



# Canton's Meter Replacement Project Registers Savings

*Carl M. Seifried, P.E., Burgess & Niple, Inc.  
Tyler S. Converse, M.B.A., City of Canton Water Department*

Canton's Automatic Meter Reading (AMR) system was originally installed between 1997 and 1999. It was one of the first systems of its kind in the country. Once installed and debugged, this fixed-based system ran well and had a projected life expectancy of approximately 20 years. In 2009, after only 11 years in service, the battery powered Meter Reading Transmitter Units (MTUs) began to fail. The failures came slowly at first, but that would soon change.

At the same time, newly appointed Superintendent Tyler Converse and the staff of the Canton Water Department were in the midst of a multi-year, \$25 million construction cycle. All three of Canton's water treatment plants were undergoing extensive renovation. The addition of a major, premature and unexpected project such as the replacement of the AMR system concurrent with the plant renovations could push the department beyond its limits.

Because Canton was one of the first utilities to install a fixed-base AMR system, they would also be the first ones to experience system failure and replacement. Canton had no replacement plan in place and little experience to draw from to advise the City how best to proceed. Many questions and unknowns had to be considered and addressed. How much time did Canton have before the MTUs began failing en masse, causing a major disruption to the Utility Billing sub-department and customer service? Would the failures occur gradually enough that the City could replace them using in-house staff, or would they be forced to conduct a full-blown replacement program using outside contractors? Should the City continue with the same automatic meter reading infrastructure or was there a better choice? Should the water meters be replaced at the same time as the MTUs?

While keeping a close eye on the MTU failure rate, Canton's staff began meeting with the AMR system manufacturer to educate themselves on the latest

technology and to choose the best direction for the City. In 2011, Canton decided to upgrade the existing AMR infrastructure. This same year a significant uptick in the number of MTU failures caused considerable concern.

As part of the technological upgrade, certain components of the existing system would have to be converted or replaced before new technology could be utilized. This upgrade began in 2012 and took most of the year to complete. Unfortunately, the MTU failure rate increased exponentially during this same year and Canton's in-house staff could no longer keep up. The staff was stressed beyond measure, and thousands of customers were instantly receiving estimated bills. It was time to enlist outside help and begin a full-blown replacement program as quickly as possible.

To better understand options and potential costs, a preliminary planning phase was initiated. The City retained Burgess & Niple, Inc. to define benefits, risks, and costs for each type of procurement program.

The approach that Canton opted to take to replace its meter reading system was in sharp contrast to the widely accepted philosophy where single source responsibility is the norm. The City weighed multiple procurement options with a single prime contractor, vendor-led system procurement, multiple contracts, or turn-key design-build approaches. The City realized there are benefits and varying costs to each option.

Through a careful assessment of the options and the City's willingness to take on some risk in order to reduce costs, the project resulted in the award of three separate contracts. This approach produced cost savings, leveraged past investments, and managed risk to ultimately deliver a fully integrated solution.

## CANTON'S EXISTING FIXED BASE AMR SYSTEM

The Canton Water Department (CWD) completed the last system-wide water meter replacement program in the late 1990s. During this time approximately 41,500 residential (primarily ABB meters), commercial, and industrial meters were replaced. Another 2,000 existing Sensus meters were retrofitted to work with the newly installed Automatic Meter Reading (AMR) system. This new AMR system, manufactured by Hexagram (now ACLARA), was one of the first fixed-base AMR systems in the country. Prior to this, Canton's meter department staff collected meter readings manually.

Canton's existing fixed-based AMR system consists of a Meter Transmitting Unit (MTU) that is wired directly to each water meter register. In most cases, these MTUs were installed inside the home or business near the meter. The MTU serves to transmit meter readings two times per day via radio signal to a nearby Data Collection Unit (DCU). These DCUs, 43 in all, are located on area commercial rooftops or telephone poles to improve reception. They collect and relay meter readings via a cell phone signal to the central server located at the Utility Billing building. Once uploaded, the meter readings are used to generate monthly or bi-monthly utility bills.



40 DCUs receive radio signals from 40,000 MTUs and send data via cell phone to Utility Billing System Database



## BATTERY FAILURES IN MTUS DETECTED

After installation and debugging, Canton's original AMR system worked pretty well. With an anticipated life cycle of 20 years, the system was expected to be relatively trouble free until 2017. In 2009, however, it was brought to the attention of Superintendent Converse that 1,974 MTUs had stop transmitting due to premature battery failure. It would seem intuitive that if a battery in an electronic device fails, you simply replace it. The lithium batteries in these devices, however, are both permanently sealed and hardwired in place. They cannot be readily replaced without destroying the device. The only practical option is to install a new unit.

The MTU failures of 2009 were noted and it was decided to observe and trend these failures over the next several years to gauge what is happening in the system and bid time until a replacement plan could be established. In 2010, approximately 1,500 MTUs stopped transmitting and were replaced. In 2011, the number jumped to 4,291 failures. This was an alarming figure. It was assumed that since the original MTUs were installed over a two-year period, the potential existed for them to fail en masse over a short period of time. It was theorized that the failure curve would be "bell shaped", making the large increase in failures in 2011 an ominous sign of things to come.

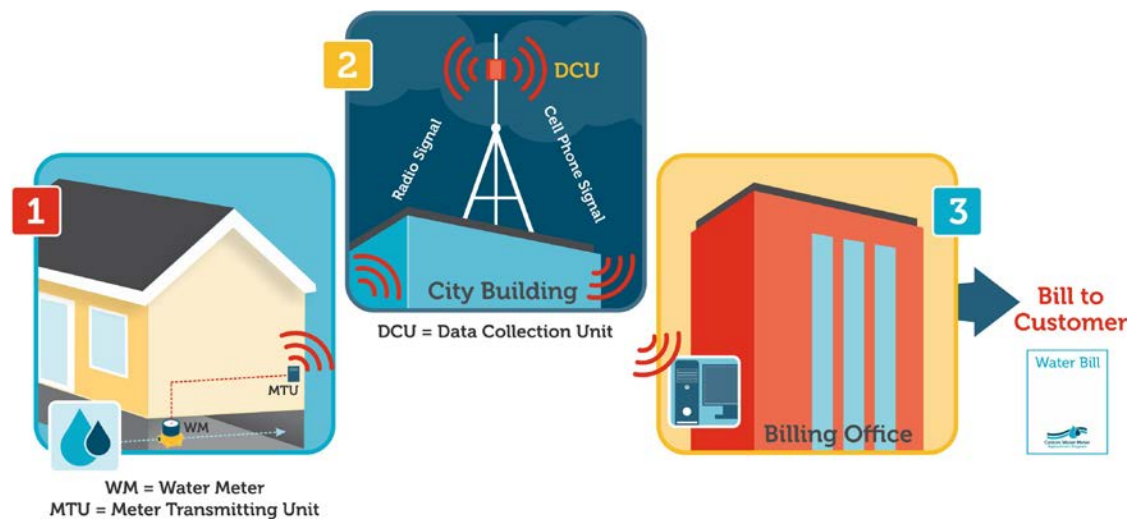


continued from page 43 - Canton's Meters

Dialogue between the CWD staff and ACLARA representatives was established as early as 2009 to start understanding and planning for the inevitable. It also should be noted that since Canton had one of the first AMR systems in the country, it would also be one of the first to figure out how to deal with replacing a failing system. CWD staff knew the replacement of this system would be a major undertaking and had many questions. Should we stick with this type of AMR system or switch to another method? What's the latest

technology and do we need it? While we are in customers' homes to replace the MTUs, should we also replace the water meters? Would the MTU batteries fail at a gradual pace so that we could replace them with in-house personnel over many years or will we become overwhelmed and need to hire an outside contractor to replace the entire system in a short period of time? After all, these units were proposed to last 15-20 years and began failing after only 11 years.

### Overview of Fixed Based Automatic Meter System Reading System.



During the same time period (2009-2012) the Canton Water Department was also in the midst of a three phase, \$25 million renovation of its three water treatment plants. In 2012, the NE WTP was nearly gutted and the administrative offices and laboratory were located in temporary trailers next to the plant. Although that project was going well, the staff was stressed and had been stretched to their limits for several years in a row. The addition of another major project during this same time period would have been exceedingly bad timing.

Various options were discussed internally. Do we scrap the AMR system to avoid costly replacement every 10-20 years and if so, what would replace this system? Manually reading meters or manually acquiring readings via touch pads is very labor intensive. AMR systems that require drive-by vehicles to obtain readings also utilize MTU-type transmitters with batteries that would require replacement, which offered no benefit. Most major water systems seem to be moving to AMR systems.

Also, some of the battery life issues have been addressed to extend the device's useful life. CWD already had the core AMR infrastructure in place. To scrap the system at this point would be costly. Therefore, Canton made the decision to upgrade the current AMR system and move forward.

In 2011, CWD staff traveled to ACLARA's facility in Solon, Ohio to take a tour, meet with key staff and learn about the latest AMR technology. It was decided to go forward with the new 3320 series MTUs that were not only less expensive than the old units, but also offered 2-way communication. The new MTUs operate on a different radio frequency than the older units, which meant the 43 Data Collection Units that accept their transmissions would have to be upgraded to read "dual frequencies." This allows both the old and new MTU models to be read simultaneously as both would exist in the system during the transition. The central server and software package also needed to be upgraded to accommodate the new 3320 series MTUs.

The contract to purchase 8,000 new MTUs and upgrade the DCUs, server and software was approved, signed and in place by the beginning of 2012. The majority of the year was spent working through this upgrade. What was supposed to take 2-3 months actually took 9-10 months as various technical obstacles were identified and resolved. The new MTUs could not be used until the upgrade was complete, so we found ourselves dead in the water for most of this year.

During this transition period the original MTUs began failing at an exponential rate. By the end of

2012, some 27,000 of the original 41,500 MTUs had experienced battery failure. Canton managed to replace 16,000 of these units with in-house staff over a relatively short period of time, but we were falling behind and had no way to close the gap. Nearly 11,000 customer bills were now being estimated, Canton's staff was exhausted and this unfortunate situation could not continue. By the end of 2012, the decision was made to hire outside help and undertake a full-blown MTU and water meter replacement program as quickly as possible.

### PRELIMINARY PLANNING PHASE

Superintendent Converse fully appreciated and understood the arduous task of working through a project of this size, scope and complexity. Within this project resides a myriad of details, logistical considerations, and specifications that must be worked out if the project was to be a success. The ultimate goal was to restore the meter reading and billing system to full functionality in the most expedient, efficient, customer friendly, and cost effective way possible. The final AMR and metering system had to be robust and warranted to last the full 15-20 years.

In early 2013, the City enlisted the help of Burgess & Niple (B&N) to assist with the pre-planning process. An overall approach, schedule, budgetary cost estimates and funding mechanism were needed. B&N's preliminary plan involved conducting workshops to identify the technical issues with the existing ACLARA hardware and software systems. The City also wanted to explore various contract and procurement options for the project, such as: Sole-source procurement from vendors; utilizing a single prime contractor; utilizing multiple contracts whereby the City purchases the water meters, MTUs, and AMR system and then competitively bids out the installation work. Another widely used approach is to have the water meter or AMR vendor as the prime contractor. They are then responsible for the whole project package including project management, and the purchase and installation of all components of an AMR system. After conducting numerous think-tank type workshops, it was determined that the City would issue individual bids for the respective purchase of the water meters, new MTUs, project management and installation services.

### FINANCING

Reduced loan rates were available from Ohio EPA through the Water Supply Revolving Loan Account (WSRLA), but the project had to be submitted by March 2013 to determine if it qualified for funding. The funds would not be available until bids advertised and awarded prior to June 2014 deadline. The City applied for an OEPA/WSRLA Loan Application to obtain funding for

the proposed \$15 million that included engineering services for planning through construction, equipment purchases, installation, and project management. The City also obtained a short-term OWDA Planning Loan to pay for the project planning and bid packages. This loan would be rolled into the final 20-year loan obtained under the OEPA WSLRA.

### PLANNING PHASE AND TENTATIVE PROJECT SCHEDULE

A Request for Qualifications (RFQ) was issued to solicit a statement of qualifications from interested consulting firms who were knowledgeable in planning and design of similar size AMR systems. A City committee was established to score and rank these qualification statements. Burgess & Niple, Inc. (B&N) was ultimately selected to prepare project specifications and bid documents.

*continued on page 46*



continued from page 45 - Canton's Meters

Also in July 2013, the City received notification that the loan application for OEPA/WSLRA funding was preliminarily approved. This meant that the MTU, water meter and installation contracts could be awarded no later than the end of March 2014 to obtain OWDA funding. Therefore B&N had six months to complete the planning and design phases of the project and three months to bid and award the contracts for meters, MTUs, and installation.

B&N was tasked with completing the contract documents as well as advertising, bidding, and awarding the contracts so that all bid documents could be submitted to OEPA by the March 2014 deadline. Once the OWDA loan was approved, the City had two months to award the contract and issue the Notice to Proceed, well in advance of the WSLRA funding deadline of June 30, 2014.

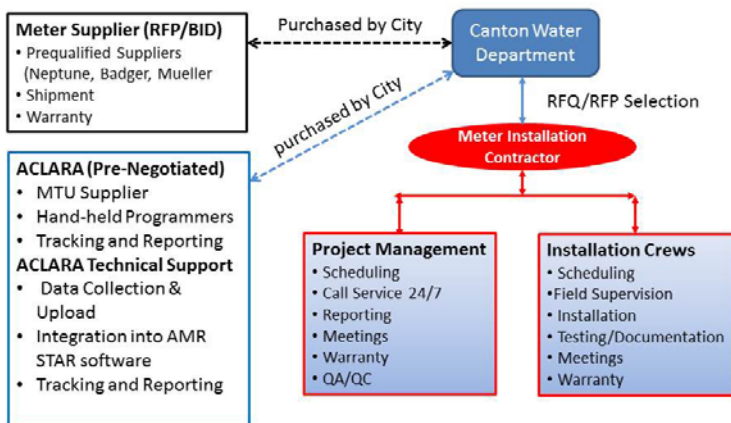
3. Evaluate water meter registers to determine compatibility with ACLARA software.
4. Evaluate the accuracy of the existing meters by random sampling and testing.
5. Develop bid documents that would ensure only experienced installation contractors would be pre-qualified to bid and provide project management and installation of the meters and MTUs.

### PROJECT TEAM INVOLVEMENT

Technology projects often experience excessive cost overruns and some of the highest failure rates due to project uncertainties, lack of coordination between parties and poor risk management. To accomplish the project goals B&N deconstructed the project into key elements. This helped them to better understand the potential problems, define functional requirements, and build consensus within the project team on cost-effective solutions.

The City's project team included staff from the Meter Reading and Repair, Utility Purchasing departments. All members attended workshops where the problems were identified, possible remedies discussed, and alternatives presented to improve system reliability and sustainability.

### Project Organization and Responsibilities



### GOALS FOR PLANNING PHASE

During preliminary discussions, it was apparent that there were several specific goals to be met in the planning phase:

1. Conduct in-depth analysis of the ALCARA AMR software to determine enhancements, software fixes, additional features, and functionality. Retaining the ACLARA system would result in savings to the City and allow it to leverage a portion of its investment in new MTUs and AMR software and hardware.
2. Evaluate other AMR/AMI fixed-based systems to determine additional features and functionality that would benefit the City.

### WATER METER TESTING

A random sample of the old, existing water meters were removed and bench tested to determine their accuracy. This group included nutating disk and piston-displacement type meters. The testing results turned out much better than expected, with accuracies varying +/- 3% of actual flows. This is well within the allowable AWWA standard of +/- 5%.

Most of the old ABB water meters installed in the late 1990s, however, are no longer supported by the manufacturer. Replacement parts are not readily available or are relatively expensive. In addition, these meters are now beyond the generally recommended 15 year replacement period. Since this project requires the installation contractor to make appointments and enter each home or commercial property to replace the MTU, it is more cost effective to replace the meter at this same time than to re-enter the premises at a later date. The savings generated by replacing both the MTU

and meter during the same appointment essentially pays for the replacement cost of the water meter. Thus, it was decided that all residential and commercial water meters would be replaced with new meters from sizes from 5/8" up to and including 1-1/2" diameter.

### WATER METER PROCUREMENT CONTRACT

Presentations by manufacturers who offered positive displacement and magnetic flow meters were conducted, and an evaluation of features of each was completed by the Project Team. The Team concluded that the electronic registers offered few advantages beyond what ACLARA software already provided and they were more costly and therefore not necessary. Since the City was satisfied with the nutating disk positive displacement meters, it was decided to prepare a performance spec that referenced AWWA standards. To minimize risk, 25 year warranties were required for meters and 10 year warranties for registers. Three water meter manufacturers were pre-qualified to provide competitive bids for the meter and register: Badger, Mueller Systems, and Neptune.

Purchasing the meters directly from the manufacturer allowed the City to avoid the typical "handling" fees normally associated with the purchase of equipment by a contractor on behalf of the owner. This approach resulted in savings of more than \$500,000 in the purchase price of the meters. All meters will be purchased by the City and delivered directly to the installation contractor for field installation.

Over 40,000 Positive Displacement Meters with Nutating Disc were purchased directly by City



### MTU PROCUREMENT CONTRACT

Confident that the technical issues with the AMR software had been resolved, the City opted to pursue a sole-source negotiated purchase of the MTUs and technical support services from ACLARA. To minimize risk, the City selected the absolute meter register to send the meter reading to the MTU since it had a proven track record of success when used with the ACLARA 3300 Series MTUs. In addition, installation contractors were required to demonstrate their prior experience installing ACLARA MTUs and uploading meter reading data into utility billing databases for similar size projects.

Another significant improvement offered by ACLARA was to provide Extended-Range units in areas where poor signal strength resulted in lost transmission of meter readings. Moving the MTU outdoors may improve communication reliability, but ACLARA ran simulations to show which areas of the City would most likely need extended range units. Extended range MTUs would be used in these areas to improve overall system reliability.

ACLARA offered the City a credit for replacing the 3-year old 8750D series MTUs with new 3320 series MTUs. But, after careful evaluation, the City opted to keep the relatively new 8750D series MTUs in service. This saved Canton more than \$500,000 in replacement costs.

The final purchase order with ACLARA resulted in a sole source contract for technical services and support during installation, and to provide approximately 24,500 of the 3300 series MTUs.

### PREQUALIFICATION OF INSTALLATION CONTRACTORS

Early in the planning phase it became evident that installation contractors must meet four key factors to ensure the project's success.

1. Proven experience on similar size projects
2. Strong project management and field supervision
3. In-house call center for scheduling appointments
4. Ability to maintain schedule by correcting minor plumbing defects (non-standard work) during initial appointment

*continued on page 48*



*continued from page 47 - Canton's Meters*

It was determined that only qualified meter installation contractors would be allowed to bid the project. The first step was to issue a Request for Qualifications (RFQ) from interested firms experienced in similar size projects. The RFQ defined that scoring method and point system for the following categories:

### **PHASE I: SOQ SCORING (150 POINTS TOTAL)**

1. Corporate Background and Financial Condition (30 Points)
2. Project References (30 Points)
3. Project Management Plan (40 Points)
4. Implementation Plan (30 Points)
5. Public Relations, Communications, and Scheduling Plan (20 Points)

### **PHASE II: COST PROPOSAL SCORING (100 POINTS)**

- 6A. Cost for Standard Work (80 Pts.)
- 6B. Cost for Non-Standard Work (20 Points)

The RFQ also summarized the scope of work to be performed by the installation contractor. Each qualified contractor was required to submit their Statement of Qualifications (SOQ) to be evaluated and scored. Each Contractor had to demonstrate in their SOQ that they could provide the labor, materials, tools, and equipment necessary to perform the work. They were also required to demonstrate that they have the specialized experience, have performed the work successfully on other projects of similar size, and have sufficient resources to manage the project.

Based on ranking of the SOQ documents received, a shortlist of pre-qualified meter installation contractors was compiled. No price proposals for the work were requested. Installation contractors who were deemed qualified received an invitation to submit a bid proposal.

The qualifications scoring counted for 60% and the price proposal accounted for the remaining 40% of the total possible points. The combined scoring of qualifications and pricing was used to select the successful bidder and award the contract for installation of the water meters and MTUs.

### **UNIQUE FEATURES OF THE INSTALLATION CONTRACT**

The final bid documents included detailed specifications for materials, installation, and overall project management. Bid packages were issued to seven pre-qualified contractors who specialized in meter installations.

**Examples of the detailed specifications required of the installation contractor are as follows:**

- Overall project management
- Training of field supervisors and installers
- Weekly progress meetings
- Customer notifications and communications
- Work scheduling
- Removal of existing water meters
- Installation of new water meters
- Repairs of non-standard installations
- Data collection and upload to the Utility Billing system
- Maintain 24/7 Customer Call Center
- Clean site, inspect work, and testing
- Handling customer complaints
- Warranty all defective workmanship
- Quality control



*Contractor required to use company service trucks for installation crews*

The meter installation contractor will provide project management services to oversee the scheduling, training, supervision, and collection of meter and MTU data for each account, and transfer of that data to the City Utility Billing department central database. A customer call center staffed by experienced customer service representatives will handle customer calls and schedule appointments for completing the installations. The contractor will be responsible for providing communication materials and public relations programs to inform customers that their meter and MTU will be replaced.

Local, licensed, commercial plumbers will perform all of the installation work. This includes removal of the existing meter and MTU, installation of the new meter, mounting the new MTU outdoors, and running interconnecting cables from the indoor meter to the outdoor MTU.

Once a new meter and MTU are installed, the installer will confirm that the new MTU is properly transmitting data. All installation data will be captured, including: Old meter readings; meter and MTU serial numbers; new meter readings; GPS coordinates; photos of the old meter register and installation; confirmation of account address; and date of installation. Finally, the installer must that the meter and MTU can successfully transmit and receive a signal from the DCU.

The contractor will be required to sign a Project Labor Agreement (PLA) with the local plumbers union, which is Local 94. This agreement requires all installations to be conducted by licensed commercial plumbers from the Canton and Stark County areas. Employees of the contractor not involved in the actual installation work are excluded from the PLA.



**BID PROPOSAL UNIT PRICES:**

**Three cost categories were included on the bid proposal forms.**

1. Project Management: Lump sum prices were provide for major work such as mobilization; warehouse/office rental; project management; field supervision; call center operation; appointment scheduling and public notifications; contractor service vehicles that bear the city project logo; data collection and management; training; quality control; and project meetings.
2. Standard Meter and MTU Installation Work: Included replacement of water meters varying in sizes from 5/8" to 1-1/2", and mounting the MTU outside.
3. Non-Standard Installation Work: The City did not want to negotiate change orders to address site specific problems with defects in homeowners' meter piping. To make it easier on customers by not having to reschedule appointments, defective valves or piping was replaced by the City at unit prices bid for Non-Standard Installation Work.





continued from page 49 - Canton's Meters

### SELECTION OF LOWEST AND BEST BID FOR THE INSTALLATION CONTRACTOR

A final total of three bid proposals were received from installation contractors. The scoring system for Phase II Construction Costs was devised to preclude a low bid for the Standard work, and high unit prices for the Non-Standard work. The contractor with the lowest Total Bid Price for Project Management and Standard Work was assigned 80 points, and all other bidders received a proportionally lower score based their bid. Therefore, if the lowest bidder was \$5 million, and the second lowest bidder was \$5.5 million, he received on 90.9% of 80 points or 72.7 points. In a similar manner, the lowest Total Price Bid for Non-Standard Work received 20 points, and others received proportionally lower scores. The scores for Phase I were added to the scores received in Phase II. The highest combined was deemed "Lowest and Best" bidder and was awarded the contract.

The project cost breakdown is as follows:

Engineering	\$348,000
Water Meter	2,103,000
ACLARA MTUs	2,032,000
Installation:	
Project	1,515,000
Standard Work	3,062,000
Non-Standard Work	511,000
Construction Administration	324,000
<b>Total Project Cost</b>	<b>\$9,895,000</b>

All bid tabulations, bid documents and forms were submitted to OEPA/WSLRA for final review. The OWDA loan application was approved by OWDA on March 27, 2014. The loan agreement was approved by the Canton City Council on April 28, 2014. Upon authorization by the Law Director and City Auditor, the Notice to Proceed will be issued.

### CONSTRUCTION SCHEDULE

The Canton Water Department anticipates no more than eighteen months for construction.

### CONCLUSIONS

As expected, the planning that led up to the start of this project was a very complex and arduous task given the number of variables to consider. The City and B&N spent countless hours over the course of 2013 researching, discussing and determining the best approach for Canton and its customers. These exceptional planning efforts allowed the Project Team to leverage the existing investment in Canton's AMR system; select a reputable and established meter manufacturer; and select a highly experienced national installation contractor, all at a price of nearly 30% lower than initial cost estimates suggest. Our hope is that these efforts result in a successful, well run and relatively low cost project that will satisfy the meter reading needs of Canton and its customers for the next 20 years.

