Final Draft Proposal

Reserve Scarcity Pricing Design

October 5, 2009

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Executive Summary

Scarcity Pricing is a mechanism that allows market prices to rise automatically, potentially beyond any applicable bid cap, when there is a shortage of supply in the market. Following general practice in other ISO markets a shortage of supply is defined as the inability by the California ISO (ISO) to procure sufficient regulation or operating reserves through market mechanisms. Properly designed scarcity prices should enhance short-term and long-term market efficiency and reliability because they may stimulate demand response, draw supply from outside of the ISO balancing authority area, create incentives for availability of generation during peak load periods, and promote long-term contracting.

The Federal Energy Regulatory Commission (FERC) directed the ISO to file tariff language and to implement a reserve shortage Scarcity Pricing mechanism within 12 months after Market Redesign.[1] The September 21 Order provided guidance that "prices should rise to reflect the increased need for reserves and energy, whether or not the shortage arises in conjunction with a generation or transmission outage, in both the day-ahead and real-time markets."[2] FERC's September 21 Order directed the ISO to develop a "mechanism that applies administratively-determined graduated prices to various levels of reserve shortage."[3]

In order to implement the Scarcity Pricing mechanism successfully and efficiently, the ISO believes the design should be guided by the following considerations: 1) consistency with the Ancillary Service (A/S) reserve requirements and the A/S Region and Sub-Region definitions under the current market design; 2) lessons learned from the design and operational experiences of other ISOs; and 3) the effective interaction between Scarcity Pricing and other market components.

Since the Issue Identification Paper for Reserve Scarcity Pricing Design was posted on May 31, 2007, the ISO has posted several versions of proposal, held several stakeholder meetings and conference calls, and requested and responded to stakeholder comments.[4] The purpose of this Straw Proposal is to identify the ISO's recommendations for the following issues of Scarcity Pricing design, building on the previous versions of proposals and stakeholder inputs.

1) Scope of Scarcity Pricing: The ISO proposes to develop Scarcity Pricing mechanism in the ISO A/S Region (the ISO system) and Sub-Regions that are defined in the tariff.

2) Triggers of Scarcity Pricing: The ISO proposes to use the minimum A/S requirements of the A/S Region and Sub-Regions as the triggers for Scarcity Pricing. If a shortage

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1 *Order Conditionally Accepting the California Independent System Operator Corporation's Electric Tariff Filing to Reflect Market Redesign and Technology Upgrade,* 116 FERC ¶ 61,274 (2006) ("September 21 Order") at P 1078.

2 September 21 Order at P 1077, 1079.

3 *Id.* at P 1079.

4 All versions of proposal and stakeholder written comments are posted on the CAISO web site at http://www.caiso.com/1bef/1bef12b9b420b0.html.

violates any of the minimum requirements for the A/S Region or Sub-Regions, Scarcity Pricing will be triggered in that A/S Region or Sub-Region.

3) Reserves in Scarcity Pricing: The ISO proposes a joint Scarcity Reserve Demand Curve for the three upward reserves including Regulation Up, Spinning, and Non-Spinning Reserves. Regulation Down Reserve will have a separate Scarcity Reserve Demand Curve due to its incompatibility with the upward reserves.

4) Scarcity Reserve Demand Curve: Based on the analysis of the ISO historical A/S bids and market clearing prices and the experience of NYISO and ISO-NE, the ISO proposes a tiered Scarcity Reserve Demand Curve for the three upward reserves in the A/S Region and a tiered Scarcity Reserve Demand Curve for Regulation Down. The lowest scarcity price in the A/S Region is higher than the A/S bid cap. The highest A/S market clearing price in the A/S Region, when supply of all upward reserves is short, may increase to the energy bid cap.

5) Energy price in case of reserve scarcity: The ISO's current market co-optimizes the energy and A/S. The opportunity cost of capacity is reflected in both prices. When Scarcity Pricing is triggered, the prices of A/S will rise automatically to the values determined by the Scarcity Reserve Demand Curves. However, the price of energy could be impacted through the opportunity cost of capacity, as ordered by FERC, if the marginal capacity is capable of and needed for providing both energy and A/S.

The ISO requests stakeholder written comments on this Straw Proposal by September 7, 2009 and will hold additional discussions with stakeholders. ISO Management intends to present a final proposal to the ISO Board of Governors in December 2009.

1 Introduction

Scarcity pricing has the potential to address one of the recognized market inefficiencies of bid caps. Although bid caps are necessary due to the inelasticity of demand in the real-time market, bid caps can prevent prices from rising sufficiently for certain resources,. This problem can be addressed by implementing some market mechanisms, such as capacity payments and scarcity pricing.

As an enhancement to the ISO market design, Scarcity Pricing is a mechanism that will allow prices for reserves and energy to rise automatically, even beyond the price cap, when there is inadequate supply in the market to maintain the target level of reserves and regulation on the ISO grid. Scarcity Pricing should set market prices to reflect the level of shortage in supply. More accurate price signals may stimulate participation in Demand Response programs, attract supply from outside of the ISO balancing authority area, and provide incentives for existing generation owners to make more generation capacity available during peak demand periods. The automatic trigger of Scarcity Pricing ensures that suppliers do not need to raise their bid prices above competitive levels to receive the higher prices.

The current ISO market has included a limited scarcity pricing mechanism that raises energy bids to the bid cap when there are insufficient energy bids in Real-Time Market and when no contingency events have occurred. In its September 21, 2006 Order, FERC accepted the ISO's initial scarcity proposal, but directed the ISO to develop a more extensive reserve shortage scarcity pricing approach. In its Order on Rehearing of the September 21 Order, FERC further emphasized these requirements and stated that "the concept of scarcity pricing involves

a systematic procedure to ensure that prices can rise during periods of genuine scarcity".[5] The FERC Orders specify that:

1) Prices should rise when energy and reserves are short in both the day-ahead and real-time markets whether or not there is a transmission or generation outage.[6]

2) The scarcity pricing mechanism should apply administratively-determined graduated prices to various levels of reserve shortage. This requirement calls for a Scarcity Reserve Demand Curve with different pre-determined prices at different levels of scarcity. The September 21 Order also stated: "In the event that a shortage occurs, prices should reflect the economic value of the reserves necessary to resolve the shortage. Thus, the prices for both reserves and energy in California should increase automatically as the severity of the shortage increases."[7]

The ISO's Scarcity Pricing proposal should be consistent with the pre-existing market design and systems in order to achieve a required implementation date. In addition, because both NYISO and ISO-NE have implemented Scarcity Pricing mechanisms with administratively-determined prices, the ISO intends to study these mechanisms as appropriate, for potential use in the ISO's Scarcity Pricing design.[8] Accordingly, to ensure successful and efficient implementation of Scarcity Pricing, the ISO is designing the mechanism consistent with the following guidelines:

1) While meeting the requirements specified by FERC Orders, the design should be consistent with the current ISO market design in order to minimize changes to the existing system.

2) The ISO's design should consider the designs of NYISO and ISO-NE as those have been tested in the market operation.

3) The design should take into account the impacts of Scarcity Pricing on other existing and future market components, such as Congestion Revenue Rights (CRR), Demand Response (DR) programs, and a capacity market (centralized or bilateral). Market monitoring and mitigation functions should not be undermined.

Scarcity Pricing is an enhancement to the ISO market design that is intended to reflect underlying market conditions. As such, and consistent with the "locational" nature of price in the ISO market, any increased price volatility in the wholesale spot market arising from Scarcity Pricing can be avoided by load serving entities (LSEs) entering into long-term bilateral contracts to hedge the price of power, by providing DR, and through holdings of CRRs.

2 Reserve Scarcity Pricing Design Issues & Proposed Solutions

This section discusses major design issues and proposes specific solutions for stakeholders to review and discuss.

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[5] *Order Granting in Part and Denying in Part Request for Clarification and Rehearing,* 119 FERC ¶ 61,706 (2007) ("April 20 Order") at P 518.

[6] September 21 Order, at P 1077.

[7] *Id.* at P 1079.

[8] ISO, Reserve Shortage Pricing Design Issue Paper, May 31, 2007 (http://www.caiso.com/1bef/1bef12e2453e90.pdf).

2.1 Scope of A/S Procurement

The ISO tariff defines A/S Regions and Sub-Regions for A/S procurement purposes.[9] There are two A/S Regions and eight A/S Sub-Regions. The A/S Regions are the System Region and the Expanded Region (i.e., the System Region and the intertie Scheduling Points with adjacent balancing authority areas). The eight A/S Sub-Regions are the following:

(1) South of Path 15 Sub-Region

(2) Expanded South of Path 15 Sub-Region

(3) South of Path 26 Sub-Region

(4) Expanded South of Path 26 Sub-Region

(5) North of Path 15 Sub-Region

(6) Expanded North of Path 15 Sub-Region

(7) North of Path 26 Sub-Region

(8) Expanded North of Path 26 Sub-Region

2.2 Triggers of Reserve Scarcity Pricing

Each ISO with a Scarcity Pricing mechanism defines Scarcity Pricing triggers according to its own reliability standards and operating procedures. The ISO sets its reserve requirements based on the WECC and NERC reliability standards. When these requirements are violated, the ISO restores its reserve margin through its market mechanism. The market needs to establish a clear price signal in such situation. In the ISO Tariff, reserve requirements are defined as the following:

> "The CAISO shall maintain sufficient Generating Units immediately responsive to Automatic Generation Control (AGC) in order to provide sufficient Regulation service to allow the CAISO Control Area to meet NERC and WECC reliability standards by continuously balancing Generation to meet deviations between actual and scheduled Demand and to maintain interchange schedules."[10]

> "The CAISO shall maintain minimum contingency Operating Reserve made up of Spinning Reserve and Non-Spinning Reserve in accordance with NERC and WECC reliability standards, including any requirements of the NRC. The CAISO from time to time may determine to use more stringent criteria.[11]

> "Within the Expanded System Region, the System Region, and any the Sub-Regions, the CAISO may establish limits on the amount of Ancillary Services that can be provided from each region or can be provided within each region. When used, these limits identify either a maximum or a minimum (or both a maximum and a minimum) amount of Ancillary Services to be obtained within the region." [12]

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[9] CAISO Tariff Section 8.3.3.

[10] CAISO Tariff Section 8.2.3.1.

[11] ISO Tariff Section 8.2.3.2. The WECC/NERC new paradigm that will be enforced does not require the exporting control area to back firm energy interchanges with Operating Reserves.

[12] ISO Tariff Section 8.3.3.1.

"The CAISO's use of an Ancillary Service Sub-Region occurs when the CAISO establishes a minimum or maximum limit for that Sub-Region. The CAISO will evaluate the use of minimum and maximum procurement limits for Ancillary Services on a daily and hourly basis in order to ensure that the dispersion of Ancillary Services throughout the CAISO Control Area accurately reflects the current system topology and deliverability needs."[13]

Since April 1, 2009, the ISO has been procuring Regulation and Operating Reserves in the Expanded South of Path 26 Sub-Region of at least 35% of the minimum requirements for the reserves in the ISO Expanded Region. The ISO plans to use this minimum reserve procurement requirement for the Expanded South of Path 26 Sub-Region in the future until the need for a change is identified.

The ISO proposes to use the minimum requirements for reserves in the A/S Regions and Sub-Regions as the triggers of Scarcity Pricing. Each time any of these requirements is violated, whether in the Day-Ahead Market (DAM) or Real-Time Market (RTM), the ISO will activate the Scarcity Pricing mechanism in the A/S Region or Sub-Region in which the reserve requirement -violation occurs.

Use of these requirements as triggers for reserve Scarcity Pricing preserves consistency between Scarcity Pricing and the penalty prices for A/S procurement requirements in the design of the current market.

In the future, before the ISO changes minimum A/S procurement requirements based on either NERC/WECC reliability standards or ISO operational requirements, the ISO will issue a Market Notice to inform stakeholders about the change.

2.3 Reserves in Scarcity Pricing Mechanism

There are four types of reserves in the current ISO markets: Regulation Up, Regulation Down, Spinning Reserves, and Non-Spinning Reserves. The ISO Tariff Section 8.2.3.5 defines the relationship among the reserves as follows:

(a) The Regulation requirement must be satisfied only by Regulation Bids for resources qualified to provide Regulation;

(b) Additional Regulation Up capacity can be used to satisfy requirements for Spinning Reserve, or Non-Spinning Reserve;

(c) Regulation Up and Spinning Reserve requirements must be collectively satisfied by the combination of Regulation Up and Spinning Reserve Bids.

(d) Additional Regulation Up and Spinning Reserve capacity can be used to satisfy requirements for Non-Spinning Reserve.

(e) Regulation Up, Spinning Reserve, and Non-Spinning Reserve requirements must be collectively satisfied by the combination of Regulation Up, Spinning Reserve and Non-Spinning Reserve Bids.

Reserves that can satisfy the requirements for other reserves are often called "higher quality" than the other reserves. Hence, Regulation Up is considered a higher quality than Spinning Reserves, which is a higher quality than Non-Spinning Reserves.

[13] ISO Tariff Section 8.3.3.2.

Using higher quality reserves to satisfy the requirements for lower quality reserves is called "substitution." The substitution capability among the three upward reserves and the minimum A/S requirements can be described using the following constraints:

Regulation Up Requirements:

$$RegUp \geq RegUp_{MinReq}$$

Spinning Reserve Requirements:

$$RegUp + Spin \geq RegUpMinReq + SpinMinReq$$

Non-Spinning Reserve Requirements:

$$RegUp + Spin + Non\text{-}Spin \geq RegUpMinReq + SpinMinReq + Non\text{-}SpinMinReq$$

where, $RegUp_{MinReq}$, $Spin_{MinReq}$, and Non-$Spin_{MinReq}$ represent the minimum procurement requirements for the reserves.

Based on the substitution capability, the market clearing prices of higher quality reserves should always be higher than or equal to the market clearing prices of lower quality reserves in the same A/S Region or Sub-region. The ISO proposes that these three types of upward reserves be considered jointly for Scarcity Pricing.

Regulation Down Reserve is provided by resources that can decrease their actual operating level in response to direct electronic signals from the ISO to maintain standard frequency in accordance with established reliability criteria. In some situations the ISO may face a shortage of supply for Regulation Down Reserve. Such shortages could become more prevalent in the near future as California continues to implement its Renewable Portfolio Standard. Connecting more renewable resources (primarily wind generation) to the ISO grid will increase the demand for Regulation Reserves. The ISO therefore proposes to include Regulation Down Reserve in the Scarcity Pricing mechanism in order to provide proper price signals and incentives to potential AGC resources. Due to its lack of compatibility, Regulation Down Reserve is measured separately from the other three types of upward reserves.

2.4 Scarcity Reserve Demand Curve

As noted above, FERC's September 21 Order specified that the Scarcity Pricing mechanism should apply administratively-determined graduated prices to various levels of reserve shortage. This requirement implies that it is necessary to define a Scarcity Reserve Demand Curve with pre-determined prices at different levels of shortages, similar to that which NYISO and ISO-NE have implemented.

In 2007, FERC proposed four possible approaches for Scarcity Pricing design.[14] In Order 719, FERC addressed the four approaches based on the comments it received and established six criteria for evaluating Scarcity Pricing design. Establishing "a demand curve for operating reserves, which has the effect of raising prices in a previously agreed-upon way as operating reserves grow short" is one of these approaches.[15]

[14] Wholesale Competition in Regions with Organized Electric Markets, Advance Notice of Proposed Rulemaking, ¶ 32,617 (2007) at P 76-80.

[15] Wholesale Competition in Regions with Organized Electric Markets, 125 FERC ¶ 61,071 (2008) at P 208.

A Scarcity Reserve Demand Curve sets a Scarcity Reserve Demand Curve Value (SRDCV) for each of the reserves and allows the market to clear in shortage conditions. Based on the experiences of other ISOs, the design of the Reserve Scarcity Demand Curve needs to establish rules for (1) setting the SRDCVs for each type of reserves; (2) calculating cumulative reserve market clearing prices (MCPs) based on SRDCVs across different types of reserves and A/S Regions and Sub-Regions; and (3) determining energy prices (i.e., LMPs) through co-optimization when reserve supply is short.

The following sections discuss the Scarcity Reserve Demand Curve for the ISO. In order to compare with that of NYISO and ISO-NE, Table 1 lists the equivalent terminologies describing the reserve demand curves used by the three ISOs.

Table 1. Equivalent Terminologies

	NYISO	ISO-NE	ISO
Demand curve	Reserve Demand Curve	Reserve Constraint Penalty Factor (RCPF)	Scarcity Reserve Demand Curve
Pre-determined price for reserve scarcity	Reserve Demand Curve Value	RCPF	Scarcity Reserve Demand Curve Value (SRDCV)

2.4.1 Overall Considerations

The ISO intends to implement a Scarcity Pricing mechanism very similar to that which has been implemented by the NYISO and ISO-NE. The proposed ISO Scarcity Pricing mechanism will be similar to the NYISO and ISO-NE approach in the following aspects.

1) The ISO will co-optimize energy dispatch and reserve procurements.
2) The three ISOs all have well-defined A/S zones that provide a basis for zonal Scarcity Pricing.
3) Due to the substitution capability between different types of reserves and the nested A/S Regions and Sub-Regions, the reserve market clearing prices derived from the SRDCVs will cascade up from a lower quality to a higher quality reserve and from A/S Region to its more granular Sub-Regions.

However, the ISO Scarcity Pricing mechanism will differ from that of NYISO and ISO-NE because of the integration of Regulation Up with Spinning and Non-Spinning Reserves in Scarcity Pricing. Regulation Up can substitute for both Spinning and Non-Spinning Reserve. In contrast, the ISO-NE did not include Regulation in its Scarcity Pricing mechanism since the ISO-NE is not short of Regulation Reserve. The NYISO chose to implement separate demand curves for Operating Reserve and Regulation because Regulation cannot substitute for Operating Reserve. One additional difference is that the ISO does not have a reserve product to meet 30-minute contingencies as do the other two ISOs.

2.4.2 Maximum Price for the A/S Region Scarcity Reserve Demand Curve

ISO-NE, NYISO, and PJM established their system-wide maximum A/S scarcity prices in reference to the energy bid cap. The ISO agrees with ISO-NE that

> "The RCPFs reflect the costs the ISO would be willing to incur to procure reserves given the $1,000/MW Energy Price cap. In other words, when the ISO is sufficiently short of

reserves it would be willing to pay up to $1,000 for energy to create additional reserves."[16]

With the maximum scarcity price in the A/S Region set to the energy bid cap, the ISO will be able to re-dispatch any available resource in order to provided the needed reserves. The ISO, therefore, proposes to establish the maximum scarcity price of the A/S Region Scarcity Reserve Demand Curve based on the energy bid cap. According to the ISO tariff, the ISO will have an energy bid cap of $500/MWh for the first year after startup of its new markets, $750/MWh for the second year, and $1000/MWh thereafter.

2.4.3 Scarcity Reserve Demand Curve Values for Reserves

To determine the scarcity price for each reserve- the SRDCVs of the Scarcity Reserve Demand Curve- the ISO proposes to consider the following factors.

1) The SRDCVs should be set high enough to accommodate the offer prices of expensive generators and demand response resources. Otherwise, some available resources might not be dispatched to restore reserves during periods in which the Scarcity Pricing mechanism is triggered.

2) The SRDCVs should not be set too high for the reserves that are likely to have transitory supply deficiency due to resource constraints but not in conditions where maximum generation availability is required. For example, during the morning and evening ramp periods, load sometimes increases more quickly than generators can ramp up. Regulation Up and Spinning Reserve could face a periodic, transitory supply shortage during this time, although clearly there are sufficient generation resources available to the system such that at some cost, sufficient Regulation Up and Spinning Reserve could be available (e.g., by maintaining uneconomic units at minimum operating levels). At such times, the ISO may desire additional reserves but may not seek to mobilize the degree of resource response needed during system emergencies or annual peak load hours. Hence, to minimize the cost of serving demand, it may be appropriate to set the SRDCV for Regulation Up and Spinning Reserve at moderate levels, despite the fact that Regulation Up and Spinning Reserve are high quality reserves, and rely on the expected correlation between shortage of Non-Spinning Reserve and more serious reliability situations to trigger high prices for Spinning Reserve.

   The ISO-NE, which does not have a scarcity price for Regulation Reserve, sets the demand curve price, the RCPF, for 10-minute Spinning Reserve (TMSR) to $50/MWh. "The TMSR RCPF value must serve two purposes. First, it must maintain TMSR during a capacity deficiency. Second, when the system becomes briefly ramp constrained, during the morning pick-up for example, the RCPF will trigger re-dispatch to preserve spinning reserve. The value of $50 meets both needs."[17] The ISO has determined that a similar approach meets the Scarcity Pricing objectives in its markets while protecting the market from extreme price volatility in periods (such as the morning and evening ramp) that do not reflect the need for such a price signal.

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[16] "Rationale and Derivation of Proposed Real Time Reserve Constraint Penalty Factors," ISO-NE, April 29, 2005, pp. 4.

[17] *ISO New England Inc.*, Docket No. ER06-613-000 (Feb. 6, 2006) at Attachment 2, Direct Testimony of Marc D. Montalvo, pp. 44.

3) The SRDCVs should be set to reflect the cost the ISO will pay to obtain additional supply at different levels of reserve shortage. That is, shortage of higher quality reserves should generally trigger higher scarcity prices than shortages of lower quality reserves to induce sufficient re-dispatch of generation resources (internal and external) to meet the reserve requirements. However, this pricing rule needs to be balanced with the expected frequency that a particular reserve may encounter shortages.

   An example of such ranking is the ISO-NE rules for ranking different reserve scarcity prices. The ISO-NE offers the following rationales for setting RCPFs. "The $100/MW TMOR [Thirty Minute Operating Reserve] RCPF value is calibrated to allow for re-dispatch of the system to create reserve under the majority of system condition." "Shortages of system TMNSR [Ten Minute Non-Spinning Reserve] represent a serious reduction of reliability…. The system TMNSR RCPF value of $850 is set high enough to create re-dispatch of virtually all internal resources. … It would allow purchases of very expensive energy from external sources and backing down internal resources." "The RCPF of local TMOR must be set lower than system reserve." [18]

4) Because reserves should generally be substituted to maintain the highest quality reserve, in a reserve shortage situation, the prices should cascade up from lower quality to higher quality reserves and from A/S Region to spatially granular nested Sub-Regions. Specifically, the market clearing price of a higher quality reserve should be higher than or equal to the price of a lower quality reserve, and the market clearing price of a reserve in an A/S Sub-Region should be no less than the price the same reserve in the A/S Region. This rule is called price cascading.

5) NERC and WECC reliability standards specify the minimum A/S requirements of the ISO Regions. Violating these requirements has severe reliability consequences. The ISO determines the desired minimum A/S requirements of the Sub-Regions based on the system topology and deliverability needs. Accordingly, the SRDCVs of the A/S Regions should therefore be higher than that of the Sub-Regions.

6) As California implements its Renewable Portfolio Standard, more renewable resources will connect to the ISO system. These resources, especially wind,may produce most of their electricity during the off-peak period. As a result, the ISO system may experience over-generation more frequently than before and experience an increased requirement for Regulation Down reserve. A clear price signal is necessary, in such situations, to provide incentives for generation to respond to the system demand. The ISO needs to structure scarcity pricing for Regulation Down to serve that purpose.

In the process of discussing Scarcity Pricing design before the startup of MRTU, the ISO conducted some analyses based on pre-MRTU market data. The findings from these analyses were presented in the previous version of proposals for Scarcity Pricing design. Since April 1, 2009, the ISO has not experienced any A/S scarcity. The ISO believes that the analyses based the pre-MRTU market data should still be helpful for supporting the Scarcity Pricing design.

The analyses examined the supply curve of various reserves. Historically each reserve has reached the bid cap in some peak hours. The ISO therefore proposed that the SRDCV for the lowest quality reserve in the A/S Region should be greater than or equal to the A/S bid cap.

[18] *Id.* pp. 41-44.

Otherwise there could be circumstances of economic scarcity in which some economic bids are higher than the SRDCV. These economic bids would not be fully used before the Scarcity Pricing mechanism is triggered.

To construct a tiered demand curve for Non-Spinning Reserve, with which the scarcity price increases with the severity of shortage, the ISO analyzed hourly Non-Spinning bid deficiency (when bid-in supply is less than requirement) data of year 2006 and 2007. Based on the analysis the ISO proposed a three-tier demand curve with break points at 70 MW (the 33rd percentile value) and 210 MW (the 67th percentile value).

In its previous Scarcity Pricing proposal the ISO proposed a single tier demand curve for Regulation Down. Stakeholders suggested that the ISO consider a tiered demand curve. Based on an analysis similar to that for Non-Spinning, the ISO proposes a three-tier demand curve for Regulation Down with break points at 32 MW and 84 MW.[19]

Based on the considerations described above and the outcomes of the ISO's analyses, the ISO proposes the SRDCVs of the ISO Scarcity Reserve Demand Curve as listed in Table 2. The SRDCVs are defined as percentages of the energy bid cap since the energy bid cap will change over the first three years of market operations. In this way, the values of SRDCVs can change automatically with the energy bid cap.

Table 2. The ISO Scarcity Reserve Demand Curve Value

Reserve	Percent of Energy Bid Cap		Bid Cap = $750/MWh ($/MWh)		Bid Cap = $1000/MWh ($/MWh)	
	Region	Sub-Region	Region	Sub-Region	Region	Sub-Region
Regulation Up	20%	10%	$150	$75	$200	$100
Spinning	10%	10%	$75	$75	$100	$100
Non-Spinning		25%		$188		$250
Shortage > 210 MW	70%		$525		$700	
Shortage > 70 & ≤ 210 MW	60%		$450		$600	
Shortage ≤ 70 MW	50%		$375		$500	
Upward Reserve Sum	**100%**	**45%**	**$750**	**$338**	**$1000**	**$450**
Regulation Down						
Shortage > 84 MW	70%		$525		$700	
Shortage > 32 & ≤ 84 MW	60%		$450		$600	
Shortage ≤ 32 MW	50%		$375		$500	

According to the price cascading rule, assuming that the supplies of all reserves are short in the ISO Region and Sub-Regions, the market clearing prices of the scarcity reserves can be calculated based on the SRDCVs in Table 2. The calculated market clearing prices are listed in Table 3.

[19] For details see the document posted at http://www.caiso.com/241c/241ccfc422550.pdf

Table 3. The ISO Scarcity Reserve Market Clearing Prices

Reserve	Bid Cap = $750/MWh ($/MWh)		Bid Cap = $1000/MWh ($/MWh)	
	Region	Sub-Region	Region	Sub-Region
Regulation Up	$750	$1088	$1000	$1450
Spinning	$600	$863	$800	$1150
Non-Spinning		$713		$950
Shortage > 210 MW	$525		$700	
Shortage > 70 & ≤ 210 MW	$450		$600	
Shortage ≤ 70 MW	$375		$500	
Regulation Down				
Shortage > 84 MW	$525		$700	
Shortage > 32 & ≤ 84 MW	$450		$600	
Shortage ≤ 32 MW	$375		$500	

The scarcity price of the lowest quality upward reserve, that is, the SRDCVs of Non-Spinning Reserves, are higher than the $250/MWh A/S bid cap. The market clearing prices under a scarcity situation should be sufficient to use all economic bids and provide the needed incentives to price responsive demand and supply resources. The highest market clearing price, when supply of all reserves are short, may increase to the energy bid cap in the A/S Region.

Regulation Down is the only reserve on the downward side. The SRDCVs for Regulation Down mirror that of Non-Spinning reserve. The scarcity prices of Regulation Down should provide an incentive to renewable generation to respond to the ISO demand in an over-generation situation.

After implementation of the Scarcity Pricing mechanism, the ISO intends to monitor its performance on an ongoing basis and review the design every three years or more frequently as needed. The ISO will discuss with stakeholders means to improve its Scarcity Pricing design as the ISO and stakeholders identify potential improvements during the monitoring and review process.

3 Other Related Issues

There are other issues closely related to the Scarcity Pricing design that have been raised by stakeholders. These issues may have significant impacts on the design and implementation of Scarcity Pricing mechanism. The ISO would like to take this opportunity to discuss these issues with stakeholders.

3.1 Energy Price in Case of Reserve Scarcity

When there is a reserve supply shortage, the Scarcity Pricing mechanism will be triggered and the reserve market clearing prices will be set by the SRDCVs. At the same time, energy prices may either rise together with the reserve prices, or may be unaffected by the increase in reserve prices.

If a generation unit has to back down generation in order to provide one additional MW of scarcity reserve, the price of energy at the location of this generation unit could include the opportunity cost of the capacity (the shadow price of the capacity constraint) as well as the offer price of the incremental energy. On the other hand, if the incremental energy dispatched to meet load cannot be used to provide reserves due to ramp rate or other constraints, the price of energy at this location may not be directly affected by the reserve scarcity prices. The energy and reserve co-optimization models will determine the market clearing reserve prices and energy prices simultaneously.

According to the ISO market design the Integrated Forward Market (IFM) model co-optimizes energy and A/S for the DAM. In the IFM meeting A/S procurement requirements has a higher priority than meeting energy demand. In RTM, energy has the priority over A/S.

The "Revised Scarcity Pricing Design Numerical Examples" provides some examples covering different situations of reserve shortage.[20] The energy price varies depending on situations of capacity shortage. The examples are based on a simplified energy and reserve co-optimization model, as described in the document.

3.2 A/S Cost Allocation

In its June 20, 2008 Order accepting MRTU compliance filings, FERC reaffirmed the ISO's proposal for a single use rate for AS cost allocation. "We reiterate here that the CAISO's procurement of ancillary services supports the use of the entire CAISO control area and, therefore, it is appropriate to allocate the costs associated with this procurement to all load in the CAISO control area."[21]

Based on this FERC order, the ISO proposes not to include A/S cost allocation by Sub-Regions in the scope of Scarcity Pricing design. In the future, when the situation has changed, the ISO may open the discussion on this issue with stakeholders.

3.3 Scarcity Pricing and Capacity Payments

Some stakeholders raised the concern that suppliers might be overcompensated for their fixed costs when both a Scarcity Pricing mechanism and a capacity market are implemented. Some stakeholders suggested that generators receiving capacity payments should be disqualified from Scarcity Pricing.

The capacity market focuses on long-term supply sufficiency. Currently, LSEs must secure sufficient capacity to meet the long-term resource adequacy requirements. The capacity price is based in part on expected revenues of resources in the energy and A/S markets. Sufficient supply will stabilize the market price in the long run and minimize the chances of scarcity. The capacity price is thus important guidance for long-term generation investments.

Scarcity Pricing, on the other hand, is a solution for short-term resource shortage while also making more explicit the reliability value of energy and A/S. It provides incentives for loads to improve price responsiveness and for existing generation owners to make more generation capacity available during the peak demand periods. The price signal will further attract supply from outside of the ISO control area. The increased price volatilities in spot markets will encourage LSEs to pursue long-term bilateral contracts in order to hedge the wholesale price

[20] http://www.caiso.com/1f65/1f65dabe49d90.pdf

[21] *ORDER CONDITIONALLY ACCEPTING, SUBJECT TO MODIFICATION, MRTU COMPLIANCE FILINGS*, 123 FERC ¶ 61,285 at P 46.

risks. Scarcity Pricing does let generation owners, especially the owners of flexible generation units, recover a portion of their investments.

It is therefore clear that capacity markets and Scarcity Pricing do not overlap, but rather complement each other. Implementing both will let the ISO make best use of all available resources according to market demand.

Currently, in California, capacity is procured through the CPUC administrated Resource Adequacy (RA) program. RA contracts are negotiated bilaterally and their prices are non-transparent. RA resources are paid to show up in the ISO markets, just like non-RA resources receiving Residual Unit Commitment (RUC) payments that have to show up in RTM. As proposed in this proposal, RA resources will be subject to both energy and A/S must-offer requirements, which may reduce energy and A/S price spikes and the chances of Scarcity Pricing being triggered. The ISO does not believe it is appropriate for the ISO tariff to exclude RA resources from receiving scarcity rents. Instead, the sellers and buyers should take into account the revenue from Scarcity Pricing in the negotiation of RA contracts.

On the other hand, a capacity revenue adjustment could be more explicit with the implementation of a centralized capacity market (if the CPUC determines to pursue such a design). For example, ISO-NE, which has a scarcity pricing mechanism similar to the one being proposed here, will implement an ex post revenue adjustment based on Peak Energy Rent with the implementation of the Forward Capacity Market in 2010.[22]

Therefore, the ISO proposes that the Scarcity Pricing design not disqualify bilateral RA resources from receiving scarcity prices, nor to adjust capacity payments to RA resources before the implementation of a centralized capacity market. Capacity payment adjustment could be implemented with a centralized capacity market, as a part of capacity market design. The ISO will review the performance of the Scarcity Pricing mechanism after the capacity market is implemented.

3.4 RA Resources Day-Ahead Market A/S Must-Offer Requirement

The ISO discussed the RA resources DAM A/S must-offer requirement in the scope of Scarcity Pricing design. This issue is under consideration in the context of Standard Capacity Product design, which was approved by the ISO Board of Governors in March 2009.

4 Next Steps

The following is a list of proposed schedules for future events of the Scarcity Pricing stakeholder process.

August 24, 2009	ISO posts Straw Proposal
August 31, 2009	Stakeholder meeting
September 8, 2009	Stakeholder comments due
October 5, 2009	ISO posts Final Draft Proposal
October 12, 2009	Stakeholder conference call

[22] ISO-NE, “Forward Capacity Market: Payments, Performance and Charges”, (http://www.iso-ne.com/markets/othrmkts_data/fcm/pres/fcm_pmnts_prfrmnc_chrgs.pdf).

October 19, 2009	Stakeholder comments due
December 16, 2009	ISO Board of Governors Meeting for decision

The ISO will discuss this Final Draft Proposal with stakeholders on October 12, 2009. Stakeholders are welcome to submit written comments to spcomments@caiso.com by close of business on October 19, 2009. The ISO will develop and post a Final Proposal based on the discussion and written comments. The final proposal will be presented to the ISO Board of Governors for decision in December 2009.