Reliability Challenges in Competitive Electric Markets -- Summer 2000 Experience and Outlook for the Future

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Introduction

Electric Power Group, LLC
• Provides management and strategic consulting services for the electric power industry
• Focus areas include industry restructuring, competitive electric markets, emerging technologies, venture investments and start-ups
• Vikram S. Budhraja, President; Formerly President Edison Technology Solutions and Senior Vice President, Southern California Edison

Consortium for Electric Reliability Technology Solutions (CERTS)
• Consortium of U.S. Department of Energy national labs, universities, and industry partners.
• Managed through a program office at Lawrence Berkeley National Lab
• Mission Statement - To research, develop and commercialize new methods, tools and technologies to protect and enhance the reliability of the U.S. electric power system under the emerging competitive electricity market structure.
• Research Areas - Reliability technology issues, real-time controls, integration of distributed resources, reliability and markets, scenario for the Grid of the Future.
• Vikram S. Budhraja, Chair, CERTS and advisor on policy, strategy, technology commercialization and industry coordination.
Electric Industry Restructuring in the U.S.A.

- EPACT 1992
  - Wholesale competition and open transmission access
- FERC Orders 888, 889 - April 1996
  - Functional unbundling of transmission
  - Voluntary formation of ISOs
- FERC Order 2000 - December 1999
  - RTO compliance filings on October 15, 2000
  - RTOs operational December 15, 2001
- Independent System Operators started operating in 1998 -- 5 ISOs covering 30% of electric loads currently operating
- 50 million customers with retail choice by 2002
Competitive Market Structure

State Regulation

Regulated
- Generation
- Transmission
- Distribution

Restructured
- Generation
- Power Exchange
- Independent System Operator
- Transmission/Grid
- Distribution/Customer Services
- Retailing

Competitive
- Competitive
- Federal Regulation
- State Regulation
- Competitive
## Recent Reliability Events

<table>
<thead>
<tr>
<th>Year</th>
<th>Event/Location</th>
<th>Date</th>
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<tbody>
<tr>
<td>1996</td>
<td>WSCC Outages</td>
<td>July 2, August 10</td>
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<tr>
<td>1997</td>
<td>Minnesota – Wisconsin Separation</td>
<td>June 11-12</td>
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<td>1998</td>
<td>NPCC Ice Storm</td>
<td>January 5-10</td>
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<td></td>
<td>MAPP Breakup</td>
<td>June 25</td>
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<td>San Francisco Outage</td>
<td>December 8</td>
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<tr>
<td>1999</td>
<td>New England states system disturbances</td>
<td>June 7-8</td>
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<td></td>
<td>Mid-Atlantic area system disturbances</td>
<td>July 6 and July 19</td>
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<td>New York City Outage</td>
<td>July 6-7</td>
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<td>Long Island Outage</td>
<td>July 3-8</td>
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<td>New Jersey Outage</td>
<td>July 5-8</td>
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<tr>
<td></td>
<td>Delmarva Peninsula Outage</td>
<td>July 6</td>
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<td>South-Central States Outage</td>
<td>July 23</td>
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<td></td>
<td>Chicago Outage</td>
<td>July 30-August 12</td>
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<td>2000</td>
<td>California Reliability Challenges</td>
<td></td>
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<tr>
<td></td>
<td>- Price Spikes</td>
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<td></td>
<td>- Load Curtailments</td>
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<tr>
<td></td>
<td>- Emergency Alerts</td>
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Restructuring in California

• System was not working -- high rates, regulatory gridlock, competing visions.

• CPUC started the retail choice debate in 1994. Stakeholders were polarized. Edison and stakeholders negotiated a solution, which became the framework for legislation passed in 1996.

• Competitive market with ISO, PX, and retail choice started on 3/31/98.

• Everyone got some of what they wanted:
  – Utilities - Stranded Cost Recovery
  – Customers - Choice, Rate Freeze
  – Generators - Market Access
  – Regulators - Competitive Market/Unbundling

• Market structure was a product of political consensus.
Attributes of the California Market

- 50,000 MW peak load
- 200 billion kWh transmitted per year
- $20 billion electricity market -- $6 billion energy
- 800 generators
- Separate Power Exchange and ISO
- Utilities effectively out of the generation business
- Multiple energy and ancillary services markets
- Service unbundling
- Choice for all customers
- Reliability through markets
## Summer 2000 Performance and Reliability Challenges

<table>
<thead>
<tr>
<th>Topic</th>
<th>Details</th>
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<tbody>
<tr>
<td><strong>Price Caps</strong></td>
<td>- Changed several times by Board (750-500-250)</td>
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<tr>
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<td>- Variable cap approved by Board in October - rejected by FERC</td>
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<td>- Soft cap proposed by FERC in 11/1/00 Order</td>
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<tr>
<td><strong>Price Spikes</strong></td>
<td>- Frequent and persistent</td>
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<td>- Summer 2000 - $5 billion uncollected</td>
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<td>- August average $183/MWh, almost 5 times previous year</td>
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<td><strong>Under-Scheduling</strong></td>
<td>- Up to 14,000 MW or 30% purchases by ISO during real-time</td>
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<td><strong>Comments on Market Design</strong></td>
<td>- Seriously flawed</td>
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<td>- Dysfunctional</td>
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<td><strong>Emergency Alerts</strong></td>
<td>- Year 2000 Emergency Alerts</td>
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<td>- Stage 1: 35 (reserves fall below 7% in real-time)</td>
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<td></td>
<td>- Stage 2: 20 (reserves fall below 5% in real-time)</td>
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<td><strong>Reliability</strong></td>
<td>- CAISO maintained reliability and “kept the lights on”</td>
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<td>under very challenging circumstances</td>
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<td>- Non-Firm load interrupted 14 times</td>
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Issues Impacting California’s Market and Reliability

- **Transition**: California did it all at once in one giant step
- **Generation Ownership**: Utilities were required to divest sooner, rather than later
- **Rate Freeze**: Protected customers, but disconnected them from the market
- **Market Power**: FERC concluded market for ancillary services was competitive
- **Market Structure**: The entire demand clears at a single spot market price
Issues Impacting California’s Market and Reliability - Cont’d

- **Forward Contracts**: Limited or none
- **Supply Adequacy**: Reliance on markets and no planning reserve responsibility for Load Serving Entities
- **Multiple Markets**: Under-Scheduling in day-ahead market. ISO real-time procurement of 20-30% as opposed to normal 2-3%
- **Generation Supply**: Tight - load growth of more than 1,000MW/Year; little, if any, new capacity in the last 5 years
- **Regional Disconnect**: Neighboring utilities can bid up prices for the last MW without impacting the rest of their portfolio, while California’s entire portfolio gets priced at the last MW
- **Demand Participation**: No real-time price signals to customers; no incentives to participate during rate freeze
Proposals for California Market Fixes

FERC Nov 1 Proposal
- Establish nonstakeholder boards
- Eliminate requirement for IOUs to buy and sell through PX
- Redesign market rules - congestion, balanced schedules
- Encourage California to promote new generation, demand response programs, use of forward contracts
- “Soft Cap” of $150/MWh

California IOUs
- Increase rates to recover wholesale energy costs
- Refunds for summer 2000 price spikes; remove rate freeze; impose stricter price caps

Other Proposals
- Use $2 billion of State surplus to buy generation and transmission assets
- Stronger State role in overseeing ISO and transmission grid
- Ballot initiative under discussion

Governor Davis
- Announcement planned December 1, 2000
Reliability Issues Facing North America

- **Market Transition** - Interconnection policies, market power, stranded cost recovery, market interventions
- **High Market Prices and the Integrity of Interchange** - Under-generation and abuses driven by spikes in energy prices threaten reliability, as experienced by persistent low frequency in July 1999 in the Eastern grid
- **Incentives to Construct Transmission** - funding, licensing, incentives
- **Market Price** - Volatility, service curtailment
- **Consumer Response to Pricing** - Lack of price signals, uncertain response
- **Load Forecasting** - Impact of distributed generation, load management
- **Firm Load** - Need firm generation obligation
- **Increasing Congestion**
- **Changing transmission flows and usage patterns**
- **Insufficient reactive power**
- **Growing incidence of TLR to curtail transactions**
- **Capacity Adequacy** - declining reserve margins, need for new generation

Source: NERC Reliability Assessment, October 2000
CERTS’ Activities to Address Reliability Needs

- **Real-Time Monitoring and Controls**: Tools for real-time VARs and ancillary services monitoring and tracking by ISOs and Security Coordinators
- **Reliability and Markets**: Analyze market behavior under different rules and market design to assess reliability impacts
- **Load as a Resource**: Assess impact of market price signals on load responsiveness and reliability
- **Microgrids**: Impact of distributed generation and operation of customer microgrids on reliability
- **Grid of the Future**: Technologies, scenarios, indicators
Can Operators Predict Market Behavior?

Results of Market Simulations Performed by PSERC

Regulated System

- Economic dispatch
- Strong correlation between power flow and demand

Deregulated Market

- Market-based dispatch
- Poor correlation between power flow and demand
Outlook for the Future

Meeting Reliability Challenges Depends On:

» Construction of new power plants and transmission lines

» Workably Competitive Markets - no market power

» Promoting demand participation - distributed generation, load control, real-time prices

» Understanding market behavior and system reliability impacts
  — The game has moved from modeling machines and engineering analysis to simulating markets to understand impact on reliability

» Simpler market structure

» Availability of real-time data, information transparency, and ability to process, analyze, and present information to operators and the market participants

» Tools and technologies for measure, monitor, assess and predict system performance for real-time management of VARs, load forecast, spinning reserves, ancillary services

» Overhauling reliability management framework