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Professional Experience

2004 –	Principal, ERS Group, Incorporated
2004 –	Research Professor, Clemson University
2003 –	Adjunct Senior Research Scholar, Columbia University
2003 – 2004	Co-CEO and Founder, Optimal Markets, Inc.
2000 – 2003	Senior Vice President, NERA
2000	Special Consultant, NERA
1999 – 2002	President and Founder, Optimal Auctions, Inc d/b/a Alkera Inc.
1999– 2000	Managing Director, Navigant Consulting Incorporated/LECG, Incorporated
1998–1999	Principal, LECG, Incorporated
1996–1998	Director, LECG, Incorporated
1995–1996	Principal, Charles River Associates Incorporated
1993–1995	Principal Member Technical Staff, GTE Laboratories Incorporated
1991–1993	Research Associate, Department of Economics, Boston University
1987–1993	Senior Member Technical Staff, GTE Laboratories Incorporated
1983–1987	Assistant Professor, Department of Economics, VPI
1979–1983	Assistant Professor, Department of Economics, SUNY at Buffalo

Education

Ph.D., (Economics) University of Rochester, February, 1981.

M.A., (Economics) University of Rochester, May, 1978.

A.B., (Economics and Mathematics) Washington University, Magna Cum Laude, May, 1975.

Publications

1. “Default Service Auctions,” with Colin Loxley, *Journal of Regulatory Economics,* Vol. 26, No. 2 (2004): 201-229.

2. “Multi-Lot Auctions: Applications to Regulatory Restructuring.” In *Obtaining the Best from Regulation and Competition*, edited by M.A. Crew and S. Spiegel. Boston, MA: Kluwer Academic Publishers (2004).

3. “Standards in Wireless Telephone Networks,” with Neil Gandal and Leonard Waverman, *Telecommunications Policy,* Vol. 27 (2003): 325-332.

4. “Auctions of Last Resort in Telecommunications and Energy Regulatory Restructuring,” Chapter 7 in Michael Crew (ed.) in *Market Pricing and Deregulation of Utilities,* Kluwer Academic Publishers (2002).

5. “Auctions and Regulation: Reengineering of Regulatory Mechanisms,” introduction to special issue on Auctions and Regulation, *Journal of Regulatory Economics,* Vol. 17, No. 3, (May, 2000): 195 – 204

6. “Third Generation Wireless Telecommunications Standard Setting,” with Peter Grindley and Leonard Waverman, *International Journal of Competition Law and Policy*, IJCLP Web-Doc 2-3-1999.

7. Up in the Air: GTE’s Experience in The MTA Auction for PCS Licenses.” *Journal of Economics and Management Strategy,* Vol. 6, No. 3 (Fall, 1997): 549-72.

8. “Adoptions and Orphans in the Early Microcomputer Market.” With Neil Gandal and Shane Greenstein. *Journal of Industrial Economics,* Vol. 47, No. 1, (March, 1999):87-105.

9. “Monopoly Prices with Network Externalities.” With Luis Cabral and Glenn Woroch. *International Journal of Industrial Organization,* Vol. 17, No.2, (February, 1999): 199-214.

10. “Cost Allocation Principles for Pipeline Capacity and Usage, With G. Campbell Watkins, *Energy Studies Review* Vol, 8, No.2 (May, 1999): 91-101.

11. “Toward the Best Bet,” with Phillip McLeod, *Electric Perspectives,* Vol. 23, No. 5, (September-October 1998): 74-83.

12. “Behind the Revolving Door: A New View of Public Utility Regulation.” *RAND Journal of Economics* Vol. 26, No.3, (Autumn 1995): 362–77.

13. "Hollygopoly: Oligopolistic Competition for Hollywood Movies." With Neil Gandal. *The Antitrust Bulletin* Vol XL, No. 3, (Fall 1995): 699–712.

14. "Preemptive Adoptions of an Emerging Technology." With Michael Riordan. *Journal of Industrial Economics* Vol. 42, No. 3, (September 1994): 247-61.

15. "Trigger Price Regulation." With Glenn Woroch. *RAND Journal of Economics* 23, No. 1 (Spring 1992): 29–51.

16. "A New Look at Public Utility Regulation Through a Revolving Door." Chapter 9 in Michael Crew (ed.), *Economic Innovations in Public Utility Regulation*. Kluwer Academic Publishers, 1992.

17. "Promoting Capital Improvements by Public Utilities: A Supergame Approach." With Glenn Woroch. Chapter 14 in W. Neuefeind and R. Riezman (eds.), *Economic Theory and International Trade: Essays in Memoriam of John Trout Rader III*. Springer Verlag, 1992.

18. "Price Setting in Professional Team Sports." Chapter 5 in Paul M. Sommers (ed.), *Diamonds Are Forever: The Business of Baseball*. The Brookings Institution, 1992.

19. "A Repeated Game with Finitely Lived Overlapping Generations of Players." *Games and Economic Behavior* 3 (May 1991): 244-59.

20. "Crossing Depuit's Bridge Again: A Trigger Policy for Efficient Investment in Infrastructure." With Glenn Woroch. *Contemporary Policy Issues* 9 (April 1991): 101–14.

21. "Time Consistency and Subgame Perfect Equilibria in a Monetary Policy Game." With Douglas McTaggart. *Journal of Macroeconomics* 11, No. 4 (Fall 1989): 575–88.

22. "Equilibrium in a Spatial Model of Imperfect Competition with Sequential Choice of Locations and Quantities." *Canadian Journal of Economics* 21, No. 4 (November 1986): 575–88.

23. "On the Consistency of Consistent Conjectures." *Economics Letters* 16 (1984): 151–57.

24. "Existence of Vote Maximizing Equilibrium in One Dimension." *Mathematical Social Sciences* 5 (August 1983): 73–87.

Non-Refereed Papers and Publications

"Exclusion and Integration in the Market for Video Programming Delivered to the Home," with Michael Riordan. August 1994.

"The Effects of Deregulation on the Cable Television Industry." With Robin Prager. June 1994.

"Some Stochastic Oligopoly Races for Experience." Technical Report #0129-01-91-419, March 1991, GTE Laboratories Incorporated, Waltham, MA

Consulting Assignments

Telecommunications

Spectrum Auctions Advisor and Strategic Analyst

- For Leapwireless in a US PCS auction (2004)
- For QUALCOMM in the 700 MHz Auction (2Q 2003)
- For Taiwan Cellular Corporation (4Q 2001 and 1Q 2002)
- For Leapwireless in US PCS auction (2001)
- For QUALCOMM in Australian 3G auction (2001)
- For participant in US 700 MHz combinatorial auction (3Q 2001)
- For participant in Danish 3G auction (2Q 2001)
- For Primus and Ericsson in Australian PCS auction (2000)
- For Orange in UK 3G auction (2000)
- For T-Mobil in German 3G auction (2000)
- For Versatel in Dutch 3G auction (2000)
- For Leapwireless in US PCS auction (1999)
- For Telus in Canadian LMDS auction (1999)
- For QUALCOMM in the Australian PCS auction (1998)

- For QUALCOMM in the Telebras privatization (1998)
- For QUALCOMM/Pegaso in Mexican PCS auction (1997-8)
- For the Netherlands PTT in the Dutch DCS 1800 auction (1997-8)
- Advised GTFT in Brazilian B block cellular sale (1996-7)
- For Geotek in SMR(trunk radio) auction (1995)
- For GTE in the US A and B block PCS auction (1994-5)

Spectrum Auction Design

- Advised Industry Canada on 2300 MHz/3500 MHz auction (2003-4)
- Advised UK Radiocommunications Agency on spectrum trading (2002)
- Advised Netherlands DGTP on design of auction for sale of AM and FM frequency rights (2001 - 2)
- Advised Italian Ministry of Communication in design of 3G spectrum auction (2000)
- Advised Industry Canada on spectrum auctions for LMCS frequencies (1996) and 24/38 GHz frequencies (1999)
- Designed and implemented first spectrum auction for paging licenses for the Mexican Ministry of Communications (SCT), November 1996
- Designed and implemented first spectrum auction for trunk radio frequencies for the Guatemalan Superintendent of Telecommunications, May 1997
- FCC experimental testing of combinatorial auction mechanisms (2000)
- Advised IDA Singapore on 3G auctions (2001)
- Advised IDA Singapore on wireless local loop auctions (2001)
- Advised Australian ACA on 3G auctions (2000)
- Advised Australian SMA on design of 500 MHz license spectrum auction (1996)

- Led team that developed auction software adopted by Industry Canada, the Mexican Ministry of Communications and Transport and the Guatemalan Superintendent of Telecommunications

- Advised Colombia (Ministry of Communications) in draft auction legislation for first spectrum auctions

- Testimony on behalf of the FCC in Nextwave Personal Communications Inc v. Federal Communications Commission, May, 1999

Other Telecommunications

- Development of wireless industry simulation modeling team at Math Science Research Center at Bell Labs (2000 – 1).

- Led team in developing GTE's Universal Service auction proposal (1995 – 6)

- Testified at hearing of the International Competition Policy Advisory Committee on 3G standard setting procedures and competition policy, June 1999.

- Principal investigator in developing an interactive engineering economic cost model of PCS and broadband network services.

- Advised Peru (OSIPTEL) on universal service and account separations (1995)

- Assisted in drafting GTE's comments on price caps

Energy and Chemicals

- Developed design and implementation plan for Empire Connection transmission rights auction (2003)

- Developed and managed auction for Williams for selling ethylene (2003 – ongoing).

- Developed auction design adopted by OMV for natural gas release program (2003).

- Advised Acquirente Unico (Italy) on default service procurement options (2002 – 3).

- Advised Texas Utilities on energy entitlement auctions (2001 – 2)

- Developed Standard Offer Service procurement auction design for New Jersey Utilities (2000 - 2)

- Advised Netherlands DTe on transmission rights auctions (2000)

- Advised EPCOR on bidding strategy in Alberta PPA auction (2000)

- Advised EPCOR on bidding strategy in Alberta Balancing Pool auction (2000)

- Advised Chevron on bid strategy in 3rd round PEDEVESA auction of oil lease rights in Venezuela (1996)

- Testified on behalf of PanCanadian at Alberta Energy Utilities Board (January, 1996) on pipeline cost allocation principles.

- Advised participant in CalPX auction rule making process (1997)

APPENDIX 2.0: COMMENTS ON DETAILS OF PROPOSED AUCTION RULES

Q. What is the purpose of this appendix?

A. This appendix documents concerns regarding ComEd's proposal that are not discussed in detail in Sections II through VI of my testimony. As discussed previously, ComEd's proposal is incomplete. Below, I provide a list of issues that ComEd should address in its rebuttal testimony so that the ICC and other parties can have a complete proposal to evaluate. The intent of this section is not to fill in all missing details, but rather to identify missing details (in addition to those addressed in Sections II through VI of my testimony). Where I believe some guidance may be appropriate, I offer suggestions regarding how ComEd could address the issues I identify.

1) ComEd should provide a detailed auction calendar.

2) ComEd should provide a bidder information packet.

3) ComEd should provide a comprehensive Auction Manager/auction management manual.

4) ComEd should specify what information the ICC and the Auction Monitor will have access to as well as when the information will be available prior to the ICC's decision in this docket. To the extent that this list will not be complete prior to the ICC's decision in this docket, ComEd should provide a timeline for when the remaining items will be provided.

5) ComEd should provide details regarding the mechanism used for bidding, including, but not limited to, answering the following questions. Will the bidding take place via fax, phone, messenger service, or computer software? Will bidders need to be physically present at a common location or will bidders be able to bid remotely?

6) ComEd should specify the testing protocols for the mechanism used for bidding. If the auction is to be conducted electronically, there need to be significantly different types of testing than is described. Test scripts, as described ComEd's Response to Data Request RZ 2-29, have value in testing procedures, but are of limited value in testing algorithms in, or reliability of, software.

7) ComEd should specify when it will make "sufficient data for suppliers to be able to estimate hourly load and daily capacity and transmission peak load allocations" and "supplemental data to assist bidders" available to bidders. (See, ComEd Exhibit 3.4, pp. 10-11.)

8) ComEd should specify when it will provide "all necessary information to potential bidders concerning how Auction prices are translated into the commodity supply portion of customer rates." (See, ComEd Exhibit 3.4, p. 6.)

9) ComEd should specify how the charges for fixed ancillary services will be determined. Moreover, ComEd should establish a mechanism to ensure the reasonableness of the charges. (See, ComEd Exhibit 3.4, p. 7.)

10) ComEd should fully specify the mechanism for nominating FTRs. (See, ComEd Exhibit 3.4, p. 7.)

11) ComEd should provide details about the process and criteria for maximum and minimum possible starting prices, actual starting prices, load caps, and auction volume adjustments.

12) ComEd should specify the guidelines the Auction Manager will use to revise the load cap for each product in the auction.

13) ComEd should provide a description of how the "target eligibility ratio" will be determined. (ComEd Exhibit 3.4, p. 24.)

14) ComEd should specify what "further information" its Auction Manager may need to release "no later than twenty-five (25) calendar days before the start of the Auction … regarding the possible values of the target eligibility ratio and the circumstances under which a second volume cutback may be undertaken." (ComEd Exhibit 3.4, p. 24.)

15) ComEd could simplify the complexity of the proposed switching and exit bid rules if the Auction Manager were to conduct the auction with small bid decrements and short rounds. If ComEd disagrees with this recommendation, it should explain why it disagrees with this recommendation.

16) ComEd's proposed auction rules do not permit bidders to request switches and withdrawals from products for which there was no excess supply in the previous round. However, such requests should be granted when there are offsetting switches to those products for which withdrawals are requested. This could lead to more efficient results. If ComEd disagrees with this recommendation, it should explain why it disagrees with this recommendation.

17) ComEd should specify the order in which simultaneous switches and withdrawals will be processed. Allowing switches to take priority over withdrawals errs on the side of keeping more supply in the auction, and is probably preferable to the reverse.

18) ComEd should provide the ICC with the formula but not the parameters used to determine the range of excess supply that will be reported to bidders. The Auction Manager should be required to develop the parameters used to determine the range of excess supply that will be reported to bidders in consultation with the ICC Staff and the Auction Monitor.

19) ComEd should clarify the order in which chains of switches and withdrawals will be processed. With four products, there can be chains of switches. For example, one bidder may wish to switch from product 1 to 2, another from 2 to 3, a third from 3 to 4, and a fourth from 4 to 1.

20) ComEd should explain why its proposals provide for both provisional and final measures of excess supply.

21) ComEd should explain why the Auction Manager has the discretion to override bid decrements in any round in the auction. ComEd should describe under what conditions the Auction Manager would use her discretion to override bid decrements.

22) ComEd should justify the selection of bid decrement ranges by the Auction Manager.

23) ComEd should explain how the Auction Manager will determine the length of a recess or extension. ComEd should also explain why recesses or extensions are necessary.

24) ComEd should explain under what circumstances the Auction Manager would call a time-out for up to four hours.

25) Bidders should be informed of the provisional allocation of tranches as soon as the auction closes and before an official decision comes from the ICC. If ComEd disagrees with this recommendation, it should explain why it disagrees with this recommendation.

26) ComEd should describe the conditions under which associated bidders can participate in the auction.

27) Bidders should be required to disclose all agreements that would prevent them from meeting the disclosure and affiliation requirements. If ComEd disagrees with this recommendation, it should explain why it disagrees with this recommendation.

28) ComEd should describe the criteria the Auction Manager will use to determine the course of action if a bidder cannot make the required certifications.

29) ComEd should describe the sanctions that will be imposed on a qualified bidder for failing to properly disclose information relevant to determining associations, for coordinating with another bidder without disclosing this fact, and for releasing confidential information.

30) ComEd should have contingency plans in place in the event that the Auction Manager or Auction Monitor is unable to perform their duties. ComEd should describe in detail those contingency plans.

31) ComEd should clarify the discussion of switching priorities because the discussion provided in its proposed auction rules is not clear. The highest priority is 1. How many other priorities are there besides 1? Are there as many priorities as there are potential switches?

32) ComEd should clarify its proposed auction rules to state that withdrawals and switches will only be disallowed when they would leave a previously fully subscribed product under-subscribed.

33) ComEd should provide a list of definitions in its CPP (ComEd Exhibit 3.4) and avoid inexact repetition of definitions. For instance, a definition of a bid decrement is provided once on page 18 and two more times on page 35.

34) ComEd should explain, in detail, why a credit limit cap is necessary in Article 6 of its supplier forward contracts. That is, would the sole use of a "percent of tangible net worth" criterion in Article 6 provide an insufficient credit limit criterion?

35) ComEd should explain, in detail, why the maximum dollar amount of net worth that is creditable differs across credit rating categories, independently of the percentage of tangible net worth ("TNW"), as shown on Table A, provided in Article 6 of the supplier forward contracts. That is, why does the ratio of the credit limit cap to the percentage of TNW vary across credit rating category?

36) ComEd should justify capping the credit limits for the supplier (or guarantor) at "A- and above", as provided in Article 6 of its supplier forward contracts.

37) ComEd should explain why it is necessary to "notch down" corporate issuer credit ratings from Moody's Investors Service, Inc. to determine suppliers' (and guarantors') creditworthiness under Article 6 of its supplier forward contracts.

38) Does ComEd agree that its proposed tariffs should include language that provides the ICC an opportunity to review any reduction in credit requirements as allowed under Section 6.1 of the supplier forward contracts? If ComEd disagrees with including such language in its proposed tariffs, then ComEd should explain why and, in addition, identify any limits on ComEd's discretion to reduce its credit requirements.

APPENDIX 1.1: DAVID J. SALANT - PARTIAL LIST OF TESTIMONY

1. Alberta Energy Utilities Board, Rate hearing.

Submitted expert report and testified at rate hearing on behalf of PanCanadian, January, 1996.

2. US Bankruptcy Court, Southern District of New York.

Submitted expert report and testified in Nextwave Personal Communications Inc v. Federal Communications Commission, 1999. Bankruptcy No. 98B-21529.

3. US Department of Justice, International Competition Policy Advisory Committee.

Testified at hearings on standard setting as means of facilitating cartel agreement on behalf of QUALCOMM, May 17, 1999.

4. Federal Communications Commission.

Affidavit on Upper 700 MHz auction rules on behalf of QUALCOMM. DA – 00-1075, June 2000.

5. United States v. Motorola, Inc and Nextel Communications, Inc, Civ. No. 94-2331 (TFH)

Declaration on behalf of Hughes Network Systems on competitive impact of Nextel's acquisition of Geotek licenses in United States District Court for the District of Columbia, September 1, 2000.

6. Federal Communications Commission

Statement of 37 Concerned Economists on Spectrum Policy. WT-00-230. Feb. 2001.

7. New Jersey Board of Public Utilities. Docket No. EX 01-05-0303.

Testified on behalf of PSE&G at hearing on BGS Auction Design. Oct. 4, 2001.

8. Public Utility Commission of Texas. Project No. 24492.

Submitted written statements and testified on behalf of TXU on auction design. 2001.

APPENDIX 3.0: DEFAULT SERVICE AUCTIONS, JOURNAL OF REGULATORY ECONOMICS, (2004), BY COLIN LOXLEY AND DAVID SALANT

ATTACHED

Journal of Regulatory Economics; 26:2 201–229, 2004

Default Service Auctions*

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Abstract
In February 2002, New Jersey completed a market process whereby the utilities were able to purchase one-year forward contracts to ensure energy needs for their default service customers for a one-year period. The auction was the first application of the simultaneous descending clock auction to power procurement. We chose this auction format to fit the specific needs of the New Jersey Electric Discount and Energy Competition Act and the New Jersey Board of Public Utilities mandate for a competitive bidding process to procure the electricity to meet the electric utilities' default service obligations.

Key words: procurement, auctions, default service

JEL Classification: L51, L94, Q48, D44

1. Introduction

On February 13, 2002, the New Jersey utilities completed an auction to purchase 17,000 megawatts for 12-month contracts beginning August 1, 2002. That auction was the first time that a simultaneous descending clock auction (SDCA) was used for the procurement of power. This auction was a modification of the simultaneous multiple round (SMR) auction format first developed for U.S. Federal Communications Commission spectrum auctions.

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* Colin Loxley was a co-leader of the PSE&G team that developed the BGS approach and David Salant was the leader of the team of PSE&G consultants that developed the SDCA auction format for the BGS auction. The views expressed herein are solely those of the authors and do not necessarily represent the views of PSE&G. The authors would like to thank seminar participants at Rutgers University Advanced Workshop in Regulation and Competition and at the University of California Energy Institute, and three anonymous referees.

Electricity restructuring that has occurred across the United States requires new supply contracting arrangements. Providing consumers with access to more competitive markets for generation services has been a primary goal of deregulation. Many states allow consumers to switch suppliers. However, consumers often do not actually switch to third party suppliers.

In New Jersey, the electric distribution companies (EDCs) retain the obligation to provide default service to those customers who are not served by competitive third party suppliers. As in a number of other states, the New Jersey EDCs provide default service at rates that are regulated. To promote competitive wholesale markets, regulators have also encouraged (sometimes required) utilities to split ownership, or at least control, of the generation function from transmission and distribution. As a result, the EDCs can no longer produce the power for their customers' energy needs, and must make formal contractual arrangements for their supply.

The supply contract arrangements can take various forms. In New Jersey, most small customers have remained on "default service." State regulators have been hesitant to allow direct pass through of the costs of open-market spot purchase of power to customers, preferring fixed prices. This means that the utilities have a continuing obligation to provide power to customers at prices that may differ widely from the market. The utilities have been left in a position of having to purchase large volumes of power, subject to regulatory review of the procurement process that benefit from information not available at the time of procurement.

Crew and Kleindorfer (2002, 15) observed that "the default service obligation is arguably one of the most difficult problems faced in regulatory economics". The "triple-threat" of rate-caps, the ability of customers to switch back and forth, and extreme volatility in wholesale markets and prices, makes this problem a potential "lose-lose" proposition for the EDC, and creates the potential for conflict with the regulators as they strive to ensure "reasonable" prices.

The New Jersey EDCs faced a legislative mandate to purchase, through a competitive process, the right amount and hourly shape of power at prices that the regulator, the Board of Public Utilities, would consider competitive and therefore "prudent." The mandate left the utilities with the challenge of determining how to buy power and the division between "forward" contracts of various durations and spot market purchases. The New Jersey EDCs decided on the basic generation service (BGS) auction for one-year forward contracts as the best means for securing power to serve this default service obligation.

The BGS auction began February 4 and ended February 13, 2002, after 73 rounds of bidding. The four New Jersey EDCs (Conectiv, GPU Energy, PSE&G and Rockland Electric) secured one-year forward contracts for approximately 17,000 MW of forecast peak load at prices that the New Jersey BPU determined were "consistent with competitive bidding, market determined prices, and efficient allocation of the BGS load".[1] 21 bidders, offering 29,600 MWs of supply, competed for the opportunity to serve the

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1 See "In the Matter of the Provision of Basic Generation Service Pursuant to the Electric Discount and Energy Competition Act" N.J.S.A. 48:3-49 et seq.—BGS Auction Results (02/15/02). http://www.bpu.state.nj.us/wwwroot/energy/EX01050303bORD.pdf

Table 1. 2002 NJ BGS Auction Results

		Number of Tranches Won per EDC Territory			
		PSE&G	JCP&L	AECO	RECO
	Number of Tranches	96	51	19	4
Winning Bidders	Final Prices/kWh	5.112¢	4.865¢	5.117¢	5.819¢
Allegheny Energy Supply		15			
Amerada Hess Corporation		9	1		
Aquila Energy Marketing		15	5		
Conectiv Energy Supply INC					1
Consolidated Edison Energy			3		
DTE Energy Trading Inc		20			
Duke Energy Trading			5		
FirstEnergy Solutions Corp		10	2	5	
MIECO		1			
NRG Energy				5	
PPL Energy Plus Corp					3
Select Energy Inc		1	15	5	
Sempra Energy Trading Corp		6	9	4	
TXU Energy Trading		7	3		
Williams Energy Marketing & Trading		12	8		

17,000 MWs of New Jersey BGS load needed in the auction. As shown in Table 1, there were 15 winners. The total value of the auction was approximately $4 billion. The bids were for tranches of each system. A tranche represented a uniform, full-requirements slice of the BGS load for that EDC. The tranches, as we explain in more detail below, were essentially financial contracts for differences.

We based the design of the SDCA used in New Jersey on the successful experience with the SMR design in auctions for spectrum and for selling electricity, in the form of Power Purchase Arrangements, in Canada.

Virtually all these auctions allowed bidders to name prices. In contrast, in the New Jersey auction, a ''clock'' set the prices of the different products while the bidders named the quantities, and the auctioneer set the rates at which the clock prices ticked down. Variations of the clock auction format have recently been introduced for spectrum auctions, and more recently in France for virtual power plants (VPPs), and for energy entitlements in Texas. These auctions have all been ascending price forward auctions for selling assets. The New Jersey BGS auction was a descending price reverse auction for purchasing energy.

For the New Jersey procurement, as was the case for the spectrum and PPA auctions, options other than auctions were available. Indeed, only over the last decade has any regulatory authority contemplated the use of open auctions instead of the still much more common alternative of negotiated agreements, or the more traditional two-stage bidding process. One advantage of open auctions over these other processes is transparency. Another is that the outcome of an auction requires little post-negotiation regulatory review, and much less than the outcome of negotiated agreement or a traditional two-stage bidding process. In a two-stage bidding process, bidders first submit qualifying offers, which generally includes qualitative information, and the qualifying bidders then enter a second stage negotiation process. The second stage negotiations are typically lengthy and multi-faceted. This process is clearly a less transparent, and arguably less efficient, auction than is an open simultaneous, multiple round auction, where the interested parties readily observe bidders and bids.

The design of an auction can be crucial to the outcome. Besides improved transparency, a properly designed auction will be more efficient than a traditional two-stage bidding process. One impediment to the use of auctions is the essentially unlimited number of possible designs from which to choose—and the fact that the auction design can have a significant effect on the outcome. Fortunately, recent theoretical analysis and a growing body of experience can provide an increasingly reliable guide to auction design.[2]

The choice of an SDCA format for the New Jersey BGS auction was made, in part, because of the need to divide the load, based on competition among the suppliers. The final outcome, with 15 winning bidders and each EDC being served by a different set of bidders, would have been difficult, if not impossible, to achieve through alternative procurement processes. In addition, such an outcome would have been difficult to achieve in a sealed bid, request for proposals or in a sequential auction of the tranches. The load caps in the BGS limited post-auction concentration and helped promote post-auction competition. These key goals—minimizing costs, economic efficiency, and transparency—are the primary reasons for the choice of the SDCA format.

In section 2, we describe the concept of default service and what was being auctioned, and conclude with a brief discussion of the alternatives for procuring BGS. Section 3 describes many of the more significant implementation issues that we encountered in the New Jersey auction. Section 4 discusses the theory and experience behind the use of the SDCA format. Recent developments in theory, both on optimality of simultaneous auctions and to limit risk due to limited bidder interest, were applied in developing the auction. Finally, section 5 describes the recent experiences with simultaneous auctions, in both telecom and electricity, and how that experience informed our choice of a design for New Jersey. It concludes with a discussion of prospects for future default service auctions in New Jersey and elsewhere.

2. BGS: Defining the Product

Deregulation that separates generation from distribution is intended, in part, to allow for competition in the supply of energy to consumers. However, for a variety of reasons, including limited potential savings, the unknown reliability of new suppliers, and relatively attractive BGS rates, few New Jersey customers have switched. Only 5% of end users have ever chosen to switch to alternative energy suppliers in New Jersey and, as of 2001, over 99% of New Jersey customers and over 90% of the load were on BGS.

In New Jersey, BGS was intended as a default service both for customers who did not

2 We provide an example below which illustrates how auction design can affect the allocation and the overall procurement costs. Milgrom in Chapter 1 of *Putting Auction Theory to Work* (2004) explains at some length how auction design can affect outcomes in practice. See also Cramton (1997).

choose a new supplier as well as for those who no longer were receiving service from the third party electricity supplier after switching. Thus, BGS made no distinction between customers who never left, those who were dropped by their supplier for any reason (including nonpayment), and those who chose to return to the regulated service. The EDCs retained a true ''provider of last resort'' role. This is what constitutes the BGS load.

In accordance with the legislation, the New Jersey Board of Public Utilities directed the four New Jersey EDCs (PSE&G, GPU Energy, Conectiv and Rockland Electric Company) to solicit bids for the supply of their BGS needs as of August 2002. The legislation did not specifically mandate an open auction, but made such an auction an attractive choice. Left open was what form the bidding should take and how the load should be divided.

To appreciate the fact that these choices could have a great effect on the outcome one need only notice that in California there were also three large utilities that faced similar choices in 1999. There, the California Power Exchange (CALPX) was chartered to provide a market in which the utilities could purchase electricity to meet their default service needs, largely, but not exclusively, in a day-ahead spot market. The results have been well documented. To a real extent, our task was to devise an alternative that would work significantly better for the four utilities in New Jersey than the CALPX did for the three California utilities. Moreover, during the design phase of this project, we could not know whether the supply conditions would be more or less favorable in New Jersey in 2002 than they were in California a couple of years earlier.

The EDCs and the state regulatory agency, the New Jersey Board of Public Utilities (BPU), had a common objective: to minimize overall expected procurement costs. While the utilities were legally entitled to recover deficits due to ''prudently incurred'' energy costs in excess of the regulated rates, such a recovery can never be certain and is subject to delay. Thus, the EDCs would prefer to minimize overall expected procurement costs so as to minimize the size of the deficit and deferral and also to mitigate risks of default.

The EDCs were also under a legislated requirement to maintain discounted, capped rates, at least through July 30, 2003. The service period for which the rates were capped, and therefore the load was needed, was from August 1, 2002 through July 30, 2003. The load was clearly variable in that it represented the energy consumption of New Jersey BGS customers. In addition, long-term non-utility generator (NUG) supply contracts between the EDCs and NUGs served some of the BGS load. This left the amount of the load that the EDCs needed to purchase variable. The requirement that suppliers be prepared to serve a variable amount of load placed a burden on potential suppliers and exposed them to risk that could adversely affect procurement costs.

One objective in the design of the BGS tranches was to make these tranches as predictable and well defined as possible so as to limit the risk and uncertainty facing potential bidders. To this end, the EDC's each divided their entire load into equal sized tranches of approximately 100 MW of peak load share.[3] The winning bidders would be

3 The peak load shares are used for capacity obligation calculations. Each year, the Pennsylvania–New Jersey–Maryland (PJM) Power Pool reviews the previous summer peak loads and does a weather-normalization for PJM as a whole. It then looks at the shares of PJM actual loads for each EDC for the five highest load days. PJM then multiplies the shares of actual loads by the PJM normalized number to

load-serving entities, responsible for capacity obligations, ancillary services and transmission. The EDCs retained responsibility for losses on the distribution systems and for customer non-payment. Thus, the winning bidders were guaranteeing the utilities a forward price for purchasing a certain percentage of the total actual BGS energy needed. Bidders would be faced with some risk, but the risk was largely confined to the variations in demand associated with normal fluctuations in business activity and weather, and the nature of the risk was fairly well known to prospective bidders.

We needed to address a number of other issues needed in order to define the obligations of the bidders winning the right to serve tranches of the load, including:

1. *Transmission rights.* Bidders could need transmission rights from PJM in order to hedge congestion costs. The PJM allocation of transmission rights was originally set to occur before the one-year term of the BGS began. This meant that the availability and cost of transmission rights could change, as a result of the PJM allocation, after the auction, but before the obligation was to start, and then change again during the term of the BGS supply agreement.

2. *Capacity costs.* Winning bidders were required to meet PJM capacity obligations, increasing the cost of serving a BGS tranche in order to cover the PJM mandated capacity requirements.

3. *Losses and collection risk.* Line losses mean that the energy customers received is less than that supplied. The BGS contract needed to allocate the cost of these losses. While the EDCs would continue to handle billing, the BGS contract needed to allocate the costs of customers failing make payments. The EDCs proposed that suppliers would be paid based upon the wholesale PJM meters. This meant that suppliers would be paid for the energy actually required, and not that delivered to the customers. Collection risks also stayed with the EDCs, who retained the collection responsibility. Similarly, EDC deferrals were to be reduced if line losses were lower than anticipated.

2.1. Default Service in Other States

Assigning or transferring the responsibility for provider of last resort (POLR) supply has typically been determined in one of three ways: (1) direct assignment, where the POLR is designated in advance, typically being the existing utility; (2) random assignment, where the POLR obligation is imposed upon the other competitive suppliers (akin to the ''high-risk'' pool approach used for auto insurance); and (3) a bidding process where there is some form of competitive selection of suppliers.

Georgia is, so far, the only state that has attempted a 100% random assignment process (for gas sales only). This process failed largely because of major billing and collection problems; a sharp increase in gas costs; and the bankruptcy or withdrawal of several major

get the EDC peak load allocation for the capacity obligation calculations. These peak load numbers are commonly referred to as ''peak load shares'' since they are created using shares of the PJM value rather than EDC estimates of their peak loads.

suppliers. New legislation has recently been enacted to provide for a subsidized POLR service and the selection of a specific provider. Virtually all other states have begun with a direct assignment model, which in most cases is in the process of transitioning to a bidding process.

The other critical distinction across states in approaches to default service, or POLR, is in the scope of the service assigned to the winners. The difference between a "wholesale" or "retail" approach is whether the bidding process transfers the specific retail customer-potentially including metering, billing and other customer account services (CAS); and whether there is an opportunity to "up sell" other products and services; or whether the bidding process involves a straightforward approach to acquiring some or all of the aggregate power supply in a wholesale approach.

The earliest example of dealing with POLR was, of course, the disaster in California. Legislation (AB1890) required all three investor owned utilities (IOUs), California Edison, PGE and Sempra, to purchase their energy in a day-ahead market operated by the CALPX.[4] This approach, ironically enough, was originally mandated, in part, due to concerns that the "big" utilities would otherwise have monopsony power in bilateral purchases from the "little" IPPs and/or could favor their own generation affiliates. The POLR service was initially rate-capped, and then was to move to market prices, using the actual hourly prices and hourly loads (metered or estimated), with a monthly adjustment to reflect actual spot prices once the IOUs had recovered their stranded costs. This system did not work well at all for reasons that have been discussed at length. Unfortunately, the deregulation process has still failed to implement long-term "capacity" requirements sufficient for generation to be constructed and available to meet demand fluctuations. In contrast, in PJM and elsewhere in the Northeast, the ISO/RTO has mandated capacity requirements.

We were very concerned about the California experience. In both states, three main utilities serve a large fraction of the customers. In New Jersey, the four largest generators have 76% of the capacity, whereas in California, the five largest suppliers have less than 50%. Both states face transmission constraints, although (as noted above) PJM has processes in place to allow suppliers to hedge the congestion costs.

One view of why the CALPX approach should work is the premise that leaving utilities exposed to the fluctuations of spot market prices provides incentives for the utilities to secure supplies in a manner so as to limit price spikes. We do not find this view compelling. Most other commodities are traded in spot markets. And it is unusual, if almost unheard of, for spot prices to spike as much and as frequently as occurred in the CALPX. Of course, had utilities been required or allowed to enter long-term contracts, such spikes might have been less severe.[5] Long-term contracts would normally be

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4 See *Energy Outlook Report—Commission Final Publication #700-00-004F*, California Energy Commission, 2002. Also see Joskow and Kahn (2002) for description of the California energy market restructuring.

5 Borenstein, S. "The Trouble with Electricity Markets and California Electricity Restructuring Disaster," POWER PWP-081, September 2001 argues that long-term wholesale contracts can mitigate utility and buyer risks. Also see the FERC (2003) Staff Report.

advantageous to buyers, in that they provide the buyers with what is effectively insurance against the risk of future price rises. Those selling such contracts could want a premium for providing such "insurance." In a well functioning market, buyers might not need to pay such a premium, as sellers will typically find it advantageous to lock in a future price to guarantee a market for their capacity. Such assurances of future revenues can be especially important in securing plant financing. However, as we now see in the efforts to annul California's subsequent long-term agreements, long-term contracts by themselves do not necessarily reduce average energy costs.

This is not at all to say that the proportion of energy purchased through long-term contracts as compared to short-term purchases is not a factor in the outcome. In California, the rules effectively required the utilities to purchase most of their default service energy needs in the CALPX day-ahead market. The California utilities were eventually allowed to purchase some contracts in the CALPX block-forward market.[6] In the New Jersey BGS auction, in contrast, the EDCs persuaded the New Jersey BPU to allow the utilities to purchase all of their default service energy needs in the form of one-year forward contracts. When the larger fraction of energy needs is purchased forward in the form of long-term contracts, and relatively limited amounts of energy are purchased in short-term markets, the strategic incentives of bidders to offer more aggressive, i.e., lower, prices is larger than when the reverse is the case.[7] Suppliers who failed to win contracts in the BGS auction were facing a prospect of having to sell in relatively thin, shorter-term, real-time or day-ahead markets. In contrast, when the utilities are making only limited purchases of long-term contracts, as was the case in California, suppliers have less of an incentive to bid aggressively.

In New England, most states either required or encouraged divestiture, and set discounted initial POLR rates, with the utility being required to purchase the power. Most states have now transitioned to a competitive bidding process, with rates being periodically adjusted by the regulators, in some cases according to the bids received and in others based on the utility's actual historical costs (similar to a fuel clause). While approaches varied, there were frequent problems with unacceptable bids and sole-source negotiations.

Pennsylvania also encouraged, but did not require, divestiture. Some utilities made attempts to solicit "retail"-style bids. In addition, several wholesale-type sealed-bid solicitations (most notably GPU) failed due to a (perceived) requirement that the bids come in below the existing POLR rates (otherwise known as "shopping credits") in order for the PUC to approve them. PECO took a different approach, taking retail bids for 20% of its default customers. There were few bids. New Power received the award after extended negotiations—a process that was challenged by Green Mountain. In PECO's case, the bid was fractionally (2%) lower than the utility POLR rate. (Ironically New Power has subsequently ceased operations and has turned the customers back to PECO).

Finally, in the most recent case of Texas, the utilities were not required to divest all of their generation assets, although they have been separated from the delivery businesses,

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6 See the FERC (2003) report.

7 See Allaz and Vila (1993).

typically through affiliates. Instead utilities have been required to sell off a large part of the power from their generation, and have been running a series of entitlement auctions to do so. However, utility retail affiliates can become the POLR within their own territory, compete to serve retail customers in other service areas, and participate in those utilities' entitlement auctions in order to acquire additional supplies. This process thus allows the POLR providers either to retain or acquire power to meet their supply needs. The process has been abetted by the fact that Texas has been encouraging new generation and has accumulated a surplus supply.

2.2. BGS Procurement Options in New Jersey

The Electric Discount and Energy Competition Act (EDECA), enacted in early 1999, provided the framework for restructuring of the electric power industry in New Jersey. As of August 1999, retail customers were allowed to choose their electric power supplier. Customers who did not choose a third party supply are served through the regulated BGS. Prior to August 1, 2002, the electric distribution companies (the EDCs) were the sole providers of BGS in their respective territories. The BPU determined that the implementation of the EDECA required the EDCs to bid out the BGS procurement for one year starting August 1, 2002. The SDCA proposal was the EDCs' collective response to these directives. The EDCs did have many options for bidding out the BGS. The choice between them could have a large impact on the final procurement prices.

The most traditional approach—negotiated contracts—was not one of the preferred options. Such direct negotiations would not easily satisfy the BPU mandate, unless there was a competitive bid component of the process. In addition, such a process tends to be opaque, not transparent. The EDCs generally felt that this lack of transparency would be of significant concern to regulators. The SDCA was designed to meet specific criteria for bidding out the BGS. Among the chief aims of the auction process was that the process be a transparent market mechanism whereby competition among potential suppliers would determine price and the allocation of the load. One objective was to ensure as close to a competitive outcome as was possible. This meant that the BGS load would be served to minimize costs to New Jersey consumers. Another criterion was transparency. Both the EDCs and the BPU were concerned with credit risks especially in light of what happened in California. Neither the EDCs nor the BPU wanted New Jersey consumers to be exposed to supplier default risk—that is, having to purchase supply in the spot market.

Most auctions, especially open auctions, are transparent processes. Traditional two stage-processes, in which bidders first qualify, and then only those qualified bidders submit offers, often lack transparency. At times, offers are evaluated based on quantitative criteria, and at other times, more qualitative criteria. In most cases, the evaluation criteria are never made explicit. This two-stage approach also tends to sacrifice potential efficiency gains of a market type solution in which competition divides the load among competing suppliers.

There are many ways in which bidding can be organized. The most standard approach is a sealed bid. Sealed bids can be simultaneous or sequential. In a sealed-bid auction or tender, bidders submit their bids in sealed envelopes or an equivalent format, and all the bids are evaluated at the same time. Bidders do not have a chance to react to competitive offers. An alternative form of bidding is an open auction, such as the oral ascending price (English) or the descending price (Dutch) auction. The BGS auctions are reverse auctions, that is, auctions to purchase. In a normal forward auction there are likely to be many bidders initially, and when price reaches a high enough level, bidders will drop out of the auction. Prices will keep increasing until demand falls to match the available supply, at which point the auction closes. The opposite is true for a reverse auction, where the price starts high, and is gradually reduced. As price falls, bidders are likely to drop out. When price falls enough so that quantity is just sufficient, then the auction closes.

To more closely approximate pure competition and also to limit risks, the New Jersey BGS auction design allowed the bidding to determine the allocation of load among the bidders. Allowing competition among bidders to divide the load more closely approximates what happens in completely unregulated competitive markets than do other alternatives such as offering the load as one block for one bidder to serve in entirety or to be split among a fixed number of bidders. So as to limit exposure to default risk and ex post concentration, the EDCs' (other than RECO) sought and obtained approval from BPU to impose load caps of approximately one third its tranches.[8]

The New Jersey BGS auction is a SDCA. In an SDCA, prices start high, and gradually fall over a sequence of rounds (or ticks of a clock). The amount by which the price for an EDC decreases from one round to the next depends on the amount of excess supply. As prices fall, bidders can reduce the amount they want to serve or switch across EDCs. The auction ends when supply falls to the number of tranches that each EDC needs to be served. This auction meets the objectives stated above. The load caps limited risk and ex post concentration. The SDCA is also a transparent auction process, which, as we explain more fully below, tends to result in economically efficient outcomes.

3. Issues and Challenges

In developing the details of the BGS bid, it was important to first address the issue of whether the bids should be for retail or ''wholesale'' (meaning no direct customer access) service. The past failures of the retail approach, combined with the relatively limited number of parties either interested in, or capable of, providing such service, meant that the BPU was inclined towards the lower-risk wholesale approach, especially for this first auction. In fact, because the EDCs retained all of the retail metering, billing, and non-payment risks, this approach eliminated the bidders' potential exposure, thereby reducing their bids. It also meant that bidders did not have to deal with distribution-level losses. Bidders could instead project loads and costs determined by PJM-based wholesale metering and accounting, rather than the EDCs' determined load of their retail customers. It should also be emphasized that the bid process was entirely a financial contract, in the sense that the physical scheduling and dispatch of generation to meet the total load was unchanged, and continued to be under the control of PJM with the normal market

8 Load caps were 32 of the 96 for PSE&G tranches, 17 of the 51 JCP&L tranches, 7 of the 19 AECO(Conectiv) tranches, and there was no cap for the four RECO tranches.

processes. Suppliers were bidding to achieve revenue and price stability, rather than relying on the volatile spot market.

In planning the auction, the conclusion was that the interest in securing reliable supply most cost-effectively would be best served if the bid was for slices that reflected the aggregate risks of the overall BGS load shape. Therefore, the bid was for slices (tranches) of the aggregate load rather than for a specific amount of power each hour. The latter approach would expose the EDCs to the risk of having too much or too little, and having to transact the difference in the spot market. This would have exposed the EDCs to the risk of getting it wrong and being second-guessed (as in California with the new State contracts). Therefore, the EDCs chose to define the product as being for a ''full-requirements'' tranche of a utility's actual BGS load. Doing so in effect transferred all the risks of weather, migration, etc. from the EDCs onto the bidders. Those with have the greatest expertise to manage the risks would be willing to offer the lowest prices in the auction, and be the likely auction winners.

We also considered the possibility of structuring the bidding to include different components for each season and selecting winners by weighting the different components. However, doing so would not only significantly complicate the bid but would also run the risk of perverse strategic bidding to game the winter/summer differentials—for example, bidding high winter prices combined with low summer. Overall, a simple one-price bid that included all the elements of supply—namely, energy, capacity, transmission, ancillary services, and any other PJM or NJ BPU requirements for a supplier—for all of the BGS load shape minimized the complexity (and therefore cost) of the bidders' decisions and the auction. We recognized that this approach could put some burden on potential suppliers who might not have a portfolio of assets that includes all these elements. The final decision reflected a desire to allow the competitors to figure out how to assemble the necessary elements and not to have the EDCs determine them and then subsequently obtain BPU approval that the EDCs made the precisely correct determination.

Within this basic structure, there were a number of challenging issues to address:

(1) *Regulatory commitment.* It was clear from past auctions that a significant delay in getting a regulatory decision was not desirable. Bidders made it clear that such uncertainty was a serious deterrent to their participation. In addition, it was generally agreed that the results of the bid had to be unambiguous and final—there would not be any ''after-the-fact'' negotiations. These considerations helped persuade the BPU to agree to thoroughly review and approve the entire auction process, as well as the contracts and all of the documentation before the auction took place. The BPU then relied upon an its own outside consultant, Charles River Associates, to confirm that the auction had been conducted in accordance with the approved process, and agreed to accept or reject the bids within two days of the end of the auction. In addition, the BPU agreed to accept or reject all of the utility-specific bids as a package, thereby avoiding any split decisions about different utilities prices. This was a major step for the regulators to take, in marked contrast to historical behavior, and played a significant role in encouraging participation and minimizing risk.

(2) *Reliability.* The EDCs and the BPU shared concerns about maintaining supply reliability, both physical and financial. The fact that the POLR obligation could push even

large utilities into bankruptcy provided a salutary lesson. Thus, bidders were required to meet stringent credit requirements. In addition, there were New Jersey specific requirements for any supplier, but these were minimized by the largely wholesale nature of the bid.[9] The most critical feature for ensuring reliability was the decision to require the winning bidders to become the PJM load-serving entities (LSEs) for the portion of the BGS load that they won. This ensured that they would be subject to all of the PJM requirements, including credit and being signatories of the Reliability Assurance Agreement. This means that they must meet the PJM rules for the capacity obligation, thereby assuring that PJM's reliability criteria are met for the year covered by the bid. A separate, but related, concern was that there was an insufficient supply of ''uncommitted'' capacity available to provide for a competitive bidding process. Fortunately, PJM has been very effective in assuring adequate supplies; a large amount of new generation is planned for this period.

(3) *Value of multiple suppliers: ''Load Caps''*. There are obvious reasons to limit the amount that a single bidder (or a group of affiliated bidders) can offer to supply in the auction process itself. One is to limit concentration in the auction. A load cap can induce a large supplier to divest contractual rights to energy holdings. This can have the effect of making the auction more competitive.

The BPU and the EDCs also saw great value in having multiple providers for several other reasons. First and foremost was to address the concern that the auction could favor EDC affiliates. This was especially cogent as EDC affiliates were explicitly allowed to bid in the auction, and there had been cases of sealed-bid auctions in which affiliates were awarded the entire contract. Therefore, the restriction on an individual bidder to no more than one-third of the total for the large EDCs reassured the BPU and other participants that affiliates would not dominate the auction, and probably encouraged some large firms to divest some entitlements and some of the smaller firms to participate. Secondly, having a number of suppliers mitigated the problem of having a large dominant supplier attempting to renegotiate the terms of the contract after the fact. As previously discussed, several bidding situations in other states collapsed into bilateral negotiations in which the supplier had an advantage due to the time constraints. Thirdly, requiring multiple awards automatically reduces the impact of a potential default by any one supplier, and ensured that there would be other suppliers available to take over the supply in the event of a default. Since the EDCs ultimate default option was to purchase through PJM's spot markets (and Enron had just gone bankrupt!) diversifying the risk in this way was considered key.

(4) *Market power*. A major concern of policy makers is the potential impact of market power on electricity prices. Obviously, New Jersey is a more concentrated market than

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9 Strictly speaking, the auction was not one for purely wholesale services, since the bidders do become LSEs for the aggregate customers. In particular, load-serving entities are retail firms with the obligation of securing capacity credits to match load. We use the term wholesale to mean without individual retail customer access.

PJM, although New Jersey was not necessarily the relevant market since all suppliers who could deliver power from or into PJM could bid in the auction. Other measures to limit potential impact of market power were introduced as additional safeguards. First, as noted above, the EDCs imposed load caps which effectively limited the market share of any winning bidder.

One such measure was to permit the auction manager to adjust auction volume if bidding behavior indicated possible supply withholding. We discuss the auction volume adjustments in more detail below, but the basic idea was to give the auction manager an ability to take measures counteracting any unilateral or coordinated efforts to limit the impact of competition in the auction on price.[10]

A further measure to limit the impact of potential market power was to coordinate with PJM to ensure that as large a set of suppliers as possible had the opportunity to bid in the auction. PJM dispatch protocols ensured that all PJM resource owners could participate, and would not be physically constrained. But, as we discuss next, we also mitigated the financial risks by coordinating the auction timing with the PJM transmission rights allocation process.

(5) *Capacity, congestion, and ''committed supply''.* One of the more significant issues for bidders concerned PJM's processes and schedules. The BGS auction's August 1 date for the transition to a set of new suppliers, for example, was of concern due to its being in the middle of the PJM summer period. PJM's capacity obligation and financial transmission rights (FTR) processes are oriented to an aggregate Summer Interval (June–September). The normal PJM process is to specify the capacity and transmission requirements of all customers and all LSEs for the aggregate June–September period, and to calculate the feasible FTRs for the entire interval based on these data by May. In addition, LSEs are supposed to acquire the capacity credits to meet their obligation for the entire four-month interval. Failure to do so can subject the LSEs to penalties for the entire interval. While the system was designed to accommodate individual customer switching due to retail competition, it had not been designed for such a large transfer of load responsibility (from the EDCs to the new suppliers). Bidders were concerned, therefore, that they might have difficulty acquiring the capacity to meet such a large transfer. EDCs were concerned that PJM's rules might theoretically penalize them for not maintaining capacity through the interval. PJM staff was concerned that some of the existing capacity previously committed to the EDCs might somehow switch to markets outside PJM and thus be unavailable.

In response, the PJM staff agreed to make adjustments to reassure all concerned that capacity credits and FTRs would be available for the ''new'' LSEs. The PJM modified its processes to allow for a seamless transfer of the capacity obligation in mid-interval. Specifically, the PJM agreed to redo the FTR calculations determining FTR availability for the August 1 period. The concern was not access to transmission; since all loads and their

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10 In this type of procurement, bidders will always want to weigh the impact of reducing supply to keep prices high against the lost sales. However, as McAdams (2001) explains, the auction volume adjustment can counteract market power.

LSEs are ensured network transmission service. Rather, bidders, especially those with resources outside of New Jersey, were concerned about their ability to hedge their exposure to congestion costs through the acquisition of FTRs. Contributing to exposure risk is the fact that parts of New Jersey are vulnerable to severe congestion. The risk premiums bidders require would be high when their ability to hedge against high LMPs in a specific EDC zone is limited.

The other major issue for potential bidders was the EDCs' ''Committed Supply'', that is, the continuation of long-term contracts that were a legacy of regulation and past supply procurements. In aggregate, these contracts represent a significant amount of resources, and so it did not make sense to exclude them from the auction process altogether or to hold them in reserve as a contingency plan. Doing so would have reduced the amount of supply offered in the auction, thereby tending to increase the likelihood that there would be insufficient bids. However, potential bidders were concerned that they had no control over these resources, and therefore felt that there was considerable uncertainty about the amount of energy that would actually be provided. As a result, the treatment of Committed Supply was split. The PJM capacity credits under contract (about which there was relatively little uncertainty) were used to reduce the BGS obligation for each EDC, thereby reducing the amount the bidders would need to supply. The energy was to be scheduled into the PJM spot market at LMP, with the revenues to be credited against the overall contract and BGS costs. These measures reduced the volatility in the load that winning bidders would be required to serve.

To ensure timely response to concerns, such as the above, raised by stakeholders, the BGS auction team maintained frequent communication with all of the parties, including the development of several bidder conferences, where concerns were aired and the auction process and design was able to be adjusted to maximize participation and, where possible, reduce risk and uncertainty. The BPU and the EDCs maintained constant communication, with regular meetings, to ensure the success of this process.

4. Theory and Experience

The SDCA used in New Jersey is a reverse auction variation of the SMR auction that has been used in dozens of spectrum auctions across the globe. In this section, we explain why there was a need for an auction in general and the rationale for the use of the SDCA in particular.

4.1. Why an Auction?

The direct rationale for an auction was the BPU mandate that the EDCs solicit bids for serving the BGS load. However, this begs the question as to why the BPU would require bids in the first place. As noted above, there are many options for soliciting offers to serve the load. In theory, there is a forward market for energy, and some amount of energy can be secured in this fashion. Purchasing in forward markets for delivery in New Jersey/PJM was not an appealing option as those markets lack sufficient volume and liquidity to serve even a large fraction of the entire BGS load. There may be adequate generating capacity in New Jersey and nearby to serve these needs, but in the short term most of this capacity is normally committed, and it is not possible to place an order for 17,000 MW of surplus capacity in the PJM or any other market at a posted price. One of the major concerns in soliciting bids is that suppliers could possibly withhold or limit supply so as to drive prices quite high. And any price information from a forward market would be of little direct value in determining specific costs of energy for serving BGS load.

The more customary approach for soliciting offers is to enter direct negotiations with a limited set of qualified suppliers. Such negotiations often involve multiple components of the transaction. One benefit of this approach is that the transaction can be customized for each supplier. For example, one supplier might be willing to accept the collection risk and another not. So, one contract can include such provisions and the other need not. And negotiations can continue over time until adequate supplies are secured.

Negotiated processes have a number of other drawbacks. First, a negotiated process is not transparent. The BPU retains regulatory review of the process. A negotiated approach would not only run counter to the spirit, if not the letter, of the BPU mandate for the EDCs to solicit bids for serving the BGS load, but would also make it more difficult to assess whether the negotiated agreements are reasonable. It would also be difficult to compare different contract prices with different provisions. In addition, a negotiated solution is likely to result in price discrepancies across contracts. Some price discrepancies could, at times, be explained by differences in contract terms or execution dates. However, it would be possible, if not likely, for price discrepancies to appear anomalous in ex post regulatory review. Finally, EDC affiliates were explicitly allowed to participate (indeed, their resources were essential) but a bilateral negotiation with an affiliate would—at a minimum—be subject to extreme scrutiny by the BPU.

A well-designed auction is transparent. The outcome of a competitive auction is generally viewed as a ''fair market'' price. And, absent market power within the auction process, the outcome approximates that of a competitive market. But not all auctions are well designed. And, in multi-lot auctions, prices won't always be uniform. So, for example, while one tranche is secured for 6.1¢ and another, identical, tranche for 5.2¢, there is no a priori way to determine whether one price is too high or the other too low. Such outcomes are not uncommon in multi-lot auctions.

4.2. What Type of Auction?

Once a decision is reached to use an auction, the next question, often overlooked by non-auction theorists, is what type of auction should be used. Answering this question requires an assessment of how various bidding processes will achieve the goals of the auction with the particular items being auctioned. In the case of the New Jersey auction, the items were 100 MW tranches from the four New Jersey EDCs (or ''full requirements'' tranches). One tranche from any one EDC is identical to all the other tranches from that same EDC. The auction did have to account for the fact that the EDCs each have somewhat different load shapes. Thus, a PSE&G tranche would not be identical in cost to a RECO tranche or a Conectiv tranche or a GPU Electric tranche. The desired outcome was for the final prices for each tranche to approximate the marginal cost of serving that tranche—which is a ''competitive'' outcome-and that all suppliers for an EDC would receive the same price for each tranche supplied. Another feature of a competitive outcome is that the prices of the different EDCs should be close. In other words, the price differences across EDCs should be within a range that could be explained by the differences in the load shapes, and other cost factors (congestion, load factor, etc.). One feature of the auction is that the tranches are all close substitutes. A good auction design should result in efficient outcomes when the lots are close substitutes.

Our team reviewed a number of alternative auction formats[11] including traditional first price and second price sealed bids, sequential auctions, weighted scoring of multi-attribute offers and combinatorial auctions. We ruled out auctions in which there would be one winner for each EDC's load mainly because no EDC wanted to incur the risk of being dependent on one supplier. We did not feel the more common and traditional type of auctions, such as first or second price sealed bids or open English auctions were likely to achieve the desired efficiency and transparency of the outcomes.

Because the EDCs wanted to allow competition among bidders to determine the division of the load, we needed a multi-lot auction format that would result in efficient outcomes, or at least not significantly inefficient outcomes. In multi-lot auctions, traditional approaches, such as sequential English and Dutch auctions, often result in non-uniform prices. Indeed, the phrases "afternoon effect" and "declining price anomaly" are associated with the observed phenomena that in a sequential (forward) auction of identical lots, the prices of the lots tend to decrease over the course of the auction. And sealed-bid auctions work even worse. The New Jersey EDCs needed 17,000 MW and wanted competition to determine the optimal division of the load among twenty or more bidders. Absent a combinatorial bidding mechanism in which bidders could submit package bids and contingent bids on combinations of tranches from the four EDCs, any party considering serving multiple EDCs would be forced to guess how much of each they were likely to win when submitting their bids.

Other auction formats had been tried for similar multi-lot auctions. One of the more similar situations was the CALPX. As in New Jersey, a regulatory mandate required the three main utilities to purchase virtually all the energy for the default service customers through a competitive bidding process. The CALPX was set up for the purpose of conducting day-ahead auctions. Both the CALPX and the California Independent System Operator elected to conduct what are essentially sealed-bid auctions in which bids were in the form of supply schedules.[12] Not only did we not want to repeat the California experience, we were also concerned that such a sealed-bid approach would be far from efficient. In an analysis of auctions with sealed-bid supply functions, Green and Newbery observed that "... generators ... could earn extremely large profits while creating large deadweight losses in a market based on price competition that was intended to keep prices close to marginal costs" (Green and Newbery 1992, 946).

Green and Newbery's analysis, and that of some subsequent work,[13] indicate that it is far from clear that, in an auction in which bids had to be in the form of supply functions,

11 Salant drafted the basic SDCA rules. Paul Milgrom reviewed the rules, making a few modifications. Chantale LaCasse was responsible for converting the auction proposal into official auction rules.

12 Since the CALPX ceased operation, the trading rules are not readily available. A summary of the rules can be found in Quan and Michaels (2001).

13 See von der Fehr and Habard (1993).

whether prices will tend to approximate competitive benchmarks. Moreover, often the supply function games, such as the day-ahead auction managed by the CAISO, will not always have pure strategy equilibrium.[14]

We also considered package bidding. Package bidding is worth considering when the some bidders view the lots as complements. This did not seem to be a significant concern in the New Jersey BGS auction because the tranches were close substitutes. Moreover, package bidding increases the complexity of the auction significantly.[15]

We eventually settled on a variation of an auction format developed in 1994 for the first FCC administered spectrum auctions that has become increasingly popular in selling assets. Known as the SMR auction, or simultaneous ascending auction, the auction format was initially developed for forward multi-lot auctions.[16] In a SMR auction, bids occur simultaneously in a sequence of rounds. Bidders place bids on one or more lots in any given round. After each round, the auction manager announces the high bids, and possibly all bids, and the minimum allowed bids for the following round. Bidders who were outbid on one or more lots respond in the next round, either by improving their offers, or by switching from one set of lots to another. The auction ends on all lots simultaneously, and only when no one is willing to increase their offer on any lot. A key feature of SMR auctions is activity rules requiring each bidder to continually improve its offer over the course of the auction. Without such activity rules, the auction can stall.

We elected a SDCA over a more traditional SMR auction, partly to limit signaling and partly, because an auction manager can control the pace of an SDCA much more tightly than a standard SMR auction. The SDCA differed in two significant ways from the standard SMR auction.

First, it is a reverse auction to buy, and not a forward auction to sell. All previous SMR auctions were forward auctions to sell. Secondly, the SDCA is a clock auction. The auction manager names the prices and not the bidders. In most previous SMR auctions, bidders choose prices, not only the quantities and the lots/tranches to bid for.

The incentive properties of forward and reverse auctions tend to be similar, except that in reverse auctions, the post-auction performance risks rest mainly with the auction originator (the buyer) and not the bidder (the sellers). In contrast, in standard forward auctions, the bidders bear most of the risk that the originator will deliver what was advertized.[17] Moreover, a similar proposal was put forward for a Massachusetts default service auction, but as a forward auction. Offers were increasing discounts off of a base amount. This is logically equivalent to starting with a high price and reducing it until the market clears.[18]

14 Firm payoffs will have jump discontinuous whenever two or more firms submit prices for blocks of their capacity at the market clearing price; in such a case, an infinitesimally small decrease in the price offered for the marginal block of capacity will result in a discrete jump in the amount sold. These discontinuities need not arise in auctions with demand uncertainty.

15 See Milgrom (2004) for a discussion of package bidding.

16 For a discussion of the FCC auctions see Cramton (1997), McMillan and McAfee (1996), Milgrom (2003) and the FCC web-site, http://wireless.fcc.gov/auctions/.

17 See Salant (2002).

18 See Peter Cramton, Andrew Parese, and Robert Wilson, ''Auction Design for Standard Offer Service,'' Working Paper, University of Maryland, July 1997.

The use of a clock auction format was, in part, in an effort to streamline the auction. Some SMR auctions have taken more than six months and 250 rounds to complete. In a clock auction, the auction manager can schedule rounds, or ticks, as quickly as the participants and the software system can manage it. Further, some features of the switching rules in the SDCA limited the number of rounds that participants could effectively manage to process in a day. However, the NJ BGS clock auction was quickly completed relative to the experience in SMR auctions. It was considered especially fast given it was the first time this format had been used, and also that there were several parties sharing responsibility for reviewing the results of the auction, including the auction manager and the BPU adviser.

Despite these differences, at the core, the SDCA is a variation of the well-tested SMR format. The main reason for use of the simultaneous auction design is efficiency. Milgrom (2000) has recently shown that if the slices (tranches) are substitutes and bidding is straightforward, then the outcome is a competitive equilibrium. In other words, the SMR will result in a set of prices and an allocation such that no bidder can do better at those prices. Straightforward bidding means that bidders place bids in each round to maximize surplus at the announced prices for the round.

While all the tranches in the New Jersey BGS auction are substitutes in the sense that one tranche is as good as another and a tranche from one EDC is very similar to that from another, it was a theoretical possibility that bidders could face synergies. We did not view this to be a significant practical concern. In addition, straightforward bidding need not be a dominant or even Nash equilibrium strategy. However, this result does suggest that the outcome of the SDCA in the circumstances of the New Jersey BGS auction is likely to be efficient. The tranches are likely to be considered substitutes, at least at the margin.

Moreover, two other features of the auction tend to discourage deviations from straightforward bidding. The two other features were the auction volume adjustments and the limits on the information provided bidders between rounds. Bidders were not told exactly how much excess supply there was after each round, so they could not know whether withholding supply would be effective in keeping prices high.[19]

As has been clearly articulated by Cramton and Schwartz (2000), the SMR auction is subject to bidder withholding demand. There have been cases in which this appears to have occurred.[20] In this case, we were concerned that bidders might withhold a portion of their supply in order to increase the price. The information limitations were intended to limit signaling and reduce the likelihood of coordination to withhold supply.

As a further step to limit the potential for bidders strategically withholding supply, under pre-defined guidelines that we had developed the auction manager was granted the authority of adjusting the amount purchased if she saw that bidder strategies suggested withholding supply. These guidelines were described in general terms in the BGS auction

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19 Between rounds, the auction manager only provided bidders information about the range of total supply, (e.g., that the number of tranches bid were between 211 and 215) and the prices for each EDC in the next round. The auction manager did not provide bidders with additional information between rounds.

20 For a discussion see Peter Cramton and Jesse Schwartz "Collusive Bidding: Lessons from the FCC Spectrum Auctions," *Journal of Regulatory Economics*, 17, 229–252, May 2000.

Table 2. Two Lot, Three Bidder Auction

	Bidder		
	A	B	C
Lot X	$60	$30	$50
Lot Y	$90	$50	$20

rules, and were approved by the BPU. Bidders were not told what the specific parameters to be used in making volume adjustments were. Recent theoretical results show that such measures can also be effective in limiting the impact of bidder coordination in SMR auctions.[21] These auction volume adjustments meant that the auction manager could offset any strategic reduction in supply intended to keep prices high.

To illustrate the advantages of SMR auctions, we conducted simulations.[22] The simulations compare, for one range of valuations, three different auctions formats: a simultaneous sealed-bid, a sequential English auction and an SMR auction. We assume there are two lots being auctioned, X and Y, and three bidders, A, B and C. We also assume that each bidder can bid for at most one lot. The valuations are as in Table 2. We first consider the outcome when the lots are sold using an SMR auction. In this situation an SMR auction will result in A winning lot Y for $50 (or one bid increment more, perhaps $55 assuming $5 increments) and C winning X for $30 (or one increment more, e.g., $35). Total revenue will be between $80 and $90, and no bidders are dissatisfied.[23] B is the marginal bidder for both lots X and Y. Bidder B will keep bidding on X as long as its price does not exceed $30 and will keep bidding on Y as long as its price does not exceed $50. Bidder A may bid for lot X, but will switch to Y whenever the price of Y exceeds the price of X by no more than $30. If A were to start the auction by bidding on X, A would soon switch to Y. B would bid on X until its price reaches $30. B would bid on Y until its price reaches $50. The outcome is efficient in that the assignment of lots maximizes the sum of valuations.

Now we contrast the outcome of the SMR auction with that of a simultaneous, second-price, sealed-bid (one-round) auction. The three bidders each submit a single bid, which consists of the name of only one lot (X or Y) and a price for that lot. To analyze the outcome of this auction format we now need to consider bidder information and beliefs, which was not a consideration in the SMR auction.

In the simultaneous, sealed-bid auction, unlike the SMR auction, bidders need to guess how much competition there will be for each lot. Bidders may not know how many competitors there are in aggregate. Even if bidders know, or have a good idea

21 See McAdams (2001).

22 Joe Fendel of Alkera Incorporated assisted with these simulations.

23 This example assumes that B, who will lose, will bother to show up. In practice, bidders may have difficulty anticipating, at the time they must decide whether to register and participate in an auction, the likely level of competition. Furthermore, we should point out that this is merely a simple three bidder example meant to illustrate how the auction rules can affect the outcome.

about, the aggregate number of competitors, they may not know their rivals' interests. Even knowing rival valuations may not be sufficient to be able to anticipate rivals' bids.[24]

Because these are second-price auctions, whether or not there is perfect and complete information, it will always be a weakly dominant strategy for each firm to bid its true value on the lot for which it submits a bid. In what follows, we assume that bidders do not know the values of their rivals, and that this lack of knowledge results in bidders wanting to randomize the choice of which lot to bid for.[25]

Under these assumptions, one lot will necessarily receive only one bid when there are three bidders. The price of this lot will necessarily be zero. In this case, the maximum possible revenues occur when A wins Y for $50, B also bids on Y, and C wins X for $0. Since there is no other bid for X its price is $0. Whether or not C submits a bid on X does not affect revenues, as if C bids on Y, X will remain unsold. The same revenue is realized if bidders A and C both submit bids for X; then the price of X will be $50 and lot Y will sell for $0. In either case, total revenue will not exceed $50.[26]

Now, we consider the situation in which the lots are sold sequentially, in standard English auctions.[27] To characterize equilibrium we need to more completely describe bidders' beliefs about rivals. If bidders do have complete information, and lot X is auctioned before lot Y, then A should win lot Y for approximately $50 plus, perhaps, one minimum bid increment, for a total of perhaps $55 and C should win X for $35. Total revenue is $90.[28]

However, if bidders do not know rival values, this need not be the case. For instance, if valuations are independent, identical distributions, then both B and C should bid less than their values for lot X. In which case, X will sell for less than $55 and Y is likely to sell for at most $25. The allocation can be inefficient in that A may win X for less than $60, which means B wins Y for $20. Total revenue will then be less than $80. Note, that C is dissatisfied with the outcome (even though it is an equilibrium outcome). Seeing the bids on Y, C would prefer to go back and bid more on X, although it can be an equilibrium strategy for to drop out of the bidding for X where it did. If C had dropped out at $35 on the bidding for X, it would want to go back and bid $40 for X. But C could not know, when X

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24 In this example, even under perfect information, B's choice of which lot to bid for can be uncertain. If this were a 1st price, rather than a 2nd price sealed-bid auction, B would randomize between X and Y.

25 For example, if each bidder assumes that rival values equal their own plus or minus a random component, then one equilibrium would be for each bidder to bid on each lot with a probability of 0.5, and to bid its true value. Other information structures can also give rise to random equilibrium bidding strategies.

26 While the "rule" that a bidder can only bid for one lot might seem artificial, such rules are sometimes imposed by auction managers. Even without such a rule, the risk of winning two lots and having to divest one can deter bidders from submitting two bids if they were allowed to do so. Notice, that the simultaneous sealed bid auction can have multiple equilibria, depending on beliefs.

27 In a standard English auction, the auctioneer starts with a low price and keeps raising price in steps as long as, after each increase, there are bidders who indicate a willingness to pay the new price.

28 At this allocation, A receives a surplus of $45. B drops out of bidding for X at $30. A could bid $35 for X, but would receive a surplus of only $25, and would therefore want to wait for the Y auction.

sold, what Y would go for.[29] So, there can be dissatisfied bidders ex post. The same can be true in the simultaneous sealed bid auctions, as—bidder B can win lot Y and A can win lot X, if C makes the unfortunate choice of bidding for lot Y.

The SMR auction produces more revenues and less dissatisfaction from losing bidders than in simultaneous sealed-bid or sequential auctions. In an SMR auction bidders need not to guess about rival valuations and bidding strategies as they would in simultaneous sealed-bid or sequential auctions. Guesses can be wrong and can result in inefficient outcomes, reduced revenues and dissatisfied bidders. These results are not specific to the examples, in that for many distributions of values, these qualitative results will still apply. With independent and uniformly distributed valuations over [$0, $100], we ran simulations in which we found that the SMR auction produces on average 20% more revenue than a sequential auction.

In addition, there were two other main factors favoring a SDCA format. We considered a more traditional SMR auction given that it had been considered previously for a similar situation.[30] In particular, in 1995 and 1996, GTE had developed a proposal for auctioning off the carrier of last resort (COLR) for basic telephone service. That situation, like the one in New Jersey, was a reverse auction. The local telephone company, the incumbent local exchange carrier, or ILEC, had the sole responsibility for providing certain services. The proposal was to establish an auction to facilitate the introduction of competition. The reasons we developed the SDCA were, in part, based on that successful experience.

Milgrom, working as a consultant on behalf of GTE, had developed another proposal for COLR auctions, which we had considered.[31] The proposal was a two stage sealed-bid process, which permitted package bids. That proposal was specifically designed to address geographic synergies. These synergies did not seem to be of much significance in the BGS auction, and so it did not seem most appropriate either.

4.3. SDCA Rules

As we already discussed, the SDCA auction is a variation of the SMR auction. We now describe the specific rules of this auction design. The official description of the rules can be found at www.bgs-auction.com. The New Jersey BGS auction was a multi-product auction—one for each the four EDCs—with a different number of lots of each type. Table 1 shows the number of lots, or tranches, for each EDC.

29 The likelihood of A winning X or not depends on A's beliefs about the valuations of its rivals. The simulations assumed that A believed that its own high valuation for Y would be correlated with rival valuations for Y, and therefore it would be unlikely to get a significantly higher surplus from Y. The example also assumes that C won't bid its value for the first lot, X. The specific equilibrium stopping rule for A or C on lot X will depend on ex ante prior distributions about rival values for lot Y. Suppose, that C's expected value of waiting for lot Y is 15, that is, it believes it can win Y for a price of 5, on average. Then C will drop out of the bidding on X, when its price tops $35. If A believes it would receive a surplus of 15 for Y, it would stop bidding for X at $45. If bidders do not bid the same fraction of values on lot X, because of differences in prior beliefs, the type of misallocation illustrated in this example is possible.

30 See Salant (1996, 2000), Sorana (2000) and Kelly and Steinberg (2000).

31 See Paul Milgrom, "Procuring Universal Service: Putting Auction Theory to Work," in *Le Prix Nobel: The Nobel Prizes, 1996*, Nobel Foundation, 1997, 382–392.

As noted previously, this was a reverse auction. Prices started high and the auction manager would reduce prices for each EDC based on the amount of excess supply. In particular, the larger the excess supply the more prices were reduced from one round to the next as determined by a pre-defined formula. Bidders were assigned an initial eligibility, measured in tranches, and based on the initial applications and credit reviews. This eligibility never increased during the auction, and bidders had to remain active to maintain it. There was essentially a 100% activity requirement in that a bidder whose activity fell below its eligibility going into a round saw its eligibility reduced for the start of the next round.

During each round, bidders could respond in four basic ways. First, they could renew their previous round bids, meaning that they would commit to a lower price for the tranches which had excess supply and whose price was being reduced. Or, subject to switching restrictions, a bidder might switch any number of tranches from one or more EDCs to another set of one or more EDCs. Switches were subject, first to eligibility limits and second to restrictions against switches that would leave one or more EDCs under-subscribed.

The main purpose of switches was to encourage bidders to arbitrage price differentials. For example, if one EDC's tranches were at a high price relative to that of another EDC, so that the profit margins were not the same, one or more bidders could switch to the more profitable EDC(s). If bidders were tending to switch to the EDC with the highest profit margins, and we set the price decrement larger the larger the ratio of supply relative to the number of tranches needed for each EDC, then the differential in profit margins across EDCs would tend to remain close. This would increase efficiency, since it would result in the differentials between the final prices of the different EDCs to reflect the differences in how marginal bidders assess the cost of serving them.

A bidder might also reduce eligibility. In other words, as prices fell, bidders could decide they want to serve fewer tranches. Finally, bidders might submit exit bids, that is, name last and best offers. The reason for this is to guard against setting the bid decrements too large. An exit bid allows any bidder to determine its own decrement immediately prior to exit. The auction rules permitted combinations of exit bids, reductions and switches. The order in which these were processed is a bit complex and essentially comprises tie-breaking rules, and is spelled out in detail in the auction rules.

One of the more innovative features of the New Jersey BGS Auction is the provision to adjust the auction volume during the auction. Many interested parties had, as we have already discussed, significant concerns that there would be limited participation in the auction, and that limited participation would result in high prices due to the lack of a competitive market. In order to provide some fall back alternatives in the event that this occurred, and to provide bidders stronger incentives to bid aggressively, the auction rules contained provisions for reducing auction volume if relatively few bidders participated. Bidders were alerted to this possibility but were not provided specific details about how volume would be adjusted. Any adjustments made would be done in the early rounds of bidding and would be based on actual activity. The reason for doing this was to encourage relatively large bidders to be more aggressive competitors so as to avoid reductions of auction volume. In the end, this proved unnecessary.

This aspect of the auction was both innovative and potentially risky. While potentially limiting the EDC exposure during the auction, the provision described above had the potential to reduce participation incentives by offering bidders a prospect of post-auction negotiation. To keep this from happening, the EDCs committed to procure any volume not purchased through the auction in PJM-administered markets (non-bilateral), thereby eliminating any prospect that bidders had of post-auction negotiation. In theory, a volume restriction could result in inefficient outcomes if the auction manager effectively reduced auction volume in a monopsonistic fashion. Regulatory oversight of the auction manager meant that this was unlikely to happen, and this design provided the auction manager with a strategic instrument that could offset any potential market power on the supply side, as has been recently analyzed in a much more general setting in McAdams.[32]

4.4. Experience with SMR Auctions

A long track record using SMR auctions also contributed to the decision to adopt this approach. The first SMR auctions were conducted in 1994 by the FCC to sell spectrum rights. Since then, the FCC has conducted more than 30 SMR auctions, and has introduced numerous refinements to the process. The FCC experience has been copied by communications agencies in more than one dozen countries and in auctions generating over $100 billion in proceeds. For the most part, the SMR auction format has been a very effective mechanism for selling spectrum rights.

The experience in electricity with SMR auctions has been much more limited. To date, there have been a few SMR auctions in this sector. Massachusetts had considered a clock auction for default service, but elected for a more conventional approach instead. The first SMR auction in the electricity sector was conducted in Alberta (2000) for Power Purchase Arrangements. For the past two years, the Texas power generation companies (PGCs) have been using SMR auctions for selling energy entitlements, in 25 MW slices. Those auctions have been clock auctions in that the sellers, and not the bidders, name prices. Electricité de France (EDF) has been using a simultaneous ascending clock auction, similar to a forward version of the SDCA, for selling virtual power plants (VPPs) in quarterly auctions starting in September 2001.

4.5. Implementation Issues

4.5.1. Management and Sponsorship

Implementation of an auction such as the BGS auction in New Jersey requires careful orchestration. The auction design itself involved a number of parties. The auction was primarily designed by David Salant, who was then a head of NERA's auction practice. Paul Milgrom, who was one of the three main contributors to the original SMR auction design (the other two are Robert Wilson and Preston McAfee), provided significant advice on the volume adjustment provisions and the activity rules.[33]

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32 See, "Essays in Multi-Unit Bargaining," Ph.D. dissertation, Stanford University, 2001.

33 Sam Dinkin of Alkera Incorporated suggested the exit bid provisions. NERA served as auction manager. The team included Chantale LaCasse, Georgina Martinez and Gene Meehan. Charles River Associates served as the BPU advisor during the auction.

The main players who actively participated in the rule making included the four EDCs, as well as the BPU and its staff, the Ratepayer Advocate, and potential suppliers. Each party had its own advisors. The Ratepayer Advocate expressed concern that a single auction for obtaining all 17,000 MW of load at one time exposed the New Jersey ratepayers to significant risk of high prices, mainly due to the impact a single purchase of that amount at one time could have on the market.

We believe two factors were persuasive in allaying these concerns. First, the auction design approved by the BPU contained volume adjustment provisions. These provisions limited the impact of a low auction turnout on price. An auction with no bidders will never produce good outcomes for the auction manager. Therefore, a provision was adopted to reduce auction volume based on auction turnout. This was both prudent and a measure suggested by recent developments in the theory of auctions (McAdams 2001).

The second factor was the resolve of the EDCs to not resort to negotiations and secondary auctions immediately after the BGS auction. Had this front weakened, potential bidders would have incentives to withhold supply so as to negotiate better prices after the auction. This turned the auction into an event that anyone having generating capacity, or long term energy contracts in the region had to attend. Failing to acquire tranches in the BGS auction could leave an energy supplier lacking known prices for their supplies, and facing significant risks of having energy sold into the spot market and risking low prices subsequently. In this regard, the sudden bankruptcy of Enron (which, fortunately, did not own any resources in PJM) may have been a plus, because it focused Wall Street's attention on the security of the generation owners' revenue streams.

Another issue that the EDCs needed to determine was who should file what specific proposal. The EDCs, with the oversight of the BPU staff, developed a joint proposal. The EDCs submitted a joint filing covering most aspects of the BGS auction. Then there was the question of how the auction would be managed. There was near unanimity in appointing an auction manager to manage the entire process for the EDCs. To finance the costs of the conducting the auction, including the software, management, and the BPU advisors' costs, winning bidders were required to pay a tranche charge of less than one tenth of 1% of the total procurement costs.

4.5.2. Starting Prices

A critical issue in any auction is the manner in which the initial starting prices for the auction are set. The auction rules approved by the BPU specified two stages in the determination of the starting prices: first, the auction manager, in consultation with the EDCs and the BPU, set the maximum and minimum possible values for the starting prices. Then, shortly prior to the start of the auction, the auction manager asked all qualified potential bidders to submit indicative bid quantities at the maximum and minimum prices. After reviewing the indicative bids, the auction manager, again in consultation with the EDCs and the BPU, set individual EDC-specific starting prices for the actual auction itself. This determination was based upon a confidential formula using forward market information and the individual EDC-specific cost drivers, such as load shapes, congestion costs, etc.

A consistent methodology for setting starting prices meant that indicative offers and differences between EDCs needed to be considered. The theoretical possibility that an auction could end after just a few rounds, without much reduction in price, was an argument in favor of low starting prices. Carefully crafted rules for adjusting the auction volume and the rates at which prices would ''tick-down'' were designed to mitigate the potential impact of low auction turnout. Moreover, theoretically it is important to keep the starting prices high enough to encourage the maximum initial participation in this, or any, auction. In the actual auction, the bidders' early switches between EDCs eliminated much of the initial differences between starting prices.

4.5.3. The BPU role

In any regulatory proceeding, the role of the regulatory commission is always prominent. In this case, the BPU involvement and efficient review was critical to the success of the outcome at a number of key steps. First, the BPU had to approve the auction proposal. An important and unique, part of this approval process was that the BPU was making a single decision to allow one combined auction for all four EDCs. The BPU decision to allow one auction contributed to bidder participation, and therefore arguably lower prices, in that all potential suppliers would then know that the auction provided them with a unique opportunity to sell to all the New Jerseys EDCs at one time. The proposal included many parts, including time table, credit provisions, load caps, volume adjustment provisions, starting prices, as well as the auction rules. Determining appropriate starting prices was one of the main issues facing the BPU. The BPU also had to agree to the load caps and the timetable for certifying the auction results. The load cap determination was subject to careful deliberation of the BPU and its advisors.

The fact that the Board reserved the right to approve the auction results after the auction closed meant that bidders could be left in limbo, having winning bids, but not knowing for certain if they would be serving that load until the BPU approved the auction results. It became critically important to resolve the possible uncertainty quickly. The BPU, its staff and advisors, and the EDCs were able to work out procedures in advance for doing so. This issue was complicated further by the fact that the auction duration was difficult to predict. The auction design was such that, if rounds were completed quickly, and the participants were comfortable with a quick pace, several dozen rounds could be completed in a day, and the auction could be completed within a few days. In practice, given the stakes and the novelty of the auction, the auction ran somewhat more slowly and took one and a half weeks to complete. The Board agreed to review the auction results quickly once bidding ended.

4.5.4. Promotion

Key to the success of any auction is bidder participation. In New Jersey's case, it was crucial to get as many potentially interested and qualified parties at the auction as possible. SMR auction experience strongly suggests that the auction originator will get better prices the greater the number of bidders that show up.

Standard economic theory based on models of complete and perfect information would suggest that the auction price should be a competitive one, and the number of bidders should not matter much at all. This is especially true when there are separate markets for spot energy transactions, which turns the auction into a common value one. However, in the BGS auction, like most other auctions, bidders do not have perfect forecasts. They have different views as to future energy costs and future demands. Greater participation is likely to lead to better results, that is, lower, final prices, and for several reasons. One is that bidders may fail to correct fully for the winner's curse. In such cases, more bidders will lead to lower prices, and a larger winner's curse (Kagel and Levin 2002). Even assuming sophisticated bidders, who understand and know how to compensate for the winner's curse, it is still the case that more competition will generally produce smaller gaps between bidder valuations in general, and specifically between the best losing valuation and the lowest winning one. Thirdly, strategic withholding is less effective the greater the number of bidders participating in an auction.

Getting participation requires significant promotional effort, which is not the usual bailiwick of either regulatory agencies or of those who work on regulatory issues. It is unusual for such a promotional effort to be part of a regulatory process. The fact that New Jersey's BGS auction was the outcome of a regulatory proceeding involving numerous parties imposed limits on the type of promotional efforts that would be acceptable or possible.

To promote bidder participation, the EDCs scheduled a series of bidder information sessions. These sessions began even before the formal BPU approval of the process and were invaluable in eliciting bidder interest, and identifying and responding to their concerns. The success of the overall process is probably in no small part due to the effort expended to encourage bidder participation.

4.5.5. Software and the Bidding Process

Finally, in order to implement a SDCA, a process for submitting and evaluating bids is needed. We had suggested early on that remote electronic bidding seemed the most practical means of running the auction—bidders did not need to be in one place and security and other management costs would be minimized in that fashion. This suggestion met with virtually no opposition.

Remote electronic bidding requires software. As some of the details of the auction were unique and somewhat complicated, some new software developments were required. The greatest subtleties in the rules involved switches, eligibility reductions and exit bids. There are several, more or less equivalent ways these can be specified, and these are largely tie-breaking procedures that should only determine whether prices are one increment more or less. However, the specification must be clear and precise for the software to be completed and tested, and it is usually wise to ''lock'' the rules at least two to three months before the software is needed. This was not possible, due to the timetable imposed by the New Jersey BPU rule making process. This led to a deliberate auction pace of approximately one round per hour. This slow pace allowed time for manual bid entry and confirmation in the event of communication or software failures. Use of the same auction rules in subsequent auctions should allow the auction to be completed in less time.

One of the alternatives for increasing the pace of the auction is to increase the size of the bid decrements and/or decrease the starting prices. As we already discussed, we set starting prices high enough to encourage participation and included an auction volume adjustment as a precaution against the EDCs having to pay the high starting prices for their entire BGS load. Large price decrements can be needed to limit the number of rounds when there are high starting prices. However, large bid decrements risk overshooting the clearing price and that tends to decrease the efficiency of the outcome (Rothkopf and

Harstad 1994). A goal of the entire process was, and continues to be, to run the rounds as fast as reasonably possible without reducing efficiency.

5. Implications for Future Auctions

The experience with the New Jersey BGS auction is invaluable. By many accounts the auction was tremendously successful.[34] However, it cannot simply be carbon copied to other states or even other years in New Jersey. What follows is a summary of the important features of the BGS auction that made the use of the SDCA appropriate.

5.1. A Limited Number of Products Simplified the Design Tremendously

The SDCA would have bogged down, and been much less practical to implement, with more than a half dozen or a dozen products. More products mean many more disallowed switches, and many of the products would be just subscribed in many rounds. The more complex the auction, the greater are the entry barriers and the fewer the bidders.

5.2. All Tranches Were for One Year

Another possibility was to have specified some one-year tranches and other tranches of longer duration. Increasing the number of products by auctioning tranches of different durations would have complicated the implementation of the switching provisions and likely have slowed the auction. A multi-year approach would also have drastically increased the migration-volume risk for the future year(s), since customers' rates for the future year(s) are not yet known. Depending on how the auction was structured, there also might have been the problem of the ''right'' discount rate for future versus current prices.

5.3. All EDCs Submitted One Proposal

The fact that the EDCs took a uniform approach was quite important. First, it meant that the bidders had relatively little choice but to make the most serious bids in the auction. Second, there was no need for bidders to try to arbitrage across bidding processes. This greatly improved the efficiency of the outcome and undoubtedly led to lower prices for all the EDCs' tranches. It also significantly reduced the total transaction costs of all parties relative to the auction size.

5.4. Sufficient Lead-Time and Financial Arrangements were Planned

This auction took a fair amount of time to set up. It could not have been done on short notice. The agreement between the EDCs and the Board facilitated the financial

34 The New Jersey procurement process has been called ''one of the great successes of deregulation,'' by *Power Markets Week*, February 10, 2003 and in Public Service Commission of the District of Columbia Formal Case No. 1017, Comments of the Morgan Stanley Capital Group, Inc. Support the Whole Standard Offer Service Model, filed January 29, 2004. The New Jersey Board of Public Utilities President Jeanne M. Fox the (BGS) ''. . .auctions to meet the electric demand of the state have been extremely successful in getting the best price for consumers at the lowest possible wholesale cost.'' (see http://www.state.nj.us/bpu/home/news2003.shtml?55-03.)

arrangements needed to ensure the process was completed. It took over 12 months from when the EDCs first began considering various auction alternatives to the conclusion of the auction and the regulatory review and approval of the process.

5.5. Other States have Different Arrangements

As we have already noted, other states have much different approaches to default service. This approach is not likely to be of any value for a reverse auction when the states do not require divestiture of a significant fraction of generating assets. Other approaches are needed in these states. In particular, a retail transfer of customers and customer account services is much more complex.

5.6. Bids were only for a Uniform Annual Price—other Features, such as Credit, were Fixed and Uniform across EDCs

In a multi-attribute auction, either the bids are evaluated subjectively or using a weighting scheme subject to gaming. The EDCs had to seriously consider whether seasonal pricing, for example, a summer/winter differential or even monthly differentials, would better reflect actual market conditions. Ultimately the concerns about strategic bidding and complexity, and the impossibility of forecasting the "right" weighting, led to the uniform price approach. For the bidders, the fact that they did not have to deal with EDC-specific metering, billing, losses, collections, etc. simplified the issue and reduced risk significantly.

Moving forward, the major issue to be addressed—in New Jersey and elsewhere—is adapting the process to allow the customers' rates to adjust to wholesale market conditions generally, and specifically to adjust rates to fluctuations and differences in the costs to serve different groups of customers at different times. The challenge is that regulatory authorities want to encourage competitive markets while at the same time there is a perceived need to protect customers from the price volatility that is typical in such markets. It is possible that a solution will be found, in part, from the installation of hourly metering, which would allow energy suppliers to adjust customers' energy prices according to a market reference index (e.g., the PJM LMP) and thereby keep these prices more closely aligned with market fluctuations. Improved markets and other opportunities for trading, such as the BGS auction, are integral parts of the solution as such markets allow all parties to observe market prices directly and result in more efficient allocations.

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