Non-Generator Resource (NGR) and Regulation Energy Management (REM) Overview – Phase 1

Client Training Team
Customer Services Department
Overview
• NGR/REM initiative

Capacity
• Determining REM capacity

Markets
• Day-Ahead
• Real-Time
• Bids / Schedules

Settlements

Overview – NGR Phased Approach

- 9/19/11 - 1/30/12: Construction Phase I
- 12/20/2011: Phase I Registration Deadline for NGR-LESR-REM only market Sim
- 3/15/2012: NGR RDT 6.0 Due
- 4/9 - 5/4: Phase I Market Sim
- 7/1/2012: Phase II Market Simulation
- 9/17 - 10/5: Phase II Market Simulation
- 11/27/2012: Fall Release 2012
- Regulation Energy Management - Dispatchable Demand Response
- Non-Generator Resources in Energy/AS markets
- 12/31/2012

9/5/2011: Enhanced DDR workshop
Regulation Energy Management (REM) for a Non-generating Resource (NGR) is an important market enhancement that enables new types of resources to participate the ISO regulation markets.

The implementation of Non-generator Resources will:

- Create the initial model for energy storage devices to fully participate in ISO markets – *Phase I*
- Enable Dispatchable Demand Response to participate in Regulation – *Phase II*
Overview - NGR/REM

- NGR - Non Generating Resources
  - LESR – Limited Energy Storage Resource – Phase I

- Flywheel
- Lithium ion battery
- Electric Vehicles
- Pumped hydro
Overview - NGR/REM

Regulation Energy Management (REM)

- Enhancement of the ISO’s current rules for regulation
- Allows NGR resources to bid their capacity more effectively into the ISO’s regulation markets
- Maintain compliance with NERC/WECC
Overview - NGR/REM

DA A/S awarded capacity

NGR with REM

4 (15 min intervals in hr.)
• Limited energy storage resources were unable to participate in *day-ahead* regulation market at full capacity w/o regulation management (REM)

Example: 20 MW / 5 MWh limited energy resource

Green – prior requirement

Yellow – regulation energy management
NGR/REM

Participation
To participate as NGR resource the CAISO will use existing business processes and agreements:

- Scheduling Coordinator
- Participating Load Agreement (PLA)
- Participating Generator Agreement (PGA)
- Metered Entity
Market and market

Non-discriminatory access to the transmission grid, supported by a range of resources generating one megawatt or more. Depending on the needs of the system, participants can elect to bid into the energy and ancillary services market products.

Process and requirements

Full Network Model Documentation and Process Reference Matrix 3/15/2012 18:55
ISO Initial Contact Information Request 2/6/2012 11:34
New Resource Project Implementation Information Request 3/15/2012 16:40

Generator interconnection application process
Requirements and resources for Generating Facilities seeking interconnection with the transmission grid in the California ISO Balancing Authority Area.

Participating generator certification
To participate in the market, generators must enter into a participating generator agreement (PGA) with the ISO. For additional information on the participating generator certification process, fill out the new entrant contact form.

Participating generator certification agreements and information request sheets [PDF]
California ISO
Regulation energy management - implementation
Draft technical specifications - SIBR web service changes
Draft Settlements Technical Documents - Configuration Guides
Business requirements specification
- Direct Telemetry Requirement for Non-Generator Resources - V1.0 3/13/2012 00:00
- DRAFT SaMC Design Standard and Convention Version 5.3 3/13/2012 11:55
- Draft Non-Generator Resource Regulation Energy Management Generator Resource Data Template 12/19/2011 15:05
- Generator Resource Data Template and Interie Resource Data Template Data Definitions ver 6.0 12/19/2011 15:07
- Presentation - Regulation Energy Management Market Simulation Call Jun 14, 2011 8/10/2011 11:00

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- Board
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- California ISO Business Practice Manuals

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Phase 1
NGR/ REM Modeling
Phase one of the ISO’s market simulation includes the deployment of the base non-generator resource model for regulation energy management.

- NGR with REM (NGR/REM) is a subset of NGR resources.
## Phase 1 - NGR/REM - Modeling
Non-Generator Resource (NGR) and NGR with REM option

<table>
<thead>
<tr>
<th>Project</th>
<th>Technology</th>
<th>Model</th>
<th>Option to REM (Special Treatment)</th>
<th>Regulation</th>
<th>Spin/Non-Spin</th>
<th>Energy</th>
<th>Qualified MW</th>
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<tbody>
<tr>
<td><strong>Non-Generator Resource (NGR) (2012)</strong></td>
<td>Limited Energy Storage Resource (LESR)</td>
<td>Operation range between negative (Charge) and positive (Discharge), constrained by State of Charge (SOC)</td>
<td>REM</td>
<td>SC Bid</td>
<td>No</td>
<td>No</td>
<td>15 minute continuous delivery</td>
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<td><strong>Phase I</strong></td>
<td>(Flywheel, battery, energy storage)</td>
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<td>Non REM</td>
<td>SC Bid</td>
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Phase 1 - NGR/REM
Certified maximum capacity - REM or Non REM

Example:
Resource 1: LESR 10 MWH  (4 - 15 min. intervals in hour)
P_{max} = 40 MW, P_{min} = -40 MW.  Ramp rate = 10 MW/min

<table>
<thead>
<tr>
<th>MW</th>
<th>REM</th>
<th>Non REM</th>
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<td>10</td>
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<tr>
<td>Regulation Down</td>
<td>40</td>
<td>10</td>
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<tr>
<td>Spinning</td>
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<td>20</td>
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<tr>
<td>Non-Spinning</td>
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<tr>
<td>P_{max}</td>
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<tr>
<td>P_{min}</td>
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Phase 1 - NGR/REM – Modeling

1. NGR is modeled as a generator on positive (generation) and/or negative (consuming energy/load)
2. NGR can be dispatched seamlessly within their entire capacity range.
3. NGR are also constrained by an energy (MWh) limit to generate or consume energy on a continuous basis.

NGR with REM option

1. NGR can elect to participate only in the ISO’s regulation markets.
2. The regulation capacity awarded in the day-ahead market is evaluated as 4 times the regulation energy it can provide within 15 minutes.
3. REM functionality will offset (purchase or sell) energy in real-time to meet the continuous energy requirements for regulation.
CAISO procures 100% of our A/S requirement on an hourly basis in the Day-ahead market.

- Minimum continuous energy A/S procurement requirement for NGR and NGR/REM:
  - Day-Ahead Regulation Up/Down: 60 minutes
  - Real-Time Regulation Up/Down: 30 minutes
  - Spin and Non-Spin: 30 minutes

- Minimum continuous energy measured from the period that the resource reaches the awarded energy output
  - Measurement starts once resource reaches awarded energy, not end of 10 minute ramp requirement
NGR/REM

Phase 1
Determining Capacity
Phase 1 - NGR/REM
Determining capacity - REM or Non REM

• The ISO shall conduct the regulation certification process
• NGR-REM must meet 10 minute ramping requirement, same as generator
• Regulation up capacity must meet the 15 minute continuous energy deliver requirements – fully charged
• Regulation down capacity must meet the 15 minute consumption of continuous energy requirements – fully discharged
Phase 1 - NGR/REM
Example – Fully charged 5 MWh Storage
Phase 1 - NGR/REM
Example – Completely discharged 2.5 MWh Storage
Phase 1 - NGR/REM
Determining capacity - REM or Non REM

- NGR (Non REM) will be subject to existing ISO requirements for the traditional generators

- To certify the capacity for regulation, spinning, non-spinning and maximum capacity must be dispatchable on a continuous basis for at least 60 minutes
Phase 1 - NGR/REM
Certified maximum capacity - REM or Non REM

Example:
Resource 1: LESR 10 MWH (4 - 15 min. intervals in hour)
\( P_{\text{max}} = 40 \text{ MW}, \ P_{\text{min}} = -40 \text{ MW}. \) Ramp rate = 10 MW/min

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NGR/REM

Phase 1
DAM - Day-Ahead Market
RTM - Real Time Market
Phase 1 - NGR/REM
Day-Ahead and Real-Time Markets

- Optimize NGR energy and A/S awards in DAM/RTM subject to:
  - Capacity Constraints;
  - Ramping Constraints;
  - State of Charge (SOC) constraints for LESR;
- NGR optimal schedule and A/S awards shall be based on its energy bid curve and A/S bids.
- For LESR (REM), SOC constraint is enforced in the RTD. IFM and RTPD shall not include SOC constraints
Phase 1 - NGR/REM
Day-Ahead and Real-Time Markets

• DAM/RTM will model NGR with energy and/or A/S bids as on-line unit; No start up cost /time, No commitment cost recovery.

• DAM will assume LESR (Non REM) SOC initial state determined by prior day’s day-ahead schedules at the end of the day.
NGR/REM

Phase 1
Bids / Schedules
Phase 1 - NGR/REM – Regulation only

Cal-ISO DA Bid Summary

- Daily Components
- Hourly Components

Markets: Day Ahead

Scheduling Coordinator: CAISO

Resource: Generator

Display Mode: [ALL]

Refresh: 10 seconds

Wednesday March 21, 2012

DA Bid Summary

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Phase 1 - NGR/REM – Regulation only
Phase 1 - NGR/REM – Regulation only

California ISO
Shaping a Renewed Future

Daily Bid Components

Day Ahead Bids

Bid Summary

Market: Day Ahead

Scheduling Coordinator: CAISO

Resource: Generator CAISO_1_NGR

Display Mode: View Latest Submitted Bid(s)

Wednesday March 21, 2012

03/21/12

Daily Bid Components

Clear Undo Update

Startup Minimum Load Ramp Rates Energy Limits Charge Limit

Time Curve Cost Curve Min Cost Operational Open Reserve

452506 576277 $0.00 809973

Ramp Curve

Operating Level Ramp Rate

-4.00 1.00

0.00 2.00

4.00 1.00

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3/2/12 16:53:35 PDT
### Hourly Bid Components

**Market:** Day Ahead

**Scheduling Coordinator:** CAISO

**Resource:** CAISO_1_NGR

**Product Type:** Ancillary Svc - Reg Up

**Display Mode:** View Latest Submitted Bid(s)

#### Wednesday March 21, 2012

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NGR/REM

Phase 1
Energy Management System (EMS)
Phase 1 - NGR/REM
Energy Management System (EMS)

• EMS shall receive NGR telemetry of the following data every four (4) seconds and send to the RTM every minute:
  - Resource Instantaneous Output (MW);
  - For LESR, State of Charge (SOC), which is the actual stored Energy (MWh) in the device;
Phase 1 - NGR/REM
Energy Management System (EMS)

- EMS shall model NGR as a generation resource with supply range of negative to positive.
  - For LESR
    Ex: A battery is discharging at 2 MW, the operation output will be 2MW. A battery is charging at 2 MW, the output will be -2 MW.

- EMS shall control NGR regulation up and down through Automatic Generation Control (AGC) based on NGR Dispatch Operating Target (DOT)
  - NGR provides regulation up if AGC dispatches the NGR above its DOT
  - NGR provides regulation Down if AGC dispatches the NGR below its DOT
NGR/REM

Phase 1
Settlements
Phase 1 – NGR/REM
Settlements

• NGR/REM shall be subject to all existing A/S No Pay categories.

• All energy will be still calculated based on algebraic difference between different MWs.
  – For example, a DOT of 7MW with a DA schedule of -3MW will possibly result in Optimal Energy of 10MW;

• Energy settlement are still based on resource level Locational Marginal Prices (LMP) and resource MWs. A decrease in energy off the CAISO grid normally results in a charge. An increase in energy onto the CAISO grid normally results in a payment.
Phase 1 – NGR/REM Settlements

- CG CC 6474 Real-Time Unaccounted for Energy Settlement
- CG CC 6490 MER WECC Charge
- CG PC Metered Demand TAC Area and CPM
- CG PC Measured Demand Black Start Excluding Exports
- CG PC HVAC Metered Load
- CG PC Measured Demand Emissions Over Control Area
- CG PC Measured Demand Over Control Area Excl Transmission Loss
- CG PC Measured Demand Over Control Area Excluding MSS Energy
- CG PC Measured Demand Over Control Area
- CG PC MSS Netting
- CG PC Real-Time Energy Quantity

***Web location: CAISO.com > Rules > Business Practice Manuals***
Thank You for Attending!!

Please send additional questions to:
MarketTraining@caiso.com