Lessons Learned From the Factor Four Metering Project

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By John Wawrysh

1 Background

The Factor Four area on the north end of the Burnaby Campus of BCIT is a group of 7 buildings. The goal of Factor Four is to reduce the consumption of energy by 75%. To achieve a goal such as this you must first know what the present energy consumption rate is. This is being accomplished through the use of smart meters.

Other examples of added value of smart metering include:

- assigning a budget in order to drive change through cost accountability
- implementing behavioural change campaigns
- improve reporting granularity
- identifying high energy users (opportunities)
- benchmark and prioritize energy saving areas
- creating simple awareness and external exposure
- providing building operators alarms
- support full building continuous recommissionning

For all seven buildings there is consumption data of electricity available (the electrical smart meter installation and integration was completed in 2012). All buildings are remotely monitored using smart meters (Schneider Ion 7350 and 7300). This data is collected, compiled and stored and can be viewed at http://ems.bcit.ca/factor4.

The largest building in the group of seven (NE01) is heated using hot water piped in from a central heating plant located outside of the Factor 4 area. Because the plant supplies multiple buildings, it is impossible to know how much heat energy NE01 is consuming.

The 7 buildings (NE01 also has gas-fired equipment inside the building thus a natural gas sub-meter) have natural gas sub-meters but not all are monitored and those that are have to be read manually.

The addition of data acquisition devices on natural gas and heat from hot water is needed to get the total energy throughput of the Factor 4 area. The Factor 4 team has chosen to purchase meter equipment that will allow hot water and natural gas to be monitored remotely just as electricity is. This report outlines the process involved and the lessons learned from the acquisitions and installation of the equipment.

2 Heat Meter

A Heat meter for hot water is simply a meter that measures: the water flow rate in a water loop, water temperature supplied to the building and water temperature exiting the building. The meter then calculates the difference in temperature and applies that to the flow. You can then calculate the amount of heat the loop has used.

Energy = [Fluid Specific Heat * Fluid density * Flow * (Temperature Supply – Temperature Return)] * duration

There are several configurations that a Heat meter can take. The three major categories for the purpose of this project are inline, hot tap and ultrasonic meters. An inline meter is installed by cutting a section of your hot water loop out and replacing it with a turbine or ultrasonic style flow reader. A hot tap installation drills a whole into the pipe and a flow meter is inserted into the hot water loop. Hot tap installation kits can be purchased so that few particulates fall into your loop and no water leaks during the installation. A clamp-on ultrasonic meter sends a sound wave through your pipe from a transmitter to a receiver and a calculation provides the flow rate of your water.

See the table below to see some of the characteristics of the various HEAT meter styles.

	Inline Heat Meter	Hot Tap Heat Meter	Clamp-on Ultrasonic Heat Meter
Cutting into the pipe	X	X	
Interruption of service/draining loop	X		
Flow meter prone to jamming	X (unless ultrasonic)	X	
Risk of filings in pipe	X (unless ultrasonic)	X	
Easy installation			X

Although there are clear advantages and disadvantages to each type of meter there are factors specific to BCIT's heating loop that influenced the type of meter selected. The iron pipe in NE01 has issues with corrosion and contains fairly dirty water. Any non-ultrasonic meters (i.e.: using a turbine) could have maintenance issues. Given that the water in the BCIT loop is "old" it has accumulated particulates. These particulates in the water would quickly foul a turbine style flow meter rendering it useless. Also, typically, inline installations are used when brand new systems are installed because of the prohibitive cost of purging all the lines prior to installation. Although hot tap installation can incorporate ultrasonic technology with no moving parts a clamp-on ultrasonic meter was selected to measure the heat consumption of NE01. In large part, the selection of the clamp-on meter was due to the request of the Facilities Department and their knowledge of the facility. The cost of the clamp-on meter was more expansive but did fit within the Factor 4 budget for this project.

Many Heat meters are developed for the oil and gas industry and it is important to insure that you select the right product for your application. Review the literature on the company web sites but if you have the opportunity to speak with others that have experience with the products that are on the market, this advice can be valuable.

Once you have selected your brand of meter you may feel the need to get multiple quotes for the same meters. It is likely that your region has an authorized dealer for your product line. This will insure that you are getting a fair price for the product you have selected and eliminate the need to get competing quotes.

Installation of the Heat meter will typically be done by an external contractor. There are two options for the purchase of a meter. The first is purchasing the meter from the authorized dealer and then contract a contractor to install the meter. The second option is to have a contractor (typically a controls company) purchase the meter from the authorized dealer and then install the meter.

Measuring the heat is only one component of this project. The data also needs to be sent from the meter to our server. The installation location of the NE1 Heat meter is in ground and surrounded by cinder block walls. This does not allow for wireless communication to and from the Heat meter. To solve the lack of wireless signal the best simplest way to connect the Heat meter is to leverage existing nearby electrical meter (Schneider Ion 7350 with available input capability) that is already communicating via Ethernet. Many modern meters have inputs and outputs included in their design to allow the units to intercommunicate. These ports can act as an infrastructure for communicating between a variety of devices. You will likely need to have a specialist calibrate the meter that is receiving the data as well as the sending device to insure the accuracy of your data. In many cases this will be two different individuals. This will add to the cost of your project.

3 Gas Meters

In British Columbia the concept of a "smart gas meter" is relatively new compared to an electric smart meter. BC Hydro is in the process of installing electric smart meters all across BC. Fortis BC has not made any announcement around the installation of smart gas meters.

When upgrading a gas meter to give it the ability to take frequent intervals readings (e.g.: every 10 or 15 minutes) and to communicate remotely there are a couple of options. You can replace the meter with a communication ready meter or you can retro fit an existing meter with a module that will allow the meter to communicate. Modules usually communicate via Ethernet or Wi-Fi and you will need to assess what method works for your facility.

3.1 Ultrasonic meter (whole meter replacement)

If you choose to replace the whole meter be aware that calibration work will be needed. The cost of replacing the entire meter will be higher than the retrofit cost described in section 3.2. You would probably go with a new ultrasonic meter with remote communication capability if you were adding meters (e.g.: new construction). But in the case where you already have a standard mechanical gas meter, it is probable that you would go with the retrofit option described in 3.2.

In the Factor 4 area, all gas meters are diaphragm meters (except the meter in NE08 which is turbine style) and there is at least one model of retrofit module available to upgrade them. We could not find a retrofit module for the NE08 gas meter. This means that we would need to go for a full meter replacement, most likely using an ultrasonic product. Because of budget constraints, we decided to keep reading the NE8 meter manually for a while.

3.2 ERTs (retrofit existing meter)

BCIT already has on its Burnaby campus a smart metering infrastructure developed and installed by the Group for Advanced Information Technology (GAIT). GAIT has worked with Tantalus Systems Corp. (Tantalus) to develop a wireless network for smart meter. Also, Tantalus has experience working with Itron who manufactures all sorts of smart meter equipment, including gas meter equipment. Tantalus expressed interest in using the Factor Four project as a test bed for integrating the Itron 100G ERT (ERG-5003-008) retrofit modules into the GAIT/Tantalus Wi-Fi/communications network present on campus. As a result it was determined that the greatest benefit to BCIT and its partners to use Itron equipment. At the request of Tantalus, Itron donated the necessary modules to BCIT.

According to Itron, the “Itron 100G gas ERT modules are radio-frequency (RF) devices designed to transmit meter data to an RF meter reading device within transmission distance of the ERT module.” They convert a mechanical movement into a RF signal.

These modules are a good fit for BCIT because they are a low maintenance product and should go their whole 25 year life without adding to facilities workload. The Itron 100G (ERG-5003-008) module is a retrofit module for the existing Rockwell natural gas meters on site (existing meter at NE1, NE2, NE3, NE4 and NE6). The ERT modules are compatible with the existing radio communication tower used as part of the Smart MicroGrid research infrastructure and will not require the installation of communication equipment other that the build-in device found inside the ERT 100G.

BCIT has a requirement that products installed on campus be Canadian Standards Association (CSA) approved. The Itron modules have a Canadian Underwriters Laboratories (CUL) approval. After researching the standards, it was found that the CUL approval was granted using a CSA standard. The B.C. Safety Authority asks for an “A” pipefitter to install the equipment under the proper piping permit. The installation of the Itron 100G will be completed by internal facilities staff.

Interesting note: If the meters that the modules are being installed on had been revenue meters, Measurement Canada would need to approve that the modules are sufficiently accurate to be used for billing. Revenue meters are owned by Fortis BC and are used for billing purposes. In this case the meters are internal BCIT owned sub meters and we are free to alter the meters.

Going from mechanical to an RF signal is only one component of this project. The data also needs to be received and saved on a BCIT server. This will be done using the existing GAIT/Tantalus hardware already on campus and a special integration software currently being developed by Tantalus. Detailed information on this part of the project was not available at the time of writing this paper.