



This is an above-ground view of the meter vault. The SCADA console is in back of the vault.

Keeping Meters On Line

Accurately Measuring Drinking Water and Sewage

D*etroit Water & Sewerage Department (DWSD) has a high stake in keeping its flowmeters up and running with calibrated accuracy. This is especially true for its 278 wholesale water meters used in its vast network of distribution lines that serve 126 communities. It also is true for metering sewage inputs from wholesale customers for its Wastewater Treatment Plant. This article focuses on a unique answer that DWSD found for keeping its magnetic meters online by means of a portable electronic system that verifies and certifies calibration, all done in-line.*

Technologies for metering water and sewage flows have developed rapidly over the years since the formation of DWSD in the mid-1800s. Meeting ever-increasing metering needs has meant keeping up with developments in metering and trying out new methods. Today, we have several basic types, including Venturi meters, mechanical (turbine type) meters and magnetic flowmeters.

In recent years, for both water and sewage applications, we have been upgrading many outmoded meters with the ABB MagMaster brand of magmeter. Current contracts will bring the total number of installations up to 45. Some 35 of these are water meters, ranging in size from 8 to 24 inches—part of the 278 master meters used for wholesale billings.

Magmeters have performed very well for us and offer several basic advantages. They can be factory-calibrated to have

Figure 1: Flow Meter System Verification Schematic



an accuracy of up to 0.15 percent of flow rate; provide a linear scale; have a rangeability of 1,500:1; come in sizes from less than an inch up to 120 inches; have zero head loss with no flow obstruction; and are unaffected by changes in fluid density or viscosity. In larger sizes, they are very heavy, but if we can check calibration in-line, once they are installed, weight is not a problem.

Checking Meter Calibration In-Line

For its MagMaster line, ABB spent considerable time and effort developing an effective, electronic method of inline (in situ) verifying and certifying the calibration of its magmeter system. Introduced in the U.S. in the late '90s, the new system confirms the entire magmeter system—transmitter, sensor and interconnecting cable. The basic hook-up at the meter site is shown as a schematic in Figure 1.



Figure 2: A technician sets up a portable PC for a CalMaster test run at a remote metering station.



Figure 3: Philip Ellison, construction instrument technician, holds the cable that connects a transmitter to the sensor in the vault.

DWSD was one of the first utilities to take advantage of this new development. Customers have the option of purchasing the services of a trained technician to perform onsite validations at scheduled intervals. However, since DWSD meter sites are numerous and widely scattered throughout the system and we wanted them visited at least at six-month intervals, we opted to purchase three of the systems. Training of our technicians by an ABB expert at our facility was included. This training gave us the flexibility of handling routine and

emergency calibration checks, as needed by ourselves.

We have been using the systems for more than three years and have found a number of benefits from their use.

- We obtained ISO certification of the complete flow metering system without having to remove the magmeter's primary sensor from its underground location in a vault. This is no small matter of expense, especially with larger water meters that currently range up to 24 inches. For metering



Figure 4: This underground vault houses the water meter sensor (inset). In the background, wall-mounted, is instrumentation that measures inlet and outlet water pressure and vault temperature.

sewage flows, magmeters can run much larger (up to 78 inches).

- Keeping the meters online also greatly reduces downtime that would be involved in taking the meter and its converter to the flow calibration facility.

ity. Even using a replacement meter would still mean a lengthy shutdown at the metering site.

- By verifying that the original calibration data are still valid, the system can help satisfy the ever more stringent

requirements of maintenance and calibration set up in our department. Such data also can be useful to answer queries from our wholesale customers. A printed verification document for proof of calibration is provided by the system.

- For each meter site, periodic calibration and performance checks provide us with a valuable tool for diagnostic and condition monitoring. CalMaster stores all previous validation data and thus can plot trend curves for various meter components. If such a curve shows a gradual deterioration in a meter parameter, preventive maintenance steps can be taken to avoid complete meter failure.

For example, in one case, a scheduled check showed a nick in the cable to the sensor. This eventually would have allowed water to leak into the sensor and cause a total meter failure. With this early warning, near-term maintenance was scheduled to replace the damaged cable.

- In our central meter calibration facility, we use several different sized MagMasters as a standard to check the calibration of various types of meters against (up to a 12-inch size). These test meters are periodically validated against one of the CalMasters.
- ABB stands behind the CalMaster certification for its magmeters, as long as the meter is installed properly and the CalMaster tool is maintained and annually certified by ABB.

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Scope of the Metering Task

Today, DWSD is the third largest water and sewerage utility in the United States. Under contracts, it services more than four million customers with drinking water in Detroit and 126 neighboring communities. It operates five water treatment plants with a combined capacity of 1,500 mgd and serves the City of Detroit through some 250,000 retail and 30,000 commercial accounts. The utility recently has completed deploying automatic meter



Figure 5: At the Detroit meter test facility, lines for test runs on different makes of meters vary in size from 1" to 12".



Figure 6: This test setup uses a MagMaster as the standard for verifying a Venturi tube primary element.

reading (AMR) for 278 wholesale water meter facilities.

On the sewage side, DWSD operates the world's largest single-site wastewater treatment plant. It has a primary

capacity of 1,750 mgd and serves almost three million people in Detroit and 78 suburban communities. There are approximately 50 wholesale sewage metering sites.

This article describes two typical meter sites for drinking water, where a technician would go with the validation equipment. For both water and sewage measurements, these sites are spread out across the approximately 1,000 square miles in DWSD service area. These areas reach out as far as 70 miles from our central facility, emphasizing the problem of maintaining meters and keeping them in calibration.

Verification at a Meter Site

As shown in Figure 1, there are just two basic components of the verification system: a portable PC that contains the software to carry out a pre-programmed verification procedure and the Control Box. Two cables come with the system for connecting the PC to the control box and connecting the box to the magmeter transmitter.

As shown in Figures 2 and 3, at the meter site the transmitter is mounted in a freestanding cabinet and permanently connected by cable to the MagMaster sensor that is installed underground in a vault (Figure 4). The technician places the PC and control box at convenient spots near the transmitter and then makes the cable connections as required.

Once the technician initiates the procedure, within a matter of minutes the system has carried out a rather complex verification procedure. The technician



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then can review results on his PC display to confirm that they meet the set standards. A certification of validation for the tested meter can be printed out at the meter shop.

Tie-In of Meters with New SCADA System

On its master water meters, DWSD has just completed a new SCADA system that ties in with the current 278 meter sites that measure drinking water to wholesale customers. A complete description of this system is beyond the scope of this article.* Briefly, the system receives flow information and other data at each remote site and, through a remote terminal unit (RTU) at the site, sends a packet of data via radio transmission to both a systems control center and commercial operations at the main office in downtown Detroit. The Meter Operations and Information Systems (I.S.) Divisions, located at the central service facility, also receive the same information.

The SCADA system reports total flow at five-minute intervals. Also included in its data packet are pressure readings for incoming and outgoing water as well as various alarms (intrusion, flooding of vault, cabinet temperature, low battery, etc). The same system now will be added to some 50 sites for wholesale sewage metering.

One unique feature of this system is that DWSD not only collects all of this information but also simultaneously transmits it to each community. This allows the DWSD wholesale customers to see their flow information before the Commercial Division prepares the bill.

To tie in with the SCADA system, the ABB MagMasters connect to a Control Microsystems RTU along with other instruments via a HART loop. The RTU is shown in Figure 3. Having an accurate metering system is the critical starting point for all this new SCADA technology.

Figure 5 shows an overview of our calibration facility where all types of meters are checked. For many of these, we have nine MagMaster meters that we use as a standard of comparison.

These are installed in 8", 6", 2" and 1" test runs.

Figure 6 shows a test setup with an 8" magmeter installed upstream from a Venturi meter to be checked. The d/p cell, shown pipe-mounted, detects the differential pressure created by the tube as a measure of flow rate. This measurement is compared to the flow rate measured by the magmeter.

* Described fully in a presentation made at a recent seminar of the Automatic Meter Reading Association (AMRA) by Dennis L. Green, PE, Head Water System Engineer, DSWD.

All photographs by Ray Warrior.

About the Author:

Rodney Johnson is assistant superintendent of meter operations at DWSD. He has been with the City of Detroit for 24 years, 21 of those with DWSD working primarily on the water side. He graduated from Wayne State University with a BA degree.

For more information on this subject, circle 865 on the reader service card.



A CalMaster system is being set up in the test facility to check the calibration of one of the nine MagMasters. Shown clockwise are Marian Bryant, instrument apprentice; Greg King, instrument technician; Mashuk Meah, instrument technician foreman; and Rodney Johnson.

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