Grid Operations Role with NRI
May 2024

Welcome
Our presentation will begin shortly.

Today’s Presenter: Drew Thompson, Lead Generation Dispatcher
Housekeeping

- Keep yourself muted to minimize background noise
- Unmute to ask verbal questions or write questions in the chat pod
- Raise your hand using WebEx interactivity tools
Objectives

- Discuss the role of Operations as a Balancing Authority (BA)
- Identify the role and process after Sync Approval in NRI with Operations
- Discuss Unit Testing and expectations prior and post COD
CAISO (California Independent System Operator)

- Maintains reliability on the grid
- Manages the flow of energy
- Oversees the transmission planning process
- Operates the wholesale electric market
- Registered NERC entity
Overview of CAISO’s Grid

- 3 Major Load Centers and Investor Owned Utilities (IOU’s)
  - Pacific Gas & Electric (PG&E), Southern California Edison (SCE), San Diego Gas & Electric (SDG&E)
- Hydro power from the eastern mountain range (Sierra Nevada)
- 1 nuclear power plant (current retirement in 2030)
- DC Intertie (PDCI) from the Pacific Northwest’s hydro power (3,100 MW)
- World’s largest geothermal system (“The Geysers”) 835 MW
- Natural gas fleet largely near the coastlines of the load centers
- Solar and Wind in less populated inland areas
2023 Statistics

Peak demand

- **44,534 MW**
  - August 16 at 5:59 p.m.
  - **5-minute average**
  - Renewables: 23.1%
  - Natural gas: 56.5%
  - Battery: 2.1%
  - Imports: 3.1%
  - Nuclear: 4.9%
  - Large hydro: 10.2%

  **Previous year:** 52,061 MW on September 6 at 4:57 p.m.

  More on Today’s Outlook

Solar peak

- **NEW RECORD**
  - **16,056 MW**
  - Sept 26 at 11:32 a.m.
  - **Previous year:** 14,352 MW on June 7 at 12:16 p.m.

Wind peak

- **6,317 MW**
  - May 28 at 5:39 p.m.
  - **Previous year:** 6,465 MW on May 28 at 5:39 p.m.

Peak net imports

- **10,480 MW**
  - May 20 at 11:36 p.m.
  - **Previous year:** 11,465 MW on Feb 10 at 5:29 p.m.
2023 Statistics

Installed renewable resources (as of 02/01/2024)

- **60.8%** solar
- **27.5%** wind
- **5.3%** geothermal
- **3.9%** small hydro
- **2.6%** biofuels

<table>
<thead>
<tr>
<th>Resource</th>
<th>Megawatts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar</td>
<td>18,517</td>
</tr>
<tr>
<td>Wind</td>
<td>8,358</td>
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<tr>
<td>Geothermal</td>
<td>1,610</td>
</tr>
<tr>
<td>Small hydro</td>
<td>1,180</td>
</tr>
<tr>
<td>Biofuels</td>
<td>778</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>30,443</strong></td>
</tr>
</tbody>
</table>

Installed battery capacity: 7,261 MW
As of 02/07/24, subject to change.

See Today's Outlook
Role of the CAISO Generation Dispatcher

Mitigation

Manage and mitigate within System Limits
~26,000 circuit miles of transmission

Balancing

Manage Supply to meet Real-Time Demand
Serve ~80% of California demand

Communication

- CAISO Transmission (TOP) to Utilities [Participating Transmission Owners (PTOs)]
- Scheduling Coordinators to Resources (GO/GOPs)
- Scheduling Coordinators to Resources (GO/GOPs)
- Reliability Coordinator (RC)
High Level Interconnection Process Map

Grid Operations – Trial Operations

You are here
Steps of Test Energy Process with Grid Operations

Pre-COD
Submit Test Schedule

Pre-COD
Unit Testing

COD
Unit Commercial

COD (Commercial Operation Date)
Grid Operations role with New Resource Implementation (NRI)

- After Sync Prerequisites are met:
  - Approval must be given prior to Resource Testing

- Scheduling Coordinator (SC) actions:
  - Submit an outage type NEW_GENERATOR_TEST_ENERGY
    » Resource availability to 0 MW, from the time of the initial sync until the assumed COD
    » Provide information from NRI Test Energy Template
    » Provide a test schedule for the resource
    » Communicate any changes to the test schedule prior to test date
Test Schedule Review in Real-Time Horizon

- D+2 and D+1 Generation Work Review Process
  - Generation Dispatcher will review the submitted work in addition to the NEW_GENERATOR_TEST_ENERGY type for test schedule plans
    - Listed in either the Short Description or External Notes section of the outage card
      - If its not present, then CAISO will contact Scheduling Coordinator (SC) to discuss updating outage information
      - If such test plans are not present, then testing will not proceed or be approved until provided
Outage Example

Submit Test Schedule

Pre-COD

Outage Card Example (CAISO View)

Availability at 0MW which shows market not available for dispatch.

Short Description: includes all NRI Energy Template Information in addition to a complete test schedule.

External Notes: includes complete test schedule for desired testing days.
Pre-Commercial (Pre-COD) Batteries (NGR) Resource Testing

Terms used during testing:
(Example: 250 MW Battery [Pmax: 250 MW and Pmin: -250 MW])

**Discharge (+)**

- 0 MW
- 250 MW

Linear Ramp NOT instantaneous

**Charge (-)**

- 0 MW
- -250 MW

Linear Ramp NOT instantaneous
Pre-Commercial (Pre-COD) Resource Testing

- **Communications**
  - Scheduling Coordinator (SC) must have good communications with CAISO and the resource (GOP) during testing.
  - Coordinate any changes to the approved test plan with CAISO.

- **Telemetry**
  - CAISO must have good quality data from the resource during testing or testing will be denied, rescheduled, or terminated.

- **Control of Resource (Must have control of resource(s) at all times)**
  - Ramping (ability to ramp to a 5 minute dispatch instruction)
    - Batteries (NGRs) have distinct ramp rates for operating in a consuming mode (charging) or in a generating mode (discharging).
    - Solar testing to develop forecasting models.
Pre-Commercial (Pre-COD) Resource Testing

- Communications

We understand on the Construction Project side that multiple parties are involved in the process from commissioning, operator groups, engineers, etc. but CAISO Generation Dispatchers should not be communicating with these parties.

These parties should be coordinating and relaying all information to their associated Scheduling Coordinator (SC).

CAISO Generation Dispatcher communicates with the Scheduling Coordinator (SC).
Overall Expectations for Communications and Performance

• Communications for Reliability
  – The CAISO will not approve testing unless sufficient transmission capacity is available to support test schedule
  • Studies will be performed and testing may need to be rescheduled

• Performance for Reliability
  – If resource is causing a reliability situation on the Grid, then an Operating Instruction will be issued from CAISO to come offline within 10 minutes until further notice
    » Note: If resource is not able to come offline, CAISO can coordinate with the transmission utility to open circuit breakers to trip resource offline to mitigate the reliability situation

(Must have control of resource(s) at all times)
NRI Process

Once you have completed all necessary steps in the final stages…
Expectations for Commercial (COD) Resources

• **Performance for Reliability**
  - Ability to follow DOTs [5 (five) minute Dispatch Operating Targets] accurately
  - Linear ramping to follow DOPs [Dispatch Operating Points] mid interval to mid interval
  - Not exceed DOT when Follow DOT and Operating Instruction (OI) flag’s are “Y” in ADS (Automated Dispatch Instruction) for Variable Energy Resources
  - Immediately follow Operating Instructions (OI) when issued by CAISO
  - Starting up and Shutting down timely
  - Resource Testing should be self-scheduled in the market.
    - *Note: Unit Testing type OMS should be submitted and test plan should match the self-schedules*
  - Ensure Outage Management System (OMS) reflects true capability and availability of resource
    - *Note: OMS fields for managing Batteries (NGRs)*
      - Load Max = Pmin(charging) derates
      - Max Energy = SOC derates (SOC = State of Charge)
      - Availability = Pmax (output/discharging) derates
Expectations for Ancillary Services (A/S) Certified Resources

• Performance for Reliability
  – In order to provide Regulation:
    • Ability to ramp on and off Automatic Generation Control (AGC) to DOP in linear fashion
    • Stay on AGC for entire duration of A/S award and have manual controls to place on AGC
      – The ADS AGC flag is a courtesy feature for AGC notification; however, the resource must have the capability to have manual control to place on AGC
        » Note: Do not program your controllers to rely on the ADS AGC feature alone
  • Following 4 second set points accurately
  • Regulation range reflects accurate capability
  • Ensure Outage Management System (OMS) reflects true capability and availability of resource
    – Resource cannot be on AGC providing Regulation with failed Telemetry
      » OMS Metering Telemetry card required with A/S fields set to 0 availability
Expectations for Commercial (COD) Resources

• **Performance for Reliability**
  – CAISO Generation Dispatcher will create internal tickets flagging a resources inability to perform:

  • CAISO will issue the following:
    – an official letter stating importance of reliability and adhering to regulatory standards, requesting;
      » completion of training
      » detailed root cause analysis that led to inability to perform and what has been done to rectify the situation
    – potential Ancillary Service (AS) block preventing AS awards
    – potential removal from market
    – for repeat offenders; potential referral to Department of Market Monitoring (DMM)
To Recap:

- Ensure proper set up and communication for resource testing and performance
- Communicate to ensure adequate control of resources
  - Operating Instructions
    - Respond to Operating Instructions (OI) within required time parameters
    - Must have control of resource(s) at all times
- Ensure proper updates for resource testing and availability
- Actively monitor your resource
  - Who is running the resource? Who has control? Can I manually place my resource on AGC? If needed, can I take the site offline within 10 minutes
- Review CAISO Operating Procedures:
  - OP 5320 – Resource Trial Operations and Test Energy Process
  - OP 5320A – Test Energy for NGR Resources
  - OP 5330 – Resource Testing Guidelines
  - OP 5330A – Resource Test Request Form
The grid is more transformative than ever, and we as an industry will need to stay agile, evolve our practices, and work together to discover creative solutions to whatever the future holds.
Thank you for your participation!

For more detailed information on anything presented, please visit our website at: www.caiso.com

For resource specific questions or concerns, please submit a CIDI ticket.