

HISTORY OF AMI DEVELOPMENT AT NAVOPACHE ELECTRIC COOPERATIVE

The development of the microprocessor and personal computers has touched all of our lives and changed, forever, the way we do business at almost every level of our society. It would be difficult to identify any business sector that does not use digital technology and high speed communications to improve its specific business functions. The experience of the electric power industry is a prime example of the positive impact the development of electronic technologies has had in the workplace. Only the creation of the REA itself, in 1935 by the FDR Administration to bring electricity to our rural countryside, can compare with the improvement in our quality of life, that technology in the electric industry has made possible.

The adoption of electronic technology and high speed communications in the electric industry is now under scrutiny for the perceived invasion of privacy and detrimental health impacts on humans that these devices are falsely accused of. The 30+ year history of implementing electronic metering systems at Navopache Electric Cooperative (NEC) and independent comprehensive scientific studies, disprove both of the claims being made against the technology which has become known as Advance Metering Infrastructure or AMI.

NEC began investigating the benefits of implementing technology to its members in the early 1980's. C. Mac Eddy, NEC General Manager from 1976-1990 had only one motivation that drove his desire to analyze the impact of technology on electric utility operations – to reduce the cost of service to cooperative members.

NEC followed the example of telephone companies in those days, whereby you could make a phone call late at night at a greatly reduced cost from a daytime phone call. Why wouldn't this work for electricity use as well? Our systems were similar, in that usage was much greater during the daytime hours than late at night, leading to inefficiency.

If there were a way to encourage members to shift their electric usage to "off-peak" times, we could lower the cost of a kilowatt hour during those time periods, without increasing power costs to the cooperative from its power supplier.

In reality, by adding electric usage to traditionally low use time periods, it would actually lower the incremental cost of a kilowatt to the cooperative at the wholesale level. NEC members would save on their individual monthly power bill, while the cooperative would save on its wholesale power bill by increasing the efficiency of the power system.

The efficiency of an electric power system is measured by its load factor, which compares average usage to maximum usage for any given time period. The higher the differential between the two quantities results in a lower load factor and lower efficiency. By encouraging electric usage at low use time periods so as to "even out" electric usage throughout a 24-hour period, load factor, or efficiency, is increased and costs are reduced.

$$\frac{\text{Average Demand}}{\text{Maximum Demand}} = \text{Load Factor}$$

NEC began experimenting with the first electronic meters developed for residential users by General Electric in the mid-1980's. The meters were equipped with a microprocessor and a time clock to be able to separate kWh usage by time periods of the day. The functionality was essential to move forward with the development of "off-peak" or "Time-Of-Use", (Time of Use or TOU) electricity rates.

The meters displayed kWh usage during different time periods of the day in a digital format, replacing the mechanical dials that meter readers previously relied upon for the total kWh consumption, regardless of when power was used. All kWh's, regardless of when they were used, were priced the same in the days of electro-mechanical meters.

NEC received permission from the Arizona Corporation Commission, (ACC), to implement Time of Use rates on an experimental basis in 1986. Based upon a financial analysis of revenue received from residential usage, we priced the off-peak kWh usage at one-half of the cost of a kWh on-peak. It became clear very soon that NEC members who volunteered for the off-peak rates were shifting their usage to off-peak times, using more energy on a monthly basis while spending less. The load factor of the NEC power system began to improve and our members began saving money on their electric costs. In 1988 NEC applied for and received a permanent "Time-Of-Use" rate tariff from the ACC.

In the meantime, electric utilities were appealing to meter manufacturers for more functionality in their electronic meters. If we were recording kWh usage in real time, it seemed that a Time of Use meter could develop a continuous load curve, which would provide information that proved invaluable in identifying when peak demands on the NEC power system were likely to occur. Knowing this, we could identify those times of the day which could be designated off-peak. Additionally, the usage data provided by the Time of Use meter helped solve billing inquiries, as members could see exactly how much and when they were using electricity in their home.

NEC originally designed off-peak rate time periods to be from 9:00 pm until 7:00 am and from 1:00 pm until 4:00 pm, Monday through Saturday. All day Sunday was designated off-peak as well. These hours equated to 60% of the total time that electricity was priced at half-price, providing a tremendous savings to NEC residential members.

With the success of TOU rates, we turned our attention to developing programs which could maximize the benefits to members. We know that electric home heating is the single largest use of electricity in most member households and considered more expensive than other forms of energy for this purpose. How could we change this reality?

NEC learned of a product called an Electric Thermal Storage heater. A system designed much like a water heater in that a similar element heated high-density bricks which provided heat evenly and quietly throughout a room. Could we equip these heaters with a time-clock so that they would only operate during the off-peak time periods? Of course we could, and we did.

We purchased an ETS heater and installed it at our headquarters to test its operation. We installed a timer on it and connected a TOU meter to it to record the electric usage of the heater. Our test proved that the ETS heater could provide home heating with electricity at half the price. We launched a program to market ETS heaters to our membership and it was an overwhelming success. Today, ETS heating accounts for 25% of the total NEC electric usage, all of which occurs during the off-peak time periods of the day at great savings to our members. The NEC load factor continues to improve and our members save more money on their electric costs.

Next on our radar was the second largest electric user in the average home: the water heater. Could a water heater that only came on during off-peak times provide enough hot water to meet the demands of an average household? The answer was yes, in most cases, with careful planning by the household. For those times when additional hot water is needed, the time clocks that were provided were equipped with an over-ride function that would allow the water heater to operate on demand, regardless of the time of day.

As these developments are taking place, NEC is constantly appealing to meter manufacturers to expand the functionality of their TOU meters. We were developing a load control system through the meter by using separate timers; could a meter be equipped with a load control switch activated by the time clock in the meter? Yes, and it was. External timers were no longer necessary with this development. The meter could control an individual load, or when connected to an enclosure of relays, provided by NEC, control multiple loads automatically.

NEC also appealed to the ETS heater manufacturer to develop an on-board timing system for its electric heaters in response to the growing acceptance of off-peak electric rates in the industry. The manufacturer did so, recognizing that they could fill a newly developing niche market with electric utilities that were offering off-peak electricity rates.

During this same time period, meter manufacturers began to add on-board communication capabilities to their meters, recognizing that physically reading meters was a significant operational cost to utilities. NEC embraced this technology as well and started installing these types of meters on its large commercial loads, where accuracy of meter reads is extremely important. NEC used various radio frequencies and cell phones through the 1990's to read these meters without a physical meter read and the associated costs.

By implementing cost effective technology such as TOU meters, ETS heating systems, high speed communications and end-use load control programs, NEC has provided its members with products and services which improve the quality of life for everyone. None of these programs would be reality without the development of NEC's AMR system over the last 25 years.

NEC has had the capability to create a load curve of member usage for many years and has never experienced a complaint that the data retrieved constituted an invasion of privacy. On the contrary, the data retrieved from a TOU meter is limited to only those quantities and values required to accurately prepare a members monthly invoice. Meter data has never been used by NEC for any other reason other than to provide superior customer service and operational system planning.

Likewise, NEC has remotely read electronic meters, through various high speed communications mediums, since the late 1980's, without having any negative health impacts. NEC urges its members to visit our website, www.navopache.org, to review scientific studies by various institutions and state agencies, which provide conclusive evidence that there are no health risks associated with reading meters via a radio frequency. The amount of RF power required to transmit meter data is thousands of times less than many electronic devices found in all of our homes. The duration of RF power transmission by the AMI meters in use at NEC transmit every 4 hours, for a total of approximately 82 seconds per day. Many of your household electronic devices operate on a continuous basis, utilizing a much higher RF to transmit and receive data.

The technologies used to develop an AMI system are the very same technologies which make doing our business on-line from home possible. Would we give up that convenience? Would we rather stand in line at the bank, or use the internet to save time and money? Would we rather write checks and buy stamps to send in our monthly payments, or do it from home, via the internet or from our cell phone?

The technologies used to develop an AMI system are the very same technologies which allow an Emergency Medical Technician to transmit a victim's vital signs and symptoms from an accident scene to doctors at a hospital. This capability greatly improves a patient's emergency treatment and prepares the hospital to ensure that the right resources are available upon the patient's arrival. These technologies save critical time and, in many cases, are the difference between life and death.

NEC believes that the benefits of developing its AMI system have been proven over the years to provide superior customer service, to save money for our members and the cooperative, and to provide information to improve the reliability and efficiency of our power system. NEC has never had a breach of personal privacy or negative health impacts, since its implementation of its AMI system. NEC welcomes any questions regarding these issues and will respond in a professional and timely manner to any inquiry it receives.