

CITY OF HAMILTON

PUBLIC WORKS DEPARTMENT *Environment & Sustainable Infrastructure Division*

TO: Chair and Members Public Works Committee	WARD(S) AFFECTED: CITY WIDE
COMMITTEE DATE: October 3, 2011	
SUBJECT/REPORT NO: SCADA Process Automation Controller (PAC) Standard (PW11074) - (City Wide)	
SUBMITTED BY: Gerry Davis, CMA General Manager Public Works Department	PREPARED BY: Dan McKinnon (905) 546-2424, Extension 5941
SIGNATURE:	

RECOMMENDATION

That Rockwell Automation (Allen-Bradley) Process Automation Controller (PAC) and its future upgrades be approved as the corporate SCADA standard process automation controller for water, wastewater and storm water real time control (RTC) for the City of Hamilton.

EXECUTIVE SUMMARY

The Water and Wastewater Operations Group of Public Works is responsible for operating the City's water and wastewater systems which includes treatment plants, municipal well systems and includes 150 facilities throughout the city. These facilities include water towers, reservoirs and water and wastewater pumping stations, combined sewer overflow tanks and reside over a large geographic area from Carlisle and Freelon in the north, to Binbrook in the south and to Fifty Road in the east.

The system that facilitates the operational control is referred to as SCADA - Supervisory Control and Data Acquisition. The SCADA system allows operators located at the Woodward Avenue treatment plant to observe the system and to remotely make operational changes to system components when operating conditions require or an alarm is received. Not only does SCADA provide the mechanism through which the systems are controlled, but it also provides the infrastructure through which millions of pieces of information are transferred for storage to ensure legislative compliance with a number of regulations including the Safe Drinking Water Act.

On any given shift Process Supervisors will respond to changes in status whether it be the operation of a pump, a loss of power, change in a process operation parameter, unauthorized entry or an adverse process condition. SCADA is a critically important and fundamental component of both the water and wastewater systems. It is not unusual for Process Supervisors to respond to 2,000 process notifications such as a change in state or alarms in a single day.

The SCADA System as a whole consists of a number of elements including data loggers, instrumentation, process automation controllers, switches, servers, software, as well as communication lines such as traditional telephone lines, fibre optic cable and wireless networks.

In 2008 the Water and Wastewater Operation Group undertook the development of a SCADA Master Plan to ensure the reliable provision of operational control throughout the system on a long term basis. As part of this process, standards were developed in a number of areas and it is approval of the PAC hardware associated with these standards that is being recommended in this report:

(a) That Rockwell Automation (Allen-Bradley) Process Automation Controller (PAC) and its future upgrades be approved as the corporate SCADA standard process automation controller for water, wastewater and storm water real time control (RTC) for the City of Hamilton in accordance with Policy #14 of the Purchasing Policy.

Periodically, practices and equipment will change as the industry evolves requiring update to the SCADA Standards. Staff will continue to modify the SCADA Standards document to reflect appropriate industry practices used in Hamilton and will bring it to Council for approval when major components of the system are to be specified for future projects.

Alternatives for Consideration - See Page 16

FINANCIAL / STAFFING / LEGAL IMPLICATIONS
--

Financial: The replacement of Process Automation Controllers (PACs) within the system occurs due to operational obsolescence or as a result of capital upgrades and additions and as such these expenditures are accounted for in both operating and project specific capital budgets.

The SCADA master plan recommends the replacement of the entire inventory of PACs over the next three years due to the fact that the existing equipment is at the end of its service life and in many cases well beyond that threshold. Replacement of the existing inventory of PACs over the next three years is estimated to cost approximately \$20 Million for PAC hardware, installation and programming.

The City of Hamilton is currently using a large number of Allen-Bradley PACs with an active support agreement with Rockwell Automation and as a result enjoys preferred pricing.

The recommendations in this report provide greater value for lower overall cost to implement the SCADA master plan by having the ability to migrate to a corporate

standard over a longer period of time. Also, leveraging the existing corporate knowledge of the preferred system and maintaining an inventory of replacement parts for a single product combines to support efficient management of the system.

Under the SCADA Master Plan staff have standardized PAC program templates which will result in lower development costs for new and upgraded PAC installations. This will allow for maximum utilization of standardized code, predictability for support, and enhanced maintenance response.

Staffing: A steering committee has been established in consultation with I.S. (Information Services) staff for the SCADA Master Plan project with a staff level working committee of key technical experts. These experts have been utilized to work with the City's SCADA engineer (Eramosa) to assist in the project.

The recommended solution represents the least impact from a staffing perspective as there is a vast amount of corporate knowledge with the Allen-Bradley product as a result of its presence in the system. The familiarity with parts and programming for these devices will help to ensure a smooth transition to one product. This will simplify future upgrades in hardware and software. The City's SCADA Team is well versed in the recommended technology, and has the ability to maintain the system. No additional staff is required at this time.

Legal: It is expected that with the additional features of the new version of the hardware, SCADA will be more efficient and robust to meet our due diligence responsibilities, as it relates to regulatory and operational information required for compliance with regulations of the Safe Drinking Water Act.

HISTORICAL BACKGROUND

The City of Hamilton currently has two products for Process Automation Controllers (PACs) which include Rockwell (Allen-Bradley) and Bristol Babcock (Emerson). These products were installed over a number of years as a result of the implementation of SCADA and plant automation beginning in approximately 1999. While a small number of unit processes were controlled by SCADA prior to 1999 the implementation of SCADA on a system wide basis occurred during the time that the treatment plants were operated under contract from 1994 to 2004. An original SCADA Master Plan was initiated in 1999 with standards being published in 2000.

Transitioning from a Bell circuit alarm dialer system to the full scale SCADA System, the implementation of SCADA Standards (2000) took place, for the most part, during the time the plant was operating through contracted services. Preparation for Y2K was also undertaken to ensure that there was reliable, smooth transition on January 1, 2000. In preparation for this the Region of Hamilton-Wentworth directed the private operator, American Water Services to begin standardization of PACs in conformity with the SCADA Standards (2000). As a result the use of Rockwell (Allen-Bradley) has grown over time and currently the presence of Allen Bradley in the system represents approximately 55% of the PACs in place.

The purpose of this report is to formalize and update the City of Hamilton SCADA Standards and to secure Council endorsement of its use.

SCADA hardware has a reliable life expectancy of approximately ten years and as a result the Water and Wastewater Operations Group began a SCADA master plan in 2008 to ensure a plan was in place when the existing inventory of devices was at the end of their service life and in need of replacement. The plan endeavoured to ensure that the system was upgraded to achieve the following objectives:

- SCADA system that is an industry best practice and is robust;
- SCADA system that is geared for expansion, utilizing best practices;
- Effective SCADA system with enough redundancy to eliminate potential failures, with maximum protection from cyber security threats, and viruses;
- Minimal data loss at any time;
- SCADA system that is user / operator friendly;
- Capability to make available operating information at all times to operators via the SCADA nodes, to other staff via the City's intranet and remotely through secured network sessions;
- Operating data is available in editable formats with the ability to generate easy to use customizable reports as needed;
- All changes are documented so that the system is consistent with most stringent quality management systems;
- Availability of up-to-date standard operating procedures (SOPs), Process Narratives, Process & Instrumentation Drawings, Operations & Maintenance manuals; and Computerized Maintenance Management System (CMMS) information available through the SCADA system;
- SCADA system is equipped with a comprehensive and intelligent remote alarming system to ensure that no operational alarm is missed;
- Provide processed real time information to operators, such as real time Chlorine Contact (CT) calculation, so that legislative compliance is always achieved.

Hamilton's water and wastewater SCADA system as a whole consists of a number of elements including; instrumentation, process automation controllers, switches, servers, and software as well as communication lines such as; traditional telephone lines, fibre optic cable and wireless networks.

Presently there are several major projects under design and/or construction at both the water and wastewater treatment plants and outstations. In addition, new outstations are being added to the SCADA system on a continuous basis. These projects are adding new SCADA demands. The challenge to the SCADA Master Plan team is to provide the City with a new SCADA platform which is "Best Practice" to the industry and which will provide reliable reporting of operational data as required under the regulations of the

Safe Drinking Water Act. The new SCADA Master Plan is a dynamic document that considers ongoing projects and their impact on the SCADA system as well as a means of incorporating the new SCADA standard into all existing systems.

A master plan for the Water and Wastewater SCADA system in Hamilton was initiated and a project team was assembled to look at what was in place in Hamilton and analyze options for going forward. As mentioned earlier the plan included a comprehensive list of objectives to be fulfilled as a result of the plan's implementation. To ensure the objectives were met an assessment of the existing system was conducted to determine if opportunities to improve it existed and if so where.

The master plan resulted in a number of deliverables including standard operating procedures, standard process narratives, installation requirements, programming narratives as well as recommendations regarding technology.

A key element of the SCADA system is the process automation controller (PAC) technology. To understand what options existed with respect to PACs and to inform the master plan an assessment of PAC technology was completed and includes the following;

- A survey was conducted to understand market share and deployment of the various products and specifically PACs
- Cost evaluation
- Evaluation of different products in the marketplace
- Reliability of product and flexibility for automation
- Availability of product and support
- Corporate knowledge of systems
- Interface with other corporate systems
- Implementation strategy evaluation

A full discussion of the technology assessment is included in the analysis section of this report.

POLICY IMPLICATIONS

The Ontario Safe Drinking Water Act and its related Acts and Regulations have within them a number of requirements respecting data acquisition and storage as well as real time control and response to operating conditions. The establishment of a SCADA standard for process automation control greatly improves operational consistency in this respect as well as reduces the opportunities for errors associated with having a number of different products to be familiar with.

Purchasing Policy #14 (Policy for Standardization) allows for the following:

"Standardization is a management decision-making process that examines a specific common need or requirement and then selects a Good and/or Service that best fills that need to become the standard".

Since 1998 the City of Hamilton has invested significantly in the acquisition of PACs from Allen-Bradley. This equipment has become a fundamental component of daily

operational requirements throughout Water and Wastewater Operations. This report serves to establish Allen-Bradley as the standard for process automation control devices for water and wastewater within the City of Hamilton. It should be noted that although the City desires to standardize on the Rockwell platform, independent Rockwell distributors compete for supply of these components through the tender process. Rockwell does not itself bid on these tender – supply is done through its distribution networks which includes Westburne, Gerrie Electric, and Ideal Supply among others.

Purchasing Policy #14 (Policy for Standardization) continues:

“Where the establishment of a standard will result in a single source purchase, that purchase shall also be approved by the Manager of Purchasing and Council or by the Standards and Approved Products Committee”.

Approval of this City of Hamilton SCADA Standard identifies Rockwell Automation (Allen-Bradley) as the standard for PACs.

The recommendations in this report support the Public Works Business Plan “Innovate Now” by the desire to implement smart processes by upgrading the SCADA system with a single technology that is best in class.

RELEVANT CONSULTATION

Operations staff worked with the Procurement Section to ensure that issues relating to Policy 14 of the Purchasing Policies were appropriately addressed.

ANALYSIS / RATIONALE FOR RECOMMENDATION

A key element of the SCADA system, as mentioned earlier, is the process automation controller (PAC) technology and is the focus of this report. PACs, as the name suggests, are devices which provide the ability to have equipment and processes function on a continuous basis without human intervention. These devices provide communication and process logic for example; the PAC will initiate the activation of a pump as a result of receiving a signal that pressure has dropped below a set limit. In any given process the PAC coordinates and controls a number of different processes and may include chlorine injection and monitoring, pressure and turbidity monitoring, the issuance of alarms related to failures and unauthorized access just to name a few. Hamilton's water and wastewater system currently has an inventory of over 200 PACs in service.

The PAC hardware within the City's system consists of both Rockwell (Allen-Bradley) representing 55% of the inventory and Bristol Babcock (now Emerson) represents 45% of active PACs. The existing Bristol Babcock platform in use in the City has now been declared obsolete by the manufacturer, consequently, the City must now replace all these devices first. As the City moves towards replacement it is recommended that the City standardize on a single PAC hardware platform based on the issues identified.

The current water and wastewater PAC hardware has reached a point where it is no longer feasible to continue using the current system without planning an upgrade path and to this end a SCADA Master Plan has been developed. As stated, just under half of the PAC hardware related to the City's water systems has been declared obsolete by the manufacturer. Maintaining obsolete product becomes increasingly difficult as time progresses, as not only parts, but hardware knowledge becomes scarce. The serial communications network in use by the Bristol system is also outdated, providing only a small fraction of the speed that an Ethernet network is capable of delivering, thereby reducing real-time control for these stations, which could hinder system operators in an emergency situation.

Phased migration is the option that staff is proposing. The City has a large quantity of existing PACs (Rockwell Allen-Bradley SLC 500s) in use that are still being manufactured and marketed and as a result the replacement of these devices carries less risk and is less urgent. It is practical to keep the existing SLC 500 series in service and proceed first with upgrading the obsolete Bristol Babcock PAC hardware to the new standard PAC platform.

The adoption of a standard hardware platform is the preferred recommendation for the City. Standardization allows for the use of one type of network, one communication protocol, one software programming package, and reduces the quantity of spare parts stock the City would need to maintain. SCADA staff training requirements would also be reduced. Standard programming methods, data collection, and hardware technology would be available across the system.

To understand what options existed with respect to PACs and to inform the master plan an assessment of PAC technology was completed and includes the following;

- Market Surveys
- Product Evaluation
- Reliability of product and flexibility for automation
- Cost evaluation
- Product availability and support
- Corporate knowledge of systems
- Interface with other corporate systems
- Implementation strategy evaluation

Market Surveys

As part of the process for assessing a best fit for Hamilton market surveys were conducted across a number of municipalities. The survey data allowed staff to analyze a number of different parameters in support of the master plan objectives and among other questions included the number of products in use in municipalities, number of municipalities using more than one product and if there were specific plans for those municipalities currently using the Bristol product.

The SCADA Steering Committee completed a market survey of similar municipalities in North America to determine the technology in use. The market survey consisted of 19 questions designed to provide feedback on the hardware and software platforms in use,

integration being undertaken with other software products such as CMMS, LIMS, and real-time control, and to identify the overall size of both the population base that is served by the system and the size of the SCADA system in terms of input and output (I/O) counts, and PAC counts. From the market survey, which included 15 municipalities, it was found the following:

- four of the fifteen municipalities utilize hardware from Allen-Bradley exclusively;
- another six of the fifteen municipalities utilize Allen-Bradley hardware in combination with other products. One of these municipalities currently has an installed base of Bristol Babcock RPU's which are being replaced going forward;
- only two of the fifteen municipalities utilize the Bristol Babcock RPU hardware and both of these noted that their intention is to replace this product going forward. One will be replacing with Allen-Bradley hardware, the other with a combination of Allen-Bradley and GE hardware;
- three of the survey respondents use platforms other than Allen-Bradley or Bristol Babcock.

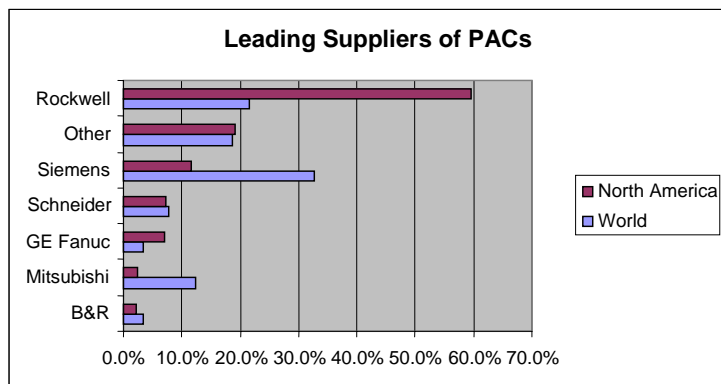
In addition to the market surveys the team contacted ARC Advisory Services who conduct market place surveys to provide information regarding current market trends and market share in terms of sales of product for the period 2007-2008 depending on the specific survey.¹

The survey produced valuable data and revealed that the products in the marketplace are very comparable as far as features and reliability. The analysis eventually became focused on price, availability of parts and support and risk associated with migration to a single product. As a result of this analysis staff determined that the best option for the City going forward was to standardize on the Allen Bradley PAC for use throughout all of Water and Wastewater.

PAC Hardware

The leading supplier of PACs in North America, based on current market data, is Rockwell Automation (Allen-Bradley).

Figure 1 - Leading Supplier of PACs

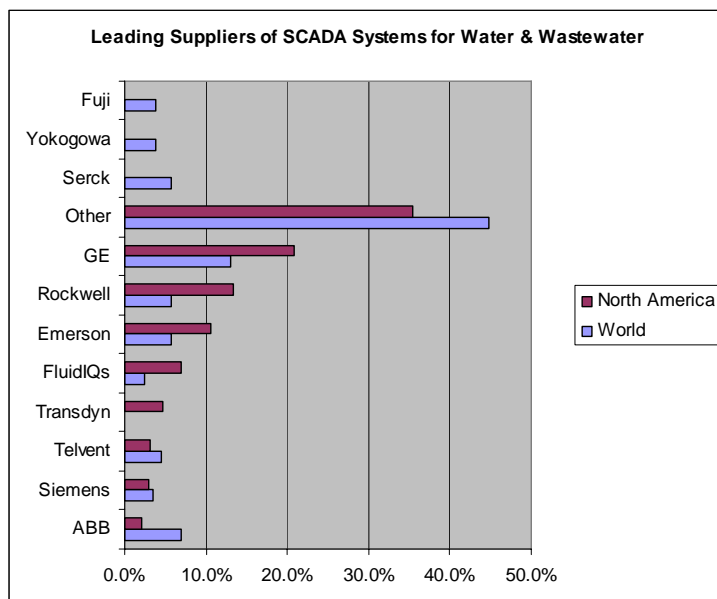


¹ The surveys reviewed included PAC hardware, HMI software, and Water & Wastewater SCADA.

Water & Wastewater SCADA

The 'SCADA' survey for water and wastewater reviewed solutions that cover large geographic areas. The analyst noted that water and wastewater is the smallest of the industries that were reviewed which also include oil and gas, electricity and transportation. The following graph identifies, based on current market data, the leading suppliers of SCADA solutions to the water and wastewater market.

Figure 2 - Leading Supplier of SCADA Systems for Water & Wastewater



The survey revealed that GE, Rockwell and Emerson account for approximately half of the water and wastewater SCADA systems market as a whole in North America.

Product Evaluation

The table presented below highlights the technical attributes of the three major PACs in use in the North American, Water and Wastewater SCADA marketplace. Upon review of the platforms it was determined that in general all of the PAC platforms presented below have similar capabilities in terms of data processing, communications, data logging, maintenance, and security.

Table 1 - Summary of Hardware Features

Feature	A-B Logix	Bristol ControlWave	GE PACSystems
Memory	CompactLogix: 0.75-1.5MB ControlLogix:0.75-16MB	Micro: 2-16MB Automation: 16MB	10-64MB
Local Data Logging	Yes, User Programmed	Yes, User Programmed	Yes, User Programmed
Communication (Primary Protocols)	DF1 (Serial) Ethernet/IP	BSAP (Serial) TCP/IP	SNP (Serial) GE Fanuc TCP/IP

**SUBJECT: SCADA Process Automation Controller (PAC) Standard
(PW11074) - (City Wide) - Page 10 of 17**

Feature	A-B Logix	Bristol ControlWave	GE PACSystems
Communication (Other Protocols)	DeviceNet Modbus (via programming) ControlNet Foundation Fieldbus DH+/DH-485	Modbus Serial Modbus TCP/IP A-B DF1 A-B DNP3	A-B DF1 A-B Ethernet/IP Modbus Modicon TCP/IP Profibus
Redundancy	CompactLogix: via DeviceNet ControlLogix: Supported	Micro: Not Supported Automation: Supported	Supported
I/O Swap Out	Compact: Cold Swap Control: Hot Swap	Micro: Cold Swap Automation: Hot Swap	Hot Swap
Security	Key Switch Username/Password	Key Switch Username/Password	Username/Password
Programming Environment	RSLogix 5000	ControlWave Designer	Proficy Machine Edition

Cost Evaluation

The following tables summarize the hardware costs associated with the three leading water and wastewater vendors. The options presented above for the migration to a new controller throughout the City's SCADA system. These are based on published, list hardware costs only and do not include the cost of field wiring modifications, reprogramming, or engineering services. Note that pricing does not include mark-up or profit for the contractor, or any associated escalation costs – it is intended to provide comparative data only as the costs required for the network, engineering, commissioning and programming are comparable and are independent of the hardware platform.

- Allen-Bradley Logix Platform (ControlLogix in the Plants, CompactLogix in the Outstations).

**SUBJECT: SCADA Process Automation Controller (PAC) Standard
(PW11074) - (City Wide) - Page 11 of 17**

Table 2 - New Allen-Bradley Logix Hardware Costs

Device	Quantity Requ'd (+/-5%)	Unit Price	Total
Water & Wastewater Plants (ControlLogix)			
Rack	85	\$772	\$65,620
Power Supply	85	\$957	\$81,345
CPU - L55M13	78	\$4,447	\$346,866
Ethernet Card - ENBT	78	\$2,075	\$161,850
Digital Input Card	339	\$377	\$127,803
Digital Output Card	325	\$469	\$152,425
Analog Input Card	173	\$1,124	\$194,452
Analog Output Card	74	\$1,266	\$93,684
Water & Wastewater Outstations (CompactLogix)			
Power Supply	105	\$483	\$50,715
CPU - L32E	105	\$3,330	\$349,650
Digital Input Card	359	\$280	\$100,520
Digital Output Card	352	\$336	\$118,272
Analog Input Card	156	\$914	\$142,584
Analog Output Card	118	\$1,305	\$153,990
Total			\$2,074,156

**SUBJECT: SCADA Process Automation Controller (PAC) Standard
(PW11074) - (City Wide) - Page 12 of 17**

- Bristol Babcock ControlWave Platform

Table 3 - New Bristol Babcock ControlWave Hardware Costs

Device	Quantity Requ'd (+/-5%)	Unit Price	Total
Water & Wastewater Plants (ControlWave)			
Rack	140	\$688	\$96,320
Power Supply	140	\$966	\$135,240
CPU - 396359-01-9	78	\$4,547	\$354,666
Digital Input Card	339	\$807	\$273,573
Digital Output Card	325	\$827	\$268,775
Analog Input Card	173	\$1,552	\$268,496
Analog Output Card	74	\$2,274	\$168,276
Water & Wastewater Outstations (ControlWave Micro)			
Rack	105	\$401	\$42,105
Power Supply	105	\$445	\$46,725
CPU - 396563-06-6	105	\$1,351	\$141,855
Digital Input Card	359	\$451	\$161,909
Digital Output Card	352	\$501	\$176,352
Analog Input Card	156	\$931	\$145,236
Analog Output Card	118	\$788	\$92,984
Total			\$2,276,192

- GE PACSystems RX3i Platform

Table 4 - New GE PACS Hardware Costs

Device	Quantity Requ'd (+/-5%)	Unit Price	Total
Rack	210	\$845	\$177,450
Power Supply	210	\$693	\$145,530
CPU - IC695CPU310	182	\$3,611	\$657,202
Ethernet Card	182	\$1,418	\$258,076
Digital Input Card	698	\$334	\$233,132
Digital Output Card	339	\$275	\$93,225
Analog Input Card	658	\$639	\$420,462
Analog Output Card	384	\$1,220	\$468,480
Total			\$2,453,557

Product Availability and Support

Product availability and support is important from the perspectives of both the existing inventory and the installation of new PACs going forward. The existing inventory of PACs is supported both by the City of Hamilton SCADA group and by outside consultants who provide support and programming services on both the Bristol and Allen-Bradley equipment. In terms of available support for existing controllers from the manufacturers the following identifies available support.

Bristol Babcock Network:

The existing Bristol Network 3000 controllers (now obsolete) have been in production since the mid 1980s and were first installed in the City of Hamilton approximately 15 years ago. The existing controllers are no longer available and support is very limited. Bristol Babcock provides direct support for their products. Bristol products can only be purchased from Bristol Babcock directly. Bristol Canada is located in Mississauga. In addition, technical support can be reached at Bristol's head office, located in Watertown, Connecticut. Repair facilities are also located at the head office.²

GE PAC Systems RX3i:

The GE PACSystems RX3i platform is available from the GE hardware distribution network that includes Gescan and Gray Matter Systems. Given that in Hamilton there are no existing installations of GE PACs or in house knowledge base/skill sets to support the GE hardware platform, further investigation of the GE PACSystems RX3i platform was suspended.

Allen-Bradley SLC 500:

The Allen-Bradley SLC 500 series controller was introduced in 1989. The City of Hamilton makes use of the SLC 500 series primarily within the water and wastewater treatment plants. These PACs remain in production and there is no indication that the manufacturer intends to discontinue them and as a result replacement parts are readily available.

Allen-Bradley has developed a wide distribution and support network in Ontario with many of their authorized distributors. Independent wholesale distributors are local to Hamilton, Kitchener, Guelph, Cambridge, Burlington, and Oakville, as well as elsewhere. This prevalence of distributors increases the likelihood of parts and service availability when required. Additionally, Allen-Bradley's Canadian headquarters is located in Cambridge, providing a large quantity of stock and same day repair-by-exchange facilities close by.

Corporate Knowledge of Systems

As mentioned earlier in the report the majority of PACs in service today are Allen-Bradley and as a result the SCADA group staff is trained and experienced in supporting

² Note that Bristol Babcock was purchased by Emerson Process Management. The term 'Bristol' is used as it is the commonly understood name of the product within the City.

and programming on the Allen-Bradley platform. Significant effort and expense would be required to upgrade City staff to become proficient in an alternative system.

As a result Allen Bradley was deemed the best choice with respect to the significant benefit of existing corporate knowledge.

Interface with Other Corporate Systems

For security reasons the SCADA hardware connectivity is isolated from other corporate networked systems. A secure portal is available for predetermined data transfer between the corporation and SCADA networks through the 'Neutral Zone' and currently the Allen-Bradley PAC is compatible with this portal. The costs associated with establishing compatibility of an alternative controller with the 'Neutral Zone' are unknown at this time.

Implementation Strategy Evaluation

An evaluation was undertaken with respect to implementing the replacement of these devices and included;

- Wholesale replacement of PAC
- New training
- No in house knowledgebase
- No Configuration tools or programming support software

Phased migration is the option that staff is proposing. The City has a large quantity of existing PAC (Rockwell Allen-Bradley SLC 500s) in use that are still being manufactured and marketed and as a result the replacement of these devices carries less risk and is less urgent and can occur later in the project. It is practical to keep the existing SLC 500 series in service and proceed first with upgrading the obsolete Bristol Babcock PAC hardware to the new standard PAC platform.

Substantial benefits (through capital deferment) will be realized by pursuing this strategy, however it carries with it the challenge of maintaining differing hardware models of the Allen-Bradley PACs throughout the phasing period. Continuing forward with the Allen-Bradley Logix platform the transition from the existing to a new system will allow software interlocks and communications between the plant processors to continue during the transition as the plant PACs can communicate with the Logix platform. The SCADA Master Plan vision is to ultimately have a future asset class of consistent hardware throughout the entire system.

As result of the prevalence of Allen-Bradley controllers within the existing system standardizing on Allen-Bradley going forward supports a much smoother migration to new technology due to the ability to continue using existing controllers until the end of the program.

Conclusion and Recommendation

Standardizing:

In summary the following supports the recommendation to standardize on a single controller and include:

- **Inter-Device Communication:** Equipment from multiple vendors often does not use the same protocol making communication between hardware from different vendors more challenging than when working with a single vendor. While communication can be established between vendors it requires that each vendor share a common communication protocol. Typically it is necessary to share information between controllers in the field for information such as level, flow, pressure, or equipment status. The sharing of such information is facilitated through the use of a single hardware platform, through simplifying the system architecture and programming requirements, thus lowering the overall configuration and maintenance costs.
- **Maintenance:** The costs associated with the maintenance of a hybrid system are typically greater than in a single controller system as additional spare parts must be stocked and multiple programming software packages are required. There are also costs associated with the configuration of the HMI application software when there are multiple hardware platforms within the system. System complexity increases, thus typically increasing costs associated with the ongoing operation and maintenance of the system.
- **Training:** There are increased training costs associated with learning multiple programming languages and hardware configuration requirements for a system that includes multiple hardware platforms.
- **Support:** Support for a system can be obtained through a number of channels, including (a) vendor support, (b) City's SCADA Group, (c) outside consultants, integrators and contractors, and (d) local distributor support. When obtaining support for a system with multiple products there is additional time and effort required to identify the problem such that appropriate support can be obtained. In instances where hardware platforms have been integrated it must first be determined which hardware platform requires support

Recommended Product:

While there are a number of products in the marketplace, staff chose to analyze Rockwell, GE and Emerson as a result of their combined dominance within the Water and Wastewater industry throughout North America. Additionally, Emerson and Rockwell are already in place in Hamilton's SCADA system.

In summary staff recommend that Rockwell Allen-Bradley be approved as the City of Hamilton corporate standard PAC for water, wastewater and storm water real time control for a number of reasons and include;

- Allen-Bradley presenting the lowest cost option for controllers based on published list prices. It is expected that all vendors would offer a significant discount off of published list price.
- There is significant existing corporate knowledge of the Allen-Bradley product within the City as a result of its current use. Conversely the value of existing corporate knowledge of the Bristol Babcock product is diminished as a result of the obsolescence of the controllers currently in use.

- Implementation of system wide PAC replacement is made easier and carries less risk as a result of the continued support and internal comfort level associated with the Allen-Bradley product.
- Local product availability and support remains a definite advantage with the Allen-Bradley product as a result of the presence of a number of local independent wholesale distributors.

SCADA Standards Update

The selection of equipment such as the PACs to be used is a major task in the development of the City's SCADA Standards documentation. It must be noted that the document is comprehensive and establishes standards for display symbology, wiring methods, documentation of hardware installation, and program updates just to name a few. The staff committee that has been established to review the selection of the best PAC for the SCADA network will also be charged with the stewardship of the SCADA Standards and will undertake periodic reviews of the documentation to ensure that it reflects current practices and industry standards that are evolving. As such, the staff committee will update the documentation on an ongoing basis and will report to Council for their endorsement of changes when a major component of the Standard such as the PACs are recommended for update. This is to ensure that Council is informed of the evolution of the Standard and provides approval to material aspects of it.

ALTERNATIVES FOR CONSIDERATION

Alternatives to the recommendation in this report include continuing on with the existing stock of PACs, replace like for like or issuing an RFP for the provision of PACs system wide.

Maintain Existing Product

The current state of the water and wastewater PAC hardware has reached a point where it is no longer feasible to continue using the current system without planning an upgrade path. As stated, over half of the PAC hardware related to the City's SCADA system has been declared obsolete by the manufacturer (Emerson). Maintaining an obsolete product becomes increasingly difficult as time progresses, as not only parts, but hardware knowledge becomes scarce. The serial communications network in use in the system for the outstations is also outdated, providing only a small fraction of the speed that an Ethernet network is capable of delivering, thereby reducing real-time control is limited at these stations, which could hinder system operators in an emergency situation.

Replace Like for Like

Replacing existing PACs like for like is an alternative but carries with it the burden of maintaining two systems with respect to parts, use of multiple networks, multiple communication protocols and multiple software programming packages. The like for like option also requires that new versions of the Emerson product be installed as a result of the retirement of the Emerson product that currently exists within the system.

Replacing existing PACs with the same product that is currently in place would result in continuing inconsistency with technology. As identified earlier in this report the presence of two different products within the water and wastewater system will require staff to maintain a high level of knowledge on both products and ensure that interfaces and associated with these devices remain effective as the technology changes

Obtaining Competitive Bids

The issuance of a contract could be undertaken to solicit the market for proposals. Staff believe that, in general, many products on the market provide reliable, flexible, robust devices for process control and ultimately the deciding factor would be costs. It would be challenging to effectively assign a cost to the value placed on the corporate knowledge of the existing devices. Ultimately the process may be viewed as unfair should the City endeavour to evaluate proposals with corporate knowledge as a part of the evaluation criteria.

Releasing a contract for the acquisition of new devices is an option, however it is recommended that should this be the direction to staff that the City continue to standardize on one product. The development of corporate knowledge in using one specific technology is very important to ensure reliable, compliant operations of the City's water and wastewater systems. This alternative is also not recommended as SCADA master plan has already recommended a preferred cost effective PAC hardware vendor to proceed with.

None of the alternatives are recommended as they carry with them added risk and added cost to implement as compared to the recommendations in this report.

CORPORATE STRATEGIC PLAN

Focus Areas: 1. Skilled, Innovative and Respectful Organization, 2. Financial Sustainability, 3. Intergovernmental Relationships, 4. Growing Our Economy, 5. Social Development, 6. Environmental Stewardship, 7. Healthy Community

Skilled, Innovative & Respectful Organization

- ♦ The use and implementation of a single PAC product allows staff to develop high degree of intimacy with this technology and work with an industry leading technology.

Financial Sustainability

- ♦ Working with a single technology for this purpose allows for a greater degree of assurance that non-compliance with regulatory requirements will not occur. This protects the City from potential of fines.

APPENDICES / SCHEDULES

None