



California ISO
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Technical Bulletin

2010-01-01

Simplified Forbidden Operation Regions for Real-Time

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1 Summary

Prior to start of the new market (MRTU), the CAISO deferred the implementation of Forbidden Operating Regions (FOR) for the Real-Time market, due to concerns about application performance. The CAISO is now testing an alternative FOR feature that will resolve the performance concerns. This feature, similar to existing functionality in the Real-Time market with one exception as described below, is scheduled for implementation on April 1, 2010.

2 Background

Forbidden Regions are distinct non-overlapping operating regions within which Generating Resources cannot operate stably. A Generating Resource may be scheduled or dispatched within a Forbidden Region in an interval only if it takes longer than the duration of the interval to cross that region. In such case, the Generating Resource must be scheduled or dispatched in subsequent intervals in the same direction (up or down) so that it clears the Forbidden Region in the least number of intervals possible. Moreover, a Generating Resource scheduled or dispatched within a Forbidden Region in an interval is not eligible to provide Ancillary Services in that interval.

The Forbidden Region functionality was intended to be used by resources which could not operate stably within a particular operating region. However, it can also be used, with varying results, to model other constraints such as operating regions enabled / disabled by the insertion / removal of feedwater pumps, operating configurations within a combined cycle unit, etc.

Due to performance concerns, particularly slower solution times, the Forbidden Region functionality was not enabled for the real-time market at the time of market go-live. However, the CAISO committed to the Federal Energy Regulatory Commission that a solution would be implemented in a reasonable

time frame. The CAISO intended for that solution to be the Multi-Stage Generator functionality which would more explicitly model many constraints such as combined cycle units. However, it became clear that this functionality would not be available before summer 2010. As an alternative the market software vendor has come up with Forbidden Region functionality similar to the existing functionality in the day-ahead market, while improving performance to an acceptable level. The functionality is the same as the Day-Ahead functionality with one change as described below. This one change will allow the vendor to simplify their algorithm, which provides the performance improvement.

Forbidden Regions are static and defined in the Master File along with all other Resource characteristics. There is support for up to four (4) Forbidden Regions for a given Generating Resource, however, not all resources have Forbidden Regions, and for those that do, they usually have only one or two. The Forbidden Region ramp rates are static and will be included in the Forbidden Region definition in the Master File, albeit not as ramp rates, but as Crossing Times; an average ramp rate can be derived by dividing the range of the Forbidden Region with its Crossing Time.

3 Implementation summary

The FOR functionality will be implemented in the Real-Time market, with features similar to the Day-Ahead market. See next section for a comparison of the features.

The FOR functionality in the Day-Ahead market will not change.

4 Comparison in functionality between Day Ahead and Real-Time

The following table compares the FOR features of the two markets.

Area	Existing FOR	new RT FOR
Dispatch	Once in forbidden region, must dispatch to the other side without stopping or changing direction.	Same, except might stop at FOR boundaries.
Ancillary Services Procurement	Cannot procure Ancillary Services during intervals where dispatching through forbidden region, unless total crossing time is 20 minutes or less.	Same. For RTPD the total crossing time must be 5 minutes or less
Number of forbidden regions	Four non-overlapping regions	Regions are same as identified for Day-Ahead
How registered	Through Master File process	Same as what is registered for the Day-Ahead

The only major difference between day ahead and real time functionality is in the way that a unit enters the FOR. In the day ahead, a unit may enter the FOR from anywhere outside the FOR or the boundary, while in Real-time the unit might first reach the FOR boundary before proceeding into the FOR. An example of this difference is shown below.

Example:

For this example let's concentrate on a RTPD run where one interval is 15 minutes.

- Unit initial condition = 225 MW
- Forbidden region between 250 and 310 MW with a crossing time of 30 minutes (effective ramp rate of 2 MW/min)
- Outside of the forbidden region, unit can ramp at 5 MW/min.
- It is economic to move the unit up throughout the time horizon.

In both cases the unit starts moving up, however with the new functionality the unit might stop at the FOR boundary. With the existing functionality, the unit will ramp at its full ramp rate through the forbidden region. The full ramp rate is:

- 5 minutes at 5 MW/min between 225 and 250 MW.
- 10 minutes at 2 MW/min between 250 and 270 MW.

Similarly, with the existing functionality the unit will ramp at its full ramp rate to exit the forbidden region, while under the new functionality the unit might stop at the upper limit. The full ramp rate is:

- 5 minutes at 2 MW/min between 300 and 310 MW.
- 10 minutes at 5 MW/ min between 310 and 360 MW.

Interval	Dispatch with Existing FOR	Dispatch with new RT FOR
Initial	225 MW	225 MW
1	270 MW	250 MW
2	300 MW	280 MW
3	360 MW	310 MW