RELIABILITY FIRST

Management Practice Abstracts

Management Practices are a natural grouping of common, functional activities that Registered Entities already perform to ensure the reliability, resiliency, and security of their respective systems. These practices are assessed to determine the maturity of an organization's processes and sustainability. The set of Management Practices form a uniform, repeatable, and transparent continuous improvement model that can be predictive of an entity's ability to remain reliable, resilient, and secure on an ongoing basis. The framework for the Management Practices is shown graphically below:

The following pages provide an overview of each of the management practices.

Asset and Configuration Management

The purpose of Asset and Configuration Management (ACM) is to establish an inventory of assets and configuration items, define the attributes of those assets and items, and maintain their integrity in the context of reliability and resilience.

ACM Objectives and Activities

Objective 1 Establish assets and configuration items inventory

- Activity 1.1 Identify assets and configuration items
- Activity 1.2 Define assets and configuration item attributes
- Activity 1.3 Establish inventory and configuration control systems
- Activity 1.4 Establish configuration baselines

Objective 2 Control Changes

- Activity 2.1 Establish change control systems and processes
- Activity 2.2 Control changes to assets and configuration items

Objective 3 Verify integrity

- Activity 3.1 Establish and maintain change records
- Activity 3.2 Perform assessments

In most Entities, many of the assets inventoried will also be considered configuration items because they are assets for which the status of the item and change in status needs to be monitored and controlled. However, some high-value assets – a building for example – may not be identified or tracked as a configurable item if its state is considered to be static for the lifespan of the asset.

Conversely, not all configuration items are necessarily considered assets and therefore may not be managed in the same manner as assets. For example, a laptop computer maybe inventoried and managed as an asset, but the laptop's physical (hardware and firmware) configuration is probably established by the laptop supplier, and not a configuration that the organization needs to manage. However, cybersecurity software residing on the laptop is probably both a high-value asset and a configuration item for the organization.

This process area includes the management of documents as one type or class of configuration items, but it does not address the management of data – such as data and information residing in a database – which is addressed in the Information Management process area.

Entities implementing processes, internal controls, and technology based on this process area could systemically mitigate the threat of equipment failure to bulk electric system reliability and resilience. Managing and maintaining asset inventories and configurations enables the organization to proactively replace or update assets that are important to bulk electric system reliability and resilience.

Because most Entities will typically have a high volume of both assets and configuration items, it may be impractical to manually inventory, monitor, manage, and control assets and configuration items. Consequently, many organizations have established software systems or applications to automate asset and configuration management work, and to mitigate the risk of human error introduced when such work is performed manually. Additionally, this process area is typically implemented in an organization at the enterprise level – regardless of the size of the organization – to leverage economies of scale for the tools and systems often used for this process area.

External Interdependencies

The purpose of External Interdependencies (EXID) is to implement organizational processes that manage external stakeholders that may impact bulk electric system reliability and resilience.

EXID Objectives and Activities

Objective 1 Identify and Prioritize External Interdependencies

- Activity 1.1 Identify Reliability Related External Interdependencies
- Activity 1.2 Prioritize Reliability Related External Interdependencies

Objective 2 Manage Risks Due to External Interdependencies

- Activity 2.1 Identify & Assess Risks
- Activity 2.2 Mitigate Risks
- Activity 2.3 Manage interdependencies to reduce risks

Objective 3 Establish Relationships

- Activity 3.1 Establish Specifications for external interdependencies

Objective 4 Manage External Entity Performance

- Activity 4.1 Monitor
- Activity 4.2 Correct

Objective 5 Reduce Interdependencies

- Objective 5.1 Reduce the Risk of Interdependencies though continuous improvement initiatives

Most organizations are unable to operate without customers and other outside organizations to help provide the goods and services required to satisfy these customers. These outside organizations include suppliers, government agencies, local communities, trade unions, and other business partners. When depending upon others to accomplish business objectives in the power industry, it is important to have the processes in place to ensure that the bulk electric system reliability and resilience is not negatively impacted. This process will include careful consideration of all the important interdependencies that exist, from customers to suppliers, and managing the risks that may occur.

In today's business environment, it is important to reinforce these external relationships with contractual agreements due to the potential impact loss of electric power has upon our nation's well-being. These contracts need to have provisions for ensuring that the external parties also exhibit appropriate resilience in their own business operations. Having contracts is not enough without some method to monitor and manage the efforts of those external to the organization.

EXID threads through almost all the other process areas, with a unique focus on the external impacts that are often neglected in typical internal processes. For example, EXID uses the Risk Management process to help identify and rank external threats (e.g., unavailability of fuel resources, potential labor strikes, or sudden changes in customer load demands). Implementation and Integration processes are enhanced to include interfaces that extend outside normal organizational boundaries. Asset and Configuration Management processes are reviewed and extended to connect with external stakeholders that are part of workflows and are extended to include configuration items that exist external to the organization. Grid Operations and Grid Maintenance processes often rely upon the help of external contractors, and are often governed by others (e.g., the operation of a transmission operator by an external balancing authority or reliance upon an external information security group to monitor software security patches and upgrades).

EXID should begin early in the organization's life cycle to establish plans, processes, standards, and procedures that address the impact of stakeholders external to the organization. Individuals responsible for external interdependencies should be clearly identified with clear expectations of their role in managing external organizations and their resources.

Grid Maintenance

The purpose of Grid Maintenance (GMAINT) is to ensure equipment reliability and resilience by proactively monitoring equipment and resolving issues as they arise in a thorough and timely manner.

GMAINT Objectives and Activities

Objective 1 Define and Prepare for Reliability Centered Grid Maintenance

- Activity 1.1 Define Reliability Centered Maintenance Procedures
- Activity 1.2 Define Lists of Historical and Emerging Equipment Failure Modes
- Activity 1.3 Define Spare Part Requirements
- Activity 1.4 Provide Reliability Centered Maintenance Training

Objective 2 Perform Grid Maintenance

- Activity 2.1 Perform Maintenance Scheduling including Backups
- Activity 2.2 Maintain Appropriate Spare Part Inventory
- Activity 2.3 Maintain Grid
- Activity 2.4 Perform Incident Management and Control
- Activity 2.5 Verify Access Rights of Resources Maintaining Equipment
- Activity 2.6 Validate Maintenance tools

Objective 3 Improve Grid Maintenance

- Activity 3.1 Monitor Maintenance Performance
- Activity 3.2 Continuously Update Failure Modes
- Activity 3.3 Continuously Improve Maintenance

Maintenance activities are undertaken to promote the proper working condition of an asset or resource while compensating for normal wear and tear. An end goal of a maintenance program is to provide proper functioning equipment. Entities strive to maintain equipment in a manner that is efficient, reliable, and safe. At a minimum, it is important for the maintenance plan to include a strategy, procedures, a schedule, and reporting.

This process area addresses personnel whose job responsibilities are to maintain and test bulk electric system and/or support equipment to ensure reliable operation is possible, including those who perform maintenance on cyber devices. Maintenance program activities are coordinated with other business units within the organization such as engineering, operations, work management and asset management to ensure Bulk Power System reliability and resilience.

Maintenance threats to bulk electric system reliability and resilience can stem from having inadequate based maintenance cycles and maintenance or testing procedures or insufficient tools for monitoring and reporting. If maintenance cycles are too long, it can lead to accelerated equipment wear causing a shortened life. Inadequate maintenance or testing procedures can also lead to shortened equipment life by not proactively addressing equipment components. Insufficient monitoring or reporting can prevent an organization from detecting indicators of equipment failure causing a shortened life. Proper training of technicians performing maintenance is addressed in the Workforce Management process area.

Successful implementation of a maintenance process area benefits the corporation and end users alike by decreasing the number of emergent maintenance events and decreasing the catastrophic failure of major equipment. Implementation of this process area is seen at the corporate level with maintenance policies that are closely aligned with Risk Management and Asset and Configuration Management. At the management level, maintenance programs are integrated into Work Management processes and monitored by Grid Operations. The maintenance department executes the plan through procedures and tasks.

Grid Operations

The purpose of Grid Operations (GOP) is to provide safe and reliable operation of the bulk electric system by establishing thorough, repeatable, and systematic processes.

GOP Objectives and Activities

Objective 1 Define and Prepare for Grid Operations

- Activity 1.1 Define Operating Procedures
- Activity 1.2 Provide Operator Training

Objective 2 Perform Grid Operations

- Activity 2.1 Perform Operator Scheduling including Backups
- Activity 2.2 Maintain Situational Awareness of Operations
- Activity 2.3 Operate Grid
- Activity 2.4 Perform Incident Management and Control
- Activity 2.5 Verify Access Rights of Resources in Operating Environment
- Activity 2.6 Validate Operations tools

Objective 3 Improve Grid Operations

- Activity 3.1 Monitor Operations Performance
- Activity 3.2 Continuously Improve Operations

Operation is the state of being operative or functional. Entities strive to operate in a manner that is efficient, reliable and safe. Achieving operational proficiency includes well defined and executable, processes and procedures that are integrated across an organization. Combining the appropriately skilled staff with the appropriate work tools is important to achieve situational awareness.

This process area addresses personnel whose job responsibilities support reliable and resilient operations of the bulk electric system by providing engineering analysis, maintenance and testing of equipment and construction of facilities. Personnel perform and support real-time operations so that monitoring, remote operating and key data communications (coordinated with adjacent neighbors) are in place to respond and minimize impacts to bulk electric system reliability and resilience.

Operational threats to the bulk electric system may stem from several sources but the response to a threat should be dealt with systemically. Internal threats can emerge from unprepared personnel, undefined interfaces or procedures and, inadequate tools. External threats such as severe weather and wildlife are risks that the organization has little control over but must respond appropriately to minimize their impact to the bulk electric system.

Successful implementation of this process area benefits the corporation and end users alike by decreasing the number and severity of bulk electric system events. Implementation of this process area is seen at the corporate level with operational policies and at the management level with operational programs and implemented by the first line through procedures. Typically, operational metrics are developed to gauge the execution and success of the policies and programs. High functioning organizations will evaluate operational metrics as a means to continually self-assess and improve the program and procedures as necessary.

Implementation

The purpose of Implementation (IMPL) is to ensure bulk electric system reliability and resilience while deploying a specified bulk electric system asset.

IMPL Objectives and Activities

Objective 1 Establish Implementation

- Activity 1.1 Identify technical processes or technical areas associated with deployment of new designs (or revisions to existing designs) critical to Grid reliability
- Activity 1.2 Ensure resources and processes are capable of implementation of modifications
- Activity 1.3 Ensure Requirements from Operations and Maintenance have been communicated and implemented

Objective 2 Implement

- Activity 2.1 Implement Systems

Changes are constantly required for most entities, and those changes have the potential to risk bulk electric system reliability and resilience. When an organization decides to implement or modify a bulk electric system asset, it is important for the organization to invoke its internal processes and procedures (based on the IMPL process area) to ensure that that the new or modified asset does not compromise bulk electric system reliability and resilience. Bulk electric system assets can include such diverse items as control centers, software patches, corporate procedures, processes, or policies, or human resources. To ensure successful implementation, entities can utilize such tools as prototypes, pilots, or simulations.

The IMPL process area results in the implementation of a bulk electric system asset that satisfies defined requirements or specifications, with successful implementation being determined through verification and validation, and it does not address operations and maintenance of bulk electric system assets.

Entities implementing processes, internal controls, and technology based on this process area could systemically mitigate the threat of new or modified bulk electric system assets from adversely impacting bulk electric system reliability and resilience. For example, unplanned implementation of new policies or human resources can lead to improper oversight of the operation of the bulk electric system.

IMPL is applicable at any level of the life cycle process, and as a result, any level of the organization may be responsible for IMPL depending upon the type of asset at issue. For example, divergent implementation plans may apply to those responsible for installing security patches and those responsible for changing relay settings. In fact, divergent implementation plans may apply to installing different types of security patches. As a result, while the entire enterprise must address IMPL, it exists at all levels of the organization.

Information Management

The purpose of Information Management (INFO) is to protect and ensure the confidentiality, integrity, and availability of information assets to reduce risks to bulk electric system reliability and resilience and increase operational resilience.

INFO Objectives and Activities

Objective 1 Establish and Maintain Information Items
- Activity 1.1 Establish and Maintain Information Items
- Activity 1.2 Classify Information Items

Objective 2 Protect Information Items
- Activity 2.1 Ensure Availability, Confidentiality, and Integrity of Information

Objective 3 Manage Information Item Risk
- Activity 3.1 Identify and Assess Information Item Risk
- Activity 3.2 Address Information Item Risk

Objective 4 Manage Information Item Confidentiality and Privacy
- Activity 4.1 Encrypt High-Value Information
- Activity 4.2 Control Access to Information Items
- Activity 4.3 Control Information Item Dispositions

Objective 5 Manage Information Item Integrity
- Activity 5.1 Control Modifications of Information Items
- Activity 5.2 Manage Information Changes
- Activity 5.3 Verify Validity of Information Items

Objective 6 Manage Information Item Availability
- Activity 6.1 Backup and Retain Information Items
- Activity 6.2 Identify and Capture Current and Historical Organizational Knowledge about Grid Reliability
- Activity 6.3 Analyze Information to Support Risk Management

INFO is the protection of information assets that are important to the reliability and resilience of the bulk electric system. Information assets are information or data that are valuable to the organization, including but not limited to drawings, memos, e-mail, electronic files, and databases.

Entities implementing processes, internal controls, and technology based on this process area could systemically mitigate such threats to bulk electric system reliability and resilience as inconsistent, compromised, or lost information and ineffective utilization of institutional knowledge in operations.

Effective INFO includes enterprise-wide protection of information assets through physical, technical, and administrative controls. Controlling access and modifications to information assets are important activities for effective INFO. Entities ensure availability of information assets throughout the assets' life cycle by implementing effective backup and storage programs for information assets. Entities similarly protect knowledge integral to bulk electric system reliability and resilience. Because most entities – regardless of size – will possess very high volumes of data and information, implementation of this process area typically requires the use of technology such as databases, data warehouses, data analytical tools, extract, transform, and load tools, and mass storage systems.

Integration

The purpose of Integration (INT) is to manage interfaces between two or more sub-system elements to ensure that any changes to bulk electric system projects behave properly and maintain and improve bulk electric system reliability and resilience.

INT Objectives and Activities

Objective 1 Establish Integration

- Activity 1.1 Establish lists of subsystems or neighbors that require interconnection of services, processes or exchange of information
- Activity 1.2 Identify personnel responsible to perform integration

Objective 2 Perform Integration

- Activity 2.1 Perform integration

INT involves the management of an organization's changes to the bulk electric system to ensure compatibility among all interfaces, including internal and external interfaces and physical, functional, and logical interfaces. INT reduces variability resulting from changes by sharing assets, data, and lessons learned while allowing the organization to assemble the sub-system elements emphasizing risk management and continuing verification of all external and internal interfaces.

The integration coordinator works to reduce and minimize errors and time spent isolating and correcting errors by verifying that all boundaries between sub-system elements have been identified and described, including physical, logical, and human-system interfaces and interactions (physical, sensory, and cognitive).

INT addresses coordination of development, service, acquisition, and support activities. Other process areas that can affect INT include Reliability Quality Management, Risk Management, and Asset and Configuration and Management. Implementation covers making the changes to each sub-system interface using criteria. The integration coordinator must account for plans utilizing these process areas that can impact the overall change. When effectively implementing INT, there is a high probability of success in the Verification and Validation processes.

Entities implementing processes, internal controls, and technology based on this process area could systemically mitigate such threats from unknown or uncontrolled aspects of both internal and external interfaces as an integration environment incompatible with bulk electric system reliability and resilience, including inadequate cyber asset management or improper installation of bulk electric system equipment.

Effective INT entails planning and managing technical interfaces to ensure the quality and integrity of the overall project or service. The organization performs INT at the top level to ensure it considers bulk electric system reliability and resilience when integrating technical interfaces.

Measurement and Analysis

The purpose of Measurement and Analysis (MA) is to enable entities to define, collect, analyze, and use measures and measurement data to quantitatively manage organizational performance and to monitor performance improvement against objectives.

MA Objectives and Activities

Objective 1 Specify Key Metrics for Measurement Activities
- Activity 1.1 Specify Key Metric measurement objectives

Objective 2 Specify Analysis Methods
- Activity 2.1 Specify Analysis Methods

Objective 3 Obtain Measurements
- Activity 3.1 Obtain Measurement Data

Objective 4 Analyze Measurements
- Activity 4.1 Draw Conclusions and Identify Possible Actions
- Activity 4.2 Communicate Results

Entities striving to improve reliability or resilience in the bulk electric system typically assess a current state – how reliable is the bulk electric system today, and how much does our organization impact overall bulk electric system reliability and resilience? The organization then defines a desired future state – how reliable do we want the grid to be? Entities then use delta between the current state and the desired future state to establish performance objectives. Performance objectives can be an organization's objectives for improving processes, technology, or the knowledge and skill of its workforce. Once the organization defines performance objectives, the organization identifies the necessary information to know that it is achieving improvement objectives, and then finally defines the measures that address those information needs.

This process addresses the collection and analysis of measures to inform decisions, but it does not address making structured decisions, which is addressed in the Structured Decision Making process area. The establishment of performance objectives and appropriate measures will enhance the successful adoption and implementation of all the process areas.

Human decisions and judgments are often flawed when made without facts and measures. Entities implementing processes, internal controls, and technology based on this process area can effectively mitigate the threat of human error resulting from decisions and judgments that are void of factual data.

Implementation of this process area benefits entities by providing organization leadership and management with quantized information about operational performance, technology performance, workforce performance, and progress toward achieving grid reliability and resilience performance improvement objectives. Implementation of this process area is made more effective with the adoption of proven techniques (such as the Goal-Question-Metric paradigm) for defining objectives and measures, and approaches (such as Balanced Score Card) for deploying a strategy and collecting and reporting measures against the strategy. Typically, the establishment of a measurement dictionary is important to the successful implementation of this process area.

Planning

The purpose of planning is to establish estimates and plans for performing work, and for monitoring, controlling and measuring work performed against plans.

PLAN Objectives and Activities:

Objective 1 Establish Estimates

- Activity 1.1 Estimate the Reliability Scope and Impact of the Project

Objective 2 Develop a Project Plan

- Activity 2.1 Identify Project Risks
- Activity 2.2 Plan the Project's Resources
- Activity 2.3 Plan Stakeholder Involvements
- Activity 2.4 Establish the Project Plan

Objective 3 Obtain Commitment to the Plan

- Activity 3.1 Review Plans That Affect the Project
- Activity 3.2 Reconcile Work and Resource Levels

Plans serve as both guidance and governance to ensure that individuals, teams, and organizations perform work as it was intended, and to avoid unintentional (unplanned) work that could negatively affect bulk electric system reliability and resilience.

A fundamental concept of planning is that estimates for effort, cost, schedule, and resources are based on the attributes of the work to be performed and the work products to be delivered. Attributes can include information such as the size or complexity of the work. Also, individuals and organizations can, over time, improve their planning capability – and thus the accuracy of plans – when historical measures such as actual-to-plan variance data is used to inform plans for future work. Plans for projects or operations may need to include subordinate plans for supporting work such as asset and configuration management plans, risk management plans, capacity plans, cybersecurity plans, and education and training plans.

This process addresses using historical measures and data to develop estimates and plans. However, the collection and analysis of measures and measurement data, however, is addressed in the Measurement and Analysis process area. Also, work performed is monitored and measured against plans using practices in the Work Management process area.

Ad hoc or unplanned work can produce unintended and undesirable consequences, thus creating risks to bulk electric system reliability and resilience. Additionally, unplanned work often results in cost and schedule overruns which, in turn, diminishes the organization's capacity to respond to threats to the bulk electric system's reliability and resilience.

Planning can and often is performed at different levels in an organization, with each lower-level plan supporting and aligning with higher level plans. For example, strategic planning at the executive level of a corporation is used to guide lower level tactical or annual planning which, in turn, is used to guide lower-level detailed operational plans. Thus, depending on its size, the organization may need a hierarchy of plans to define work to be performed, and then use that hierarchy to track the progress and accomplishments of tasks and activities.

The development and deployment of processes and internal controls that enable the implementation of this process area can be effectively accomplished with personnel having knowledge and experience project planning practices such as the Project Management Institute's Body of Knowledge (PMBOK).

Reliability Quality Management

The purpose of Reliability Quality Management (RQM) is to provide objective insight into processes and associated work product related to bulk electric system reliability and resilience.

RQM Objectives and Activities

Objective 1 Specify the Reliability Management System

- Activity 1.1 Identify business processes associated with reliability
- Activity 1.2 Perform Reliability Policy and Promote Awareness
- Activity 1.3 Define Reliability Objectives
- Activity 1.4 Define Key Reliability Metrics

Objective 2 Identify Gaps in Reliability

- Activity 2.1 Hold Internal Audits for Objective Evaluation
- Activity 2.2 Maintain System for identifying and deploying Internal Controls
- Activity 2.3 Maintain System for validating Internal Controls for Grid Reliability

Objective 3 Monitor Reliability

- Activity 3.1 Perform Annual Management Process Review for system to validate process, including all stakeholders

Objective 4 Correct Reliability Issues

- Activity 4.1 Perform Corrective and Preventive Action measures including Root Cause Analysis/Problem solving
- Activity 4.2 Provide Reliability Training Program for Organization (including reliability and awareness)

Objective evaluations of the quality of an organization's bulk electric system reliability and resilience activities ensure the integrity of these activities. Objectively evaluating involves reviewing activities and work products against criteria that minimize subjectivity and bias by the reviewer. For example, entities can utilize objective criteria to perform activities such as formal audits, peer reviews, desk audits, or process checks for quality assurance of its bulk electric system reliability and resilience activities.

RQM may address the same work product as other process areas from a different perspective. For example, RQM ensures entities implement planned bulk electric system reliability and resilience processes, but Verification ensures that specified bulk electric system reliability and resilience requirements are satisfied.

When an organization does not focus on RQM, bulk electric system reliability and resilience may become secondary considerations, and as a result, non-compliances are more likely to cause bulk electric system reliability and resilience issues.

RQM should begin early in the organization's lifecycle to establish plans, processes, standards, and procedures to add value to the organization. Quality should be a daily focus rather than an afterthought, and the organization should promote an environment that encourages staff participation in identifying and reporting quality issues. Individuals responsible for RQM should be independent from individuals directly involved in developing or maintaining bulk electric system reliability and resilience, and effective RQM implements a mechanism for raising quality issues with senior management. Independence of RQM activities from bulk electric system reliability and resilience activities ensures the objectivity of the quality assurance activities.

Risk Management

The purpose of RM is to establish, operate, and maintain a risk management program to identify and remediate potential problems before they occur so the organization can plan and invoke risk mitigating activities to reduce adverse impacts on the reliability and resilience of the bulk electric system.

RM Objectives and Activities

Objective 1 Establish Risk Management

- Activity 1.1 Establish Reliability Risk Areas and Objectives
- Activity 1.2 Establish process to identify specific risks
- Activity 1.3 Establish risk response plans

Objective 2 Evaluate Risks

- Activity 2.1 Assess the potential impact of the identified risks (likelihood of occurrence, detection, and impact)

Objective 3 Mitigate Risks

- Activity 3.1 Mitigate and control risk

RM is the development of a continuous program to identify, categorize, prioritize, and mitigate risks to the reliability of the bulk electric system. Risk refers to operational risk, or the risk to the operation and delivery of bulk power and includes the risk of disruption to any asset that potentially renders the organization unable to ensure the reliability and resilience of its elements of the bulk electric system. Entities develop methods to identify risk sources, which are fundamental drivers that cause risk to reliability or resilience of the bulk electric system.

This process area includes RM at the enterprise-level, but it does not address the collaboration of relevant stakeholders to identify risks during the Planning process area or the association of services to assets in the Asset and Configuration Management process area.

Entities implementing processes, internal controls, and technology based on this process area could systemically mitigate such threats to bulk electric system reliability and resilience as cyber attacks, equipment failure, and inadequate emergency operations. Continuously identifying and mitigating risks to bulk electric system reliability reduces the likelihood that such risks will materialize.

Effective RM includes early and aggressive risk identification through enterprise-wide collaboration and defining risk parameters for consistent measurement of operational risks across the organization including its business units, subsidiaries, related interconnected entities, and stakeholders. Entities ensure they develop specific risk management strategies, such as cybersecurity risk management, consistent with bulk electric system reliability and resilience. An example of mitigating risks includes implementing layered administrative, technical, and physical controls to prevent compromise to physical or cyber assets.

Structured Decision Making

The purpose of Structured Decision Making (SDM) is to apply process rigor to high-impact decisions to improve the decision results and their effect on bulk electric system reliability and resilience, and to improve an organization's decision-making capability.

SDM Objectives and Activities

Objective 1 Determine Decisions that Impact Reliability

Activity 1.1 Use Defined Criteria to Determine Decisions to Consider

Objective 2 Establish Decision Environment

Activity 2.1 Establish Guidelines for Decision Analysis

Activity 2.2 Establish Evaluation Criteria

Objective 3 Decide

Activity 3.1 Identify Alternative Solutions

Activity 3.2 Select Evaluation Methods

Activity 3.3 Evaluate Alternative Solutions

Activity 3.4 Make Decision using Selected Method

Activity 3.5 Record and Communicate Decision

In many entities, day-to-day operational decisions that impact bulk electric system reliability and resilience are routine, and perhaps even formulaic. For example, decisions made by control room operators, decisions about generator output, or decisions about load balance are often made within very narrow parameters and may even be decisions that are automated to the point of being made by instrumentation.

However, some human decisions important to bulk electric system reliability and resilience are currently made intuitively or ad hoc and could benefit from applying SDM practices. Typical organization business decisions that can be improved with structured decision making include:

- Decisions regarding investment bulk electric system reliability and resilience improvement initiatives
- Vulnerability analysis and decisions about the most effective solution approach
- Decisions on which mitigation actions to take toward a risk when there are multiple options
- Decisions on the course of action in a threat event such as a cyber attack
- Capital equipment or infrastructure investments
- Employee or contractor candidate selection
- Alternative bulk electric system design or solution approach

This process area addresses structured decisions being made by individuals or teams and does not address transactional decisions that are codified in algorithms or applications, and not made by humans.

Entities implementing processes, internal controls, and technology based on this process area can evolve a decision-making capability which, when appropriately applied, can reduce the threat of outages resulting from flawed human decisions (i.e., human error).

Because SDM is heavily dependent upon the availability and use of facts and measures, entities should consider implementing the Measurement and Analysis and Information Management process areas prior to or in conjunction with implementing this process area.

Validation

The purpose of Validation (VAL) is to confirm that changes to the systems comprising the bulk electric system function as designed in the intended environment and conditions, both before the changes are made operational, and during operation.

VAL Objectives and Activities

Objective 1 Prepare for Validation

- Activity 1.1 Select Sources for Validation
- Activity 1.2 Establish the Validation Environment
- Activity 1.3 Establish Validation Procedures and Criteria

Objective 2 Perform Validation

- Activity 2.1 Perform Validation

Objective 3 Analyze and Record Validation Results

- Activity 3.1 Analyze Validation Results
- Activity 3.2 Record Validation Results

Although the bulk electric system is in the operation and maintenance phase of its lifecycle, its subsystems and components are under a constant state of change. Each time a change occurs (e.g. an update to patches in an EMS workstation, new firmware in a digital relay, or maintenance action on DC protective control wiring) it is important to have a check in place to ensure that the intention of change was fulfilled. Validation is the process that reflects upon all the stakeholders impacted by the change and ensures that the bulk electric system continues to fulfill the stakeholders' intentions.

There are many ways to validate that a change meets its intended purpose. Examples include validating by test (testing of software updates), validating by simulation (proper setting of load shed limits), or validating by inspection (cleanliness of current transformer connections). Regardless of the VAL method, it is important to trace the results to the intentions of the stakeholders. Preferably, these intentions would take the form of documented criteria for success. However, in the case where documented criteria do not exist, VAL also includes the processes of bringing stakeholders together to gain their consensus that the implementation of a change meets their expectations.

VAL addresses confirming changes to the system after they are implemented but before becoming operational in the system, and the Verification process area addresses confirming changes to the bulk electric system before they are implemented.

This process area includes validation processes, but not the potential corrective actions that result when the validation indicates a problem. Corrective actions are addressed in the Reliability Quality Management (RQM) process area. When measurements are required to perform VAL, the control of those measurements is addressed in the Measurement and Analysis process area.

Mistakes made during validation can have detrimental impacts to the reliability of the bulk electric system. For example, if patch updates are verified as installed correctly, but were not installed in a timely fashion, cyber vulnerabilities could be introduced. If the replacement of a mechanical relay by a digital relay is verified to have been properly installed with settings that matched vaulted settings, there may still be a threat to the bulk electric system if the intended protection zone was not achieved.

Each organization develops standard validation processes for its domain and needs. Generators, transmitters, and balancing authorizes are each likely to have different VAL goals and thus different validation processes and methods. In some cases, it may not be possible to conduct VAL due to the potential negative impact on consumers, and verification (see the Verification process area) may be the greatest extent an organization can ensure bulk electric system reliability and resilience.

Verification

The purpose of Verification (VER) is to confirm that any changes to the systems comprising the bulk electric system impacting its reliability and/or resilience are conducted in accordance with requirements, plans, or specifications. Verification ensures that the bulk electric system continues to be updated, operated, and maintained in accordance correctly.

VER Objectives and Activities

Objective 1 Prepare for Verification

- Activity 1.1 Select Sources for Verification
- Activity 1.2 Establish the Verification Environment
- Activity 1.3 Establish Verification Procedures and Criteria

Objective 2 Perform Verification

- Activity 2.1 Perform Verification using Peer Reviews and/or Acceptable Methods
- Activity 2.2 Analyze Peer Review/Acceptable Method Data

Objective 3 Analyze and Record Verification Results

- Activity 3.1 Analyze Verification Results
- Activity 3.2 Record Verification Results

Although the bulk electric system is in the operation and maintenance phase of its life cycle, its subsystems and components are under a constant state of change. Each time a change occurs (e.g. an update to patches in an Energy Management System (EMS) workstation, new firmware updated for a digital relay, or maintenance actions on DC protective control wiring) checks should be in place to ensure that the change was made in accordance with requirements. Verification is the process to perform what is required to make sure the bulk electric system is not adversely affected by any changes.

There are many ways to verify that a change is made correctly. Examples include verifying by test (testing of software updates), verifying by simulation (proper setting of load shed thresholds), or verifying by inspection (cleanliness of current transformer connections). Regardless of the verification method, it is important to make sure it is trusted and is conducted with proven practices. The verification should also be performed in the applicable environment whenever possible. Multiple people may need to be involved to agree that the verification was performed correctly, perhaps in the form of a peer review. Reviewers scrutinize results of the verification to make sure that the targeted success criteria were achieved.

Verification addresses confirming changes to the system before they are implemented, and the Validation process area addresses confirming changes to the bulk electric system after they are implemented but before becoming operational in the system.

This process area includes the verification processes, but not the potential corrective actions that result when the verification indicates a problem. Corrective actions are addressed in the Reliability Quality Management process area. Finally, when measurements are required to perform the verification process, the control of those measurements is addressed in the Measurement and Analysis process area.

Mistakes made during verification can have detrimental impacts to the reliability of the bulk electric system. For example, a poorly verified current transformer replacement could cause equipment failures due to overloading. A poor verification of a new control room EMS could result in a loss of reserve of capacity or generation and load unbalance. Resiliency of the bulk electric system could be impacted if, for example, the blackstart cranking path was improperly simulated, preventing timely restorations.

This process area is typically distributed throughout organization, and frequently at the enterprise level. Regardless of where it takes place in an organization, the key is to have objective verification criteria.

Work Management

The purpose of Work Management (WM) is to manage and monitor execution of the organization's process to improve and maintain bulk electric system reliability and resilience.

WM Objectives and Activities

Objective 1 Manage Organizational Work

Activity 1.1	Establish a Work Management Policy and Work Management Process for Grid Reliability Related Activities
Activity 1.2	Document and Monitor Projects and Activities of Current Grid Reliability Related Work
Activity 1.3	Prioritize and manage work for least risk impact upon grid reliability

WM ensures that entities maintain bulk electric system reliability and resilience while engaging in the management of their everyday business. WM includes managing and integrating projects and operations in accordance with defined processes, collecting necessary information to monitor the projects and operations, and ensuring that all necessary people are available to support the projects and operations.

Many operational process areas may rely on data collected and distributed through the monitoring process and, as a result, monitoring is a core capability for improvement and sustainment of an adequate level of bulk electric system reliability and resilience.

This process area includes management of day-to-day operations, but the Measurement and Analysis process area addresses the measurement of operational performance to support day-to-day operations. In addition, WM includes collecting and storing data, but it does not address managing that data when it constitutes an organizational asset, which is addressed in Information Management. Further, WM focuses on availability of people for the services they support, while Workforce Management focuses on managing people through their employment life cycle, including their operational training and awareness.

WM provides valuable information about operating conditions that could indicate a need for active organizational involvement, including action to prevent organizational impact. In this way, entities implementing processes, internal controls, and technology based on this process area could systematically reduce unnoticed or undetected events, incidents, vulnerabilities, or threats.

Effective WM ensures the management of corrective, elective, and preventive maintenance, surveillance, testing, and modifications to support reliable and resilient bulk electric system operation during both outage and online periods. When the organization may outsource certain monitoring activities such as security operations, the organization should identify such instances to ensure the party performing the monitoring activities is effectively doing so. Entities successfully implementing WM also identify vital individuals in the organization and establish plans for staff redeployment to other roles during a disruptive event.

Workforce Management

The purpose of Workforce Management (WFM) is to ensure the ongoing suitability and competence of personnel to minimize the frequency and consequences of events related to bulk electric system reliability and resilience.

WFM Objectives and Activities

Objective 1 Establish Resource Needs
- Activity 1.1 Establish Proficiency Baseline
- Activity 1.2 Perform Survey of Skills and Identify Skills Gaps
- Activity 1.3 Remediate Skill Gaps

Objective 2 Manage Staff Acquisition
- Activity 2.1 Verify Baseline Requirements of Candidate Personnel
- Activity 2.2 Establish Terms and Conditions of Employment

Objective 3 Manage Staff Performance
- Activity 3.1 Establish Grid Reliability and Resilience as a Job Responsibility
- Activity 3.2 Establish Grid Reliability and Resilience Performance Goals and Objectives
- Activity 3.3 Manage Succession Plans
- Activity 3.4 Manage System to Minimize Human Performance Issues
- Activity 3.5 Measure and Assess Performance
- Activity 3.6 Establish Disciplinary and Reward Processes for Employees

Objective 4 Manage Changes to Employment Status
- Activity 4.1 Mitigate Impact of Job Function Changes
- Activity 4.2 Manage Employee Permissions and Access to Assets
- Activity 4.3 Mitigate Involuntary Terminations

Objective 5 Establish Organizational Training, Education, and Awareness Capability
- Activity 5.1 Establish Strategic Reliability Training, Education, and Awareness Needs
- Activity 5.2 Determine Which Training, Education, and Awareness Needs Are the Responsibility of the Organization
- Activity 5.3 Establish an Organizational Reliability Training, Education, and Awareness Tactical Plan
- Activity 5.4 Establish a Reliability Training, Education, and Awareness Capability

Objective 6 Provide Training, Education, and Awareness
- Activity 6.1 Deliver Training, Education, and Awareness to employees
- Activity 6.2 Establish Training, Education, and Awareness Records
- Activity 6.3 Assess Training, Education, and Awareness Effectiveness

The way that an organization hires, manages, trains, and terminates staff can have a significant effect on the organization's operational reliability and resilience. WFM includes both managing the employment life cycle and promoting awareness and developing skills of individuals in support of bulk electric system reliability and resilience. Appropriately acquiring, managing, and terminating staff in a manner that minimizes organizational impact is important to operational reliability.

Effective WFM also includes promoting awareness and providing training to staff in support of their roles in maintaining bulk electric system reliability and resilience. Awareness focuses on communicating a message to gather support for an organizational imperative; skill-based training is aimed at imparting knowledge to staff that is necessary to perform a role or fulfill a responsibility. Awareness creates cognizance to bring about desired behaviors in support of bulk electric system reliability and resilience and to support a risk-aware culture. Training imparts skills and knowledge to enable staff to perform a specific reliability or

resilience function, and can include informal mentoring, formal training vehicles, web-based training, self-study, or formal on-the-job training. The individuals subject to the WFM process area include an entity's

employees as well as vendors, contractors, and consultants.

This process area includes providing skills to the human resources to further bulk electric system reliability and resilience, but effective entities utilize the Planning process area to distinguish between which training needs are the organization's responsibility and which are left to the individual project or support group. WFM does not address non-human resources such as tools, databases, communication systems, financial systems, and information technology. Although the efficacy of training should be measured, measurement activities are addressed in the Measurement and Analysis process area.

Entities implementing processes, internal controls, and technology based on this process area could systematically mitigate such threats as unauthorized access to assets, improper operation of bulk electric system equipment, and inability of operators to recover assets in unusual emergency situations.

WFM is an enterprise process area that ensures that staff is aware of the organization's reliability and resilience needs and concerns, and that staff behaves consistent with the organization's operational reliability and resilience requirements and goals. Entities should consider establishing bulk electric system reliability and resilience as a job responsibility for applicable individuals.

Due to entities' increased reliance on advanced technology for digital communications and control, entities should address cybersecurity and risk management for these systems in its implementation of WFM. Key cybersecurity roles, such as system administrators, should have appropriate redundancy in place.