

# PLC v's MultiSmart Comparison

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## The PLC Compared with a MultiSmart pump station manager

The PLC has achieved great success across a wide range of process control applications, including the water/wastewater pump station panel.

This document looks at the advantages and disadvantages against an application specific product such as the MultiSmart family of pump station managers from MultiTrode.

### Why Question the PLC?

For many, questioning the application of the PLC to the pump station panel would be surprising. After all, the pump station panel used to be controlled with a range of relays, timers, and other devices. This is exactly the kind of application where the PLC has had such success in industrial automation. The PLC is easy to program, even for non-programmers, with the intuitive ladder logic interface offered. Changing the control logic is so much easier than rewiring a panel.

However, across Australian and US water & wastewater authorities, there are a large (and ever-increasing) number of authorities specifying MultiTrode pump station managers even where a PLC-based RTU already exists in the panel.

The reasons for reconsidering the PLC as the control device can be categorized as follows:

- Software development, commissioning and maintenance costs are too high
- Reliability of the “one-off” software in a critical environment
- No user interface – still need additional wiring to indicator lights and control switches
- Non-standard I/O specific to a pump station application require additional components



### Brief Summary of the MultiSmart Features

The MultiSmart pump station managers was developed primarily for control and monitoring of pump stations in water and wastewater networks.

The key requirements identified by customers around the world were:

- “Out of the box” control of a range of pump stations
- Intuitive operator interface with level indication, pump status, auto/off/manual control, fault resets, detailed fault data
- Simple interface for setpoint adjustment, station optimization, supply protection setup, etc
- 3-phase voltage monitoring, supply protection
- Detailed on-site datalogging with date/time stamp for every event
- Pump efficiency monitoring
- Flexible & expandable I/O to handle pump seal/thermal, any type of level devices
- High speed communications including 10Mbit/s ethernet
- Open protocols for remote telemetry – DNP3 and Modbus

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## Software Issues with the PLC

### Software Development

A ladder logic implementation of 2 pumps alternating in a well with common fault inputs is very straightforward and this often leads to the conclusion that a PLC will be ideal for a municipal pump station.

However, consider some of the functions that authorities usually want to implement:

- Pump efficiency calculations (combination of power monitoring and flow measurements)
- Preventative maintenance indicators of insulation resistance to indicate when pump windings require service
- Maximum off time for the station to minimize odours (configurable)
- Maximum pump run-time (to reduce inefficient pumps running continually) – where the next pump to run cuts in after this time
- Maximum pumps to run (usually due to hydraulic constraints) – with the standby pump taking over from the duty pump at the standby level
- Primary 4-20mA level sensing with a backup device
- Fault inputs with flexibility to choose whether pumps/station locked out, manual/SCADA reset required, auto-restart periods, etc
- Sump clean out once per day (pump down below the normal duty cut-out point to the snore point to clean out the well)
- Different setpoint profiles for different applications/times of the day, as required

There are many more functions of course. Typically the authority starts with the simple logic of 2 pumps alternating in a well with some hydraulic delays, and gradually introduces the required functions on stations that need them. Over a period of time, there will be multiple software variants across the network.

As the software gets more complex, the competent electrician model gives way to the system integrator requirement. Or the authority takes on specialist staff to help develop, test, and maintain the software.

Once competent system integrators are involved the following steps usually take place for new functions, or commissioning of new stations:

- Evaluating tenders/proposals from system integrators and then selecting integrator
- Developing the user requirements and functional specification (the authority is paying the contractor for this)
- Reviewing and signing off the user requirements and functional specification (internal costs)
- Development of the application (the authority is paying)
- Procurement of new hardware required (e.g. I/O modules)
- Implementation and commissioning of new functions (internal costs of project management plus the contactors time and travel costs)
- Possibility of further site visits for issues identified during commissioning
- Signing off the site acceptance tests

There may be additional specialist work required in mapping new information into the SCADA system, usually through a master RTU. This will incur additional costs.

## Software Maintenance

A common scenario when the system integrator arrives on site for the first time and looks at the existing code in the PLC is:

"It's just a mess, I have no idea what they were trying to do; I'll have to rewrite it"

After several integrators have played around with the same station over a period of time, the operations manager starts to consider putting in place guidelines for software development. These are procedures to ensure uniform standards and documentation of code so that each succeeding contractor does not trash development work.

This procedural work takes time and expertise, and therefore imposes a significant cost burden on the authority.

It is also important to note that usually software development, software maintenance, and software standards are not a core competence of a municipal authority. That is, it's not a regular part of their work, so the skills have to be learnt.

Each time a contractor comes to site, the authority is typically paying around \$100 per hour, sometimes more, and often, additional travel costs will be incurred.

## Software Reliability

Consider the following example with a water authority in Australia:

*One local authority had a contractor at site working on the PLC code and testing it. He mistakenly added the door contact to the pump starting logic but tested the station with the door open (very common).*

*After he shut the door, he drove home.*

*Two hours later, a high level alarm occurred and the contractor went back to site. The first thing he did was open the door, and then started checking the control logic. Everything appeared ok, so he closed the door and went home again.*

*Another hour went by and the high level alarm recurred. This time he found the problem and fixed it.*

Each authority has a number of stories similar. In some cases, the contractor is footing the bill, but in many cases the authority is paying, and especially when there is a spill and an EPA report required.

The primary problem is not the competence of contractors or the inherent reliability of a PLC. The primary problem is how to test the one-off code in a PLC, in all the environments that might occur.

This problem is well understood by organisations that develop software for commercial deployment. These organisations, such as MultiTrove, have developed well-proven systems and processes to ensure that code is progressively more reliable and bug-free. These include automated test suites which run over 10,000,000 different tests on the software before a new release.

As the PLC is for a one-off application or even if the code is to be used in 50 pump stations – There is no guarantee that the latest code will be an improvement on the previous version.

Usually, the testing is limited to the particular function added. The more complex the code and the less familiar the contractor is with the overall architecture of the code, the more likely that a change will introduce a bug into other functions within the code.

## Contrast of Software Issues with MultiSmart dedicated products

MultiTrode has more than 15,000 pump controllers and pump station managers in the field at water and wastewater pump stations.

The experience of the MultiTrode support and sales staff with the product means around 95% of problems called in by customers' onsite can be diagnosed within a few minutes. Sometimes the problem involves other equipment in the panel; sometimes a configuration of the product (which can be easily changed), and sometimes a fault has developed (usually related to power surges or lightning).

In very rare cases, and usually with a peculiar set of circumstances, a bug is found, and this will be targeted in the next release of software. Most bugs identified have a simple work-around to tide the customer over until the next release.

There is no software development on the part of the local authority, simply a determination of which parameters they want to enable and with what values. Therefore, their software development costs and software maintenance costs are negligible. These costs are simply limited to upgrades, which are usually supplied as part of a software package for a nominal sum.

## User Interface & I/O

The other aspects of the comparison between the PLC and MultiSmart are related to the user interface and the I/O.

### Application Specific I/O

The MultiSmart unit contains flexible I/O which can be configured as pump seal, thermistor, Flygt FLS, CLS wired directly from the pump. Frequently with a PLC, authorities are taking a separate control relay to be able to wire in these inputs. For example, with Flygt pumps, the Flygt miniCAS relay is used, which costs around \$400 per pump. Therefore, a 2-pump system requires an additional \$800 of components over the purchase price of the PLC.

## User Interface

### PLC

Typically, the PLC controlled municipal pump station has a set of selector switches (for auto, off, manual [hand]) wired in, along with a set of indicator lights. This is to allow the operators who visit site to turn on and off the pumps and to allow them to see the status of the pump station at a glance.

This adds additional cost, usually in the order of a couple of hundred dollars, and frequently there is no level indicator. This means the operators have to open the well to see what is happening – an increased hazard which municipal authorities are trying to avoid.

With a PLC implementation, no changes can be made to the site configuration without a contractor or highly trained staff member visiting the site with a laptop loaded with the appropriate licensed programming software.

### MultiSmart

The MultiSmart pump station manager has integrated the entire operator control and status annunciation into the control unit. There is also the ability to program the unit –i.e. to change setpoints, delays, and enable/disable/change the configurable parameters that govern the functionality of the unit.

Operators can visit site and change setpoints, as well as seeing which specific alarm conditions (if any) have occurred and clearing those alarms.

Electricians and engineers can make changes when they require, without needing to go through the extensive documentation and testing regime required of a PLC system.

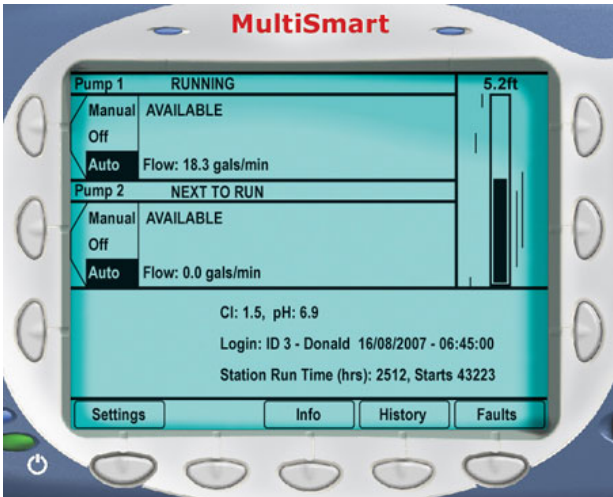


Figure 1 – Main screen, 2-pump station

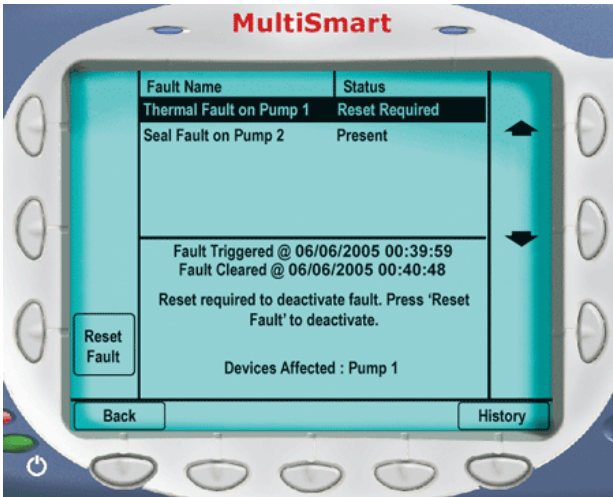


Figure 2 – Fault screen



Figure 3 – History Screen



Figure 4 – Settings, p1 of 1



Figure 5 – Flow values

## Conclusion

When considering the lifetime cost of the solution, all of the above factors should be considered. Some are easy to quantify, such as the additional components required to bring a PLC to the level of MultiSmart. It is common to find that the actual commissioning cost of a new panel with a PLC is \$2,000 higher than one with a MultiSmart pump station manager.

The software development, maintenance, and stability are much harder to quantify. However, based on our research, the costs associated with developing and maintaining a PLC to anything like the level of the MultiSmart are many times the purchase price of the PLC, and far outweigh the cost price of this innovative produce.

## Customer Comments

The final word belongs to our customers, across our range of pump controllers ...

*We have tested and installed 6 MultiSmart pump station managers over the past 6 months and I wish to let you know that we have been very pleased with the performance and ease of installation. The field staff have saw the benefits over float controls, and over our next water plan we will be looking to convert all our stations. The specification for sewer stations now incorporates the MultiSmart as standard for pumping station management and control.*

*For the past 12 years in the UK, with Scottish Water, I installed only the Siemens Enviranger (LUC 500). This is an excellent and reliable pump controller, however, after testing MultiSmart, we have been pleased to find it is reliable, easier for operators to use, and offers additional monitoring capabilities over any other pump controllers I have used.*

Frank Mc Shane, Manager of Operations, East Gippsland Water Authority, Australia

*"The City of Tavares has been using the MultiSmart products for just under a year. I can't imagine how we did it before; we can now monitor and control every station with speed and with the accuracy of information we require. We have also found the flow calculations invaluable for I&I studies during rain events.*

*Our experience with the product and tech support to date has been excellent. We highly recommend MultiTrode and its products. The City of Tavares has standardized on MultiTrode products and stand by them."*

Brad Hayes, Utilities Director & Jerry Blair, Supervisor, City of Tavares, FL

*"Someone has finally put all the versatility (previously available only with a custom programmed PLC) into a user configurable platform. From simple to complex, this unit handles it all. The wealth of pump station operational information available to the end user is virtually limitless."*

J.C. Van Harn, President, GrandTech, Inc., Byron Center, MI