Automatic Generation Control (AGC) Enhancement for Fast-Ramping Resources

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Overview

• Purpose
  – Present recent market development on MISO’s Automatic Generation Control (“AGC”) enhancement

• Key Takeaways
  – With increase in renewable generation portfolio, comes an increased need for flexible regulation
  – Opportunities exist to maximize fast-response capabilities of resources
  – MISO’s new AGC enhancement provides incentives and means to better use fast ramping resources to participate in Regulation market
Market Vision: Our market vision is to foster wholesale electric markets that deliver reliable and economically efficient outcomes.
MISO Market Roadmap Guiding Principles

- Support an economically efficient wholesale market system that minimizes cost to distribute and deliver electricity
- Facilitate non-discriminatory market participation regardless of resource type, business model, sector or location
- Develop transparent market prices reflective of marginal system cost and cost allocation reflective of cost-causation and service beneficiaries
- Support market participants in making efficient operational and investment decisions
- Maximize alignment of market requirements with system reliability requirements
## AGC Design Principles

<table>
<thead>
<tr>
<th>Goal</th>
<th>Design Concern</th>
<th>Principles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reliability</td>
<td>Fast Signal design</td>
<td>Maintain system reliability before meeting individual unit needs</td>
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<td></td>
<td>Coordinate fast-slow signal</td>
<td>Avoid fast/slow competing against each other</td>
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<td>Keep in mind slow resource capability</td>
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<td>Efficiency</td>
<td>All regulation reserve for system reliability</td>
<td>Avoid using charging fast regulation resources with slow regulation resources</td>
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<tr>
<td>Flexibility</td>
<td>Technology Independent</td>
<td>Signal flexibility to attract various technology for reliability and market efficiency</td>
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</tbody>
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To maintain reliability, improve efficiency and flexibility these design principles are followed
Fast AGC Logic

- Deploy and un-deploy fast resource first
  *Flexibility & efficiency; will increase mileage payments*

- Gradually replacing deployment on fast resources with slow resources after first response
  *Efficiency & reliability; uses resources for greatest contribution*

- Align both direction of slow and fast signal with total deployment
  *Efficiency & reliability; resources do not fight & less liability*

- Move limited-duration resources back to neutral whenever situation permits, based on the state of charge
  *Flexibility; keep resources participating as long as desired*
Fast Ramping Resource Utilization

- Fast Ramping Resources will address the rapid regulation needs (i.e. for ACE turn around)
- Slow Ramping Resources will handle load following requirement
Fast Ramp Resource Qualification in Real Time
5min interval

UDS
Regulation Cleared on resources every 5 mins

UDS to AGC Interface

To Qualify Fast Resource
- Validate Hourly Offer (Fast Flag)
- Validate Ramp Rate
- Validate Duration
- Validate Regulation Limits
- Validate Performance
Set Fast Ramp Resource True/False

Offered as Fast?
YES

Ramp Rate >= 80 MW/min?
YES

Duration >= 20min?
YES

Regulation Max Limit >= 1 MW?
YES

Performing?

NO

Fast Ramp Resource = False

Fast Ramp Resource = True

YES
AGC Fast Signal Design for Energy Limited Resources

Need Charge

- Energy Level (SoC) < NZLL - \( \varepsilon \)
- \( \varepsilon + \text{NZUL} \leq \text{Energy Level (SoC)} \geq \text{NZLL} - \varepsilon \)
- Energy Level (SoC) > NZUL + \( \varepsilon \)

Need Discharge

NZUL: Neutral Zone Upper Level
NZLL: Neutral Zone Lower Level
\( \varepsilon \): Change
AGC Input Data Changes

• AGC will receive State of Charge for Energy Limited Resources via ICCP at 4 second frequency

• AGC will receive below additional data from UDS on each 5 min interval
  – Fast Ramp Resource qualification
  – Default priority grouping based on available ramp rate
  – Neutral Zone Upper and Lower Limits for Energy Limited Resources
AGC will be changed to have two signals - fast and slow
Cost Benefit Study

• **Benefit**
  – With fast ramping resource providing regulation reserve, production cost reduced from freeing up resources to provide energy or contingency reserves
  – Estimated annual saving with 200 MW fast ramp resource into MISO market is $14 million

• **Fast resource Revenue**
  – Fast resources benefit from extra regulation mileage payment
  – Simulation results shows with recommended design fast resource mileage roughly doubled comparing to current logic
  – Estimated annual extra mileage payment is $3 million
Project Timeline

**After Order 755**
Stakeholder requested further AGC enhancement

**AGC Simulation and Study**
Building simulation model and study AGC strategies under various scenarios. Providing options and recommendations.

**Prioritization**
High priority item in MISO Market Roadmap (2015)

**Conceptual Design**
Stakeholder discussion and design

**Implementation**
Software construction and business process modification.

- **2017 3rd Quarter**
- **2017 4th Quarter**
- **2019 4th Quarter**
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Appendix
Priority group Calculation in AGC

- **Ramp Rate ranking**
  - highest to lowest. Same rank to the resources that have same ramp rate

- **State Of Charge ranking for Regulating Down**
  - highest to lowest based on the distance from Neutral Zone Lower Limit for Energy Limited Resource

- **State Of Charge ranking for Regulating Up**
  - highest to lowest based on the distance from Neutral Zone Upper Limit for Energy Limited Resource

**Regulating Down?**
- YES
  - Priority Regulating Down Bucket
    - Rank = (higher rank for the resources with SOC below Neutral Zone * Ramp Rate Rank)

**Regulating Up?**
- YES
  - Priority Regulating Up Bucket
    - Rank = (higher rank for the resources with SOC above Neutral Zone * Ramp Rate Rank)

- **Priority Neutral Bucket**
  - Rank = (Ramp Rate Rank for the resources with SOC within Neutral Zone and resources of non stored energy type)
AGC deployment for Fast Ramping Resources (Using Permissive Charging)

START

Regulation Requirement >> TARF

NO

Regulation Up direction?

YES

RU

N

RD

First Use Resources in this Bucket
Second Use Resources in this Bucket
If needed more then use resources from this bucket

We will start with Regulating Up Priority Bucket and then work through until we meet our need

Regulation Down direction?

NO

STOP

If needed more then use resources from this bucket
Second Use Resources in this Bucket
First Use Resources in this Bucket

We will start with Regulating Down Priority Bucket and then work through until we meet our need

Total Achievable Regulation From Fast Ramp Resources (TARF)
Regulation Requirement = Total Regulation Need – Regulation previously deployed on Slow Resources
System Flow

UDS
Regulation Cleared on resources every 5 mins

UDS to AGC Interface

Market to AGC Data

Market User Interface

AGC

Market Participant

Metered Data

SCADA

Settlement System

ICCP

From MISO
Dispatch Target, Control Status, Cleared Regulation, Deployed Regulation, Ramp Regulation Mileage Metric, On Regulation Test Flag, RT Control Set point, etc...

ICCP

TO MISO
- Resource Breaker Status, MW, MVAR
- Control Mode (0 – Offline, 1 – Online, 2 – Regulating, 3 – Off Control)
- State Of Charge*

Extra Data
- Fast Ramp Resource True/False
- Fast Ramp Resource Neutral Zone Upper Limit*
- Fast Ramp Resource Neutral Zone Lower Limit*

To Qualify Fast Resource
- Validate Hourly Offer (Fast Flag)
- Validate Ramp Rate
- Validate Duration
- Validate Regulation Limits
- Validate Performance
- Set Fast Ramp Resource True/False

(*Only for SER type Resources)