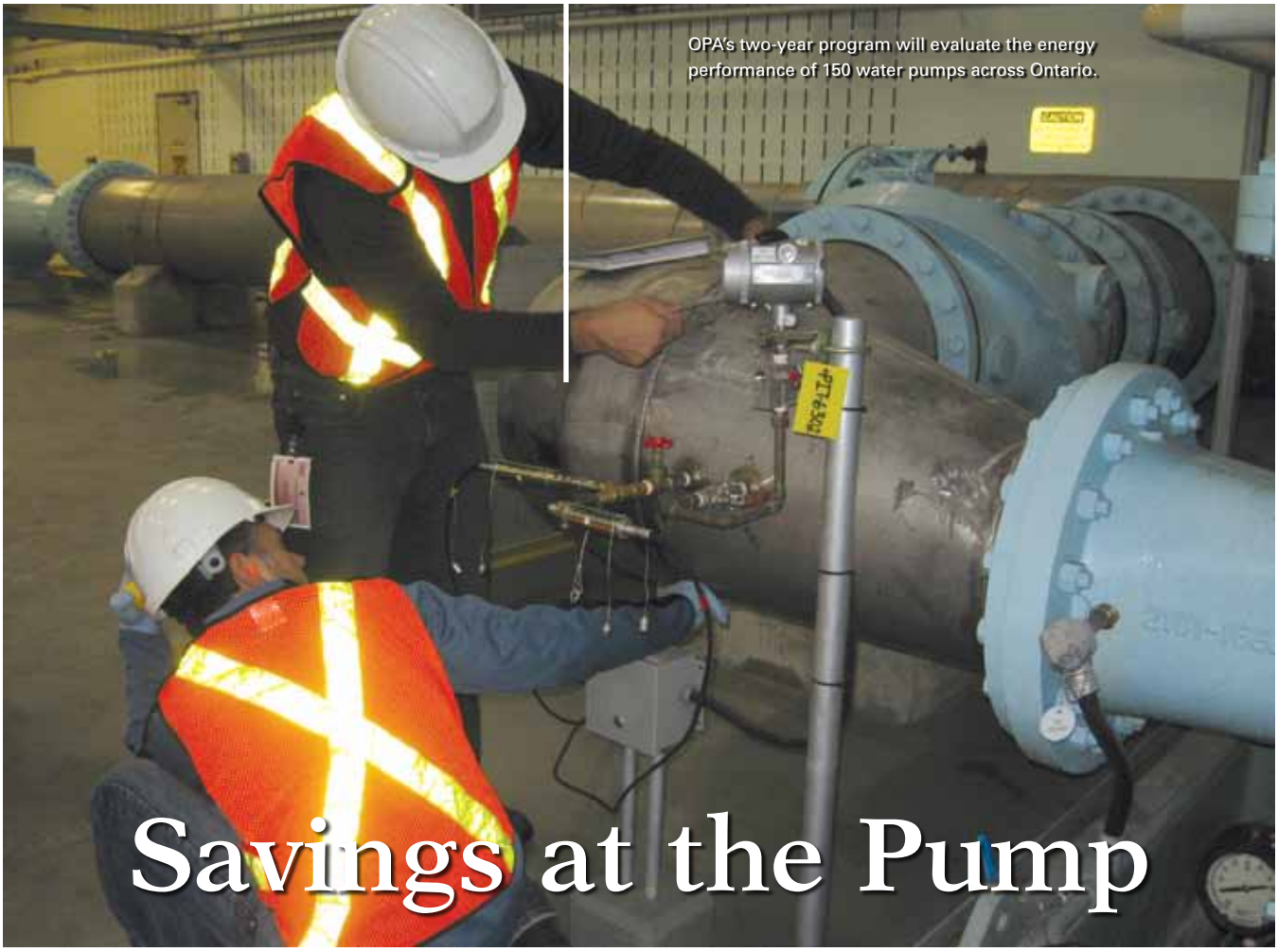

OPA's two-year program will evaluate the energy performance of 150 water pumps across Ontario.

Savings at the Pump

Understanding the real energy efficiency of water pumps.

BY FABIAN PAPA AND DJORDJE RADULJ

IN A RECENT University of Toronto publication discussing the water-energy nexus, Bryan W. Karney writes: "…if you are thinking about big challenges, and big threats, and those topics that are likely to dominate humanity over this century, you might want to think of water and energy." In the context of our urban existence, we often take the availability and reliability of electricity and water for granted and simply expect to have these luxuries at the flick of a switch or opening of a tap.

Behind the scenes, however, massive amounts of energy are being expended to process water to make it suitable for public consumption, to transport and distribute the water from its source to its points of use, and to provide it at a pressure that is generally enviable by most global comparisons. With the exception of the relatively few gravity-fed systems, this energy is imparted to the water by pumps tucked deep within non-descript buildings that are working continuously to provide us the comforts we enjoy.

While the amount of energy used for pumping varies depending on a number of factors, values in the order of 20 per cent of total electricity consumption being used for this purpose are common. The life-cycle cost of running a pump is often roughly split 50/50 between its original capital cost and the cost of operating it. In addition, pump inefficiencies often account for up to approximately 25 per cent of potential energy savings in pumping stations. It therefore stands to reason that energy efficiency should be an important consideration to our municipalities and utilities that are responsible to deliver water services. In fact, it is.

The importance of this extends more broadly beyond the cost of operating our pumping systems into the complementary infrastructure systems related to energy production, transmission, and distribution. In recognition of this, the Ontario Power Authority (OPA) Conservation Fund is sponsoring a program titled Toward Municipal Sector Conservation: A Pump Efficiency Assessment and Awareness

> Pump inefficiencies often account for up to approximately 25 per cent of potential energy savings in pumping stations.

Pilot Study. This two-year program, scheduled to conclude toward the end of 2012, will evaluate the energy performance of 150 water pumps across the province in conjunction with seven municipal partners. The results and findings will become publicly available and will provide the basis for industry benchmarking and energy conservation.

This program is an excellent example of partnership between the water and energy sectors. OPA's leadership in this regard is significantly lowering the barriers to municipalities and utilities to performing these assessments which, in turn, will help increase awareness and understanding of the benefits that such testing has to offer. This will serve as an example for Canada and beyond, resulting in the wider adoption of conservation practices and leading towards a more sustainable existence.

How does it work?

The tests are conducted using the thermodynamic testing method which is generally regarded as a very efficient and highly accurate method, and one that relies on technology available from only a couple of suppliers globally. This interesting technology measures the heat gain in the water across a pump as a measure of the pump's inefficiency; that is, the energy which is not imparted to the water as flow and pressure (which is what we want) is actually wasted to heat. Most importantly, the results of the tests tell us the following:

1 **Actual pump efficiency and performance.** Although this is obvious enough, it is not uncommon for system planners to use original manufacturer efficiency and performance values, thereby introducing errors, in their work. Pump efficiency is an excellent indicator of pump health and degree of degradation, and is a key measure to inform preventative maintenance.

2 **Estimates of energy and cost savings.** Comparing the results of the testing with original manufacturer information, or identifying improvements to pump operations, can provide an indication of how much energy can be saved, in terms of metrics such as kilowatt-hours or greenhouse gas (GHG) emissions. Cost savings can accordingly be estimated which help to develop business cases around pump retrofits, replacement, as well as operational strategies.

The savings at the pump are just the start of the energy efficiency story in water systems. But they are a very important part of this story. Numerous municipalities have completed, are in the process of, or are planning the undertaking of system-wide optimization studies which seek to balance the needs of service levels (including flows, pressures, and water quality) with the various costs of delivering the service, a major component of which is the energy input. Such studies can be quite complicated

and involve matters such as alternative pumping and storage strategies in an environment of time-of-use electricity pricing.

The results of these studies are subject to the errors introduced in their input parameters along the way of which pump characteristics form an integral part. This OPA-sponsored program will give analysts meaningful insights into how reliable their model inputs might be, as well as pave the way for further on site measurement and testing to support these various initiatives. In simple words, one cannot manage what one does not measure.

The results

While it is too early to report the results as testing is ongoing, the general observations suggest that pump operating efficiencies on the order of 10-15 per cent less than the manufacturer's best efficiency point are quite common. To understand the meaning of this, let's do some simple math:

- A conservative estimate of the annual power consumption due to municipal water pumping in Ontario is 500 GWh (that is, 500,000,000 kWh).
- If the average pump inefficiency is 10 per cent, then 50 GWh are being lost each year.
- Being realistic, we can't recover the entire inefficiency for various reasons, but a reasonable target might be half (i.e., recovering 5 per cent of the 10 per cent total), or 25 GWh.
- The average Ontario household consumes about 1,000 kWh each month (12,000 kWh annually). So, the potential energy savings could power over 2,000 homes.
- At an average tariff of 10 cents/kWh, Ontario municipalities could save in the order of $2.5 million annually. Of course, this value will undoubtedly climb as electricity tariffs are only to increase going forward.

These are only the direct benefits. Indirect benefits are expected to come from additional improvements that become visible as more information becomes available and as system knowledge is improved through increased awareness. WC

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