Comments of Southern California Edison on the Need for Immediate Action to Reform the Current Residual Unit Commitment (RUC) Process

December 19, 2008

I. Introduction & Background

In light of RUC prices produced in simulations, the CAISO initiated a stakeholder process on 12/11/08 to revisit the RUC process and to determine if modifications to RUC are appropriate. SCE presented material at the meeting indicating our concerns with RUC and a proposed solution. The presentation is posted at http://www.caiso.com/209b/209bbf236eb40.pdf. On 12/15/08 the CAISO issued a Market Notice inviting stakeholders to submit comments on the issue. SCE appreciates the opportunity to provide comments on this important issue.

For clarity, SCE fully supports the need for a CAISO mechanism to commit additional capacity after the IFM if it is needed for reliability (i.e. we support a Residual Unit Commitment process). What we object to is the price formation mechanism of the current RUC process, and the resulting prices. We note that while all ISO/RTOs have a mechanism to commit additional capacity for reliability, the CAISO is the *only* ISO that attempts to price this capacity, and then price it on a nodal level.

Per our presentation, SCE continues to believe the methodology used to prices RUC suffers from serious structural deficiencies. As a result, it will not produce prices reflective of the capacity available to the market from California's Resource Adequacy (RA) program, and it will fail to meet the statutory requirements of producing just and reasonable rates.

As detailed within, SCE offers a reasoned solution to this problem: Continue to use the current RUC infrastructure, but run the process off-line using only RA capacity. If non-RA units are needed to maintain reliability, and these units must be committed in the day-ahead timeframe, issue these units an Exceptional Dispatch and offer them a monthly ICPM contract. No RUC prices will be published, but all other RUC functionality (RUC dispatch instructions, settlements) will continue with the existing software.

Due to the serious nature of this problem, the CAISO should immediately file with FERC to modify the RUC process per SCE's proposal. We believe a timely filing in late December or early January, in conjunction with our proposed solution, will not compromise MRTU's start date of April 1, 2009, and will eliminate a problem that otherwise will threaten the success of both MRTU and California's RA program.

II. Market Simulations Provide Conclusive Evidence that RUC cannot be Relied Upon to Produce Just and Reasonable Rates

The CAISO has conducted market simulations for well over six months. In addition, the CAISO included two structure simulations that attempted, to the greatest degree possible, to simulate realistic market conditions and realistic bidding behavior. One set of simulations was actually performed in a "laboratory" environment to control the exact bids that went in to the process.

In all of these simulations, RUC has produced results that are at times extreme, highly volatile, and simply not reflective of the fact that California has a locational RA program that provides the CAISO with at least 115% of their capacity needs for the peak of every month.

Specifically, we observe the following from the simulations:

1) Extreme RUC capacity prices (at the RUC cap of $250/MW or greater) in specific locations, even with very small RUC purchases of less than 100MW.

2) Frequent deep negative prices (below -$25/MW), sometimes system-wide.

3) Frequent high ($50/MW or greater) or extreme high prices (above the bid cap of $250/MW) system wide prices during peak hours.

4) Consistent high system-wide prices (typically above $50/MW) during hour16 and/or hour 17 in most structure simulation cases.

5) Frequent extreme price swings hour-to-hour, such as prices below $10/MW in hour 15 and then jumping to over $200/MW in HE16.

6) High RUC prices – sometimes system wide- at the same time that $0 bid RA capacity is not selected.

7) Frequent high RUC prices in specific areas.

For example, Figure 1 below is an ISO graph of RUC prices from the recent simulations of November 10 through November 14[1]. We observe that RUC regularly produced non-zero prices during the hours 12-23. Price had extreme ranges from about $250/MW to below -$100/MW.

[1] Source: CAISO Weekly Pricing Review Report at http://www.caiso.com/2083/208385011e3f0.pdf page 5

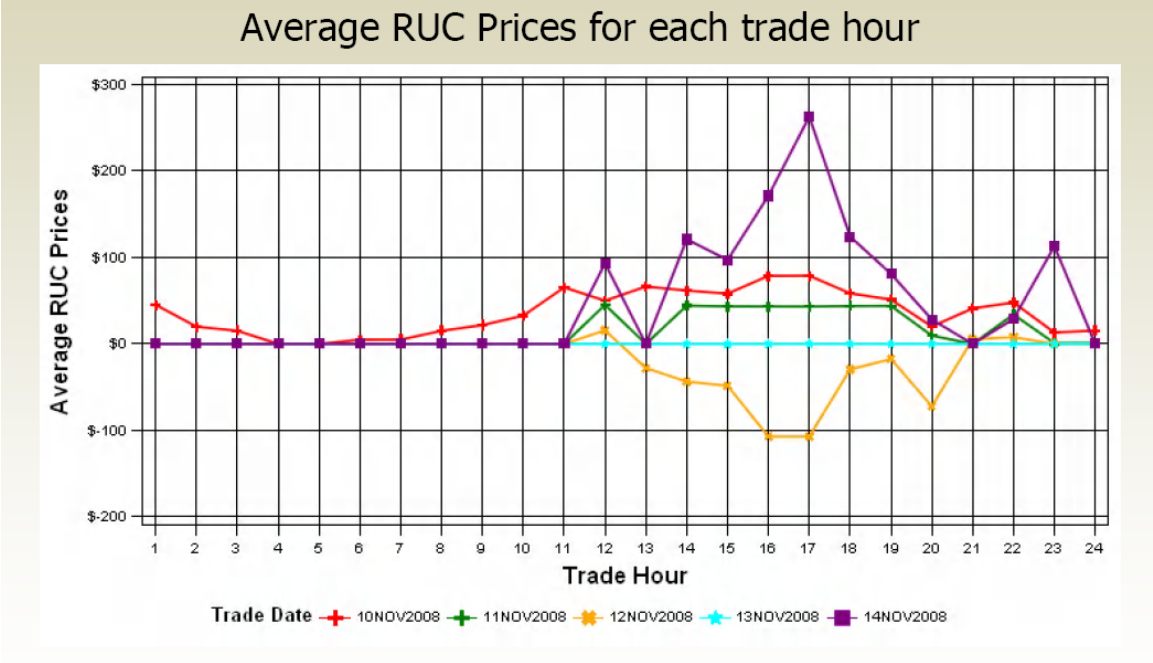


Figure 1: RUC prices November 10 – 14.

While the November simulation certainly lacked controls, the CAISO has recently completed a very controlled simulation. The point of the simulation was to see how the software would perform with a controlled set of bids that, in the CAISO's view, reasonably reflected what they expect actual bids will resemble when MRTU goes live. The result of RUC prices for typical units in the PG&E, SCE and SDG&E areas from this controlled simulation are shown in Figures 2a-2d. We again note price spikes on every day of the four-day simulation. Spikes consistently occur in hours 16 and/or 17, with the highest prices exceeding $250/MW. We also continue to observe extreme price volatility, with prices between hours (around the spikes) at times exceeding $200/MW.

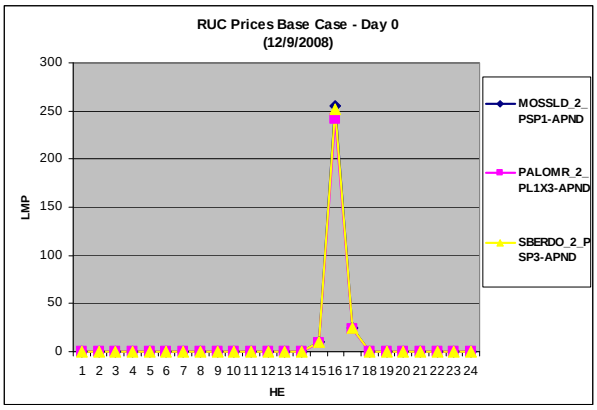


Figure 2a: Day 0

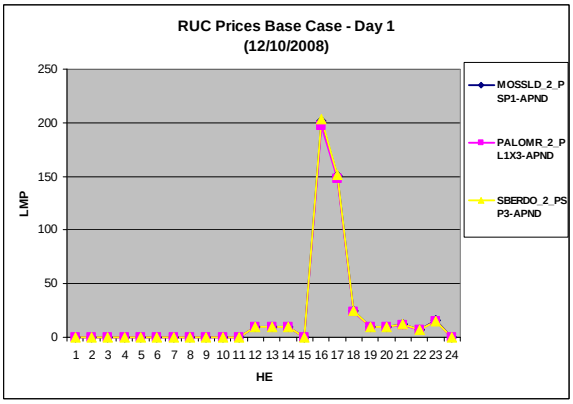


Figure 2b: Day 1

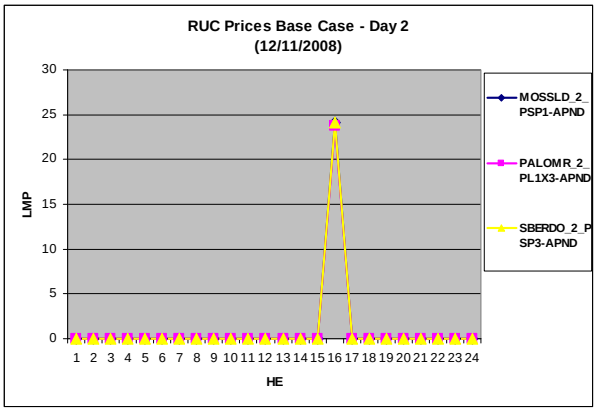


Figure 2c: Day 2

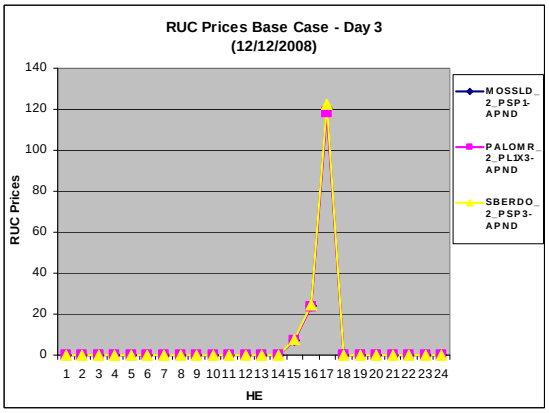


Figure 2d: Day 3

Figure 3 show the results of an earlier structured test[2]. This test was also performed in a controlled simulation environment, with the CAISO submitting all bids. The green dashes represent average RUC LMPs by hour and the red dashes represent maximum RUC LMPs. Base Case 0 was designed to clear at least 95% of the CAISO forecast in every hour of the market. It was intended to represent a near ideal situation from a bidding perspective. This simulation also shows RUC prices are extreme, even in hours when minimal quantities of RUC are procured. For example, in hour 4 less than 200MW is purchased, yet we see average RUC prices of about $250/MW (green dash) and maximum nodal RUC prices exceeding $400/MW (red dash).

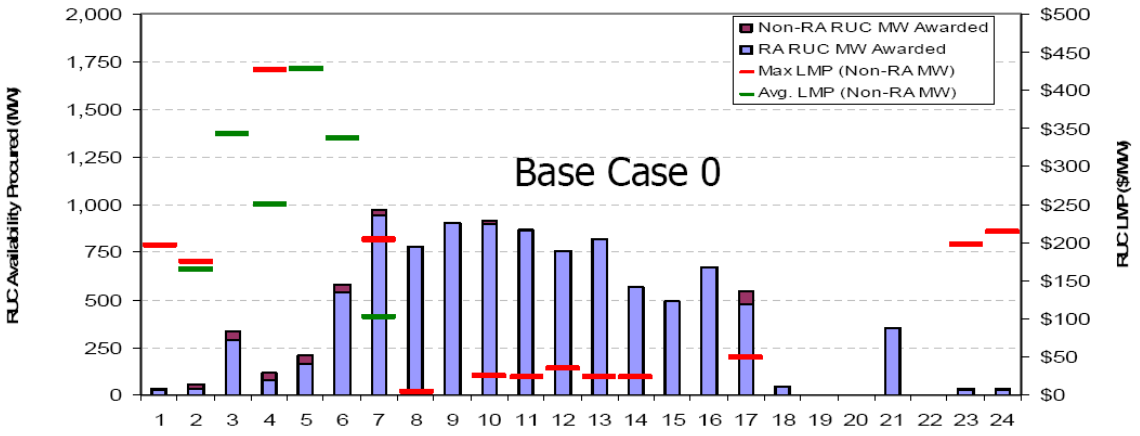


Figure 3: RUC prices from the original structured simulation

Figure 4 shows simulation results from the period of 11/27/08 through 12/18/08 for a generating facility that SCE schedules, Mountainview. This graph demonstrates that

[2] Review of MRTU Base-Case Modeling Results – Day Ahead Market, November 21, 2008. Found at http://www.caiso.com/2086/208674a846140.pdf

RUC prices of $50 or more are not rare and random events, rather they occur frequently, with a particularly high likelihood of price spikes between hours 15 through 18.

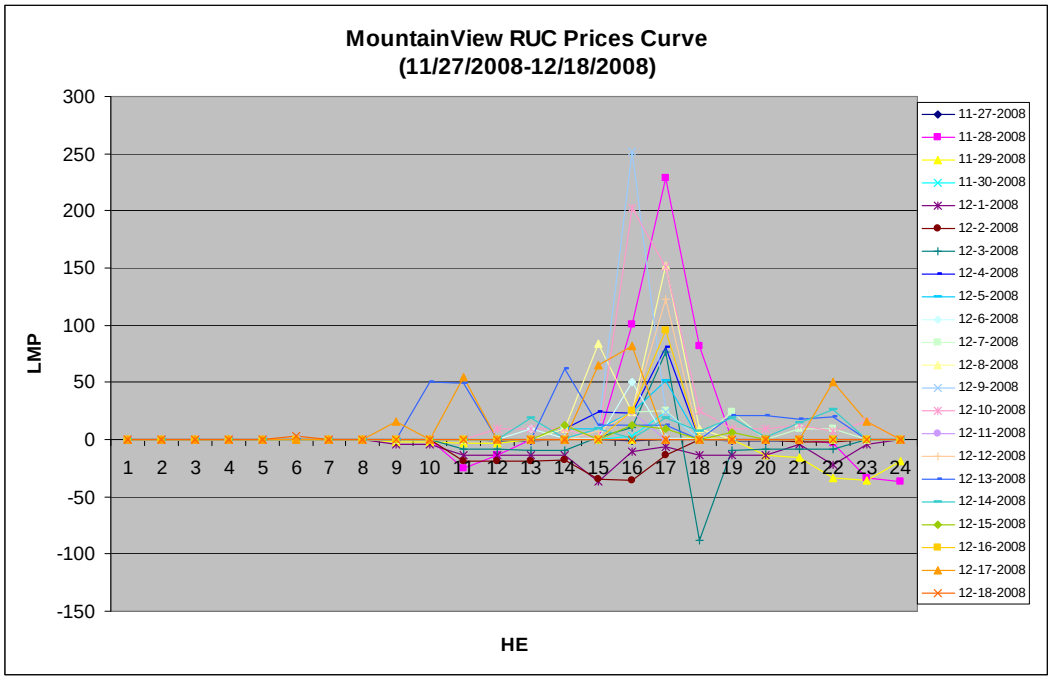
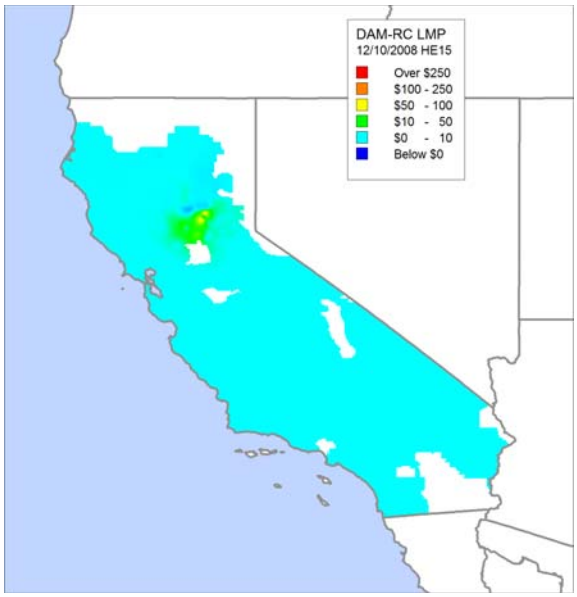


Figure 4: RUC prices for SCE's Mountainview unit during recent simulations

Figure 5a and 5b demonstrate both the volatility and the extreme prices we see in RUC. The graphs are price heat maps that show a dramatic jump in RUC LMPs throughout the entire CAISO between hour 15 and hour 16 of the recent structure simulation. In hour 15 the CAISO is "blue" indicating RUC prices are below $10 throughout the CAISO. Hour 16 the CAISO turns "red" indicating prices are $250 or greater. RUC's pricing methodology is unstable; small increases in RUC purchases can cause prices to spike throughout the entire CAISO.



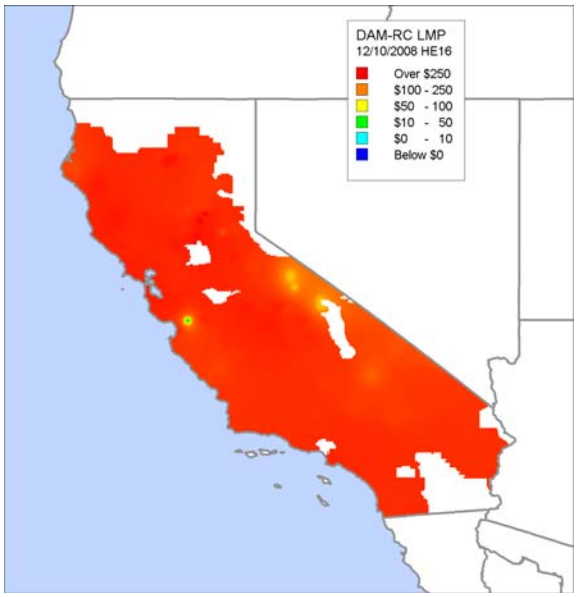


Figure 5a: Hour 15, Day 1 (below $10) Figure 5b: Hour 16, Day 1 ($250 or greater)

Collectively, and most cases individually, SCE views these results as clearly unjust and unreasonable. In every simulation environment – whether unstructured, participant structured or laboratory structured - we see extreme and highly volatile RUC prices. Moreover, these results are clearly inappropriate in the context of a RA market structure that already requires all loads in the CAISO to obtain locational capacity for every month of the year. For example, the IOUs and ESPs are required to secure 115-117% RA at least a month prior to the delivery month. However, as currently formulated, RUC frequently passes over these units. Moreover, the extreme volatility demonstrates price formation is unstable.

Local areas create additional problems because RUC lacks any local market power mitigation for non-RA units. We also see frequent instances of very high local prices. In the case of system-wide RUC prices, RUC produces produce price signals indicating insufficient RA capacity, even when this is clearly not the case given the existing RA requirements and the fact that RUC often skips over RA capacity during as part of its price formation process.

RUC's price formation methodology is the core problem, not the current RA program

Upon review of pricing results and further consideration of the algorithmic approach used in RUC, SCE has concluded the core problem lies with RUC's price formation process, sequential nature and the objective function. For emphasis, the core problem with RUC is not the current RA process, it is the approach used to set nodal prices.

Key problems of RUC's price formation include:

1) RUC is *sequential* to the day-ahead energy market

The MSC has also identified this as a key structural flaw to price formation in RUC. Every commitment and dispatch from day-ahead is now a "constraint" in the RUC process, and this makes it difficult or impossible for RUC to find a feasible solution, even if it exhausts all RA and economic bids. For example, units that have a schedule from the IFM cannot be moved down below their schedule without RUC applying a penalty price that is then incorporated in the price formation. Similarly, units that are committed in the IFM cannot be decommitted. Not only are many of these assumptions unrealistic from a real-world operational perspective (e.g. the CAISO can always turn a unit down/off in real-time) they create hundreds of additional constraints on top of all transmission, unit operation, bid constraints and contingency analysis used in the IFM. In short, RUC is over constrained due to this sequential nature. This makes it difficult for RUC to find solutions and results in high volatility between hours, and extreme prices that frequently incorporate penalty prices, as well as price that reflect high bids.

2) RUC's sequential process, with inelastic nodal demand requirements and nodal price production cannot be expected to produce just and reasonable results

In addition to the constraints noted above, in the sequential RUC process the CAISO introduces inelastic demand requirements at every node within the CAISO's grid. That is, each node's load requirement, as determined by the CAISO, must be satisfied irrespective of price. A sequential process that faces the myriad of constraints inherent to the gird plus the additional constraints as a result of the IFM results, that then must satisfy inelastic demand on a nodal level will have great difficulty finding economic solutions, and in many case solutions will not exist.

In effect, the CAISO waits for the results IFM supply schedules, and then "self-schedules" *all of this supply* in RUC. Then, the CAISO "self-schedules" *its entire* load forecast in RUC. As a result, RUC starts out with almost all supply and all load self-scheduled. The CAISO has continuously warned market participants that they should not submit excessive self-schedules in the IFM because this will make it difficult for the IFM to find solutions and will likely result in extreme prices. However, the CAISO fails to follow its own grave warnings and instead it

self-schedules just about everything in RUC. And the results are as predicted by the CAISO: extreme prices. This sequential, self-scheduled price formation process of RUC is simply too constrained for it to produce just and reasonable results.

3) RUC is not required to utilize all feasible RA capacity before selecting non-RA bids

RUC is not required to utilize RA units prior to selecting bids from non-RA or partial RA units. This is a key reason why we have observed system-wide RUC prices when RA units have been skipped over. This is also a key reason that the current RA process is not the core problem of RUC pricing. To see why this undermines price formation in RUC, consider a partial RA unit (e.g. a 100MW unit that sold 99MW of RA, and has 1 MW of non-RA capacity). Assume RUC needs 1 additional MW and the only option it has is to select the 1MW of non-RA capacity at a $250 MW-h bid or to select an RA unit that is not already committed. Even though the RA units are required to bid $0 for capacity, the optimization takes in to account the commitment costs (i.e. startup cost) of the RA unit. If the startup cost of the RA unit is greater than $250, the optimization will not select the $0 RA bid, and instead will select the 1MW of non-RA unit at $250. In the process, if this is a system need, prices for RUC in the CAISO will raise to about $250 even though there is $0 cost RA capacity available.

For emphasis, even if there was not just 1 RA unit available, but instead there where 100 different RA units, or a 1000, or even 10,000 uncommitted RA units available, the optimization would still select the $250/MW-h bid, and set prices to about $250/MW-h throughout all of the CAISO as long as this bid was below the startup cost of these RA units. RUC would still send a price signal to the market that we had a capacity shortage even if we had thousands of MW of uncommitted RA resources. *Thus, the solution to aberrant RUC prices is not to "fix the RA program"; rather it is to avoid the current RUC price formation process*.

4) RUC's objective function does not consider alternatives to RUC procurement

Another limitation of RUC's objective function, in conjunction with its sequential nature, is that it views RUC outcomes in complete isolation without any consideration of rational alternatives to RUC.

SCE has observed frequent instances in which RUC prices exceed the prices for ancillary services, and when RUC prices spike, they generally exceed day-ahead LMPs for energy.

RUC is, from an operational perspective an "inferior" product when compared to ancillary services. That is, RUC is just a promise that unit will follow CAISO commitment and output instructions in the future. Or put another way, RUC simply buys a must-offer requirement. In comparison, an ancillary service commitment for Spinning and/or Non-spinning reserves requires a unit to be either synchronized with the grid, or to be capable of being synchronized with the grid within 10 minutes *plus* a commitment to follow CAISO output instructions. Since ancillary services are operationally superior to RUC, this begs the question: Why not buy additional ancillary services instead of RUC? The same question holds for energy in some instances, and while ancillary services are zonal, MRTU can select energy on a nodal locational basis.

The answer is the sequential nature of RUC effectively precludes the ability to make any such rational substitutions.

5) RUC's objective function does not consider broader market impacts its flawed RUC prices will have on energy, ancillary services or RA capacity markets

If instead of being sequential, RUC was simultaneously cooptimized with energy and ancillary services, RUC prices would directly serve as an opportunity cost when valuing all other products in the IFM. This is fully analogous to how ancillary services are cooptimized today and opportunity costs are considered in pricing these services. For example, under MRTU if a unit is selected to provide Spinning Reserves, the clearing price for Spin reflect the unit's Spin bid plus any lost opportunity cost the unit incurs by forgoing energy sales. If RUC were included as part of this simultaneous cooptimization, the Spin prices would further reflect any opportunity cost of selling RUC instead of Spin. There should be no room for disagreement that under a simultaneous formulation the opportunity cost of RUC would enter directly into prices for energy and ancillary services.

However, we do not currently have a simultaneous cooptimization of RUC; we nevertheless have transparent RUC prices. And since the IFM will not directly consider these opportunity costs, it is economically rational to assume bidders will consider *expected* RUC prices, and attempt to internalize these RUC opportunity costs as they formulate their IFM bids for energy and ancillary services. And given all of the serious flaws in RUC's current price formation, *these opportunity costs will be artificially inflated* relative to a more efficient formulation of RUC procurement or a RUC-like process used in other ISOs. Moreover, these distorted RUC prices will also enter into the calculation of what a generator will be willing to sell its RA capacity for on a forward basis. Distorted RUC prices should be expected to distort energy bids and in turn energy prices as well as RA prices.

The RUC objective function is completely oblivious to the impacts and costs its flawed prices will have on IFM energy, ancillary services and RA markets. And unlike RUC, these markets are massive in their clearing volume. The CAISO served an adjusted load in 2007 of 242,265,000 MWh[3]. Moreover, the CAISO has total capacity requirements of about 50,000,000 kW-year. *If the current RUC process distorts energy and capacity prices by just 1% on average, the resulting societal cost would be over $350 million[4] per year*. Clearly any consideration of the fiscal impact on other markets would drive the RUC process to a "RA-first" process that would select RA resources whenever possible to avoid creating artificial high price signals and resulting behavioral reaction.

6) RUC fails to recognize real-world operational solutions to contingencies

In discussions with the CAISO, it has become apparent that the "solutions" produced in RUC do not always reflect real-world operational solutions. That is, RUC not only models transmission flows, it also models around 100 different contingencies that are not expected, but that could happen unexpectedly in real-time. In various conversations, CAISO staff has indicated that the solution RUC is trying to find (e.g. dispatch additional units in very specific locations) is not the proper operating solution if the contingency does in fact happen in real-time. For example, prudent operating procedures/practices might curtail very local load, or interrupt pump loads on the rare instance that a contingency actually comes to fruition in real-time.

Once again, the objective function is oblivious to these real-world operational solutions. Worse yet, the RUC "solution" may include violating constraints at high penalty prices, and in turn establishing artificially high administratively set RUC prices in the process. Again the solution is hampered by the sequential nature of RUC and additional artificial constraints respected during price formation.

7) CAISO runs RUC every hour of every day even when they face no reliability issues

The software in place today requires the CAISO to run RUC over a 24 hour horizon. The CAISO has further indicated that RUC will run every day, even if sufficient load clears the IFM such that there are no operational concerns. As a result, RUC should not be assumed to be a reliability process that is run now and then when the CAISO observes questionable IFM results. Rather, RUC will be run for every hour of every day, regardless of whether it is needed. Thus the

[3] Market Issues & Performance 2007 Annual Report, Table E.1

[4] Assuming a $60/MWh average energy price and $41/kW-year average capacity price and the volumes listed above.

market will face the flaws of RUC at all times – the damage can not be argued away on the grounds that the tool will be seldom used.

8) Besides the $250 bid cap, RUC has no market power mitigation for non-RA capacity

Due to RUC's sequential nature, artificial constraints, lack of recognition of alternative real-world operating solutions, high administrative penalty prices, locational requirements on a nodal basis, an objective function that fails to correctly calculate true direct cost and that makes no attempt to calculate indirect costs, and no mandated preference to find solutions using "RA-first" results in seriously flawed RUC price formation. To make things even worse, *this system is required to satisfy a completely inelastic demand requirement*. That is, the CAISO puts in its RUC requirement, and tells the optimization to satisfy this requirement, irrespective of price. Taken together, the RUC process is highly susceptible to the exercise of market power, particularly on a local level. However non-RA units, as well as the non-RA portion of partial RA units have no local market power mitigation except the $250 cap. Given these known structural defects in the RUC design, it cannot be assumed that it will produce just and reasonable results.

9) RUC and ICPM are similar products, but there is no alignment of their pricing

While the process is still underway at FERC, the current CAISO proposal offers a 1-month ICPM contract if it has to commit a non-RA unit through exceptional dispatch. Recognizing the potential for market power, current proposals for monthly ICPM contracts have a predefined capacity payment ($41/kW-year). Further, if parties reject an ICPM contract, special mitigation rules apply to limit the amount of rents they can extract from the market. In contrast, the same unit could receive a commitment instruction from RUC and receive a $250/MW payment in every hour of the month. For example, under ICPM a 10MW unit would have monthly revenues capped at ($41/kW-year)/12*10,000kW = $34,167. Compare the maximum payments to this same unit if it is selected by RUC in every hour of the month. Under RUC, it could receive payments of up to $250/MW-h*10MW*30days*24hours/day = $1,800,000[5].

This vast discrepancy between ICPM payment and maximum RUC payments for what is in effect the exact same product, clearly illustrates the flaw in allowing RUC to price capacity.

[5] This calculation assumes that RUC prices clear at the RUC bid cap of $250/MW in every hour. In fact, we have observed RUC prices far in excess of $250, including prices that have exceeded a $1,000/MW. Thus this value understated the unit's theoretical maximum payments.

10) RUC's objective function makes it difficult to estimate actual total costs to consumers or to conclude the current formulation produces the lowest possible costs

The RUC objective function effectively minimizes under a "pay as bid" calculation, even though bids establish market clearing prices RUC will skip over committing an RA unit if it finds a "cheaper" solution through bids. However, the objective functions definition of "cheaper" is not reflective of the actual payments that will be made based on its selection of units. The objective function minimizes total bid cost, rather than total payments. That is, the objective function defines total cost as the sum of an individual unit's bid times its selected quantity, and it repeats this process for every unit it selects. It ignores the fact that the marginal bid may set a clearing price that is paid to all units.

For example, assume RUC requires 200 MW for system needs in a particular hour, and it has two options to satisfy the need:

Option (1) A bid for 100 MW at $5/MW and a bid for 100 MW at $200/MW

Option (2) A short-start 200MW RA unit with SU/ML costs of $21,000

Under Option (1) assume the RUC LMP price for both units will be the marginal bid of $200/MW-h. The objective function will assume a total cost of bid*quantity for each unit, or 100MW*$5+100MW*$200, for a total objective function cost of $20,500. However, this is not the actual cost that will be charged to customers or paid to generation: the optimization fails to recognize it establishes a market clearing price of $200/MW-h for both units. The true cost is the clearing price times the output of both units, 100MW*$200+100MW*$200= $40,000.

Based on the "cost" seen by the objective function, $20,500, Option 1 appears superior to the Option 2 since Option 2 has a cost of $21,000. Thus, in this example RUC will elect Option 1, establish $200/MW prices for RUC throughout all of the CAISO, and will leave the RA unit untouched.

This is exactly the wrong solution.

The true cost of Option 1 is $40,000, not the fictitious objective function cost of $20,500. If instead, the optimization selected the 200MW RA unit, the costs would be $21,000, and importantly, the clearing price for RUC throughout the CAISO would be $0/MW. Moreover, the $21,000 start-up cost may never have to be incurred. That is, if the CAISO discovers in real-time that it has ample supply available (for example from import bids), the CAISO will only commit and incur

the $21,000 start-up cost from the RUC unit if it is the least cost solution. If it is not, the unit will not be started and the CAISO will never incur this cost.

Individually, each of these issues calls in to question the reasonableness of the RUC process. Collectively, they demonstrate that the structural flaws of RUC are so pervasive that RUC cannot be relied on to produce just and reasonable rates.

III. The Rational Default Economic Assumption must be that RUC Price Signals will Impact Behavior; Parties that Argue Otherwise have the Burden of Proving Why This is Not So

During the stakeholder process, parties have attempted to argue that somehow, RUC price signals will not impact behavior or be viewed as an opportunity cost when preparing bids for the IFM or when selling RA products. SCE is unconvinced by these arguments. Economic theory dictates that parties will value their marginal sales based on prices available for this marginal production. As described *intra*, if RUC were simultaneously cooptimized, this RUC opportunity cost would automatically influence energy and ancillary services prices. Since we do not cooptimize, parties will instead internalize these opportunity costs within their bids.

Rational economic participants will seek to maximize profits based on all products that they are capable of selling. This is a fundamental foundation of rational behavior, not just in MRTU, but rather in all markets. Moreover, all markets in MRTU are linked through arbitrage. In MRTU, non-RA resources will essentially face the choice of either 1) selling energy or ancillary services in the IFM, or 2) withholding from the IFM sales in an attempt to get RUC payments *plus* real-time energy payments. In effect, RUC rewards parties for withholding, and provides free money. To assume parties will not try to capture this free money is to assume sellers are irrational.

Similar arguments hold for sales of RA capacity. If the CAISO is producing price signals valuing RUC capacity, one can rationally argue these prices reflect the marginal value of capacity, even if the quantity of RUC purchased is *de minimis*. RUC's price formation process is flawed and will produce artificially high prices. Sellers of RA capacity will consider these inflated price signals when valuing their RA capacity in the bilateral markets.

As noted before, even if RUC creates a very small distortion in energy, ancillary services and capacity prices, since these markets are so large, the societal costs would easily be in the magnitude of hundreds of millions of dollars, or more.

Thus, the rational baseline assumption should be that RUC prices will in fact impact behavior, and will impact energy and RA prices. And further, that even a small impact on these prices will result in significant societal costs. Parties that argue instead that RUC prices will not impact behavior, since this is contrary to rationally expected

outcomes, must bear the burden of demonstrating their position should instead be assumed as the default.

If in contrast, RUC prices are argued to be too irrational and too unpredictable to impact behavior, RUC should not be used to produce prices in the first instance

Some parties may attempt to argue that, because of the flaws in its price formation and other causes, that RUC will produce prices that are so irrational and unpredictable, and that RUC prices are available to such small quantities of MWs, that this will 1) prevent RUC price signals from impacting behavior and, 2) this will disqualify RUC prices as being legitimate opportunity costs.

Should these arguments prevail, and RUC is found to be irrational, unpredictable and meaningless, *then logically there should be no objection to simply eliminating the process that produces these irrational and meaningless prices in the first instance.*

More than that, FERC has a legal obligation to ensure that MRTU produces just and reasonable rates. If we instead conclude that RUC produces irrational and meaningless prices and rates, SCE questions if the current RUC price formation process is even allowable given FERC's legal mandate.

IV. The Potential "rewards" from the Current RUC Pricing Mechanism in no way Compensate for the Tremendous Risk RUC Imposes; it is Irrational to Continue Forward without Modifications

It is unclear what economic benefits RUC offers the market. In the first instance, non-RA units have no apparent justification for RUC capacity bids of anything but $0. RUC fully compensates for start-up and minimum load costs, and even if the unit is selected for RUC, it can bid energy and/or ancillary services in accordance with MRTU rules. In general, RUC is free money, and absent market power or price formation flaws, RUC should be $0 in all hours. However, we simply do not observe these results in the simulation. At bottom, we do not find the current formulation of RUC to provide any meaningful societal benefits or rewards; to the contrary we appear to be seeing and face the risk of wealth transfers.

In contrast, SCE has already demonstrated that if RUC even slightly distorts energy, ancillary services and capacity prices, hundreds of millions of dollars are at risk annually.

Taking a page from Markowitz, SCE believes that to be willing to assume risk, a rational participant must have an expectation of a commensurate reward, and further, they will attempt to minimize risk at every level of potential reward. Juxtaposed to this rationality, RUC offers huge risk without any apparent reward.

The CAISO and other responsible policy makers should take great offense with RUC's value proposition and should reject it squarely. In sum, it is neither rational nor reasonable to allow RUC to move forward without modification.

V. SCE Supports the Continued Need for a Residual Unit Commitment; We Object to Pricing Capacity in this Commitment

For clarity, SCE believes that a post-IFM capacity commitment is proper and necessary for go-live of MRTU. We fully agree that the CAISO needs a tool to commit capacity after the IFM to address residual reliability concerns.

Further, we feel that providing this capacity is one of the key reasons California has adopted a comprehensive and locational RA program. Reliability constraints are effectively an inelastic constraint that the CAISO must satisfy, and for reasons noted earlier are prone to market power abuse, especially if these problems are addressed in the spot markets just prior to need. Again these concerns helped drive California's Resource Adequacy construct. We have already addressed all or nearly all of the CAISO's reliability concerns with RA capacity. And, importantly, we already paid for this capacity. In effect, we have paid in advance to make sure the CAISO has capacity it can access in order to maintain reliability. Thus the CAISO should exhaust these RA solutions before it attempts to purchase additional "solutions" on the spot market. The current formulation of RUC is not consistent with the intent of the RA systems and RUC needs modifications to address its shortfalls.

We note further that all RTO/ISO have this ability to commit additional capacity. However, the CAISO is the *only* ISO that attempts to price capacity in this commitment. Why should the CAISO run this risky process 24 hours a day, 7 days a week, when no other ISO even attempts it? Capacity commitment is needed at MRTU go-live, but pricing this capacity is neither necessary nor proper given the existing RUC design.

Developments since RUC's initial approval further justify modifications

As noted in Dr. Lorenzo Kristov's presentation, RUC was originally approved in September 2003. At that time, it was unclear what the CPUC would implement as part of an RA program, and FERC had legitimate concerns the CAISO needed a tool in case RA was not successful or not implemented. Fast forwarding to 2008, we have had a locational RA program in place since delivery year 2006, and while we continue to improve and refine the process, the CAISO has found the current process workable and largely effective in maintaining short-term reliability. In fact, the CAISO was able to successfully navigate many operational challenges, including an all-time system peak of over 50,000MW in the very first year that RA was in place. RA has only improved since then.

Moreover, FERC was concerned about "under-scheduling" and wanted RUC to address this concern. Long after RUC's approval, in 2008 FERC took additional steps to directly

address under-scheduling by applying large charges (either $150 or $250/MWh) to LSE's that serve 15% or more of their load in the real-time market during any hour. FERC has explicitly addressed under-scheduling, RUC no longer needs to address this issue.

We continue to develop a monthly backstop capacity product, ICPM, that wasn't even on the drawing board in 2003. The CAISO has proposed, and SCE has supported providing generators with a 30-ICPM capacity contract if a non-RA unit is committed via an "Exception Dispatch". The CAISO now has (or will soon have) an explicit mechanism to pay non-RA units for capacity if they are needed for reliability. Again, RUC no longer needs to address this issue.

SCE understood the approved RUC to be an "as needed process". That is, if sufficient load cleared the CAISO, and there were no apparent reliability issues, RUC would not be run. We now understand that the software, as currently implemented, will require the CAISO to run RUC 24 hours a day, every day, even if load has purchased quantities that exceed the CAISO's forecast.

In summary, when RUC was originally approved, it was trying to address multiple issues instead of just focusing on getting additional RA capacity dispatched, as is the case in other ISOs. Since RUC's approval we have successfully implemented a comprehensive RA program, and added or are in the process of adding market features targeted at addressing specific problems like under-scheduling and paying non-RA units for needed capacity. RUC no longer needs to serve double or triple duty in light of our new tools – in attempting to do so RUC is creating problems far more serious than the issues it attempts to solve. And in light of these new tools, and in light of what is done in other ISOs, RUC should be modified to focus solely on committing capacity, and should not be used to price this capacity commitment.

RUC requires both immediate action and long-term reform

Below, SCE proposes a short-term solution to RUC that we believe can be implemented without delaying MRTU. However, in the longer-term, RUC requires a major redesign. We have noted the problems that the sequential nature of RUC creates, and we see benefits to integrating RUC simultaneously in the IFM. However, this will not be a trivial task and may have impacts on the IFM process and optimization engine. Further, the CAISO will implement Virtual Bidding (VB) within 1-year of MRTU go-live and we are concerned RUC will need significant revisions to address VB. Not only will RUC have to commit additional capacity if the market clears below forecast, it will have to commit additional capacity to replace Virtual Supply with physical supply, and it may have to decrement physical supply that was dispatched to serve Virtual Load.

Moreover, if the long-term RUC process produces prices, something SCE recommends strongly against, price formation of both RUC capacity as well as IFM products must be closely examined in light of VB.

V. SCE's Proposed Solution

RUC should not be implemented as currently formulated. Instead the CAISO should file with FERC as soon as practical to implement the following revised structure. We believe this revised structure can and should be implemented on MRTU go-live. Further, if rapid action is taken by the CAISO, we believe this change will not prevent an April 1 MRTU start date.

The Proposal

For convenience, we will refer to the process as Revised RUC or R-RUC. We propose using the current RUC infrastructure, but running the process off-line without publishing prices. Further, we propose running R-RUC using only RA capacity. CAISO has indicated this is feasible, and it is possible to only utilize the RA capacity or partial RA units.

After running R-RUC off-line, with only RA capacity, the CAISO will examine the results. We expect that in almost all cases there will be a feasible solution. If this is the case, the process is over, and the CAISO will use existing infrastructure to issue R-RUC commitments to RA units and to settle these units just as is done in the current RUC process.

However, if the initial pass of R-RUC cannot find a feasible solution using only RA capacity, the CAISO will inspect the results. At this time the CAISO will consider other ways to address contingencies that the R-RUC process currently cannot model. Solutions could include real-world operating solutions such as dropping local load or pump load in the rare event that the contingency actually occurs in real-time. The CAISO will also review the results to see if reliability is still adequately addressed even though the R-RUC process did not find a feasible solution. For example, R-RUC wanted 25MW but could only find 24MW without violating a constraint. The CAISO may conclude this poses no reliability issue and requires no further action.

If, after reviewing the results of R-RUC, the CAISO concludes it must commit non-RA resources in the day-ahead time frame to maintain reliability, the CAISO will issue an exceptional dispatch to any needed unit, and the unit will be offered a one month ICPM contract. If a unit has an ICPM contract, it will be included in future R-RUC runs along will all other RA capacity.

For emphasis, no RUC prices will be published, but all other RUC infrastructure (RUC dispatch instructions, settlements) will continue forward using existing software.

Benefits of R-RUC

R-RUC has four primary benefits:

1) It allows the CAISO to maintain reliability using the bulk of the current RUC infrastructure and processes. Further, it better aligns the CAISO's processes with what is done in other ISOs/RTOs.

2) It eliminates the possibility that the current RUC process and the associated prices will distort energy, ancillary service and RA capacity market prices. As argued *intra*, even a small distortion in these markets has significant societal consequences. R-RUC fully addresses these concerns.

3) Non-RA generation is compensated if needed. Offering ICPM contracts ensures generation is reasonably compensated if its capacity is needed to maintain reliability. As is the case with all ICPM contracts, SCE expects the CAISO will report the details of why the contract was issued. This information can be incorporated in the RA process in the following year. For example, if the CAISO discovers it must issue an ICPM contract to address a local capacity issue, they can incorporate this information when they establish their local RA needs in the subsequent year.

4) It can be implemented without delaying MRTU. Since R-RUC uses current software and processes, it can be implemented quickly and seamlessly at both the ISO and market participant level. In effect, R-RUC will look identical to a RUC hour that produced $0 prices state-wide.

Parties may argue that, since R-RUC limits selection to only RA capacity, it may actually increase prices/costs relative to RUC (which includes non-RA capacity in the process). While SCE agrees that the objective function result of R-RUC will never be less than that of RUC, based on the difference between actual costs and the "objective function costs", as well as the fact that units selected in R-RUC may never be committed and thus commitment cost may never occur (as argued above) it is impossible to conclude categorically that the direct costs of R-RUC will exceed those of RUC. Further, even if direct R-RUC costs exceed comparable direct RUC costs, we believe the risk of potential indirect costs done by market distortions of the RUC pricing scheme more than compensates for the potential for minimal additional R-RUC costs.

VI. Conclusions and Recommendations

Simulations have demonstrated conclusively that the current RUC price formation process is structurally flawed and cannot be relied on to produce just and reasonable rates. The problems with RUC pricing are not caused by, nor can they be effectively remedied through the RA process. Because of problems in RUC's price formation process, problems which include its sequential nature along with many other defects, RUC produces artificially high capacity prices. As a rule, participants react to price signals, and we should assume RUC price signals are no exception. These inflated RUC price signals threaten to distort MRTU's energy and ancillary services markets, as well as

California's RA process. Since these other markets clear/will clear tremendous volumes, even a relatively minor upward distortion in prices would create societal costs in the hundreds of millions of dollars. As formulated, RUC offers no clear benefits, but creates enormous risks. It is neither rational nor reasonable – and arguably illegal – to allow the RUC process to run without modifications.

SCE supports the continued need for a Residual Unit Commitment process, but we object to pricing capacity in this process. All other ISOs have some form of residual commitment, but none of them price this capacity. The CAISO's process should be consistent with the practices elsewhere.

SCE offers a reasoned solution to these problems: the R-RUC process. The CAISO should adopt R-RUC and file it with FERC as soon as practical. R-RUC allows the CAISO to secure needed capacity and maintain a reliable grid, it relies on RA capacity to the maximum extent possible, in the event a non-RA unit is required that unit is reasonably compensated, and it eliminates all risks that the flawed RUC price formation will distort the much larger energy and RA capacity markets. R-RUC is consistent with what is done elsewhere in the nation, and, since it relies on existing RUC software and processes, it should not delay the implementation of MRTU.

Thank you for the opportunity to provide comments on this important issue.