline Tree Program range from three to sixteen years. Note: Certain ROWs are wide enough that sideline work is seldom necessary.
- 5.2 **Integrated Vegetation Management (IVM):** herbicide treatments shall be the preferred method of vegetation management. Hand cutting or mowing shall be used where herbicide use is prohibited.
- 5.3 **Safety:** All vegetation management operations shall be conducted in a safe, effective manner in conformance with Federal and State laws, regulations and permit conditions.
- 5.4 **Regulatory Compliance:** All vegetation management operations shall be conducted in conformance with national and regional standards including but not limited to NERC FAC-003-4 and ISO 14001.
- 5.5 **Permitting:** All Federal state or local permits necessary for any vegetation management operations shall be obtained and adhered to.
- 5.6 **Notifications:** All applicable state, local and residential notification procedures shall be followed.
- 5.7 **Contractors:** Contractors are retained to carry out nearly all hands-on vegetation management work on National Grid ROWs. Contractors are to be appropriately licensed, certified and qualified. They shall conduct all vegetation management operations consistent with National Grid safety requirements, the A.N.S.I. Z-133 safety standard, ANSI A300 Standard and National Grid Environmental Policy.
- 5.8 **Operations:** National Grid Forestry staff shall provide local supervision, coordination and enforcement of the VMS, VMP and the companion VMSpecs for contractors.
- 5.9 **Imminent Threat of Interruption:** National Grid personnel or contractor personnel shall report any observed vegetation-related imminent threats that may cause interruptions to the appropriate Company Regional Control Center in accordance with approved procedures for the affected voltage class. The Regional Control Center shall take appropriate action per National Grid Control Center operating procedures.
- 5.10 **Vegetation Inspections:** The systematic examination of vegetation conditions on a ROW and those vegetation conditions under the 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 (FAC 003-4).
- 5.11 **Documentation of Work:** Documentation shall be maintained at all stages of work and be available through the VIPER (Vegetation Inspection Planning Evaluation and Reporting), or current record maintenance system.
- 5.12 **Document Control:** This VMS shall be updated by Vegetation Strategy as needed and authorized through the signature of the vice president of Asset Management.

6.0 Clearance Distances

National Grid specifies three clearance distances to be achieved during maintenance cycles as a defense in-depth strategy and interruption risk abatement management work. Clearance distances established by National Grid below conform to the following regulatory standards and industry guidelines:

- North American Electrical Reliability Counsel (NERC) Vegetation Management Standard FAC-003-4;
- National Electric Safety Code (NESC) Rule 218; and
- Applicable State vegetation management standards or regulations.

6.1 National Grid At Time of Vegetation Management Clearance Distances (ATVM)

When performing ROW vegetation management, the following At Time of Vegetation Management (ATVM) Clearance Distances, by voltage, shall be achieved. (See Definitions in Section 3.0).

At Time of Vegetation Management Clearance Distances (ATVM)		
Voltage¹	Vertical (feet)	Horizontal (feet)²
23 to 46kV	12	12 – 38
69kV	14	14 – 42
115kV	18	18 - 50
230kV	22	22 – 50
345kV	26	26 – 50
450kV DC	28	28 - 50

1 Includes some Distribution Voltages below 23kV in New England

2 For span lengths greater than 500 feet, contractors need to achieve a horizontal ATVM clearance distance at the higher end of the range. Each range incorporates span lengths, an increase in voltage increases span length, and therefore increases clearance distance.

ATVM Clearance Distances are greater than the Minimum Clearance Distances. In establishing these clearance distances, National Grid considered site-specific conditions such as operating voltage, IVM techniques, fire risks, tree and conductor movement, species types and growth rates, species failure characteristics, local climate rainfall patterns, line terrain and elevation, location of vegetation within the span, worker approach distance requirements and the expected time frame (the maintenance cycle) before vegetation management will be repeated at the site.

6.2 National Grid Minimum Vegetation Clearance Distances (NGMVCD)

Notwithstanding the ATVM Clearance Distances above, the National Grid Vegetation Clearance Distances specified below shall be maintained to minimize risk of flashover between vegetation and conductors. These clearances, while based on published guidance, are intended to mitigate risk and are not used for FAC-003-4 regulatory compliance purposes. The transient overvoltage factor is known for most of the 12kV through 345kV voltages, however, National Grid has chosen to base the NGMVCD on Tables in Annex D of the IEEE Standard 516-2009, a more conservative approach. For the 450kV DC voltage, Table 10.3 of the EPRI HVDC Reference Book is cited for the NGMVCD.

National Grid Minimum Vegetation Clearance Distances (NGMVCD)	
Voltage	Radial Clearance (feet)
12 to 46kV	1
69kV	2
115kV	4
230kV	6
345kV	10
450kV DC	12

6.3 Minimum Vegetation Clearance Distance (MVCD)

Transmission Standard FAC-003-4 for Vegetation Management requires a minimum clearance for voltages operated at or above 200kV or any line operated below 200kV designated by the Planning coordinator as an Interconnection Reliability Operating Limit (IROL). The table below depicts a clearance distance that is representative of the most conservative minimum for elevations above sea level for the service territory (up to 3000 feet). The comprehensive table is located in the FAC-003-4 Standard and must be used for regulatory reporting purposes. National Grid maintains MVCD at all times, as required by FAC 003-4.

Minimum Vegetation Clearance Distances (MVCD) for US Operations	
Voltage	Radial Clearance (feet)
115kV IROL	2.0
230kV	4.3
345kV	4.5
450kV DC	8.71

6.4 Right-of-Way Width

ROW width used for purposes of compliance with FAC-003-4 is defined as the linear distance from the center line transmission to the ROW edge. The ROW edge is typically provided for by easements or fee owned ROW purchased at the time of initial transmission line construction. ROW widths are determined using different methodologies, including the width of the legal easement, engineering specifications, or construction documentation. Verification of ROW widths for purposes of FAC-003-4 compliance can be completed by checking records stored in the VIPER application or

construction diagrams, and in all cases can be verified through the Company Real Estate department

ATVM clearance requirements are based on the “optimum” ROW width developed for various voltage classes. Optimum ROW widths may be used for guidance or planning purposes for either maintenance or construction, but are not used for regulatory compliance purposes. A majority of transmission lines on National Grid’s system have widths that are “optimum.” This is why the ATVM horizontal distances were specified as a range. The optimum ROW widths specified below are those distances shown over 50 years of operational experience to render the combined benefits of good access, public safety, ease of construction and enhanced reliability. .

Optimum Right-of-Way Width	
Voltage	Optimum Width from Centerline of Circuit (feet)
12-46 kV	37.5
69 kV	37.5
115 kV	50
230 kV	60
345 kV	75

6.5 Exceptions to Clearance Distances:

6.5.1 ATVM Clearances

Legal restrictions and environmental and social concerns may prevent National Grid from achieving ATVM Clearance Distances at various sites across the transmission system. For NERC regulated circuits, National Grid shall map these sites within the VIPER system. All such sites will be inspected as needed and mitigation procedures taken to assure adherence to NGMVCD and MVCD.

6.5.2 Optimal Widths

6.5.2.1 New Construction

When new transmission lines are constructed, the optimal ROW width is the target width sought during ROW acquisition. Width may vary as a result of construction type, terrain and acquisition feasibility.

6.5.2.2 Excess Fee Owned Right of Way

Where fee ownership extends beyond optimal width, other factors may determine a width, such as:

- Historic vegetation management records
- Construction Plans
- Engineering Guidance

7.0 National Grid Roles and Responsibilities

National Grid owns and is responsible for ensuring maintenance of their transmission, sub-transmission and distribution facilities on ROW. They are responsible for system-wide design, planning, coordination and supervision of all ROW vegetation management operations. The roles are shared by two departments; Vegetation Strategy and Vegetation Operations. These departments work together to provide local oversight, coordination and enforcement of vegetation management policy, procedures and this VMS on National Grid transmission ROW. Specified duties are listed below.

7.1 Vegetation Strategy

The Vegetation Strategy Department is responsible for system-wide design, and planning of ROW vegetation management programs. Specific duties of Vegetation Strategy are: preparing the VMS, VMP and VMSpec, workplan development, obtaining necessary permits, providing technical expertise and acting as a liaison between National Grid and local and state officials, or other interested parties. Specific duties are described as follows:

7.1.1 Prepare documents

Vegetation Strategy is responsible for ensuring that all required internal and external documents, the Annual Work Plan, Field Inventory, plans, regulatory permits and reports have been developed and submitted to required parties. Key regulatory documents are summarized below.

Regulatory Documents Required						
Document Required	NERC	MA DAR	RI DEM	NH PES	VT AAFM	NY PSC/DEC
Long Term Plan		√		√	√	√
Annual Work Plan (YOP and NY PART 84)		√				√
Self-Certification	√					
Permit				√	√	√
Annual Report						√

7.1.2 Obtain Plans/Permits/Approval

Vegetation Strategy has responsibility for ensuring that all required state level plans, permits and approvals have been obtained prior to initiating vegetation management activities.

7.1.3 Prepare VMS , VMP, and VMSpecs

Vegetation Strategy annually reviews this VMS, the VMP and the VMSpec, and revises the documents as required.

7.1.4 Maintains VIPER

Vegetation Strategy is responsible for the design and maintenance of the VIPER system.

7.1.5 Notification to Company FERC Compliance

Vegetation Strategy will review and report outages and encroachments into the MVCD as defined in FAC 003-4 to Company FERC Compliance management.

7.2 Vegetation Operations

Vegetation Operations is responsible for implementing this VMP, scheduling work, estimating budgets, prescribing herbicides and application methods for each ROW, selecting contractors, spot checking treatment crews, entering field data into VIPER, and acting as a liaison between National Grid and landowners. Specific duties are described as follows:

7.2.1 Procure Services

Vegetation Operations has responsibility for ensuring that appropriate contractor services have been procured in order to fulfill the requirements of the Annual Work Plan.

7.2.2 Delivers workplan according to VMP and VMSpec

Vegetation Operations informs the contractor which ROW will be treated, the range of dates of treatment and the vegetation management methods, materials and mixing rates to be used. Vegetation Operations also provides inventory information, ROW maps and other information from VIPER.

7.2.3 Utilizes VIPER

Vegetation Operations records and tracks field data that is associated with the, patrols, work plan and maintenance activities.

7.3 Vegetation Maintenance Personnel Qualifications

7.3.1 Managers of Vegetation Operations and Vegetation Strategy

The Transmission Forestry Managers shall have at least ten (10) years of electric utility experience. The Managers may also have the vegetation management qualifications listed below for National Grid Supervisors and Specialists.

7.3.2 Supervisors and Specialists

The National Grid Foresters hold 2-year or 4-year degrees in forestry, urban forestry, arboriculture or related field. Other qualifications may include certified pesticide applicator license, ISA Certified Arborist, utility industry

experience and/or significant experience in contract and contractor management. Tasks may be carried out by in-house staff or professional-level contractors holding equivalent qualifications.

8.0 Annual Work Plan

National Grid's Transmission Vegetation Management annual work plan defines the ROWs/circuits scheduled for either Integrated Vegetation Management (IVM) or sideline pruning and hazard tree removal.

8.1 Development

The work plan process for both the IVM and sideline components of the annual vegetation management work is developed in four steps. The steps are described below:

Step One: A list of work (ROWs/circuits) is developed using the scheduled treatment year for each transmission element in the current data management system.

Step Two: The resulting list from Step One is reviewed against field data, capital project schedules and other data sources including reliability history to remove ROWs where work is not yet needed. Any non-FAC-003-4 ROW that is deferred from the list is rescheduled into a future year and the maintenance cycle revised accordingly. Note also that in some cases a ROW may be added from outside the Step One list, possibly "short cycled", due to information from the same data sources. Note: Deferrals only apply to non-FAC 003-4 regulated work and inspections. Regardless of any changes encountered during the work plan process, National Grid will complete 100% of its annual vegetation work plan, in accordance with FAC-003-4 Requirements R6 and R7:

- Requirement R6 mandates that the Company perform vegetation management inspections of the entire length of its transmission lines within the scope of FAC 003-4 every year.
- Requirement R7 requires the Company to complete its entire annual vegetation work plan for transmission lines covered by FAC-003 every year, although the Requirement acknowledges that revisions to the work plan may be needed in response to changing conditions or inspection results. Such revisions are permitted so long as encroachments into the MVCD are prevented.

Step Three: Using the latest version of the draft work list developed in Step Two, an estimated cost or budget for the fiscal year is developed using estimated costs and/or actual bid results. Based on the results of the comparison, any work considered marginal in need could be deferred to a future year or additional budget funding requested.

Step Four: The final annual work plan for both IVM and sideline is then published and provided to Vegetation Operations for their action.

8.2 Monitoring

Vegetation Strategy in concert with Vegetation Operations uses a monthly scorecard to monitor work progress. The scorecard is broken down by Company locations and includes the appropriate unit of work for each program type (e.g. IVM in acres, sideline in miles). When judged necessary by Vegetation Strategy due to apparent schedule slippage or changes in work priorities a formal action plan to ensure work plan completion is requested and developed by Vegetation Operations.

8.3 Revisions

National Grid may adjust the annual work plan during the year by either adding or subtracting ROWs/Circuits from the list. Situations may occur during the year related to such things as updated ROW field conditions, major storm events, short term emergency construction projects, limited contractor resources, property rights issues and/or changes or delays in permit requirements which may have an affect on the annual work plan. When necessary, Vegetation Strategy has the authority to revise the work plan when judged appropriate to do so. Any changes to the annual work plan are documented in VIPER.

8.4 Completion:

Final completion of the work plan is attested by the Director of Vegetation Operations through the submission of the final scorecard summary at the end of the fiscal year. Filed with this final scorecard submission is any documentation noted above in the Revisions section.

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