



CONSERVATION, CUSTOMER SERVICE AND ADVANCED LEAK DETECTION THROUGH RADIO FREQUENCY AMR/AMI SYSTEMS

E-CODER® HIGH RESOLUTION DATA AS THE FOUNDATION FOR LEAK DETECTION

In the face of revenue pressures, increasing operational costs, and manpower shortages, utilities can't afford to ignore water loss. Nor can they afford to literally underestimate the problem. As utilities review better methods to conserve water and control costs, leak detection has become a critical component of any modern utility management system. This paper will explore how utilities utilizing Neptune Technology Group's ARB® Mobile™ and ARB® FixedBase™ Systems can build successful leak detection programs, whether that system collects mobile or fixed network meter readings through one-way automatic meter reading (AMR) or uses two-way fixed network advanced metering infrastructure (AMI).

In either Neptune's AMR or AMI system, the keystone and starting point is the smart encoder – the E-Coder® Solid State Absolute Encoder. An E-Coder-based system provides an advanced level of leak detection and detailed consumption data that accurately identifies water leaks on the customer side of the meter. Providing advanced 8-digit, high resolution data, the E-Coder provides resolution down to 1/10th of a gallon (1/100th cubic foot, 1 litre). This allows the utility to identify leaks that might otherwise be overlooked by lower resolution encoder registers that cannot deliver granular enough data to the AMR/AMI system to enable post-processing leak detection.

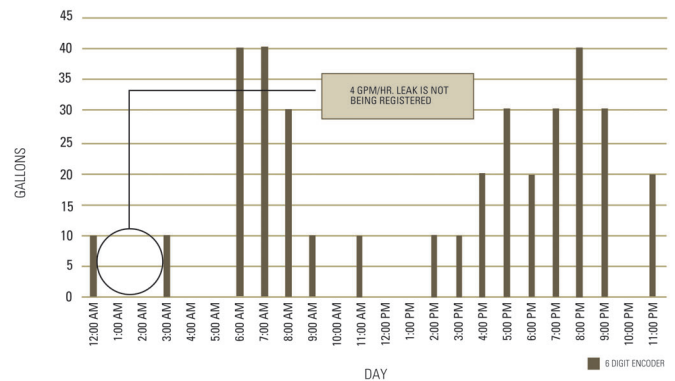
The E-Coder divides each 24-hour day into 96 15-minute intervals and monitors flow during each of those intervals. The E-Coder continually checks for consumption in each 15-minute interval, while its "smart" metrology distinguishes between intermittent and continuous leak conditions. It also keeps track of the

number of days the leak condition has existed. The E-Coder sets flags in the register to mark these leak conditions, updating the flags every 15 minutes. This level of advanced data, E-CoderPLUS data, is a valuable tool in water conservation and customer service.

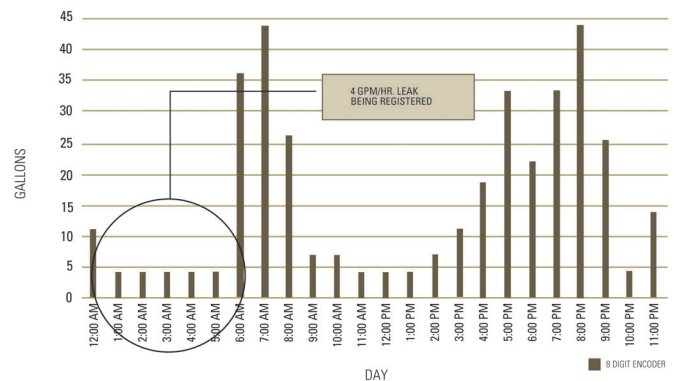
A small leak may seem insignificant. But if not caught early, it can add up to a significant volume of water. Leak detection for most competitive systems is dependent on meter reading resolutions of 1 to 10 gallons from conventional 6-digit encoders. At best, these systems have to rely on algorithms programmed into the MIU or software analysis at the host to "infer" that a leak state existed – never really knowing whether there was a true leak. The fact of the matter is that a 6-digit encoder may not increment in an hourly interval with flows that are indicative of leaks so neither the algorithm in the MIU or post-processing in the host can accurately determine whether a leak has in fact occurred.

Consumption graphs based on Neptune's E-Coder further illustrate the value of the E-Coder's 8-digit resolution. Graph 1 shows a typical residential utility service connection using a traditional 6-digit encoder with a visual registration of 10 gallons. Graph 2 demonstrates the same residential utility service

connection with the E-Coder's 8-digit reading, which provides 1/10th of a gallon resolution. This residence developed a four-gallon-per-hour leak at 12:00 a.m. (See the circled area on Graph 2.) The E-Coder's 8-digit resolution not only identifies the leak but also displays the consumption when the leak starts. Additionally, the E-Coder sets flags for each 15-minute interval during a 24-hour period when this leak is present. With a 6-digit encoder, the leak could be masked, as this consumption would not register for three hours until the low resolution encoder incremented, and in all likelihood would appear as normal consumption.



Graph 1 – 6-digit encoder



Graph 2 – 8-digit encoder

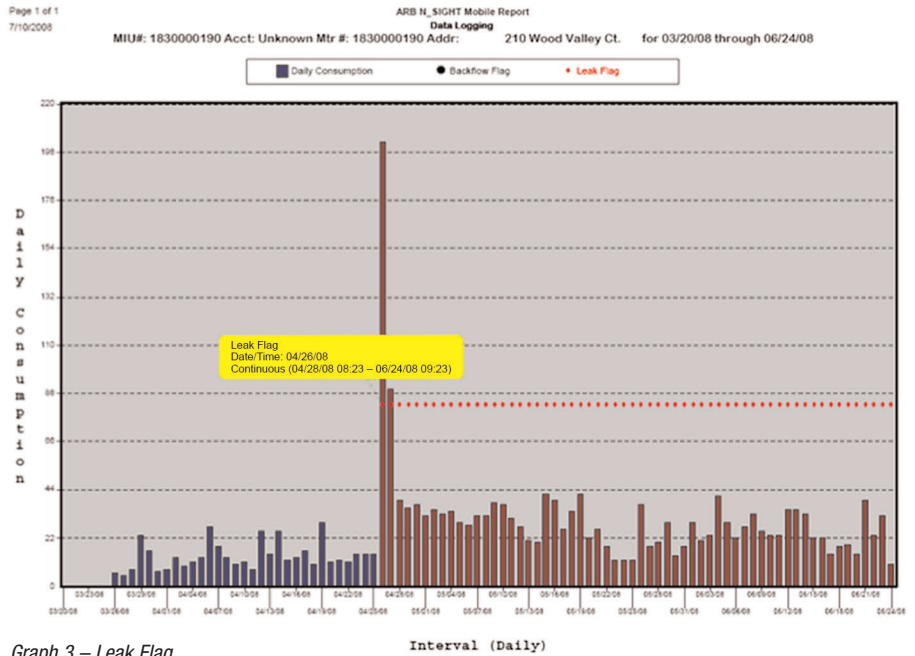
For utilities using an R900®-based radio frequency (RF) system, such as ARB Mobile or ARB® FixedBase™ AMR, Neptune's solid state E-Coder/R900™ DL data logger provides a rolling 96 days of hourly meter readings, plus leak and reverse flow flags. The hourly readings and leak flag data generated by the E-Coder/R900/DL can be extracted via RF interface using a Neptune handheld and transceiver for transfer to ARB® N_SIGHT™ AMR software, where utilities can view reports that identify not only when leaks start but also the duration of the leak event.

R900 DATA LOGGING AS A CUSTOMER SERVICE TOOL

Historically, when responding to customer calls regarding high water bills, a utility's only option was to issue a service order and dispatch a technician to the residence where the complaint occurred. The technician would then go through the process of ensuring that all of the external faucets were turned off, verify with the customer that no water was running in the home, and then check the leak indicator on the water meter. Sometimes the technician could verify the leak on the spot, but other times he or she would leave the homeowner frustrated and unhappy about their water bill.

The E-Coder/R900/DL data logger records consumption as it happens, every hour, allowing utilities to analyze usage patterns as proof of when and how much usage occurred. This historical consumption data can then generate consumption graphs within ARB N_SIGHT AMR software. These graphs are available for either daily or hourly consumption. Leaks can be identified either when usage does not reach zero over a 24-hour period or when an E-Coder leak flag is triggered. In addition, reverse flow events are also illustrated. For example, Graph 3 indicates daily consumption collected over the time period and shows a leak flag, the start date, and time of the leak.

The daily or hourly consumption graph can be given to the customer – identifying when water was consumed and flagging leak states that help justify the amount charged on the bill, and resolve any issues.

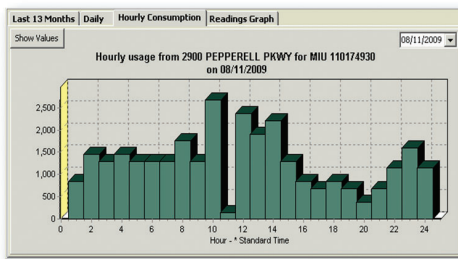


Graph 3 – Leak Flag

This kind of proactive approach enhances customer service. Neptune's ARB® FixedBase™ AMI System provides time-synchronized reads at midnight and 24-hour customer usage profile data for every customer under the network. Customer service representatives can, with the click of the mouse, pull up hourly, weekly, and monthly usage information to assist in resolving high

water bill complaints. Up to two years of consumption history is retained in the ARB N_SIGHT AMI host software, so consumption data can be compared from one year to the next for the same period of time. Consumption data is displayed in graphical and tabular formats, making analysis quick and easy.

Utilities that seek to proactively notify their customers of potential leaks can have their billing or customer information system provider transfer the E-Coder leak information directly to their customers' bills, allowing customers to fix water leaks before the condition reaches the point where they issue a high water bill complaint.



Hourly Usage Graph

Date	Consumption	Hourly Consumption						
		Hour 1	Hour 2	Hour 3	Hour 4	Hour 5	Hour 6	Hour 7
08/11/2009	30611	839	1451	1298	1451	1298	1298	1298
08/09/2009	41029	902	902	1312	1722	2338	2543	2748
08/08/2009	42100	1254	833	1465	2096	1886	2307	2728
08/06/2009	37369	1113	926	1300	1300	1300	1487	1487
08/06/2009	37369	1113	926	1300	1300	1300	1487	1487
08/06/2009	37369	1113	926	1300	1300	1300	1487	1487
08/05/2009	31334	1118	1284	1294	1450	1450	1615	2444
08/04/2009	36482	730	1094	1824	1277	1459	1642	2006
08/04/2009	36482	730	1094	1824	1277	1459	1642	2006
08/03/2009	32317	2003	549	872	1033	2326	145	1680
07/31/2009	31228	611	611	1080	1392	1236	1236	1861
07/31/2009	31228	611	611	1080	1392	1236	1236	1861
07/29/2009	29198	946	654	1822	1238	1384	143	1384

Hourly Volumes Table

MASS BALANCING AND DISTRICT METERED AREA (DMA) MONITORING

The Neptune ARB FixedBase AMI System provides synchronized meter readings at midnight from every water meter in a utility's system, allowing utilities to compare production water versus revenue water and conduct District Metered Area (DMA) analyses.

Using the system's time-synchronized midnight meter readings, the utility will have the total consumption for

any given collection of meters within a district or "area." This total consumption is compared to the master or "bulk" meter(s) servicing the area. Systems having a large discrepancy between the total consumption in the area and the respective master meter(s) are indicative of potential distribution system leaks within a particular area. This is only possible with exact time-synchronized reads for accurate comparison.

Water leaks in any form – leaks at the meter on the customer side or leaks along the distribution system – can be extremely costly for a utility. Using Neptune's smart encoders, data logging, acoustic leak noise logging, and, in the case of ARB FixedBase AMI, synchronized system-wide meter reading, utilities can help prevent the loss of millions of gallons of water while recapturing revenue. 