Demand Response in the ERCOT Markets

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The ERCOT Region is one of 3 North American grid interconnections.

The ERCOT grid:
- Covers 75% of Texas land
- Serves 85% of Texas load
- >40,000 miles of transmission lines
- >550 generation units
- Physical assets are owned by transmission providers and generators, including municipal utilities and cooperatives
- 68,294 MWs – peak set 08/03/2011

ERCOT connections to other grids are limited to direct current (DC) ties, which allow control over flow of electricity.
## Demand Response in ERCOT Today

<table>
<thead>
<tr>
<th>Resource Type</th>
<th>Service</th>
<th>Requirements</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voluntary Load Response (VLR)</td>
<td>Load reduction in response to Market Price or other factors</td>
<td>● Metering&lt;br&gt;● Load reduction technology&lt;br&gt;● Retail contract with price response incentives</td>
<td>● Commercial &amp; industrial Loads with few exceptions</td>
</tr>
<tr>
<td>Load Resources (LRs)</td>
<td>Responsive Reserves Non-Spinning Reserve Service</td>
<td>● Interval metering&lt;br&gt;● Telemetry&lt;br&gt;● Under-Frequency Relay&lt;br&gt;● Load reduction technology&lt;br&gt;● ERCOT Qualification</td>
<td>● Industrial Loads</td>
</tr>
<tr>
<td>Controllable Load Resources (CLRs)</td>
<td>Regulation Service Responsive Reserves Non-Spinning Reserve Service</td>
<td>● Interval metering&lt;br&gt;● Telemetry&lt;br&gt;● Ability to receive AGC-type signals&lt;br&gt;● Governor-type frequency response&lt;br&gt;● ERCOT Qualification</td>
<td>● Industrial Loads</td>
</tr>
<tr>
<td>Emergency Interruptible Load Service (EILS)</td>
<td>10-minute special emergency DR service</td>
<td>● Interval metering&lt;br&gt;● Load reduction technology&lt;br&gt;● ERCOT Qualification</td>
<td>● Mid- to large commercial &amp; industrial Loads</td>
</tr>
</tbody>
</table>
• Total Load Resource Capacity – 2400 MW Registered
• Most capacity comes from large industrial electro-chemical process loads – 10 Load Resources account for about 1030 MW of capacity
• Next group is made up of medium size industrial facilities 10 to 50 MW in size – 40 Load Resources account for the next 820 MW of capacity
• Balance is made up of small industrial and commercial facilities that are 10 MW of capacity or less –139 Load Resources account for the balance of 550 MW of capacity
• Facilities include electro-chemical processing, oil field equipment, cement plants, manufacturing, compression, pumping, data centers, and other industrial loads.
### ERCOT Load Resource Deployments (21 since April ‘06)

- Six of 21 deployments have occurred during summer peak hours
- Eight of 21 deployments occurred during non-business hours
- ERCOT needs operational DR any time (not just on peak)

<table>
<thead>
<tr>
<th>Day</th>
<th>Date</th>
<th>Time</th>
<th>Type of Deployment</th>
<th>Season</th>
<th>EILS TP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mon</td>
<td>4/17/2006</td>
<td>15:34</td>
<td>EECP Step 2 Systemwide VDI</td>
<td>Spring</td>
<td>BH2</td>
</tr>
<tr>
<td>Tue</td>
<td>10/3/2006</td>
<td>17:37</td>
<td>Systemwide VDI for frequency restoration</td>
<td>Fall</td>
<td>BH3</td>
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<tr>
<td>Fri</td>
<td>12/22/2006</td>
<td>2:54</td>
<td>UF Event followed by VDI for frequency restoration</td>
<td>Winter</td>
<td>NBH</td>
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<tr>
<td>Mon</td>
<td>7/2/2007</td>
<td>19:38</td>
<td>Systemwide VDI for frequency restoration</td>
<td>Summer</td>
<td>BH3</td>
</tr>
<tr>
<td>Wed</td>
<td>9/5/2007</td>
<td>7:57</td>
<td>Systemwide VDI for frequency restoration</td>
<td>Summer</td>
<td>NBH</td>
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<tr>
<td>Wed</td>
<td>12/12/2007</td>
<td>1:56</td>
<td>Systemwide VDI for frequency restoration</td>
<td>Winter</td>
<td>NBH</td>
</tr>
<tr>
<td>Tue</td>
<td>2/26/2008</td>
<td>18:49</td>
<td>EECP Step 2 Systemwide VDI</td>
<td>Winter</td>
<td>BH3</td>
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<tr>
<td>Sun</td>
<td>3/16/2008</td>
<td>11:37</td>
<td>UF Event, frequency &lt; 59.7 Hz</td>
<td>Spring</td>
<td>NBH</td>
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<tr>
<td>Mon</td>
<td>8/11/2008</td>
<td>17:14</td>
<td>Systemwide VDI for frequency restoration</td>
<td>Summer</td>
<td>BH3</td>
</tr>
<tr>
<td>Tue</td>
<td>12/16/2008</td>
<td>15:49</td>
<td>Systemwide VDI for frequency restoration</td>
<td>Winter</td>
<td>BH2</td>
</tr>
<tr>
<td>Sat</td>
<td>1/9/2010</td>
<td>10:32</td>
<td>Systemwide VDI for frequency restoration</td>
<td>Winter</td>
<td>NBH</td>
</tr>
<tr>
<td>Sat</td>
<td>5/15/2010</td>
<td>16:14</td>
<td>UF Event, frequency &lt; 59.7 Hz</td>
<td>Spring</td>
<td>NBH</td>
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<tr>
<td>Wed</td>
<td>6/23/2010</td>
<td>15:20</td>
<td>UF Event followed by VDI to selected QSEs for frequency restoration</td>
<td>Summer</td>
<td>BH2</td>
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<tr>
<td>Fri</td>
<td>8/20/2010</td>
<td>15:28</td>
<td>Systemwide VDI for frequency restoration</td>
<td>Summer</td>
<td>BH2</td>
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<tr>
<td>Wed</td>
<td>11/3/2010</td>
<td>10:21</td>
<td>UF Event followed by VDI to selected QSEs for frequency restoration</td>
<td>Fall</td>
<td>BH1</td>
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<tr>
<td>Wed</td>
<td>2/2/2011</td>
<td>5:20</td>
<td>EEA Level 2A Systemwide VDI</td>
<td>Winter</td>
<td>NBH</td>
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<tr>
<td>Wed</td>
<td>3/23/2011</td>
<td>14:47</td>
<td>UF Event (partial), frequency dropped to near 59.7 Hz</td>
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<td>BH3</td>
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<tr>
<td>Tue</td>
<td>4/5/2011</td>
<td>22:02</td>
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<tr>
<td>Wed</td>
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<td>14:08</td>
<td>UF Event (partial), frequency dropped to near 59.7 Hz</td>
<td>Spring</td>
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<td>Thu</td>
<td>8/4/2011</td>
<td>14:32</td>
<td>EEA Level 2A Systemwide VDI</td>
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<tr>
<td>Wed</td>
<td>8/24/2011</td>
<td>15:11</td>
<td>EEA Level 2A Systemwide VDI</td>
<td>Summer</td>
<td>BH2</td>
</tr>
</tbody>
</table>
Requirements to Qualify

Requirements for Load Resources:

• Registration as a Load Resource under a Resource Entity with an existing relationship to a Qualified Scheduling Entity
• Interval Data Recording (IDR) Meter Installed
• Real Time Telemetry provided to ERCOT thru QSE
  – Net Power Consumption (MW)
  – Reactive Power (MVars) for CLRs
  – Low Power Consumption (LPC) (MW)
  – Max Power Consumption (MPC)(MW)
  – Load Resource Breaker status (CB, etc.)
  – Ancillary service Schedule (in MWs)
  – Ancillary Service Resource Responsibility (in MWs)
  – Status of UF Relay (Non-Controllable Load Resources)
  – Resource Status (ONRL, Offline)
• One Line Drawing submitted with all applicable data
• Relay Test Reports Submitted (Non-Controllable Load Resources)
• Complete Qualification Test for the Ancillary Service(s) to be provided
• Today’s triggers (ERCOT):

  – Operations/reliability
    • Energy Emergency Alert
    • Grid frequency drop (UFR trip)
    • Frequency recovery (NERC Disturbance Control Standard)
    • Local congestion management (not used since 2003)
New Frontiers in Load Participation at ERCOT

- Look Ahead SCED
- Load Resources in SCED
- Storage Resources
- Small Load Participation
Look Ahead SCED

- Under zonal systems Loads had 7-8 minutes to respond to energy price that would be in effect for the following 15 minutes

- Under nodal systems, settlement prices are not known until after the 15 minute interval is over

- Market Participants are looking at potential ways to “look ahead” and post informational prices based on best information known

- Concept is based on Market Designs in several other ISOs in which SCED looks at the Generation to be Dispatched
Load Resource Participation in SCED

• In current market design most non-Controllable Load Resources can only participate in Non-Spin and Responsive Reserve Markets

• Dispatched by verbal instruction from ISO Operator

• Few LR are willing to participate in Non-Spin since they have no control over the energy price at which they are deployed

• Change the paradigm to have LRJs economically dispatched by SCED and let them set the price at which they would be willing to be dispatched

• Some settlement issues need to be resolved
1. Current ERCOT systems built to recognize only Generation and Load Resources, Energy Storage is in some way similar to both and in some ways neither.

2. Ancillary Services are purchased in hourly increments and therefore Energy Storage technologies that are Energy Limited may have issues providing services at maximum output capability under current protocol requirements.

3. ERCOT systems not designed to recognize State-of-Charge and therefore current systems not able to dispatch Energy Storage Resources efficiently.
Off-peak vs. on-peak load by customer type

- Customer class breakdown is for competitive choice areas; percentages are extrapolated for NOIEs to achieve region-wide estimate.
- Large C&I are IDR Meter Required (>700kW).

Wed., March 9, 2011 5:15 PM
ERCOT Load: 31,262 MW
Temperature in Dallas: 64°

- Residential 27.4% (~8,500 MW)
- Small Commercial 28.9%
- Large C&I 43.7%

Wed., Aug. 3, 2011 5:00 PM
ERCOT Load: 68,416 MW
Temperature in Dallas: 109°

- Residential 51.2% (~35,000 MW)
- Small Commercial 25.2%
- Large C&I 23.7%

3/9/2011 IE 17:15
8/3/2011 IE 17:00
Small Load Participation

- Current market activities for most part preclude participation by Residential and Small Commercial Load
- With new AMI infrastructure, low cost communication and advanced control capabilities there are opportunities for these Loads to be aggregated and provide service to ISO AS Markets
- Some issues or barriers that need to be resolved:
  - Real time telemetry
  - How to model in the ISO network
  - Primary Frequency Response
- Possibly move to Pilot by next Summer