California’s Electricity Crises

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Vikram S. Budhraja
President, Electric Power Group, LLC
Chair, Consortium for Electric Reliability Technology Solutions

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Outline

• Introduction
• Electric Industry Restructuring in the U.S.A.
• Reliability Events Cause Widespread Damage with Increasing Frequency
• Managing Electric Reliability in the Competitive Market
• CERTS Vision – Grid of the Future
• CERTS Reliability Research Program
• Restructuring in California
• California Market Description – 1998
• What Caused the California Crises?
• Spot Gas Prices
• NO\textsubscript{X} Emission Costs
• California’s Spot Market Purchases – Average Cost
• California’s Market Performance
• California’s Market Design
• California’s Electricity Action Plan
• Reliability Agenda for the U.S. Electric Industry
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
  - Chair, Consortium for Electric Reliability Technology Solutions (CERTS)
  - Advisor, State of California, Department of Water Resources
  - Formerly President Edison Technology Solutions and Senior Vice President, Southern California Edison Company

Consortium for Electric Reliability Technology Solutions (CERTS)
- Consortium of U.S. Department of Energy national labs, universities, and industry partners; managed by Lawrence Berkeley National Lab
- Mission Statement – To research, develop and commercialize electric reliability technology solutions to protect and enhance the reliability of the U.S. electric power system under the emerging competitive electricity market structure
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
- Five ISOs covering 30% of electric loads operating
- FERC Order to form four big grids in the U.S. – July 2001
Reliability Events Cause Widespread Social Disruption and Economic Damage and Are Occurring With Increasing Frequency

<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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<td>1997</td>
<td>Minnesota – Wisconsin Separation</td>
<td>June 11-12</td>
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<td>1998</td>
<td>Northeast Ice Storm, MAPP Breakup, San Francisco Outage</td>
<td>January 5-10</td>
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<td>June 25</td>
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<td>December 8</td>
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<tr>
<td>1999</td>
<td>New England states system disturbances, Mid-Atlantic area system</td>
<td>June 7-8</td>
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<td>disturbances, New York City Outage, Long Island Outage, New Jersey</td>
<td>July 6-7</td>
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<td>Outage, Delmarva Peninsula Outage, South-Central States Outage</td>
<td>July 3-8</td>
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<td>July 5-8</td>
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<td>July 6</td>
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<td>July 23</td>
</tr>
<tr>
<td></td>
<td></td>
<td>July 30-August 12</td>
</tr>
<tr>
<td>2000</td>
<td>California Experience – price spikes, emergency alerts, load</td>
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<td></td>
<td>curtailments.</td>
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<td>Eastern Interconnection – three times more time-corrections</td>
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<td>as compared with past years</td>
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<tr>
<td>2001</td>
<td>Outlook - Blackouts forecast in California. Reliability concerns in</td>
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<td>New York, New England</td>
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Managing Electric Reliability in the Competitive Market Requires Integration and Real-Time Information Management
CERTS Vision
Grid Of The Future

- Competitive electric market structure
- Deployment of new technologies to transform the static grid to an intelligent, automatic, switched network
- Integration of distributed technologies for generation, storage, control, communications to support reliability needs of the grid and customer micro-grids
- Information transparency to enhance reliability management through market mechanisms
- Customer participation in distributed generation, energy management, market price signals
CERTS’ Reliability Research Program

- **Grid Mgmt. and Operations**: Tools for real-time VARs and ancillary services monitoring and tracking by ISOs and Security Coordinators.
- **Grid Reliability and Power Quality**: Grid reliability monitoring tools and power quality.
- **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.
- **Micro-Grids**: Impact of distributed generation and operation of customer microgrids on reliability.
- **Grid of the Future**: Technologies, scenarios, indicators, phasors, WAMS for an automatic switchable network.
CERTS VAR Management Tool Turns Data Into Information – Capability Could Have Prevented 1996 WSCC Outage
Restructuring in California

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

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

• 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.
California Market Description ‘98

- 50,000 MW peak load
- 200 billion kWh transmitted per year
- $20 billion electricity market –
  - $100/MWh average
  - $6 billion energy market - $30/MWh average
- 800 generators – capacity surpluses in California and Western grid
- 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
What Caused the CA Crises?

Dysfunctional Market
California reserve margins decline to single digits
-- no reserve responsibility

Reliance on Spot Markets
-- utilities required to sell generation
-- no forward contracts

Path 15 Transmission bottlenecks limit south to north transfers

NOx emission costs increase
10-fold to $45 per lb

Dry hydro in PNW and load growth in western states eliminates surplus

FERC “hands-off” approach to wholesale market regulation

Siting and Permitting Bottlenecks

No real-time price signals to customers

Spot market price of gas spikes above $60/MMBtu
– 20-30 fold increase

Electricity prices averaged $317/MWh in Dec. 2000 – a TENFOLD INCREASE
Spot Natural Gas Prices

source: email from Todd Peterson of CEC and from Natural Gas Market Update (http://www.energy.ca.gov/naturalgas/up)
**NO\textsubscript{X} Emission Costs ($/lb)**

- Governor signs Executive Order on Emissions
- NO\textsubscript{X} emissions fee at $7.50/lb

June 2001

Source: CA-ISO
California’s Spot Market Costs

- Utility Rates for Energy - $70/MWh
- Headroom – Stranded Cost Recovery
- Utility Under Collection

January 2001 State steps in to buy power

$8 Billion State Expenditures on Net Short

$12 Billion Utility Under Collection
California’s Market Performance

**Price Spikes**
- Frequent and persistent
- Utilities under collections exceed $12 billion – PG&E filed for bankruptcy in April 2001

**Market Design**
- Seriously flawed
- Dysfunctional
- Under Scheduling - Up to 14,000 MW or 30% purchases by ISO during real-time

**Reliability**
- Emergency alerts increasing with frequent load interruptions, brownouts due to supply shortage and transmission constraints
California’s Market Design

**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**
- Reliance on spot market with entire demand clearing at a uniform price
California’s Market Design -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%
  
  Persistent shortages due to load growth and little, if any, new power plants in the last 10-15 years
- **Generation Supply**: 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
- **Regional Disconnect**: No real-time price signals to customers; no incentives to participate during rate freeze
California’s Electricity Actions

- Create a power purchase portfolio to reduce dependence on spot market, provide price stability and certainty.
- Expedite construction of new power plants.
- Implement aggressive conservation and demand management program.
- Optimize use of existing transmission and expand transmission grid.
- Optimize and coordinate use of state hydro electric resources.
- Promote small distributed generation power plants.
- Augment natural gas supplies, pipelines, and storage facilities.
Reliability Agenda for the U.S. Electric Industry

Electric Infrastructure
- Power Plants and Performance
- Transmission Grid
- Fuel Pipelines

Demand Participation
- Real-Time Prices
- DGen
- Load as Reliability Resource

Workably Competitive Markets
- Structure and design
- Understanding correlation between design and reliability performance

Reliability Management Framework
- Statutory Authority
- Mandatory Rules
- SRRO
- Monitoring

Tools and Technologies
- Intelligent Grid
- Real-Time Controls
- Information Transparency
- Integrating Systems and Processes
SUMMARY

- Electric reliability is critical to support economic growth
- Reliability incidents are increasing and resulting in substantial economic and social disruption
  - 1996 WSCC outage impacted 7.5 million people and cost $2 billion
  - Poor power quality impacts the U.S. economy to the tune of $150 billion
  - 1999 outages in Chicago, New York, New Jersey, and other reliability events caused substantial economic and social disruption
- California is facing tenfold increase in power costs and forecasts for rolling blackouts
- California’s market has not functioned properly costing the state billions of dollars.
- To manage California’s electricity crises, the state has entered into long term contracts, expedited construction of new power plants, and implemented conservation and load management programs.
- New industry structure defining role of utilities, state, Power Authority, ISO is still evolving.