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Creating Results-Based Reliability Standards

to ensure
the reliability of the
bulk power system

Training Objectives

- Identify and give examples of the elements that define a results-based standard
- Analyze the current standards and requirements for weaknesses
- Identify the needs, goals, and objectives for this standard
- Create an initial draft of this standard and requirements using result-based methods
- Create measures and necessary supporting material for the standard and requirements

Topics to be Covered

1. Results-based standards/requirements – what are they and why they matter
2. Scope – what you need to know before writing requirements
3. Standard requirements – observations and improvements
4. Where information is recorded - templates

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Standards Development Map

to ensure
the reliability of the
bulk power system

Standards Development Process Roadmap



- **NEED:** Why the standard is being developed or modified
- **GOALS:** What must be accomplished to meet the need
- **OBJECTIVES:** Criteria for success
- **OPERATIONAL CONCEPTS:** Day in the life
- **STAKEHOLDERS:** Individuals or groups impacted or interested
- **DRIVERS:** External constraints

Get consensus before writing requirements

Standards Development Process Roadmap



- Necessary: It is needed?
- Attainable: Can you meet it?
- Clear: Can be understood only one way?
- Measures: Is there achievable compliance with requirements?

Write results-based requirements

Standards Development Process Roadmap



- Conduct reviews
- Collect and analyze comments
- Revise scope and requirements in response to comments
- Recycle per planned schedule
- Submit for approval

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Results-Based Standards

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Results-Based Reliability Standards*

- Standard: A portfolio of requirements designed to achieve an overall defense-in-depth strategy and comply with the quality objectives.
- Each requirement has a role in preventing system failures
- Requirements within a standard are complementary and reinforcing
- Answer the question: *Who, under what conditions (if any), shall perform what action, to achieve what particular result or outcome?*

Requirement Types*

- Performance-based – define a particular reliability principle or outcome to be achieved
- Risk-based – preventive requirements to reduce the risks of failure to acceptable tolerance levels
- Competency-based – defines a minimum set of capabilities an entity needs to have to demonstrate it is able to perform its designated reliability functions

Examples of Types

- Performance Based

“Each Transmission Owner shall prevent vegetation from encroaching within the Minimum Vegetation Clearance Distance (MVCD), as shown in Table 2, of each applicable line conductor.”

- Risk Based

“Each Transmission Owner shall perform a Vegetation Inspection of all applicable transmission lines at least once per calendar year. “

- Competency Based

“Each Transmission Owner shall document the procedures, processes, or specifications it uses to prevent the encroachment of vegetation into the MVCD.”

- Interconnected bulk power systems shall be planned and operated in a coordinated manner to perform reliably under normal and abnormal conditions as defined in the NERC Standards.
- The frequency and voltage of interconnected bulk power systems shall be controlled within defined limits through the balancing of real and reactive power supply and demand.
- Information necessary for the planning and operation of interconnected bulk power systems shall be made available to those entities responsible for planning and operating the systems reliably.

Reliability Principles (cont.)

- Plans for emergency operation and system restoration of interconnected bulk power systems shall be developed, coordinated, maintained, and implemented.
- Facilities for communication, monitoring, and control shall be provided, used, and maintained for the reliability of interconnected bulk power systems.
- Personnel responsible for planning and operating interconnected bulk power systems shall be trained, qualified, and have the responsibility and authority to implement actions.

Reliability Principles (cont.)

- The reliability of the interconnected bulk power systems shall be assessed, monitored, and maintained on a wide-area basis.
- Bulk power systems shall be protected from malicious physical or cyber attacks.

Proven Techniques to Avoid Requirement Defects

1. Scope first – what is your standard to cover and why
2. Standard - contains necessary information for understanding by all stakeholders involved
3. Standard – does not contain unnecessary information
4. Requirements - necessary, measureable, and attainable
5. Requirements - can only be read one-way
6. Measures – addressed when writing requirements

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Scope

What you need to know and agree upon in order to develop a standard and write requirements

to ensure
the reliability of the
bulk power system



- **Need, goals and objectives**
- Operational concepts
- Stakeholders
- Drivers

Finding the Need – Vegetation Management (VM) example

Need – why is the standard being written

- 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 – *and a partridge in a pear tree.*
- The real need is: to prevent vegetation-related outages
- Is not: by effective vegetation management
- While recognizing... is neither useful nor necessary

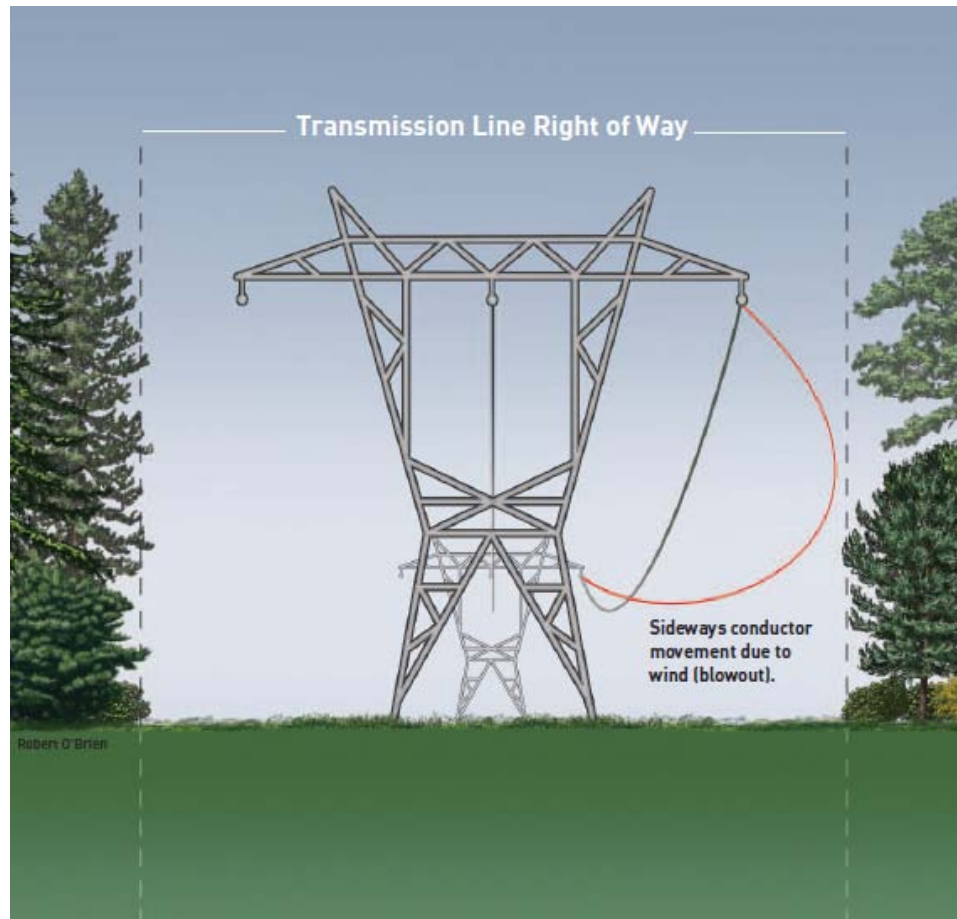
Needs, Goals, and Objectives

- **Need**
 - Answers "why is this particular standard needed?"
- **Goal**
 - "What needs to be accomplished on the way to meeting the need"
- **Objective**
 - "Initiatives that are implemented to meet goals"
 - How you know when you get there

- Need = Purpose (in existing standards)
- Purpose for the standard answers “why the particular standard is needed”
- Purpose is the basis for everything else in the standard
- Purpose in existing standards:
 - Doesn't always state a need for the standard
 - Often states much more than a need
 - Is too general – “improve reliability”

Exercise 1: Purpose Statement Weakness

- **BAL-002-1. Disturbance Control Performance Purpose:** The purpose of the Disturbance Control Standard (DCS) is to ensure the Balancing Authority is able to utilize its Contingency Reserve to balance resources and demand and return Interconnection frequency within defined limits following a Reportable Disturbance. Because generator failures are far more common than significant losses of load and because Contingency Reserve activation does not typically apply to the loss of load, the application of DCS is limited to the loss of supply and does not apply to the loss of load.
- Identify any concerns you have with the statement given
 - What is missing
 - What is unnecessary
 - What is confusing
- Do not attempt to rewrite – that's later



Goals – VM example

Goals – what do you have to accomplish to meet the need

1. Maintain situational awareness of vegetation on the active transmission line ROW for applicable lines
2. Control vegetation risks
3. Define method to control tree/wire risk
4. Define action if risk is identified

Objectives – VM examples

Objectives – how will you know when you get there

1. Zero outages due to contact between vegetation and lines
2. Define a minimum safe clearance distance between vegetation and lines
3. Effective, immediate response to report of critical risk

Need: to prevent vegetation-related outages

GOALS

1. Maintain situational awareness of vegetation on the active transmission line ROW for applicable lines
2. Control vegetation risks
3. Define method to control tree/wire risk
4. Define action if risk is identified

OBJECTIVES

1. Zero outages due to contact between vegetation and lines
2. Define a minimum safe clearance distance between vegetation and lines
3. Effective, immediate response to report of critical risk



Exercise 2: Needs, Goals and Objectives

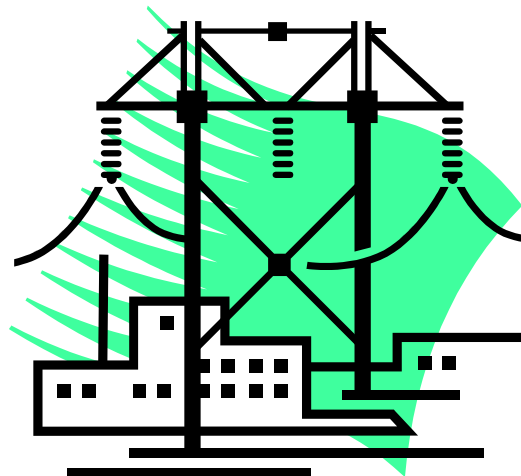
- Define Need, Goals and Objectives for BAL-002-2
 - First redo the Purpose (Need)
 - After Purpose is agreed upon by SDT, develop goals and objectives to meet the purpose

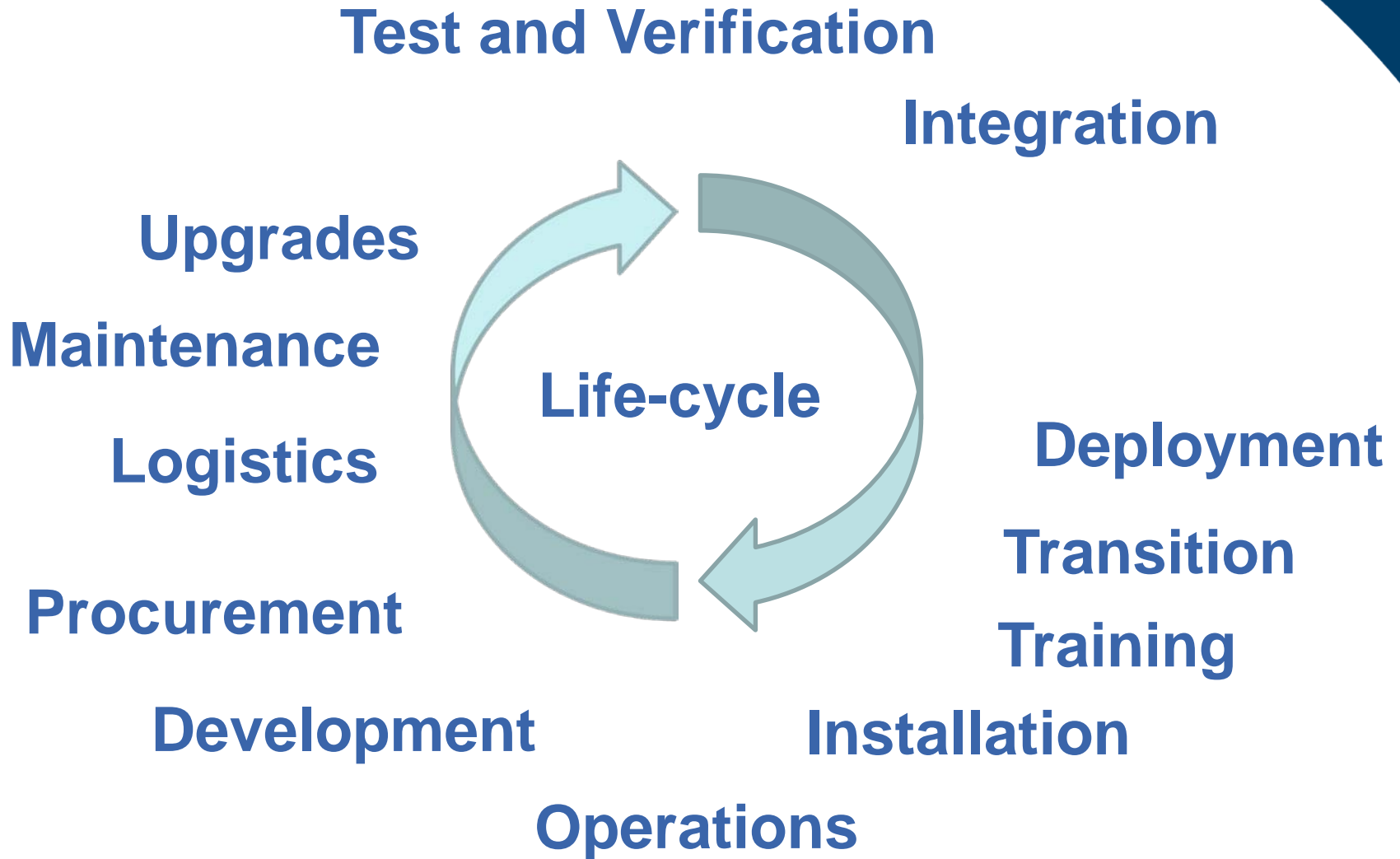


- Need, goals and objectives
- **Operational concepts (scenarios)**
- Stakeholders
- Drivers

Operational Concepts/Scenarios

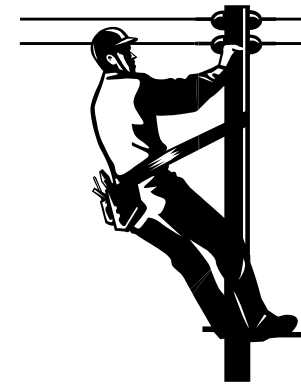
- Describe “a day in the life of the system”
 - What is done now?
 - What is needed to increase reliability?
- Address both normal and abnormal conditions





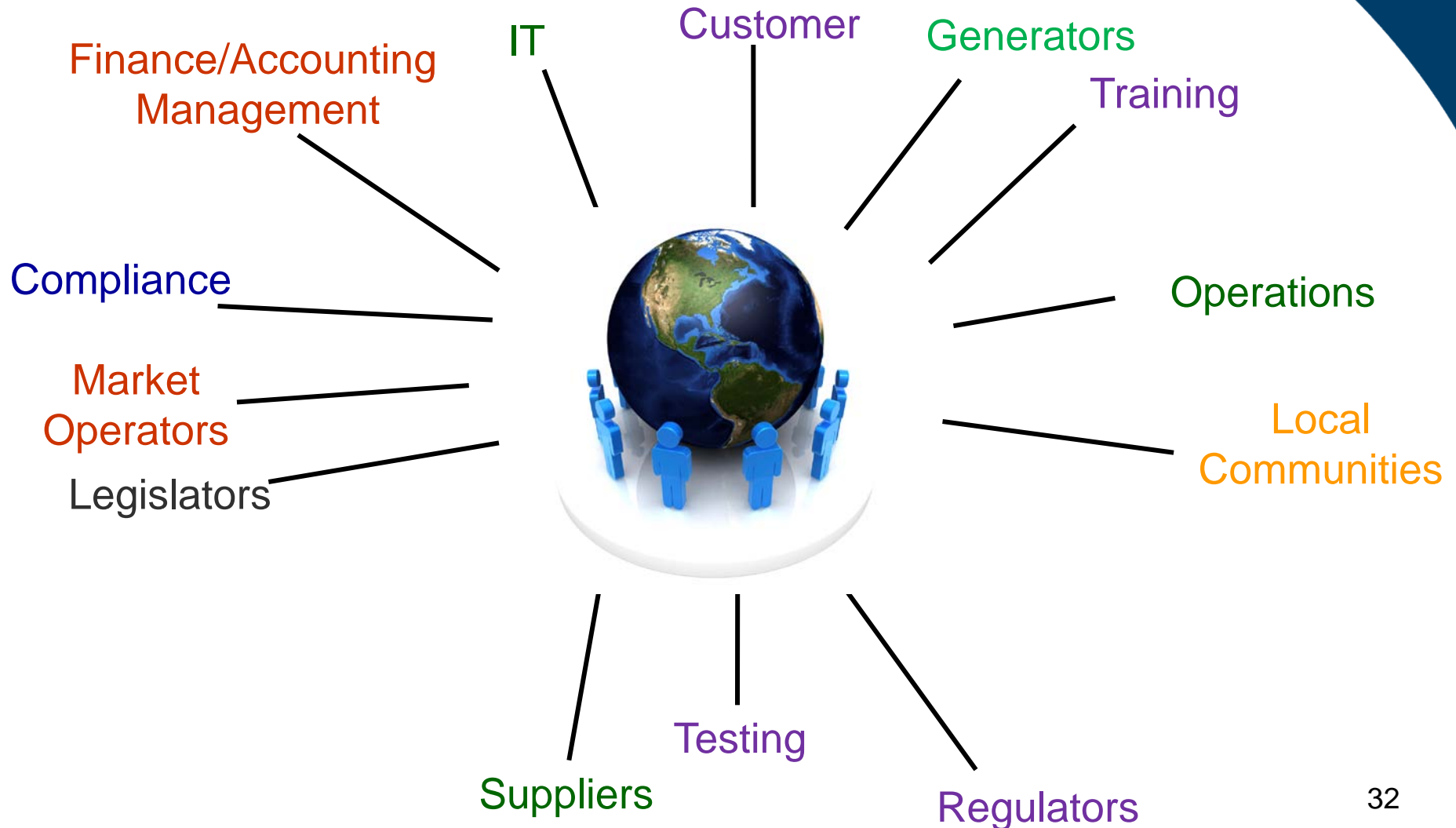
Why Identify Stakeholders

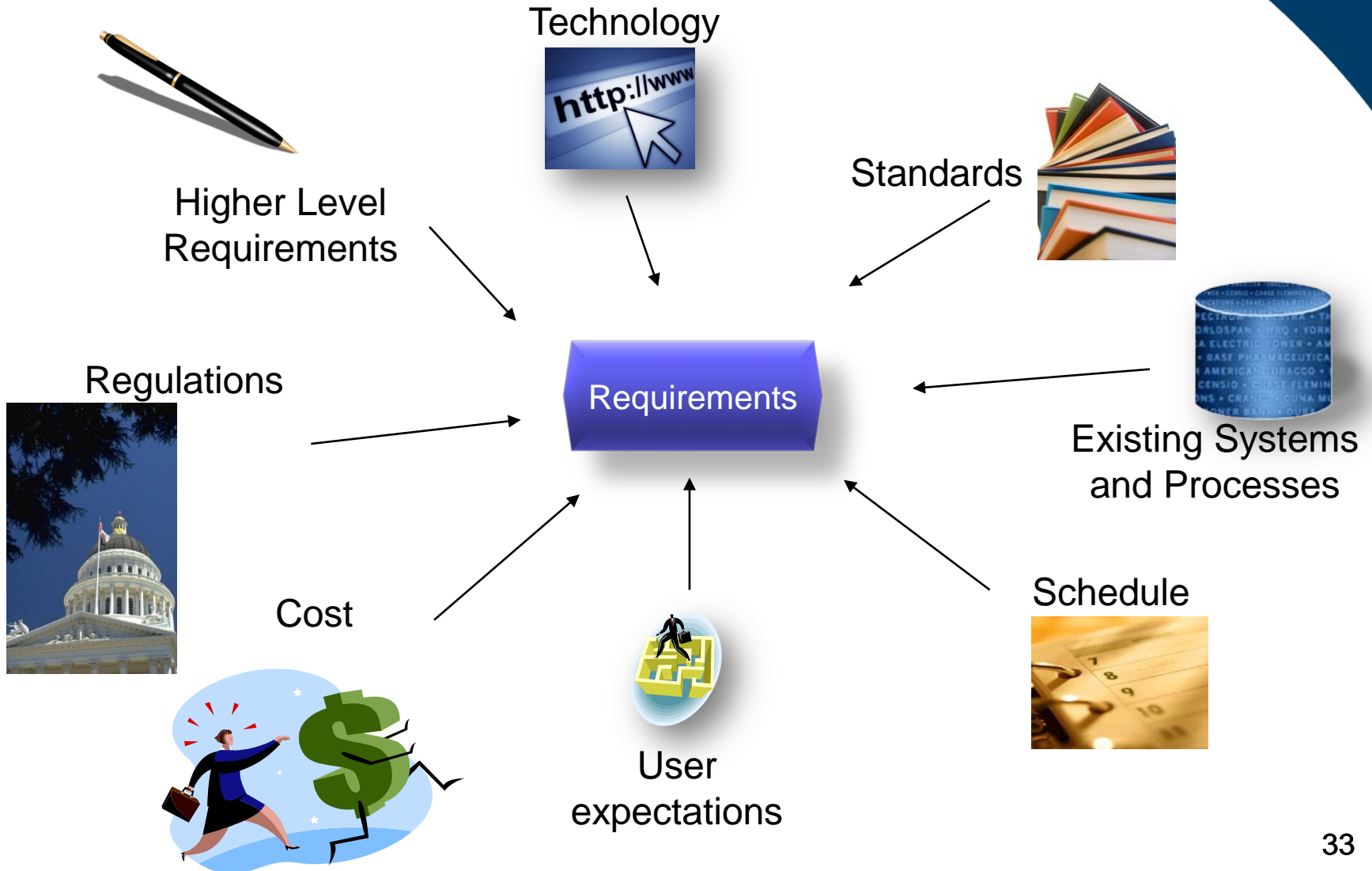
- Each has unique information and perspective
 - agenda
 - priorities
 - drivers
 - needs
 - expectations
 - assumptions
- Each stakeholder can influence your requirements



- Defined as an individual or group who is impacted by or is some way accountable for the success or failure of a project
- Three types of stakeholders:
 - Vested Interest
 - Influential
 - Participating

Stakeholders





Exercise 3: Scenario Development

- Develop a scenario for one life cycle phase for
 - Nominal conditions
 - Abnormal conditions
- Define your stakeholders, not just those who must comply
- Define your drivers

- Maintain the Scope information as it is discussed
- Make it available to all SDT members
- Some of the information may find its way into SAR updates
- Much of it will be used in your standard to help everyone understand the bounds of the standard and what has been considered

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Requirements

to ensure
the reliability of the
bulk power system

Standards Development Process Roadmap



- Necessary: Is it needed?
- Attainable: Can you meet it?
- Clear: Can be understood only one way?
- Measures: Is there achievable compliance with requirements?

Write results-based requirements

- Before creating requirements, we will discuss:
 - Characteristics
 - Defects
 - Correct terminology
 - Rationale for the requirement
 - Guidelines for creating a requirement

Requirement Defects Result In



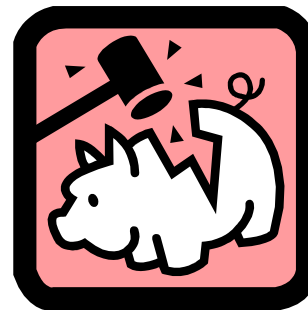
Frustration to all



Battles over
interpretation



Wasted funds



Compliance penalties

Requirements Section of the Standard*

- Each reliability standard must include one or more requirements, which if achieved by the applicable entities, will provide for a reliable bulk power system, consistent with good utility practices and the public interest.
- Each requirement must establish an objective that is the best approach for bulk power system reliability, considering the costs and benefits of implementing the proposal.
- Each requirement must be stated so as to be objectively measurable by a third party with knowledge or expertise in the area addressed by that requirement.
- Requirements should have the characteristics on the next slide.

*Excerpts from Acceptance Document.

Requirement Characteristics*

- Each requirement must identify what functional entity shall do what, under what special conditions (if any), for what reliability benefit.
- Each requirement should be aimed at achieving one objective.
- If specific results can be practically measured quantitatively, metrics should be provided within the requirement to indicate satisfactory performance.
- To the maximum extent possible the requirement must be designed to apply throughout the interconnected North American Bulk-Power System.
- Reliability standards should not contain:
 - Requirements that prescribe commercial business practices which do not contribute directly to reliability.
 - Requirements that duplicate or conflict with one another.

* Excerpts from Acceptance Document.

Common Requirement Defects

1. Don't provide adequate reliability
2. Can be interpreted different ways
 - Subjective terms
 - Poor grammar
 - Multiple requirements in a single statement
3. Don't clearly state who has what responsibility
4. Can't be measured
5. Can't be enforced

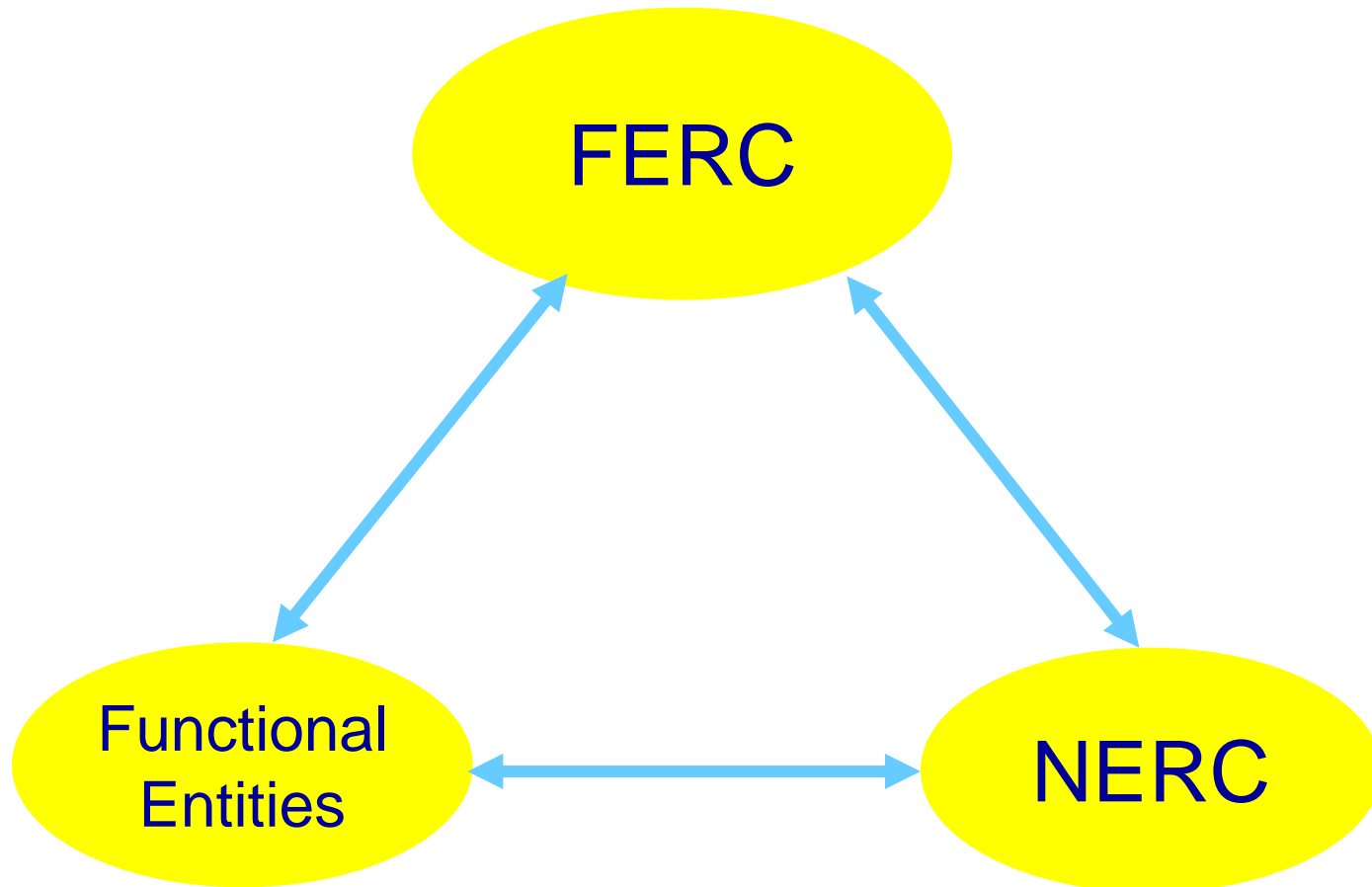
Characteristics of Good Requirements

Improving Communications

- One Thought
- Concise
- Simple
- Stated Positively
- Grammatically Correct
- Can only be understood one way



Requirement Can Only Be Understood One Way



What a requirement must state

WHO is responsible

WHAT shall be done

Each Transmission Owner conduct a vegetation inspection.....

Each Planning Coordinator provide data to...

Each Generator Owner report changes made to

Use The Correct Terms

- Noun (*Authorized functional entity(s)*)
- Verb (intransitive):
 - Requirements are binding - Shall
 - Facts or Declaration of Purpose - Will
 - *Don't use must*
- Verb (transitive): An excerpt from the Drafting Team Guidelines Appendix O is on the next slide.

Active Verbs*

- **Acquire** — To obtain something new, such as a trait, ability or characteristic; to get as one's own; to locate and hold.
- **Activate** — To make active; to start development of
- **Alert** — To give warning or notice, or to call to a state of readiness; to make clearly aware of
- **Calculate** — To make a mathematical computation; to solve or probe the meaning of; to design or adapt for a purpose
- **Check** — To test, compare or examine to determine if something is as it should be
- **Communicate** — To receive or distribute, to convey or make known information via personal, written or electronic methods

Avoid Ambiguous Terms

- etc
- Including, but not limited to

-
- Maximize
 - Sufficient
 - User-friendly
 - Robust
 - High speed
 - Minimize
 - Adequate
 - Easy
 - Ultra-low power
 - TBD

-
- Accommodate
 - Support

-
- Indefinite pronouns
 - this
 - these
 - it
 - and/or
 - be able to/be capable of

- States “why” what is stated in a requirement needs to be performed
- Provides a justification (technical or otherwise) for a given requirement
- Used in the background explanation for a standard
 - Provides a key to understanding
 - Reduces interpretation problems
 - Facilitates maintenance and upgrades
 - Preserves corporate knowledge
- Not part of the requirement

Example Rationale for a Requirement

- Requirement – States “who shall do what under what conditions”

The Transmission Owner (TO) shall alert the Operations Planner (OP) when something occurs.

- Rationale – States “why”

The OP needs the alert to handle a situation that could lead to reduced reliability. The TO has information that makes issuing an alert imperative. Standard XXX-00Q covers the OP action.

Rationale – defines

- Why a requirement is needed
 - Why the requirement needs to be included in the document – reason, justification.
- What assumptions were made
 - Assumptions made that must be true for the requirement to be valid
- What analysis effort drove the requirement
 - Trade studies, research, or historical data the requirement is based on
- Information to help understand the requirement
 - Information to help the reader understand the intent of the requirement.
- Source of any numbers
 - If the requirement contains numbers, where did the numbers come from: What analysis resulted in that number? What or who was the source

What NOT to Put in Rationale

- A rewrite of the requirement
- Hidden requirements
- Duplicate another requirement's rationale
- Everything you know on the topic

Guideline Checklist for Writing a Requirement

1. Does the requirement identify “Who (functional entity), under what conditions (if any), shall perform what action (including the word “shall”)?
2. Does the requirement address a single activity with a single reliability goal?
3. Is the requirement written in the “active” voice?
4. Is the requirement stated in a clear and concise manner without the use of any ambiguous words or unnecessary explanatory information?
5. If a specific performance can’t be identified, is the acceptable performance qualified and bounded by measurable conditions/parameters?
6. Is the requirement limited to the facilities contained within the boundaries of the bulk power system?
7. Has the drafting team provided a technical justification (rationale) for the requirement?

Exercise 4: Inspect Requirements

- Look at the list of requirements from our standard
- For each requirement, identify if it is
 - Prescriptive or administrative – If deleted does it need to be replaced with something else?
 - Unclear – give the reason
 - Enforcement problems – state a reason
 - Does not meet guidelines

Do not try to fix the requirements – just identify defects

Requirement Rewrites – EOP-004 & CIP-001

- OLD: A Reliability Coordinator, Balancing Authority, Transmission Operator, Generator Operator or Load Serving Entity shall promptly analyze Bulk Electric System disturbances on its system or facilities.
- NEW: Each RC, BA, TOP, GOP or LSE shall analyze BES Impact Events within 30 days of the Impact Event.
- Rationale: The DSR SDT has used the term “Impact Events” in place of disturbance since the defined term “Disturbance” does not comport with the intent of the standard. The entity is expected to gather data and perform load flow studies to determine root causes of the Impact Event and “lessons learned” to reduce the risk of repeat events.

Example from PRC-0005-2

- OLD: Each Transmission Owner, Generator Owner, and Distribution Provider shall establish a Protection System Maintenance Program (PSMP) for its Protection Systems *that use measurements of voltage, current, frequency and/or phase angle to determine anomalies and to trip a portion of the BES and that are applied on, or are designed to provide protection for the BES.* The PSMP shall meet the following criteria:
- NEW: Each Transmission Owner, Generator Owner, and Distribution Provider shall establish a Protection System Maintenance Program (PSMP) for its Protection Systems that contains the following:

Example from MOD-010

- OLD: The Transmission Owners, Transmission Planners Generator Owners, and Resource Planners (specified in the data requirements and reporting procedures of MOD-011-0_R1) shall provide appropriate equipment characteristics, system data, and existing and future Interchange Schedules in compliance with its respective Interconnection Regional steady-state modeling and simulation data requirements and reporting procedures as defined in Reliability Standard MOD-011-0_R1.
- NEW: . Each Planning Coordinator and Transmission Planner shall have a documented specification for the data necessary for it to complete its Planning Assessments. The specification shall include:
 - A list of the functional entities that it needs data from
 - A list of required data to be exchanged
 - A mutually agreeable format
 - A deadline for providing the data

Example from Steady-State Data - Before

- The Regional Reliability Organizations within an Interconnection shall document their Interconnection's steady-state data requirements and reporting procedures, shall review those data requirements and reporting procedures (at least every five years), and shall make the data requirements and reporting procedures available on request (within five business days) to Regional Reliability Organizations, NERC, and all users of the interconnected transmission systems.

Example from Steady-State Data - After

Each Regional Entity within an Interconnection shall document its Interconnection's steady-state data requirements and reporting procedures in DOC 123.

Rationale: The Regional Entity is responsible for modeling the interconnection's steady-state performance and thus has the knowledge and need to specify the data and reporting needs.

Each Regional Entity shall review and update DOC 123 at least every five (5) years.

Each Regional Entity shall provide its DOC 123 within five (5) business days of a request from another Regional Entity, NERC, or any user of the interconnected transmission systems.

More ways to improve requirements (1)

- Pictures or graphs
 - The Balancing Authority may use a fixed Frequency Bias Setting that is not less negative than the lesser of the Balancing Authority's FRO or FRM., and
 - not more negative than 150% of the lesser of the Balancing Authority's FRO or FRM
- Draw the zone that is okay
- It is okay to put in words, but include a schematic as well.

More ways to improve requirements (2)

- **Use tables where appropriate**
- The Load-Serving Entity, Planning Authority and Resource Planner shall each provide the following information annually on an aggregated Regional, subregional, Power Pool, individual system, or Load-Serving Entity basis to NERC, the Regional Reliability Organizations, and any other entities specified by the documentation in Standard MOD-016-1_R1.
 - Integrated hourly demands in megawatts (MW) for the prior year.
 - Monthly and annual peak hour actual demands in MW and Net Energy for Load in gigawatthours (GWh) for the prior year.
 - Monthly peak hour forecast demands in MW and Net Energy for Load in GWh for the next two years.
 - Annual Peak hour forecast demands (summer and winter) in MW and annual Net Energy for load in GWh for at least five years and up to ten years into the future, as requested.

Exercise 5: Rewrite Existing Requirements

- Use the handout you earlier used to identify defects
- Do appropriate rewrites, include rationale

Exercise 5: Write New Requirements

- Scope to requirements
 - Look at NGO – make a bulleted list of items needing requirements
 - Look at operational concepts/scenarios – add any requirements there to the bulleted list
- Consolidate lists across the team
- Write requirements for the consolidated list
- Write the rationale for each requirement

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Measures

to ensure
the reliability of the
bulk power system

- At least one Measure for each requirement
- Each measure must identify the functional entity
- Each measure must be tangible, practical, and as objective as is practical
- Measures should support requirements by identifying what evidence or types of evidence could be used to show that an entity is compliant with the requirement
- Do not use “shall” or “should” in a Measure
- Measures need to meet drafting team guidelines
- New template puts Requirements and Measures together

Requirements and Measures Guidelines

Requirement	Measure
Calls for document	Require the responsible entity to provide that document
Calls for document having timing-related aspects such as “current” or “updated”	Evidence must include references to dates
Is to verify something	Include the criteria for verification and the evidence to support that the verification was conducted
Is for verification to be executed on some periodic basis	Evidence must include references to dates
Is to take an action	Include evidence that the action was performed
Is for action under specified conditions or with some specified frequency	Include evidence of the conditions under which the action was performed or a reference to the times when action took place, to support the frequency

Exercise 6: Writing Measures

- Take requirements and rationale written so far and using guidelines from previous slide, create measures.

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Standards Template

to ensure
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bulk power system

Adding Information into the Template

- Background sets the stage
- Additional Information in the requirements and measures for clarity that came from the scenarios and other scoping activities
- Guidelines at the end of the document excerpted from the white paper or technical papers add further clarification

Results-Based Standard Template Layout

Introduction

VERSION OF THE ST

- Title:** Self-explanatory
- Number:** Self-explanatory
- Purpose:** Why is this standard needed? This should be a brief statement of the reason for the standard. Examples are “to prevent sustained outages due to vegetation”, “to ensure proper notification in the event of disturbances”, “to ensure timely and accurate collection of data needed to model the system”.
- Applicability:** Which entities are assigned reliability requirements

What facilities, with threshold criteria where appropriate, are subject to this standard or specific requirements.
- Background:** Provide a bit more substance on the reasons for this standard/change, and how it ties with the Adequate Level of Reliability (ALR).

New

Results-Based Standard Template Layout

Requirements and Measures (criteria, requirements or “must follow” procedures, and the evidence needed to demonstrate compliance)

Requirements and measures specify:

- The performance targets that responsible entities must achieve or the capabilities they must implement to meet the stated Purpose. For example: recovering DCS within some minutes, mitigating SOL/IROL exceedances within some specific times, developing operational plans to respect SOLs/IROLs, developing redundant backup operating capability, etc.
- The actions that responsible entities must take to meet the stated objective. For example: issuing directives to restore the system, requesting implementation of certain procedures to relieve transmission constraint or recover from emergency, etc.
- Must be specific on the expected outcome and the conditions under which the requirement applies.
- The evidence or parameters are used to demonstrate the extent to which or whether or not the responsible entities have met the requirements. For example, the percentage or number of times certain threshold is met/exceeded, the mitigation or recovery time, the yes or no for an action requirement, etc. (similar to the measures in the existing standards).

Appropriate text may be put here as illustration or provide examples to help readers better understand the requirement. Text boxes will be removed from the approved version of the standard.

Guideline and Technical Basis

What are the practices or technical merit that responsible entities *should adopt or consider* to help them meet the reliability requirements? Some examples to illustrate the coverage or intent of the requirements may be placed here. Also, the content in the Text Boxes that are posted next to proposed requirements and measures during the standard development stage can be moved here after the standard has received ballot approval.

This section is needed if we decide to keep supporting technical materials contained within the body of the standard. However, if we want to keep the standard focused on results-based/risk-based reliability requirements and compliance elements only, we may eliminate this Section.

In addition, sizable guideline or reference materials may be placed in an appendix.

VM Standard Layout Example

Requirements and Measures

Requirement

R1. Each Transmission Owner shall manage vegetation to prevent encroachment that could result in a Sustained Outage of any line identified as an element of an Interconnection Reliability Operating Limit (IROL) or Major Western Electricity Coordinating Council (WECC) transfer path (operating within Rating and Rated Electrical Operating Conditions). Types of encroachment include:

1. An encroachment into the Minimum Vegetation Clearance Distance (MVCD) as shown in Table 2, observed in real time, absent a Sustained Outage,
2. An encroachment due to a fall-in from inside the active transmission line ROW that caused a vegetation-related Sustained Outage,
3. An encroachment due to blowing together of applicable lines and vegetation located inside the active transmission line ROW that caused a vegetation-related Sustained Outage,
4. An encroachment due to a grow-in that caused a vegetation-related Sustained Outage.

[VRF – High] [Time Horizon – Real-time]

M1. Each Transmission 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.

Multiple Sustained Outages on an individual line, if caused by the same vegetation, will be reported as one outage regardless of the actual number of outages within a 24-hour period. If an investigation of a Fault by a qualified person confirms that a vegetation encroachment within the MVCD occurred, then it shall be considered a Real-time observation.

Rationale

The MVCD is a calculated minimum distance stated in feet (meters) to prevent spark-over between conductors and vegetation, for various altitudes and operating voltages. The distances in Table 2 were derived using a proven transmission design method.

Rationale

Measure

Exercise 7: Develop other standard material

- Background –
 - If you have background elsewhere – point out where and review it
 - If you don't, then write it now
- Guidelines and Technical Basis
 - If you have this in a white paper – note that now
 - Plan to revise after you finalize scope and requirements with measures and rationale
 - Select from this information that needs to be with the each requirement to help clarify it.

Competency-based Issue

- Two requirements may be needed
 1. Provide your documented process or procedure
 2. Provide proof that you have followed your process

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Standards Development Map

to ensure
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bulk power system

Standards Development Process Roadmap



- Submit the document and supporting material for Comment, Review and Approval

Dealing with Comments

- Refer to scope, NGO, rationale, guidelines, and other documents when responding
- Avoid obvious problems
- Important to consider all carefully
- Not important to agree to all
- Don't waste time playing the assumptions game
- Do not hesitate to ask for clarification
- If many comments from one person or group – ask for priorities

Wrap-up