Summer 2001 Northeast Load Response Initiatives' Reliability Impacts

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Abstract

This paper reviews the reliability impacts occurring from the implementation of the demand response initiatives offered in New York's Emergency Demand Response Program (EDRP) and New England's Load Response Program (LRP) for the summer of 2001.

The New York Independent System Operator, Inc. (NYISO), the New England Power Pool (NEPOOL) and the Independent System Operator of New England Inc. (ISO-NE) have developed and implemented a diverse portfolio of demand reduction programs designed to allow customers to avoid higher energy costs and reduce their load in response to wholesale energy prices.

1. Background

On March 13, 2001, the NYISO filed a new Attachment G to its Market Administration and Control Area Services Tariff with FERC. Attachment G described an Emergency Demand Response Program (EDRP) that the NYISO would administer from May 1, 2001 until October 31, 2002. The EDRP is a voluntary program designed to pay qualified program participants that respond to NYISO requests for demand reductions in emergency situations.

The NYISO announced four programs this year [1] aimed at the wholesale electricity market for the summer of 2001. The Emergency Demand Response Program and the ICAP Special Case Resource Program are reliability based emergency programs called by the NYISO during times of capacity deficiency. The Zonal Price-Capped Load Bidding Program and the Incentivized Day-Ahead Economic Curtailment Program are customer load reduction programs bid into the NYISO's wholesale market.

The New York Department of Public Service has directed New York State's investor owned utilities to coordinate their related efforts through these NYISO programs.

The Commission accepted for filing the tariff revisions submitted by the NYISO as a new Attachment G to its Services Tariff on April 27, 2001 [1]. The revised tariff sheets submitted by the NYISO to implement an Incentivized Day-Ahead Economic Load Curtailment Program were accepted for filing, subject to modification, on May 16, 2001 [2].

The New York State Energy Research and Development Authority (NYSERDA) has provided $12.4 million in financial incentives to encourage participation in these peak-load reduction programs [2].

On March 19, 2001, the New England Power Pool (NEPOOL) made a compliance filing in response to an order issued by the Commission on July 26, 2000 [3]. The compliance filing consisted of proposed changes to NEPOOL’s Market Rules and Procedures (Market Rules) to expand the load response programs within the NEPOOL control area, to encourage reduced consumption of electricity during peak demand periods and help moderate price fluctuations in the wholesale electricity market. The Commission accepted NEPOOL’s proposed Market Rule changes, without suspension or hearing, on May 18, 2001 [4]. Participating customers are equipped with an internet-based Load Management Dispatcher (LMD).

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3 New England Power Pool, 92 FERC Sec. 61,065 (July 26 Order), order granting clarification, 92 FERC Sec. 61,254 (2000), reh’g pending.
that allows them to monitor the cost of electricity each hour of the day, and base their consumption accordingly. These customers are then eligible to be paid for reducing their consumption. Atlanta-based Retx.com is the program’s application service provider [3].

2. New York Program Summary

2.1. Emergency Demand Response Program

The following information, excerpted from [4] summarizes the New York Emergency Demand Response Program (EDRP). The EDRP provides a mechanism for load reduction during emergency conditions, thereby facilitating the reliability of the New York State bulk power system. Retail end users who agree to participate in the EDRP can be accommodated through one of four types of Curtailment Service Providers (CSPs):

- Load Serving Entities (LSEs), either that currently serving the load or another LSE,
- through NYISO-approved Curtailment Customer Aggregators,
- as a Direct Customer of the NYISO,
- as a NYISO-approved Curtailment Program End Use Customer.

Curtailment Customer Aggregators and Curtailment Program End Use Customers must register with the NYISO as Limited Customers. CSPs should be able to provide load reduction of at least 100 kW per Zone 5 and be able to respond within two hours of emergency notification. Participation in the EDRP is voluntary and no penalties attach if a CSP fails to respond to a NYISO notice to reduce load. Retail end users participating in the EDRP may also participate in the NYISO’s Special Case Resources Program if otherwise qualified. CSPs will be given notice no less than two hours in advance of the time specified to reduce load, pursuant to NYISO emergency operations procedures.

If the NYISO activates the Emergency Demand Response Program for more than four hours, each CSP is paid the higher of $500/MWh, or the zonal Real-Time Locational Based Marginal Price (LBMP) per MWh of demand reduced, starting with the hour specified by the NYISO as the starting time of the activation, or, in the event that the NYISO specified that the demand reduction begin as soon as possible, starting with the hour that the CSP began its response.

If the NYISO activates the EDRP for four hours or less, each CSP shall be paid as if the EDRP had been activated for four hours. Each CSP that reduces demand shall be paid the higher of $500/MWh or the zonal Real-Time LBMP per MWh of demand reduced, for the duration of the NYISO activation of the EDRP or for two hours whichever is greater, starting with the hour specified by the NYISO as the starting time of the activation, or, in the event that the NYISO specified that the demand reduction begin as soon as possible, starting with the hour that the CSP began its response. Each CSP shall be paid the zonal Real-Time LBMP per MWh of demand reduced for the remainder of the four-hour minimum payment period, provided that a verified demand reduction was effectuated by the time specified in the NYISO’s notice.

The program became effective on May 1, 2001, and continues through October 31, 2002. At the end of each Capability Period (May-October and November-April), program performance will be evaluated to see if any rules and procedures need to be modified. Entities wishing to participate may apply for entry into the program at any time.

The EDRP allows wholesale electricity market participants to subscribe retail end users able to provide Load Reduction (Demand Side Resources) when called upon during emergency conditions. Wholesale market participants are grouped into four broad classes of Curtailment Service Providers:

- Load-Serving Entities (LSEs) that currently serve retail end users capable of load reduction, or an LSE that subscribes another LSE’s load solely for the purpose of participating in the NYISO EDRP. LSEs may claim load reductions from their retail end users or the retail end users of another LSE. Load curtailment programs currently in place or under implementation may directly qualify for the EDRP.
- Direct Customers of the NYISO may claim their own load reductions.

5 Zone – one of eleven geographic areas located within the New York control area that is bounded by one or more of the fourteen New York State Interfaces. During the implementation of the LBMP Markets, all Loads located within the same Load Zone pay the same Day-Ahead LBMP and the same Real-Time LBMP for Energy purchased in those markets.
2.2. ICAP Special Case Resources Program

The EDRP pays for energy during times of emergency, but does not pay for capacity. The NYISO has a separate program called Special Case Resources (SCR) within the Installed Capacity (ICAP) market that pays for capacity. SCR is available to generators and load reduction providers that meet testing, metering and other requirements. The capacity payments under SCR and the EDRP energy payments are additive. While there are no penalties for non-performance as an EDRP provider, the SCR program will reduce future capacity payments if the NYISO calls for operation and the SCR does not perform. In the event that the NYISO activates SCR to reduce their consumption of energy, the NYISO will activate the EDRP.

2.3. LSE-Sponsored Curtailment Programs

There are curtailment programs in New York State both currently in place and under development that are designed to help the local utility with distribution load management. Each program is aimed at enhancing the reliability of the local electric system during time of high usage or outages. The EDRP is designed to be compatible with these programs Demand Side Resources may participate in both the EDRP and the Day-Ahead Demand Reduction Program (DADRP) offered by the NYISO [5]. If an EDRP event is called and a Demand-Side Resource is participating in both programs, payments will be made as follows:

1. If the Demand-Side Resource has not had a demand reduction bid accepted in the Day-Ahead Market for the day of the EDRP event, demand reduction provided as a result of the EDRP event call will be paid in accordance with the rules set forth in this manual.
2. If the Demand-Side Resource is responding to the schedule determined from the bid accepted in the Day-Ahead Market, payments will be made in accordance with the DADRP rules up to the demand reduction scheduled in the Day-Ahead Market.

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6 The New York ICAP Manual located at www.nyiso.com/markets/icapinfo.html has more details on SCR.
3. New England Program Summary

The following excerpts from [6] summarize New England’s Load Response Program (LRP). The commencement of the LRP for 2001 went into effect on June 1, 2001, and continues through May 31, 2002. The program terminates as of June 1, 2002 unless NEPOOL votes to continue or revise the program.

The LRP provides incentives for NEPOOL Participants to reduce their electricity demands during peak power periods. Load-serving entities (LSEs) in turn can offer incentives to their end-users through the following:

- The Demand Response Program, which compensates users for reducing consumption at ISO-NE’s direction; and
- The Price Response Program, which compensates users for monitoring and controlling their consumption in response to real-time market prices.

Through the LRP program, power marketers, competitive energy suppliers, utility companies, and other retail and wholesale energy market participants belonging to NEPOOL can enter into agreements with retail customers to encourage them to reduce their electricity consumption during periods of peak demand. ISO-NE is offering two separate programs:

- The Demand Response Program (known as Class I) requires participating customers to commit to mandatory energy reductions (100 kW to ~5 MW) on 30-minute notice from ISO-NE. Customers in the Demand Response Program receive payments for their ongoing participation in the program, and additional payments for the actual energy they save.
- The Price Response Program (known as Class 2) allows its participating customers to voluntarily reduce energy consumption during certain periods as determined by ISO-NE. Customers in the Price Response Program only receive payments for the actual energy they curtail. The voluntary energy reduction must be between 100 kW and 5 MW.

For the Demand Response Program, customers will be notified of mandatory interruptions in one of two cases:

1) During NEPOOL Operating Procedure No. 4 (OP 4) and when the 10-minute operating reserve is deficient with calculated Voltage Reduction amounts considered.

2) When a contingency loss occurs and ISO-NE determines that the 10-minute reserve will not be restored in 30 minutes.

The period of interruption will normally not exceed two hours. However, during times of capacity deficiency or system emergency, the period may be longer.

For the Price Response Program, voluntary reductions will be allowed when the forecasted hourly Energy Clearing Price (ECP) produced by the Unit Commitment Schedule or any of the Unit Commitment updates is greater than or equal to $100/MW.

During a Load Response event, participants will be contacted via an Internet-Based Communication System (IBCS) supplied by Retx.com. All participants are required to use the IBCS.

The first 1000 customers to sign up for each program will be reimbursed by NEPOOL for installation of the Retx.com Internet data collection equipment according to the following terms:

- 100% of hardware costs for the first 1000 Class I customers will be paid for by NEPOOL. All payments will be made to the Participants.
- 50% of hardware costs for the first 1000 Class 2 customers will be paid for by NEPOOL. All payments will be made to the Participants.

Customers must sign on as either a Class I or Class 2 customer; they cannot be both.

If a customer elects to have the hardware costs reimbursed by NEPOOL, the customer must remain in its original Class through May 31, 2002.

The LRP allows any NEPOOL participant to subscribe either itself and/or an end-user to provide Load Reduction of not less than 100 Kilowatts (kW) and not more than 5 Megawatts (MW) (larger load reductions may be allowed at the discretion and approval by ISO-NE). Active Participants can sign up any eligible load located within the ISO-NE control area.

\[\text{Footnote: Communication through the “World Wide Web” sent in the form of electronic messages on the Retx.com web site.}\]
All customers who participate in the LRP will be referred to as Type 6 customers. They will be subdivided into two classes:

- **Class 1 Customers (Class 1)** - Customers that participate in the Demand Response Program and agree to a certain level of reduction at the discretion of ISO-NE. Class 1 customers:
  - Must be willing and capable of interrupting load within 30 minutes after receiving the instruction from ISO-NE through the Retx.com System.
  - Must be able to interrupt Monday-Friday, on non-holidays between 7:00 AM – 11:00 PM.
  - During OP 4, when system conditions indicate that 10-minute operating reserve is deficient with calculated Voltage Reduction amounts considered as 10-minute reserve or, when a contingency loss occurs and the ISO-NE Operations Shift Supervisor has determined that required 10-minute reserve will not be restored in 30 minutes.
  - Interruptions will normally not exceed two hours, but an interruption during OP 4 may be longer.

Class 1 customers are paid to be available and willing to interrupt based on the above criteria. Customers are paid an ongoing administrative fee based on the Thirty-Minute Operating Reserve (TMOR) clearing price, in addition to receiving payment for an actual interruption at the Energy Clearing Price (ECP). Class 1 customers that fail to curtail their load when notified by ISO-NE are subject to penalties.

- **Class 2 Customers (Class 2)** - Customers that participate in the Price Response Program and act on a strictly voluntary basis. Class 2 customers:
  - Utilize price signals to decide whether to voluntarily reduce load.
  - Will be notified when the posted Unit Commitment (UC) has an hourly forecast ECP that is greater than or equal to $100.

- Once notified, the window of availability for Class 2 Load Response will fall between the hours of 7 AM – 11 PM (i.e., between the hour ending 0800 through the hour ending 2300).
- Must indicate their intent to participate through the IBCS within the Respond By Time provided as part of the Class 2 Notification.

The hourly ECP is paid for the duration of the interruption. Class 2 customers that fail to respond when ISO-NE issues a directive to curtail load are not subject to any penalties.

### 4. Summer 2001 Experience

#### 4.1 New York Program Performance

Soaring temperatures and high humidity lead to three new all-time peak consumptions records for the NYISO [7]:

- 30,509 MW - Tuesday, August 7 (2-3 PM)
- 30,665 MW - Wednesday, August 8 (3-4 PM)
- 30,983 MW – Thursday, August 9 (2-3 PM)

Prior to this week, the highest recorded peak occurred on July 6, 1999 when electricity demand rose to 30,311 MW.

The NYISO estimated that the combined conservation efforts of the various groups yielded more than 1,000 MW in reduced electricity demand statewide.

The NYISO successfully implemented its Emergency Demand Response Program (EDRP) during two days in which the New York State electric demand reached all time highs.

As of July 31\(^8\), [8] there were 12 LSE participants (11 registered, 1 in process), 9 Aggregators (5 registered, 4 in process) and 7 End-use customers (all registered) in the EDRP, representing a total of load reduction capability of 611 MW. Of this total, 467 MW is considered interruptible load, 107 MW is on-site

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\(^8\) All peak load figures represent integrated averages over a one-hour period.
generation, and 37 MW is combined interruptible load and on-site generation. Table 1 provides a summary of the EDRP participation by New York Zones.

### Table 1.
**New York EDRP Summary**

<table>
<thead>
<tr>
<th>Zone</th>
<th>Total Load</th>
<th>Interruptible Load</th>
<th>On-Site Generation</th>
<th>Load &amp; Generation</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A-K)</td>
<td>ALL</td>
<td>611</td>
<td>467</td>
<td>107</td>
</tr>
<tr>
<td>A</td>
<td>271</td>
<td>12</td>
<td>271</td>
<td>0</td>
</tr>
<tr>
<td>B</td>
<td>12.5</td>
<td>12</td>
<td>0.5</td>
<td>0</td>
</tr>
<tr>
<td>C</td>
<td>73.3</td>
<td>68</td>
<td>0.9</td>
<td>4.4</td>
</tr>
<tr>
<td>D</td>
<td>0.7</td>
<td>0.5</td>
<td>0</td>
<td>0.2</td>
</tr>
<tr>
<td>E</td>
<td>25.6</td>
<td>22.9</td>
<td>2.7</td>
<td>0</td>
</tr>
<tr>
<td>F</td>
<td>93.2</td>
<td>65.4</td>
<td>2.1</td>
<td>25.7</td>
</tr>
<tr>
<td>G</td>
<td>24.9</td>
<td>18.2</td>
<td>6.4</td>
<td>0.3</td>
</tr>
<tr>
<td>H</td>
<td>5.9</td>
<td>1.7</td>
<td>4.2</td>
<td>0</td>
</tr>
<tr>
<td>I</td>
<td>9.8</td>
<td>1</td>
<td>6.3</td>
<td>2.5</td>
</tr>
<tr>
<td>J</td>
<td>68.8</td>
<td>6.2</td>
<td>58.9</td>
<td>3.7</td>
</tr>
<tr>
<td>K</td>
<td>25.3</td>
<td>0</td>
<td>24.8</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Table 2 provides a summary of New York EDRP performance during the summer 2001 peak period.

### Table 2.
**Estimated New York EDRP Performance**

<table>
<thead>
<tr>
<th>Date</th>
<th>Time Event Called</th>
<th>Estimated From Non-TO CSPs (MW)</th>
<th>Estimated From TOs (MW)</th>
<th>Total Estimated MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>August 6</td>
<td>Advisory Only Issued</td>
<td>206</td>
<td>200</td>
<td>406</td>
</tr>
<tr>
<td>August 7</td>
<td>1500-1900</td>
<td>233</td>
<td>200</td>
<td>433</td>
</tr>
<tr>
<td>August 8</td>
<td>1300-1900</td>
<td>229</td>
<td>200</td>
<td>429</td>
</tr>
<tr>
<td>August 9</td>
<td>1100-1900</td>
<td>276</td>
<td>200</td>
<td>476</td>
</tr>
<tr>
<td>August 10</td>
<td>1330-1800 (Zones F-K)</td>
<td>82</td>
<td>62</td>
<td>144</td>
</tr>
</tbody>
</table>

4.2 New England Program Experience

The New England region experienced two periods of high heat and humidity and correspondingly high electrical loads during the summer of 2001, resulting in an all-time peak load of 25,158 MW (preliminary) on August 9th [9].

New England set all time peak loads on five separate occasions during the summer of 2001. On July 24th, New England exceeded its previous record peak load of 22,544 MW, established in 1999. New records were set on July 25th, August 7th, and August 9th at Hour Ending (HE) indicated below:

- 24,153 MW – Wednesday, July 25 (HE 1600)
- 24,615 MW - Tuesday, August 7 (HE 1700)
- 25,158 MW – Thursday, August 9 (HE 1500)
- 24,369 MW – Friday, August 10 (HE1200)

ISO-NE issued the following load response notifications [10]:

- Class 1
  - August 9
- Class 2
  - July 24, 25
  - August 7,8,9,10

Class 1 customers must be able to interrupt within 30 minutes of receiving ISO-NE instructions following a contingency loss or after accounting for voltage reduction as 10-minute reserve. The actual interruption is paid at the Energy Clearing price (ECP). Table 3 provides a summary of New England Class 1 performance during the summer 2001 peak period.

### Table 3.
**Estimated New England Class 1 – Demand Response Program**

<table>
<thead>
<tr>
<th>Date</th>
<th>Curtailment Payments (S)</th>
<th>Average Payment ($/MWh)</th>
<th>Total Estimated MWh's Curtailed</th>
</tr>
</thead>
<tbody>
<tr>
<td>August 9</td>
<td>47.67</td>
<td>64.38</td>
<td>0.7</td>
</tr>
</tbody>
</table>

ISO-NE calls for Class 2 customers when the Forecast ECP is greater than or equal to $100 and
defines a time period (window) of Class 2 availability. The consumer chooses when to reduce load (within the window) based on the forecast/actual ECP, and receives compensation based on the ECP for the hours in which the reduction occurs. Table 4 provides a summary of New England Class 1 performance during the summer 2001 peak period.

Table 4. Estimated New England Class 2 – Price Response Program Summary

<table>
<thead>
<tr>
<th>Date</th>
<th># of Participants</th>
<th>Curtailment Payments</th>
<th>Average Payment</th>
<th>Total Estimated MWh’s Curtailed</th>
</tr>
</thead>
<tbody>
<tr>
<td>July 24</td>
<td>2</td>
<td>55,596.76</td>
<td>449.32</td>
<td>123.7</td>
</tr>
<tr>
<td>July 25</td>
<td>2</td>
<td>123,018.42</td>
<td>972.31</td>
<td>126.5</td>
</tr>
<tr>
<td>August 7</td>
<td>1</td>
<td>6,970.8</td>
<td>127.43</td>
<td>54.7</td>
</tr>
<tr>
<td>August 8</td>
<td>3/2</td>
<td>534.91</td>
<td>68.45</td>
<td>7.8</td>
</tr>
<tr>
<td>August 9</td>
<td>4/2</td>
<td>35,981.41</td>
<td>236.11</td>
<td>152.4</td>
</tr>
<tr>
<td>August 10</td>
<td>3/2</td>
<td>6,483.74</td>
<td>95.58</td>
<td>67.8</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>228,586.04</td>
<td>428.86</td>
<td>533.0</td>
</tr>
</tbody>
</table>

5. Observations

The summer 2001 experience demonstrated the contribution demand-side response programs in New York and New England made to system reliability. For example, as shown in Table 5 below, just one customer in the Boston load pocket contributed to over 500 MWh of curtailment during the periods of high peak demand of July 24-25 and August 7 through August 10th [11].

Table 5. Estimated Boston Area Response

<table>
<thead>
<tr>
<th>Date</th>
<th>Curtailment (MWh)</th>
<th>Average ECP During Event ($/MWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>July 24</td>
<td>119.1</td>
<td>262.38</td>
</tr>
<tr>
<td>July 25</td>
<td>123.4</td>
<td>537.54</td>
</tr>
<tr>
<td>August 7</td>
<td>54.7</td>
<td>85.86</td>
</tr>
<tr>
<td>August 9</td>
<td>149.3</td>
<td>191.92</td>
</tr>
<tr>
<td>August 10</td>
<td></td>
<td>67.58</td>
</tr>
</tbody>
</table>

The average prices shown in Table 5 reflect the NEPOOL Energy Clearing Price (ECP). As shown, the response decreased on those days when the ECP was lower, reflecting the price elasticity of demand relative to curtailments. If the actual marginal cost of serving load in Boston was higher than the ECP during these events, an opportunity for economic congestion management was lost; i.e., it may have been possible to issue curtailment requests and reduce flexible loads rather than pay to purchase the additional generation.

Presently in NEPOOL, any increased cost as a result of running generation in a load pocket at costs greater than the ECP would be passed on to all market participants in the form of congestion uplift. ISO-NE has estimated that congestion costs in NEPOOL may range from approximately $125 to $600 million per year [12]. Retx.com has proposed to NEPOOL and ISO-NE that if the Load Response Programs in New England were to pay demand-side resources location-based prices for curtailments rather than an average market-wide ECP, the estimated congestion costs could be drastically reduced.

In addition, Load Response Programs may provide a potential benefit in terms of reducing air pollution. Class 1 resources in New England, for instance, act as a source of operating reserve, providing the delivery of energy and capacity on short notice. This could result in less frequent operation of older, less efficient power plants, which are generally used only during the periods of peak electrical demand. These resources are typically large fossil fuel steam units that are not economic to dispatch for their energy, but are committed at their minimum run level as a source of operating reserve. These units typically are not available to synchronize to the grid from cold start condition upon 30 minutes notice, so they are kept on-line at their minimum level in order to deliver within 30 minutes.

ISO-NE has estimated that by acting as non-spinning reserve, a 280-ton reduction in nitrous oxide (NOx), a 200-ton reduction in sulfuric oxide (Sox) and a 230 Kton reduction in carbon dioxide (CO2) could result given utilization of approximately 500 MW of Class 1 LRP resources11.

The role that robust demand response programs can play toward broader market-based solutions to

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managing transmission congestion and improving overall system reliability need to be considered when planning for adequate power supply and sufficient transmission capability.

6. References


7. Acknowledgements

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8. Biography

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