Analysis of Residual Unit Commitment Results from MRTU Structured Testing

Department of Market and Infrastructure Development

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Executive Summary

On March 31 the ISO will launch the comprehensive redesign of its markets developed under the Market Redesign and Technology Upgrade (MRTU) program. In preparation for the upcoming launch, for many months the ISO and the market participants have been engaged in a market simulation process that has included many different types of simulations and tests to assess and validate all aspects of market and system performance. In response to certain market simulation results observed in November and December of 2008, some participants raised questions about the performance of one major component of the new markets, the Residual Unit Commitment (RUC) procedure. The ISO therefore conducted an investigation into the RUC market simulation results in order to:

- Summarize the RUC prices, procurement quantities and procurement costs observed over five complete days of the December 2008 structured testing phase of market simulation; and
- Explain certain outcomes observed in structured testing, specifically the procedure's procurement of RUC capacity from non-Resource Adequacy capacity at market-clearing prices in hours where zero-priced Resource Adequacy capacity appeared to be available.

The present document reports the findings of the ISO's investigation.[1] For this investigation ISO staff examined RUC results for all 24 hours of the five days of structured testing, December 6 and 9-12, 2008. The ISO's principal findings are summarized as follows:

- RUC LMPs for the majority of the hours during the five day period were at zero or close to zero; specifically, of the 415,400 hourly RUC LMPs calculated for the five day period, 368,000 or 88% percent were between -$10 and +$10
- The total cost to the market for the test period for RUC awarded to non-RA capacity was only $94,882 for 1,566 MW;
- Quantities of RUC awarded to non-RA capacity were small relative to the quantity of RUC capacity procured; non-RA capacity was awarded in only 24 out of 120 hours, for a total of 1566 MW out of 94,944 MW RUC capacity procured over the five-day period

In the final section of this report the ISO identifies several important differences between the way the RUC procedure functioned in the market simulation environment in which the results described here were obtained, and how it will function in the actual production environment that is being brought on line in these final weeks leading up to market launch. The production

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1 The ISO Department of Market Monitoring (DMM) has also analyzed the structured testing results and its conclusions regarding RUC are consistent with the findings reported here. The DMM report, "Review of California ISO MRTU Structured Market Simulation Results Trade Days – December 9-12, 2008" dated January 16, 2009, can be obtained from the ISO web site at the following link: http://www.caiso.com/2338/2338847e69480.pdf

environment includes certain features, not activated in market simulation, to fine-tune the RUC procurement target so that the RUC process will more optimally balance the dual objectives of one, ensuring that sufficient supply capacity is available to serve load and meet operating needs in each hour of the following day, while two, not incurring unnecessary costs due to over-procurement of RUC capacity.

Based on the investigation described in this document, the ISO is confident that the results and performance of RUC are consistent with the FERC-approved RUC design and, most importantly, do not indicate any flaws in either the design or the implementation of RUC that suggest there could be unintended consequences that would jeopardize the successful performance of the new MRTU market structure. The ISO is committed, both before and after the March 31 launch, to continuous and careful monitoring of the performance of RUC and all other elements of the new market structure, so that any anomalous or extreme market results will quickly be identified and analyzed and any problems promptly addressed. In addition, the ISO has identified the RUC design as a topic for discussion in the post-launch stakeholder process to finalize the design of convergence bidding, to ensure full compatibility between convergence bidding and the RUC design.

1. Introduction

The new spot market structure being implemented under the MRTU program consists of a day-ahead market and a real-time market. These markets are designed to commit and dispatch resources in an optimal, least-cost manner to balance energy supply and demand, procure required ancillary services, and manage congestion on the transmission system. The day-ahead market performs these functions once a day for all 24 hours of the next trading day, while the real-time market performs these functions within the trading day starting roughly one hour ahead of each trading hour and continuing into the operating time frame where resources are optimally economically dispatched every five minutes.

The new markets are based on the Locational Marginal Pricing (LMP) paradigm. The LMP-based markets will produce locational or “nodal” energy prices at each of roughly 3000 nodes in a detailed network model that accurately reflects the transmission facilities operated by the ISO and includes certain other facilities adjacent to and closely integrated with the facilities operated by the ISO. The LMP paradigm was adopted by the ISO as the basis of its new market structure because it represents, as demonstrated by the other ISOs operating in the United States, the most accurate, efficient and transparent way to manage congestion on a fully detailed model of the transmission grid. The LMP approach in conjunction with an accurate network model ensures operationally feasible schedules and dispatches, and provides locational prices that reflect the true cost of delivering energy to each network location.

Within the market structure described above, the RUC procedure is the third and final major sequential component of the day-ahead market. The first component in the sequence is the Market Power Mitigation and Reliability Requirements Determination (MPM-RRD) procedure, which sets up the day-ahead financial market by performing any needed mitigation of potential market power and addressing local reliability needs. The second and central component is the Integrated Forward Market (IFM), which establishes financially binding day-ahead resource commitments and schedules for energy and ancillary services for all 24 hours of the next day. The results of the IFM, as the core financial market of the day-ahead, reflect the bids submitted by buyers and sellers expressing the prices they are willing to pay or accept to buy or sell energy and capacity. As such, the IFM does not explicitly schedule resources to meet the ISO demand forecast, and there is no requirement that the IFM result in sufficient commitment of resources to meet the expected demand and operating needs of each hour of the next day. The RUC procedure is therefore a necessary third day-ahead component that is performed after the IFM to identify any additional capacity needed to meet the next day's forecast load and operating requirements beyond what was committed and scheduled in the IFM.

Thus the RUC is designed as a reliability procedure, to fill whatever gap may result between the supply that clears the IFM based on participants' submitted bids and the ISO forecast of the load expected in each hour of the next day. Toward this end the RUC procedure must balance two somewhat conflicting objectives: first, to ensure that sufficient capacity will be available to meet the load and operating needs of each hour, and second, to control procurement costs by not procuring unnecessary supply capacity. Because the next day's load, supply offers and system conditions cannot be known perfectly in the day-ahead time frame, the RUC procedure must rely on forecasting and estimation algorithms as well as the judgment of ISO operators following good utility practice. Recognizing this fact, the FERC-approved RUC procedure sets the hourly RUC procurement target by starting from the ISO forecast of internal demand for each hour, then applying adjustments to reflect such things as expected supply self-schedules in the real-time market, expected output from intermittent renewable generation that was not scheduled in the IFM, any shortfall in ancillary service procurement in the IFM, and a few other factors identified in MRTU tariff section 31.5. The same tariff section also explicitly recognizes the need for operator judgment in setting the RUC target and authorizes the operators to accept, modify or reject any of the calculated adjustments just mentioned.

The RUC procedure takes account of resource locations and generator operating characteristics. It utilizes the same LMP paradigm, network model, and security-constrained unit commitment (SCUC) algorithm utilized by the IFM and the other spot-market optimization procedures. The RUC procurement target is represented as demand at each of the 3000 nodes of the grid, and the optimization commits and dispatches supply resources to serve that demand. The rationale for this design is that the capacity scheduled in RUC must be able to support a real-time dispatch in each hour that will meet the demand in a manner that is fully feasible given grid conditions known at the time RUC is run. If RUC were to ignore the network and just procure a target quantity of supply capacity irrespective of location and generator performance capabilities, RUC would not be able to ensure that the capacity so procured will be able to be dispatched to meet the forecasted demand in a reliable manner.

One result of the LMP-based design of RUC is that it calculates nodal RUC availability prices at each of the 3000 nodes of the network. Unlike the IFM, however, the RUC optimization does not use the energy bids submitted by resources, but uses special availability bids that are offered by bidders to reflect their willingness to have their capacity reserved to meet ISO load the next day. In the RUC optimization these availability bids play the same role as the energy bids play in the IFM. An important restriction on RUC availability bids, however, is that Resource Adequacy (RA) capacity is required to offer RUC capacity at a zero dollar availability price. Thus only non-RA capacity is able to submit non-zero RUC availability bids and only non-RA capacity is paid the calculated RUC availability prices, even though non-zero RUC prices may be calculated for all 3000 nodes of the network. Looking only at RUC prices in any given hour could therefore make it appear that the cost of RUC procurement is much greater than it really is. As the analysis presented in this paper will show, the MW quantity and the cost of the RUC "awards" – i.e., those MW of scheduled RUC capacity that are actually paid the availability price – have been quite small in the dates examined in this report and throughout the market simulation.[2]

2. Study Period and Data

Concerns were raised by some market participants regarding RUC results in market simulation and baseline testing when non-RA capacity is awarded RUC to meet system or local requirements. In order to address these concerns the ISO has analyzed market data for MRTU structured test dates December 6 and December 9 – 12. The data set used in the analysis included clean bids from SIBR, Day-Ahead Market results, Resource Adequacy data from the ISO master file and the July 2008 Resource Adequacy showing.

The key objectives of the analysis were to

(1) Summarize the overall frequency distribution of RUC prices and costs,

(2) Identify the causal factors behind RUC prices and costs in hours where non-RA capacity was awarded RUC, and

(3) Investigate the reasons why non-RA RUC capacity was awarded in hours where RA RUC capacity was appeared to be available.

During these structured market test days the ISO submitted bids on behalf of market participants. These structured test days used a base case (Base Case – 0) that assumed cost based supply bids and submitted structured demand bids that ensured that 90-95% of the load forecast would clear the IFM. Variations of this base case were run on subsequent days to test certain aspects of market performance. A summary of the base case scenarios is provided in Table 1.

A number of conditions in this structured market simulation differed from what will exist in live production. These conditions which are summarized in Table 1 below, created results that may be inconsistent with bidding behavior and market results that will occur after MRTU start-up.

2 The term "RUC Capacity" refers to the total amount of capacity procured by RUC for each trading hour, without regard to whether that capacity is RA or non-RA. The term "RUC Awards" refers to the amount of non-RA capacity procured, which is eligible to bid a positive availability price for RUC and to be paid the nodal RUC availability price. As this report demonstrates, the quantity of RUC Awards in any given trading hour, if any, is a very small percentage of the RUC Capacity procured for that hour.

Table 1 – Unique Conditions in Structured Market Simulation

Condition or Parameter	**Structured Market Simulation**	**Production (After MRTU Start-up)**	**Outcome**
RUC Bids for Non-Must Offer Resource Adequacy Units	Bids submitted by ISO based on the minimum of either the registered RA Capacity or the highest energy bid quantity on the energy bid curve submitted to the Day-Ahead Market	Bids for Non-Must Offer RA units will be submitted by market participants based on their submitted RA use plans	RA Non-Must offer unit bidding behavior not necessarily realistic in Market Simulation.
Adjustments to RUC target based on expected Real-Time Incremental Supply Self-Schedules and intermittent resource supply not scheduled in IFM	Not incorporated into calculation of RUC target in market simulation	Will be incorporated into the calculation of the RUC target	Higher RUC target in market simulation than will see in production
Maximum Energy [3]Constraint - This constraint limits the total quantity of IFM Energy Schedules plus RUC Minimum Load Energy to be less than a percentage of the total RUC target	Set to 90% during structured test days analyzed in this study. Now set to 99% in market simulation	To be determined but somewhere between 95% to 100%	Low setting in market simulation limited unit commitment in RUC so as to avoid procuring minimum load energy, mainly in cases where the IFM cleared at least 90% of forecast
Short Start Unit [4]Capacity Constraint	Set to 75% during structured test days analyzed in this study	To be determined but range may be set between 75% and 100%	The total capacity of Short Start units committed in RUC must be less than or equal to 75% of

[3] For more information on the Maximum Energy Constraint please see the BPM For Market Operations section 6.7.2.7.2 at http://www.caiso.com/2054/2054afab56e90.doc#_Toc210186781

[4] For more information see BPM for Market Operations section 6.7.2.7.3

			the total Short Start Unit capacity available to the CAISO
Base Case Scenarios	Base Case 0 – (Dec 6, Dec 9) Cost-based bids, 90-95% cleared in IFM, DA forecast equals RT actual load	Not applicable	Created specific market conditions in order to test certain aspects of market performance which affected market results. Note that Base Case 3 did not affect RUC because real-time load was realized after RUC was run.
	Base Case 1 (Dec 10)– Same as Base – 0 except only 85% of the load clears the IFM		
	Base Case 2 (Dec 11) – Same as Base– 0 except create extreme generator bids in load pockets		
	Base Case 3 (Dec 12) – Same as Base - except real-time load forecast was 5% higher in all IOU territories		

A detailed review of the RUC results for the structured market simulations is described in Section 3 and 4 below.

3. RUC Prices and Costs

Figure 1 and Figure 2 show the amount of RUC capacity procured by the ISO for all hours of the structured test period as well as the quantity of RUC awards to non-RA capacity. Figure 2 is an expanded-scale version of Figure 1 to show the magnitude of RUC awards.

With the exception of December 10 there were a small number of hours during the structured test days where RUC was awarded to non-RA capacity. On December 10 this occurred for a period of eleven hours from HE 12 – HE 23, which is not surprising because Dec 10 was the structured test day where base case 1 was used to clear load in the IFM at 85% of the load forecast. This scenario, as expected, resulted in significantly more RUC capacity procured especially in peak hours, on this trade day.

The quantity of RA Capacity procured by the ISO was consistent throughout most of the test days ranging from 0 MW in the low load hours to 2,694 MW during peak hours. Again, December 10 was the exception where RUC capacity procured was as high as 6,322 MW in HE 16 with 117 MW of RUC awarded to non-RA capacity.

When RUC awards did occur, the quantities during the test period were minor, ranging from a minimum of 11 MW to a maximum of 117 MW for hour 16 on December 10.

Figure 1. RUC Capacity and RUC Awards for all Hours (Dec 6, Dec 9-Dec 12)

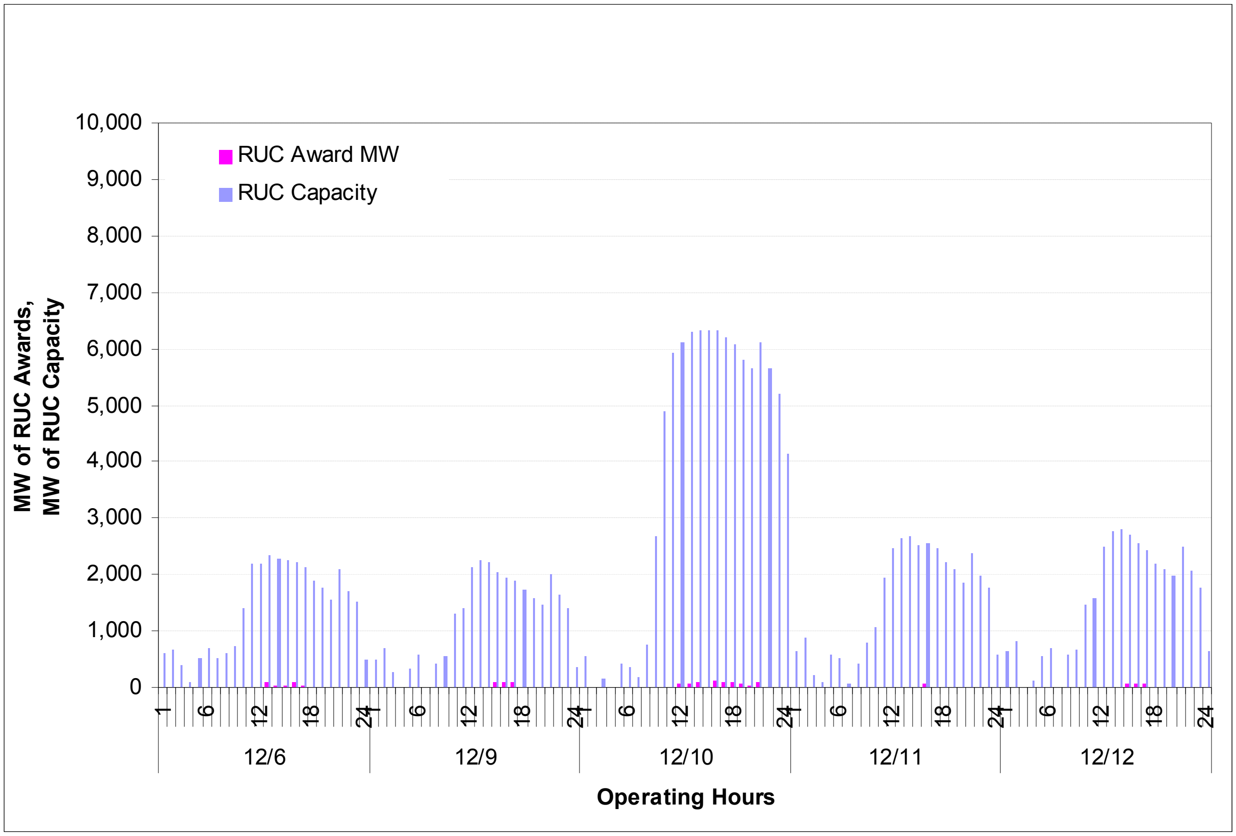


Figure 2. – Magnified to Show RUC Awards

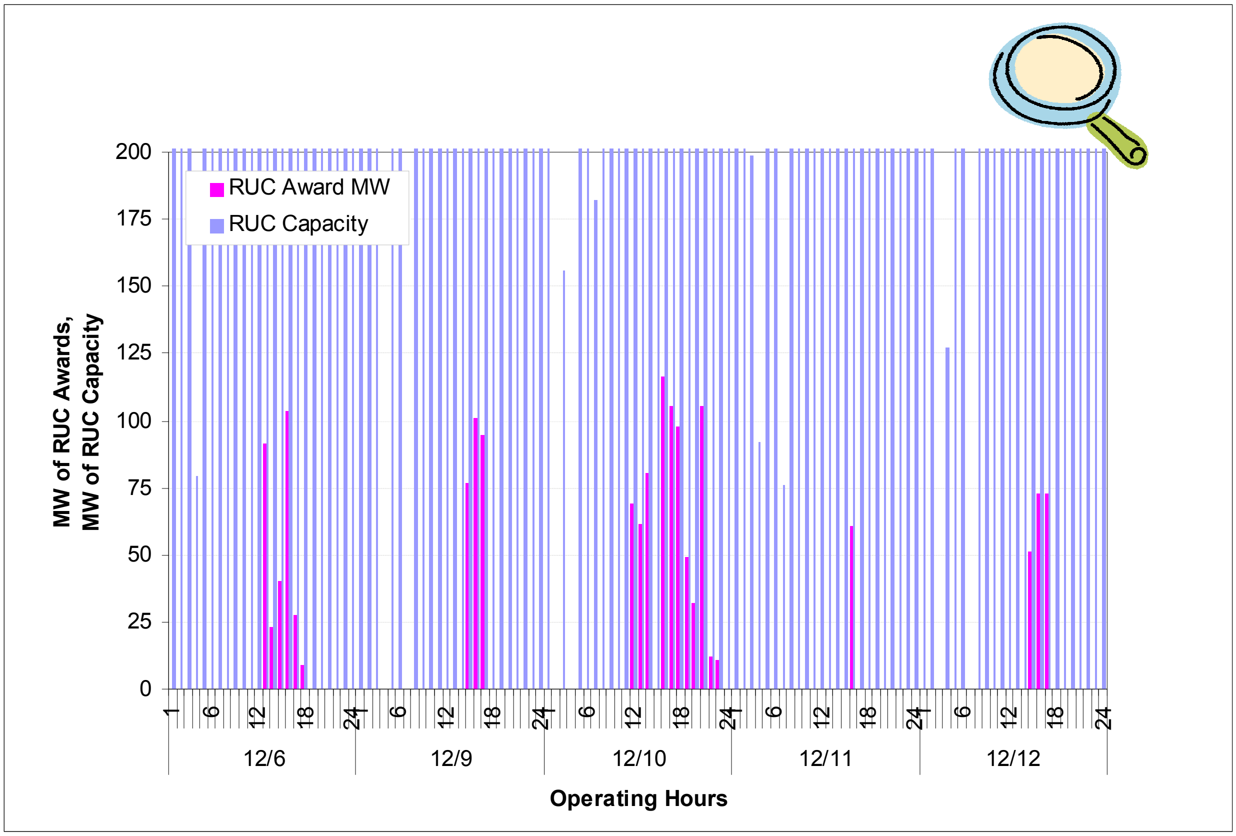
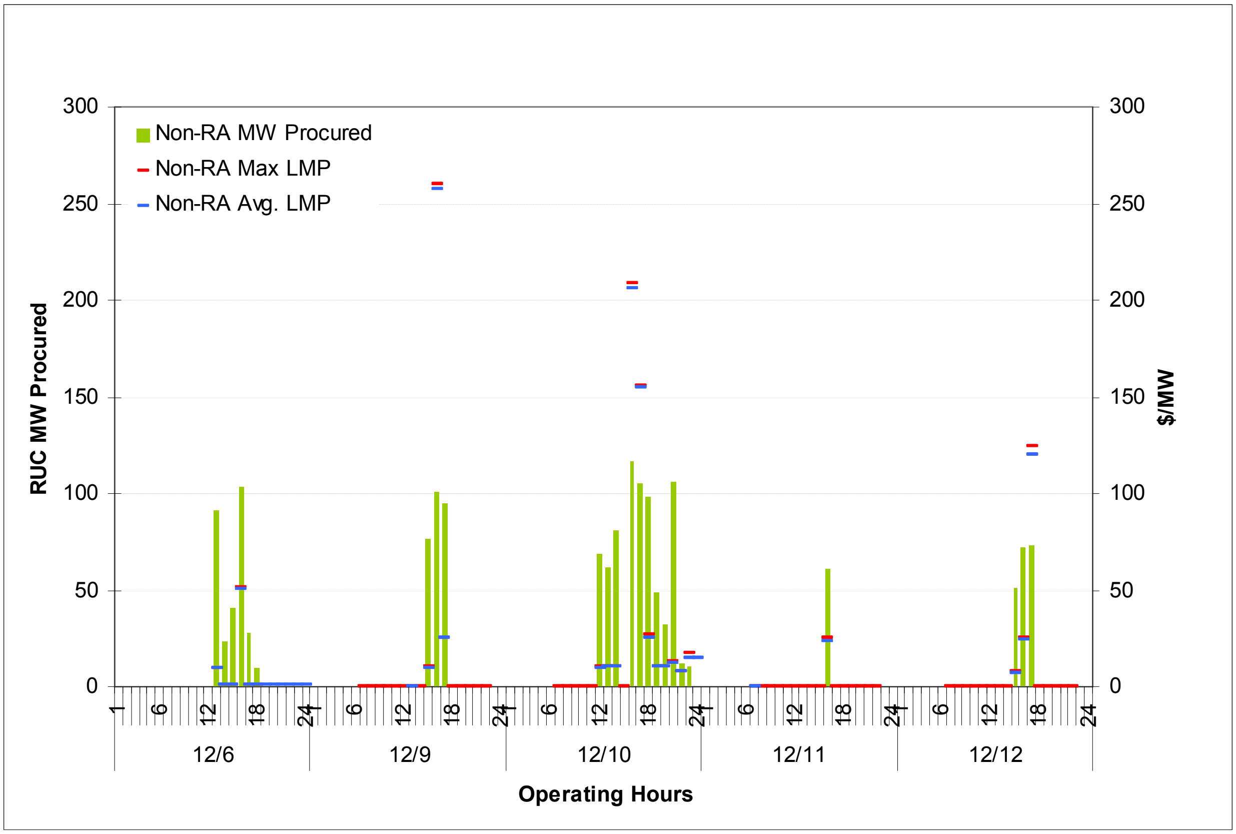


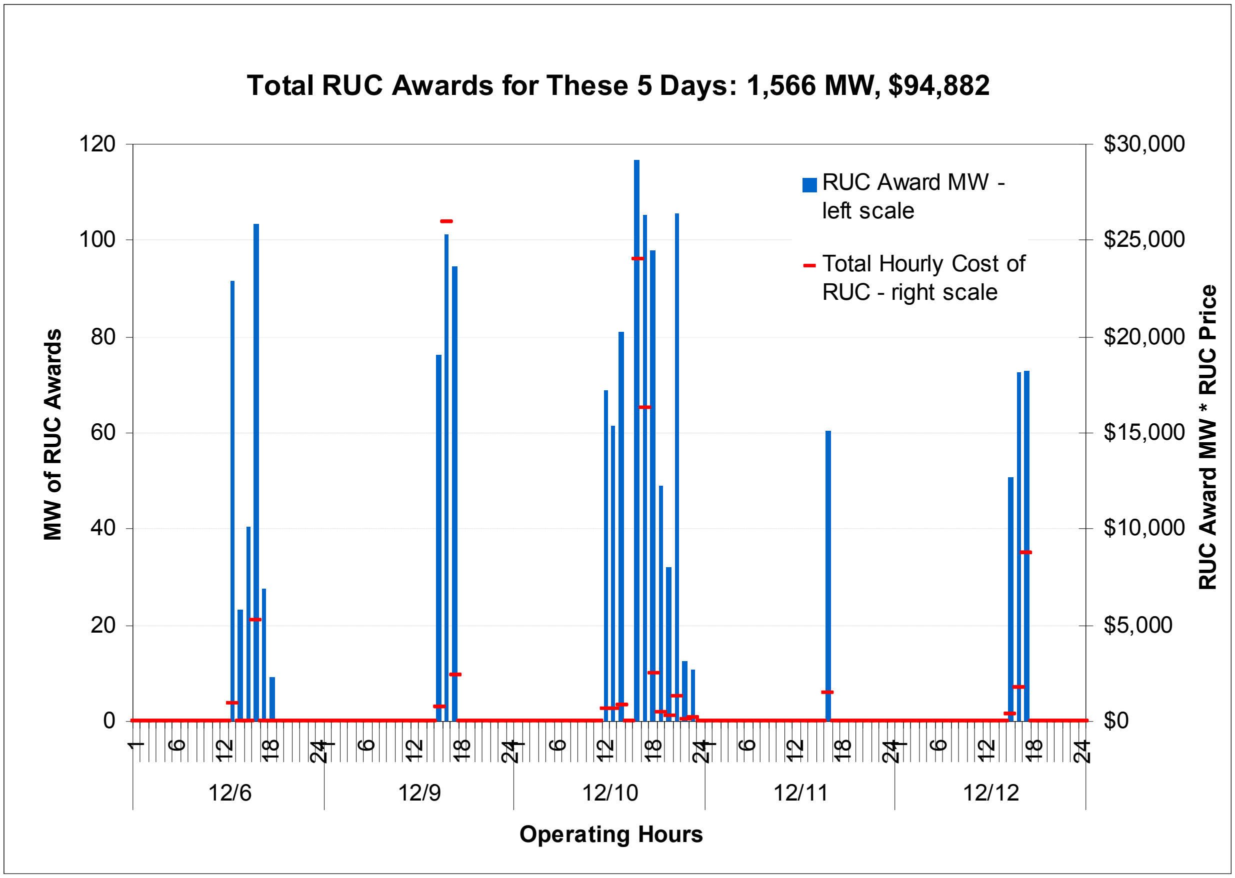
Figure 3 shows the hourly quantities of RUC awards to non-RA capacity and the average and maximum RUC LMPs paid for that capacity. As shown in figure 3, prices were generally moderate with the majority of hourly RUC LMPs at $25 or less at locations where there were RUC awards, and only four hours with RUC LMPs over $100/MW. The highest price occurred in hour 16 on December 9th where the RUC LMP range was 247 – 260. These prices were driven by the relaxation of several flowgates since the pricing parameter for flowgate relaxation is $250.

Figure 3. Maximum and Average RUC LMPs paid for Non-RA Capacity



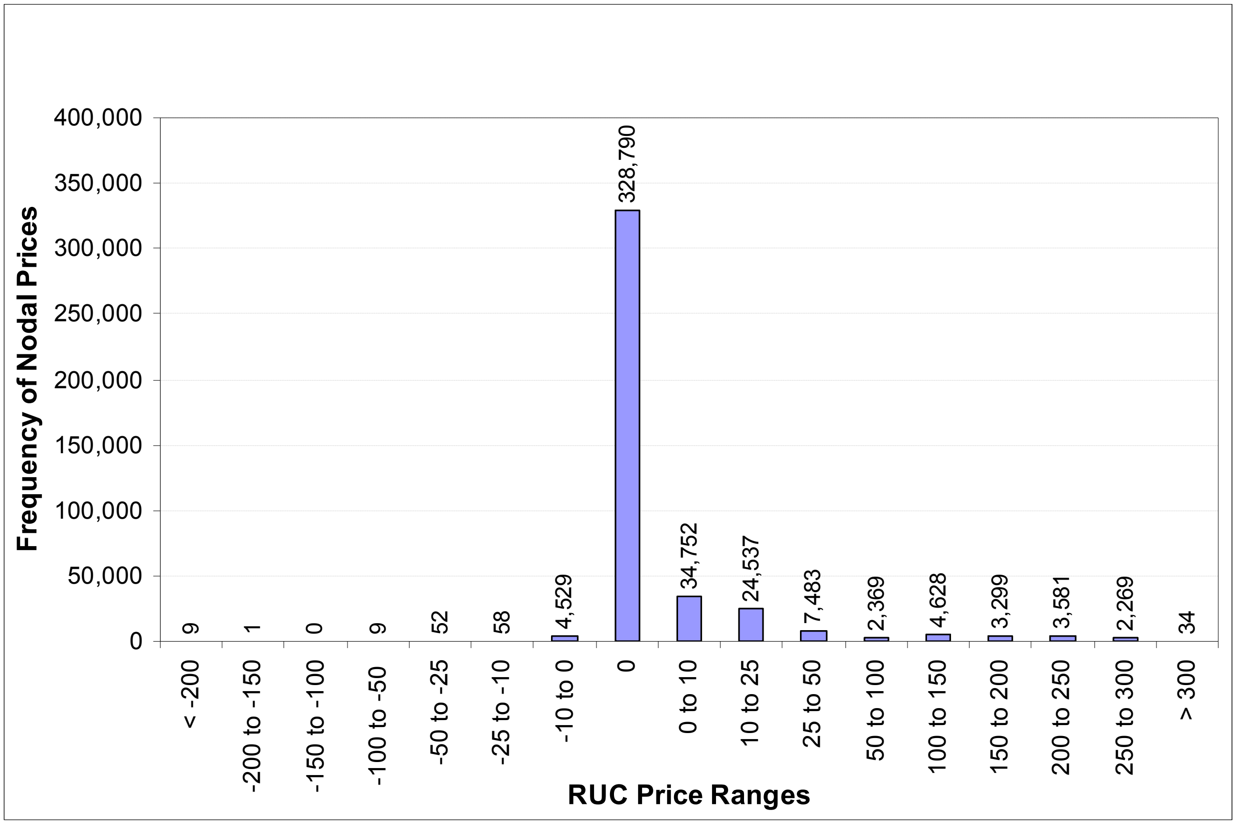
For the entire structured test period the total cost to the market for RUC Awards was minimal, $94,882 for 1,566 MW of RUC capacity. In comparison, the cost for energy in the Day-Ahead market during this period was approximately $235,606,000 for 3,165,000 MW of energy. This cost for RUC awards is illustrated in Figure 4 which shows the total hourly cost for RUC capacity for each of the test days.

Figure 4. Total Cost for RUC Awards All Hours



Concerns were raised by some market participants about the frequency of high RUC LMPs throughout the grid during the structured market simulation test days, irrespective of whether there were any RUC awards associated with most of those LMPs. Figure 5 shows a frequency distribution of RUC LMPs across all network nodes and all hours of the 5 day test period. Results show that 88% of the nodal prices over the 5 day period were at zero or very close to zero within a range of -$10 to +$10.

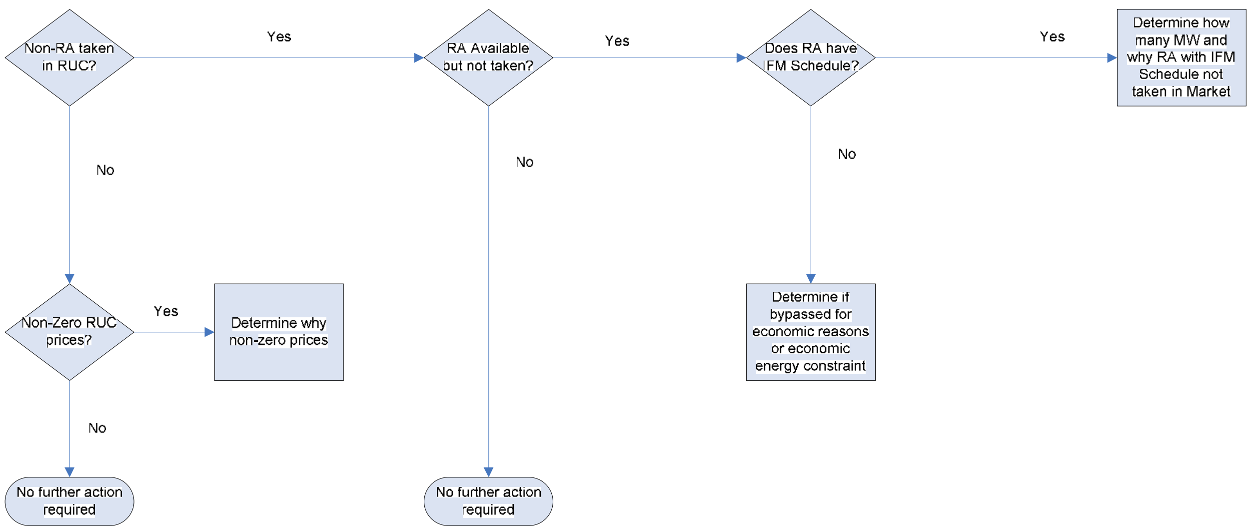
Figure 5. Frequency of RUC Nodal Prices



4. Causal Factors of RUC Prices

Figure 6 shows the decision tree upon which the ISO based the analysis of the data to determine the causal factors of RUC prices.

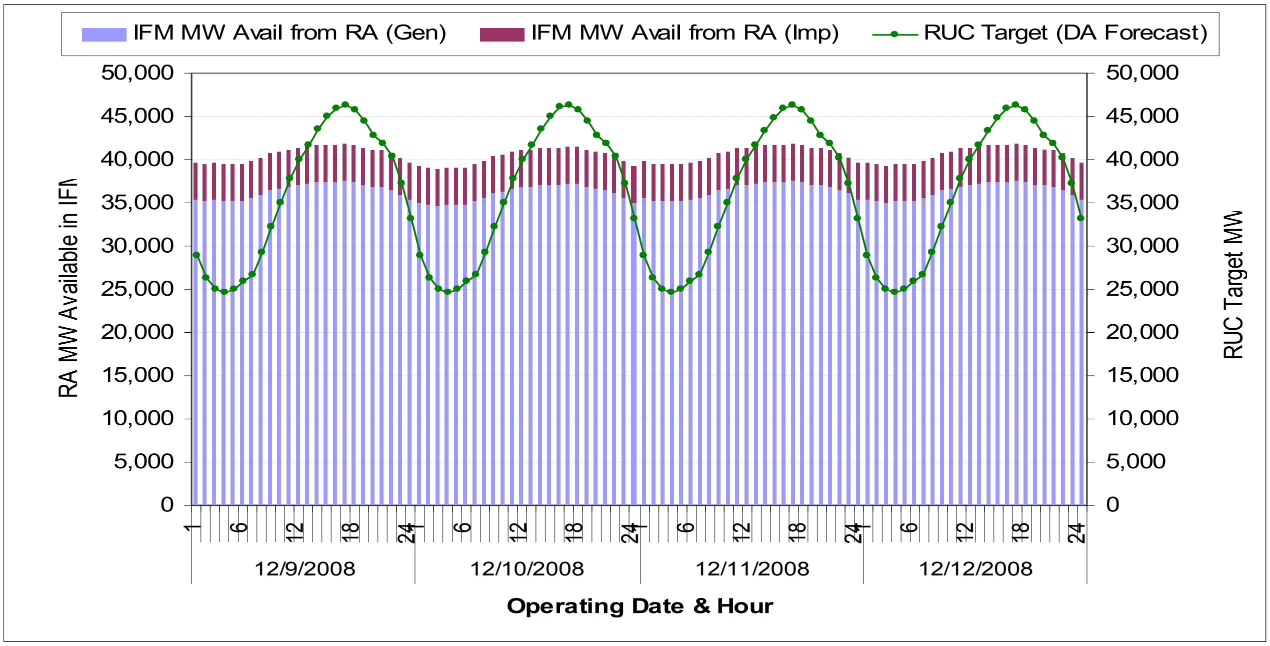
Figure 6. RUC Analysis Decision Tree



As explained in Department of Market Monitoring report "Review of California ISO MRTU Structured Market Simulation Results Trade Days – December 9 – 12, 2008," the identified RA capacity available to the IFM[5] (import and generation resources) was about 5,000 MW short across the peak hour based on the peak load forecast in the structured simulation of 46,000 MW. Figure 7 below, which was obtained from DMM's report, shows the hours where this shortage occurred during the five test days. About 18% of the July 2008 RA showings (approximately 9,400 MW out of 52,000MW) is comprised of non-resource specific resources (liquidated damages (LD) contracts) which the CAISO markets have no ability to identify, and an additional approximately 2,700 MW is comprised of emergency Demand Response which do not participate in the markets. For more details please see DMM's report.

[5] Including RA capacity available to the MPM-RRD procedure, which is run prior to the IFM.

Figure 7. Comparison of RA Capacity Available to IFM to DA Load Forecast (December 9-11)[6]



RUC was awarded to non-RA capacity in a number of hours in each of the structured test days. Figure 8 shows the quantity of RUC award for each hour as well as how much RA capacity was available but not utilized in the market for each of those hours. Available RA capacity means RA capacity that was offered into the DAM and was not taken for energy or ancillary services in the IFM.[7] The RA capacity that was not utilized in the RUC process is broken down into two categories: (1) RA capacity for which the underlying generator had no IFM schedule (the light blue portion of bar), and (2) RA capacity available from resources that had an IFM schedule for that hour, designated "RA capacity other" (the dark blue portion of the bar).

If the RA capacity was in the first category, that capacity could have been skipped in RUC for either of two reasons. First, the RUC optimization could have determined that it would be more costly to incur the start-up and minimum load costs of that capacity than to utilize available capacity from resources already committed in the IFM. Alternatively, the RUC optimization could have hit the maximum energy constraint, so that the additional minimum load energy from committing a resource that was not committed in the IFM would have violated that constraint. Since the maximum energy constraint was set to 90 percent for the structured testing, it would be

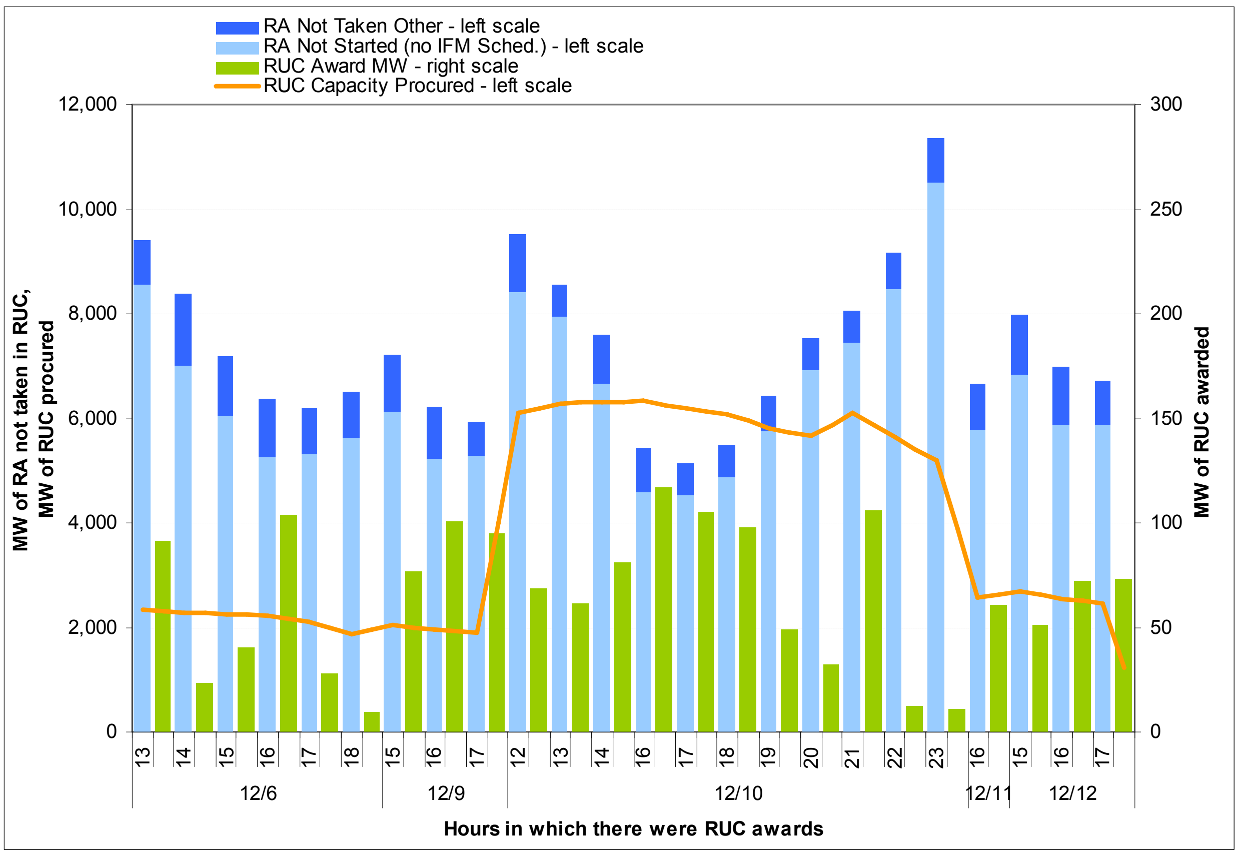
6 Chart obtained from "Review of California ISO MRTU Structured Market Simulation Results Trade Days – December 9 – 12 , 2008", Figure 1, page 11

7 In some cases, some relatively small quantities of RA capacity that was offered into the DAM and not explicitly taken in the IFM for energy or ancillary services might not be available in RUC because of certain operating characteristics of the resource related to its ability to provide regulation service. In such cases the sum of the RA capacity scheduled in the IFM plus the RA capacity available in RUC would be slightly less than the total RA capacity of the resource. The data set discussed in this section accounts for such cases in calculating RA capacity available in RUC.

binding in any hour where the IFM cleared at least 90 percent of the load forecast. This occurred in most hours of the simulation with the exception of December 10 where the scenario for that day was set for the IFM to clear at 85 percent of the load forecast. Thus, in all structured testing hours except for the December 10 hours, the maximum energy limit was a factor that caused RUC not to commit additional units.

The category of available RA capacity "other" means that the RA was skipped by the RUC procedure for reasons other than not being started up or in other words, not having an IFM schedule. Those reasons include for the most part, congestion constraints and ramp limitations. The discussion below provides more detail on the trade days within the market simulation where these were the causal factors.

Figure 8. RA not Taken in RUC and RUC Capacity Procured and Awarded



As Figure 8 indicates, most of the RA capacity that was not utilized in RUC in the hours where there were RUC awards was RA capacity associated with resources that did not have an IFM schedule. Consistent with the bid-cost minimizing objective function in RUC, the RUC optimization may have avoided start-up and minimum-load costs for offline RA units and instead have paid the RUC price to a non-RA unit in order to minimize total RUC bid cost over the 24-

hour optimization horizon. Although RUC commitment of a "quick start" resource[8] does not result in a binding start-up instruction unless and until the resource is determined to be needed in one of the next day's real-time market commitment processes, the RUC objective function considers start-up and no-load costs for all offline units including the quick start units.[9] The RUC process will only issue binding start-up instructions to units with a start-up time of 5 hours or more. Alternatively, RUC may have avoided committing RA resources due to the maximum energy limit discussed above. As noted, this limit was binding in all structured testing hours in which the IFM cleared above 90 percent of the load forecast, which includes all the test days and hours except for December 10.

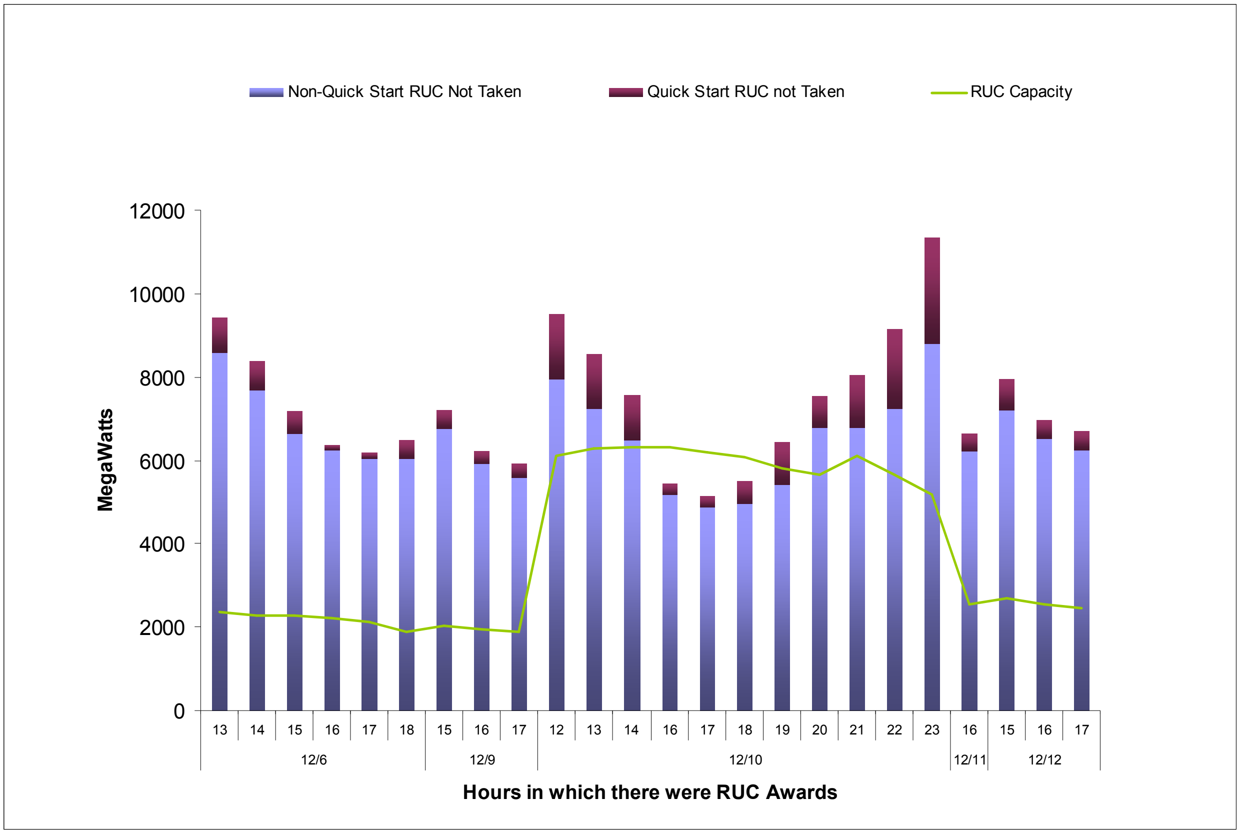
Figure 9 shows the quantity of RA capacity not utilized in the RUC process with a start-up time of less than five hours in the hours where there were RUC awards. The quantity of quick start RA capacity not utilized was very small in most hours with the exception of Dec 10 where there was as much as 1500 to 2500 MW of quick start capacity not utilized in RUC.

8 The different flavors of "quick start" resources – consisting of Fast, Short or Medium Start resources – have start-up times that are no greater than five hours, which is short enough to be started up in a timely manner within the unit commitment processes of the next day's Real Time Market.

9 Some market participants have suggested that the RUC optimization should be changed to ignore the start-up and minimum load costs of these quick start units since they will not be given binding start-up instructions in the RUC process and may not even be utilized the next day. Such a modification must be weighed carefully because it could have the unintended consequence of biasing RUC toward reliance on quick-start units when it might be more efficient to commit additional long-start capacity in the day-ahead time frame. The ISO has looked into the possibility of having RUC ignore the commitment costs of quick-start units, and if production experience in the new market environment were to indicate that this change would be appropriate and cost effective, the ISO would revisit it at that time.

Figure 9. Quick Start RA Capacity Not Utilized in RUC

(Dec 6, Dec 9 – 12)



The RA Capacity not taken category type of "other" comprised a small quantity of RA capacity that was not utilized in RUC in the hours where there were RUC awards. There are many possible causes of skipping RA capacity and using non-RA resources in the RUC, including transmission constraints and ramping limitations**.**

Table 2 provides a more detailed summary of the reasons why there was non-RA capacity awarded on each of the structured testing days.

Table 2. Reasons for Non-RA RUC Awards

December 6	▪ More economic to procure capacity from on-line non-RA capacity and avoid SU/ML cost of committing RA in some hours ▪ Maximum energy constraint binding ▪ A number of inter-tie scheduling points at maximum capacity in

	the IFM which prevented utilization of some RA capacity available from inter-ties
December 9	▪ More economic to procure capacity from on-line non-RA capacity in some hours ▪ Maximum energy constraint binding ▪ A number of inter-tie scheduling points at maximum capacity in the IFM which prevented utilization of some RA capacity available from inter-ties ▪ Congestion occurred resulting in the relaxation of several flow gates ▪ Several units had ramp limitations and could not be utilized for additional capacity ▪ RA Resource needed to mitigate a line and moved down ▪ Colgate nomogram congestion impacted the use of several RA units
December 10	▪ More economic to procure capacity from on-line non-RA capacity in some hours ▪ A number of inter-tie scheduling points at maximum capacity in the IFM which prevented utilization of some RA capacity available from inter-ties ▪ Several units had ramp limitations and could not be utilized for additional capacity
December 11	▪ More economic to procure capacity from on-line non-RA capacity in some hours ▪ A number of inter-tie scheduling points at maximum capacity in the IFM which prevented utilization of some RA capacity available from inter-ties ▪ Colgate nomogram congestion impacted the use of several RA units
December 12	▪ More economic to procure capacity from on-line non-RA capacity in some hours ▪ A number of inter-tie scheduling points at maximum capacity in the IFM which prevented utilization of some RA capacity available from inter-ties ▪ Colgate nomogram congestion impacted the use of several RA units

5. Conclusions and Next Steps

Based on the findings discussed above, the ISO is confident that the results and performance of RUC are consistent with the FERC-approved RUC design. Most importantly these findings do not indicate any flaws in either the design or the implementation of RUC that could jeopardize the successful launch and performance of the new MRTU market structure.

As noted earlier, the MRTU tariff specifies some important features of RUC that were not activated in market simulation but will be activated in the production environment, and that are expected to moderate both the magnitude of RUC capacity procurement and the extent to which RUC utilizes non-RA capacity. Specifically, in production the RUC procedure will:

- Utilize an adjustment to the RUC procurement target to reflect additional supply self-schedules expected to be submitted in the real-time market based on recent comparable hours;
- Utilize an adjustment to the RUC procurement target to reflect additional supply expected from intermittent generating resources that do not schedule in the day-ahead market; and
- Set the maximum energy limit in RUC to a high enough level that it will not prevent the RUC procedure from procuring additional minimum load energy when it might otherwise be economic to do so. As noted this limit was set to 90 percent in structured testing, a value that proved to be too low in many hours because the amount of energy scheduled in the IFM was greater than 90 percent. In such cases the maximum energy limit would prevent any further unit commitment in RUC, even if the start-up and minimum load costs are small. Subsequently the limit has been set to 99 percent and the ISO currently expects to retain this level for MRTU launch.

The findings described in this report also reinforce an observation made by the DMM in its January 16 report on the structured testing, namely, that during peak hours there was not enough RA capacity offered into the day-ahead market to supply the forecast load. This observation may not immediately appear to be important, given the fact that there seemed to be enough available RA capacity in all hours in which non-RA capacity was awarded RUC. At the same time, given the frequency with which the RA capacity was not taken due to transmission constraints and ramping limitations, it is quite possible that the availability of greater quantities of RA capacity could have obviated the need for RUC to utilize non-RA capacity. Thus the occurrence of non-RA RUC awards and the corresponding prices may be important signals to those entities that control use-limited RA and other non-resource specific RA capacity, which is not subject to the RA must offer obligation, to offer more of that capacity into the day-ahead market when high loads are expected. Finally, it is important to bear in mind the caveat that the participant behavior observed in market simulation cannot be assumed to be an accurate predictor of participant behavior in production when the results of the market are financially binding. Behavior will change with market launch and the resulting market outcomes will differ from those of market simulation. The ISO is committed, both before the March 31 launch and in production, to continuously and diligently monitor the performance and results of RUC and all other elements of the new market structure, so that any anomalous or extreme results will be identified and analyzed promptly and any problems addressed. For the longer term, the ISO has identified the RUC design as a topic for discussion in the post-launch stakeholder process to finalize the design of convergence bidding, to ensure full compatibility between these two market elements.