

Analysis Track Testing of CAISO MRTU Pricing and Dispatch Preliminary Results

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for the California ISO

May 21, 2008
California ISO Board of Governor Meeting

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EXECUTIVE SUMMARY

To date, a number of day-ahead market and real-time predispach cases have been analyzed to validate that prices are being correctly calculated.

- Most of the remaining issues appear to involve either minor inconsistencies in the truncation, or rounding of shift factors or loss factors or errors in aggregating prices across nodes (LAP prices).
- There are also unresolved issues involving the penalty prices used to relax transmission constraints and self-schedules in the pricing run.

TEST METHODOLOGY

The CAISO is conducting a variety of tests of the MRTU software and systems; this presentation and the related report cover one set of those tests.

Seven tests were applied to the analysis track cases:

- Replication of LMP energy prices.
- Validation of energy prices based on marginal generators.
- Consistency between energy dispatch and energy prices.
- Replication of ancillary service prices.
- Validation of ancillary service prices based on marginal suppliers.
- Consistency between ancillary service schedules and prices.
- Consistency between unit commitment and prices.

REPLICATION OF ENERGY AND ANCILLARY SERVICE PRICES

We were able to replicate the LMP energy prices from the underlying constraint shadow prices, shift factors, loss factors and reference bus prices for every location in almost every case analyzed.

We were able to replicate the regional ancillary service prices in every case analyzed.

REPLICATION OF ENERGY AND ANCILLARY SERVICE PRICES

The instances in which we could not replicate energy prices were as follows:

- There were seven nodes in three IFM cases for which we could not replicate the congestion component of the price. The cause has been identified as a discrepancy in Cnode ID data within different elements of the IFM, resulting in these nodes being modeled as disconnected from the grid for some purposes but not for others.
- We have not been able to replicate the PG&E hub price from the underlying Pnode prices.

VALIDATION OF ENERGY AND ANCILLARY SERVICE PRICES BASED ON MARGINAL OFFERS

The number of marginal offers appropriately exceeded the number of binding transmission constraints or binding regional ancillary service requirements in almost every hour of every case.

- There are three hours in one IFM case in which the correct number of marginal units has not been identified. This is very likely a side effect of a small dispatch inconsistency causing the offers of marginal generators to differ from the price by a cent or two.
- In both IFM and RTUC cases with violated transmission constraints, we observed some constraints that were not relaxed despite constraint shadow prices in excess of \$3,000/MW.

CONSISTENCY OF PRICES WITH DISPATCH

Resources are dispatched consistent with their bids and offers at almost every location in every case. The exceptions are:

- There are small \$0.01 to \$0.02 discrepancies between prices and the dispatch for a number of resources in IFM and RTUC cases with very high constraint shadow prices. We expect that these differences arise from some kind of shift factor or loss factor rounding or truncation, but we have not yet been able to identify the source of the discrepancy.
- There is a single price-capped load bid that is dispatched slightly inconsistently with its bid in one IFM case. We have not been able to identify the source of this discrepancy.
- Minimum downtime requirements were not correctly applied to resources offering to provide non-spinning reserve in RTUC. This problem previously existed in IFM and has been corrected and has not been present in recent RTUC test cases.

CONSISTENCY OF UNIT COMMITMENT WITH LMP PRICES

Our test of consistency between the dispatch and LMP prices corresponds to verifying the price equals marginal cost equilibrium condition of a competitive market.

- If the cost functions were convex and cost reflective, these equilibrium conditions would also define the profit maximum for each unit and the overall social optimum.
- In practice, the relevant cost functions may not be convex, so we carried out additional tests to verify that the unit commitment and dispatch approximate both the profit maximum for each unit and the social optimum.

CONSISTENCY OF UNIT COMMITMENT WITH LMP PRICES

Because of the non-convexities of the unit commitment problem, there is a potential for units to be uneconomically committed or to not be committed when they are economic.

- A degree of imperfection in the unit commitment is generally viewed as acceptable in return for reducing the number of iterations at various stages and speeding market closure.
- The commitment or decommitment of a unit can change prices, change binding constraints, and change marginal losses, so it is normal to observe small losses on units that are correctly committed or small hypothetical profits on units that are optimally not committed.
- Our review has therefore focused on identifying big anomalies.

CONSISTENCY OF UNIT COMMITMENT WITH LMP PRICES

We did not observe any instances of resources that were not committed, yet would have earned substantial profits had they been committed, holding prices constant.

We did not observe any instances of large uplift costs (as bid costs that exceed market revenues) on units that were committed, other than on self-scheduled units that have much more negative offers in the scheduling pass than in the pricing path.

We did observe instances of forgone profit in the scheduling of resources having non-convexities in their ramp rates.