



**CALIFORNIA ISO**

# **Annual Report on Market Issues and Performance**

• • • • • • • •

*Prepared by the Market Surveillance Unit*

*California Independent System Operator*

*June 1999*



## **ACKNOWLEDGEMENT**

The following staff members of the Market Surveillance Unit,  
California Independent System Operator,  
contributed to this report:

Anjali Sheffrin  
Farrokh Rahimi  
Lorenzo Kristov  
Eric Hildebrandt  
Jason Christian  
Keith Casey



## **BRIEF TABLE OF CONTENTS**

**CHAPTER 1. EXECUTIVE SUMMARY**

**CHAPTER 2. INTRODUCTION TO THE ISO MARKETS**

**CHAPTER 3. ANCILLARY SERVICES MARKETS**

**CHAPTER 4. REAL-TIME ENERGY MARKET**

**CHAPTER 5. CONGESTION MANAGEMENT**

**CHAPTER 6. MARKET INTER-RELATIONSHIPS**

**CHAPTER 7. MARKET POWER AND COMPETITIVENESS**



## DETAILED TABLE OF CONTENTS

<b>CHAPTER 1. EXECUTIVE SUMMARY .....</b>	<b>1-1</b>
<b>1.1 Overview .....</b>	<b>1-1</b>
<b>1.2 The New California Electric Market.....</b>	<b>1-4</b>
1.2.1 Annual Retail Energy and ISO Costs .....	1-4
1.2.2 Market Structure .....	1-5
1.2.3 Unique Features of the Californian Electric Services Marketplace.....	1-6
1.2.4 Market Surveillance .....	1-8
<b>1.3 Ancillary Services Market Performance .....</b>	<b>1-8</b>
1.3.1 Summary of Market Performance .....	1-8
1.3.2 Analysis of Ancillary Services Market Performance.....	1-11
1.3.3 Summary.....	1-18
<b>1.4 Real-time Energy Market Performance.....</b>	<b>1-19</b>
1.4.1 Comparison of PX and Real-time Prices .....	1-19
1.4.2 Frequency of High Real-time Prices.....	1-21
1.4.3 Summary.....	1-22
<b>1.5 Congestion Management Market Performance .....</b>	<b>1-22</b>
1.5.1 Congestion Frequency and Cost.....	1-22
1.5.2 Congestion and Market Efficiency.....	1-24
1.5.3 Bid Sufficiency and High Usage Charges.....	1-25
<b>1.6 Key Challenges Affecting First-year Performance.....</b>	<b>1-26</b>
1.6.1 System Implementation Issues.....	1-26
1.6.2 Gaming Behavior .....	1-26
1.6.3 Regulatory Disparities Leading to Bid Insufficiency .....	1-27
1.6.4 Market Design and Market Power Issues .....	1-27
<b>1.7 Remaining Market Issues .....</b>	<b>1-29</b>
1.7.1 Further RMR Reform .....	1-29
1.7.2 Reduce the Demand for Regulation .....	1-29
1.7.3 Enhance the Hour-ahead A/S Markets .....	1-30
1.7.4 Reduce Barriers to Ancillary Service Imports .....	1-30
1.7.5 Monitor Market Power in New FTR Market .....	1-31
1.7.6 Integrated Transmission Grid Expansion Process .....	1-31
1.7.7 Promote Demand Responsiveness to Market Prices.....	1-31
1.7.8 Mitigation of Market Power after Stranded Cost Recovery Ends .....	1-32
<b>1.8 Conclusion.....</b>	<b>1-32</b>
<b>CHAPTER 2. INTRODUCTION TO THE ISO MARKETS .....</b>	<b>2-1</b>
<b>2.1 Chapter Overview.....</b>	<b>2-1</b>
<b>2.2 Restructuring of the Electric Utility Industry .....</b>	<b>2-1</b>
<b>2.3 Overview of the California ISO Markets .....</b>	<b>2-3</b>

<b>2.4</b>	<b>Ancillary Services Markets.....</b>	<b>2-6</b>
<b>2.5</b>	<b>Real-time Imbalance Energy Market.....</b>	<b>2-7</b>
<b>2.6</b>	<b>Congestion Management Markets.....</b>	<b>2-8</b>
2.6.1	Congestion Zones.....	2-9
2.6.2	Inter-zonal Congestion .....	2-10
2.6.3	Intra-zonal Congestion .....	2-11
<b>2.7</b>	<b>Reliability Must-Run Generation.....</b>	<b>2-11</b>
<b>2.8</b>	<b>Major Issues Encountered in the First Year of Operation.....</b>	<b>2-12</b>
2.8.1	Real-time Energy Price Cap .....	2-12
2.8.2	Insufficient Bids for Ancillary Services and Cost-based Price Caps.....	2-13
2.8.3	Regulation Energy Payment Adjustment (REPA).....	2-13
2.8.4	Lifting of Cost-based Caps for New Generation Owners (NGOs) .....	2-13
2.8.5	July Price Spikes .....	2-14
2.8.6	Damage Control Ancillary Service Price Caps .....	2-14
2.8.7	Record Loads and Emergency Conditions.....	2-14
2.8.8	Out-of-Market Purchases.....	2-14
2.8.9	Market Design Modifications .....	2-15
2.8.10	Changes in Criteria for Determining A/S Purchase Requirements.....	2-15
2.8.11	Uninstructed Deviations .....	2-16
2.8.12	Separate Procurement of Upward and Downward Regulation.....	2-16
2.8.13	Removal of All Cost-based Price Caps.....	2-16
2.8.14	Negative Energy Bids and Over-generation .....	2-17

## **CHAPTER 3 ANCILLARY SERVICES MARKETS ..... 3-1**

<b>3.1</b>	<b>Introduction .....</b>	<b>3-1</b>
3.1.1	Chapter Overview.....	3-1
3.1.2	Market Description .....	3-1
<b>3.2</b>	<b>Summary of Market Issues and Performance.....</b>	<b>3-2</b>
3.2.1	Bid Sufficiency.....	3-3
3.2.2	Procurement of Ancillary Services by Zone.....	3-3
3.2.3	Short-term Market Design Changes.....	3-3
3.2.4	Ancillary Services Market Redesign .....	3-4
3.2.5	Opening of A/S Markets to Imports.....	3-5
3.2.6	Sequential Auction Design and the Replacement Reserve Market.....	3-5
3.2.7	Stage 2 Alerts and Operating Reserve Shortfalls.....	3-6
3.2.8	Market Operations Software .....	3-7
<b>3.3</b>	<b>Demand for Ancillary Services.....</b>	<b>3-7</b>
3.3.1	Overall Demand for Ancillary Services .....	3-7
3.3.2	Regulation Reserves .....	3-11
3.3.3	Operating Reserves .....	3-12
3.3.4	Replacement Reserves .....	3-12
<b>3.4</b>	<b>Regulating Reserve .....</b>	<b>3-13</b>
3.4.1	Supply of Regulation Services .....	3-13
3.4.2	Bid Sufficiency.....	3-13
3.4.3	Regulation Prices.....	3-19
3.4.4	Regulation Costs.....	3-22
<b>3.5</b>	<b>Spinning, Non-Spinning and Replacement Reserve.....</b>	<b>3-23</b>

3.5.1 Reserve Supplies .....	3-23
3.5.2 Bid Sufficiency.....	3-27
3.5.3 Ancillary Service Imports .....	3-31
3.5.4 Spinning, Non-Spinning and Replacement Reserve Prices .....	3-36
<b>3.6 Ancillary Services Market Re-design .....</b>	<b>3-40</b>
<b>3.7 Conclusion.....</b>	<b>3-42</b>
<b>3.8 Appendix – the Rational Buyer Algorithm.....</b>	<b>3-43</b>

## **CHAPTER 4. REAL-TIME ENERGY MARKET..... 4-1**

<b>4.1 Introduction .....</b>	<b>4-1</b>
4.1.1 Chapter Overview .....	4-1
4.1.2 Real-time Market Description.....	4-1
<b>4.2 Key Market Issues, Successes and Failures.....</b>	<b>4-2</b>
4.2.1 Real-time Price Cap .....	4-2
4.2.2 Price Spikes .....	4-2
4.2.3 Impacts of Operational and Software Constraints on Real-time Market Efficiency.....	4-2
4.2.4 Under-scheduling of Load .....	4-3
4.2.5 Lack of Demand Elasticity.....	4-3
<b>4.3 Demand for Real-time Imbalance Energy.....</b>	<b>4-3</b>
4.3.1 Deviations from Scheduled Loads.....	4-5
4.3.2 Deviations from Generation Schedules .....	4-8
4.3.3 Reliability Must Run (RMR) Generation .....	4-8
4.3.4 Inaccurate Accounting for Transmission Losses.....	4-9
<b>4.4 Supply of Imbalance Energy .....</b>	<b>4-10</b>
4.4.1 The BEEP Stack.....	4-11
4.4.2 Real Time Energy Dispatched .....	4-14
4.4.3 Merit Order Dispatch of Real Time Energy Bids.....	4-15
<b>4.5 Real-time Energy Prices .....</b>	<b>4-17</b>
4.5.1 Real Time Price Spikes During the Summer Peak Season .....	4-19
4.5.2 Real Time Price Spikes During the Winter and Spring Seasons .....	4-21

## **CHAPTER 5. CONGESTION MANAGEMENT..... 5-1**

<b>5.1 Introduction .....</b>	<b>5-1</b>
5.1.1 Chapter Overview.....	5-1
5.1.2 Market Description .....	5-1
<b>5.2 Overview of Market Performance.....</b>	<b>5-4</b>
5.2.1 The Inter-zonal Congestion Market.....	5-5
5.2.1.1 Transmission Market Supply and Demand.	5-5
5.2.1.2 Adjustment Bid Sufficiency.....	5-10
5.2.1.3 Inter-zonal Congestion Prices .....	5-12
5.2.1.4 Inter-zonal Congestion Costs.....	5-16
5.2.1.5 Impact of Inter-zonal Congestion on Day Ahead Energy Costs.....	5-20
5.2.2 Intra-zonal Congestion.....	5-24
5.2.2.1 Market Power in Inter-zonal and Intra-zonal Congestion .....	5-24
5.2.2.2 Use of RMR Contracts to Mitigate Intra-zonal Congestion.....	5-25

5.2.2.3 Intra-zonal Congestion Costs.....	5-25
<b>5.3 Future Market Issues.....</b>	<b>5-26</b>
5.3.1 New Zone Creation.....	5-26
5.3.2 Firm Transmission Rights.....	5-28
5.3.3 Existing Transmission Contracts .....	5-29

<b>5.4 Appendix – Current Intra-zonal Congestion Management Operating Protocol .....</b>	<b>5-31</b>
--	-------------

## **CHAPTER 6. MARKET INTER-RELATIONSHIPS..... 6-1**

<b>6.1 Background.....</b>	<b>6-1</b>
6.1.1 Chapter Overview.....	6-1
6.1.2 Markets, Arbitrage, and Decentralized Optimization .....	6-1
<b>6.2 ISO Real-time and PX Energy Markets.....</b>	<b>6-2</b>
6.2.1 Background.....	6-3
6.2.2 Comparison of Real-time and PX Day-ahead Energy Prices .....	6-3
<b>6.3 PX Energy and ISO Ancillary Services Markets .....</b>	<b>6-7</b>
6.3.1 Competitive Benchmarks for the Ancillary Services Markets.....	6-7
6.3.2 Direct and Indirect Cost of Supplying Ancillary Services.....	6-7
6.3.3 Illustration of the Relationship Between Energy and Ancillary Service Prices .....	6-9
6.3.4 Comparison of A/S Capacity and PX Energy Prices .....	6-12
6.3.5 Scenario Analysis of Ancillary Service Costs .....	6-15
<b>6.4 Rate Caps and Alternatives .....</b>	<b>6-19</b>
<b>6.5 Reliability Must-Run Contracts .....</b>	<b>6-19</b>
6.5.1 Market Impacts of RMR Contracts.....	6-19
6.5.2 Dispatch of RMR Units After the Day-ahead Market.....	6-21
6.5.3 Summary of the Partial RMR Settlement.....	6-21
6.5.4 Market Impacts of the Partial RMR Settlement.....	6-23
6.5.5 Key Unresolved Issues.....	6-24

## **CHAPTER 7 MARKET POWER AND COMPETITIVENESS ..... 7-1**

<b>7.1 Background.....</b>	<b>7-1</b>
7.1.1 Chapter Overview.....	7-1
7.1.2 Measuring Market Competitiveness .....	7-1
7.1.2.1 Market Concentration.....	7-1
7.1.2.2 Bid Markup.....	7-2
7.1.3 Modeling Price Markup .....	7-3
<b>7.2 Pivotal Supplier Analysis.....</b>	<b>7-4</b>
7.2.1 Residual Supply Index .....	7-4
7.2.2 Example of Residual Supply Index .....	7-5
<b>7.3 Analysis of Market Power Using RSI.....</b>	<b>7-7</b>
7.3.1 Comparison of Residual Supply Index and the HHI .....	7-8
7.3.2 Market Power in Regulation Market.....	7-9
7.3.3 Market Power in the Spin, Non-spin and Replacement Reserve Markets .....	7-14
<b>7.4 Monitoring of Bilateral Contracts .....</b>	<b>7-19</b>

# LIST OF FIGURES

## **CHAPTER 1**

Figure 1-1. Annual Retail Energy and ISO Market Costs .....	1-4
Figure 1-2. The ISO's Role in the California Market.....	1-6
Figure 1-3. Key Periods of Market Performance .....	1-11
Figure 1-4. ISO System Daily Peak Load, PX Price and A/S Cost by Month .....	1-11
Figure 1-5. Cost Components of Ancillary Services .....	1-14
Figure 1-6. Cost Components of Regulation Service .....	1-14
Figure 1-7. Ancillary Service Costs Per MWh of Load and as Percent of Energy Cost.....	1-15
Figure 1-8. Percent of Peak Hours the A/S Price Hit the Cap.....	1-16
Figure 1-9. Percent of Hours with RSI < 100% in Downward Regulation by Operating Hour .....	1-18
Figure 1-10. Comparison of PX Day-ahead and ISO Real-time Energy Prices (Average, Minimum and Maximum - Peak Hours).....	1-19
Figure 1-11. Average Hourly Difference between Real-Time and PX Prices.....	1-20
Figure 1-12. Energy Prices and Frequency of Hitting the Cap, in Relation to System Loads (July–Sept. 1998) ...	1-21
Figure 1-13. Inter-zonal Congestion Frequency by Major Path in Day-ahead Market.....	1-23
Figure 1-14. Congestion Cost and Price by Major Paths in Day-ahead Market.....	1-23
Figure 1-15. Congestion Frequency and Direction on Path 15 by Month .....	1-24

## **CHAPTER 2**

Figure 2-1. Examples of Existing or Emerging Market Structures .....	2-2
Figure 2-2. Comparison of ISO Models .....	2-3
Figure 2-3. Time Sequence of Key Activities in ISO and PX Market Operations .....	2-5
Figure 2-4. Payments by ISO to Other Control Areas.....	2-15
Figure 2-5. Chronology of Key Events in California Electricity Markets .....	2-17

## **CHAPTER 3**

Figure 3-1. Average Hourly Ancillary Service Requirements (Aug. 1998).....	3-9
Figure 3-2. Average Hourly Ancillary Service Requirements as Percent of Total ISO System Loads (Aug. 1998).....	3-9
Figure 3-3. Average Hourly Ancillary Service Requirements (Feb. 1998) .....	3-10
Figure 3-4. Average Hourly Ancillary Service Requirements as Percent of Total ISO System Loads (Feb. 1998) .....	3-10
Figure 3-5. Regulation Bid Sufficiency (Peak Hours).....	3-15
Figure 3-6. Regulation Bid Sufficiency (Off-Peak Hours) .....	3-15
Figure 3-7. Bid Sufficiency in Upward Regulation Market (Oct. 1998-Mar. 1999) .....	3-18
Figure 3-8. Bid Sufficiency in Downward Regulation Market (Oct. 1998-Mar. 1999).....	3-18
Figure 3-9. Regulation Market Clearing Prices .....	3-20
Figure 3-10. Effect of Eliminating REPA on Regulation Prices.....	3-21
Figure 3-11. Average Prices and Price Spikes in Regulation Market.....	3-21
Figure 3-12. Total Monthly Cost of Regulation.....	3-22
Figure 3-13. Average Bid Quantities and Prices – Spinning Reserves, Peak Hours .....	3-24
Off-Peak Hours.....	3-24
Figure 3-14. Average Bid Quantities and Prices – Non-spinning Reserves, Peak Hours .....	3-25
Off-Peak Hours.....	3-25
Figure 3-15. Average Bid Quantities and Prices – Replacement Reserves, Peak Hours .....	3-26
Off-Peak Hours.....	3-26
Figure 3-16. Bid Sufficiency Levels – Spinning Reserves, Peak Hours (7-22) .....	3-28
Off-Peak Hours (1-6, 23-24) .....	3-28
Figure 3-17. Bid Sufficiency Levels – Non-spinning Reserves, Peak Hours (7-22) .....	3-29
Off-Peak Hours (1-6, 23-24) .....	3-29
Figure 3-18. Bid Sufficiency Levels – Replacement Reserves, Peak Hours (7-22) .....	3-30

Off-Peak Hours (1-6, 23-24) .....	3-30
Figure 3-19. Import and Domestic Capacity Bids for Spinning Reserves .....	3-32
Figure 3-20. Import and Domestic Capacity Bids for Non-Spinning Reserves .....	3-33
Figure 3-21. Import and Domestic Capacity Bids for Replacement Reserves .....	3-34
Figure 3-22. Operating Reserve Imports as a Percent of Total Requirements (Aug. 1998 – March 1999) .....	3-35
Figure 3-23. Shares of Operating Reserve Imports by Import Region During Hours when 25% Limit on Imports Was Binding .....	3-35
Figure 3-24. Spinning Reserve Market Clearing Prices .....	3-37
Figure 3-25. Non-Spinning Reserve Market Clearing Prices.....	3-38
Figure 3-26. Replacement Reserve Market Clearing Prices .....	3-39

## **CHAPTER 4**

Figure 4-1. Real-time Energy Imbalances and Total System Loads.....	4-4
Figure 4-2. Sources of Real-time Energy Imbalances .....	4-4
Figure 4-3. Average Hourly ISO System Loads and Schedules (April–June 1998).....	4-4
Figure 4-4. Average Hourly ISO System Loads and Schedules (July–Sept. 1998).....	4-6
Figure 4-5. Average Hourly ISO System Loads and Schedules (Oct.–Dec. 1998) .....	4-7
Figure 4-6. Average Hourly ISO System Loads and Schedules (Jan.–March 1999).....	4-7
Figure 4-7. Impact of Reliability Must Run Generation on Energy Imbalance .....	4-9
Figure 4-8. Sources of Real-time Imbalance Energy.....	4-10
Figure 4-9. Real-time Energy Bids (BEEP Stack) for Typical Off-Peak Hours .....	4-12
Figure 4-10. Real-time Energy Bids (BEEP Stack) for Typical Peak Hours.....	4-12
Figure 4-11. Real-time Energy Bids at \$250 Price Cap (Peak Hours 7-22).....	4-13
Figure 4-12. Sources of Real-time Energy Dispatched by ISO.....	4-14
Figure 4-13. Sources of Real-time Energy Dispatched by ISO (12 months) .....	4-14
Figure 4-14. Percent of Bids Dispatched in Merit Order, by System Load .....	4-16
Figure 4-15. Real-time Energy Imbalances and Total System Loads.....	4-18
Figure 4-16. Total System Loads and Energy Prices (July–Sept. 1998) .....	4-20
Figure 4-17. Total System Loads and Real-time Price Spikes (July–Sept. 1998) .....	4-20
Figure 4-18. Total System Loads and Real-time Imbalances During Real-time Price Spikes (July–Sept. 1998) ...	4-21

## **CHAPTER 5**

Figure 5-1. California Transmission Network Model .....	5-3
Figure 5-2. Congestion Frequency – Day-ahead Market.....	5-7
Figure 5-3. Congestion Frequency – Hour-ahead Market .....	5-7
Figure 5-4. Total Curtailments in the Day-ahead Market.....	5-8
Figure 5-5. Day-ahead Curtailments as Percentages of Total Preferred Day-ahead Schedule Flows in All Hours... <td>5-8</td>	5-8
Figure 5-6. Day-ahead Curtailments as Percentages of Total Preferred Day-ahead Schedule Flows in Congested Hours .....	5-9
Figure 5-7. Total Curtailments in the Hour-ahead Market .....	5-9
Figure 5-8. Typical Inter-zonal Transmission Demand Curve, for a Particular Interface in a Particular Direction, Based on Matched Pairs of SC Adjustment Bids .....	5-10
Figure 5-9. Actual Transmission Demand Curve Constructed from Adjustment Bids.....	5-11
Figure 5-10. Day-ahead Import Congestion on COI (Peak Hours) .....	5-13
Figure 5-11. Day-ahead Import Congestion on NOB (Peak Hours).....	5-13
Figure 5-12. Day-ahead South to North Congestion on Path 15 (Peak Hours).....	5-14
Figure 5-13. Day-ahead South to North Congestion on Path 15 (Off-Peak Hours) .....	5-14
Figure 5-14. Day-ahead Import Congestion on Eldorado (Peak Hours).....	5-15
Figure 5-15. Day-ahead Import Congestion on Palo Verde (Peak Hours).....	5-15
Figure 5-16. Hour-ahead Import Congestion on COI (Peak Hours).....	5-16
Figure 5-17. Total Congestion Costs and Average Prices – Day-ahead Market .....	5-17
Figure 5-18. Hour-ahead Market Total Congestion Costs and Average Prices .....	5-17
Figure 5-19. Day-ahead Import Congestion Costs for COI .....	5-18
Figure 5-20. Day-ahead South to North Congestion Costs for Path 15 .....	5-18
Figure 5-21. Day-ahead Import Congestion Costs for NOB.....	5-19

Figure 5-22. Day-ahead Import Congestion Costs for Palo Verde.....	5-19
Figure 5-23. Day-ahead Import Congestion Costs for Eldorado.....	5-20
Figure 5-24. Impact of Congestion on Day-ahead Energy Costs to the Load April 1998 through March 1999 .....	5-21
Figure 5-28. Schematic One-line Diagram Illustrating Relative Location of Paths 15 and 26 .....	5-27
Figure 5-29. Day-ahead Import Curtailments on COI with and without Unscheduled ETC Capacity .....	5-30
Figure 5-30. Day-ahead South to North Curtailments on Path 15 with and without Unscheduled ETC Capacity..	5-30

## **CHAPTER 6**

Figure 6-1. Comparison of Monthly Average Real-time and PX Prices .....	6-4
Figure 6-2. Percentage Differences Between Monthly Average Real-time and PX Prices.....	6-4
Figure 6-3. Differences in Hourly Real-time and PX Prices.....	6-5
Figure 6-4. Monthly Average Real-time and PX Prices .....	6-5
Figure 6-5. Differences between Daily Average Real-time and PX Prices (Peak Hours 7-22) .....	6-6
Figure 6-6. Differences in Daily Average Real-time and PX Prices (Off-peak) .....	6-6
Figure 6-7. Direct and Indirect Costs of Providing Ancillary Services .....	6-8
Figure 6-8. When PX Prices Exceed Variable Energy Costs, Ancillary Service Prices Should Reflect Opportunity Cost of Not Participating in Energy Markets.....	6-10
Figure 6-9. Illustrative Example of the Cost of Providing A/S.....	6-10
Figure 6-10. Effect of PX Prices on Ancillary Service Costs for a Unit with \$30 Operating Cost .....	6-11
Figure 6-11. Relationship Between Ancillary Services Costs and PX Prices .....	6-11
Figure 6-12. Comparison of A/S and PX Market Clearing Prices.....	6-12
Figure 6-13. Relationship of Regulation and PX Energy Prices (with REPA, May 20 to Nov. 27, 1998) .....	6-13
Figure 6-14. Relationship of Regulation and PX Energy Prices (without REPA, Nov. 28, 1998 to March 31, 1999).....	6-13
Figure 6-15. Other Ancillary Service Capacity and PX Energy Prices (April 1998 to March 1999) .....	6-14
Figure 6-16. Regulation Price Duration Curve .....	6-17
Figure 6-17. Replacement Reserve Capacity Price Duration Curve.....	6-17
Figure 6-18. Annual Comparison of A/S Cost Scenarios .....	6-18
Figure 6-19. Annual Comparison of A/S Cost Scenarios .....	6-18

## **CHAPTER 7**

Figure 7-1. Residual Supply Index and Market Power.....	7-4
Figure 7-2. Calculation of Residual Supply Index for Individual Firms .....	7-6
Figure 7-3. Residual Supply Index for Individual Firms .....	7-6
Figure 7-4. Comparison of Hourly RSI and HHI – Upward Regulation Market, October 1998 through March 1999 .....	7-8
Figure 7-5. Pivotal Player Analysis Regulation Market .....	7-10
Figure 7-6. Minimum Hourly RSI Values (IOUs), October 1998 – March 1999 .....	7-11
Figure 7-7. Minimum Hourly RSI Values (IOUs) by Operating Hour .....	7-11
Figure 7-8. Minimum Hourly RSI Values (NGOs), October 1998 – March 1999 .....	7-12
Figure 7-9. Minimum Hourly RSI Values (NGOs) by Operating Hour .....	7-12
Figure 7-10. Pivotal Hours in Downward Regulation Market, by Operating Hour.....	7-13
Figure 7-11. Pivotal Hours in Upward Regulation Market, by Operating Hour .....	7-13
Figure 7-12. Pivotal Player Analysis for the Spin, Non-spin and Replacement Reserve Markets .....	7-15
Figure 7-13. RSI for Pivotal IOU in Spinning Reserves v. Total ISO Load.....	7-16
Figure 7-14. RSI for Pivotal NGO in Spinning Reserves v. Total ISO Load .....	7-16
Figure 7-15. RSI for Pivotal IOU in Non-Spinning Reserves v. Total ISO Load .....	7-17
Figure 7-16. RSI for Pivotal NGO in Non-Spinning Reserves v. Total ISO Load.....	7-17
Figure 7-17. RSI for Pivotal IOU in Replacement Reserves v. Total ISO Load.....	7-18
Figure 7-18. RSI for Pivotal NGO in Replacement Reserves v. Total ISO Load .....	7-18