**RECOMMENDATION TO NAESB EXECUTIVE COMMITTEE**

**For Quadrant:** Wholesale Electric Quadrant (WEQ)
**Requesters:** NAESB Smart Grid Task Force (SGTF)
**Request No.:** 2010 WEQ Annual Plan Item 6(c)
**Request Title:** Requirements Specifications for Wholesale Standard DR Signals - for NIST PAP09

## 1. RECOMMENDED ACTION:

| | |
|---|---|
| X | Accept as requested |
| | Accept as modified below |
| | Decline |

## EFFECT OF EC VOTE TO ACCEPT RECOMMENDED ACTION:

| | |
|---|---|
| X | Change to Existing Practice |
| | Status Quo |

## 2. TYPE OF DEVELOPMENT/MAINTENANCE

| Per Request: | | Per Recommendation: | |
|---|---|---|---|
| X | Initiation | X | Initiation |
| | Modification | | Modification |
| | Interpretation | | Interpretation |
| | Withdrawal | | Withdrawal |
| X | Principle | X | Principle |
| X | Definition | X | Definition |
| X | Business Practice Standard | X | Business Practice Standard |
| | Document | | Document |
| | Data Element | | Data Element |
| | Code Value | | Code Value |
| | X12 Implementation Guide | | X12 Implementation Guide |
| | Business Process Documentation | | Business Process Documentation |

## 3. RECOMMENDATION

**SUMMARY:**

The business process flows and use cases presented in this document illustrate the standard interactions between a System Operator and various Market Participants for the administration and deployment of demand response resources in organized wholesale electric markets.

**RECOMMENDED STANDARDS:**

In response to NIST's Priority Action Plan 9, this document contains draft requirements specifications, in the form of business process flows and use cases, to support the standardization of the information exchanged during interactions between the System Operator and various Market Participants for the administration and deployment of demand response resources in organized wholesale electric markets. Common terminology from the NAESB Measurement and Verification Standards for Demand Response has been incorporated into the development of the business process flows and use cases. As a result of the development of this document, a standard set of actors and additional terminology will expand the existing NAESB documentation of associated terms and definitions for demand response.

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New WEQ-016 Abbreviations/Acronyms and Defined Terms to be added to WEQ-000 are included below for reference *(previously added in Recommendation 2010 WEQ Annual Plan Item 6(b) / 2010 Retail Annual Plan Item 9(b))*

## 000-1 ABBREVIATIONS AND ACRONYMS

| Abbreviation / Acronym | Meaning |
|---|---|
| DDE | Designated Dispatch Entity |
| EA | Environmental Authority |
| ED | End Device |
| FR | Federal Regulator |
| LA | Local Authority |
| LSE | Load Serving Entity |
| MA | Metering Authority |
| MP | Market Participant |
| RA | Reliability Authority |
| RM | Response Method |
| RMA | Response Method Aggregation |
| SE | Scheduling Entity |
| SO | System Operator |
| SP | Service Provider |
| SR | State Regulator |
| TDSP | Transmission/Distribution Service Provider |
| UC | Utility Customer |
| UDO | Utility Distribution Operator |

## 000-2 DEFINITION OF TERMS

| Term | Definition |
|---|---|
| Business Entity | The wholesale or retail entity that interacts with other entities in its market. |
| Communication Method | The method by which an object communicates with another object to instruct, measure or control. |
| Control | The role associated with the control of an End Device. |
| Demand Response Objects | Physical and logical types of demand response resource objects. |
| Designated Dispatch Entity | A role which carries the responsibility of receiving and processing demand resource dispatch instructions or market information and (optionally) providing response information. |
| End Device | A physical end-use device that consumes or supplies electricity. |
| Environmental Authority | A regulatory authority responsible for the development, reporting and enforcement of environmental activities. |
| Facility | The location at which connection to the transmission or distribution system is made. |
| Federal Regulator | A Federal regulatory authority. |
| Load Serving Entity | A role which carries the responsibility of serving end-users and selling electric energy to end-users. |
| Local Authority | A regulatory authority responsible for the oversight and administration of utility service-related functions within its jurisdiction. |
| Market Enrollment | The collection of enrollment or tariff data for a Demand Resource Object to provide a specific market product or service. |
| Market Participant | An organization registered with the System Operator that may take on roles such as SP, LSE, TDSP, DDE, SE, and/or MA in accordance with the System Operator's market rules. |

| Term | Definition |
|---|---|
| Measurement | The role associated with the device or algorithm that measures the consumption or supply of an End Device. |
| Metering Authority | A role which carries the responsibility of providing data necessary to determine the performance of a Resource. |
| P-Node | The price location of the Facility in the transmission and/or distribution network. |
| Participant | The entity that represents resources to a market or distribution operator. |
| Regulator | A rule-making and enforcement entity. |
| Reliability Authority | A regulatory authority responsible for the development, reporting and enforcement of electric reliability-related activities. |
| Response Method | A measurable action taken in response to an instruction to change consumption. |
| Response Method Aggregation | A logical entity that has a reportable interval level consumption, e.g. a site may also be a physical entity that may have its own meter, a neighborhood of homes that has a net meter, or an estimate of consumption of an aggregation of retail customers. |
| Resource | A market-dependent group of Response Method Aggregations that represents a dispatchable entity. |
| Scheduling Entity | A role which carries the responsibility of submitting bids/offers and receives Schedules and Awards. |
| Service Provider | A role which carries the responsibility of coordinating resources to deliver electricity products and services to a market or distribution operator. |
| State Regulator | A regulatory authority responsible for the oversight and administration of electric utilities. |
| Supporting Objects | Objects that support the interaction of Business Entities and Demand Response Objects. |

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**Request Title:** Requirements Specifications for Wholesale Standard DR Signals - for NIST PAP09

| Term | Definition |
|---|---|
| System Operator | An entity which carries the responsibility of administering the demand response process, from Resource enrollment to performance evaluation. |
| Transmission/Distribution Service Provider | A role which carries the responsibility of operating a local electricity transmission and/or distribution system. |
| Utility Customer | An end-use customer of the Utility Distribution Operator that takes on roles such as Facility or Resource. |
| Utility Distribution Operator | An entity which carries the responsibility of operating an electricity distribution system. |
| Zone | A physical or electrical region. |

## New Business Practice Standards WEQ-016 – Smart Grid Activities

## RECOMMENDED STANDARDS:

### Executive Summary

### Specifications for Wholesale Standard Demand Response Signals

The following addresses the business objectives and context for standardizing control and pricing signals for Demand Response (DR) and Distributed Energy Resources (DER)[1] as part of the Smart Grid implementation, which is called for by National Institute of Standards and Technology (NIST) Priority Action Plans (PAP) 09. The North America Energy Standards Board (NAESB) Smart Grid Task Force (SGTF) in cooperation with UCA International Users Group (UCAIug) Open Smart Grid (OpenSG) Task Force, the Independent System Operator/Regional Transmission Organization Council (ISO/RTO Council), and other organizations, have developed DR use cases that provide requirements for developing consistent DR control and pricing signal standards.

The business process flows and use cases contained in this Recommendation address the requirements for standardizing the information exchanged during interactions between the System Operator and various Market Participants for the administration and deployment of demand response resources in organized wholesale electric markets. Additional documents under

[1] DERs are small, modular, energy generation and storage technologies that provide electric capacity or energy where it is needed. DERs may be either connected to the local electric power grid (e.g., for voltage support) or isolated from the grid in stand-alone applications, such as part of a MicroGrid. Definition of DER provided by the Department of Energy, http://www1.eere.energy.gov/femp/pdfs/31570.pdf

development through the NAESB Smart Grid Task Force will focus on other aspects of the PAP 09 objectives. To maintain consistency throughout materials developed by the NAESB Smart Grid Task Force, a common set of actors, terms and definitions have been adopted.

The following describes the end-to-end business process flows relating to the wholesale market communications between the System Operator (SO) and the Service Provider (SP) common to all ISOs/RTOs that offer opportunities for demand resources to participate in organized wholesale electric markets.

## Introduction

## Specifications for Wholesale Standard Demand Response Signals

**Purpose**: To accelerate the development of standards for Smart Grid Interoperability, NIST is working with all stakeholders of Smart Grid and has developed a set of PAPs[2]. A number of PAPs (03, 04, and 09) are related to the use of Smart Grid technologies to enable DR and the integration of DER for DR purposes.

Specifically for PAP 09, NAESB, with support from UCAIug OpenSG task forces and the ISO/RTO Council, have responsibility to collect, analyze, and consolidate use cases and develop Unified Modeling Language (UML) based use case models for DR. Such responsibility now falls under the NAESB Smart Grid Task Force.

NIST Smart Grid Interoperability[3] Roadmap leverages the GridWise Architecture Council (GWAC) interoperability framework . This framework calls for the establishment of business objectives, procedures and context before technical interoperability standards can be established. To apply this framework to the development of interoperability standards for DR Signals, it is clear that the industry needs an overarching business framework to guide the development of technical standards, given the complexity and range of DR programs.

The purpose of the following is to provide standards developers with a context for understanding the range of scenarios to which DR programs and DERs may be applied and implemented across the various electricity systems and jurisdictions in the United States of America with some overlaps

[2] http://collaborate.nist.gov/twiki-sggrid/bin/view/_SmartGridInterimRoadmap/PriorityActionPlans

[3] Interoperability is the capability of two or more networks, systems, devices, applications, or components to share and readily use information securely and effectively with little or no inconvenience to the user. The characteristics of interoperability as set forth in the GridWise® Interoperability Context- Setting Framework are (1) exchange of meaningful, actionable information between two or more systems across organizational boundaries, (2) a shared understanding of the exchanged information, (3) an agreed expectation for the response to the information exchange, and (4) a requisite quality of service: reliability, fidelity, and security. The result of interoperability is that interfaces, systems, and devices are capable of being integrated, scalable, adaptable, and upgradable and utilize open standards to promote competitive technology and to avoid stranded investments. Interoperability can only be achieved if there is a seamless, end-to-end coordination and exchange of data between many organizations, interfaces, systems, and devices resulting in behavior changing information given to the consumer.

to Canada. A major objective in producing this document is to emphasize the importance of interoperability at all levels of the GWAC Interoperability Framework.

**Scope**: There are certain principles and boundaries that have been established. These include:

1. Demand Response practices must be consistent with NERC and applicable regional reliability authority requirements.
2. All involved entities are registered through the applicable ISO/RTO market participant registration process, which may include credit checks. However, the specifics related to the business processes associated with registration are not documented in these requirements.
3. Settlement input parameters are defined as an output to the Measurement & Performance business process. However, specific business processes associated with settlements are not documented in these requirements.
4. Intra-system operator information exchanges and specific system operators market rules, calculations, algorithms, and Performance Evaluation models are excluded.
5. Planning functions are not documented in these requirements. This includes, but is not limited to, long-term load forecasting and transmission planning.
6. Capacity auctions, awards processes, and resource certification are not documented in these requirements.

**Assumptions**: The following has been developed with the consideration of the following key assumptions:

- The scope of DER applications will be limited to the context of grid-connected DR use cases and does not include the other possible applications of DER.
- The standards shall not prescribe a specific implementation technology.
- Information Technology security is explicit in the information model but is implicit in the business process models.
- Outputs from one process flows are considered inputs to subsequent following flows.
- A single entity may have multiple roles (e.g., a participant can function in the roles of DDE and MA).
- The process flows describe the standard path. Subsequent use cases will address exceptions other than standard data validation procedures.

**Business Practice Standards**

**016-2 Specifications for Wholesale Standard Demand Response Signals**

The following describes the wholesale market business process flow and provides the necessary business context and reference architecture for use cases that connect to the retail level. The descriptions provide a common linkage to the retail use cases presented in the companion specification for the Retail Electricity Quadrant.

Conventions:

- Glossary terms are shown in bold + italics.
- Implementation does not require every communication flow shown in the process flows.

**016-2.1** ACTORS

The actors for the wholesale use cases are role-based, with the registered Market Participant business entity therefore taking on one or more roles. It is possible that a single Market Participant may take on all six Market Participant roles; six Market Participants take on one role each, or any combination in-between. Rules for how Market Participants qualify for various roles are specific to market rules and regional reliability requirements. The System Operator role is unique and must be taken by the System Operator business entity.

**Table 1 - Actor Roles**

| Term | Acronym | Definition |
|---|---|---|
| Service Provider | SP | A role which carries the responsibility of coordinating resources to deliver electricity products and services to a market or distribution operator. |
| Designated Dispatch Entity | DDE | A role which carries the responsibility of receiving and processing demand resource dispatch instructions or market information and (optionally) providing response information. |
| Load Serving Entity | LSE | A role which carries the responsibility of serving end-users and selling electric energy to end-users. |
| Metering Authority | MA | A role which carries the responsibility of providing data necessary to determine the performance of a ***Resource.*** |
| Scheduling Entity | SE | A role which carries the responsibility of submitting bids/offers and receives ***Schedules*** and ***Awards***. |
| System Operator | SO | An entity which carries the responsibility of administering the demand response process, from Resource enrollment to performance evaluation. |
| Transmission/Distribution Service Provider | TDSP | A role which carries the responsibility of operating a local electricity transmission and/or distribution system. |

**016-2.2** WHOLESALE ENTITY RELATIONSHIP MODEL

The Entity Relationship Diagram in Appendix A, **Error! Reference source not found.** shows the Business Entities and other objects used in the demand response use cases. The definitions of objects not used in use cases are included in this document's glossary. The lines among the elements illustrate the cardinality amount the entities and objects (see inset for cardinality key).

**016-2.3** USE CASE OVERVIEW

The use cases presented in this document represent a combination of three dimensions of demand response participation in wholesale markets: product, deployment, and performance evaluation method. As shown in the table below, product and deployment dimensions are identified by a single alphabetic character and performance evaluation methods are indicated by a numeric identifier; each character is separated by a dash (-). For example, use case E-R-1 refers to the use case for the Energy (Economic) product with a Resource-specific deployment and performance evaluated using a Baseline.

**Table 2 - Use Case Dimensions**

| **Product** | **-** |
|---|---|
| Energy (Economic) | E |
| Energy (Reliability) | R |
| Capacity | C |
| Reserve | V |
| Regulation | G |
| **Deployment** | **-** |
| Bulk | B |
| Resource | R |
| Self | S |
| **Performance Evaluation** | **-** |
| Baseline | 1 |
| MB/MA | 2 |
| MBL | 3 |
| MGO | 4 |

A sample of the use case list is shown in the table below. Appendix B contains the complete list of use case combinations.

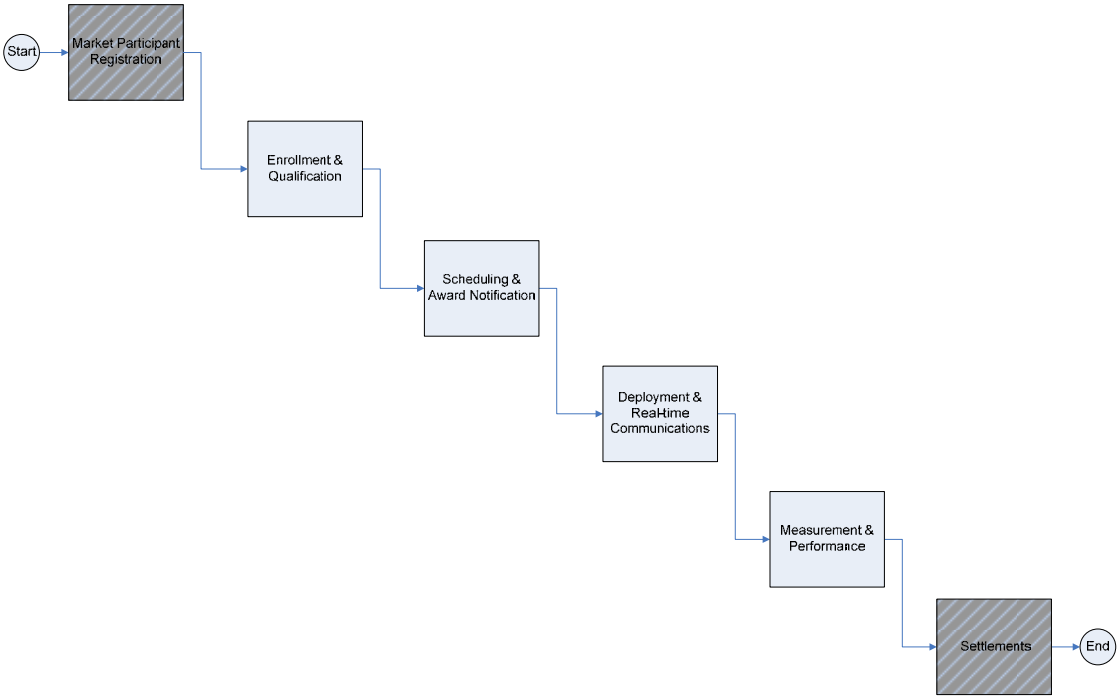
**Table 3 - Sample Use Case List**

| Use Case | Product | Deployment | Performance Evaluation |
|---|---|---|---|
| **E-R-1** | Energy (Economic) | Resource | Baseline |
| **E-R-2** | Energy (Economic) | Resource | MB/MA |
| **E-R-3** | Energy (Economic) | Resource | MBL |
| **E-R-4** | Energy (Economic) | Resource | MGO |
| **E-S-1** | Energy (Economic) | Self | Baseline |
| **E-S-2** | Energy (Economic) | Self | MB/MA |
| **E-S-3** | Energy (Economic) | Self | MBL |
| **E-S-4** | Energy (Economic) | Self | MGO |

The following illustrates the process flows for use cases combinations that are considered to be representative of the types of demand response in wholesale electricity markets today. Each process flow description includes a table of the use cases to which the process flow applies.

The wholesale Demand Response end-to-end business process flow for the communications between the System Operator (SO) and the Service Provider (SP) is comprised of four major functions: Enrollment & Qualification, Scheduling & Award Notification, Deployment & Real-Time Communications, and Measurement & Performance. Two additional processes, Market Participant Registration and Settlements, are shown in the high-level business process flow, but are considered outside the scope of what is required for the communications flow for demand response.

**Figure 1 - Demand Response**



**016-2.4** SPECIFIC USE CASES

## 016-2.4.1 Enrollment and Qualification

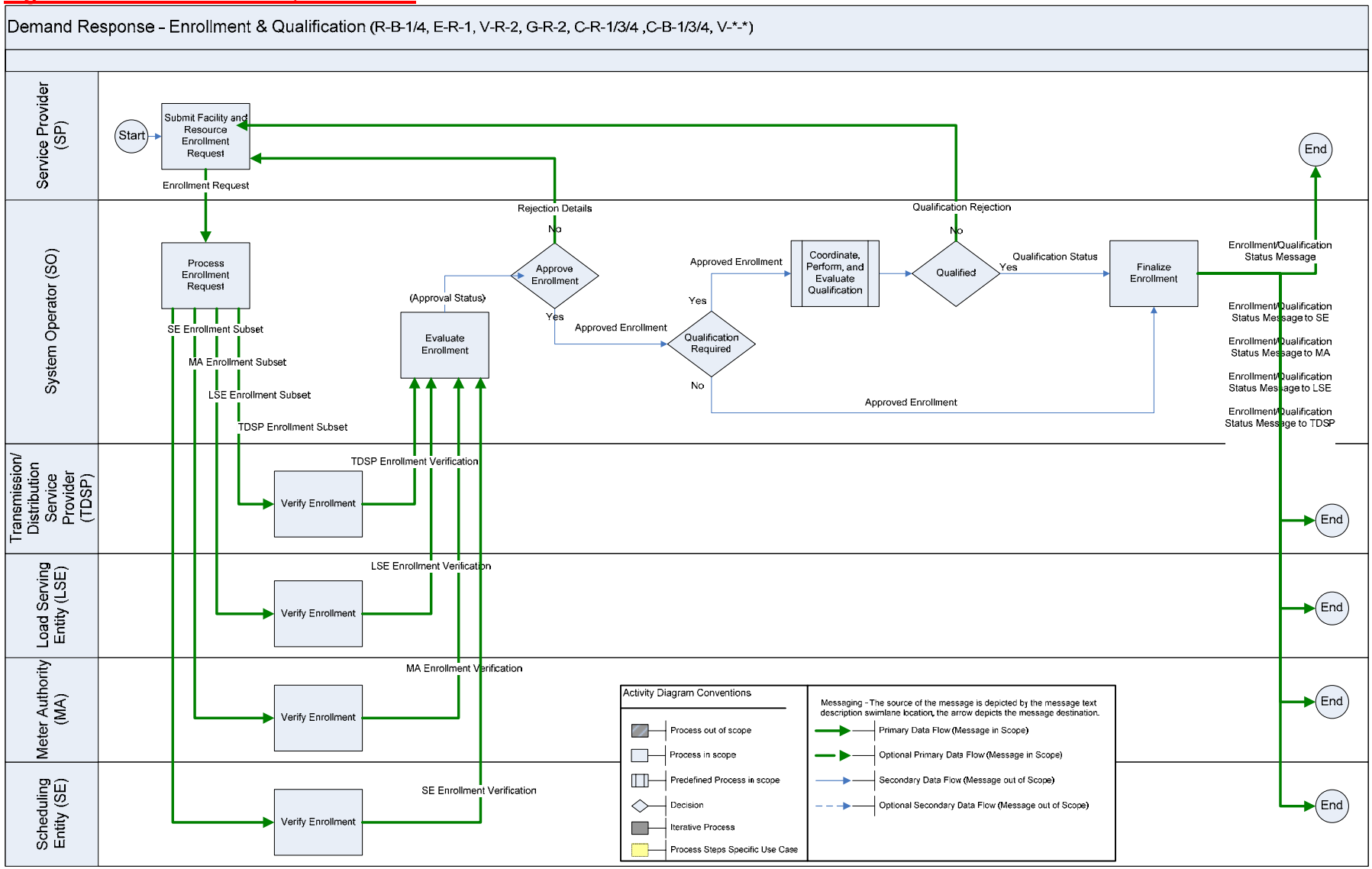
Overview: The Enrollment and Qualification process documents the steps required to enroll a ***Resource*** in a wholesale demand response program.

Use Cases: All valid Use Cases defined in this document

- The process begins when the ***SP*** submits an enrollment request to the ***SO***.
- The ***SO*** processes the enrollment request, which may include interactions with the ***TDSP***, ***LSE***, ***MA*** and/or ***SE***.
- The ***SO*** evaluates the enrollment request, which may include verification information from the ***TDSP***, ***LSE***, ***MA*** and/or ***SE***.
- The result of the evaluation is the approval or rejection of the enrollment request.
  - If the enrollment request has been rejected, the ***SO*** sends information to the ***SP***, indicating the rejection details.
  - If the enrollment request has been approved, a determination is made by the ***SO*** as to whether qualification of the ***resource***'s capability is required prior to final approval.
    - If no qualification is required, the ***SO*** sends information to the ***SP***, indicating the approval of the enrollment.
    - If qualification is required, the ***SO*** coordinates the qualification procedure with the ***SP***.
      - If the ***resource*** has failed to qualify, the ***SO*** sends information to the ***SP***, indicating the qualification rejection details.
      - If the ***resource*** achieves qualification, the ***SO*** sends information to the ***SP*** and enrollment is finalized.
- At the end of the Enrollment and Qualification process, the ***SO*** finalizes enrollment, notifies the ***SP*** and may also notify the ***TDSP***, ***LSE***, ***MA*** and/or ***SE***.

## Activity Diagram and Data Flow:

## Figure 2 - Enrollment and Qualification



## 016-2.4.2 Scheduling and Award Notification – Economic

Overview: The Scheduling and Award Notification process describes the process from offer submission to award notification. This process also includes the supplemental commitment and reassessment of reliability to determine whether demand resources that are enrolled in reliability-based (emergency) demand response programs should be advised of a possible reliability deployment.

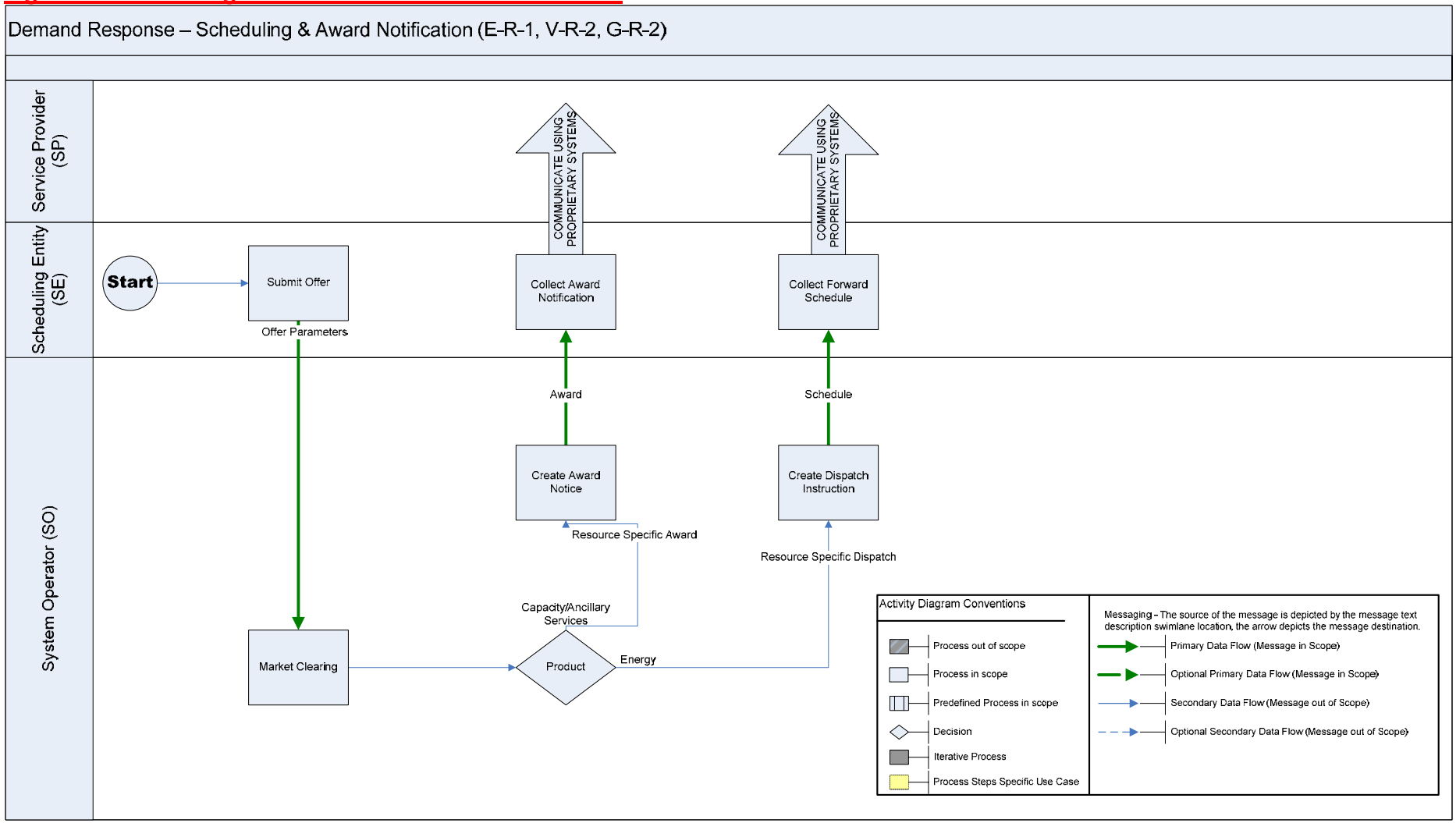
### Table 4 - Use Cases

| Use Case | Product | Deployment | Performance Evaluation |
|---|---|---|---|
| **C-R-1** | Capacity | Resource | Baseline |
| **C-R-2** | Capacity | Resource | MB/MA |
| **C-R-3** | Capacity | Resource | MBL |
| **C-R-4** | Capacity | Resource | MGO |
| **E-R-1** | Energy (Economic) | Resource | Baseline |
| **E-R-2** | Energy (Economic) | Resource | MB/MA |
| **E-R-3** | Energy (Economic) | Resource | MBL |
| **E-R-4** | Energy (Economic) | Resource | MGO |
| **G-R-1** | Regulation | Resource | Baseline |
| **G-R-2** | Regulation | Resource | MB/MA |
| **G-R-3** | Regulation | Resource | MBL |
| **G-R-4** | Regulation | Resource | MGO |
| **V-R-1** | Reserve | Resource | Baseline |
| **V-R-2** | Reserve | Resource | MB/MA |
| **V-R-3** | Reserve | Resource | MBL |
| **V-R-4** | Reserve | Resource | MGO |

- The process begins when the ***SE*** submits a supply offer to the ***SO***.
- The ***SO*** evaluates the offer through its market clearing process.
- The resulting resource-specific dispatch information is transformed into dispatch instructions by the ***SO***.
- The ***SO*** makes the schedule available.
- The ***SE*** collects the forward schedule.

## Activity Diagram and Data Flow:

## Figure 3 - Scheduling and Award Notification - Economic



## 016-2.4.3 Scheduling and Award Notification – Reliability

Overview: The Scheduling and Award Notification process describes the process from offer submission to award notification. This process also includes the supplemental commitment and reassessment of reliability to determine whether demand resources that are enrolled in reliability-based (emergency) demand response programs should be advised of a possible reliability deployment.

**Table 5 - Use Cases**

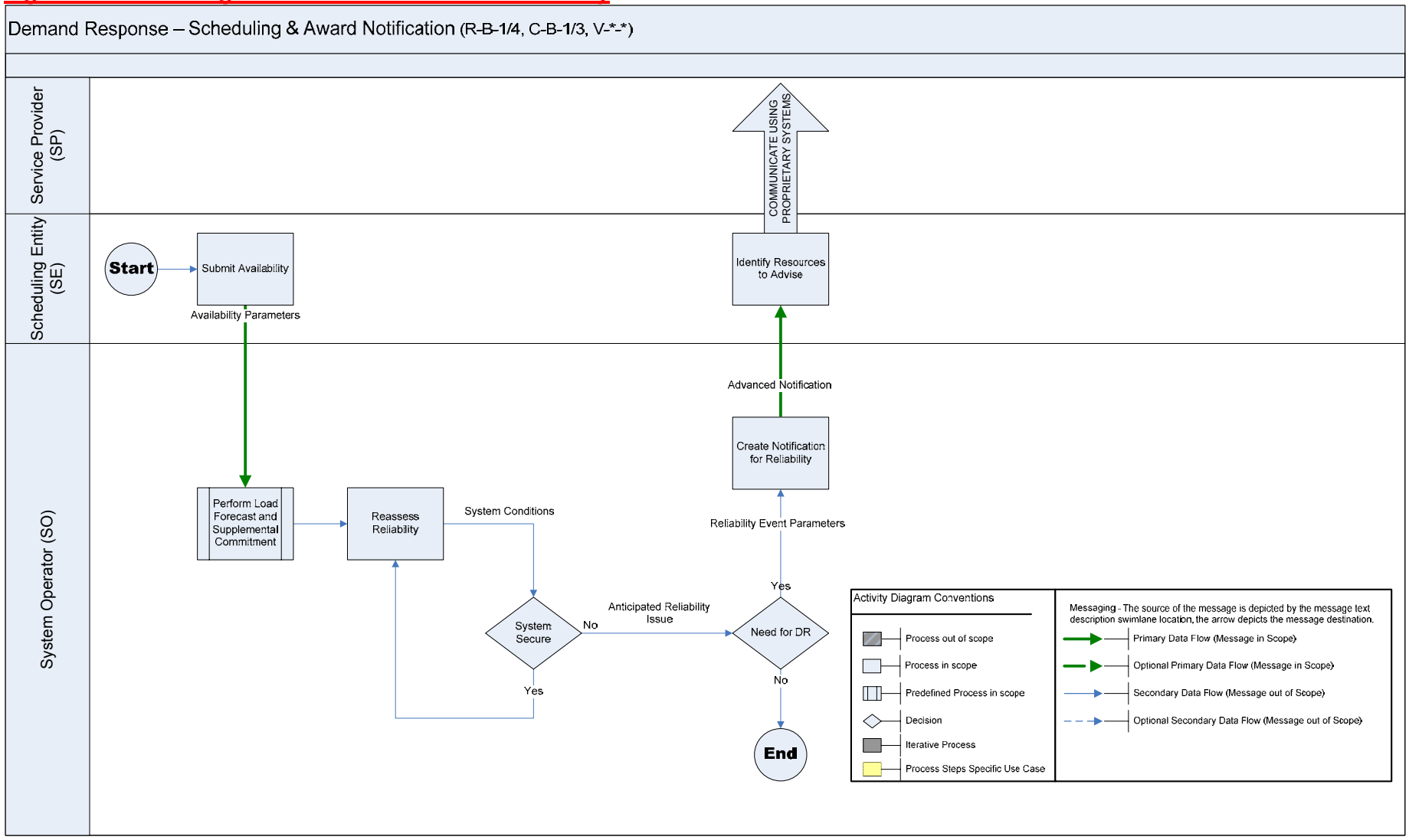
| Use Case | Product | Deployment | Performance Evaluation |
|---|---|---|---|
| **R-B-1** | Energy (Reliability) | Bulk | Baseline |
| **R-B-3** | Energy (Reliability) | Bulk | MBL |
| **R-B-2** | Energy (Reliability) | Bulk | MB/MA |
| **R-B-4** | Energy (Reliability) | Bulk | MGO |
| **C-B-1** | Capacity | Bulk | Baseline |
| **C-B-3** | Capacity | Bulk | MBL |
| **C-B-2** | Capacity | Bulk | MB/MA |
| **C-B-4** | Capacity | Bulk | MGO |
| **V-B-1** | Reserve | Bulk | Baseline |
| **V-B-3** | Reserve | Bulk | MBL |
| **V-B-2** | Reserve | Bulk | MB/MA |
| **V-B-4** | Reserve | Bulk | MGO |
| **V-R-1** | Reserve | Resource | Baseline |
| **V-R-3** | Reserve | Resource | MBL |
| **V-R-2** | Reserve | Resource | MB/MA |
| **V-R-4** | Reserve | Resource | MGO |

- The process begins when the ***SE*** submits availability to the ***SO***.
- The ***SO*** performs the Load Forecast and Supplemental Commitment process after the market has been settled. Reliability is reassessed by the ***SO*** to determine whether the system is secure (sufficient supply to meet forecasted load conditions).
  - If ***SO*** determines that the system is secure, no demand response advance notification is required and reliability is assessed by the ***SO*** at the next interval.
  - If ***SO*** anticipates that a reliability issue is expected, the ***SO*** decides whether demand response is needed for reliability.
    - If demand response will not be needed, the process ends.

- If the ***SO*** determines that demand response will be provided with an advance notification, the reliability event parameters are prepared by the ***SO*** to create a reliability event notification.
  - The advance notification message is sent to the ***SE***.
  - The ***SE*** identifies the demand resources to notify and relays the message to ***SP***s through the proprietary communication system of the ***SE***.

## Activity Diagram and Data Flow:

## Figure 4 - Scheduling and Award Notification - Reliability



## 016-2.4.4 Deployment and Real-Time Communications - Economic

Overview: The Deployment and Real-Time Communication process describes the process for real-time communications to demand resources providing market-based services on a real-time basis and dispatch for reliability-based (emergency) demand response programs. The process flows and descriptions below reflect a sequential nature to the real-time process solely for the purposes of describing the process of the real-time data flow; the real-time communication process simultaneously scans and updates in the same step.

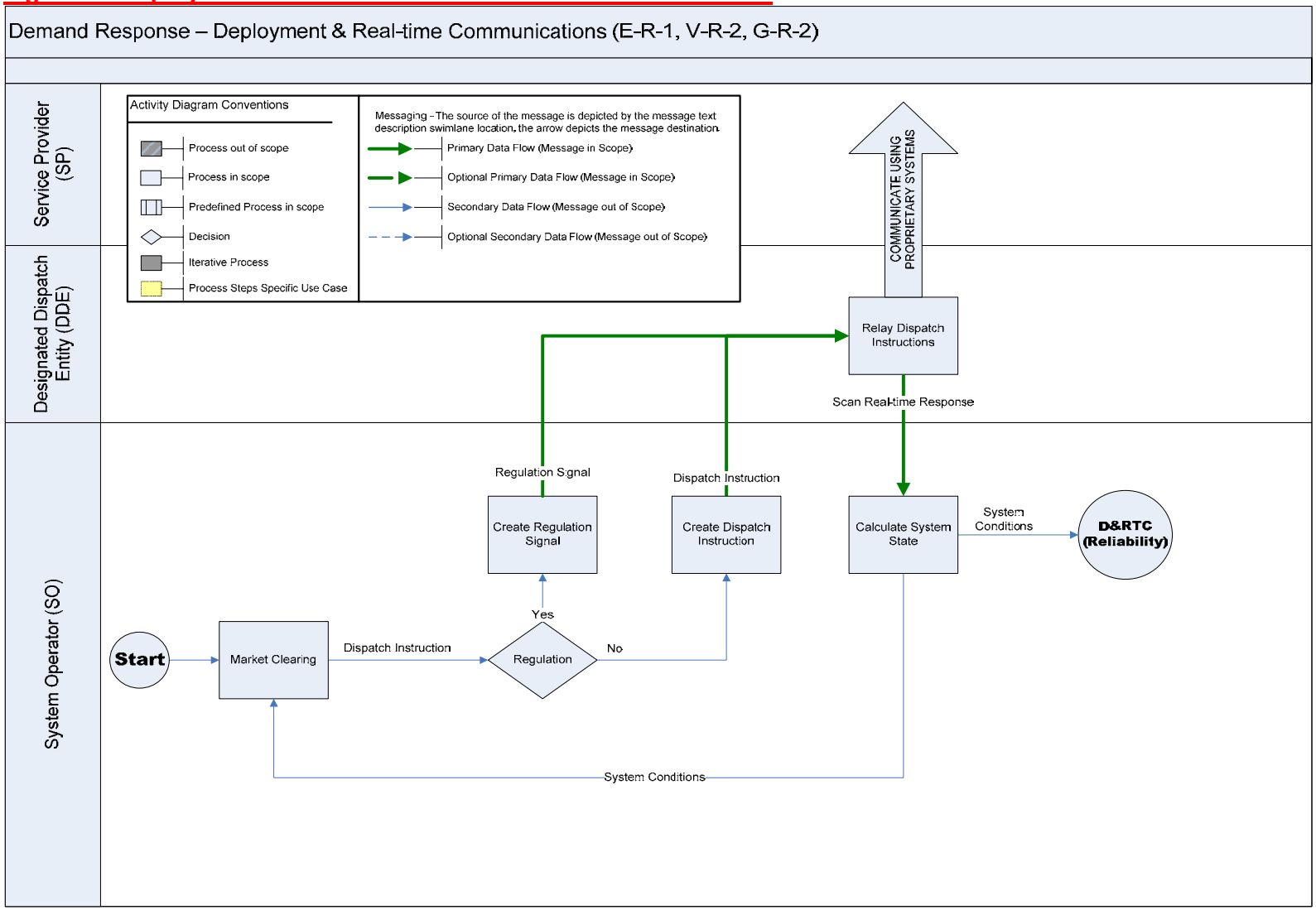
**Table 6 - Use Cases**

| Use Case | Product | Deployment | Performance Evaluation |
|---|---|---|---|
| **E-R-1** | Energy (Economic) | Resource | Baseline |
| **R-B-1** | Energy (Reliability) | Bulk | Baseline |
| **R-B-4** | Energy (Reliability) | Bulk | MGO |
| **V-R-2** | Reserve | Resource | MB/MA |
| **G-R-2** | Regulation | Resource | MB/MA |

- The process begins when the ***SO*** evaluates real-time system conditions through its market clearing process.
- The resulting resource-specific real-time dispatch information is transformed into dispatch instructions by the ***SO***.
  - If the dispatch instruction is for Regulation, the ***SO*** sends the Regulation signal to the ***DDE***.
  - If the dispatch is not for Regulation, the ***SO*** sends the dispatch instruction to the ***DDE***.
- The ***DDE*** communicates with the ***SP*** through the proprietary communication system of the ***DDE***.
- The ***SO*** collects real-time response from the ***DDE*** for evaluating the next interval and uses the information to calculate the system state.
- System conditions are made available to the market clearing process for the next interval and to **Deployment and Real-Time Communications – Reliability**.

## Activity Diagram and Data Flow:

## Figure 5 - Deployment and Real-Time Communications - Economic



## 016-2.4.5 Deployment and Real-Time Communications – Reliability

Overview: The Deployment and Real-Time Communication process describes the process for real-time communications to demand resources providing market-based services on a real-time basis and dispatch for reliability-based (emergency) demand response programs. The process flows and descriptions below reflect a sequential nature to the real-time process solely for the purposes of describing the process of the real-time data flow; the real-time communication process simultaneously scans and updates in the same step.

**Table 7 - Use Cases**

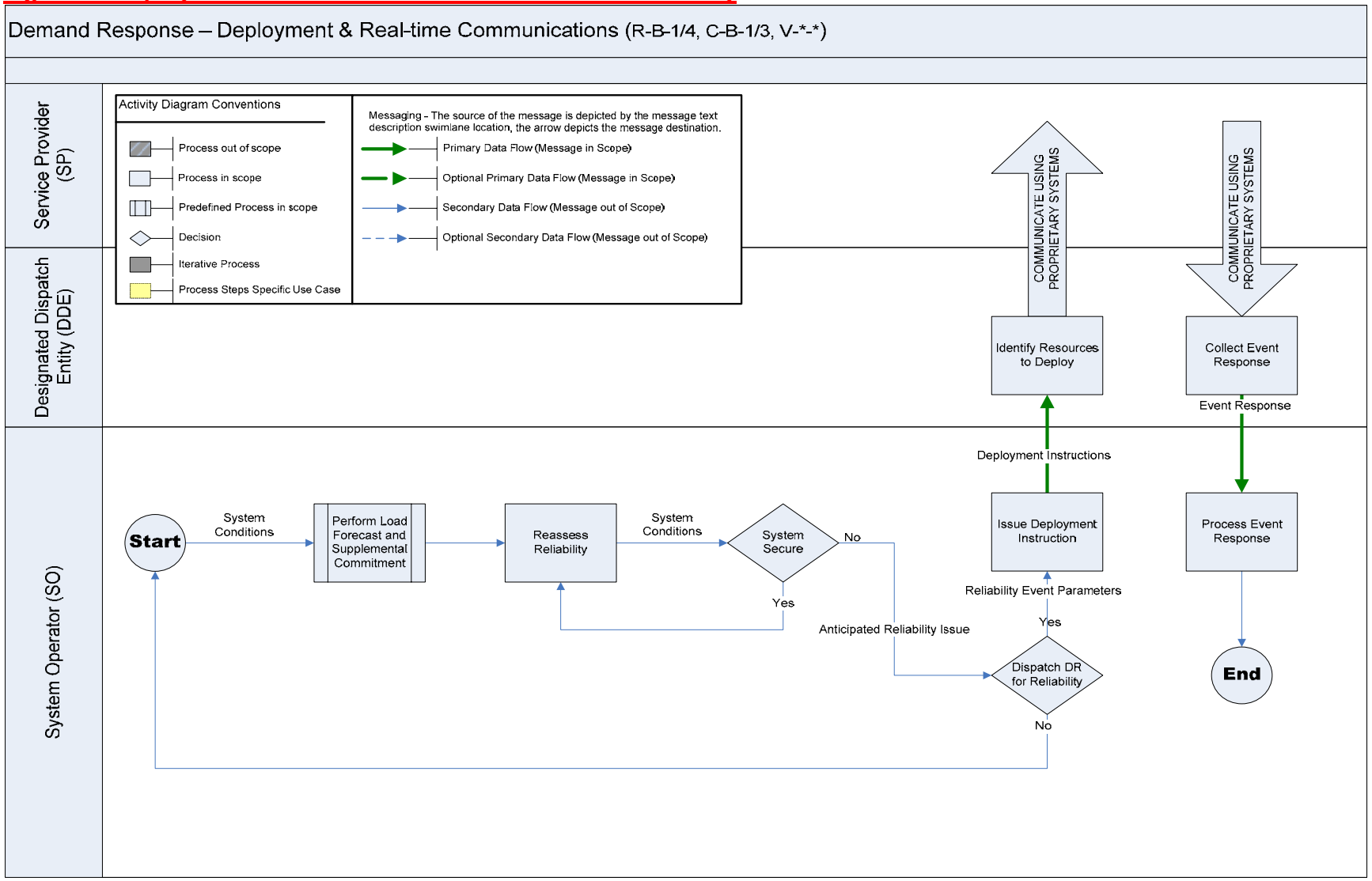
| Use Case | Product | Deployment | Performance Evaluation |
|---|---|---|---|
| **C-B-1** | Capacity | Bulk | Baseline |
| **C-B-3** | Capacity | Bulk | MBL |
| **E-B-1** | Energy (Economic) | Bulk | Baseline |
| **E-B-4** | Energy (Economic) | Bulk | MGO |
| **E-R-1** | Energy (Economic) | Resource | Baseline |
| **V-B-1** | Reserve | Bulk | Baseline |
| **V-B-2** | Reserve | Bulk | MB/MA |
| **V-B-3** | Reserve | Bulk | MBL |
| **V-B-4** | Reserve | Bulk | MGO |
| **V-R-1** | Reserve | Resource | Baseline |
| **V-R-2** | Reserve | Resource | MB/MA |
| **V-R-3** | Reserve | Resource | MBL |
| **V-R-4** | Reserve | Resource | MGO |
| **V-S-1** | Reserve | Self | Baseline |
| **V-S-2** | Reserve | Self | MB/MA |
| **V-S-3** | Reserve | Self | MBL |
| **V-S-4** | Reserve | Self | MGO |

- The ***SO*** performs the Load Forecast and Supplemental Commitment process after the interval has been dispatched. Reliability is reassessed by the ***SO*** to determine whether the system is secure (sufficient supply to meet forecasted load conditions).
  - If ***SO*** determines that the system is secure, no demand response deployment is required and reliability is assessed by the ***SO*** at the next interval.
  - If ***SO*** anticipates that a reliability issue is expected, the ***SO*** decides whether demand response is needed for reliability.

- If demand response will not be needed, the process ends.
- If the ***SO*** determines that demand response will be deployed, the reliability event parameters are prepared by the ***SO*** to create a reliability event notification.
  - The deployment instruction is sent to the ***DDE***.
  - The ***DDE*** identifies the demand resources to notify and relays the message to ***SP***s through the proprietary communication system of the ***DDE***.
- Real-time or near real-time response data is collected by ***DDE*** using the proprietary communication system of the ***DDE***.
- The ***DDE*** sends the event response information to the ***SO***.

## Activity Diagram and Data Flow:

## Figure 6 - Deployment and Real-Time Communications - Reliability



## 016-2.4.6 Measurement and Performance – Baseline

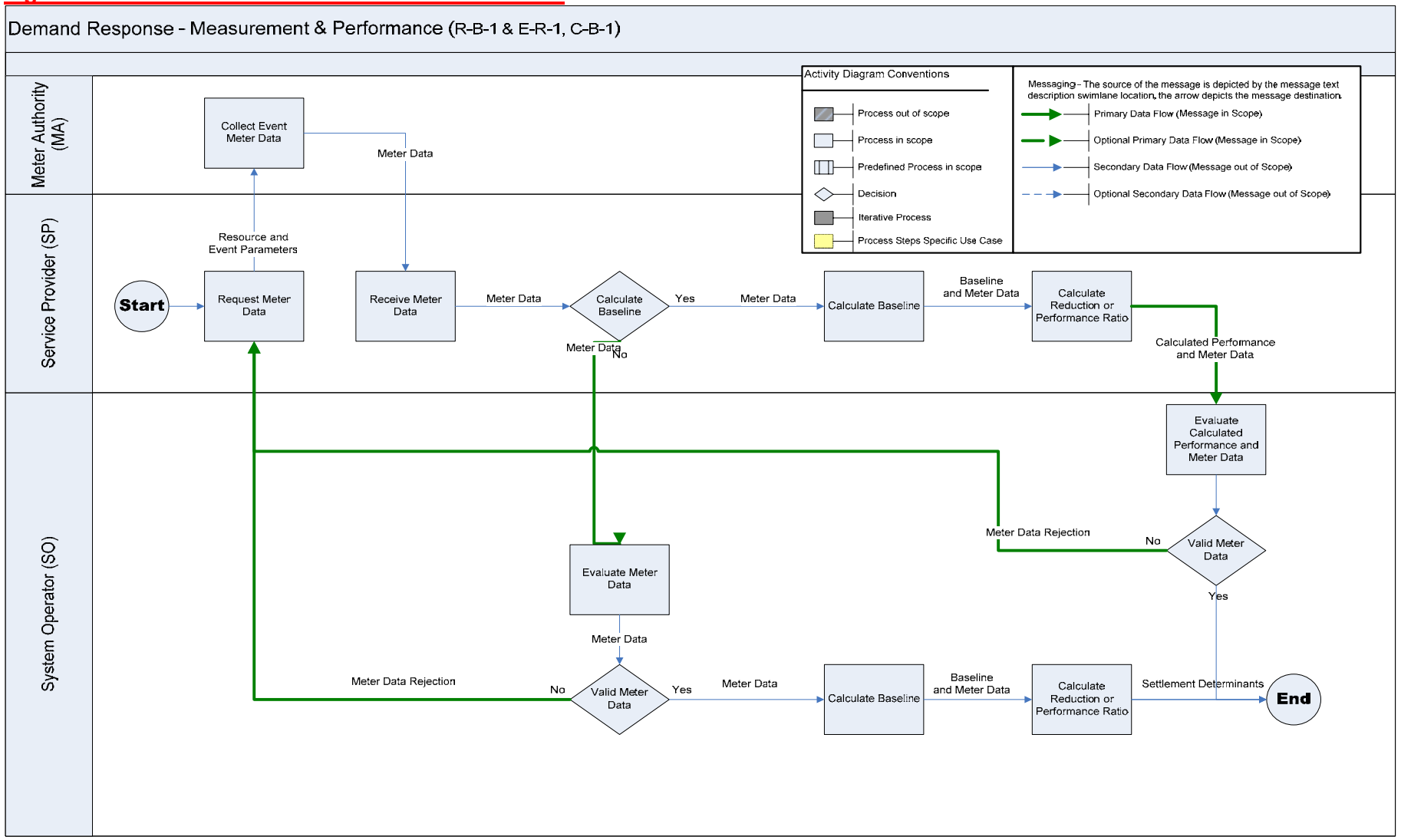
Overview: The Measurement and Performance process documents the steps to collect demand resource meter data and prepare the determinants for settlement.

Use Cases: All use cases where ***Baseline*** applies.

- The process begins when the ***SP*** requests event meter data from the ***MA***.
- The ***MA*** sends the event meter data to the ***SP***.
- If the **SP** is required to calculate the baseline, the **SP** uses the event meter data to calculate the baseline.
  - The ***SP*** uses the baseline and event meter data to calculate the event reduction amount or event performance ratio.
  - The ***SP*** sends the calculated event performance and meter data to the ***SO***.
  - The ***SO*** evaluates the calculated event performance and meter data.
    - If the calculated event performance data are complete, the ***SO*** uses the settlement determinants in the Settlements process.
    - If the calculated event performance data are incomplete, the ***SO*** sends an event data rejection to the ***SP***.
- If the ***SO*** calculates the baseline, the ***SP*** sends the event meter data to the ***SO***.
  - If the event meter data are complete, the ***SO*** uses the event meter data to calculate the baseline.
    - The ***SO*** uses the baseline and event meter data to calculate the event reduction amount or event performance ratio.
    - The ***SO*** uses the settlement determinants in the Settlements process.
  - If the event meter data are incomplete, the ***SO*** sends an event data rejection to the ***SP.***

## Activity Diagram and Data Flow:

## Figure 7 - Measurement and Performance – Baseline



## 016-2.4.7 Measurement and Performance - All Others

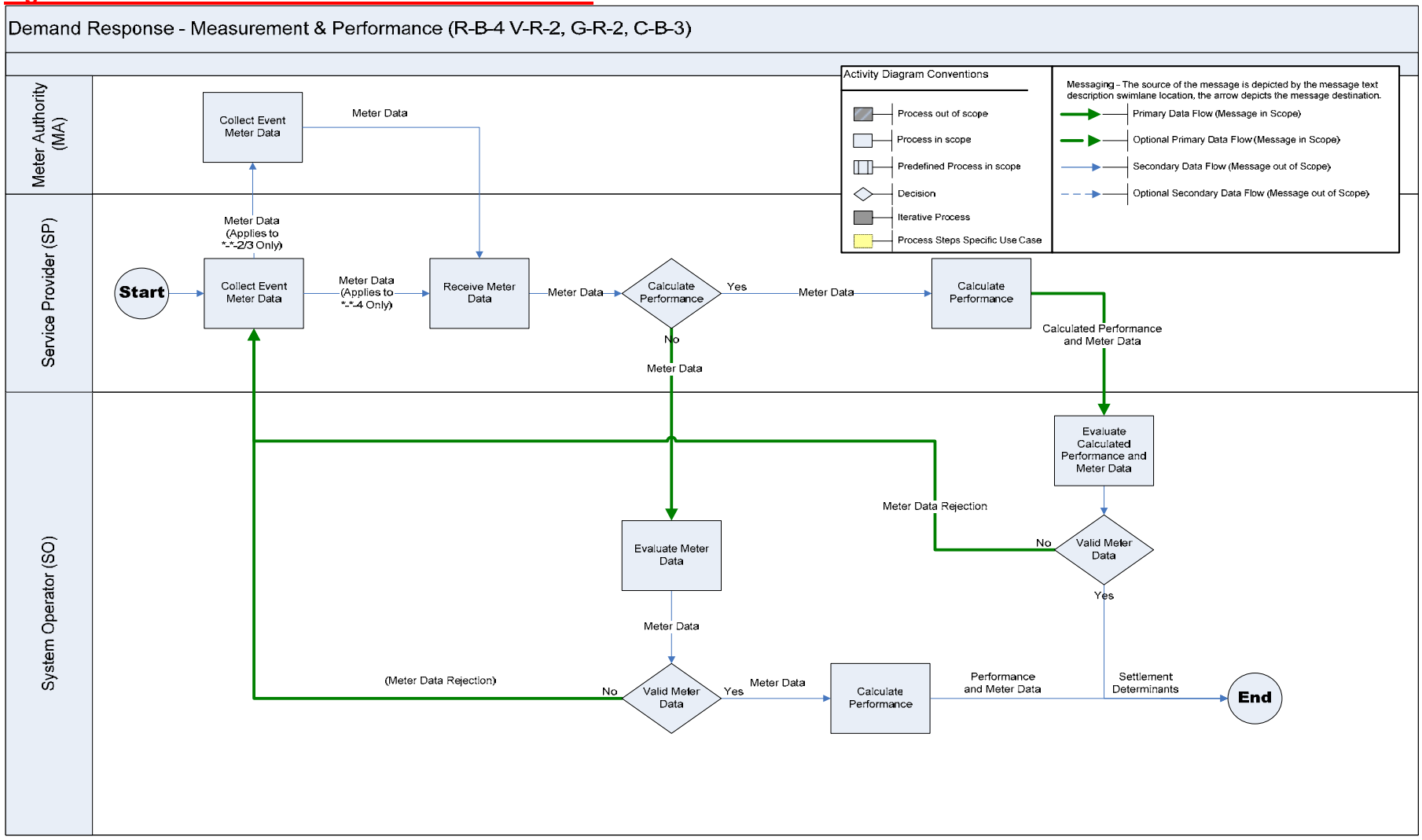
Overview: The Measurement and Performance process documents the steps to collect demand resource meter data and prepare the determinants for settlement.

Use Cases: All use cases where ***Meter Before/Meter After, Maximum Base Load,*** or ***Meter Generator Output*** applies.

- The process begins when the ***SP*** collects event meter data from the ***MA*** for the specified performance evaluation method.
  - If the performance evaluation method is ***Meter Before/Meter After*** or ***Maximum Base Load***, the ***MA*** sends the event meter data to the ***SP***.
  - If the performance evaluation method is ***Meter Generator Output***, the SP uses the data from the meter on the generator.
- If the **SP** is required to calculate performance, the **SP** uses the event meter data to calculate performance.
  - The ***SP*** uses the meter data to calculate the event reduction amount or event performance ratio.
  - The ***SP*** sends the calculated event performance and meter data to the ***SO***.
  - The ***SO*** evaluates the calculated event performance and meter data.
    - If the calculated event performance data are complete, the ***SO*** uses the settlement determinants in the Settlements process.
    - If the calculated event performance data are incomplete, the ***SO*** sends an event data rejection to the ***SP***.
- If the ***SO*** calculates performance, the ***SP*** sends the meter data to the ***SO***.
  - If the event meter data are complete, the ***SO*** uses the event meter data to calculate performance.
    - The ***SO*** uses the event meter data to calculate the event reduction amount or event performance ratio.
    - The ***SO*** uses the settlement determinants in the Settlements process.
  - If the event meter data are incomplete, the ***SO*** sends an event data rejection to the ***SP***.

## Activity Diagram and Data Flow:

## Figure 8 - Measurement and Performance – All Others



New WEQ-016 Appendix A is included below for reference *(previously added in recommendation 2010 WEQ Annual Plan Item 6(b) / 2010 Retail Annual Plan Item 9(b))*

## 016-A Appendix A – Entity-Relationship Model

The following terms and definitions correspond to a set of actor/object classes and sub-classes as illustrated in the entity-relationship model in Figure 1 of Appendix A. Abbreviations/Acronyms correspond to the IDs shown in the figure.

### ABBREVIATIONS AND ACRONYMS

| Abbreviation / Acronym | Meaning |
|---|---|
| EA | Environmental Authority |
| ED | End Device |
| FR | Federal Regulator |
| LA | Local Authority |
| LSE | Load Serving Entity |
| MA | Metering Authority |
| MP | Market Participant |
| RA | Reliability Authority |
| RM | Response Method |
| RMA | Response Method Aggregation |
| SE | Scheduling Entity |
| SO | System Operator |
| SP | Service Provider |
| SR | State Regulator |
| TDSP | Transmission/Distribution Service Provider |
| UC | Utility Customer |
| UDO | Utility Distribution Operator |

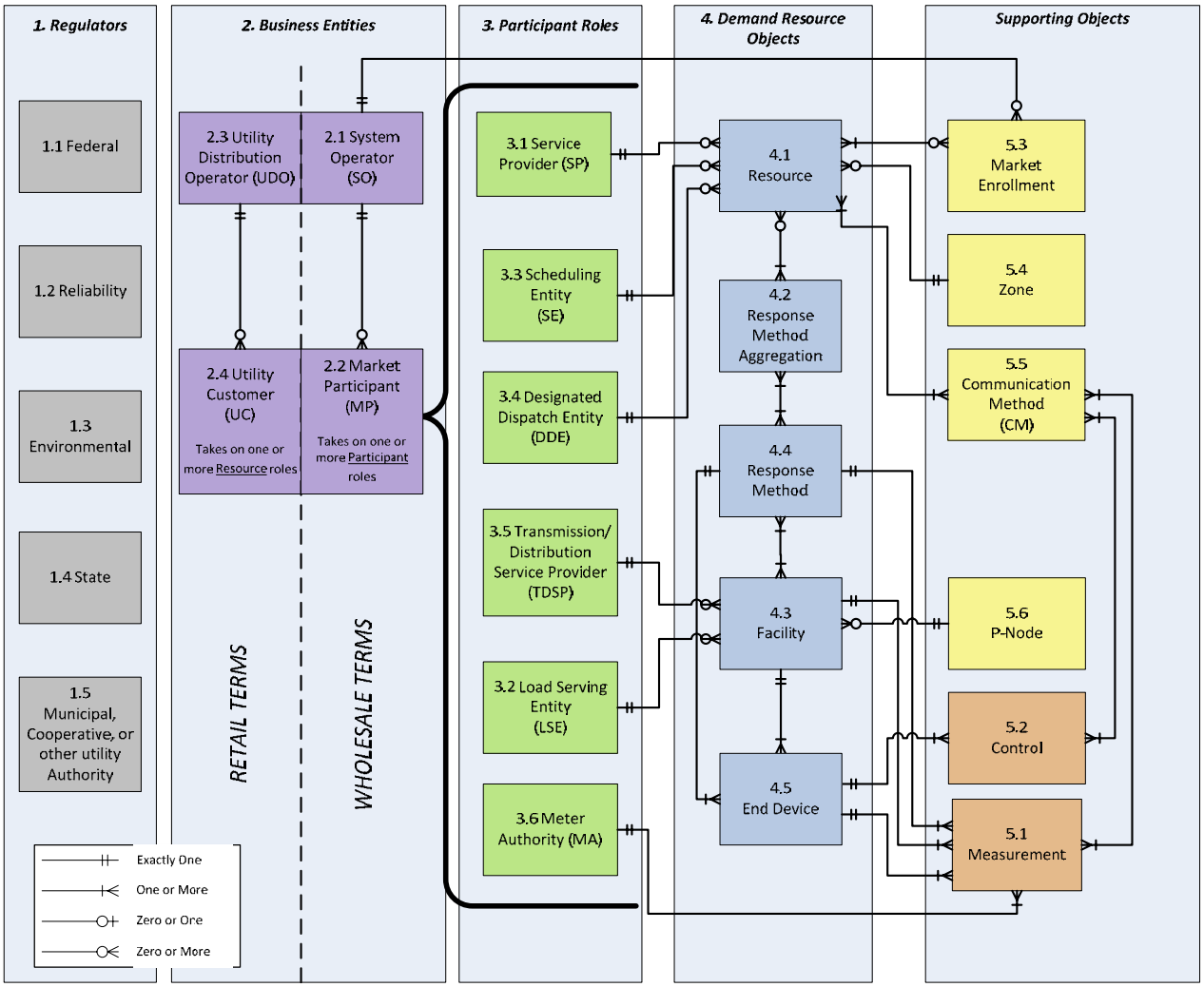
**DEFINITION OF TERMS**

| Term | Definition |
|---|---|
| Business Entity | The wholesale or retail entity that interacts with other entities in its market. |
| Communication Method | The method by which an object communicates with another object to instruct, measure or control. |
| Control | The role associated with the control of an End Device. |
| Demand Response Objects | Physical and logical types of demand response resource objects. |
| Designated Dispatch Entity | A role which carries the responsibility of receiving and processing demand resource dispatch instructions or market information and (optionally) providing response information. |
| End Device | A physical end-use device that consumes or supplies electricity. |
| Environmental Authority | A regulatory authority responsible for the development, reporting and enforcement of environmental activities. |
| Facility | The location at which connection to the transmission or distribution system is made. |
| Federal Regulator | A Federal regulatory authority. |
| Load Serving Entity | A role which carries the responsibility of serving end-users and selling electric energy to end-users. |
| Local Authority | A regulatory authority responsible for the oversight and administration of utility service-related functions within its jurisdiction. |
| Market Enrollment | The collection of enrollment or tariff data for a Demand Resource Object to provide a specific market product or service. |
| Market Participant | An organization registered with the System Operator that may take on roles such as SP, LSE, TDSP, DDE, SE, and/or MA in accordance with the System Operator's market rules. |

| Term | Definition |
|---|---|
| Measurement | The role associated with the device or algorithm that measures the consumption or supply of an End Device. |
| Metering Authority | A role which carries the responsibility of providing data necessary to determine the performance of a Resource. |
| P-Node | The price location of the Facility in the transmission and/or distribution network. |
| Participant | The entity that represents resources to a market or distribution operator. |
| Regulator | A rule-making and enforcement entity. |
| Reliability Authority | A regulatory authority responsible for the development, reporting and enforcement of electric reliability-related activities. |
| Response Method | A measurable action taken in response to an instruction to change consumption. |
| Response Method Aggregation | A logical entity that has a reportable interval level consumption, e.g. a site may also be a physical entity that may have its own meter, a neighborhood of homes that has a net meter, or an estimate of consumption of an aggregation of retail customers. |
| Resource | A market-dependent group of Response Method Aggregations that represents a dispatchable entity. |
| Scheduling Entity | A role which carries the responsibility of submitting bids/offers and receives Schedules and Awards. |
| Service Provider | A role which carries the responsibility of coordinating resources to deliver electricity products and services to a market or distribution operator. |
| State Regulator | A regulatory authority responsible for the oversight and administration of electric utilities. |
| Supporting Objects | Objects that support the interaction of Business Entities and Demand Response Objects. |
| System Operator | An entity which carries the responsibility of administering the demand response process, from Resource enrollment to performance evaluation. |

| Term | Definition |
|---|---|
| Transmission/Distribution Service Provider | A role which carries the responsibility of operating a local electricity transmission and/or distribution system. |
| Utility Customer | An end-use customer of the Utility Distribution Operator that takes on roles such as Facility or Resource. |
| Utility Distribution Operator | An entity which carries the responsibility of operating an electricity distribution system. |
| Zone | A physical or electrical region. |

**Figure 1. Entity-Relationship Model for Smart Grid Use Cases**



016-B

# Appendix B – Use Case Combinations

| Use Case | Product | Deployment | Performance Evaluation |
|---|---|---|---|
| **E-B-1** | Energy (Economic) | Bulk | Baseline |
| **E-B-2** | Energy (Economic) | Bulk | MB/MA |
| **E-B-3** | Energy (Economic) | Bulk | MBL |
| **E-B-4** | Energy (Economic) | Bulk | MGO |
| **E-R-1** | Energy (Economic) | Resource | Baseline |
| **E-R-2** | Energy (Economic) | Resource | MB/MA |
| **E-R-3** | Energy (Economic) | Resource | MBL |
| **E-R-4** | Energy (Economic) | Resource | MGO |
| **E-S-1** | Energy (Economic) | Self | Baseline |
| **E-S-2** | Energy (Economic) | Self | MB/MA |
| **E-S-3** | Energy (Economic) | Self | MBL |
| **E-S-4** | Energy (Economic) | Self | MGO |
| **R-B-1** | Energy (Reliability) | Bulk | Baseline |
| **R-B-2** | Energy (Reliability) | Bulk | MB/MA |
| **R-B-3** | Energy (Reliability) | Bulk | MBL |
| **R-B-4** | Energy (Reliability) | Bulk | MGO |
| **R-R-1** | Energy (Reliability) | Resource | Baseline |
| **R-R-2** | Energy (Reliability) | Resource | MB/MA |
| **R-R-3** | Energy (Reliability) | Resource | MBL |
| **R-R-4** | Energy (Reliability) | Resource | MGO |
| **R-S-1** | Energy (Reliability) | Self | Baseline |
| **R-S-2** | Energy (Reliability) | Self | MB/MA |
| **R-S-3** | Energy (Reliability) | Self | MBL |
| **R-S-4** | Energy (Reliability) | Self | MGO |

| Use Case | Product | Deployment | Performance Evaluation |
|---|---|---|---|
| **C-B-1** | Capacity | Bulk | Baseline |
| **C-B-2** | Capacity | Bulk | MB/MA |
| **C-B-3** | Capacity | Bulk | MBL |
| **C-B-4** | Capacity | Bulk | MGO |
| **C-R-1** | Capacity | Resource | Baseline |
| **C-R-2** | Capacity | Resource | MB/MA |
| **C-R-3** | Capacity | Resource | MBL |
| **C-R-4** | Capacity | Resource | MGO |
| **C-S-1** | Capacity | Self | Baseline |
| **C-S-2** | Capacity | Self | MB/MA |
| **C-S-3** | Capacity | Self | MBL |
| **C-S-4** | Capacity | Self | MGO |
| **G-B-1** | Regulation | Bulk | Baseline |
| **G-B-2** | Regulation | Bulk | MB/MA |
| **G-B-3** | Regulation | Bulk | MBL |
| **G-B-4** | Regulation | Bulk | MGO |
| **G-R-1** | Regulation | Resource | Baseline |
| **G-R-2** | Regulation | Resource | MB/MA |
| **G-R-3** | Regulation | Resource | MBL |
| **G-R-4** | Regulation | Resource | MGO |
| **G-S-1** | Regulation | Self | Baseline |
| **G-S-2** | Regulation | Self | MB/MA |
| **G-S-3** | Regulation | Self | MBL |
| **G-S-4** | Regulation | Self | MGO |
| **V-B-1** | Reserve | Bulk | Baseline |
| **V-B-2** | Reserve | Bulk | MB/MA |
| **V-B-3** | Reserve | Bulk | MBL |
| **V-B-4** | Reserve | Bulk | MGO |
| **V-R-1** | Reserve | Resource | Baseline |
| **V-R-2** | Reserve | Resource | MB/MA |
| **V-R-3** | Reserve | Resource | MBL |
| **V-R-4** | Reserve | Resource | MGO |
| **V-S-1** | Reserve | Self | Baseline |
| **V-S-2** | Reserve | Self | MB/MA |
| **V-S-3** | Reserve | Self | MBL |
| **V-S-4** | Reserve | Self | MGO |

## 4. Supporting Documentation

### a. Description of Request:

On September 30, 2009, the National Institute of Standards and Technology officially assigned NAESB the responsibility to develop Requirements and Use Cases pertinent to Priority Action Plan items 3, 4 and 9. A complete description of each item is available on the NIST Web site located at http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/WebHome in the section titled Priority Action Plans (PAPs).

This recommendation specifically pertains to PAP 09[4], "Standard DR Signals".

### b. Description of Recommendation:

See Section 3 Summary

### c. Business Purpose:

This recommendation has been developed in response to a request from NIST to provide use cases and requirements germane to the use of dates/times within a broad spectrum of energy transactions. The scope of this effort has been limited to Demand Response Programs in order to meet NIST's deadline for this effort.

### d. Commentary/Rationale of Subcommittee(s)/Task Force(s):

Joint Smart Grid Standards Task Force and Fix Protocol Meeting Notes/Documents:

- September 17, 2009 Meeting Notes – To be posted
- October 1, 2009 Meeting Notes – To be posted
- October 15, 2009 Meeting Notes – To be posted

NAESB Smart Grid Standards Task Force Sub-Group Meeting Notes/Documents:

- October 13, 2009 Meeting Notes – To be posted
- October 20, 2009 Meeting Notes – To be posted
- October 27, 2009 Meeting Notes – To be posted
- November 3, 2009 Meeting Notes – To be posted
- November 4-6, 2009 Meeting Notes – To be posted
- November 10, 2009 Meeting Notes – To be posted

NAESB Smart Grid Standards Task Force Meeting Notes/Documents:

- October 22, 2009 Meeting Notes – http://naesb.org/pdf4/smart_grid_ssd102209notes.doc
- October 29, 2009 Meeting Notes – To be posted
- November 5, 2009 Meeting Notes – To be posted
- November 13, 2009 Meeting Notes – To be posted

[4] http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/PAP09Schedules

- December 3, 2009 Meeting Notes – To be posted
- December 10, 2009 Meeting Notes – http://naesb.org/pdf4/smart_grid_ssd121009notes.doc
- December 17, 2009 Meeting Notes – http://naesb.org/pdf4/smart_grid_ssd121709notes.doc
- January 7, 2010 Meeting Notes – To be posted
- January 14, 2010 Meeting Notes – To be posted
- January 21, 2010 Meeting Notes – To be posted
- January 28, 2010 Meeting Notes – To be posted
- February 5, 2010 Meeting Notes – To be posted