

## NERC Reliability Functional Model

### Function Definitions and Responsible Entities

Version 3

**Approved by Standing Committees:**

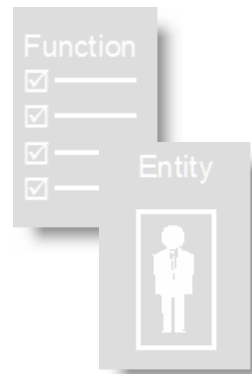
**Operating Committee: December 6, 2006**

**Planning Committee: December 6, 2006**

**Standards Committee: January 12, 2007**

**Approved by Board of Trustees: February 13, 2007**

**Prepared by the  
Functional Model Review Working Group**



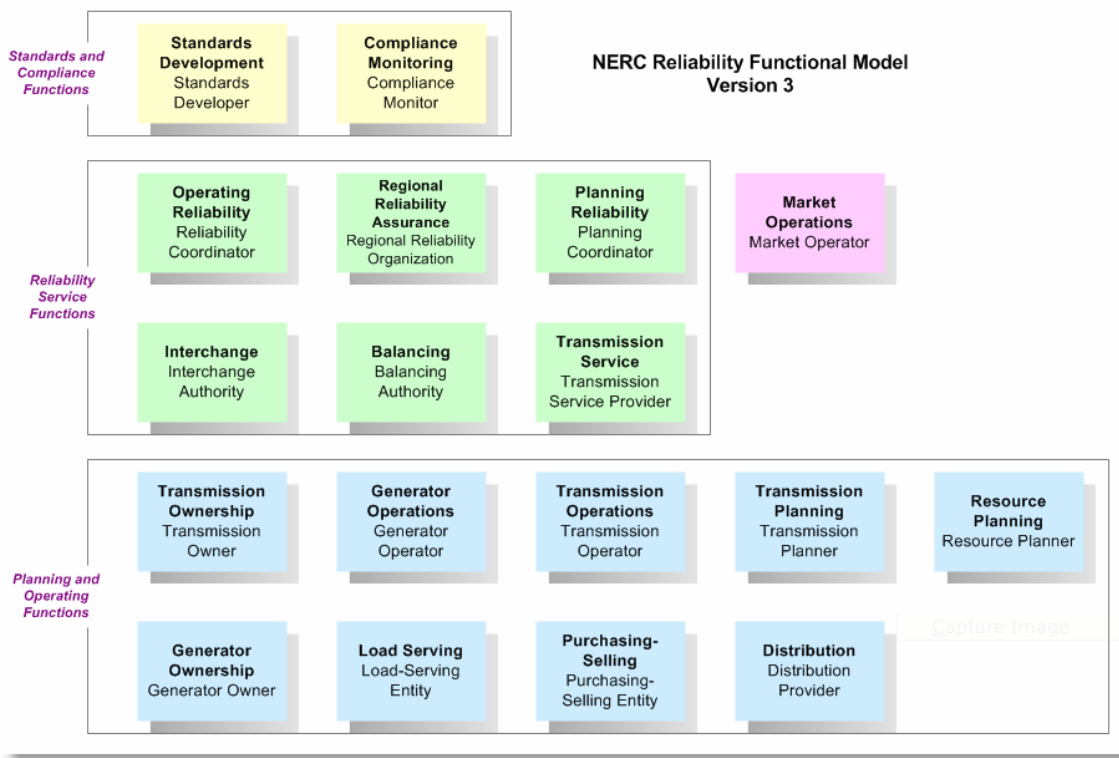
## Table of Contents

---

Table of Contents .....	2
Functional Model Diagram .....	4
Terms Used in the Functional Model .....	5
Functions and Responsible Entities .....	6
Function – Standards Development .....	7
Responsible Entity – Standards Developer .....	8
Function – Compliance Monitoring.....	9
Responsible Entity – Compliance Monitor .....	10
Function – Regional Reliability Assurance .....	11
Responsible Entity – Regional Reliability Organization .....	12
Function – Planning Reliability.....	13
Responsible Entity – Planning Coordinator.....	14
Function – Transmission Planning .....	16
Responsible Entity – Transmission Planner .....	17
Function – Resource Planning.....	18
Responsible Entity – Resource Planner .....	19
Function – Reliability Operations .....	20
Responsible Entity – Reliability Coordinator.....	21
Function – Balancing .....	23
Responsible Entity – Balancing Authority .....	24
Function – Market Operations.....	26
Responsible Entity – Market Operator (or Resource Dispatcher) .....	27
Function – Transmission Operations .....	28
Responsible Entity – Transmission Operator .....	29
Function – Interchange.....	31
Responsible Entity – Interchange Authority.....	32
Function – Transmission Service.....	33
Responsible Entity – Transmission Service Provider.....	34
Function – Transmission Ownership.....	35
Responsible Entity – Transmission Owner .....	36
Function – Distribution .....	37
Responsible Entity – Distribution Provider .....	38
Function – Generator Operation.....	39
Responsible Entity – Generator Operator .....	40
Function – Generator Ownership .....	41

Responsible Entity – Generator Owner.....	42
Function – Purchasing-Selling.....	43
Responsible Entity – Purchasing-Selling Entity .....	44
Function – Load-Serving .....	45
Responsible Entity – Load-Serving Entity.....	46

# Functional Model Diagram



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

## Terms Used in the Functional Model

---

The following terms are used in version 3 of the Functional Model. The definitions for Reliability Coordinator Area and Balancing Authority Area have been copied from the *Glossary of Terms Used in Reliability Standards*. The remaining terms below have not been approved through the standards development process and are provided here simply to facilitate a clearer understanding of the Functional Model.

### Areas

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

**Transmission Operator Area.** The Transmission Operator Area is defined as the collection of transmission facilities over which the Transmission Operator is responsible for operating.

**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.

**Planning Coordinator Area.** That area under the purview of the Planning Coordinator. It will include one or more Transmission Planners and Resource Planners.

### General

**Responsible Entity.** The term used by NERC which applies to an organization that is responsible for carrying out the Tasks within a Function. Responsible Entities are registered by the Electric Reliability Organization (ERO) and maintained in its registry as described in the ERO Rules of Procedure and ERO Delegation Agreements.



**Function.** A set of Tasks so closely related to one another that separating those Tasks, by assigning them to different organizations, would threaten to impair the integrity of the Function.



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

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

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

## Functions and Responsible Entities

---

This section defines the functions and associated tasks that are necessary to plan and operate the bulk electric system in a reliable manner. It then characterizes the Responsible Entities who perform these tasks, and provides examples of the inter-relationships that take place between entities to ensure reliability. The list of Tasks within Functions is not an all inclusive list. As standards are developed the Model will be revised to add and remove Tasks under specific Functions to aid in the development of standards. Relationships between Responsible Entities in the Model are reciprocal. Where a one-to-one relationship exists, the Model will include the relationship specifically; and where a one-to-many relationship exists, the reciprocal relationships are implied.





## **Function – Standards Development**

---

### **Definition**

Develops and maintains reliability standards to ensure the reliability of the Bulk Electric System.

### **Tasks**

1. Develop and maintain a standards development process.
2. Develop reliability standards for the planning and operation of the Bulk Electric System.
3. Incorporate compliance measures for each reliability standard.
4. Provide for appeals procedures.
5. Submit reliability standards to appropriate regulatory authorities for approval.



## **Responsible Entity – Standards Developer**

---

### **Introduction to the Standards Developer**

The Model addresses reliability standards created at NERC using the NERC standards development process and regional standards that are created through an open regional process and approved by NERC for enforcement. The Functional Model is intended to serve as a guide for the development and enforcement of these reliability standards. There are also regional criteria which are requirements that regions create and enforce, that are not included in the Model.

### **Relationships with Other Responsible Entities**

1. Receives request for reliability standards through the public process.
2. Sends reliability standards to the Compliance Monitor.
3. Obtains approval for standards development process from NERC.



## Function – Compliance Monitoring

---

### Definition

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

### Tasks

1. Evaluate and document compliance of all Responsible Entities defined in the appropriate reliability standards.
2. Perform compliance audits.
3. Administer sanctions for identified violators.
4. Develop and maintain appropriate appeals process.
5. Certify Responsible Entities.



## **Responsible Entity – Compliance Monitor**

---

### **Introduction to the Compliance Monitor**

The Compliance Monitor develops and implements a Compliance Enforcement Program to promote the reliability of the Bulk Electric System by enforcing compliance with approved reliability standards in those regions of North American in which the Compliance Monitor has been given enforcement authority. There are reliability standards consisting of those created at NERC using the NERC standards development process and regional standards that are created through an open regional process and approved by NERC for enforcement.

### **Relationships with Other Responsible Entities**

1. Receives reliability standards from the Standards Developer.
2. Monitors all Responsible Entities as required by reliability standards.
3. Administers the sanctions to the identified violators.



## **Function – Regional Reliability Assurance**

---

### **Definition**

Conducts the regional activities related to planning and operations, and coordinates activities of Responsible Entities to secure the reliability of the Bulk Electric System within the region and adjacent regions.

### **Tasks**

1. Coordinate reliability assurance among adjacent regions within an Interconnection through the development of necessary protocols and processes.
2. Coordinate the activities related to maintaining critical infrastructure protection.
3. Establish reliability assurance criteria related to planning and operations within the region.
4. Develop and maintain a Regional Reliability Plan.
5. Perform both regional transmission and regional resource adequacy evaluations.
6. Perform evaluations of protection systems as they relate to the reliability of the Bulk Electric System within the region.
7. Participate in readiness assessments.
8. Perform disturbance analysis evaluations.



## **Responsible Entity – Regional Reliability Organization**

### **Relationships with Other Responsible Entities**

1. Coordinates reliability assurance activities of the Responsible Entities within the region.
2. Coordinates reliability assurance activities with adjacent Regional Reliability Organizations.
3. Coordinates the evaluation of protective systems between Planning Coordinators, Transmission Planners, and Transmission Owners.
4. Coordinates critical infrastructure protection programs with Responsible Entities.
5. Collects information from the Responsible Entities for the development of the Regional Reliability Plan.
6. Collects information from the Planning Coordinators, Resource Planners, and Transmission Planners for the transmission and resource adequacy evaluations.
7. Collects information from Responsible Entities for disturbance analysis evaluations.



## Function – Planning Reliability

---

### Definition

Ensures a plan (generally one year and beyond) is available for adequate resources and transmission within a Planning Coordinator Area. It integrates and evaluates the plans from the Transmission Planners and Resource Planners within the Planning Coordinator Area to ensure those plans meet the reliability standards.

### Tasks

1. Maintain and develop methodologies and tools for the analysis and simulation of the transmission systems in the evaluation and development of transmission expansion plans and the analysis and development of resource adequacy plans.
2. Define information required for planning purposes, consolidate and collect or develop such information, including:
  - a. Transmission facility characteristics and ratings.
  - b. Demand and energy forecasts, capacity resources, and demand response programs.
  - c. Generator unit performance characteristics and capabilities.
  - d. Long-term capacity purchases and sales.
3. Evaluate, develop, document, and report on resource and transmission expansion plans for the Planning Coordinator Area. Integrate the respective plans and verify that the integrated plan meets reliability standards, and, if not, report on potential transmission system and resource adequacy deficiencies and provide alternative plans to mitigate identified deficiencies.
  - a. Evaluate the plans that are in response to long-term (generally one year and beyond) customer requests for transmission service.
  - b. Review transmission facility plans required to integrate new (End-use Customer, generation, and transmission) facilities into the Bulk Electric System.
  - c. Review and determine total transfer capability (generally one year and beyond) as appropriate.
  - d. Monitor and evaluate transmission expansion plan and resource plan implementation.
  - e. Coordinate projects requiring transmission outages that can impact reliability and firm transactions.
4. Coordinate with adjoining Planning Coordinators so that system models and resource and transmission expansion plans take into account modifications made to adjacent Planning Coordinator Areas.
5. Develop and maintain transmission and resource (demand and capacity) system models to evaluate transmission system performance and resource adequacy.



## **Responsible Entity – Planning Coordinator**

---

### **Introduction to the Planning Coordinator**

The Planning Coordinator is responsible for assessing the longer-term reliability of its Planning Coordinator Area. While the area under the purview of a Planning Coordinator may include as few as one Transmission Planner and Resource Planner, the Planning Coordinator's scope of activities is more "global" than individual system plans. By its very nature, Bulk Electric System planning involves multiple entities. Since all electric systems within an integrated network are electrically connected, whatever one system does can affect the other systems. Planning Coordinators work through a variety of mechanisms to conduct facilitated, coordinated, joint, centralized, or regional planning activities.

### **Relationships with Other Responsible Entities**

1. Coordinates and collects data for system modeling from Transmission Planner, Resource Planner, and other Planning Coordinators.
2. Coordinates total transfer capability (generally one year and beyond) with Transmission Planners, Reliability Coordinator, Transmission Owner, Transmission Operator, Transmission Service Provider, and neighboring Planning Coordinators.
3. Coordinates plans with Reliability Coordinator and other Planning Coordinators on reliability issues.
4. Receives Transmission Planner's plans.
5. Collects information including:
  - a. Transmission facility characteristics and ratings from the Transmission Owners, Transmission Planners, and Transmission Operators.
  - b. Demand and energy forecasts, capacity resources, and demand response programs from Load-Serving Entities, and Resource Planners.
  - c. Generator unit performance characteristics and capabilities from Generator Owners.
  - d. Long-term capacity purchases and sales from Transmission Service Providers.
6. Collects and reviews reports on transmission and resource plan implementation from Resource Planners and Transmission Planners.
7. Submits and coordinates the plans for the interconnection of facilities to the Bulk Electric System within its Planning Coordinator Area with Transmission Planners and Resource Planners and adjacent Planning Coordinator Areas, as appropriate.
8. Provides and informs Resource Planners, Transmission Planners, and adjacent Planning Coordinators of the methodologies and tools for the simulation of the transmission system.
9. Provides the coordinated plans to affected Regional Reliability Organization(s), Transmission Service Providers, Transmission Planners, Transmission Operators, and Transmission Owners.
10. Integrates the respective plans of the Resource Planners and Transmission Planners within the Planning Coordinator Area.
  - a. Verifies that the integrated plan meets reliability standards.

- b. In coordination with the Resource Planners and Transmission Planners, develops corrective actions for plans that do not meet those reliability standards.**



## Function – Transmission Planning

---

### Definition

Develops a plan (generally one year and beyond) for the reliability of the interconnected Bulk Electric System within its portion of the Planning Coordinator Area

### Tasks

1. Maintain transmission system models (steady state, dynamics, and short circuit) to evaluate transmission system performance.
2. Collect information required for transmission planning purposes, including transmission and generation facility characteristics and ratings and load characteristics.
3. Evaluate, develop, document, and report on a transmission expansion plan, including:
  - a. Verify that plans meet reliability standards for its portion of the Planning Coordinator Area.
  - b. Identify and report on potential transmission system deficiencies and provide alternate plans that mitigate these deficiencies.
4. Evaluate and plan for all requests required to integrate new (End-use Customer, generation, and transmission) facilities into the Bulk Electric System.
5. Support the development of total transfer capability values.
6. Monitor and report on its transmission expansion plan implementation.
7. Notify Generation Owners and Transmission Owners of any planned transmission changes that may impact their facilities.
8. Define system protection and control needs and requirements, including special protection systems (remedial action schemes), to meet reliability standards.



## **Responsible Entity – Transmission Planner**

---

### **Relationships with Other Responsible Entities**

1. Coordinates with its Planning Coordinator, other Planning Coordinators, and other Transmission Planners within its Planning Coordinator Area on transmission expansion plans.
2. Coordinates its transmission models with its Planning Coordinator.
3. Coordinates the evaluation of transmission expansion plans with Transmission Service Providers, Transmission Owners, Reliability Coordinators, Planning Coordinators, Resource Planners, and other Transmission Planners.
4. Coordinates with Distribution Providers, Transmission Owners, Generator Owners and Load Serving Entities in the evaluation and plans for all requests required to integrate new (End-use Customer, generation, and transmission) facilities into the Bulk Electric System.
5. Coordinates with other Transmission Planners, Reliability Coordinators, Transmission Operators, Transmission Service Providers, and Planning Coordinators with the development of total transfer capability values.
6. Coordinates its transmission expansion plan implementation with other Transmission Owners, Transmission Operators, and Planning Coordinator.
7. Coordinates with Transmission Owners and Regional Reliability Organization to define system protection and control needs and requirements, including special protection systems (remedial action schemes), to meet reliability standards.
8. Receives maintenance schedules and construction plans from Transmission Operator or Transmission Owner.
9. Receives from the Planning Coordinator methodologies and tools for the analysis and development of transmission expansion plans.
10. Collects the data for system modeling from Load-Serving Entities, Generator Owners, Distribution Providers, other Transmission Planners, Transmission Owners, and Transmission Service Providers.
11. Provides transmission information, as appropriate, to Planning Coordinator and Regional Reliability Organization.
12. Notifies adjacent Transmission Owners, Transmission Operators, Planning Coordinators, and other entities that may be impacted of any planned transmission changes.

## Function – Resource Planning

---

### Definition

Develops a plan (generally one year and beyond) within its portion of a Planning Coordinator Area for the resource adequacy of its specific loads (End-use Customer demand and energy requirements).

### Tasks

1. Consider generation capacity from resources both within and outside of the Planning Coordinator Area.
2. Monitor and report, as appropriate, on its resource plan implementation.
3. Maintain resource (demand and capacity) models to evaluate resource adequacy.
4. Collect or develop information required for resource adequacy purposes, including:
  - a. demand and energy forecasts, capacity resources, and demand response programs,
  - b. generator unit performance characteristics and capabilities, and
  - c. long-term capacity purchases and sales.
5. Evaluate, develop, document, and report on a resource adequacy plan for its portion of the Planning Coordinator Area.
6. Assist in the evaluation of the deliverability of resources.



## **Responsible Entity – Resource Planner**

---

### **Relationships with Other Responsible Entities**

1. Coordinates the resource models with its Planning Coordinator.
2. Coordinates with Transmission Owners and Transmission Planners on the deliverability of resources to customers.
3. Coordinates with and collects data for resource planning from the Load-Serving Entities, Generator Owners, Generator Operators, Transmission Owners, Transmission Operators, Interchange Authorities, and Regional Reliability Organizations.
4. Coordinates with Transmission Planners, Transmission Service Providers, Reliability Coordinators, and Planning Coordinators on resource adequacy plans.
5. Coordinates with other Resource Planners within the Planning Coordinator Area to avoid the double-counting of resources.
6. Reports its resource plan to the Planning Coordinator for evaluation and compliance with reliability standards.
7. Reports on resource plan implementation to the Planning Coordinator and Regional Reliability Organization.
8. Works with Planning Coordinator and Transmission Planners to identify potential alternative solutions to meet resource requirements.
9. Applies methodologies and tools for the analysis and development of resource adequacy plans from the Planning Coordinator.



## Function – Reliability Operations

---

### Definition

Ensures the real-time operating reliability of the Bulk Electric System within a Reliability Coordinator Area.

### Tasks

1. Monitor all reliability-related parameters within the Reliability Coordinator Area, including generation dispatch and transmission maintenance plans.
2. Identify, communicate, and direct actions if necessary to relieve reliability threats and limit violations in the Reliability Coordinator Area.
3. Develop interconnection reliability operating limits (to protect from instability and cascading outages).
4. Assist in determining reliability-related services requirements for balancing generation and load, and transmission reliability (e.g., reactive requirements, location of operating reserves).
5. Perform reliability analysis (actual and contingency) for the Reliability Coordinator Area.
6. Direct revisions to transmission maintenance plans as permitted by agreements.
7. Direct revisions to generation maintenance plans as permitted by agreements.
8. Direct implementation of emergency procedures.
9. Direct and coordinate system restoration.
10. Deny or interrupt bilateral schedules that adversely impact reliability.



## **Responsible Entity – Reliability Coordinator**

---

### **Introduction to the Reliability Coordinator**

The Reliability Coordinator is responsible for the real-time operating reliability of its Reliability Coordinator Area and in coordination with its neighboring Reliability Coordinator's wide-area view. The wide-area view includes situational awareness of its neighboring Reliability Coordinator Areas. Its responsibilities include both transmission and balancing operations, and it has the authority to direct other Responsible Entities to take certain actions to ensure that its Reliability Coordinator Area operates reliably.

**Transmission operations.** With respect to transmission operations, the Reliability Coordinator and Transmission Operator have similar roles, but different scopes. The Transmission Operator is directly responsible for its own defined area. However, the Reliability Coordinator is also responsible, in concert with the other Reliability Coordinators, for the Interconnection as a whole. Thus, the Reliability Coordinator must have a “wide-area” view that reaches beyond its boundaries to enable it to operate within Interconnection Reliability Operating Limits. The Transmission Operator may or may not have this “wide-area” view, but the Reliability Coordinator must. The Reliability Coordinator may direct a Transmission Operator within its Reliability Coordinator Area to take whatever action is necessary to ensure that Interconnection Reliability Operating Limits are not exceeded.

**Balancing operations.** The Reliability Coordinator is responsible for ensuring that the generation-demand balance is maintained within its Reliability Coordinator Area, which, in turn, ensures that the Interconnection frequency remains within acceptable limits. The Balancing Authority has the responsibility for generation-demand balance in the Balancing Authority Area. The Reliability Coordinator may direct a Balancing Authority within its Reliability Coordinator Area to take whatever action is necessary to ensure that this balance is maintained.

### **Relationships with Other Responsible Entities**

#### Ahead of Time

1. Coordinates with other Reliability Coordinators, Transmission Planners, Planning Coordinator, and Transmission Service Providers on transmission system limitations.
2. Receives facility and operational data from Generator Operators, Load-Serving Entities, Transmission Owners, Generator Owners, and Transmission Operators.
3. Receives generation dispatch from Balancing Authorities and issues dispatch adjustments to Balancing Authorities to prevent exceeding limits within the Reliability Coordinator Area (if not resolved through market mechanisms).
4. Receives integrated operational plans from Balancing Authorities for reliability analysis of Reliability Coordinator Area.
5. Receives transmission and generation maintenance plans from Transmission Operators and Generator Operators, respectively, for reliability analysis.
6. Receives interchange transactions from Interchange Authorities for reliability analysis.
7. Calculates interconnection reliability operating limits based on Transmission Owners' and Generator Owners' specified equipment ratings and provides to Transmission Operators.

8. Assists Transmission Operators in calculating and coordinating System Operating Limits.
9. Provides interchange transaction denial to Interchange Authorities based on reliability analysis.
10. Provides reliability analyses to Transmission Operators, Generator Operators and Balancing Authorities in its area as well as other Reliability Coordinators.
11. Directs Generator Operators and Transmission Operators to revise generation and transmission maintenance plans respectively as permitted by agreements.
12. Receives balancing information from Balancing Authorities for monitoring.
13. Receives final approval or denial of interchange transactions from Interchange Authority.
14. Coordination of available transfer capability with Transmission Service Providers.
15. Develop operating agreements or procedures with Transmission Owners.
16. Coordinate with Transmission Operators on system restoration plans, contingency plans and reliability related services.

#### Real Time

17. Coordinates reliability processes and actions with and among other Reliability Coordinators.
18. Receives real-time operational information from Balancing Authority, Interchange Authority and Transmission Operator for monitoring.
19. Issues reliability alerts to Generator Operators, Transmission Operators, Transmission Service Providers, Balancing Authorities, Interchange Authorities, Planning Coordinators, Regional Reliability Organizations, and NERC.
20. Issues corrective actions and emergency procedures directives (e.g., curtailments or load shedding) to Transmission Operators, Balancing Authorities, and Interchange Authorities.
21. Specify reliability requirements to Balancing Authorities.
22. Receive verification of emergency procedures from Balancing Authorities.
23. Receive notification of interchange schedule interruptions from Balancing Authorities.
24. Order redispatch of generation by Balancing Authorities.
25. Direct use of flow control devices by Transmission Operators.
26. Respond to requests from Transmission Operators to assist in mitigating equipment overloads.



## Function – Balancing

---

### 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. Operate its Balancing Authority Area to maintain load-interchange-generation balance.
4. Review generation commitments, dispatch, and load forecasts.
5. Formulate an operational plan (generation commitment, outages, etc.) for reliability evaluation.
6. Approve interchange transactions from ramping ability perspective
7. Implement interchange schedules by incorporating those schedules into its ACE calculation.
8. Support Interconnection frequency through tie-line bias.
9. Monitor and report control performance and disturbance recovery.
10. Provide balancing and energy accounting (including hourly checkout of interchange schedules and actual interchange), and administer inadvertent energy paybacks.
11. Determine needs for reliability-related services.
12. Deploy reliability-related services.
13. Implement emergency procedures.



## **Responsible Entity – Balancing Authority**

---

### **Relationships with Other Responsible Entities**

#### Ahead of Time

1. Receives operating and availability status of generating units and operational plans and commitments from Generator Operators (including annual maintenance plans) within the Balancing Authority Area.
2. Receives reliability evaluations from the Reliability Coordinator.
3. Receives approved, valid, and balanced interchange schedules from the Interchange Authorities.
4. Compiles load forecasts from Load-Serving Entities.
5. Develops agreements with adjacent Balancing Authorities for ACE calculation parameters.
6. Submits integrated operational plans to the Reliability Coordinator for reliability evaluation and provides balancing information to the Reliability Coordinator for monitoring.
7. Confirms interchange schedules with Interchange Authorities.
8. Confirms ramping capability with Interchange Authorities.
9. Implements generator commitment and dispatch schedules from the Load-Serving Entities and Generator Operators who have arranged for generation within the Balancing Authority Area.
10. Acquires reliability-related services from Generator Operator.
11. Receives dispatch adjustments from Reliability Coordinators to prevent exceeding limits.
12. Receives generator information from Generator Owners including unit maintenance schedules and retirement plans.
13. Receives information from Load Serving Entities on self-provided reliability-related services.
14. Coordinates system restoration plans with Transmission Operator.
15. Provides generation dispatch to Reliability Coordinators.
16. Receives final approval or denial of interchange transactions from Interchange Authority.

#### Real Time

17. Coordinates use of controllable loads with Load-Serving Entities (i.e., interruptible load that has been bid in as a reliability-related service).
18. Receives loss allocation from Transmission Service Providers (for repayment with in-kind losses).
19. Receives real-time operating information from the Transmission Operator, adjacent Balancing Authorities and Generator Operators.
20. Receives operating information from Generator Operators.

21. Provides real-time operational information for Reliability Coordinator monitoring.
22. Receives reliability alerts from Reliability Coordinator.
23. Complies with reliability requirements specified by Reliability Coordinator.
24. Verifies implementation of emergency procedures to Reliability Coordinator.
25. Informs Reliability Coordinator and Interchange Authorities of interchange schedule interruptions (e.g., due to generation or load interruptions) within its Balancing Authority Area.
26. Directs resources (Generator Operators and Load-Serving Entities) to take action to ensure balance in real time.
27. Directs Transmission Operator (or Distribution Provider) to reduce voltage or shed load if needed to ensure balance within its Balancing Authority Area.
28. Directs Generator Operators to implement redispatch for congestion management as directed by the Reliability Coordinator.
29. Implements corrective actions and emergency procedures as directed by the Reliability Coordinator.
30. Implements system restoration plans as directed by the Transmission Operator.
31. Directs Transmission Operator to implement flow control devices.
32. Receives information of interchange schedule curtailments from Interchange Authority.

After the hour

33. Confirms interchange schedules with Interchange Authorities after the hour for “checkout.”
34. Confirms interchange with adjacent Balancing Authorities after the hour for “checkout.”

## Function – Market Operations

---

The Market Operations function, its tasks, and the interrelationships with other entities are included in the Functional Model only as an interface point of reliability Functions with commercial functions.





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

---

### **Relationships with Other Responsible Entities**

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

## Function – Transmission Operations

---

### Definition

Ensures the real-time operating reliability of the transmission assets within a Transmission Operator Area.

### Tasks

1. Monitor and provide telemetry (as needed) of all reliability-related parameters within the Transmission Operator Area.
2. Monitor the status of transmission line protective relaying systems, under-frequency load shedding systems, and under-voltage load shedding systems.
3. Provide transmission maintenance schedules.
4. Develop system operating limits and operate within those limits.
5. Develop and implement emergency procedures.
6. Develop and implement system restoration plans.
7. Operate within established Interconnection Reliability Operating Limits.
8. Perform reliability analysis (actual and contingency) for the Transmission Operator Area.
9. Adjust flow control devices within the transmission area for those interchange transactions that include these facilities in the transmission path.
10. Deploy reactive resources to maintain transmission voltage within defined limits.



## **Responsible Entity – Transmission Operator**

---

### **Introduction to the Transmission Operator**

The Transmission Operator is responsible for the real-time operating reliability of the transmission assets under its purview, which is referred to as the Transmission Operator Area. The Transmission Operator has the authority to take certain actions to ensure that its Transmission Operator Area operates reliably.

**The Transmission Operator Area.** The Transmission Operator Area is defined as the collection of transmission assets over which the Transmission Operator is responsible for operating.

The Transmission Operator and Reliability Coordinator have similar roles with respect to transmission operations, but different scopes. The Transmission Operator scope is narrower than the Reliability Coordinator, and the Transmission Operator does not necessarily “see” very far beyond its own boundaries. Therefore, the Transmission Operator can calculate system operating limits, but the Model does not require the Transmission Operator to calculate Interconnection Reliability Operating Limits, which requires wider scope of the Reliability Coordinator.

### **Relationships with Other Responsible Entities**

#### Ahead of Time

1. Coordinates restoration plans with Reliability Coordinator, Transmission Operators, Balancing Authorities, and Distribution Providers.
2. Receives maintenance requirements and construction plans and schedules from the Transmission Owner and Generation Owner
3. Receives Interconnection Reliability Operating Limits as established by the Reliability Coordinator.
4. Receives reliability evaluations from the Reliability Coordinator.
5. Develops agreements with adjacent Transmission Operators for joint transmission facilities.
6. Revises transmission maintenance plans as directed by the Reliability Coordinator and as permitted by agreements.
7. Defines System Operating Limits based on facility information provided by the Transmission Owners and Generator Owners and assistance from Reliability Coordinator.
8. Determines amount required and arranges for reliability-related services from Generator Operators to ensure voltage support (e.g., reactive supply from generation resources) in coordination with (or direction of) the Reliability Coordinator.
9. Develops contingency plans, and monitors operations of the transmission facilities within the Transmission Operator Area control and as directed by the Reliability Coordinator.
10. Provides maintenance schedules and construction plans to Reliability Coordinator and Transmission Planner.
11. Provides facility and operating information to the Reliability Coordinator.

12. Provides to the Transmission Planner information on the capability to curtail (reduce) and shed load during emergencies.
13. Coordinates available transfer capability with Transmission Service Provider.
14. Receives operating and availability status of generating units from Generation Operators including status of automatic voltage regulators.
15. Develops operating agreements or procedures with Transmission Owners.

#### Real Time

16. Coordinates load shedding with, or as directed by, the Reliability Coordinator.
17. Provides real-time operations information to the Reliability Coordinator and Balancing Authority.
18. Notifies Generator Operators of transmission system problems (e.g., voltage limitations or equipment overloads that may affect generator operations).
19. Requests Reliability Coordinator to assist in mitigating equipment overloads. (e.g., redispatch, transmission loading relief).
20. Deploys reactive resources from Transmission Owners and Generator Owners to maintain acceptable voltage profiles.
21. Directs Distribution Providers and Load Serving Entities to shed load in response to direction from Reliability Coordinator, or Balancing Authorities.
22. Implements flow control device operations for those ties under the Transmission Operator's purview as directed by the Balancing Authorities or Reliability Coordinator.
23. Receives reliability alerts from Reliability Coordinator.
24. Directs Balancing Authorities and Distribution Providers to implement system restoration plans.



## Function – Interchange

---

### Definition

Ensures communication of interchange transactions for reliability evaluation purposes and coordinates implementation of valid and balanced interchange schedules between Balancing Authority Areas.

### Tasks

1. Coordinate (i.e., collect, consolidate, and disseminate) interchange approvals, changes, and denials.
2. Receive confirmations of Balancing Authorities for requested interchange schedules.
3. Consolidate evaluations of valid, balanced, interchange schedules (validation of sources and sinks, transmission arrangements, reliability-related services, etc.).
4. Communicate interchange transaction approval for implementation.
5. Communicate interchange transaction information to Reliability Assessment Systems (e.g., the interchange distribution calculator in the Eastern Interconnection).
6. Maintain record of individual interchange schedules.



## **Responsible Entity – Interchange Authority**

---

### **Relationships with Other Responsible Entities**

#### Ahead of Time

1. Receives requests from Purchasing-Selling Entities to implement interchange transactions.
2. Receives confirmation from Transmission Service Providers of transmission arrangement(s).
3. Receives confirmation from Balancing Authorities of the ability to meet ramping requirements for submitted interchange transactions.
4. Submits all interchange transaction requests to the Reliability Coordinators, Balancing Authorities, and Transmission Service Providers for approvals.
5. Communicates final approval or denial of Interchange transactions to the Balancing Authorities, Transmission Service Providers, Reliability Coordinators, and Purchase Selling Entities for implementation.

#### Real Time

6. Receives curtailments and redispatch implementation from Reliability Coordinators.
7. Receives information on interchange schedule interruptions from the Balancing Authorities and communicates the interchange schedule status to Balancing Authorities, Transmission Service Providers, Reliability Coordinators, and Purchase-Selling Entities.
8. Informs Transmission Service Providers, Purchasing-Selling Entities, Reliability Coordinators, and Balancing Authorities of interchange schedule curtailments.
9. Receives reliability alerts from Reliability Coordinators.

#### After the hour

10. Maintains and provides records of individual interchange transactions for the Balancing Authorities.
11. Confirms interchange schedules with Balancing Authorities after the hour for “checkout.”



## Function – Transmission Service

---

### Definition

Administers the transmission tariff and provides transmission services 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. Determine and post available transfer capability values.
3. Approve or deny transmission service requests.
4. Approve interchange transactions from transmission service arrangement perspective.
5. Allocate transmission losses (MWs or funds) among Balancing Authority Areas.



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

### **Relationships with Other Responsible Entities**

#### Ahead of Time

1. Coordinates available transfer capability with Reliability Coordinator, Transmission Operators, and other Transmission Service Providers.
2. Receives transmission facility ratings from Transmission Owners.
3. Receives transmission expansion plans identified by the Planning Coordinator to help determine ability to accommodate long-term transmission service requests.
4. Approves or denies transmission service requests from Purchasing-Selling Entities, Generator Owners, and Load-Serving Entities.
5. Confirms transmission service requests to Interchange Authorities.
6. Develops agreements or procedures with Transmission Owners.
7. Receives final approval or denial of interchange transactions from Interchange Authority.

#### Real Time

8. Receives interchange transaction implementation and revisions (including curtailments) from the Interchange Authorities.
9. Receives reliability alerts from Reliability Coordinator.
10. Provides loss allocation to Balancing Authorities.

## **Function – Transmission Ownership**

---

### **Definition**

Owns and maintains transmission facilities.

### **Tasks**

1. Develop interconnection agreements.
2. Establish ratings of transmission facilities.
3. Install and maintain transmission facilities and rights-of-way according to good utility practice.



## **Responsible Entity – Transmission Owner**

---

### **Relationships with Other Responsible Entities**

1. Coordinates with Transmission Planners and the Planning Coordinator, Generator Owners, other Transmission Owners, and Load-Serving Entities desiring to connect with the bulk electric system.
2. Receives approved transmission expansion plans from the Transmission Planner.
3. Develops agreements or procedures with the Transmission Service Providers.
4. Develops operating agreements or procedures with the Transmission Operators and Reliability Coordinators.
5. Develops agreements with adjacent Transmission Owners for joint transmission facilities.
6. Provides transmission expansion plans and changes to the Planning Coordinator and Transmission Planners.
7. Provides transmission facility ratings to Transmission Operators, Reliability Coordinators, Transmission Service Providers, Transmission Planners, and Planning Coordinator.
8. Provides construction plans and schedules to the Transmission Operator and Transmission Planner.
9. Provides maintenance plans and schedules to the Transmission Operator and Transmission Planner.
10. Develops interconnection agreements with the Distribution Provider and Generation Owner for connecting to the Bulk Electric System.
11. Provides reactive resources to Transmission Operator.



## Function – Distribution

---

### Definition

Delivers electrical energy to the End-use Customer.

### Tasks

1. Provide and operate electrical delivery facilities between the transmission system and the End-use Customer.
2. Implement voltage reduction.
3. Design and maintain protective relaying systems, under-frequency load shedding systems, under-voltage load shedding systems, and Special Protection Systems that interface with the transmission system.
4. Provide and implement load-shed capability.
5. Maintain voltage and power factor within specified limits at the interconnection point.



## **Responsible Entity – Distribution Provider**

---

### **Introduction to the Distribution Provider**

The Distribution Provider delivers electrical energy to the End-use Customer and the transmission system. For those End-use Customers who are served at transmission voltages, the Transmission Owner may also serve 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 knows which End-use Customers are “critical” loads that should be shed only as a last resort, and provides the switches and reclosers for this emergency action.

### **Relationships with Other Responsible Entities**

#### Ahead of Time

1. Coordinates with Transmission Planners on transmission expansion.
2. Coordinates system restoration plans with Transmission Operator.
3. Coordinates with End-use Customers and Load-Serving Entities to identify new facility connection needs.
4. Develop interconnection agreements with Transmission Owners on a facility basis.
5. Provides operational data to Transmission Operator.

#### Real Time

6. Implements voltage reduction and sheds load as directed by the Transmission Operator or Balancing Authority.
7. Implements system restoration plans as coordinated by the Transmission Operator.
8. Directs Load-Serving Entities to shed load during emergency conditions.

## Function – Generator Operation

---

### Definition

Operates generating unit(s) to provide real and reactive power.

### Tasks

1. Formulate daily generation plan.
2. Report operating and availability status of units and related equipment, such as automatic voltage regulators.
3. Develop annual maintenance plan for generating units and perform the day-to-day generator maintenance.
4. Operate generators to provide real and reactive power or reliability-related services per contracts or arrangements.
5. Monitor the status of generation plant protective relaying systems and transmission line protective relaying systems on the transmission lines connecting the generation plant to the transmission system.

## **Responsible Entity – Generator Operator**

---



### **Relationships with Other Responsible Entities**

#### Ahead of Time

1. Provides generation commitment plans to the Balancing Authority.
2. Provides Balancing Authority and Transmission Operator with requested amount of reliability-related services.
3. Provides operating and availability status of generating units to Balancing Authority and Transmission Operator for reliability analysis.
4. Reports annual maintenance plan for generating units to Reliability Coordinator, Balancing Authority and Transmission Operator.
5. Reports status of automatic voltage regulators to Transmission Operators.
6. Provides operational data to Reliability Coordinator.
7. Revised generation maintenance plans per directive of Reliability Coordinator.
8. Receives reliability analyses from Reliability Coordinator.
9. Receives notice from Purchasing-Selling Entity if interchange transaction approved or denied.
10. Receives reliability alerts from Reliability Coordinator.
11. Receives notification of transmission system problems from Transmission Operator.

#### Real Time

12. Provides real-time operating information to the Transmission Operator and the required Balancing Authority.
13. Adjusts real and reactive power as directed by the Balancing Authority and Transmission Operator.

## Function – Generator Ownership

---

### Definition

Owns and maintains generating facilities.

### Tasks

1. Establish generating facilities ratings, limits, and operating requirements.
2. Design and maintain generation plant protective relaying systems, protective relaying systems on the transmission lines connecting the generation plant to the transmission system, and Special Protection Systems.
3. Maintain its generation facilities according to good utility practices.
4. Verify generating facility performance characteristics.



## **Responsible Entity – Generator Owner**

---

### **Relationships with Other Responsible Entities**

1. Provides generator information to the Transmission Operator, Reliability Coordinator, Balancing Authority, Transmission Planner, and Resource Planner.
2. Provides unit maintenance schedules and unit retirement plans to the Transmission Operator, Balancing Authority, Transmission Planner, and Resource Planner.
3. Develops an interconnection agreement with Transmission Owner on a facility basis.
4. Receives approval or denial of transmission service request from Transmission Service Provider.
5. Provides reliability related services to Purchasing-Selling Entity.

## Function – Purchasing-Selling

---

### Definition

Purchases or sells energy, capacity, and necessary reliability-related services as required.

### Tasks

1. Purchase and sell energy or capacity.
2. Arrange interchange transactions.
3. Arrange for transmission service that is required by tariffs.
4. Request implementation of interchange transactions.



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

---

### **Relationships with Other Responsible Entities**

#### Ahead of Time

1. Arranges for transmission service from Transmission Service Providers and makes arrangements for reliability-related services with Generator Owners or Load-Serving Entities as applicable for interchange transactions.
2. Submits requests to Interchange Authorities to implement interchange Transactions.
3. Notifies Generator Operators and Load-Serving Entities if interchange Transaction requests are approved or denied.
4. Receives final approval or denial of interchange transaction from Interchange Authority.

#### Real Time

5. Notifies Interchange Authorities of Transaction cancellations or terminations.
6. Receives notice of interchange schedule curtailments from Interchange Authority.
7. Receives load profiles and forecasts from Load-Serving Entities.



# Function – Load-Serving

---

## Definition

Secures energy and transmission service (and reliability-related services) to serve the End-use Customer.

## Tasks

1. Collect individual load profiles.
2. Identify and provide capability for load curtailment.
3. Design and evaluation of under-frequency load shedding systems and under-voltage load shedding systems.
4. Identify facilities and provide capability of self-provided reliability-related services for its load.
5. Develop overall load profiles and forecasts of end-user energy requirements.
6. Acquire necessary transmission service, and reliability-related services.
7. Manage resource portfolios to meet demand and energy requirements of End-use Customers.



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

---

### **Relationships with Other Responsible Entities**

1. Submits load profiles, plans, and forecasts as needed to the Balancing Authorities, Purchasing-Selling Entities, Planning Coordinator, Resource Planners, and Transmission Planners.
2. Identifies new facility connection needs for End-use Customers.
3. Provides generation commitments and dispatch schedules to the Balancing Authority.
4. Provides information as to self-provided reliability-related services to the Balancing Authority.
5. Provides planned purchases to the Resource Planner and Transmission Planner for system modeling and reliability evaluation.
6. Arranges for transmission service via Transmission Service Providers.
7. Implements load shedding during emergency conditions and provides load-interruption capability as directed by the Balancing Authority, Transmission Operator, and Distribution Provider.
8. Coordinates with distribution provider on identifying new facility interconnection needs.
9. Informed by Purchasing-Selling Entity if interchange transaction requests approved or denied.