Auction Design for Standard Offer Service

During the transition to a competitive electricity market, when a consumer does not select an electricity provider, who provides service to the customer and at what price? An auction for this "standard offer service" is a market-based way to assign the service responsibility and to determine its price. We explore the design issues in establishing rules for such an auction.

Peter Cramton, Andrew Parece, and Robert Wilson

Peter Cramton is Professor of Economics at the University of Maryland and Principal with Market Design Inc. Dr. Cramton holds a B.S. degree in Engineering from Cornell University and a Ph.D. in Business from Stanford University.

Andrew Parece is Principal with Charles River Associates. Mr. Parece holds a BA degree in Economics and Computer Science and an M.B.A. from Cornell University.

Robert Wilson is Atholl McBean Professor of Economics at Stanford University and Vice President with Market Design Inc. Dr. Wilson holds an A.B., M.B.A., and D.B.A. in Business from Harvard University.

In a competitive market for electricity, consumers will select electricity providers based on information about the alternative providers. However, this information is not available or reliable prior to the move to a competitive market. Indeed, some of the most critical information in selecting a provider, such as the provider's reputation for the long-term supply of electricity at competitive prices, cannot be known until several years after the shift to competition. Hence, it makes sense to provide for a transition period during which consumers are not forced to select a provider, but rather receive service under "standard offer" terms.

Standard offer service can also be used to guarantee a rate reduction to consumers. For example, in Massachusetts, the utilities and regulators negotiated stipulated prices, which mandate at least a 10% rate reduction for the standard offer service during the first year. These stipulated prices define a ceiling on the generation component of unbundled electricity prices.

An open auction is a market-based way both to assign this standard offer service obligation and to determine competitive discounts from the stipulated prices. The design of the auction for standard offer service can greatly affect the efficiency of the assignment and the prices consumers pay for electricity.

In this paper, we explore the design issues of a standard offer service auction. This is not an academic exercise. Standard offer service auctions are already being implemented. Utilities in Massachusetts are perhaps furthest along in this process. New England Power Service Company (NEPSCo), a subsidiary of New England Electric System (NEES), has scheduled the first standard offer service auction for September 15, 1997.[1] Because of the prominence of the NEES auction, we will

[1] Throughout we refer to this auction as the NEES auction, rather than naming one of the NEES affiliates (e.g., NEPSCo, Massachusetts Electric Company, or Nantucket Electric Company). The September 15th start date is estimated based on a January 1, 1998, retail access date, the date at which consumers can first select an electricity provider.

specifically address the design choices made by NEES and suggest how the design can be improved. Since the NEES design may be a template for subsequent designs, we feel that a critical appraisal is warranted.

We begin by discussing principles of auction design, and use the standard offer service setting to illustrate these principles. Next we present our recommended design, which conforms to these basic principles. Then we present and critique the NEES design, focusing on how our recommended design differs from the NEES design. We conclude with illustrations of how these ideas can be applied more broadly in the move to a competitive electricity industry.

I. Principles of Auction Design for Electricity Supply

A. Establish the Objective of the Auction

Design cannot be discussed without first specifying the goal of the auction. In the case of standard offer service the primary goal is clear: consumers first. The auction should produce the lowest cost, reliable long-term sources of electricity available in the current market. Presumably, this is what consumers want. A second goal is that an open and transparent competitive process be used to establish these lowest-cost sources. A transparent auction yields a fair process in which the marketplace provides much of the regulatory oversight. Fortunately, these two goals are not in conflict. A well-designed auction encourages the open competition that is the clearest sign that the best possible terms have been found for consumers.

Reliability is an important component of the primary goal. It does consumers little good to get promised low prices only to find that these prices vanish when firms default on their promises. To guard against this possibility, bidders must provide sufficient financial security to assure that they will fulfill their commitment to provide electricity at the terms bid.

B. Identify What is Being Sold

One of the virtues of an auction is that it forces the auctioneer to fully describe what is being sold. In many cases this is obvious. A fish auctioneer simply displays the fish for all to see (and smell). Standard offer service is much more complicated, but the same idea applies. The more clearly the auctioneer can describe what is on the block, the more competition is fostered.

In essence, standard offer service is an auction for load responsibility. A winner in the auction is committing to meet its share of the standard-offer load at specified terms. One major complicating factor is that the standard-offer load is highly uncertain. Although we have decades of experience predicting the demand for electricity (both in energy and peak terms), we have no experience on how quickly consumers will move off the standard offer service. Moreover, the attrition rate is impossible to predict, since it depends fundamentally on two sets of endogenous prices: the standard-offer prices, set at the auction, and the spot market prices, set at the time of electricity consumption. Hence, while we can be clear about what is being sold (load responsibility), the quantity being sold is determined ex post, perhaps several years after the auction.

Quantity uncertainty is an important complication that the design must address. Ultimately, this uncertainty should be borne by the bidders, since it is the bidders that have the generating capacity to meet the load (assuming the utility divests its generating capacity). However, the definition of “quantity” can have a large impact on the extent of the uncertainty and its impact on the auction. This issue will be addressed in the next section.

C. Encourage Participation by Serious Bidders

A key element of any good auction design is that it encourages bidder participation. Whether the goal is economic efficiency, maximum revenues, or lowest costs, greater bidder participation improves auction outcomes. Hence, the design should reflect in part the preferences of potential bidders. The following are ways to encourage participation by serious bidders:

1. Reduce Bidder Participation Costs

The most direct way to encourage participation is to reduce the cost of participating. Entry fees should be modest. Deposits should be fully refundable (with interest). The auctioneer can further reduce costs by providing detailed information on what is being sold and information that would help the bidder evaluate its worth. One might think that these costs would be insignificant, especially for the largest bidders. However, what the auctioneer is attempting to do is to get the marginal bidder – the one that is sitting on the fence – to participate. These marginal bidders are often essential to vigorous competition. Without them, the large bidders have a much greater opportunity to exercise their market power in the auction. Although it is essential to have appropriate bid deposits to assure that the bidders are serious, care should be taken in not setting deposits so high as to discourage participation.

2. Limit Complexity

Although new, computerized auction designs sometimes overcome important limitations of traditional auctions, the complexity of these designs may raise bidder participation costs. Complexity is especially a problem for the smaller bidders. These bidders may not have the resources to work out all the issues generated by the complexity. Hence, they may go into the auction with an incomplete analysis and hope for the best, or they may simply decide not to participate. Wise bidders will often opt for the second option.

One must evaluate complexity from the bidder's perspective. For example, a first-price sealed-bid auction has very simple rules (high bidder wins and pays its bid) compared with an ascending auction, which involves bid increments, timing issues, stopping rules, etc. However, from the bidder's perspective the ascending auction is simpler. With an ascending auction the simple strategy "bid up to your valuation" is a good rule of thumb. In contrast, with a sealed-bid auction, no simple rule of thumb can be followed. "Bid less than your valuation" is a good start, but how much less? To answer this question the bidder must conduct a careful equilibrium analysis that involves assessing what the other bidders may do.

It is not so much the length of the rules that increases complexity, but rather the strategic issues that the rules generate. Rules that can be "gamed" are the most problematic. Bidders will invest substantial resources to identify loopholes in the rules. These opportunities for gaming increase participation costs for everyone, and are especially harmful to small bidders.

Some amount of complexity may be needed for the auction to effectively meet its objectives. A good design strikes the right balance between necessary complexity and low bidder participation costs.

3. Reduce Bidder Uncertainty

Bidders dislike uncertainty. Indeed, bidders will expend resources to try to reduce uncertainty. Thus, uncertainty is often a substantial source of participation costs. The auction rules can greatly influence the amount of strategic uncertainty that the bidders face. Some uncertainty is unavoidable, but the auctioneer should do what it can to reduce strategic uncertainty. Rules that expose the bidders to large gambles not only reduce auction efficiency, but discourage participation by marginal bidders. The risks are simply not worth taking for these bidders.

The loss in participation due to bidder uncertainty is especially important in the standard offer service auction. The reason is that in this auction nonparticipation is a viable option. In most auctions, nonparticipation means that you are out of luck – you don't get the good. But in a standard offer service auction, an electricity supplier can still supply electricity to end users, just not as standard offer service. If the risks are too large, the supplier simply decides to compete with the auction winners after the auction, rather than during the auction. Indeed, competing ex post has the advantage that the supplier avoids the obligation to serve at specified prices. Instead, the supplier can participate in the ex post market and offer service that reflects the supplier's current opportunity costs.

4. Eliminate Possible Conflicts of Interest

Conflicts of interests arise when one of the bidders is affiliated with the auctioneer. In standard offer service auctions, the Distribution Company that is holding the auction may wish to participate in the auction, either directly or through an affiliate. This is potentially a problem, since the auctioneer has access to within-round and between-round bidding information that is not public to the other bidders. To avoid this conflict of interest – if the Distribution Company or an affiliate elects to participate in the auction – it is necessary to delegate the actual running of the auction to a third party, ideally a professional auctioneer. The auctioneer implements and enforces the rules of the auction, and makes all decisions in cases where the rules allow discretion. There is no net cost to this delegation, once in-house opportunity costs are recognized, since professional auctioneers are in a better position to implement auctions based on their years of experience.

II. Overview of an Effective Auction Design

This section provides a concise description of our recommended auction design. Later sections present its motivation, implementation, and features.

The design is based on two overriding considerations, both essential to promoting competition.

- To reduce bidder uncertainty and participation costs, the auction rules should be as simple as possible, without encouraging gaming or inefficient outcomes.
- To encourage active bidding, there must be clear winners and losers in each round and at the close of the auction.

The following auction design promotes an economically efficient assignment of the load responsibility for standard offer service by adequately addressing these considerations. It should be emphasized that a goal of the auction is not to schedule efficient dispatch. This is best accomplished in the secondary, the day-ahead, and the hourly markets. Rather this auction simply facilitates trading in these later markets by assigning the load responsibility early on.

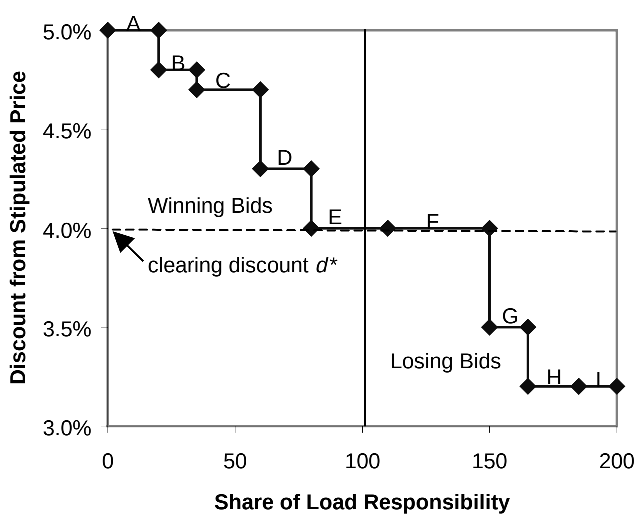
A. The Bid Process

To be auctioned are 100 shares of the load responsibility for each year. These shares are sold in a simultaneous ascending auction, in which the service obligation for each year is on the block at the same time. Suppliers bid for service over a series of rounds until no bidder is willing to improve its bid in any year. This format is similar to the successful FCC auctions for radio frequency spectrum. Before the auction, bidders make a deposit, which determines the maximum number of shares they are eligible to bid on. Each bidder also specifies minimum share by year – a share below which it would prefer to win nothing. A bidder cannot submit bids that are smaller than its minimum share.

In each round, each bidder tenders a supply schedule as a group of bids. A bid is a triple (y, s, d), where y is the year, s is the number of shares, and d is the discount (in percent). A winner of s shares in year *y* at a discount *d* is obligated to serve *s*% of the standard offer service load in year *y* at a discount *d*%. A bidder can submit as many bids as it likes, subject to its eligibility as initially determined by its deposit.

At the end of each round of bidding, the bids are ranked in descending order of discount (separately for each year), then in ascending order of time-stamp (earlier bids are ranked higher) to form the aggregate supply schedule for the year. For each year, starting with the largest discount, bids are designated as winning bids until the cumulative shares reaches 100. All other bids are designated losing bids. The lowest-winning bid defines the clearing discount d^*.[2] After the final round of bidding, all winning bids are awarded at the discounts bid. The example in Figure 1 illustrates how the clearing discount is determined for a particular year. A bid is also referred to as a "step," since each bid represents a step on the supply schedule.

Figure 1. Sample Supply Schedule



B. Activity Rules

Opening Rule: In the initial round, the bidder specifies a minimum share by year, below which it will win nothing. All bids must be for at least this minimum share amount. A new step in the bid schedule can be submitted only in the first four rounds.

Eligibility Rule: The bid deposit determines a bidder's maximum eligibility. A bidder must submit bids totaling at least 25% of eligibility in the first round, 50% in the second round, 75% in the third round, and 100% in the fourth round. Failure to maintain these activity levels results in a proportionate reduction in eligibility.

Sorting Rule: In each round, the steps are sorted in decreasing order by discount, and then in increasing order by time-stamp. Steps are designated as winners, until the cumulative shares exceed 100. The next step is rationed as follows:

Rationing Rule: The first step with cumulative shares greater than 100 is split into two steps: a winning step with shares so that cumulative shares are exactly 100 and a losing step for the remaining

[2] If the total shares bid in a year is less than 100, then the clearing discount is –1 bid increment. Any positive bid is accepted.

shares of the step. All steps further down the schedule are losing steps. If after rationing the rationed bidder has winning shares less than its minimum share for the year, then the (entire) rationed step becomes a losing step, and the Sorting Rule is reapplied with this losing step removed.

Rejection Rule: A losing step from the prior round is rejected after the current round if its discount is not improved (i.e. its discount is not raised above the previous round's clearing discount by the minimum bid increment). Rejected steps are permanently removed from the bidder's bid schedule. All steps that are not rejected are automatically carried over to the next round.

Revision Rule: A step can be divided into two or more steps with total shares equal to the initial step, so long as each step is greater than or equal to the minimum share for the year. A step can be revised only by improving the previous clearing discount. That is, the revised step must bid a new discount that is more than the previous clearing discount by at least the specified minimum bid increment.

Closing Rule: All the yearly markets stay open until a round goes by with no improvements in any market. Hence, all markets close simultaneously.

III. An Auction Design for Standard Offer Service

A. Auction Load Responsibility by Year

We begin with the key question: what is being auctioned? There are three dimensions to a bid in this setting: time, price, and quantity. Time is the year of standard offer service. The auction is to produce supply schedules for each year in the transition period, here assumed to be seven years.[3] Price is the discount from the prices stipulated in the settlement agreement. In the event that the auction is undersubscribed, the generation affiliate provides the remaining standard offer service without discount to the Distribution Company. For example, the stipulated prices from the NEES settlement agreement are shown below:

Year	1	2	3	4	5	6	7
Calendar Year	1998	1999	2001	2002	2003	2004	2005
Price (cents/kWh)	3.2	3.5	3.8	3.8	4.2	4.7	5.1

The quantity dimension requires some thought. There are three possibilities.

1. *Energy Auction*

The first approach is to let energy be the unit of quantity. For example, the NEES auction is for 134 energy blocks in each year. Each energy block is 150 GWh of delivered energy. A bid is for the rights and obligations to supply the specified maximum annual amount of standard offer service energy to customers' meters at a specified discount from the stipulated prices. Hence, a bid for 10 blocks in year 2 at a 5% discount obligates the bidder to supply up to 1,500 GWh of energy to customers' meters in year 2 at a 5% discount from 3.5 cents.

However, of critical importance to the bidders is knowing the consequence of a bid: under what circumstances and how much does a bidder supply. A bid for ten blocks (1,500 GWh) does not mean that the bidder will supply 1,500 GWh of energy in the specified year. Rather the final bids at the end of the auction are used to create a supply schedule for each year. Then periodically (monthly or quarterly), NEES estimates the annual requirement for standard offer service in GWh. For example, on March 15, 1999, it estimates that standard offer service will require 15,000 GWh (100 blocks) from April 1, 1999,

[3] The length of the transition period varies by settlement agreement.

to March 31, 2000 (this estimate does not take into account any attrition from standard offer service during the year in question). It then adds a 25% safety factor to yield a maximum energy need of 125 blocks. Then NEES moves up the supply schedule for 1999 and designates the first 125 blocks (i.e., the best discounts) as winning bids and the bidders are notified. If the smallest winning bid was 3%, then the bid for 10 blocks at 5% would be a winning bid and that bidder would be obligated to serve 10/125 = 8% of the standard offer load for every hour during the next period (say, from April 1, 1999, to June 30, 1999). If the smallest winning bid was 6%, then the 5% bid would be designated a losing bid. In this case, the bidder is told that it will not be asked to serve at any time in the remainder of year 2. All winning bidders face identical load curves.[4]

Although the auction is cast as an energy auction with bidders bidding for 150 GWh energy blocks, it should be clear from the description above that this energy auction is fundamentally an auction of the load responsibility. The 25% safety factor, together with not taking account of attrition for standard offer service, make it extremely unlikely that a supplier will actually be asked to supply the maximum energy quantity. Hence, all the energy blocks do is provide a way to *assign* load responsibility. The problem with doing it this way is that it adds both complexity and uncertainty. In the energy auction, bidders do not find out whether they are winners or losers until years after the auction. Not only does this add uncertainty, but it further undermines competition. A key element of competition in an auction is being bumped from a winning position to a losing position. This encourages the bumped parties to come back and improve their bids. This element is lost in an energy auction.

2. Capacity Auction

A variation of the energy auction is a capacity auction, in which the quantity unit is blocks of capacity. For example, there might be 200 blocks, each for 20 MW of capacity. Like in the energy auction, a bid in the capacity auction is translated into a load responsibility on a periodic basis (monthly or quarterly). Each period, the Distribution Company estimates the annual peak demand. For example, on March 15, 1999, it estimates that the annual peak load for standard offer service will be 2,000 MW (100 blocks). As before, the bids are sorted from largest discount to smallest discount until the 100^{th} block of capacity is reached. The load responsibility is then assigned among these winning bidders in proportion to their bids. A winning bid for 10 capacity blocks would translate into an obligation to serve 10/100 = 10% of the standard offer load for every hour during the next period (say, from April 1, 1999, to June 30, 1999). It is important to emphasize that the capacity auction does not actually provide a cap on the capacity that is required to serve the load. The capacity figure simply serves as an estimate of the required capacity. The winning bidders are entirely responsible for meeting the specified percentage of load, regardless of how much capacity is actually required.

The capacity auction has the advantage that it states the obligation in terms most relevant to the supplier: the required capacity. However, like the energy auction, the capacity auction suffers from the fact that it does not identify auction winners until the beginning of each supply period. Hence, both during the auction and after the auction (until the beginning of the specified supply period), the bidder does not know whether she is a winner or a loser. This undermines competition in the auction and increases uncertainty, since the bidders do not know based on their bids whether they will be called on to serve.

3. Load Responsibility Auction

Our third alternative for the quantity unit provides a simple and elegant fix to this problem. It solves a fundamental shortcoming of the previous two methods of assigning load responsibility: as the auction

[4] The load curves will be determined separately by voltage level, so that line losses and other costs are allocated appropriately.

progresses, there are no clear winners and losers, resulting in reduced incentive to compete. We propose that rather than bid for energy or capacity blocks, let the bidders directly bid for shares of the standard offer service load responsibility. Instead of 134 energy blocks or 200 capacity blocks, there could be 100 shares of load responsibility. A bid for 10 shares corresponds to a 10% share of the load responsibility. With this minor change, bidder uncertainty is dramatically reduced. Bidders then know after each round of bidding which of their bids are winners and which are losers. They then can improve the losing bids if they so desire. Moreover, since they know what they have won (to the extent possible) at the close of the auction, they can base their business decisions on this information, lining up the capacity (through actual generation or market contracts) as required.

There is one sense in which this load-responsibility auction may increase uncertainty relative to a capacity auction. In particular, in the capacity auction, the bidder knows that a bid for 10 blocks will ultimately translate into either a losing bid or a winning bid in which case the bidder serves a load with a peak very close to the estimated peak of 10×20 MW = 200 MW. However, up until just before the start of the period the bidder does not know whether she will be serving at all! In contrast, in the load-responsibility auction, a bidder knows immediately whether her bid for 10 shares of the load is a winning bid. Then between the end of the auction and the beginning of the period (up to seven years), the winner is able to revise her estimate of what a 10% share of the load means and take the steps to best serve that load.

A second important advantage is that the Distribution Company can get out of the forecasting business. The need to do monthly or quarterly updates vanishes. Not only do these forecasts postpone the resolution of major uncertainty, but they introduce unnecessary conflicts of interest. If an affiliate of the Distribution Company participates in the auction and the relationship is not severed after the auction, then there may be incentives to make “strategic forecasts” based on the market prices and where the affiliate ends up on the aggregate supply curve.

Under option 3, our recommended approach, we auction 100 shares of load responsibility for each year. A bid is a triple (y, s, d), where y is the year, s is the number of shares, and d is the discount (in percent). The number of decimal places allowed for the share and discount components are design parameters. Zero or one decimal places for the share s and two decimal places for the discount d seem about right. A winner of s shares in year y at a discount d is obligated to serve s% of the standard offer service load in year y at a discount d%. A bidder can submit as many bids as it likes, subject to its eligibility as initially determined by its deposit.

This structure accomplishes two things. First, it gives the bidders the flexibility to tailor their bids for standard offer service to their particular situation over the seven-year transition period. Second, it immediately resolves the uncertainty about who the winners and losers are in the auction. This stimulates competition. Moreover, it greatly improves efficiency and reliability by giving the bidders the information they need to plan for the supply of standard offer service.

B. Use a Bid Deposit to Assure that the Bidders Are Serious

A bid deposit is an essential requirement of participation. It is an up front payment that can be applied to penalties in the event of default. The deposit assures that the bidders are serious and thereby guarantees the integrity of the bidding process. The maximum quantity of shares that a bidder can bid on is determined from the bidder’s bid deposit. The bid deposit is applied to all costs of default in the event a winning bidder fails to execute the Contract for Load Responsibility at the conclusion of the auction.[5]

[5] Default costs include (1) the cost of any change in prices, and (2) the cost of reauctioning the shares of load responsibility on which there was default or the cost of reauctioning all shares. Which method is chosen in (2) is at the discretion of the auctioneer, based on the extent of the default and its likely impact on prices. A large default is

A bid deposit of $x is required per share of eligibility. The weighted-sum of shares of the bidder's bids cannot exceed its eligibility. The eligibility weights vary by year as follows: [6]

Year	1	2	3	4	5	6	7
Calendar Year	1998	1999	2001	2002	2003	2004	2005
Weight	1.00	0.80	0.64	0.51	0.41	0.33	0.26

Hence, to get one share of eligibility in year 7 requires only about one-quarter of the deposit required to get a share of eligibility in year 1. This reflects the fact that the load in year 7 will be less than the load in year 1, because of attrition from standard offer service. The weights above are not a prediction of likely attrition from standard offer service. Attrition must be estimated by the bidders.

Bid deposits are returned with interest shortly after the close of the auction. Winners in the auction must provide a performance bond at the time the Contract for Load Responsibility is executed. A performance bond of $z is required for the weighted-sum of shares won. The yearly weights are identical to the eligibility weights above. The performance bond can decline in amount as performance is met; that is, the performance bond in year 3 is just the weighted-sum of shares won in years 3 to 7.

C. Use a Simultaneous Ascending Auction Design

There are three basic features of a simultaneous ascending auction. First, all the goods are on the auction block at the same time. In the case of the standard offer service auction, this means that all shares of load responsibility for all years are bid on simultaneously, with clearing prices determined separately by year. Second, bids are accepted for any or all goods in a sequence of rounds. And third, the auction does not end until a round goes by in which no improved bids are received on any of the goods. This auction design is the natural extension of the traditional English auction of a single good to the case where the auctioneer is selling many interrelated goods. The advantage of a simultaneous ascending auction is that it provides a robust process of price discovery. Bidders can initially bid conservatively, and then raise their bids in response to market forces, which appear as willingness to supply excess electricity at low discounts.

Compared with a sealed-bid auction, this design reduces bidder uncertainty. The bids from prior rounds reveal information, which the bidders can take into account in future rounds. Being able to condition on more information reduces the winner's curse, and thereby allows bidders to bid more aggressively.[7]

In addition to reducing uncertainty, the design encourages competition by reducing participation costs. Moreover, it generates market prices for electricity in each of the transition years. Finally, it is an open and transparent process. Bidders, consumers, and regulators can track the competitive process and confirm that the rules are being followed and that no bidders have an unfair advantage. At the end of the auction, the auction winners are winners solely because no one else was willing to offer larger discounts.

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likely to result in the reauctioning of all shares. A small default is likely to result in the reauctioning of only the defaulting shares. The cost of the change in prices is calculated based on (1) the change in prices for all shares reauctioned and (2) the quantity of energy sold in a base year (say, 1996) discounted by the eligibility weights.

[6] The weight in year y is 0.8^{y-1}.

[7] The winner's curse is the tendency for naïve auction winners to actually lose money, because they fail to take account of the information contained in winning a competitive auction. To avoid the winner's curse, smart bidders shade their bids. The amount of shading depends in part on the amount of uncertainty the bidders face. See Milgrom, Paul R. and Robert J. Weber (1982), "A Theory of Auctions and Competitive Bidding," *Econometrica*, 50, 1089-1122.

The simultaneous ascending auction has now been thoroughly tested in auctions worldwide. It was first used in the FCC spectrum auctions for wireless communications. These auctions have been an enormous success, raising over $23 billion in revenues in the first three years.[8]

D. Use Pay-Your-Bid Pricing

A primary goal of the auction is to determine market prices for standard offer service. Pay-your-bid pricing in an ascending bid auction best accomplishes this goal. Pay-your-bid pricing works as follows. With each round of bidding the bids are ranked in descending order of discount, and then ascending order of time-stamp, to form the aggregate supply schedule. For example, Figure 1 shows the supply schedule for a particular year based on the following table of bids:

Bidder	Bid	Discount	Time-stamp	Shares	Cumulative Shares	Status
3	A	5.0%	10/16/97 09:35:42	20	20	Winning
1	B	4.8%	10/18/97 12:14:25	15	35	Winning
2	C	4.7%	10/16/97 11:51:45	25	60	Winning
4	D	4.3%	10/17/97 14:21:52	20	80	Winning
4	E	4.0%	10/19/97 10:02:47	30	110	Rationed
2	F	4.0%	10/19/97 13:12:45	40	150	Losing
1	G	3.5%	10/19/97 13:47:20	15	165	Losing
3	H	3.2%	10/19/97 13:14:06	20	185	Losing
1	I	3.2%	10/19/97 13:36:42	15	200	Losing

Starting with the largest discount, bids are designated as winning bids until the cumulative shares reaches 100. All other bids are designated losing bids. The lowest-winning bid (bid E) defines the clearing discount d^*. After the final round of bidding, all winning bids are awarded at the discounts bid – that is, the winning bidders receive the share of the load they bid for at the discounts bid. The example in Figure 1 illustrates two details. First, ties are broken by the time-stamp of the bid. Bids E and F are tied in discount (4%); however, bid E has an earlier time-stamp and thus has higher priority.[9] Second, in the event the marginal bid crosses beyond the 100-share point, then the bid is only partially filled and is designated as a rationed bid. For example, bid E, the marginal bid, extends the cumulative shares to 110; hence, the bid is reduced by 10 (20 of the 30 shares are won). At most one bid is rationed.

One might think that it might make sense for the winners to pay the market-clearing discount, rather than the actual discounts bid. This approach, know as uniform pricing, has the advantage that every bidder pays the same discount. However, it has the distinct disadvantage that more collusive equilibria are possible under uniform pricing.[10] Hence, it runs the risk that the bidders will be able to coordinate on small or no discounts, especially if competition is weak.

In the context of an ascending-bid auction, pay-your-bid pricing has the main advantage of uniform pricing, and yet minimizes the risk of collusive outcomes. With pay-your-bid pricing, the auction will still end with near-uniform prices, since bidders have a strong incentive not to beat the clearing price by

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[8] See Cramton, Peter (1997), "The FCC Spectrum Auctions: An Early Assessment," *Journal of Economics and Management Strategy*, forthcoming, 6.

[9] Notice that the time-stamps occur over several days. This is because the bids were submitted over several rounds of bidding. When a bidder improves a bid on its bid schedule, only the time-stamp for the revised bid is updated. All other bids retain the original time-stamp.

[10] See Wilson, Robert (1979), "Auction of Shares," *Quarterly Journal of Economics*, 94, 675-689; Back, Kerry and Jaime F. Zender (1993), "Auctions of Divisible Goods: On the Rationale for the Treasury Experiment," *Review of Financial Studies*, 6, 733-764.

more than a single bid increment. Hence, the auction is likely to end with all winning bids close to the clearing discount.

E. Use an Activity Rule Based on Revealed Preference

A basic element of the simultaneous ascending auction is the activity rule, which promotes sincere bidding. The activity rule we propose is adapted from the design for the California Power Exchange's day-ahead auction.[11] The rule is based on the principle of revealed preference: a bidder's refusal to improve a previous clearing price is presumptive evidence that it cannot do so profitably. This principle is represented here by the Rejection Rule, which permanently rejects a bid that fails to improve the previous clearing price.

1. The Role of Activity Rules

Activity rules are needed to ensure that price discovery is reliable. The issue is very simple: without activity rules no supplier has any incentive to make serious bids until the final round; and without serious bids, the tentative clearing prices in early rounds are unreliable predictors of the final clearing prices. Indeed, any large bidder has the opposite incentive: it withholds information about its own final bids in the early rounds, preferring instead to rely on others to provide such information contributing to price discovery. Activity rules are imposed in order to force all bidders to reveal early some credible signal about the bids they will tender in the final round.

In designing activity rules, the guiding principle is that they should be the least restrictive rules that suffice to assure reliable price discovery. Ideally, they impose no limit on the efficiency attainable at the close of the auction. In particular, they should impose no significant restrictions or disadvantages on suppliers who elect to bid their actual costs. The only effect of the activity rules is to suppress gaming, or render it ineffective, by imposing constraints on revisions of bids during the iterative process. These constraints create increasingly strong incentives for cost-based bids. The net effect is the same as rounding up wild horses by driving them into the chute of a V-shaped fence.

Activity rules can be designed using the principle of "revealed preference." By interpreting previous bids as reliable indicators of what is feasible and profitable for the supplier, constraints can be imposed on subsequent bids. As the auction progresses, these constraints narrow the supplier's allowed strategies, until in the final round there is little room for bids that differ significantly from actual costs. Realistically, costs must be interpreted here as opportunity costs rather than actual running costs, since each supplier also has opportunities to trade in other markets.

As a practical matter the activity rules must be easily understood by bidders, and simple to implement. The activity rules should be applied automatically by the auction software: the portion of any submitted bid schedule that violates the rules is discarded without any "negotiation" with the bidder.

Activity rules are generally of two kinds. One kind pertains to the opening and closing of the auction, and the other pertains to the ways in which tenders can be revised. We first describe the activity rules for the revision of tenders.

2. An Illustration of the Proposed Activity Rules

In every round, each bidder tenders a bid schedule, which is a bundle of bids or steps. Each step consists of a discount for a specified quantity of shares of the load responsibility in a particular year. The table below gives the four bid schedules from our prior example. Bidder 1's bid schedule has three steps:

[11] Wilson, Robert (1997), "Activity Rules for the Power Exchange," Report to the California Trust for Power Industry Restructuring, March 14.

a 4.8% discount for 15 shares, a 3.5% discount for 15 shares and a 3.2% discount for 15 shares. At the conclusion of each round, steps are designated as winning or losing, depending on whether the discount is above or below the clearing discount. Steps at the clearing discount are ordered by the time-stamp (earliest first) and are designated winning, so long as the cumulative shares is less than or equal to 100. The next step is rationed, unless the cumulative winning shares is exactly 100, in which case there is no rationed step. The rationed step (step E in our example) is split into two parts: a winning step (EW), which increases the cumulative total to exactly 100, and a losing step (EL). All remaining steps at the clearing price (step F) are designated losing.

Bidder	Bid	Discount	Time-stamp	Shares	Cumulative Shares	Status
1	B	4.8%	10/18/97 12:14:25	15	35	Winning
1	G	3.5%	10/19/97 13:47:20	15	165	Losing
1	I	3.2%	10/19/97 13:36:42	15	200	Rejected
2	C	4.7%	10/16/97 11:51:45	25	60	Winning
2	F	4.0%	10/19/97 13:12:45	40	150	Losing
3	A	5.0%	10/16/97 09:35:42	20	20	Winning
3	H	3.2%	10/19/97 13:14:06	20	185	Rejected
4	D	4.3%	10/17/97 14:21:52	20	80	Winning
4	E	4.0%	10/19/97 10:02:47	30	110	Rationed
	Bid E is split as follows:					
4	EW	4.0%	10/19/97 10:02:47	20	100	Winning
4	EL	4.0%	10/19/97 10:02:47	10	110	Losing

The revision rule has four parts. In each round after the first, for each step of the bid schedule:

1. The discount cannot be decreased.
2. A step can be split into two or more steps with total shares equal to the original step.
3. The discount can be increased only if the new discount is more than the clearing discount in the previous round by at least the minimum bid increment. We say in this case that the new discount "improves" the previous clearing discount.
4. Steps designated as losing in the prior round that do not improve the previous clearing discount are rejected and can never be improved.

Part 1 is a fundamental requirement for a competitive auction. Part 2 gives bidders the flexibility to improve a portion of a step. Part 3's requirement that a discount change improves the clearing discount eliminates extraneous revisions. A minimum increment averts stalling the auction.

Part 4 is the key provision. To see how this works, suppose in our example that the clearing price in the prior round was 3.5% and that the minimum bid increment is 0.5%. Then since steps H and I were losing steps in the prior round and they were not improved, they are rejected. This means that they are permanently deleted from the bidders' schedules and so cannot be improved in any subsequent round. All other steps were either winning steps in the prior round or improved this round.

The motivation for Part 4 is as follows. In the current round, Bidder 3 failed to improve her losing step H. This is taken as *de facto* evidence that she cannot profitably improve the step with a 4% bid

(0.5% above the prior clearing discount). Hence, the step is permanently rejected, since Part 1 assures that discounts can only increase.

The effect of Part 4 is to reject any part of a supplier's bid schedule for which there is presumptive evidence that her cost exceeds the clearing discount. Part 3 prevents a supplier from profiting by withholding supply until the final round.

Activity rules of this form produce a characteristic process of competition among suppliers. After each round the bids are divided into those that are winners, because their bid discounts are more than the clearing discount, and those that are losers, because their bid discounts are less than the clearing discount (or they are rationed). In the next round, each losing bid must improve the previous clearing discount or lose that step of the schedule. Thus, if the previous clearing discount is less than the supplier's cost then the incentive to revise the bid discount is quite strong, since this is the supplier's last opportunity. However, when the bid is revised, it displaces some previous winning bid, which now becomes a losing bid, and that supplier now faces a similar problem. The resulting process resembles a tug-of-war among the marginal suppliers to determine which ones' bids will be accepted at the clearing discount. This battle is resolved when the clearing discount is driven up to the cost of some of the contenders, who then prefer to let their bids be rejected. The characteristic pattern is that in each round there are many bids near the previous clearing discount; but if the suppliers must be rationed, then those with losing bids and lower costs find it advantageous to raise their discounts. This feature is not present in the auctions that have been considered to date for assigning standard offer service (see methods 1 and 2 above).

3. A Proposed Implementation

This subsection describes a complete set of procedural rules. These rules are intended to implement the main ideas elaborated in the prior subsection.

The activity rules apply separately for each step on the bid schedule. Each step is a binding bid that remains in force until it is improved or rejected. An improved step replaces the prior step. Except for those rejected or improved, all steps continue in force for the next round. At the close of the auction, those steps with discounts below the clearing discount are rejected, with ties at the clearing discount resolved by the Rationing Rule. The remaining steps are accepted, and each becomes automatically a binding contract for the bid share at the discount bid. This contract is an obligation for serving the specified share of the standard offer load under the terms of a pre-defined and agreed upon power supply contract.

The Opening and Eligibility Rules require that all new bids must be received early in the auction. Yet it gives the bidders the flexibility to balance their activity across the years in response to the bids of the others. For example, during the fourth round, a bidder may place most of its new bids on year 2, because of a shortage of bids in that year. However, once bids are placed, the bidders cannot shift bids across years. This is to prevent a bidder from placing a large bid for year 1, say, and then shifting it to year 7 near the end of the auction, causing a large disturbance to prices.

Opening Rule: In the initial round, the bidder specifies a minimum share by year, below which it will win nothing. All bids must be for at least this minimum share amount. A new step in the bid schedule can be submitted only in the first four rounds.

Eligibility Rule: The bid deposit, due by the Final Qualification date, determines a bidder's maximum eligibility. A deposit of $x per share of eligibility is required. Shares are weighted by year as follows:

Year	1	2	3	4	5	6	7
Calendar Year	1998	1999	2001	2002	2003	2004	2005
Weight	1.00	0.80	0.64	0.51	0.41	0.33	0.26

A bidder must submit bids totaling at least 25% of eligibility in the first round, 50% in the second round, 75% in the third round, and 100% in the fourth round. Failure to maintain these activity levels results in a proportionate reduction in eligibility.[12] For example, if a bidder has eligibility to bid on 100 shares, but only bids on 20 in the first round, then its eligibility is reduced to 4×20 = 80 shares.

It should be expected that there will be little price discovery in the first several rounds. Until the end of round 4, there may be no losing bids (i.e., no excess supply) and so no pressure to improve bids. This period of little price activity is intended to give the bidders an opportunity to digest the extensive quantity activity in the first four rounds.

In each later round the only bids allowed are improvements of ones submitted in the first four rounds. This rule ensures that the maximum supply in each yearly market is revealed by the fifth round. This rule is essential for effective price discovery; otherwise a bidder could wait until the final round to submit its first bids.

Next we describe the Sorting, Rationing, Rejection, and Revision rules.

Sorting Rule: All steps that are not rejected are automatically carried over to the current round. The steps are sorted in decreasing order by discount, and then in increasing order by time-stamp (equivalent bids are taken on a first-come first-served basis). Steps are designated as winners, until the cumulative shares exceed 100. The next step is rationed as follows:

Rationing Rule: The first step with cumulative shares greater than 100 is split into two steps: a winning step with shares so that cumulative shares is exactly 100 and a losing step for the remaining shares of the step. All later steps are losing steps. If after rationing the rationed bidder has winning shares less than its minimum share for the year, then the (entire) rationed step becomes a losing step, and the Sorting Rule is reapplied with this losing step removed.

This rationing rule has worked well in experiments. It has been found to lead to the fastest convergence, because it minimizes the splitting of steps.

In each round after the first:

Rejection Rule: A losing step from the prior round is rejected after the current round if its discount is not improved (i.e. its discount is not raised above the previous round's clearing discount by the minimum bid increment). Rejected steps are permanently removed from the bidder's bid schedule.

The Rejection Rule is based on the inference that refusal to improve the previous clearing discount signals that the improved discount would not be profitable. The restriction that rejected steps cannot be improved is essential to reliable price discovery. Otherwise, a supplier could wait until the last round to improve steps, and in the meantime other bidders would be getting no information about higher discounts the supplier might be willing to bid. Thus, each discount that is below the clearing discount in one round must be revised in the next round lest it thereafter be permanently rejected.

Revision Rule: A step can be divided into two or more steps with total shares equal to the initial step, so long as each step is greater than or equal to the minimum share for the year. A step can be revised only by improving the previous clearing discount. That is, the revised step must bid a new discount that is more than the previous clearing discount by at least the specified minimum bid increment.

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[12] If a bidder has eligibility e_j and total activity a_j (the weighted sum of the shares of all non-rejected bids) in round $j \leq 4$, and $a_j < ¼\, j \cdot e_j$, then $e_{j+1} = 4a_j/j$. Otherwise, $e_{j+1} = e_j$.

Thus, a losing step for 25 shares can be revised by breaking it into two steps, say for 10 and 15 shares. Then, the bidder can improve the previous clearing discount on just one of the steps. In this case, the second step is rejected. Alternatively, the bidder can improve both steps at different discounts, in which case neither step is rejected.

The clearing discount is computed using all non-rejected steps on the current bid schedules. It is important to realize that the bid increment is an important design parameter that can substantially affect the rate of convergence of the iterative process. In a worst-case scenario the clearing discount moves by no more than the bid increment from one round to the next.

Closing Rule: All the yearly markets stay open until a round goes by with no improvements in any market. Hence, all markets close simultaneously.

Both theory and experiments show that the markets converge naturally.

IV. The NEES Design

In this section, we summarize the NEES design, focusing on features that we view central to the design.[13]

NEES proposes to hold an energy auction as described earlier. Hence, the quantity dimension of bids is 150 GWh blocks of delivered energy. NEES actually uses two auctions to determine the supply schedule for each year: a full-term auction and a multi-round auction.

A. The Full-Term and Multi-Round Auctions

In the full-term auction bids are for the entire seven-year transition period. Hence, a bid for 10 blocks at 5% in the full-term auction is like a bid for 10 blocks at 5% in each of the seven years. This auction is a sealed-bid auction. The bids are collected just before the multi-round auction begins. These bids are then put in a safe, unopened, until after the multi-round auction ends. Full-term bids can only be for a fixed discount in all seven years.

In the multi-round auction, bids are year specific. A bidder can bid a specified discount for any number of blocks up to its maximum eligibility as determined by its bid deposit. The multi-round auction gives the bidder the flexibility to bid different amounts (in both price and quantity) in each of the seven years. Bidders may desire this flexibility if they anticipate their capacities will change over the years or if they believe the appropriate discount varies across years.

The mechanics of the multi-round auction are similar to (and modeled after) the FCC's successful spectrum auctions. All seven years are on the block simultaneously. In each round, a bidder can submit bids for any of the years up to its maximum eligibility. Bids in subsequent rounds must be either new bids (for additional quantity) or improvements of prior bids. All improvements must top the bidder's prior bid by some minimum, the "minimum bid increment."

In addition to a minimum increment, there is an activity rule, designed to keep the auction moving at a reasonable pace. The activity rule requires that a bidder's activity in a round be at least as great as a

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[13] The NEES design is spelled out in the following NEPSCo documents: "Request for Qualifications to Provide Standard Offer Service Electricity Supply to Customers of Massachusetts Electric Company and Nantucket Electric Company," April 3, 1997. The design is further clarified in "Massachusetts Electric Company's Auction of Standard Offer Electricity Supply," Pre-Bid Conference Slides, May 9, 1997; "Question and Answer Summary," May 9, 1997; "Additional Question and Answer Summary," May 21, 1997; and "Proposed Changes in Mass. Electric's Standard Offer Service Auction," Memo to Interested Power Suppliers, June 16, 1997. The description that follows does not include the changes proposed in the memo of June 16, 1997, since these changes have not been adopted.

specified percentage of its current eligibility. A bid counts as activity if it is an improvement over the bidder's prior bid or it is the largest discount for the particular year. If a bidder fails to satisfy the activity rule more than once, the bidder loses its ability to submit any new or improved bids. The rules specify four stages of bidding with the following activity requirements and minimum bid increments in each stage. The minimum starting bid is 2%.

Stage	Activity Requirement	Minimum Bid Increment
1	25%	2%
2	75%	1%
3	50%	1%
4	25%	1%

Stage transitions are at the discretion of NEES with the exception that stage 1 can last a maximum of three rounds. After each round, the revised supply schedules are posted for each year, so that each bidder can see where it stands in the tentative supply schedule for each year.

B. Combining the Two Auctions

The final, but critical, component to the auction rules is how the two auctions are combined to form a single, final supply schedule for each year. First, the multi-round schedules are used to form complete (seven-year) "strips" for each block of energy. Two sample blocks are shown below.

Year:	1	2	3	4	5	6	7
Block 54	3%	5%	8%	12%	15%	18%	20%
Block 55	2%	5%	8%	10%	15%	18%	17%

It remains to consolidate each seven-year strip into a single discount that can be compared with the single discount bids in the full-term auction. NEES does this aggregation by taking the *minimum* discount for each strip. These minimums are referred to as ranking discounts. Hence, in the example, Block 54 has a ranking discount of 3% and Block 55 has a ranking discount of 2%. The resulting multi-round schedule is then combined with the full-term schedule in the traditional way by merging (i.e., adding) the supply schedules in the quantity dimension. This forms a single aggregate supply schedule, which is then used as described in the beginning of this section to assign the load responsibility.

Finally, we must specify what each bidder is paid for energy supplied. Full-term bidders are paid the stipulated price less the next-lower discount (either full term or multi-round) for each GWh of energy. Hence, a winning full-term bid of 2.5% would receive the stipulated price discounted by 2% if 2% was the next-lowest bid discount. Multi-round bidders are paid the stipulated price less the discount they bid. If Block 54 from the multi-round auction is a winning strip, then the year 4 bidder would receive the stipulated price discounted by its bid discount of 12% for all energy delivered.

V. A Critique of the NEES Design

We believe that the NEES auction design is flawed. In this section, we present the problems and suggest improvements.

A. The Full-Term and Multi-Round Auctions are Not Properly Combined

One of the basic problems with the NEES design is the way in which the full-term and multi-round auction results are combined. Using the minimum discount across the seven years to rank a strip severely handicaps the multi-round auction. Here is the problem: The schedule of stipulated prices increases steadily from year 1 (3.2 cents) to year 7 (5.1 cents) for a total increase of 62.5% over the seven years. Hence, many suppliers that find the pricing in the later years to be attractive will be reluctant to bid large discounts in the early years. As a result, we can expect the discount in year 1 to be the smallest, and it will be the year 1 bidding that determines the ranking discount (the ensuing discussion presumes this, although the problem is the same regardless of where the minimum occurs). Thus, the bids in all other years are *irrelevant* to the ranking; these bids do, however, determine what the bidder gets paid for electricity delivered. Notice that the yearly bids after year 1 may be much larger than the year 1 discounts. For example, the full-term bid of 2.5% (which gives a 2% discount) beats the Block 55 strip, which has a ranking discount of 2%. Yet *all* consumers prefer the Block 55 discounts. Consumer groups (and the bidders on the Block 55 strip) are likely to complain that companies bid substantial discounts in the multi-round auction and yet consumers will get much smaller discounts.

The difficulty is that using the minimum to determine the ranking discount puts all the weight on year 1 and no weight on the other years. The solution is to use nonzero weights in each year. A standard and universally accepted approach for weighting in a multi-year decision problem is discounting. Under this approach, early years are given more weight than later years, which are discounted at a constant discount rate. In most problems, the discount rate represents the time value of money. A dollar today is worth more than a dollar tomorrow. However, in this context, there is an additional source of discounting: attrition from standard offer service. Price discounts in year 1 are worth more in aggregate to consumers, since the savings is earlier *and* the savings is received by a greater number of consumers (once a consumer moves off of standard offer they cannot return to it).[14] Hence, appropriate weights account for both the time value of money and the attrition from standard offer service). For example, suppose that there is a 10% discount rate due to the time value of money, and that in each year 20% of the consumers move off of standard offer service. Then the appropriate price factors and weights are given below.

Year	1	2	3	4	5	6	7	Ranking Discount: Minimum Rule	Ranking Discount: Discounting Rule
Price Factor	3.20	2.55	2.01	1.46	1.18	0.96	0.75		
Weight	0.26	0.21	0.17	0.12	0.10	0.08	0.06		
Sample Strips									
Block 54	3%	5%	8%	12%	15%	18%	20%	3%	9%
Block 55	2%	5%	8%	10%	15%	18%	17%	2%	8%

The price factor in year n is simply $p_n \cdot [(1-a)/(1+i)]^{n-1}$ where p_n is the stipulated price in year n, i is the time discount rate and a is the yearly attrition rate. These rates put over four times as much weight on year 1 as year 7. Of course, if it is believed that attrition will occur at more (less) than 20% per year, then the discount rate should increase (decrease) accordingly. The weights are the price factors normalized so that the weights sum to 1. The last two rows of the table show what the ranking discount would be in our example under the two alternative rules. The ranking discounts under the discounting rule are substantially larger and reflect the actual bids. These are the rankings that should be used if the goal is to maximize the net present value of consumers' savings from discounts.

One might argue that an advantage of the minimum rule is that it does not involve the choice of an arbitrary discount rate. However, the minimum rule is implicitly using an arbitrary discount rate of infinity (no weight on years after year 1). Hence, the choice between the minimum rule and the discounting rule depends on whether one believes a discount rate about 30% is more appropriate than a

[14] An exception is made in year 1. In year 1, some consumers can switch back to standard offer service provided the switch occurs within 90 days.

discount rate of infinity. Of course, if the answer is infinity, then we should simplify further by dropping years 2 to 7 from the settlement agreement, because we would be saying that these years are totally irrelevant to consumers.

The apparent reason for the minimum rule is to encourage bidding in the early years. However, this is accomplished more successfully by the discounting rule. Nonetheless, neither rule is terribly effective at encouraging bidding in the early years. The reason is the well-know free-rider problem. If bidding in year 1 were a losing proposition, then each bidder would prefer the other bidders to step in and raise their bids in year 1. In this way the bidder avoids the year 1 losses, but the bidder is more likely to be called into action in the later years, because of the higher-ranking discount resulting from the year 1 bidding of the other bidders. The only real solution to this free-rider problem is to directly subsidize the bids in the early years, but this is simply undoing the intent of the stipulated price settlement.

B. Two Auctions for the Same Thing Dampen Competition

A major complicating factor in the NEES design is having both full-term and multi-round auctions. Not only does this make the auction much more complicated for the bidders, but it impairs competition. Whenever an auctioneer holds more than one auction for the same thing, competition is reduced. The reason is that there is a strong tendency for a bidder in this setting to compete seriously in one auction or the other, but not both; thereby, avoiding competing with oneself. The net effect is that bidders are split between the two auctions, and overall competition is reduced.

Multi-round bidders are not in a position to compete effectively with the full-term bidders. The reason is again the free-rider problem. If competition is light in the multi-round auction, then the bidders in the multi-round auction may well prefer that someone raises the bids in year 1, so that the multi-round schedule will do better against the (as yet unknown) full-term schedule. However, each bidder wants the others to raise the bids in year 1. Bidders in the multi-round auction are further handicapped by the use of a “second-price” pricing rule for the full-term bids. This is a confused application of Vickrey’s Nobel-prize winning idea: if we charge winning bidders the opportunity cost of their winnings, then it is a dominant strategy for them to bid their true valuations. However, the use of the next-lowest bid for the “billing discount” in the full-term auction does not correspond to the opportunity cost of the winnings, and so Vickrey’s result does not apply.[15] The basic problem with this application, which Vickrey understood and solved, is that the second-price rule works only for sealed-bid auctions of a single good.[16] The rule does favor the bidders in the full-term auction, and hence discourages competition in the multi-round auction.

The simplest solution to this problem is to eliminate the full-term auction. The full-term auction is unnecessary and appears to be another attempt to encourage bidding in year 1. The idea behind it appears to be that with full-term bidding, bidders can recoup any loses in the early years with gains in the later years. If this is true, then it is true only to a very limited extent. The reason is that market forces necessarily bound gains in the later years. Suppose a bidder bids a 10% full-term discount thinking that losses in the early years will be more than compensated by large gains in the later years. Such a bidder is almost surely going to be disappointed. If there are large gains in the later years, then there are large gains for a competitor to step in and offer service at a price that just beats the standard offer. In years 1 and 2 some customers may be reluctant to move off standard offer service for an apparent better deal. But in the later years, there is no compelling reason to stay with the standard offer. The reputations of the suppliers will be established and the consumer will be forced to select a supplier shortly anyway.

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[15] Vickrey, William (1961), “Counterspeculation, Auctions, and Competitive Sealed Tenders,” *Journal of Finance*, 16, 8-37.

[16] See Ausubel, Lawrence M. and Peter C. Cramton (1996), “Demand Reduction and Inefficiency in Multi-Unit Auctions,” Working Paper No. 96-07, University of Maryland.

The consequence of the full-term auction – rather than to stimulate bidding in the early years – is to discourage bidding in *all* the years. This is because of the enormous complexity and uncertainty it adds to the auction. Potential bidders have a good option to avoid this uncertainty – not participating. Many will take it.

C. Auction Details Matter

Compared to the problems above, the issues below may appear minor. However, in auction design, it is important to get the details right. Bidders making billion dollar decisions will spend a great deal of resources looking for ways to game the rules to their advantage. Unlike a negotiation, which can be postponed in light of problems, postponing an auction is difficult, since the timing involves many parties. Moreover, many auction mistakes are irreversible. The savvy auctioneer will get the details right.

1. Timing

The critical timing events for the bidders are the final rules date, the qualification date, the auction date, and the timing of all payments. To encourage participation, it is important that there be ample time between the final rules date and the qualification date. Until the rules are set it is not realistic to think that all bidders can do the work necessary to qualify. Prudent investors are unlikely to commit resources until the auction rules are known and ambiguities are resolved. In a recent FCC spectrum auction for wireless communication services, revenues were far below expectations largely because Congress dictated an auction schedule that was too fast. The FCC was able to give the bidders just a few weeks between the final rules and the qualification date. As a result, the bidders did not have sufficient time to line up the money needed to participate.

The time between the qualification date and the auction date should be as short as possible. This allows entry into the auction up to the last moment. The electricity industry is in the midst of a massive restructuring. It is not realistic to think that in this setting all bidders can make commitments to participate months before the auction date. Yet NEES's qualification date was May 30, 1997 for an auction scheduled to begin on September 15, 1997. On May 30th all bidders had to submit complete qualification documents to NEES. The qualification date should be much closer to the auction date. Two weeks should be all that is needed to check qualifications. Deposits and final qualification should occur one week before the auction. Certainly, this rapid turnaround puts a burden on the auctioneer, but it is a burden well rewarded by increased participation.

2. Bid Increments and Minimum Initial Bids

NEES uses a constant minimum bid increment across the seven years. This does not make sense if the auctioneer expects larger discounts in the later years. The size of the minimum bid increment should correspond to the expected final bids. A more reasonable plan is shown below.

Minimum Bid Increment	Years 1 and 2	Years 3 to 7
Early in the Auction	1%	2%
Late in the Auction	½%	1%

The minimum starting bids should be 0%. This encourages participation at no potential cost to consumers. NEES uses a 2% minimum initial bid in the multi-round auction, yet consumers would benefit from any positive discounts.

3. Activity Rule

The goal of the activity rule is to encourage reliable price discovery. It is intended to prevent bidders from adopting a snake-in-the-grass strategy – simply waiting while the others reveal valuable information before stepping in with large bids at the last minute. The activity rule should speed the auction along by encouraging sincere bidding, and minimize the possibility for creating distortions in the bidding.

NEES borrowed the activity rule from the highly successful FCC spectrum auction design. Unfortunately, that rule makes no sense in the context of the NEES design. An essential element of the FCC rule is that after each round of bidding there are tentative winners and losers. Bidders are required to have a level of activity that is consistent with their eligibility or they lose eligibility. Activity is defined as being a standing high bidder (a tentative winner) or placing a valid new bid (which moves the bidder from a losing to a winning position).

With the NEES definition of what is being auctioned, winners and losers cannot be identified until years after the auction. This creates a difficulty in applying the FCC rule. The NEES approach is to use the lowest point on the supply schedule (i.e. the highest discount) as the high bid. This high bid counts as activity, but a sufficient percentage of all other bids for each bidder must be improved by the minimum increment for the bidder to maintain the flexibility to improve bids later. Note that the bidder with the largest discount, only gets activity credit for the largest bid. This bidder may well have to improve some of its other bids to satisfy the activity rule.

Unfortunately, the NEES rule is distortionary. As currently structured, large bidders can upset the strategies of small sincere bidders. Consider a small bidder bidding on 5 blocks in year 1. The small bidder can profitably offer a discount of up to 6%. It submits an initial bid of 3% on 5 blocks, hoping to make a reasonable profit. The large bidder submits the minimum bid of 2% on 49 blocks and a bid of 20% on 1 block. In round 2, the small bidder, since she is not the high bidder, is forced to raise her 3% bid to 5% (assuming the minimum bid increment is 2%) or lose flexibility. She may well gamble that her expected profits are higher by sticking at 3%. Once her flexibility is lost, the large bidder then steps in with a bid of 3.0001% (after the minimum bid increment has dropped to 1%) on his remaining eligible blocks.

VI. Conclusion

We have proposed a simple auction to determine market prices for standard offer service. The design is a simultaneous ascending auction. This gives the bidders maximum flexibility to adjust their bids within each year. It also reduces uncertainty by revealing essential information during the bidding process. The process ends naturally when no bidder is willing to improve its bid in any year. In this way, market prices are found that are both fair and efficient. Standard offer service is assigned to those suppliers who offer consumers the best prices. Consumers benefit from this competition, since stranded costs are reduced by larger discounts. In addition, consumers retain the option of moving off of standard offer service when presented with a better offer at any point during the transition period.

To promote sincere bidding, activity rules are included in the design. The essential element is a requirement that a losing bid from the prior round must be revised to improve the prior clearing price by at least one bid increment, or the bid is permanently rejected. The rule is based on the principle of revealed preference: a bidder’s refusal to improve a previous clearing price is presumptive evidence that it cannot do so profitably.

We describe an alternative auction design proposed by NEES. We find that the NEES design is too complex and is prone to gaming. Moreover, the NEES design discourages participation and is vulnerable to inefficient outcomes.

Standard offer service is but one application of the principles of auction design that we presented here. Indeed, these principles can be applied to many of the critical steps in the move to a competitive electricity industry. These applications include (1) the divestiture of generation assets, (2) the pricing and exchange of electricity in day-ahead and hour-head power pools, and (3) the pricing of ancillary services and transmission congestion. In each case, the goal is to determine an efficient allocation and establish market prices. A well designed auction structures the price discovery process to best meet this goal.