# Calculate Water and Energy Consumption Using the SEL-2411

Chris Hilling

## INTRODUCTION

Facilities managers and engineers need accurate, reliable water and energy consumption data systems that are similar to the system shown in Figure 1. They use the data to monitor operating expenses, track energy usage, conserve resources, perform maintenance applications, and conform to regulatory requirements. This application note outlines some of the possibilities of how an SEL-2411 Programmable Automation Controller can be implemented to provide this information.
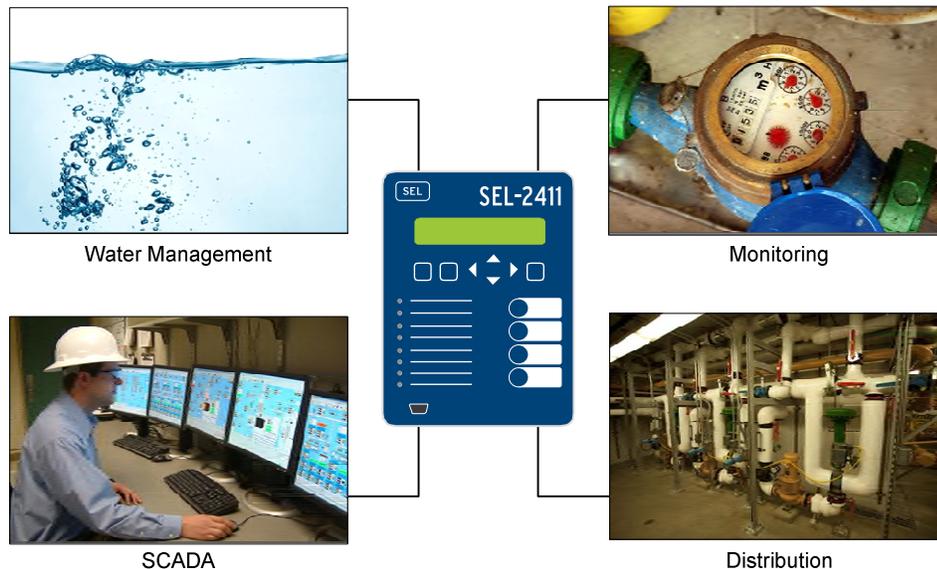


**Figure 1   Example SEL-2411 Water and Energy Data System**

## OPPORTUNITY

In building management system (BMS) and industrial water applications, having one device that can monitor the flow of multiple water meters and calculate the thermal capacity of a water chiller is of definite importance. Also, displaying real-time data on a local screen and sending the data to the supervisory control and data acquisition (SCADA) system of the facility is critical for energy and resource tracking and useful as a maintenance tool. Accounting for how much water is used for irrigation is important to determine and monitor how much water is going into the sewage system.

## SEL SOLUTION

The SEL-2411 is a simple, yet powerful, tool to track water and energy consumption. With a flexible I/O arrangement, the SEL-2411 can read analog and pulse signals from multiple water meters and temperature sensors, as shown in Figure 2.
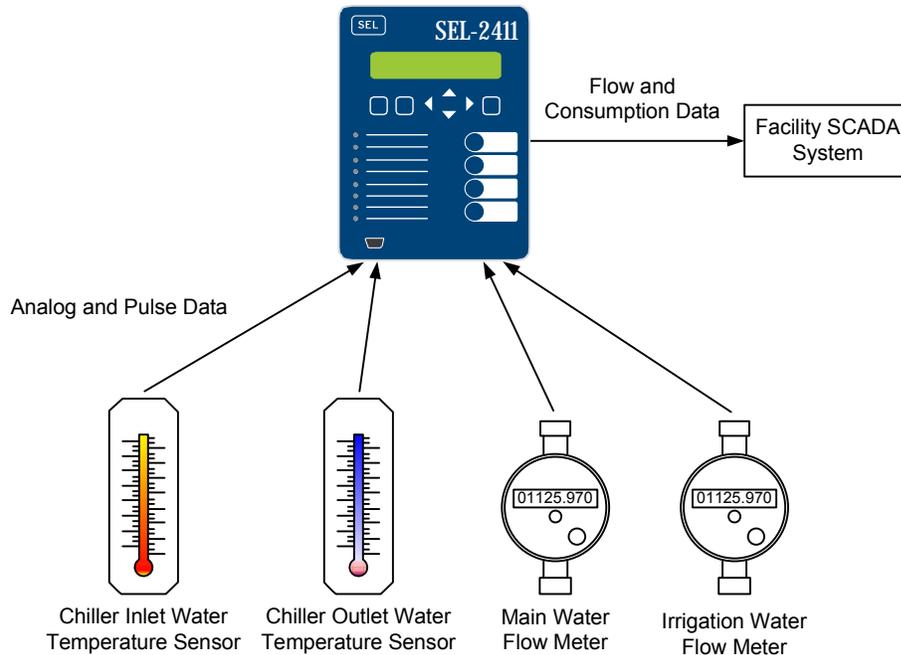


**Figure 2    Example Water and Temperature Measurement System**

With the powerful programming features of SELOGIC® control equations, the SEL-2411 can calculate the total water flow and chiller energy consumption. The totaled water flow calculations can then be used to verify values from the water flow meter.

With the support of industry-standard serial and Ethernet communications protocols (such as DNP3 and Modbus®) and a local liquid crystal display (LCD), the SEL-2411 easily shares data with maintenance technicians and SCADA equipment. Facility managers can subtract the irrigation usage from the water consumption to determine sewage flow. Maintenance personnel can read flow data from the front of the SEL-2411 for troubleshooting, and the SCADA system can collect, report, and archive data from the SEL-2411.

## PRINCIPLE OF OPERATION

Water temperature and analog flow sensors connected to inputs on an optional analog card provide instantaneous values to the SEL-2411. Pulse water flow meters connected to discrete inputs provide flow data to the SEL-2411. Connecting additional meters, such as an irrigation water meter, expands the amount of data that the SEL-2411 provides.

SELOGIC control equation programming inside the SEL-2411 monitors instantaneous values, records cumulative water flow, and calculates chiller thermal capacity in British thermal units (Btus) per hour or in tons. Equation (1) shows an example of this formula. Figure 3 shows the example SELOGIC control equation settings in the SEL-2411 that perform the calculations. Additional logic can also record the cumulative values for demand tracking.

$$Btu\ Per\ Hour = \Delta T \bullet Flow\ in\ GPM \bullet 500$$

$$Tons = \frac{\Delta T \bullet Flow\ in\ GPM \bullet 500}{12,000} \tag{1}$$
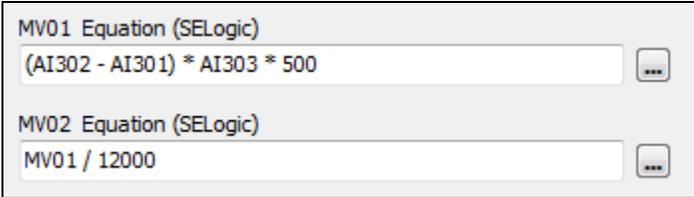


**Figure 3   Example SELOGIC Control Equation Energy Consumption Calculations**

MV01 calculates $\Delta T$ by subtracting inlet temperature (input AI302) from outlet temperature (input AI301) and then multiplies the difference by water flow in gallons per minute (GPM) (input AI303) and 500 (a constant). MV02 calculates the tons by dividing the Btus per hour (MV01) by 12,000 (a constant).

Water usage can also be monitored using the SEL-2411. The instantaneous flow rate can be monitored for leak detection or other troubleshooting purposes. Water consumption values inside the flow meter can also be verified using the totaled flow values calculated in the SEL-2411. These values can be easily displayed on the LCD screen, as shown in Figure 4.
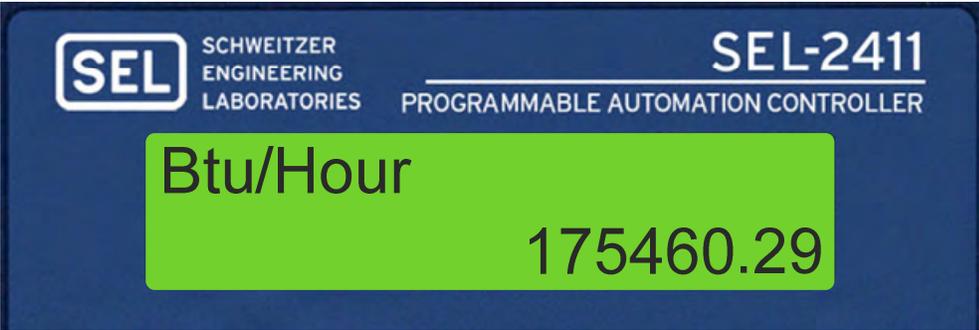


**Figure 4   SEL-2411 LCD Screen**

The SEL-2411 can send flow and energy consumption information to the SCADA network of the facility over industry-standard serial or Ethernet protocols.

**4**

**SCHWEITZER ENGINEERING LABORATORIES, INC.**
2350 NE Hopkins Court • Pullman, WA 99163-5603  USA
Tel: +1.509.332.1890 • Fax: +1.509.332.7990
www.selinc.com • info@selinc.com