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9/29/06

From: Pentti Aalto and Roy Morrison

To: NH PUC

Re: DE 06-061
• Time Based Metering and Communications ("Smart Metering")
Section 1252 of Energy Policy Act of 2005
• Interconnection of Distributed Resources
Section 1254 of the Energy Policy Act of 2005

We submit the following:

I. Section 1252: Pilot Proposal for Real Time Pricing
II. Section 1252/ 1254 General Comments Applicable to Both Standards: Nature of Smart Grid and Need for Proper Utility Revenue Incentives

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I. Time Based Metering and Communications Section 1252

Following is a Pilot Program Proposal:

NH Real Time Pricing Phase I Pilot Project Proposal

This pilot addresses elements of issues 11,12,14,15 in the NHPUC relevant scoping document:

11. What are the available technology options for communicating with interval meters and transmitting the price or cost information to utility and customer? What are the strengths and weaknesses of each? Which technologies make the most sense for each utility and each customer class?

12. What is the current availability of interval meters and communications equipment and systems by customer class? What is the timeline for acquiring such capability if not currently available?

14. What are the monetary costs and benefits of time-based pricing?

15. What implementation issues should be considered? For example, should utilities develop education and outreach plans, develop targeted technical assistance programs, and/or implement pilot programs? What would these efforts entail?

Real Time Pricing for Consumer Response:
A Pilot Proposal by Pentti Aalto and Roy Morrison

NH Real Time Pricing Phase I Pilot Project Proposal

A. Summary

This proposal is for Phase I of a New Hampshire real time pricing pilot for participating utilities. Pilot Phase I will be small, with one hundred participants. It will test and assess the functioning and reliability of a system we have developed for cost-effective use of real time pricing using a pager network. The pilot will examine operation of the system, track participation, costs, savings and effectiveness, the suitability of particular technologies to different applications, the integration with existing and proposed utility metering technologies, organizational and implementation issues.

The system is intended to effectively control user load in response to changes in 5-minute real time ISO-NE pricing. This response will potentially effect the ISO-NE system dispatch to the benefit all customers. The pilot will be function as a project of the non-profit United Sustainable Energy Cooperative, a N.H. cooperative corporation. Roy Morrison and Pentti Aalto will direct and manage the Pilot. Pilot Phase I is planned for one year. Phase I is intended to lead to Phase II with approximately 1,000 customers that will establish the basis for adoption of a real time pricing tariff option for residential and small commercial customers.. The budget for Phase I is $349,543.

Phase II will include examination of other transmission and control means, user recruitment issues, and cooperative organization questions and servicing and billing of participants (as in the successful Chicago smart metering project.)

Phase I NH Smart Metering pilot project will in summary:

- Extract ISO 5-minute NH zone pricing signals;
- Transmit price information to customer receiving/control equipment;
- Control customer load automatically based on preset price trigger levels;
- Monitor power use information from the customer meter; calculate the ongoing cost of power used, and record the cumulative value of electricity and dollars;
- Will explore modifications to price information as appropriate to cover other costs (such as ancillary services and capacity charges).

B. Operational Outline of Real Time Pricing Pilot Phase I:

1. ISO-NE 5 minute pricing information as the basis for control.
2. ISO-NE information will be extracted by our server and sent to a satellite pager network.
3. The satellite-paging network will send signals either by broadcast or as separate messages to individual microprocessor based control devices at the homes or small businesses in Pilot Phase I.
4.The control device receives the ISO-NE 5-minute price signal, and based on a pre-programmed control algorithm monitors power use and controls load based on the price.
5. Based on user selected control points, the smart controller will perform three basic functions in Pilot Phase I. The controller will:

A. Control one to three separate devices e.g. electric hot water, air conditioning, clothes dryer, heat pumps primarily on an on-off/duty cycle basis. (Control may be expanded to up to seven devices in Pilot Phase II, with more sophisticated control such as temperature resets will be in Pilot Phase II)

B. Accumulate the quantity and value of the power used

C. Transmit the accumulated values back to the pager network and to our server for access.

6. The usage information will be transmitted in Pilot Phase I to the users via e-mail and posted on a web site for inspection. (In Pilot Phase II the web based user interface and control possibilities will be expanded.
7. Users will be informed what they would have paid under the variable prices. Actual payments will be at current tariffs.

(Note: Subsequent Pilot Phases will use an actual provisional real time pricing tariff.)

C. Operational Details and Dynamics

1. Extract 5-Minute ISO-New England Zonal Prices

a. Our central office computer is programmed to scan once per minute the ISO-NE Current 5-Minute Marginal Price Page. This page includes the total ISO system demand, and for each of the eight zones and the NE-ISO hub it lists the 5-minute Locational Marginal Price (LMP) and its components: energy, congestion, and marginal loss.

b. When we detect any change in this ISO-NE data, we record the new data in a database.

c. Computer sends price and time information to the paging network for transmission to user receivers. (If necessary to add additional pricing data for fully loaded price beyond spot kWh value, it can be added by the central computer.)

2. Skytel Network Transmits Price and Time Signal

a. Skytel paging system sends price and time signal to each of the user receivers.

b. Skytel system for the purposes of the Pilot is a secure and timely method of sending information to users.

3. Motorola-Create-a-Link II Controller

a. Signal received by Motorola Crate-a-Link II transceiver using the Reflex 50 communications protocol. (Control Sequence in 4. below.)

b. Control board is sophisticated programmable system with central processor and memory designed for control and communications using a two-way transceiver. The control board has:

-- eight input/output channels including two high capacity channels
-- two analog to digital inputs
-- board temperature sensor
-- battery backup with sensor monitoring battery voltage
-- transceiver to send and receive data
-- volatile and non-volatile memory to prevent data loss

c. Controller uses one of input/output channels to receive consumption data over a hard-wired path from the pulse meter. The controller is programmed to properly account for value of pulse and record in data file.

d. Controller either hard wired to controlled load devices or connected to house wiring using X-10 controller for "wireless" control.
e. Controller uses low voltage, and is properly fused to protect meter, controller, and residence.
f. Controller located either outside residence or small business near the meter box or inside the residence or business.

4. On site data and control scenarios

a. Basic Data Flows

i. Controller receives and stores 5-minute ISO price and time data from Skytel signal.
ii. Controller receives stores pulse input from electric meter and values electricity based on most recent 5-minute price.
iii. Controller stores cumulative data on kilowatt-hour use and $ value.
iv. Controller transmits cumulative price and use data to central office as desired.

b. Basic Control Scenario

i. Controller compares price signal with price set points chosen by user and sends signals from one of its I/O channels to control user device either through hard wired connection or X-10 "wireless" controller using the house wiring.
ii On/Off Control, for example, turn off one of two water heater elements in response to price, to duty cycle air conditioners, to turn on/off onsite generators.
iii More complex control can be done in the future, for example, to reset air conditioning or heating temperature setting based on predetermined user selection, to preheat water or space or pre-cool space during times when 5-minute prices and control scenarios indicate.

5. User Billing and Communications

a. User kWh use and cost data sent periodically to central office.
b. In Pilot Phase I users can request a limited number of remote control setting changes that will be sent by central office computer to user receiver.
c. User in Pilot Phase I will receive detailed information concerning their power use and prices they were exposed to and load deferrals and time duration and price savings analysis.
d. We will examine additional ways of measuring savings.

D. Advantages of the 5-Mintue Pricing Model

Instead of interval metering and hourly pricing, we are proposing a method of 5-minute price communication to the customer. This method provides 5-minute almost real time price signals used for billing and automated control. This facilitates not only optimized control, but also consumer choice of predetermined price points and control strategies. This is likely to be of substantially greater appeal than, for example, central office controlled on/off duty cycling of air conditioning.

Five-minute pricing provides superior information for both pricing and control. Hourly pricing is after the fact. Day ahead pricing provides the ability to plan, but doesn't necessarily reflect actual market price and grid conditions. Actual power dispatch is done on nearly instantaneous basis. Our 5-minute pricing signal is a proxy for the actual dispatch value.

Five-minute Pricing:

- Allows prices to be applied to power as it is used;
- Allows the customer to respond to the actual billing price;
- Allows the customer response to fit into ISO 10-20 minute dispatch widow to achieve balance with neighboring systems;
- Provides general economic benefits as power consumption is reduced in high price times where small reduction in load can cause relatively large reductions in price.
- Can help reduce or eliminate forward capacity market charges through the development of statistically reliable demand control resources.

It's also important to note that the vigorous pursuit of demand response and distributed generation can be an effective supplement, or perhaps a complete replacement to planned forward capacity markets. The FERC discussion of the statistical durability of demand response resources is most relevant in this regard. See: FERC 2006 Assessment of Demand Response and Smart Metering, Staff Report for Docket: AD-06-000, August 2006

Smart metering based on 5-minute pricing has a benefit for all users by being able to influence price in congestion times, reduce system peak, and act within the ISO response time window. Such a system if widely installed could have substantial benefit for all in terms of reducing costs, pollution, need for new generation.

E. Utility Role and Rate Treatment of Smart Metering

The role of distribution utility is crucial in making smart metering work, whether in the pilot or beyond. We want to work cooperatively with participating distribution utilities and explore compatibility and proper integration with their system and metering and identify problem areas that need to be addressed. Further, to the extent feasible, we want to make the operation of such a control system compatible with other smart-metering systems being considered by utilities.

In the long run, we believe it may be logical and in the public interest for the utility to be responsible for installing and maintaining the hardware involved in the smart metering network, and that such hardware and maintenance become part of the rate base.

Further, the more efficient operation of the system will benefit all customers by reducing system load, peaks, and price dispatch. This will be a consequence of feedback effecting ISO-NE system state from user load control in response to ISO 5-minute price. If such beneficial smart meter system operation leads to a reduction in kilowatt-hour sales, the utility reduction of kilowatt-hour sales should be compensated and held harmless by an increased rate of return.

F. Pilot Implementation

The Pilot will be a project of the non-profit United Sustainable Energy Cooperative, P.O Box 201 Warner, N.H. 03278, a N.H. Cooperative Corporation. The cooperative was organized for the purpose of pursuing such innovative efficiency and renewable energy initiatives to benefit members and society. Membership is open to all. Voting is on the basis of one member, one vote according to cooperative principles. There is no stock. The cooperative is a suitable non-profit entity for operating the pilot and serving its participants.

All pilot participants will be members of the non-profit cooperative. There will be carefully control and accounting for all Pilot expenses. Roy Morrison and Pentti Aalto will serve as project staff as consultants under contract with the cooperative.

We note that we, Roy Morrison and Pentti Aalto, are founders and Board members of the non-profit United Sustainable Energy Cooperative, Inc. Pentti Aalto has extensive experience in developing and testing this particular prototype of smart metering systems. Roy Morrison has extensive experience organizing consumer energy cooperatives and developing innovative electricity policy measures. (Brief vitas attached.)

The Pilot Phase I will work with the PUC, utilities, and other interested parties such as Governor's Energy Office and consumer Advocate's Office to develop and then implement the pilot five-minute smart-metering program. Funds for this broadly beneficial pilot could be provided from Systems Benefit Charges or through other means, such as participating utility funding, as deemed appropriate by the NHPUC.

Subsequent Pilot phases will address the use of a full internet based system for the transmission of control information and alternatively the use of other and potentially more powerful broadcast means for data transmission across many LMP locations. These means may include use of cellular networks and satellite radio broadcast.

Pilot Phase I we believe is a feasible and highly cost effective place to start with the practical use of real time pricing for all classes of customers, in particular for residential and small business customers. The benefits of real time pricing and computer control in the 21st century need not be limited to large users but can become a feature of a higher efficiency electric grid system that responds dynamically to real time price signals.

Based on the lessons of Pilot Phase I, Pilot Phase II is anticipated to involve 1,000 to 2,000 customers using real time pricing and a rate structure and billing designed to be broadly similar to one that may be employed if real time pricing becomes a tariff option.

We note that In Illinois, the Community Energy Cooperative, operating in ComEd territory, has conducted a successful "Smart Energy Pricing Plan" project for over 1,400 customers. The Illinois legislature recently passed unanimously and sent to the governor SB 1705 requiring utilities to offer residential customers real time pricing in 2007, and contract with an independent organization for implementation.

G. Questions Answered by the Pilot Phase I:

Pilot Phase I will allow us to test the feasibility and practicality of a satellite pager system for real time load control and metering. It will answer questions such as:

1. Does the system receive pricing signals reliably and in a timely fashion?
2. What are the geographical and other limitations upon such a system in obtaining pricing signals?
3. Do multiple signals need be sent?
4. Is the broadcast means of transmission feasible and reliable in terms of sending and receipt?
5. How effectively does the control operate?
6. Is the control system reliable?
7. What did installers learn about problems and best practices?
8. Are users satisfied with amount of input they have in selecting control?
9. Does the system save energy?
10. What lessons are learned about installation problems of the controller inside or outside the facility?
11. What are the lessons for device control methods such as X-10 and hard wiring?
12. What control algorithms have proven effective and popular?
13. What was the user experience?
14. Do users support, enjoy, and participate in the process?
15. What are the lessons for Pilot Phase II likely costs and design?
16. What did we learn about user reactions that will help recruit participants in larger Pilot activities?
17. What are lessons applicable for future large-scale installation and utility cost recovery for the devices, e.g. should they be part of the rate base?
18. What ways make sense in view of Pilot experience to compensate utilities for potential lost revenue from higher efficiency, and examine lessons from pilot for tools such as enhanced rate of return, and putting relevant equipment in the rate base.

(Detailed budget follows).

I. Budget for N.H. Smart Metering Pilot Phase I

Item	Cost
1. Programming	
A. Programming Price and Use Data handling (15 person days@$1,000/day)	$15,000
i. ISO-NE 5 minute price data collection from our server and transmission to pager network	
ii. Internet interface for data collection from end users from pager network, providing such information for user account billing and posting on web site	
B. Programming X-10 Control End-user devices, ($1,000/dy x 3 days)	$3,000
2.Set-up/Use Skytel Network	
A, Non-broadcast ($35/month x 100 units x 12 months)*	$42,000
(*Broadcast channel at lower cost use may be possible for some or all of Pilot Phase I Maximum savings = $20/unit x 100 units x 12 months =$20,000)	
3. Motorola Controller Create-a - Link II	
A. Assemble in Box with Receiver ($300 @ x 100 controllers)	$30,000
B. Install in resident/businesses (100 devices @$300)	$30,000
4. End-use device control	
A. On-off relay control for device power (X-10 or hard wire $150 installed x100)	$15,000
B. Computer upgrade	$5,000
5. Pulse meters (assumed provided by utilities)	$0
6. Professional services	
A. Electrical Engineer (PE) ($150/hr x 40 hr)	$6,000
B. Project Management /Design (two 1/2time consulting positions @ $50,000/yr)	$100,000
Oversee, design, coordinate, and implement all aspects Pilot	
C. Legal ($175/hr x 30/hr.)	$5,250
D. Accounting	$5,000
7. Recruitment of Pilot Participants	$5,000
Brochures, literature, web design	
8. Support Staff, part time (1 half-time position)	$23,000
9. Phone /Copying/Postage ($600/month x 12)	$7,200
10. Office (in kind contribution)	$0
11.Public Relations/Communications Includes Newsletter production, distribution	$5,000
12. Insurance, Liability	$7,500
sub-total:	$303,950
13. Overhead expenses 15% overhead	$45,593
14. Total:	$349,543

7. Brief Vitas

Pentti Aalto is an energy analyst and consultant. He has 35 years experience in the development of innovative energy solutions. Current projects include designing and testing a low-cost communication and control system to permit spot market access to small participants. He has developed analytic models for optimizing financial hedges. He has long experience in alternative energy resource issues such as development of the New England Sustainable Energy Association and the Massachusetts "Governor's Commission on Cogeneration". He has experience in comprehensive plant energy assessment and dynamic modeling including plant pinch point energy analysis. His expertise includes ground source heat pumps, district heating, biomass energy, cogeneration, and energy markets, regulatory and policy developments including those for retail competition in the electric industry.

Roy Morrison is an energy consultant with over 25 years of diverse experience. He has extensive experience in energy efficiency work, performing energy audits and technical assistance analyses for business, institutional, and government clients. He was the author of the first in the nation law for municipal aggregation for retail electric competition based on his Josiah Bartlett Foundation award winning proposal. He was the founder of the NH Consumers Utility Cooperative that was the first retail seller of competitive electricity in New Hampshire to over 400 residential consumers. He is currently pioneering wind hedge development. He writes books and articles addressing questions of sustainability and ecological transformation. His books include Ecological Democracy (South End Press, 1985), Ecological Investigations (Glad Day Books, 2001), Tax Pollution, Not Income (Writers Publishing Cooperative, 2003) and Eco Civilization 2140 (Writers Publishing Cooperative, 2006).

II. General Comments Applicable to Both Standards

In regard to the issues concerning both Sections 1254, Interconnection, and Section 1252, Time Based Metering of the Energy Policy Act of 2005 (EPACT) its necessary and appropriate to address underlying issues that inform directly or indirectly most of the specific questions under consideration. If we ignore these underlying issues the results of these deliberations will most prove to be far less than optimal in terms of the general interest.

A. Need for Appropriate Utility Economic Incentives

Current utility rate structure that relies heavily upon generation of revenue through kilowatt hour sales is a fundamental disincentive for utilities to participate in distributed generation, smart metering, and demand management activities that will substantially reduce their net kilowatt hour sales and hence their revenue.

If the pursuit of such activities is in the public interest, as evidenced by Sec. 1252 and 1254 of the EPACT, than appropriate measures must be undertaken to provide proper revenue incentives for utility participation. Such measures can include an increase in the utility rate of return, and the ability of the utility to include appropriate smart metering and distributed generation equipment in the rate base.

These questions are addressed in the FERC 2006 Assessment of Demand Response and Smart Metering, Staff Report for Docket: AD-06-000, August 2006.

http://www.ferc.gov/legal/staff-reports/demand-response.pdf

This document by reference is included in these remarks.

B. The Smart Network

We have the opportunity to build a 21st century electric utility system based on developing smart networks that can dramatically improve system utilization, efficiency, and control.

The smart network will perform better economically and ecologically. It will benefit all users from residential to industrial. It will make the entire system more reliable and reduce its ecological footprint. It will be a network that maximizes communication, control and interconnection based on relevant and secure open source/open access protocols. It will be capable of sending real time price signals based on the system state that include values for all aspects of generation and distribution using market prices and dynamic regulatory pricing structures. It will develop means to appropriately reward and incentivize users from all customer classes, generators of all sizes, control and efficiency providers, transmission and distribution utilities. All of us will benefit from the operation of this smart network.

These aims and goals of the smart network provide a basic framework for users, generators, policy makers, utilities, and regulators to shape the institutions and polices that will build the smart 21st century network.

The issues raised under the Energy Policy Act of 2005 (EPAct) Sections 1252 and 1254 being considered under NHPUC investigation DE 06-061 provide an essential opportunity for further development of the smart network.

C. Rate Structure Dynamics and Lessons for Smart Metering and Distributed Generation

Traditional rate making has always had the problem of balancing cost causation and accurate cost allocation with the need to maintain simplicity and low cost in metering. In the early years customers were charged for the number of light bulbs that they had. That changed with the advent of kWh metering and later demand metering. Demand metering was incorporated primarily as a way of providing more stable cash flow in an environment of changing use. Later changes included peak and off peak metering and, for larger customers, interval metering, which allowed for recording use in as little as fifteen minute intervals. Cost of service studies were used to provide load profiles for customer classes to better assess contribution to peak, and reactive power charges were applied to larger customers.

Each of these improvements made cost allocation a bit easier, but the primary rates that were available used kilowatt-hours and kilowatt demand as determinants.

While these rate structures provided for adequate revenue collection, they provided very poor price signals to customers, since all components were averages of total system expense. Even with the improved peak and off peak rates, customers generally obtained relatively fixed prices per kWh since the price variation was relatively small due to the extensive averaging between different time periods. Demand charges were always a poor proxy for representing capacity requirements of the system, because the customer's demand was not necessarily related to system demand. With the exception of interruptible rates and direct load control, customers have no way of responding to the real time system state.

The primary cost items for electric utilities are the cost of fuel, cost of capital, operations and maintenance, and other administrative and regulatory costs and taxes. Fuel costs can vary widely depending on the price and type of fuel and the efficiency of the plants in converting the fuel to electricity. Capital costs vary with the type of equipment used and the level of usage. For example, base load plants are generally expensive but run a lot and spread out the cost of capital service, while peaking plants are less expensive but run very little.

Customers generally have had very little information or incentive to help control any of these costs. Prices are generally the same to the customer when the system is at low load or operating at peak capacity. The customer may unknowingly trigger decisions requiring the investment in new capacity.

Interruptible rates, direct load control and recent demand response programs that require performance do help alleviate system peaks in real time but do not adequately balance the customers need for power with the system need for load reduction at that time. New programs like critical peak rates do give the customer choice but still only deal with peak conditions. Making the actual price available to the customer at all times would foster optimum results.

New day ahead and hourly real time price programs are a major improvement and have successfully been applied to both large and small customers. While customers have had very little time to lean to respond to variable electricity prices, even residential customers have been able to reduce loads sustainably by 10 to15% with out automation.

The current day ahead and hourly real time price programs do still have limitations. The day ahead pricing allows customers to plan ahead and know tomorrow's hourly prices but it only provides information on the expected conditions not those that actually occur. The hourly real-time prices are generally for the hour that just ended. The customer does not know the value of power when it is used and can only guess at it based on the projected day a head price and actual price in the preceding hours. Neither system reacts fast enough to influence the real time dispatch of the system.

The ideal pricing system would provide the customer with a continually variable price that would allow billing as the power was used and control of the customer's equipment based on a control algorithm that meets the customers needs. The system would respond as soon as change in the system state was detected.

ISO-New England currently has the data to establish this type of price signal but it does not have a method to do so. It does however have a five-minute price that dramatically reduces the problems associated with the hourly price. This price is available two or three minutes after it is developed and can serve as the basis for a price that could be sent to the customer. The customer response can occur within the ten-minute dispatch window. While this arrangement is not ideal it is a practical alternative that is available today.

The five-minute energy price is adjusted for losses and congestion at each of about one thousand locations in New England. The price to the customer would need to be further adjusted by among others, capacity cost, ancillary services, reserve requirements and distribution losses. Distribution charges should also be included as a variable kWh charge that reflects the changes in distribution circuit loading.

This type of pricing system is practical today. What is needed is to establish the size and type of load where the equipment is cost effective, introduce the concept to customers, begin to develop technologies to respond to varying price, explore non-technical hedges to reduce price volatility and begin to explore the changes that will develop. This type of system has the potential to dramatically reduce cost to everyone by making better use of existing infrastructure and controlling the need for new investment.

End