Overview of ISO/RTO Demand Response Programs
Farrokh Rahimi, Ph.D. (farrokh.rahimi@oati.net)
Vice President; Market Design and Consulting

Panel Session on Demand Response under Smart Grid
PSCE, Seattle, March 17, 2009
Trade Secret
This document and attachments contain confidential and proprietary information of Open Access Technology International, Inc. This information is not to be used, disseminated, distributed, or otherwise transferred without the expressed written permission of Open Access Technology International, Inc.

Proprietary Notice
All OATI products and services listed are trademarks and service marks of Open Access Technology International, Inc. All rights reserved.
Panel Session on Demand Response in ISO/RTO Markets under Smart Grid

• Topics:
  - Overview of Demand Response at different ISO/RTOs
  - Integrating Demand Response into Wholesale Electricity Markets
  - Effective Business Models for Demand Response under the Smart Grid paradigm
  - PG&E’s Perspective on Demand Response under Smart Grid
  - Smart Grid of the Future with Large Scale DR/DER Penetration
Changing Industry: New Emerging Business Environment

- Renewable Resources
- Aging Infrastructure
- Conservation & Demand Response
- Asset Management
- Greenhouse Gases
- Timely Information
- Operational Efficiency
- Customer Satisfaction
- Supply Economics

Smart Grid

Operational Excellence

System Reliability

The Environment
The Environment

- Three Key Elements of Environmental Compliance

  - Increased Use of Renewable Resources
  - Reduction in Greenhouse Gases
  - Conservation and Demand Response

- They Impact Both Market and Power System Operations
Demand Response
FERC Order 719 - Oct 17 2008 Ruling Summary

- Rule aimed to strengthen competition in organized wholesale electric markets
- Seeks to Improve wholesale markets by establishing a more forceful role for Demand Response (DR)
- Directs RTO/ISOs to:
  - Accept bids/offers from DR resources for Ancillary Services (A/S) comparable to any other A/S capable resources
  - Allow DR units to specify limits on frequency, duration, and the amount of their service in bids/offers to provide A/S
  - Eliminate, during system emergencies, charges to buyers for taking less electric energy than scheduled (current rule in some markets)
  - Permit aggregators to bid DR on behalf of retail customers directly into the market
  - Study and report on reforms needed to eliminate barriers to DR in energy markets
  - Assess, through pilot projects, the technical feasibility and value to the market of using A/S from small DR units
Demand Response Classification

- Attributes of Demand Response Programs:
  - **Geographic Granularity:**
    - Retail
      - Commercial & Industrial Customers
      - Small Consumers
    - Wholesale:
      - Node/Aggregated Node
      - Local Reliability Area
      - Demand Zones (Service Areas)
  - **Trigger:**
    - Market-based: Demand adjustment in response to market signals
    - Reliability-based: Demand curtailment in the face of supply shortage or contingencies
  - **Dispatchability:**
    - Bidirectional response (demand reduction and increase)
    - Unidirectional response (demand reduction)
Demand Response Classification (Continued)

- Possible DR-based ISO/RTO Market Products:
  - Capacity:
    - ICAP
    - Unit Commitment
  - Energy:
    - Day-Ahead
    - Real-time
  - Ancillary Services (Market-based DR with required Real-time Telemetry and Control):
    - Contingency Reserves (Spinning Reserve; Supplemental/Non-Spinning Reserve)
    - Regulating Reserve
NYISO Demand Response Programs

- **Existing Programs:**
  - *Emergency Demand Response Program (EDRP)*
    - Voluntary load reduction during emergency conditions (Reliability-based)
    - Mostly large commercial and industrial consumers
    - Underlying Market Product: Real-time Energy
    - Compensated by NYISO when asked to curtail, and verified to have performed (higher of $500/MWh or the zonal real-time LBMP)
  - *ICAP Special Case Resources (SCR)*
    - Load reduction during emergency conditions (Reliability-based)
    - Mostly large commercial and industrial consumers
    - Underlying Market Product: ICAP
    - Compensated as ICAP for agreeing to curtail
    - Must perform when asked
  - *Day-Ahead Demand Response Programs (DADRP)*
    - Load reduction bid into Day-head market as “Negawatts”
    - Paid day-ahead Energy clearing price if cleared
    - Underlying Market Product: Day-Ahead Energy

- **New:** Demand-Side Ancillary Service Program (DSASP)
PJM Demand Response Programs

- **DR Products**: Energy, Capacity, Synchronized Reserve, Regulation
- **DR Participation in Energy Markets:**
  - *Economic Load Response*:
    - Providers: Agent PJM members, Curtailment Service Providers (CSPs)
    - Trigger: Curtail consumption when LMP > $75/MWh
    - *Energy dispatched out of DR sold as Capacity or Ancillary Services (paid Real-time LMP)*
- **DR Participation in Capacity Market:**
  - Providers: LSEs and CSPs
  - *Capacity Credit for MW of Load Response*
PJM Demand Response Programs (Continued)

• DR Participation in Synchronized Reserve Market:
  - *DR must be able to provide metering data at no less than 1 minute scan rate*
  - *DR participation in Synchronized Reserve market is limited to 25% of the Synchronized Reserve requirement in each zone*
  - *Mandatory training requirements for CSPs bidding DR in Synchronized Reserve market*

• DR Participation in Regulation Market:
  - *DR bidding Regulation must meet all real-time telemetry requirements like a generator*
  - *DR participation in Regulation market is limited to 25% of the Regulation requirement*
  - *Mandatory training requirements for CSPs bidding DR in the Regulation market*
ISO-NE Demand Response Programs

• Real-time Demand Response (RDR) Programs:
  - Mandatory Energy Reduction
  - Trigger: Extreme Emergency Operating Conditions (Operating Procedure #4)
  - Minimum Reduction: 100 kW
  - Sub-programs based on Notification Time:
    • 30-minute DR Program
    • 2-hour DR Program
  - Compensation:
    • Max. of Real-time Load Zone LMP or $500/MWh
    • Capacity Credit

• Real-time Price Response (RPR) Programs:
  - Voluntary Energy Reduction
  - Compensation: Greater of Real-time Zonal LMP or $100/MWh (no Capacity Credit)
ISO-NE Demand Response Programs (Continued)

- **Day-Ahead Load Response Program:**
  - Optional Program available to resources participating in RDR and RPR programs
  - Minimum Reduction: 100 kW
  - Bid Price: Min. ($50/MWh); Max ($1,000/MWh)
  - Cleared as part of Day-Ahead Market
  - Compensation: Greater of Day-ahead Zonal Price or Bid Price (no Capacity Credit)

- **DR Eligible to Participate in the Forward Capacity Market:**
  - Real-time DR Programs (**RDR**)
  - Energy Efficiency Programs
  - Load Management Programs
  - Distributed Generation Programs
Midwest ISO Demand Response Programs

- **DR under ASM Market:**
  - Demand Response Resource Type I (DRR Type I)
  - Demand Response Resource Type II (DRR Type II)

- **Demand Response Resource Type I (DDR Type I):**
  - Physical interruptible load under Midwest ISO command
  - May supply Energy or Contingency Reserve, but not Regulation
  - Can be committed (ON or OFF) but not dispatched
  - Can be committed for Energy or cleared for Contingency Reserve, but not both at the same time
  - Cannot set Energy LMP, but can set Ancillary Service MCP.
  - Can offer Targeted Demand Reduction (MW), shut down cost ($), and hourly curtailment cost ($/hr), but no Energy ($/MWh) curve; can also offer Contingency Reserve ($/MW/hr)
  - Eligible for RSG / make-whole payment subject to performance
  - Can offer in Day-ahead, RAC and Real-time markets

- **Demand Response Resource Type II (DRR Type II):**
  - Behind the meter generation or controllable load under Midwest ISO command to supply Energy, Contingency Reserve, or Regulation
  - Committable and dispatchable, like a generator
SPP Demand Response Programs

• **Current (EIS) Market Enhancements Under Consideration:**
  - *Variable Dispatch Demand Response (VDDR):*
    • Offered and deployed like a generator (5 minute dispatch)
    • Requires real-time telemetry like a generator
    • Paid higher of LIP or Offer Price
  - *Block Dispatch Demand Response (BDDR):*
    • Fixed MW blocks at a price
    • Hourly Dispatch
    • After-the-fact interval metering required
  - **Geographical Granularity:** Each DR resource must be completely within an existing Load Settlement Point

• **Future Markets:**
  - *DR able to participate in Day-Ahead, Reliability Unit Commitment, and Ancillary Services markets*
  - *No Capacity Market planned at this time*
ERCOT Demand Response Programs

- Voluntary Load Response:
  - Self directed
  - Decision to reduce consumption from scheduled or anticipated load in response to prices

- Qualified Balancing Energy Up Load (BUL):
  - Directed by ERCOT
  - Services Provided:
    - Up-Balancing Energy Service
    - Down-Balancing Energy Service
  - Compensation:
    - Market-Clearing Price for Ancillary Service (MCPC)
    - Market-Clearing price for Energy (MCPE) if dispatched

- Load acting as a Resource” (LaaR):
  - Similar telemetry and dispatchability requirements as a generator
  - Services Provided:
    - Responsive Reserve Service
    - Non-Spinning Reserve Service
    - Replacement Reserve Service
  - Compensation:
    - Market-Clearing Price for Ancillary Service (MCPC)
    - Market-Clearing price for Energy (MCPE) if dispatched
CAISO Demand Response Programs

• Types of Demand Response Programs in MRTU Release 1:
  - *Emergency Demand Response*:
    • Reliability-based
    • Geographical Granularity: Load Aggregation Point (LAP)
    • Triggered by LSEs based on out-of-market conditions
    • Announced to CAISO before close of the Day-Ahead market
    • CAISO reduces RUC procurement target accordingly
    • May not provide Ancillary Services
    • Will not bid in to be curtailed in the Real-Time Market
  - *Participating Load DR*:
    • Modeled as a pair of resources (Custom Load; Pseudo Generator)
    • Market-based
    • Must execute Participating Load Agreement with CAISO
    • Must respond to CAISO dispatch instructions
    • Types:
      - *Pumping Load associated with Pump Storage*
      - *Single Pumping or Non-pumping Load*
      - *Aggregated Pumping and Non-pumping Load*
    • Geographical Granularity: Custom Load Aggregation Point (CLAP)
    • May participate in Energy and Non-Spinning Reserve Markets
    • Requires telemetry to participate in Non-spinning Reserve market
CAISO Demand Response Programs Continued

- **Extension of Demand Response Programs MRTU:**
  - *Proxy Demand Resource (PDR):*
    - To be implemented shortly (a few months) after MRTU Release 1
    - Geographical Granularity: Within Local Capacity Area (CRR sub-LAP, Node, or a CLAP)
    - Market-based
    - Product offered:
      - Primarily Energy market
      - Possibly Non-Spinning Reserve market
  - *Dispatchable Demand Resource (DDR):*
    - To be implemented in MAP (a year after MRTU release 1)
    - Replaces Release 1 Participating Load (single resource)
    - Market-based
    - Must execute Participating Load Agreement with CAISO
    - Must respond to CAISO dispatch instructions
    - Geographical Granularity: Custom Load Aggregation Point (CLAP)
    - May participate in Energy and Non-Spinning Reserve Markets
    - Requires telemetry to participate in Non-spinning Reserve market
Questions?
THANK YOU

Farrokh Rahimi, Ph.D.
sales@oati.net
763-201-2000