FINAL TECHNICAL REPORT

PROJECT TITLE:
LOW FREQUENCY WIRELESS COMMUNICATION TECHNOLOGIES

AWARDEE:
Nxegen, Inc.

PNNL AWARD NO.:
8952

May 3, 2004

FINAL TECHNICAL REPORT

Project Title: Low Frequency Wireless Communication Technologies

Date of Report: May 3, 2004

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Award Number: 8952

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EXECUTIVE SUMMARY

Project Objective:

The proposed project (the "Project") primary objective was to perform a study correlating peak demand from commercial, municipal, and light industrial consumers to the peak demand of a regional power grid. In order to perform this analysis, Nxegen developed a database of energy consumption patterns from a sample of thirty (30) customers. Nxegen installed main meter monitoring devices at each of the thirty customer's facilities. Nxegen used its wireless monitoring system and installed main meter data collection systems at each of the thirty facilities. Nxegen's system allows it to collect both demand (KW) and kilo-watt hour (KWh) consumption in 15-minute intervals.

Nxegen has collected customer main meter load during the months of December 2003 through March 2004. In addition, Nxegen has collected ISO-NE market data for the months of June 2003 through March 2004. This information was used to perform a variety of correlation analysis.

Research Contributions:

The electric generation and delivery industries are going through unprecedented changes. The generation industry, in many regions of the United States, is a fully deregulated industry whereby power generation companies operate in both the wholesale electricity and retail electricity markets. Competitive bidding at both levels is required to ensure ongoing business operations and economic activities. The wholesale electricity markets have experienced significant price volatility in the early periods of deregulation as a result of; (1) poorly designed market rules and regulations, (2) early entrants gaming and manipulating the market through the exercising of "market power", (3) significant weather changes, (4) the August 14th, 2003 Northeast blackout, as well as other events.

Competitive generation markets have also struggled in the financial markets as a result of significant lack of financial liquidity and resources. The financial markets have viewed the power generation industry as a high-risk industry with below average predictability of revenues and returns. In addition, generation construction, especially in high demand and growth areas, has not kept pace with consumer demand. As a result, significant power delivery constraints exist in load pockets throughout the Northeast, including;

1. New York City and Long Island
2. Southwest Connecticut
3. Greater Boston area

The electricity transmission and distribution industry has also suffered from a lack of investment and construction of new T&D systems to keep pace with growing consumer demand for

electricity. As a result, electricity congestion prices (Federally-mandated charges) have continued to rise substantially and remain a significantly volatile component of consumer electricity prices.

Over the past twenty-four (24) months, the Federal Energy Regulatory Commission ("FERC") has identified the need for consumers to have the ability to actively participate in the electricity markets through their ability to reduce electricity consumption (Demand Response). The FERC, The Department of Energy (DOE), the Independent System Operators (ISOs) have all performed analysis that validates the positive impacts of demand response on market prices and volatility. These studies have identified the value and the ability for consumers to reduce and to a large extent control electricity prices and price volatility.

The FERC has focused on developing the structural framework for market rules that allow consumers, through demand response, to participate in the wholesale electricity markets. This framework is a component of the FERC's Standard Market Design (SMD) framework. Demand Response programs are in the early phases of development. Rules for active participation are in the formative stages. Predictability of revenues and the ability to actively participate in the wholesale electricity markets continue to be a major inhibitor to the development and commercialization of technologies, services, and service providers.

This DOE/PNNL funded research project is one facet in demonstrating the ability of wireless technologies to allow for consumer participation in the wholesale electricity markets through load management. In addition, this research project is being leveraged to support the development of advanced technologies to control greater consumer electricity loads as well as to develop a data infrastructure to leverage demand response and load management for the purpose of reducing electricity price volatility and to minimize congestion costs.

Technical Effectiveness and Economic Feasibility:

The Project seeked to develop correlation analysis and accurate data as to when system peak demand occurs and correlation between commercial, industrial, and municipal peak demands. This data set is also extremely valuable as it validates when peaks occur on the system (on a monthly basis) that can be used to develop standard load control strategies for the commercial markets.

Nxegen's business focus is in the commercial, industrial, and municipal market segments. Nxegen believes that the initial market adoption for real-time electricity monitoring and demand response will start in the commercial sectors for a number of reasons, including;

- Energy is a higher cost of doing business compared to residential sectors,
- Service providers have a higher probability of serving the commercial sectors profitably compared to the residential sector due primarily to customer acquisition cost,

- The commercial sectors can absorb the higher cost of technology in the early phases of market development and maturation

The middle C&I markets are generally made up of small to medium sized businesses and facilities (peak demands ranging from 25KW to 500KW). The recent independent report[1] prepared by RLW Analytics, LLC and Neenan Associates, LLC, as stated in the report clearly identifies the residential and commercial markets as those with the greatest opportunity for load management and demand response;

> The market sectors with the most potential for future growth in demand response program participation appear to be the Residential and Commercial Sectors, although, as noted above, *harnessing that asset potential would require a demand response provider willing to make the necessary equipment investment* required to bring this resource to market.

As explained earlier in the Report:

> Knowing the program in which a customer participates does not help to predict its size, nor can size be used to predict participation in any program, or a specific program, with any degree of comfort. This result challenges the credibility of the conventional wisdom that large customers are the best candidates for demand response program participation. Larger customers may be desirable in that they are easier to locate and contact, and if they enroll they may provide a larger curtailment asset. But, based on the results of the survey, smaller customers appear to be likely to participate in both demand and price programs. If these customers can be reached cost effectively, they should not be overlooked.

[1] Independent Report filed by ISO-NE to FERC on December 31, 2003. Report prepared by RLW Analytics and Neenan Associates titled "An Evaluation of the Performance of the Demand Response Programs Implemented by ISO-NE in 2003" dated December 30, 2003.

PROJECT SCHEDULE & MILESTONES

The following project scope and steps were adhered to during the duration of the project. Below is a detailed matrix of the project steps, deliverables, and a brief synopsis of activities. A more detailed summary of project activities and results are included in the subsequent section of this report (Summary of Project Activities).

Project Step	Project Goals	Accomplishments
Task 1: Data Collection, Customer Segmentation	• Format database for customer load data and ISO-NE system load data, market clearing price and congestion price data	• Nxegen has completed the database formatting for both customer main meter load profile data and has collected main meter load data for the months of December 2003 through March 2004 • Nxegen has completed the formatting and populating the database of system load data and pricing data for market clearing prices and congestion prices in the Connecticut zone. • See attached Appendices for sample ISO-NE Data formats.
Task 2: Installation of customer monitoring equipment	• Installation of Nxegen's wireless real-time technology to collect electricity use data at (30) customer locations	• Nxegen has completed the installation of wireless monitoring systems at thirty (30) customer locations located throughout Connecticut. • Nxegen has collected main meter data for each of the thirty (30) customers for the period December 2003 through March 2004.
Task 3: Data collection activities	• Collect customer load data utilizing Nxegen's system • Populate the established database	• Nxegen has collected load interval data (KW and KWh) for thirty (30) additional customers for the period December 2003 through March 2004. • See attached Appendices for sample Customer load profile data.
Task 4: Perform correlation analysis	• Prepare a correlation analysis of facility energy consumption patterns with ISO-NE system load data • Prepare an analysis and correlation statistics of system load data and the	• Nxegen developed correlation analysis and statistics providing analysis between customer load profiles and system load profiles and peaks. In addition, correlation analysis between system loads and market clearing prices and congestion prices was

	market clearing price of electricity and congestion prices of electricity.	performed in order to develop potential load control strategies and frequencies of load control in given time periods/months. • See body of this document for summary of the analysis and attached Appendices for detailed data support.
Task 5: Final Report Preparation	• Prepare final report detailing the correlation analysis.	• See Final Report Body and supporting Appendices and attachments.
Task 6: Monthly Status Reports	• Prepare monthly status reports for duration of the project.	• Monthly status reports were prepared and submitted by Nxegen in accordance with the contract.

SUMMARY OF PROJECT ACTIVITIES

The overall project objective in summary was three-fold:

1. Collect actual load profile data from a sample of commercial, industrial, and municipal (referred to as "commercial" customers) customer in Connecticut for a period of four months (December 2003 through March 2004), and

2. Develop a correlation analysis between ISO-NE system loads and the market clearing price of electricity and congestion prices of electricity. This is a critical component to determining the potential impacts of commercial electricity consumption and demand response on Locational Marginal prices (LMP) and congestion cost relief, and

3. Develop a correlation analysis between ISO-NE system load data and customer load profile data to determine how commercial customers electricity use correlates to system peaks. This information is critical in determining how market segments contribute toward system peak demand and determining what opportunities exist for these segments to curtail loads to reduce system peaks.

What significant activities were performed and how did they contribute toward achieving the project objectives?

1. Customer Load Profile Data

Nxegen completed the installation of thirty (30) customer sites with real-time electricity monitoring systems that collect 15-minute interval data of demand (KW) and kilo-watt hours (KWh). This data was collected for a four-month period – December 2003 through March 2004. A list of the customers is included in Appendix A of the body of this report. Detailed data of load profiles and associated analysis is included in separate tabs of this Final report.

A summary of the aggregate coincident peak loads of all thirty (30) customers are illustrated below. For analysis purposes and in order to derive correlation relationships between the sampled customer loads and system loads, Nxegen sorted the data and chose the highest three (3) aggregate coincident peaks for each of the months.

Month	Date	Time	Peak Load (MWs)
Dec-2003	12/11/03 Thursday	10:45 am	3007.18
	12/11/03 Thursday	11:15 am	2997.06
	12/11/03 Thursday	10:15 am	2996.80
Jan-2004	1/13/04 Tuesday	1:00 pm	2894.58
	1/13/04 Tuesday	2:15 pm	2876.58
	1/13/04 Tuesday	2:00 pm	2846.50

Month	Date	Time	Peak Load (MWs)
Feb-2004	2/3/04 Tuesday	1:30 pm	2855.68
	2/3/04 Tuesday	1:00 pm	2854.14
	2/3/04 Tuesday	11:00 am	2823.64
Mar-2004	3/26/04 Friday	11:15 am	2852.10
	3/26/04 Friday	11:45 am	2827.38
	3/26/04 Friday	11:30 am	2809.10

2. Development of a Database of Market Data and Market Data Correlation

Nxegen has completed and developed a sophisticated database of ISO-NE market data (for the months of June 2003 through March 2004). Nxegen has developed a database of ISO-NE data that includes the following information;

1. Hourly Market Clearing Prices of Energy (LMP) for both the Day Ahead Market and the Real-Time Market,

2. Hourly Congestion Prices for both the Day Ahead Market and Real-Time Market, and

3. Hourly Load Data (MWs) for the Connecticut Zone for both the Day Ahead Market and Real-Time Market

Data collected from ISO-NE has been used to develop statistical models that include correlation analysis and linear regression formulas between Connecticut system loads and the market clearing price of energy and congestion prices. The primary purpose of developing these databases was to determine the frequency of hours where congestion was occurring in Connecticut and the hourly cost to Connecticut consumers for congestion. Once this data was gathered, Nxegen performed a variety of analysis (e.g. correlation analysis and data sorting) to determine potential load management control strategies as well as to evaluate the types of loads needed and the frequency they were needed in order to impact market savings and congestion avoidance. This base information and analysis was also used as a precursor to performing correlation analysis between the thirty customers peak demand and system peak demand to identify the impacts of specific market segments related to coincident peak demand.

Findings:

Nxegen analyzed ten (10) months of data and identified the following significant trends.

1. The bulk of congestion occurs during very few hours of the month. In most months (see data files for details), the bulk of congestion costs (75% or greater) occurs in an average of 15 to 20 hours of the month (30 day month – 720 hours, 31 day month – 744 hours).

This is a very small number of hours (less than 3% of the time) where congestion costs are incurred by Connecticut consumers.

A sample of the data is provided below. Detailed database files for each month are included in the attachments.

LMP prices for Day-ahead and Real-time					Sorted By: Day and Time								
Time period: 06/01/2003-06/30/2003													
Location/Node: .Z.CONNECTICUT(4004)													
Report generated: Tue Aug 19 8:38:55 EDT 2003													
Date	Hour Ending	Day Ahead LMP	Day Ahead Energy	Day Ahead Loss	Day Ahead Congestion	Real Time LMP	Real Time Energy	Real Time Loss	Real Time Congestion	Real Time MWH	Day Ahead MWH	Real-Time Congestion ($)	Day Ahead Congestion ($)
6/1/2003	1	45.44	44.8	0.64	0	47.64	47.28	0.36	0	2617.6	1767.5	$0.00	$0.00
6/1/2003	2	40.73	40.14	0.59	0	47.64	47.3	0.34	0	2444.8	1644.6	$0.00	$0.00
6/1/2003	3	40.22	39.64	0.58	0	60.34	60.16	0.18	0	2362.4	1584.1	$0.00	$0.00
6/1/2003	4	38.61	37.68	0.55	0.38	44.49	44.45	0.04	0	2302.4	1539.3	$0.00	$584.93
6/1/2003	5	38.57	38.01	0.56	0	38.15	38.16	-0.01	0	2285.2	1527.4	$0.00	$0.00
6/1/2003	6	38.57	38.01	0.56	0	39.89	39.91	-0.02	0	2309.2	1525.5	$0.00	$0.00
6/1/2003	7	40.73	40.13	0.6	0	29.67	29.56	0.11	0	2369.9	1601.6	$0.00	$0.00
6/1/2003	8	45.75	45.08	0.67	0	29.91	29.8	0.11	0	2556.2	1754.3	$0.00	$0.00
6/1/2003	9	44.13	43.5	0.63	0	38.43	38.42	0.01	0	2856.9	1976.5	$0.00	$0.00
6/1/2003	10	50.55	49.84	0.71	0	162.2	162.78	-0.58	0	3150.1	2152.8	$0.00	$0.00
6/1/2003	11	51.28	50.36	0.69	0.23	109.27	108.76	0.51	0	3331.7	2284.4	$0.00	$525.41
6/1/2003	12	54.21	52.8	0.72	0.69	75.5	75.04	0.46	0	3441.2	2352.1	$0.00	$1,622.95
6/1/2003	13	54.22	52.78	0.71	0.73	80.9	80.64	0.26	0	3468.3	2360	$0.00	$1,722.80
6/30/2003	20	53.59	54.2	1.52	-2.13	49.81	47.86	1.95	0	4810.1	3810.4	$0.00	($8,116.15)
6/30/2003	21	54.84	55.43	1.56	-2.15	51.3	49.2	2.1	0	4755.3	3794.4	$0.00	($8,157.96)
6/30/2003	22	49.76	48.4	1.36	0	49.96	48.12	1.84	0	4652.4	3534.9	$0.00	$0.00
6/30/2003	23	44.46	43.24	1.22	0	37.22	36.13	1.09	0	4160.2	3084.3	$0.00	$0.00
6/30/2003	24	41.81	40.68	1.13	0	34.75	34.21	0.54	0	3662.1	2921.3	$0.00	$0.00
720 lines										2661440.6		$2,534,991.54	$4,663,522.48
							Cumulative Congestion Costs for Hours > $50,000					$2,007,806.01	$4,410,640.42
							% of Total Congestion Costs Incurred					79.20%	94.58%
							No. of Hours with Congestion Costs > $50,000 per Hour					15	23

A summary of each month's data shows the following trend of when congestion occurs and the frequency of occurrences.

Monthly Data Summary:

Day-Ahead Market Data:

Month	Total Congestion ($)	No. of Hours – Congestion > $50,000 per Hour	Total Congestion ($) during Hours in Column 3	% of Total Congestion
June 2003	$4,663,522	23	$4,410,640	94.5%
July 2003	$1,079,284	6	$330,908	30.7%
August 2003	$11,736,055	42	$10,678,841	91.0%
September 2003	$287,767	0	$0	0%
October 2003	$2,612,814	14	$1,218,618	46.6%
November 2003	$5,782,472	28	$2,955,655	51.1%
December 2003	$703,668	0	$0	0%
January 2004	$5,824,205	22	$2,544,071	43.7%
February 2004	$1,668,527	8	$601,155	36.0%
March 2004	$1,506,362	5	$402,772	26.7%
TOTALS	**$35,864,676**	**148**	**$23,142,660**	**64.5%**

Real-Time Market Data:

Month	Total Congestion ($)	No. of Hours – Congestion > $50,000 per Hour	Total Congestion ($) during Hours in Column 3	% of Total Congestion
June 2003	$2,534,992	15	$2,007,806	79.2%
July 2003	$8,706,367	31	$8,378,135	96.2%
August 2003	$15,019,427	55	$14,540,528	96.8%
September 2003	$151,182	1	$56,398	37.3%
October 2003	$3,514,779	13	$3,447,449	98.1%
November 2003	$3,142,976	10	$2,516,135	80.1%
December 2003	$870,304	5	$558,930	64.2%
January 2004	$1,311,105	2	$405,999	31.0%
February 2004	$705,092	1	$50,037	7.1%
March 2004	$152,715	2	$112,494	73.7%
TOTALS	**$36,108,939**	**135**	**$32,073,911**	**88.8%**

This analysis has provided Nxegen with invaluable data. It shows that congestion costs occur in very few hours of the day (also see correlation analysis below). Nxegen's primary focus on load control is to identify solutions that provide maximum kilo-watt hour (KWh) savings to the customer. This is a critical infrastructure issue (Nxegen believes) for commercial customer participation.

2. LMP is highly correlated with system loads (MWs), however, congestion costs are not highly correlated with system loads. This finding is extremely significant. In most circles, it is generally understood that congestion occurs when the system is "strained" due to high demand. However, Nxegen performed a correlation analysis between congestion prices and system loads and found that the correlation coefficients where in many cases less than 50%. In looking at the data, Nxegen found congestion prices to be high even during off-peak hours (e.g. November 25th from 5 pm to 7 pm was the highest congestion prices for the month).

A summary of the correlation between LMP and CT system loads and Congestion prices and system loads is provided below.

Day-Ahead Market Data:

	Correlation	Coefficient
Month	LMP	Congestion Prices
June 2003	80.0%	34.8%
July 2003	87.3%	27.0%
August 2003	81.5%	37.3%
September 2003	88.7%	17.4%
October 2003	80.1%	23.3%
November 2003	83.2%	35.6%
December 2003	74.6%	39.3%
January 2004	49.0%	36.1%
February 2004	85.5%	30.7%
March 2004	87.7%	17.4%

Real-Time Market Data:

	Correlation	Coefficient
Month	LMP	Congestion Prices
June 2003	63.1%	33.5%
July 2003	78.2%	23.5%
August 2003	72.4%	38.8%
September 2003	73.5%	12.3%
October 2003	67.6%	16.9%
November 2003	71.0%	19.4%
December 2003	39.5%	16.5%
January 2004	50.6%	15.6%
February 2004	70.4%	22.6%
March 2004	71.0%	7.5%

The results of this data are extremely valuable. In summary, Nxegen believes that a central control strategy for utilizing customer loads for the benefit of reducing LMP and congestion would contain the parameters.

1. Because LMP in both the Day-Ahead and Real-Time markets are highly correlated (predictable), Nxegen believes that all customer segments can contribute toward the reduction in LMP volatility through proactive demand response. Since Day Ahead pricing is available at the end of a day, scheduled controls can be initiated that optimize LMP benefits both in the Day Ahead markets and the Real-Time markets.

2. The Congestion Pricing markets are not as easy to predict or schedule. In addition, because of a weak correlation between congestion prices and system loads, the ability to target specific market segments that contribute toward higher congestion is difficult and unpredictable. Nxegen has concluded that the use of quick response demand control (e.g. emergency generator dispatch) is probably the only way to manage congestion price volatility due to short notice times.

The conclusions reached by Nxegen, through the use of ISO-NE data, are consistent with recent requests for proposals issued by ISO-NE for demand response resources in Southwest Connecticut. Recently (December 2003), the ISO-NE issued a solicitation for upwards of 300 MWs of load response in Southwest Connecticut beginning on June 1st, 2004. These resources are classified into three (3) primary types:

- Central Generation
- Emergency Generator Dispatch
- Conservation & Load Management Resources

These resources can be utilized in a variety of programs with varying dispatch criteria (10 to 30 minute dispatch and 2 hour dispatch). This solicitation indicates a move by ISO-NE toward a more flexible demand-side resource market.

3. Correlation Analysis Between Customer Loads and System Loads

Nxegen utilized data collected from ISO-NE for purposes of developing a database of system loads (Connecticut hourly load data) for the months of June 2003 through March 2004. Nxegen collected customer interval load data beginning in December 2003 through March 2004. A study and correlation analysis was performed during the months of December 2003 through March 2004.

The following approach to the correlation was performed by Nxegen.

1. Nxegen documented the three (3) highest aggregate coincident peak demand (KW) values recorded for each month by its thirty (30) customers. The date and interval times were also recorded.

2. Nxegen documented the three (3) highest system peak demand (KW) values for the Connecticut zone for the months of December 2003 through March 2004.

3. Nxegen also documented the highest aggregate coincident peak demand (KW) values of the thirty (30) customers for each of the hourly intervals where the Connecticut system loads peaked (2., above). Nxegen compared the customer loads as a percentage of the customer peak loads in 1., above to assess the correlation of the thirty (30) customer load profiles to the system peak loads.

The following data summarized below is based on actual data included in the attached appendices and sections of this final report.

	SYSTEM LOADS			CUSTOMER LOADS			CUSTOMER LOADS (at System Peak)			
	Date	Time	Peak (GW)	Date	Time	Peak (MW)	Date	Time	(MW)	%
Dec-03	12/15/03 Mon	6:00 PM	5243.10	12/11/03 Thu	10:45 AM	3007.18	12/15/03 Mon	6:00 PM	2192.3	72.9%
	12/15/03 Mon	7:00 PM	5219.10	12/11/03 Thu	11:15 AM	2997.06	12/15/03 Mon	7:00 PM	2403.86	80.2%
	12/3/03 Wed	7:00 PM	5206.60	12/11/03 Thu	10:15 AM	2996.80	12/3/03 Wed	7:00 PM	2287.62	76.3%
Jan-04	1/15/04 Thu	7:00 PM	5904.40	1/13/04 Tue	1:00 PM	2894.58	1/15/04 Thu	7:00 PM	2050.08	70.8%
	1/15/04 Thu	6:00 PM	5844.90	1/13/04 Tue	2:15 PM	2876.58	1/15/04 Thu	6:00 PM	2274.28	79.1%
	1/15/04 Thu	8:00 PM	5837.90	1/13/04 Tue	2:00 PM	2846.50	1/15/04 Thu	8:00 PM	2110.44	74.1%
Feb-04	2/3/04 Tue	7:00 PM	5223.20	2/3/04 Tue	1:30 PM	2855.68	2/3/04 Tue	7:00 PM	2331.92	81.7%
	2/3/04 Tue	6:00 PM	5190.10	2/3/04 Tue	1:00 PM	2854.14	2/3/04 Tue	6:00 PM	2204.78	77.2%
	2/2/04 Mon	7:00 PM	5074.20	2/3/04 Tue	11:00 AM	2823.64	2/2/04 Mon	7:00 PM	2329.72	82.5%
Mar-04	3/16/04 Tue	7:00 PM	5001.00	3/26/04 Fri	11:15 AM	2852.10	3/16/04 Tue	7:00 PM	1989.22	69.7%
	3/16/04 Tue	8:00 PM	4899.30	3/26/04 Fri	11:45 AM	2827.38	3/16/04 Tue	8:00 PM	2145.96	75.9%
	3/17/04 Wed	7:00 PM	5860.00	3/26/04 Fri	11:30 AM	2809.10	3/17/04 Wed	7:00 PM	2033.76	72.4%

Conclusion:

Based on the data analyzed, the following significant findings were noted;

1. On only one of the days of the four months, the system peak and test customer coincident peaks matched (February 3rd, 2004).

2. On February 3rd, the test customer coincident peaks and system peaks occurred on the same day, however at different times. The system peaks appear to occur much later in the day than the test customer peaks.

3. Nxegen also recorded the test customer coincident peaks at the same time intervals as the top three system peak demand values recorded for each of the four months. Nxegen then took a percentage of the test customer coincident peak demand against the highest peak demand values for the month. Based on these findings, the test customer peak demands represented approximately 75% of their maximum peaks.

What this data shows, and what Nxegen concludes is;

1. Commercial customers in general do not drive the system peak demand especially in the four-month test period.

2. Intuitively what is happening is that system peak demand is occurring later in the day when residential loads begin to rise as people are coming home and increasing electricity usage while commercial customers are reducing consumption but not down to zero thus resulting in system peaks being reached. This shows that in order to proactively manage system peak demand, the residential sector must be a component of the strategy to implement demand response on a system wide basis.

COMPUTER MODELING ASSUMPTIONS AND DATA SOURCES

Model Description & Model Components

Nxegen has developed individual excel databases (included in Final Technical Report package) for the months of June 2003 through March 2004.

The source of this data was ISO-New England Congestion and LMP pricing database files available directly through their website (www.iso-ne.com).

The key data fields in the database include:

1. Date and hourly intervals for each hour during each of test months
2. Real-Time and Day Ahead LMP prices for each corresponding hour
3. Real-Time and Day Ahead Congestion prices for each corresponding hour
4. Real-Time and Day Ahead system loads for the Connecticut Zone (MWs) for each corresponding hour

The model calculates congestion in the real-time markets and the day ahead markets. The models were not peer reviewed, however, the raw data is received directly from ISO-NE.

All data files are run from the following hardware and software platforms:

1. Microsoft Windows 2000 Excel
2. Dell Workstation Pentium 4 2.4 GHz
3. 523 KB RAM

APPENDIX A

List of (30) customer installations of Nxegen's wireless monitoring & load management system.

No.	Customer Name	Bldg Type	Address
1	Double A Transportation, Inc.	Trans	667 Cromwell Avenue, Rocky Hill, CT 06067
2	Firestone	Retail-Svs	136 Berlin Road, Cromwell, CT 06416
3	Cadbury Schweppes	Indus	30 Trefoil Drive, Trumbull, CT 06611
4	Stone Academy	Muni-Sch	1315 Dixwell Avenue, Hamden, CT 06514
5	Champions Sports Center	Retail-Svs	6 Progress Drive, Cromwell, CT 06416
6	ACES – Tech Services	Muni-Sch	204 State Street, North Haven, CT 06473
7	ACES – Village School	Muni-Sch	31 Temple Street, North Haven, CT 06473
8	ACES – Arise	Office	204 State Street, North Haven, CT 06473
9	ACES - Collaborative Magnet school	Muni-Sch	26 Old Post Road, Northford, CT 06472
10	ACES – Central Administration	Office	350 State Street, North Haven, CT 06473
11	ACES – ECA	Office	55 Audobon Street, New Haven, CT 06510
12	ACES – Whitney High School North/West	Muni-Sch	205 Skiff Street, Hamden, CT 06517
13	ACES – Wintergreen Magnet School	Muni-Sch	670 Wintergreen Avenue, Hamden, CT 06517
14	ACES – SDA	Office	205 Skiff Street, Hamden, CT 06517
15	ACES- Whitney High School East	Muni-Sch	261 Skiff Street, Hamden, CT 06517
16	ACES – Access	Muni-Sch	60 United Drive, North Haven, CT 06473
17	CT Department of Public Utility Control	Office	10 Franklin Square, New Britain, CT 06051
18	Webster Bank	Bank	975 South Main Street, Cheshire, CT 06410
19	ACES – Little Theater	Muni-Sch	1 Lincoln Way, New Haven, CT 06510
20	Westport Public Library	Muni-Office	Arnold Barnhard Plaza, Westport, CT 06880
21	ACES Thomas Edison Middle School	Muni-Sch	1355 Broad Street, Meriden, CT 06450
22	Norwalk Board of Education – Central Kitchen	Muni-Svs	350 Main Street, Norwalk, CT 06855
23	Norwalk Main Library	Muni-Office	1 Belden Avenue, Norwalk, CT 06850
24	Norwalk City Hall	Muni-Office	125 East Avenue, Norwalk, CT 06856
25	Capewell Components	Indus	105 Nutmeg Road, South Windsor, CT 06074
26	Firestone	Retail-Svs	72 Cook Avenue, Meriden, CT 06451
27	Adams Food Store	Retail-Food	1390 New Haven Avenue, Milford, CT 06460
28	Clearwater Associates general partnership	Office	2187 Atlantic Street, Stamford, CT 06902
29	Webster Bank	Bank	275 Newington Avenue, New Britain, CT 06051
30	Webster Bank	Bank	435 South Main Street, New Britain, CT 06051

APPENDIX A

Building Types:

Trans	Transportation Facility
Retail-Svs	Retail Services
Indus	Light Industrial
Muni-Sch	Municipal School
Office	Office Building
Bank	Bank Main Office or Bank Branch
Muni-Office	Municipal Office
Retail-Food	Retail Food Service

APPENDIX B

Below is a sample format of Nxegen's customer load profile data and associated analytical analysis. Nxegen has provided a complete database of December 2003 through March 2004 data as an attachment to this report.

Demand (KW) Interval Data

Demand (kW)

	1	2	3	4
Collected Date/Time	Foodbag - 3 Mill Street,Kensington,CT 06037	Talcott St. Parking Garage - 1 Talcott St.,Hartford,CT 06103	New Boston - 55 Corporate Dr - 55 Corporate Drive,Trumbull ,CT 06611	New Boston - 35 Corporate Dr - 35 Corporate Dr, Ste 1100,Trumbull,CT 06611
12/01/2003 12:00 AM	54.40	0.00	17.12	32.00
12/01/2003 12:15 AM	54.40	0.00	17.32	32.00
12/01/2003 12:30 AM	56.00	0.00	17.12	32.00
12/01/2003 12:45 AM	54.40	0.00	17.24	32.00
12/01/2003 01:00 AM	58.80	0.00	17.08	38.40
12/01/2003 01:15 AM	61.20	0.00	17.24	32.00
12/01/2003 01:30 AM	59.20	0.00	17.20	32.00
12/01/2003 01:45 AM	54.40	0.00	17.32	32.00
12/01/2003 02:00 AM	56.00	0.00	17.16	32.00
12/01/2003 02:15 AM	54.40	0.00	17.32	32.00
12/01/2003 02:30 AM	55.20	0.00	23.48	32.00
12/01/2003 02:45 AM	54.80	0.00	30.04	32.00
12/01/2003 03:00 AM	56.00	0.00	29.88	32.00
12/01/2003 03:15 AM	54.00	0.00	39.60	32.00
12/01/2003 03:30 AM	56.40	0.00	49.16	38.40
12/01/2003 03:45 AM	56.00	0.00	46.60	32.00
12/01/2003 04:00 AM	57.20	0.00	49.16	32.00
12/01/2003 04:15 AM	56.00	0.00	46.12	32.00
12/01/2003 04:30 AM	54.80	0.00	61.92	32.00
12/01/2003 04:45 AM	55.20	0.00	65.24	32.00
12/01/2003 05:00 AM	55.20	11.20	68.24	32.00
12/01/2003 05:15 AM	57.20	55.60	65.24	38.40
12/01/2003 05:30 AM	54.40	56.80	58.72	38.40

APPENDIX B

Kilo-Watt Hour (KWh) Interval Data

Consumption

	1	2	3	4
Collected Date/Time	Foodbag - 3 Mill Street,Kensington,CT 06037	Talcott St. Parking Garage - 1 Talcott St.,Hartford,CT 06103	New Boston - 55 Corporate Dr - 55 Corporate Drive,Trumbull ,CT 06611	New Boston - 35 Corporate Dr - 35 Corporate Dr, Ste 1100,Trumbull,CT 06611
12/01/2003 12:00 AM	13.60	0.00	4.28	8.00
12/01/2003 12:15 AM	13.60	0.00	4.33	8.00
12/01/2003 12:30 AM	14.00	0.00	4.28	8.00
12/01/2003 12:45 AM	13.60	0.00	4.31	8.00
12/01/2003 01:00 AM	14.70	0.00	4.27	9.60
12/01/2003 01:15 AM	15.30	0.00	4.31	8.00
12/01/2003 01:30 AM	14.80	0.00	4.30	8.00
12/01/2003 01:45 AM	13.60	0.00	4.33	8.00
12/01/2003 02:00 AM	14.00	0.00	4.29	8.00
12/01/2003 02:15 AM	13.60	0.00	4.33	8.00
12/01/2003 02:30 AM	13.80	0.00	5.87	8.00
12/01/2003 02:45 AM	13.70	0.00	7.51	8.00
12/01/2003 03:00 AM	14.00	0.00	7.47	8.00
12/01/2003 03:15 AM	13.50	0.00	9.90	8.00
12/01/2003 03:30 AM	14.10	0.00	12.29	9.60
12/01/2003 03:45 AM	14.00	0.00	11.65	8.00
12/01/2003 04:00 AM	14.30	0.00	12.29	8.00
12/01/2003 04:15 AM	14.00	0.00	11.53	8.00
12/01/2003 04:30 AM	13.70	0.00	15.48	8.00
12/01/2003 04:45 AM	13.80	0.00	16.31	8.00
12/01/2003 05:00 AM	13.80	2.80	17.06	8.00
12/01/2003 05:15 AM	14.30	13.90	16.31	9.60
12/01/2003 05:30 AM	13.60	14.20	14.68	9.60
12/01/2003 05:45 AM	13.40	13.90	15.52	9.60
12/01/2003 06:00 AM	13.50	13.70	14.70	11.20
12/01/2003 06:15 AM	13.60	14.00	17.92	9.60