

**Comment Version**

**Comments due  
February 27, 2004**

## **NERC Reliability Functional Model**

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### ***Function Definitions and Responsible Entities***

Version 2

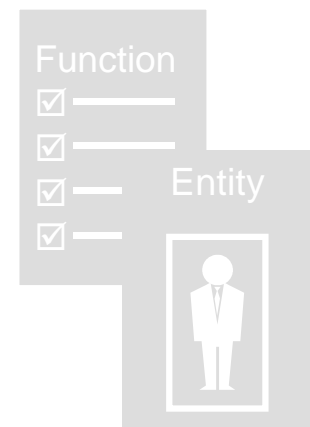
Approved by Standing Committees: November 11 – 13, 2003

Approved by Board of Trustees:

Name:

Organization:

***Prepared by the  
Functional Model Review Task Group  
Planning Reliability Model Task Force***





## Function – Operating Reliability

### Definition

Ensures the real-time operating reliability of the interconnected bulk electric transmission systems within a Reliability Authority Area.

### Tasks

1. Enforce operational reliability requirements
2. Monitor all reliability-related parameters within the Reliability Authority Area, including generation dispatch and transmission maintenance plans
3. Direct revisions to transmission maintenance plans as required and as permitted by agreements
4. Request revisions to generation maintenance plans as required and as permitted by agreements
5. Develop Interconnection Reliability Operating Limits (to and cascading outages).
6. Perform reliability analysis (actual and contingency) for the Reliability Authority Area
7. Approve or deny bilateral schedules from the reliability participants
8. Assist in determining Interconnected Operations Services requirements for balancing generation and load, and transmission reliability (e.g., reactive requirements, location of operating reserves).
9. Identify, communicate, and direct actions to relieve reliability threats and limit violations in the Reliability Authority Area
10. Direct implementation of emergency procedures
11. Direct and coordinate System Restoration

Please do not mark up this area.

## Comments – Function – Operating Reliability

Add new Item 6: Direct actions to mitigate Interconnected Reliability Operating Limit violations.

8. Assist in determining Interconnected Operations Services requirements for balancing generation and ~~load~~demand, and transmission reliability (e.g., reactive requirements, contingency reserves, location of operating reserves).

Place comments in this section. You may cut-and-paste and show markups to help us understand your suggestion.

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## Foreword

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This document replaces Version 1 of the NERC Functional Model that the Board of Trustees approved in June 2001.

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Historically, Control Areas were established by vertically integrated utilities to operate their individual power systems in a secure and reliable manner and provide for their customers' electricity needs. The traditional Control Area operator balances its load with its generation, implements interchange schedules with other Control Areas, and ensures transmission reliability.

As utilities began to provide transmission service to other entities, the Control Area also began to perform the function of Transmission Service Provider through tariffs or other arrangements. NERC's Operating Policies and Standards have reflected this traditional electric utility industry structure, and ascribed virtually every reliability function to the Control Area.

Beginning in the early 1990s with the advent of open transmission access and restructuring of the electric utility industry to facilitate the operation of wholesale power markets, the functions performed by Control Areas began to change to reflect the newly emerging industry structure. These changes occurred because:

1. Some utilities were separating their transmission from their Merchant Functions (functional unbundling), and even selling off their generation,
2. Some states and provinces were instituting "customer choice" options for selecting energy providers, and
3. The developing power markets were requiring wide-area transmission reliability assessment and dispatch solutions, which were beyond the capability of many Control Areas to perform.

As a result, the current NERC Operating Policies, which are centered on Control Area operations, were beginning to lose their focus, and become more difficult to apply and enforce.

**The Control Area Criteria Task Force.** The NERC Operating Committee formed the Control Area Criteria Task Force in 1999 to address this problem. The Task Force began by listing all the tasks required for maintaining electric system reliability and then organizing these tasks into basic groups that it called "functions." The Task Force then attempted to assign these functions to the basic "reliability organizations" such as Control Areas or Regional Transmission Organizations. But that didn't work because the Control Areas themselves were unbundling some of the functions they traditionally performed, and the emerging RTOs and ISOs, while following structures as defined in Order 2000, were not alike.

Realizing that there was no longer a "standard" reliability organization, the Task Force decided to build a "Functional Model" consisting of the functions that ensure reliability and meet the needs of the marketplace. Then, organizations—whether they be traditional, vertically-integrated control areas, regional transmission organizations, independent



## Introduction

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The NERC Functional Model defines the set of functions that must be performed to ensure the reliability of the bulk electric system. It also explains the relationship between and among the entities responsible for performing the tasks within each function. The Model provides the foundation and framework upon which NERC develops and maintains its Reliability Standards. NERC's Reliability Standards establish the requirements of the responsible entities that perform the functions defined in this Model.

While the Model is not a standard, and does not have compliance requirements, the Reliability Standards must respect the definitions and interrelationships contained in the Model. Doing otherwise could result in Reliability Standards that conflict with one another.

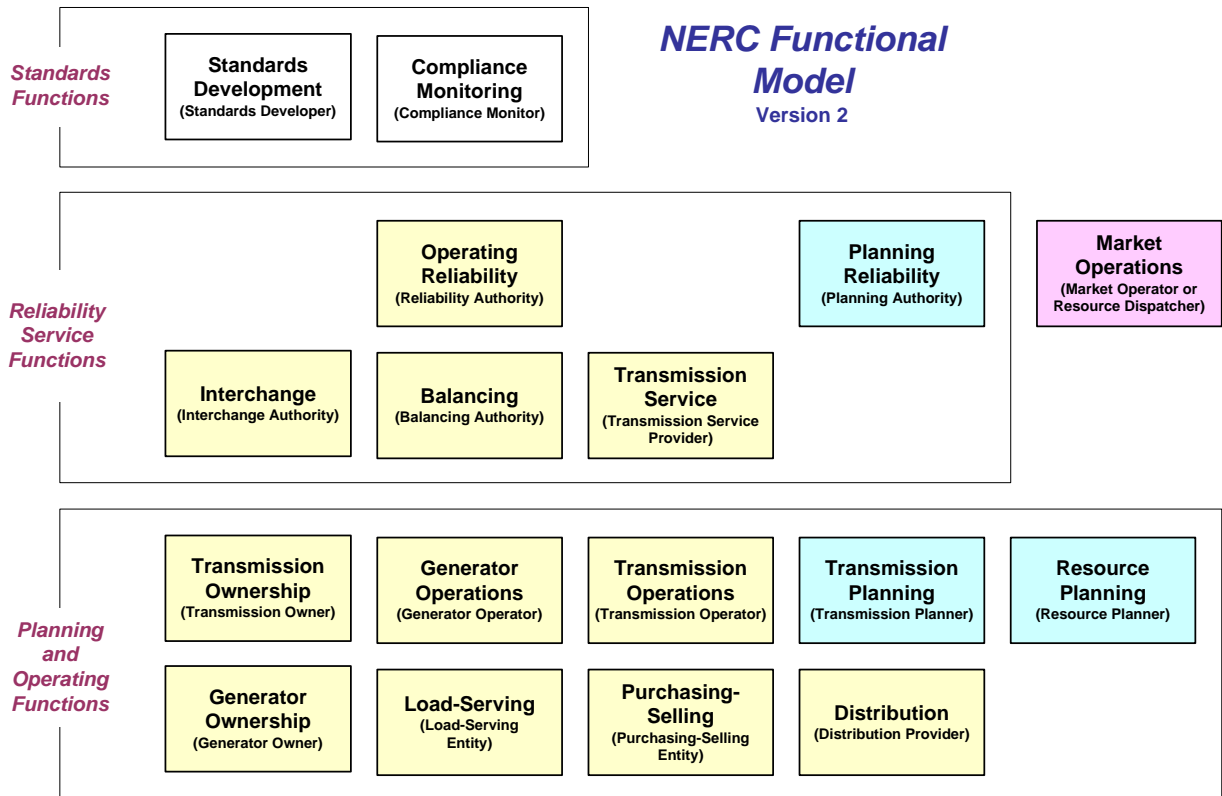
The Model does not prescribe any particular organization or market structure. Organizations may perform one or more functions as they see fit, but must recognize that some functions require the organization and its personnel to be certified to perform that function. Organizations must also recognize that, as responsible entities, they are responsible for ensuring that all tasks within each function are performed. While organizations may agree to split the tasks of a particular function (for example, an RTO may perform some Transmission Operator tasks with their members performing the remainder), NERC will require that one of the organizations be the "responsible entity," ensuring that all of the tasks of the function are performed.

**Functional Model maintenance.** The Functional Model is maintained by the NERC standing committees and Board of Trustees. The section titled, "Functional Model Approval Procedure," in this document explains the procedures for reviewing and revising the Model.

**Technical discussions.** The companion document, "Functional Model – Technical Discussions," provides additional details on the functions themselves, how organizations can "roll up" those functions they wish to perform, and how organizations as "responsible entities" interrelate.

### Comments – Introduction

Functional Model Diagram



<i>Function Name</i>	<i>Responsible Entity</i>
Operating Reliability Function	Reliability Authority
Planning Reliability Function	Planning Authority
Balancing Function	Balancing Authority
Interchange Function	Interchange Authority
Transmission Service Function	Transmission Service Provider
Transmission Ownership Function	Transmission Owner
Transmission Operations Function	Transmission Operator
Transmission Planning Function	Transmission Planner
Resource Planning Function	Resource Planner
Distribution Function	Distribution Provider
Generator Ownership Function	Generator Owner
Generator Operations Function	Generator Operator
Load-serving Function	Load-serving Entity
Purchasing-Selling Function	Purchasing-Selling Entity
Market Operations Function	Market Operator (or Resource Dispatcher)
Standards Development Function	Standards Developer
Compliance Monitoring Function	Compliance Monitor

## Terms used in the Functional Model

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### **Areas**

**Reliability Authority Area.** The collection of generation, transmission, and loads within the boundaries of the Reliability Authority. Its boundary coincides with one or more Balancing Authority Areas.

**Balancing Authority Area.** The collection of generation, transmission, and loads within the metered boundaries of the Balancing Authority. The Balancing Authority maintains load-resource balance within this area.

**Transmission Planning Area.** That area under the purview of the Transmission Planner.

**Planning Authority Area.** That area under the purview of the Planning Authority. It will include one or more Transmission Planning Areas.

### **General**

**Task.** One of the elements that make up a Function in the Functional Model.

**Responsible Entity.** The label that NERC applies to an organization that is responsible for carrying out the tasks within a Function.

**Function.** A group of tasks that can not be logically subdivided into other groups.

**Authority.** The highest level of responsible entity for a particular function. The Reliability Authority is the highest level of all responsible entities.

**Transaction.** An agreement arranged by a Purchasing-Selling Entity to transfer energy from a seller to a buyer.

**Transmission Arrangements.** An agreement between a Transmission Service Provider and Transmission Customer (Purchasing-Selling Entity, Generator Owner, Load-Serving Entity) for transmission services.

**Customer.** A Purchasing-Selling Entity, Generator Owner, Load-Serving Entity, or End-user.

**End-use Customer.** The customer served by a Load-Serving Entity.

### **Comments – Terms Used in the Functional Model**

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## **Purpose of the Functional Model**

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The purpose of the NERC Reliability Functional Model is to:

1. Functionalize the tasks being performed today for electric system reliability so that reliability organizations such as Control Areas, Regional Transmission Organizations, Independent System Operators and others can more easily and clearly identify the reliability functions they provide. A specific organization may provide one or more of the functions identified in the Functional Model.
2. Define in general terms each function and the relationships between the entities who are responsible for performing the tasks within the functions. The framework for developing the function definitions is:
  - a. The responsibility for performing a function should not be split by organizations
  - b. The functions are independent of the organization structure performing the function, and
  - c. The function definitions provide flexibility to accommodate the range of presently conceivable organization structures.
3. Provide a framework for Reliability Standards (including organization certification criteria) and compliance measures developed through the NERC Standards Development Process that will apply to certain tasks defined in the Functional Model.
  - a. It is not expected that standards will be developed for each task since the Functional Model is developed in more detail than is needed for reliability standards. However, standards may contain more detail than the associated activity in the Functional Model.
  - b. Responsibility for compliance with a standard will apply to the organizations performing that function.
  - c. Other organizations developing standards may use the NERC Functional Model in the same manner.
4. Provide linkages between business practices developed by other organizations showing how certain practices may relate to the reliability functions in the Functional Model.

### **Comments – Purpose of the Functional Model**

## Guiding Principles of the Functional Model

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For further details, refer to “Functions, Tasks, Responsible Entities, and Organizations” in the Technical Discussions document.

As explained in the “Purpose of the Functional Model,” the Functional Model provides the framework on which the NERC reliability standards are based. To ensure that this framework remains viable, the Model itself is governed by a set of “guiding principles” that define a *function*, and establish the relationship between the *responsible entities* who are responsible for performing the *tasks* listed in the Model, and the NERC *reliability standards*. NERC must work within these guiding principles when revising or interpreting the Functional Model to maintain the integrity of the Model and NERC’s Reliability Standards.

1. The Functional Model defines the *functions* that must be performed and does not imply organization structure or hierarchy.
  - a. Functions comprise *tasks*.
  - b. Tasks are *what* must be done, not *how*.
2. An *organization* who registers with NERC as performing a function is considered a *responsible entity* and must ensure that all tasks are performed.
  - a. Reliability standards are those requirements that must be performed by *responsible entities*. Thus, we say that the Functional Model is the framework on which the reliability standards are based.
  - b. An organization may delegate a task to another organization, but may not delegate its responsibility for ensuring that the task is accomplished.
3. Organizations that perform certain functions must be certified as being capable of performing those functions. Organization certification requirements are a category of NERC standards
4. Some tasks in the Functional Model may not result in a reliability standard.

### Comments – Guiding Principles of the Functional Model

Function

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## Function – Operating Reliability

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### **Definition**

Ensures the real-time operating reliability of the interconnected bulk electric transmission systems within a Reliability Authority Area.

### **Tasks**

12. Enforce operational reliability requirements
13. Monitor all reliability-related parameters within the Reliability Authority Area, including generation dispatch and transmission maintenance plans
14. Direct revisions to transmission maintenance plans as required and as permitted by agreements
15. Request revisions to generation maintenance plans as required and as permitted by agreements
16. Develop Interconnection Reliability Operating Limits (to protect from instability and cascading outages).
17. Perform reliability analysis (actual and contingency) for the Reliability Authority Area
18. Approve or deny bilateral schedules from the reliability perspective
19. Assist in determining Interconnected Operations Services requirements for balancing generation and load, and transmission reliability (e.g., reactive requirements, location of operating reserves).
20. Identify, communicate, and direct actions to relieve reliability threats and limit violations in the Reliability Authority Area
21. Direct implementation of emergency procedures
22. Direct and coordinate System Restoration

### **Comments – Function – Operating Reliability**



## **Responsible Entity – Reliability Authority**

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### ***Relationships with other Responsible Entities***

#### **Ahead of Time**

1. Receives facility and operational data from Generator Operators, Load-Serving Entities, Transmission Owners, Generator Owners, Transmission Operators, Distribution Providers.
2. Calculates Interconnection Reliability Operating Limits based on Transmission Owners' and Generator Owners' specified equipment ratings.
3. Receives generation dispatch from Balancing Authorities and issues dispatch adjustments to Balancing Authorities to mitigate congestion within the Reliability Authority Area (if not resolved through market mechanisms).
4. Receives Interchange Transactions from Interchange Authorities for reliability analysis.
5. Provides Interchange Transaction approvals to Interchange Authorities based on reliability analysis.
6. Receives generation operation plans and commitments from Balancing Authorities for reliability analysis of Reliability Authority Area.
7. Receives transmission maintenance plans from Transmission Operators for reliability analysis of Reliability Authority Area.
8. Direct Transmission Operators to revise transmission maintenance plans as required and as permitted by agreements
9. Provides reliability analyses to Transmission Operators, Generator Operators, Transmission Service Providers, and Balancing Authorities in its Area as well as other Reliability Authorities.

#### **Real Time**

10. Receives real-time operational information from Balancing Authority and Transmission Operator for monitoring.
11. Issues reliability alerts to Generator Operators, Load-Serving Entities, Transmission Operators, Transmission Service Providers, Balancing Authorities, Interchange Authorities, Planning Authorities, Regional Councils, and NERC.
12. Issues corrective actions (e.g., curtailments or load shedding) to Transmission Operators, Transmission Service Providers, Balancing Authorities, and Interchange Authorities.
13. Coordinates reliability processes and actions with and among other Reliability Authorities.
14. Coordinates with Transmission Planners, Planning Authority, and Transmission Service Providers on transmission system limitations.
15. Coordinates with Planning Authorities on reliability issues, as appropriate.

### ***Special Considerations***

The Reliability Authority's purview must be broad enough to enable it to calculate Interconnection Reliability Operating Limits, which may be based on the operating

parameters of other transmission systems beyond the Transmission Operator's vision. The Transmission Operator is responsible for the reliability of its "local" transmission system, and may not be aware that its system is violating an Interconnection Reliability Operating Limit. Therefore, the Reliability Authority may direct the Transmission Operators or Balancing Authorities to take action to mitigate Interconnection Reliability Operating Limits.

**Comments – Response Entity – Reliability Authority**

Function



## Function – Planning Reliability

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### **Definition**

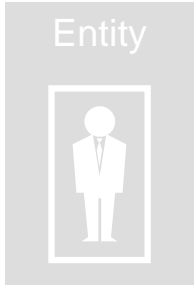
Ensures a long-term (generally one year and beyond) plan is available for adequate resources and transmission within a Planning Authority Area. It integrates and assesses the plans from the Transmission Planners and Resource Planners within the Planning Authority Area to ensure those plans meet the reliability standards, and develops and recommends solutions to plans that do not meet those standards.

### **Tasks**

1. Develop and maintain transmission and resource (demand and capacity) system models to evaluate transmission system performance and resource adequacy.
2. Maintain and apply methodologies and tools for the analysis and simulation of the transmission systems in the assessment and development of transmission expansion plans and the analysis and development of resource adequacy plans.
3. Define and collect or develop information required for planning purposes, including:
  - a. Transmission facility characteristics and ratings,
  - b. Demand and energy end-use customer forecasts, capacity resources, and demand response programs,
  - c. Generator unit performance characteristics and capabilities, and
  - d. Long-term capacity purchases and sales.
4. Evaluate plans for customer requests for transmission service.
  - a. Evaluate responses to long-term (generally one year and beyond) transmission service requests.
  - b. Review transmission facility plans required to integrate new (end-use customer, generation, and transmission) facilities into the interconnected bulk electric systems.
5. Review and determine TTC values (generally one year and beyond) as appropriate.
6. Assess, develop, and document resource and transmission expansion plans.
  - a. Integrate and verify that the respective plans for the Planning Authority Area meet reliability standards.
  - b. Identify and report on potential transmission system and resource adequacy deficiencies, and provide alternate plans that mitigate these deficiencies.
7. Provide analyses and reports as required on the long-term resource and transmission plans for the Planning Authority Area.
8. Monitor transmission expansion plan and resource plan implementation.
9. Coordinate projects requiring transmission outages that can impact reliability and firm transactions.

10. Evaluate the impact of revised transmission and generator in-service dates on resource and transmission adequacy.

**Comments – Function – Planning Reliability**



## **Responsible Entity – Planning Authority**

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### ***Relationships with other Responsible Entities***

1. Collects information as appropriate, including:
  - a. Transmission facility characteristics and ratings from the Transmission Owners, Transmission Planners, Transmission Operators, and others.
  - b. Demand and energy end-use customer forecasts, capacity resources, and demand response programs from Load-Serving Entities and Resource Planners.
  - c. Generator unit performance characteristics and capabilities from Generator Owners and others.
  - d. Long-term capacity purchases and sales from Transmission Service Providers.
2. Receives requests for long-term transmission service from Transmission Planners and provides the resulting plans to Transmission Service Providers and Transmission Owners.
3. Provides transmission facility plans required to integrate new (end-use customer, generation, and transmission) facilities into the interconnected bulk electric systems to the Transmission Owners, Generator Owners, and other requesters.
4. Coordinates TTC values (generally one year and beyond) with Transmission Planners and neighboring Planning Authorities.
5. Integrates and verifies that the respective plans of the Resource Planners and Transmission Planners meet reliability standards.
6. Coordinates the plans for the interconnection of facilities<sup>1</sup> to the bulk electric systems within its Planning Authority Area with Transmission Planners and Resource Planners.
7. Coordinates as appropriate with resource suppliers outside of the Planning Authority Area.
8. Coordinates transmission system protection and control, including special protection systems, with Transmission Planners, other Planning Authorities, Generator Owners, Generator Operators, Transmission Owners, Transmission Operators, Reliability Authorities, and Distribution Providers.
9. Coordinates with its related Reliability Authority(ies) and other Planning Authorities on reliability issues, as appropriate.

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<sup>1</sup> Generators, transmission lines, and end-use customer equipment

**Comments – Responsible Entity – Planning Authority**



## Function – Balancing

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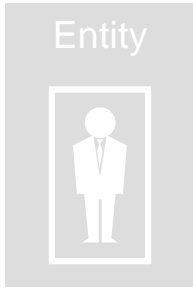
### **Definition**

Integrates resource plans ahead of time, and maintains load-interchange-generation balance within a Balancing Authority Area and supports Interconnection frequency in real time.

### **Tasks**

1. Must have control of any of the following combinations within a Balancing Authority Area:
  - a. Load and Generation (an isolated system)
  - b. Load and Scheduled Interchange
  - c. Generation and Scheduled Interchange
  - d. Generation, Load, and Scheduled Interchange
2. Calculate Area Control Error within the Balancing Authority Area.
3. Review generation commitments, dispatch, and load forecasts.
4. Formulate an operational plan (generation commitment, outages, etc) for reliability assessment
5. Approve Interchange Transactions from ramping ability perspective
6. Implement interchange schedules by entering those schedules into an energy management system
7. Provide frequency response
8. Monitor and report control performance and disturbance recovery
9. Provide balancing and energy accounting (including hourly checkout of Interchange Schedules and Actual Interchange), and administer Inadvertent energy paybacks
10. Determine needs for Interconnected Operations Services
11. Deploy Interconnected Operations Services.
12. Implement emergency procedures

### **Comments – Function – Balancing**



## **Responsible Entity – Balancing Authority**

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### ***Relationships with other Responsible Entities***

#### **Ahead of Time**

1. Compiles load forecasts from Load-Serving Entities.
2. Receives operational plans and commitments from Generator Operators within the Balancing Authority Area
3. Determines amount required and deploys Interconnected Operations Services to ensure balance (e.g., amount of operating reserve, load-following, frequency response) in coordination with the Reliability Authority.
4. Submits integrated operational plans (including maintenance plans from Generator Operators) to the Reliability Authority for reliability assessment and provide balancing information to the Reliability Authority for monitoring.
5. Receives approved, valid, and balanced Interchange Schedules from the Interchange Authorities.
6. Confirms interchange schedules with Interchange Authorities.
7. Confirms ramping capability with Interchange Authorities.
8. Implements generator commitment and dispatch schedules from the Load-Serving Entities and Generator Operators who have arranged for generation within the Balancing Authority Area. The Balancing Authority provides this commitment and dispatch schedule to the Reliability Authority.
9. Provides generation dispatch to its Reliability Authority for reliability analysis.
10. Acquires Interconnected Operations Services from Generator Owners.

#### **Real Time**

11. Directs resources (Generator Operators and Load-Serving Entities) to take action to ensure balance in real time.
12. Directs Transmission Operator to reduce voltage or shed load if needed to ensure balance within its Balancing Authority Area.
13. Receives loss allocation from Transmission Service Providers (for repayment with in-kind losses).
14. Provides real-time operational information for Reliability Authority monitoring.
15. Complies with reliability requirements specified by Reliability Authority.
16. Informs Reliability Authority and Interchange Authorities of Interchange Schedule interruptions (e.g., due to generation or load interruptions) within its Balancing Authority Area.
17. Directs Generator Operators to implement redispatch for congestion management as directed by the Reliability Authority.
18. Requests operating information from Generator Operators.
19. Verifies implementation of emergency procedures to Reliability Authority.
20. Coordinates use of controllable loads with Load Serving Entities (i.e., interruptible load that has been bid in as Interconnected Operations Services).

21. Implements emergency procedures as directed by the Reliability Authority.

**After the hour**

22. Confirms Interchange Schedules with Interchange Authorities after the hour for “checkout.”

23. Confirms Actual Interchange with adjacent Balancing Authorities after the hour for “checkout.”

**Comments – Responsible Entity – Balancing Authority**

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Function

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## Function – Market Operations

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### ***Definition***

Integrates energy, capacity, balancing, and transmission resources to achieve an economic, reliability-constrained dispatch of resources. The dispatch may be either cost-based or bid-based.

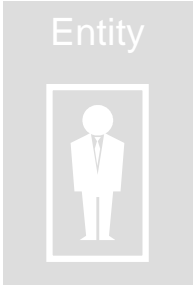
### ***Tasks***

1. Administer a market that provides capacity, energy, balancing resources, and other Ancillary Services subject to system requirements and constraints.
2. Arrange resources for congestion management.
3. Provide dispatch plans.

### ***Special Considerations***

The Market Operations function, its tasks, and the interrelationships with other entities is included in the Functional Model only as an interface point with other types of industry models.

### Comments – Function – Market Operations



## **Responsible Entity – Market Operator (or Resource Dispatcher)**

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### ***Relationships with other Responsible Entities***

Market Operator tasks and relationships are specific to a particular Market Operator and will depend on the market structure over which the Market Operator presides.

The Resource Dispatcher performs the same dispatch duties as the Market Operator, but in a non-market environment.

### **Comments – Responsible Entity – Market Operator (or Resource Dispatcher)**

Function

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## Function – Resource Planning

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### **Definition**

Develops a long-term (generally one year and beyond) plan for the resource adequacy of specific loads (customer demand and energy requirements) within a Planning Authority Area.

### **Tasks**

1. Maintain resource models and apply appropriate tools for the development of adequate resource plans.
2. Define and collect or develop demand and resource information required for planning purposes.
3. Provide capacity resource information to planning and operating functions and service functions.
4. Assist in the evaluation of the deliverability of resources to customers.
5. Include consideration of generation capacity from resources both within and outside of the Planning Authority Area.
6. Develop and report, as appropriate, on its resource plans to others for assessment and compliance with reliability standards.
7. Monitor and report, as appropriate, on its resource plan implementation.

### **Comments – Function – Resource Planning**



## **Responsible Entity – Resource Planner**

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### ***Relationships with other Responsible Entities***

1. Coordinates the resource models with its Planning Authority.
2. Works and coordinates with Transmission Owners and Transmission Planners on the deliverability of resources to customers.
3. Reports its resource plan to the Planning Authority for assessment and compliance with reliability standards.
4. Reports on resource plan implementation to the Planning Authority.
5. Works with Planning Authority to identify potential alternative solutions to meet resource requirements.
6. Coordinates with and collects data for resource planning from the Load-Serving Entities, Generator Owners, Generator Operators, Transmission Owners, Transmission Operators, and Interchange Authorities.
7. Coordinates with Transmission Service Providers, Reliability Authorities, and Planning Authorities on resource adequacy plans as appropriate.
8. Coordinates with other Resource Planners within the Planning Authority Area to avoid the double-counting of resources.

### ***Special Considerations***

In some markets, it may be required that the same entity perform the Resource Planning Function and the Planning Authority Function. For example, the Resource Planner may also be the Planning Authority in those markets where there are no entities responsible or obligated to serve load. In these cases, the Resource Planning Function becomes a resource assessment function performed by the Planning Authority that identifies the need for additional resources to be provided by the market.

### **Comments – Responsible Entity – Resource Planner**

Function

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## Function – Transmission Operations

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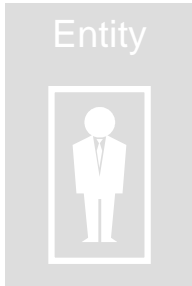
### **Definition**

Operates or directs the operations of the transmission facilities.

### **Tasks**

1. Maintain reliability of the transmission area in accordance with Reliability Standards.
2. Provide detailed maintenance schedules (dates and times)
3. Adjust dc ties within the transmission area for those Interchange Transactions that include the dc tie in the transmission path
4. Maintain defined voltage profiles.
5. Define operating limits, develop contingency plans, and monitor operations of the transmission facilities.
6. Provide telemetry of transmission system information

### **Comments – Function – Transmission Operations**



## **Responsible Entity – Transmission Operator**

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### ***Relationships with other Responsible Entities***

#### **Ahead of Time**

1. Receives maintenance requirements and plans from the Transmission Owner.
2. Defines operating limits, develops contingency plans, and monitors operations of the transmission facilities under the Transmission Operator's control and as directed by the Reliability Authority.
3. Provides operating information to the Reliability Authority.
4. Determines amount required and arranges for interconnected operations services from Generator Owners to ensure voltage support (e.g., reactive supply from generation resources) in coordination with the Reliability Authority.
5. Provides maintenance schedules and construction plans to Reliability Authority and Planning Authority.
6. Revises transmission maintenance plans as requested by the Reliability Authority and as permitted by agreements, recognizing that equipment maintenance must be performed as needed to ensure the life of the equipment and meet warranty requirements.
7. Provides Planning Authority information on capability to curtail (reduce) and shed load during emergencies.

#### **Real Time**

8. Operates or directs the operations of the transmission system within equipment and facility ratings established by the Transmission Owners and Generator Owners, and system ratings established by the Reliability Authority.
9. Deploys reactive resources from Transmission Owners and Generator Owners as Interconnected Operations Services to maintain acceptable voltage profiles.
10. Provides real-time operations information to the Reliability Authority.
11. Notifies Generator Operators of transmission system problems (e.g., voltage limitations or equipment overloads that may affect generator operations).
12. Requests Reliability Authority to mitigate equipment overloads. (e.g., redispatch, transmission loading relief).
13. Coordinates load shedding with, or as directed by, the Reliability Authority.
14. Directs Distribution Providers to shed load.
15. Implements dc tie operations for those ties under the Transmission Operator's purview as directed by the Transmission Service Provider.

**Comments – Responsible Entity – Transmission Operator**

Function

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## Function – Interchange

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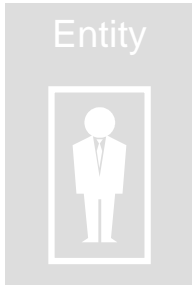
### **Definition**

Authorizes implementation of valid and balanced Interchange Schedules between Balancing Authority Areas, and ensures Interchange Transactions are properly identified for reliability assessment purposes.

### **Tasks**

1. Determine valid, balanced, Interchange Schedules (validation of sources and sinks, transmission arrangements, interconnected operations services, etc.).
2. Verify ramping capability of the source and sink Balancing Authority Areas for requested Interchange Schedules
3. Collect and disseminate Interchange Transaction approvals, changes, and denials
4. Authorize implementation of Interchange Transactions
5. Enter Interchange Transaction information into Reliability Assessment Systems (e.g., the Interchange Distribution Calculator in the Eastern Interconnection)
6. Maintain record of individual Interchange Transactions

### **Comments – Function – Interchange**



## **Responsible Entity – Interchange Authority**

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### ***Relationships with other Responsible Entities***

#### **Ahead of Time**

1. Verifies ramping capability for requested Interchange Schedules with Balancing Authorities.
2. Receives requests from Purchasing-Selling Entities to implement Interchange Transactions.
3. Submits all Interchange Transaction requests to the Reliability Authorities, Balancing Authorities, and Transmission Service Providers for approvals.
4. Receives confirmation from Transmission Service Providers of transmission arrangement(s).
5. Receives confirmation from Balancing Authorities of the ability to meet ramping requirements for submitted Interchange Schedules.
6. Receives information from Balancing Authorities of expected Interconnected Operations Services deployments that result in an Interchange Transaction (for example, an Interchange Schedule that is enabled by reducing load in a Balancing Authority Area, which frees up resources.)
7. Informs Purchasing-Selling Entities on implementation of load-provided Interconnected Operations Services that were bid into the market that result in an Interchange Transaction.
8. Provides approved, valid, and balanced Interchange Schedules to the Balancing Authorities for implementation.

#### **Real Time**

9. Provides Transmission Service Providers with the requested Interchange Transactions received from Purchasing Selling Entities using that Transmission Service Providers' transmission system.
10. Receives curtailments and redispatch implementation from Reliability Authorities.
11. Informs Transmission Service Providers, Purchasing-Selling Entities, Reliability Authorities, and Balancing Authorities of Interchange Schedule Implementations and Curtailments.
12. Receives information on Interchange Schedule interruptions due to generation loss or load interruption from the Balancing Authorities.

#### **After the hour**

13. Maintains and provides records of individual Interchange Transactions for the Balancing Authorities.

**Comments – Responsible Entity – Interchange Authority**

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Function

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## Function – Transmission Planning

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### **Definition**

Develops a long-term (generally one year and beyond) plan for the reliability (adequacy) of the interconnected bulk electric transmission systems within its portion of the Planning Authority Area

### **Tasks**

Develops a long-term (generally one year and beyond) plan for the reliability (adequacy) of the interconnected bulk electric transmission systems within a portion of the Planning Authority Area.

### **Tasks**

1. Maintain transmission system models (steady-state, dynamics, and short circuit) and apply appropriate tools for the development of transmission plans.
2. Define and collect transmission information and transmission facility characteristics and ratings.
3. Develop plans within defined voltage and stability limits and within appropriate facility thermal ratings.
4. Define system protection and control needs and requirements, including special protection systems (remedial action schemes), to meet reliability standards.
5. Determine TTC values<sup>2</sup> as appropriate.
6. Notify others of any planned transmission changes that may impact their facilities.
7. Evaluate and plan for transmission service and interconnection requests beyond one year.
8. Develop and report, as appropriate, on its transmission expansion plan for assessment and compliance with reliability standards.
9. Monitor and report, as appropriate, on its transmission expansion plan implementation.

### **Comments – Function – Transmission Planning**

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<sup>2</sup> TTC is the total transfer capability and refers to the amount of electric power that can be moved or transferred reliably from one area to another area of the interconnected transmission systems by way of all transmission lines (or paths) between those areas under specified system conditions.





## **Responsible Entity – Transmission Planner**

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### ***Relationships with other Responsible Entities***

1. Provides transmission information, as appropriate, to planning and operating entities and service entities.
2. Coordinates and collects data as appropriate for system modeling, and plans transmission system modifications and expansion for Load-Serving Entities, Generator Owners, and Distribution Providers with other Transmission Planners, Transmission Owners, and Transmission Service Providers.
  - a. Coordinates its transmission models with its Planning Authority.
  - b. Notifies Generator Owners and Transmission Owners of any planned transmission changes that may impact their facilities.
  - c. Coordinates with Resource Planners on the deliverability of new and proposed generation facilities, as appropriate.
3. Coordinates with Transmission Service Providers, Transmission Owners, Reliability Authorities, Planning Authorities, and other Transmission Planners on system limitations, transmission adequacy plans, and the determination of TTC values as appropriate.
4. Coordinates with its Planning Authority, other Planning Authorities, and other Transmission Planners within its Planning Authority Area on reliability issues, as appropriate, including
  - a. Develops and reports its transmission expansion plan to its Planning Authority for assessment and compliance with reliability standards.
  - b. Works with its Planning Authority to identify potential alternative solutions, including solutions proposed by stakeholders, to meet interconnected bulk electric system requirements.
  - c. Reports on transmission expansion plan implementation to its Planning Authority.

### **Comments – Responsible Entity – Transmission Planner**



## Function – Transmission Service

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### **Definition**

Administers the transmission tariff. Provides transmission services to qualified market participants under applicable transmission service agreements (for example, the *pro forma* tariff).

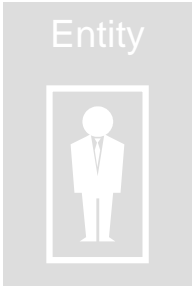
### **Tasks**

1. Receive transmission service requests and process each request for service according to the requirements of the tariff.
  - a. Maintain commercial interface for receiving and confirming requests for transmission service according to the requirements of the tariff (e.g., OASIS).
2. Approve or deny transmission service requests
3. Approve Interchange Transactions from transmission service arrangement perspective
4. Determine and post available transfer capability (ATC<sup>3</sup>) values.
5. Allocate transmission losses (MWs or funds) among Balancing Authority Areas.

### **Comments – Function – Transmission Service**

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<sup>3</sup> In this document, we use the term “ATC” in the generic sense to refer to the amount of transmission transfer capability that is offered under regulatory requirements.



## **Responsible Entity – Transmission Service Provider**

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### ***Relationships with other Responsible Entities***

#### **Making Deals**

1. Approves or denies transmission service requests from Purchasing-Selling Entities, Generator Owners, and Load-Serving Entities

#### **Ahead of Time**

2. Receives transmission expansion plans identified by the Planning Authority to help determine ability to accommodate long-term transmission service requests
3. Coordinates ATC with Reliability Authority (who may adjust operating reliability limits) and other Transmission Service Providers
4. Confirms Transmission Service requests to Interchange Authorities.

#### **Real Time**

5. Receives Interchange Transaction implementation and revisions from the Interchange Authorities

### **Comments – Responsible Entity – Transmission Service Provider**



## Function – Transmission Ownership

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### ***Definition***

Owns and maintains transmission facilities.

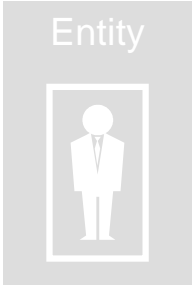
### ***Tasks***

1. Install and maintain transmission facilities according to prudent utility practice
2. Establish ratings of transmission facilities.
3. Develops interconnection agreements.

### **Comments – Function – Transmission Ownership**

## Responsible Entity – Transmission Owner

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### ***Relationships with other Responsible Entities***

1. Coordinates with Transmission Planners and the Planning Authority and those entities (Generator Owners, other Transmission Owners, and Load-Serving Entities) desiring to interconnect facilities with the bulk electric systems.
2. Considers transmission expansion plans identified by the Planning Authority
3. Provides transmission expansion plans and changes to the Planning Authority and Transmission Planners.
4. Develops agreements or procedures with the Transmission Service Providers.
5. Develops operating agreements or procedures with the Transmission Operators and Reliability Authorities.
6. Provides transmission facility ratings to Transmission Operators, Reliability Authorities, Transmission Service Providers, Transmission Planners, and Planning Authority.
7. Provides construction plans to the Reliability Authority and Planning Authority
8. Provides maintenance plans to the Transmission Operator.
9. Develops agreements with adjacent Transmission Owners for the design, construction and operation and maintenance of joint transmission facilities.

### **Comments – Responsible Entity – Transmission Owner**



## Function – Distribution

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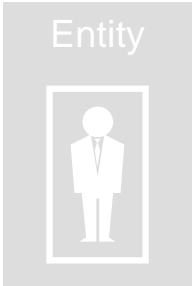
### ***Definition***

Provides and operates the “wires” between the transmission system and the end-use customer.

### ***Tasks***

1. Provide the interface between the transmission system and the end-use customer.
2. Provide voltage reduction and load shedding as necessary

### **Comments – Function – Distribution**



## **Responsible Entity – Distribution Provider**

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### ***Relationships with other Responsible Entities***

#### **Ahead of Time**

1. Coordinates with Load-Serving Entities, Transmission Planners and their related Planning Authority on transmission expansion (e.g., coordination of system protection, special protection systems, load shedding, etc).
2. Works with end-use customers to identify new facility connection needs.

#### **Real Time**

3. Implements voltage reduction and sheds load as directed by Transmission Operators.

### ***Special Considerations***

The Distribution Provider provides the physical connection between the end-use customer and the electric system. For those end-use customers who are served at transmission voltages, the Transmission Owner also serves as the Distribution Provider. Thus, the Distribution Provider is not defined by a specific voltage, but rather as performing the Distribution function at any voltage.

The Distribution Provider is responsible for “local” safety and reliability. The Distribution Provider knows which customers are “critical” loads that should be shed only as a last resort, and provides the switches and reclosers for this emergency action.

### **Comments – Responsible Entity – Distribution Provider**

Function

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## Function – Generator Operation

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### **Definition**

Operates generating unit(s) and performs the functions of supplying energy and Interconnected Operations Services.

### **Tasks**

1. Operate generators to provide energy or Interconnected Operations Services (or both) per contracts or arrangements
2. Formulate daily generation plan
3. Report operating and availability status of units and related equipment, such as automatic voltage regulators.
4. Develop annual maintenance plan for generating units and performs the day-to-day generator maintenance

### **Comments – Function – Generator Operation**



## **Responsible Entity – Generator Operator**

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### ***Relationships with other Responsible Entities***

#### **Ahead of Time**

1. Provides generation commitment plans to the Balancing Authority after notification by Purchase-Selling Entities or Load Serving Entities of transaction approvals.
2. Provides Balancing Authority and Transmission Operator with requested amount of Interconnected Operations Services.
3. Provides operating and availability status of units to Reliability Authority and Balancing Authority for reliability analysis.
4. Reports annual maintenance plan for generating units to Balancing Authority.
5. Reports status of automatic voltage regulators to Transmission Operators.
6. Provides long-term unit maintenance schedules and unit retirement plans to Resource Planner and Planning Authority.

#### **Real Time**

7. Implements, upon direction by Balancing Authority, redispatch and interchange schedules
8. Provides real-time operating information to the Transmission Operator and Balancing Authority (to both the “host” Balancing Authority in which the Generator is physically located and the sink Balancing Authority in case the generation is dynamically transferred between Balancing Authority Areas).

### **Comments – Responsible Entity – Generator Operator**



## Function – Generator Ownership

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### **Definition**

Owns and maintains generating units.

### **Tasks**

1. Establish generating unit ratings, limits and operating requirements.
2. Maintain its generation facilities according to prudent utility practices.
3. Verify generating unit performance characteristics

### Comments – Function – Generator Ownership



## **Responsible Entity – Generator Owner**

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### ***Relationships with other Responsible Entities***

1. Provides generator ratings, limits, and models to Transmission Planners and Planning Authorities.

### **Real Time**

2. May deal directly<sup>4</sup> with either Load Serving Entities or Purchase-Selling Entities via bilateral contracts for energy, capacity, and Interconnected Operations Services products
3. Provides voltage support to Transmission Operators

### **Comments – Responsible Entity – Generator Owner**

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<sup>4</sup> The Generator Owner can serve as its own Purchasing-Selling Entity, or be affiliated with a Load-Serving Entity.

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## Function – Purchasing-Selling

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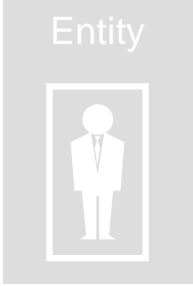
### **Definition**

Purchases or sells energy, capacity and all necessary Interconnected Operations Services as required. Purchasing-Selling Entities may be Marketers or Merchant Affiliates.

### **Tasks**

1. Purchase and sell generation or capacity
2. Arrange Interchange Transactions
3. Arrange for transmission service (as required by tariffs)
4. Purchase and sell Interconnected Operations Services
5. Request implementation of Interchange Transactions

### **Comments – Function – Purchasing-Selling**



## **Responsible Entity – Purchasing-Selling Entity**

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### ***Relationships with other Responsible Entities***

#### **Making Deals**

1. Assists Load Serving Entities (LSE) define Interchange Transactions in meeting the LSE’s needs.
2. Assists Load Serving Entities and other Purchasing-Selling Entities in supplying the Interconnected Operations Services needs of the Load-Serving Entities. (E.g., supplying regulation service via Interchange Transactions).
3. Arranges for transmission service from Transmission Service Providers and makes arrangements for Interconnected Operations Services with Generator Owners or Load-Serving Entities as applicable for Interchange Transactions.

#### **Transaction Approval and Plans Ahead of Time**

4. Submits requests to Interchange Authorities to implement Interchange Transactions.
5. Notifies Generator Operators and Load Serving Entities if Interchange Transaction requests are approved or denied.

#### **Real Time**

6. Notifies Interchange Authorities of Transaction Cancellations or Terminations.

### **Comments – Responsible Entity – Purchasing-Selling Entity**

Function

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## Function – Load-Serving

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### **Definition**

Secures energy and transmission service (and related Interconnected Operations Services) to serve the end-use customer.

### **Tasks**

1. Collect individual and develop overall load profiles and forecasts of end-user energy requirements. (Daily, weekly, monthly, annually etc...)
2. Identify and provide facilities for load curtailment
3. Identify and provide facilities for self-provided Interconnected Operations Services
4. Negotiate agreements for needed energy, transmission service, and Interconnected Operations Services
5. Manage resource portfolios to meet demand and energy requirements of end-use customers.

### Comments – Function – Load-Serving



## **Responsible Entity – Load-Serving Entity**

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### ***Relationships with other Responsible Entities***

#### **Making Deals**

1. Assists end-use customers develop and submit load profiles, plans, and forecasts as needed to the Balancing Authorities, Generator Owners, Generator Operators, Purchasing-Selling Entities, Planning Authority, Resource Planners, Transmission Planners, and Market Operator(s).
2. Assists Purchasing-Selling Entities in arranging for the delivery of energy to a specific metering point for loads via bilateral contracts
3. Assists Generator Owners and Generator Operators on behalf of end-use customers in securing energy and Interconnected Operations Services needed via bilateral contracts. (In this role the Load Serving Entity is acting like the Purchasing-Selling Entity.)

#### **Ahead of Time**

4. Arranges for transmission service via Transmission Service Providers.
5. Provides generation (affiliated and non-affiliated) commitments and dispatch schedules to the Balancing Authority.
6. Works with end-use customers to identify new facility connection needs
7. Works with Resource Planners to ensure planned purchases that cross Planning Authority Area boundaries are properly reported for system modeling and reliability assessments
8. Coordinates with Transmission Planner and the Planning Authority on data requirements for system modeling and transmission expansion.
9. Works with the Balancing Authorities and Transmission Operators for implementing load shedding during emergency conditions and to provide load interruption capability as an Interconnected Operations Service.

#### **Real Time**

10. Assists Distribution Providers in implementing load shedding during emergency conditions and Balancing Authorities to provide load interruption capability as an Interconnected Operations Service

### **Comments – Responsible Entity – Load-Serving Entity**



## Function – Compliance Monitoring

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### ***Definition***

Monitors, reviews, and ensures compliance with Reliability Standards and administers sanctions or penalties for non-compliance to the standards.

### ***Tasks***

1. Audit and document compliance of all registered Responsible Entities to Reliability Standards
2. Recommend sanctions or penalties for non-compliance with Reliability Standards

### **Comments – Function – Compliance Monitoring**



## **Responsible Entity – Compliance Monitor**

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### ***Relationships with other Responsible Entities***

1. Receives oversight direction from the Standards Developer for consistency
2. Monitors all responsible entities as required by Reliability Standards and Certification Criteria.
3. Provides compliance information to the Standards Developer and others as appropriate

### **Comments – Responsible Entity – Compliance Monitor**

Function

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## Function – Standards Development

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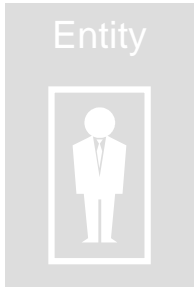
### ***Definition***

Develops, maintains, and implements Reliability Standards to ensure the reliability of the interconnected bulk electric transmission systems in the United States, Canada, and Baja California Norte, Mexico.

### ***Tasks***

1. Develop Reliability Standards for the planning and operation of the interconnected bulk electric transmission systems that serve the United States, Canada, and Baja California Norte, Mexico.
2. Develop compliance measurement and enforcement procedures for each Reliability Standard.
3. Develop Criteria and Certification Procedures for Balancing, Interchange, and Reliability Authorities, Transmission Operators, and others as needed.
4. Provide for appeals and dispute resolution procedures.

### **Comments – Function – Standards Development**



## **Responsible Entity – Standards Developer**

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### ***Relationships with other Responsible Entities***

Coordinates with other standards-approving organizations

### **Comments – Responsible Entity – Standards Developer**

## **Functional Model Approval Procedure**

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Changes to the Functional Model are approved by the standing committees and the board of trustees. The Functional Model is the framework for the Reliability Standards, and the functions, their definitions, and interrelationships must be observed as SARs and Standards are drafted. Doing otherwise would cause conflicts among the Reliability Standards as they are developed over time.

The Functional Model Working Group considers all requests to revise the Functional Model, and manages the revision process:

1. Functional Model Working Group reviews the proposed revision to the Model, considering current Reliability Standards, and SARs and Standards being drafted. The Working Group will work with the individual or group requesting the change to the Model.
2. Working Group posts revision for public comment for 45 days.
3. Working Group submits revision to the standing committees for review and approval. (The revision will include an implementation date for the revisions.)
4. Working Group submits standing committee-approved revision to the NERC Board of Trustees for approval.
5. NERC staff posts revised Functional Model.

### **Comments – Functional Model Approval Procedure**