

TO: James L. App, City Manager
FROM: Doug Monn, Public Works Director
SUBJECT: Water Treatment for Ronconi Wells
DATE: December 16, 2008

NEEDS: For the City Council to consider authorizing the purchase of a Pall Corporation mobile water treatment unit for the Ronconi Wells.

FACTS:

1. The City has 19 production wells which pump groundwater from the Paso Robles Groundwater Basin and the Salinas River underflow. During the seasonal high demand period (June through October) all production wells operate 24 hours a day, 7 days a week.
2. The City's current maximum summertime production capacity is roughly equivalent to summertime demands, but there is no excess production capability. If the City's production is reduced due to mechanical or electrical failures there is a direct impact on system storage.
3. The groundwater basin is stressed by intensive localized pumping, manifested by sustained groundwater level declines in the portion of the basin that serves the City (Estrella Subbasin).
4. Current production capacity is down significantly compared to recent years due to the combination of increased basin pumping and the ongoing drought conditions throughout the state.
5. The City's Salinas River underflow wells (which account for 50% of the City's production capacity) are experiencing historic-low production levels. Thunderbird Well #17 which typically produces between 900-1,000 gpm has been shut down for the past 7 weeks due to excessively low groundwater conditions. Well production is roughly half of what is typical for this time of year; never has the production of this wellfield been this low.
6. With the reduced production capability of the Thunderbird Wells, the additional full-time pumping and treatment of the Ronconi Wells is needed to meet annual demands.
7. Due to the proximity of the Ronconi Wells to the Salinas River, they are classified by the California Department of Public Health (CDPH) as "groundwater under the direct influence of surface water." The wells require a level of treatment that complies with the EPA's Surface Water Treatment Rule to ensure protection against pathogens including cryptosporidium and giardia. Additionally, the treatment technology must be capable of satisfying limits set on turbidity and manganese; both known to be high in the Ronconi Wells.
8. Minimum tank levels required to provide emergency and fire protection in the Golden Hills Reservoirs is 18.6 feet. Without the production contribution from the

Ronconi wells it is very likely that the reservoirs will fall below this level. Last year tank levels fell to approximately 15 feet before the Pall treatment system was put into operation, allowing the Ronconi wells to be added to production.

9. Pall Corporation has a mobile microfiltration unit, which provides effective treatment that satisfies all CDPH requirements. The mobile treatment unit is self-contained in a semi-truck trailer.
10. For the last two high-demand seasons the City leased the Pall Corporation equipment to treat Ronconi well water. The cost to lease this equipment is over \$1,000 per day.
11. Over the last year the City has sought to replace the Ronconi Wells with a new underflow well/s that are of a better quality, not subject to the Surface Water Treatment Rule, and would not require treatment other than providing for chlorine residual.
12. New underflow well locations along the Salinas River corridor were evaluated. Several test wells were developed, but none were of a quality suitable for municipal use.
13. Regular year-round use of the Ronconi Wells would add approximately 800 gallons per minute, or about 10% of the City's current production.

ANALYSIS &

CONCLUSION: The City's water demands often outpace production capabilities during peak season. The production of the Ronconi wells is required to meet seasonal peak demands. An additional benefit of utilizing the Ronconi Wells is that it will help the City establish beneficial use of the full 4,600 acre-feet allotment in the City's Salinas River pumping permit. In 2005, the City filed a 4-year extension to allow the City additional time to establish beneficial use of the allotment.

Staff is seeking authorization to purchase the system currently in operation and successfully treating Ronconi well water. The system has been tested, debugged and configured for City operations. Additionally, the manufacturer has agreed to several price incentives including 25% deduction of the current years lease payments and no charge for the final month of the lease (a savings of approximately \$60,000)

Purchase of Microfiltration System..... \$ 870,000
 Required Appurtenances: \$ 205,000

Total Project Cost.....\$ 1,075,000

Proceeding with this project has several benefits over entering into a long-term lease with Pall Corporation:

- This project includes system modifications that will allow the use of the Ronconi wells on a year-round basis. Due to the current system configuration, water treatment is not possible during the wet season.
- The system will always be available and on hand, preventing the need to pay for annual delivery and startup costs.
- The City will more effectively put to beneficial use its underflow entitlement with year-round operation of the Ronconi Wells.
- The membranes are warranted for 10-years, and the system is expected to have a useful life of over 20-years. The payback period (relative to a long-term lease) for this project is approximately 2.6 years and the City will own an asset with substantial value.

POLICY

REFERENCE: Integrated Water Resource Management Plan and Title 22 CCR

FISCAL

IMPACT: The City has planned for this project and it has been included in the current Capital Improvement Projects Budget. The funding for this project will come from the Water Operations Fund with current balance of \$10.8M.

- OPTIONS:**
- A. That the City Council Adopt Resolution No. 08-xx authorizing:
 - 1. A purchase order to Pall Corporation for an amount not to exceed \$870,000.
 - 2. Authorizing City staff to issue purchase orders for required appurtenances in an amount not to exceed \$205,000.
 - B. Amend, modify or reject the above option.

Prepared by: Christopher Alakel, Water Resources Manager

Attachments: (2)

- 1) Quotation from Pall Corporation
- 2) Resolution

**Pall Corporation
Budgetary Proposal**

Mobile Microfiltration System



*City of Paso Robles, California
Water Treatment Plant*

October 24, 2008

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700 GPM MOBILE ARIA MICROFILTRATION SYSTEM

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S E C T I O N O N E

Process Description

1.1 Microfiltration System Description Overview

The Pall Mobile ARIA Microfiltration (MF) System is a self-contained mobile filtration plant capable of operating at 700 GPM. Installation of the system will be by others with construction technical advice provided by Pall. The system includes the components as identified in our Scope of Supply.

Parameters	Mobile ARIA Microfiltration System
	700 GPM System
Percent Recovery	>95%
# of Racks	2
# of Modules per Rack	40 max.
CIP Interval (Days)	30-90

1.2 Microfiltration Module Description

The Microza Microfiltration modules are specially designed for municipal drinking and wastewater processing applications. These modules use proprietary, 0.1 micron rated PVDF (Polyvinylidene fluoride) hollow fiber membrane technology that support high and stable flux rates and constructed with advanced bonding techniques for an exceptionally strong module design.

The Microza Microfiltration Modules operate in an outside-in mode with a small amount of recirculation. In conventional filtration or single pass filtration, the membrane filter is perpendicular to feed flow direction. Solids are dead end filtered by the media and are generally removed when the filters are backwashed. For Microza modules, the membranes are placed parallel to the feed direction and only clean liquid passes through the membrane. Two exit streams are produced during filtration: filtrate or permeate and the recirculation. The filtrate is the processed water and the recirculation is a small portion of the flow that is returned to the feed stream. This flow stream is taken from the top of the module and ensures complete utilization of the available filter area by increasing the velocities in the upper end of the module. Solids retained on the filter are removed via periodic backwashing, air scrubbing and chemical cleaning.

Microza Microfiltration (hollow fiber) membranes provide:

- A very high filter area (50m²) per module
- A small footprint,
- Low energy requirements,
- Low system hold-up and efficient regeneration.
- High porosity membranes
- Strongest fiber in the industry

1.3 Microfiltration System Operation

Water is pumped through pre-filters into the system then through the supply manifold to the module rack holding Microza Microfiltration Modules. Each module rack is fed an equivalent flow rate.

- *Forward Flow*
The feed pumps are controlled to maintain a variable feed pressure. As water flows through each module, the module filaments will gradually foul, and the pump speed will increase automatically to increase feed pressure as required to maintain the filtrate flow set point. At the same time a control valve at the inlet to the unit adjusts to maintain appropriate flow to the rack.

- *Reverse Filtration & Air Scrub (Typical)*
Periodically, the module racks will go through a combined reverse filtration (RF), air scrub (AS) cycle that cleans the modules. First isolation valves are closed. The RF backwash valves open. The RF pump, which takes filtrate from the filtrate header, modulates to maintain the RF flow set-point, at which time clean filtrate is pumped through the module filaments in the reverse direction. This flow is combined with compressed air and is maintained for a short period of time and is diverted to the drain. As the air bubbles up the outside of the fibers, the air shakes them vigorously, loosening particulate adhering to the fiber skin. At the end of this time period, the RF pumps speed up and flush the system. At the end of this cycle, the valves revert and the control block goes back on line.

- *Enhanced Flux Maintenance (EFM)*
To further enhance the performance of our system, we have developed a new step in the operation of our system. We now incorporate a short chemical soak with chlorine or acid depending on the water source and have called it an Enhanced Flux Maintenance (EFM). The EFM or chemical soak reduces the daily TMP rise and assists with reducing the system's transmembrane-pressure. The Chemical soak is an automated procedure and can be utilized on a daily basis or a weekly depending on the solids loading and quality of feed water.

Below outlines the typical steps involved with the procedure.

400-ppm Chlorine Soak (EFM):

- Add 400-ppm of Cl to the module
- Allow to soak for 30-minutes with filtrate
- Reverse Flush system with water
- Return back to forward flow – back on-line

Complete EFM takes less than 35-minutes.

▪ **Clean In Place (CIP)**

Every so often the system will require a more thorough cleaning than RF/AS can provide. This can occur as maintenance clean or a full CIP. Cleaning chemicals will be added to the system and circulated as required to regenerate the modules. Even though the clean in place (CIP) operation is required infrequently, it is designed to be an automatic operation, which the operator manually initiates when indicated by the control system. The CIP system is designed to clean one unit at a time, while the second unit stays on line, producing water. Included in this section is a more detailed description of the cleaning procedure.

▪ **Integrity Test**

Integrity testing of hollow fiber microfiltration modules specified in the proposed water filtration system is conducted in accordance with standardized procedures developed at Pall Corporation. These methods have been optimized for modular installations and have proven successful in detecting an integrity breach in system modules consisting of over a half of a million hollow fibers.

In operation, the filtrate quality is constantly monitored to immediately detect a performance change at the system level while an off line *pressure hold test* provides the ability to isolate and identify a questionable module. These automatically implemented procedures ensure system reliability without adding an extensive cost (capital or operating) and maintenance burden on users.

Cleaning Procedures for Pall Microza* MF Filtration System

Pall specifies Clean-In-Place (CIP) procedures to maintain proper hollow fiber membrane operation. The frequency, duration and chemicals will vary, depending on the feed water quality. The following is our standard CIP procedure:

Required chemicals:
100% citric acid
40% solution NaOH
12.5% solution NaOCl

The following procedure involves two steps:

Citric Acid Procedure:

- a. Make up a 2% citric solution (e.g. 16 lbs 100% citric acid in 100 gal 30° C water)
- b. Recirculate at 75% system flow rate for 20 min.
- c. Perform air scrub (AS) and reverse filtration (RF) – make sure no chlorine is injected during RF.
- d. Soak for 20 min.
- e. Flush with water until pH is neutral (5-10 min).

Caustic Procedure:

- a. Create a 0.4% NaOH with 300 ppm NaOCl solution
- b. Recirculate at 75% system flow rate for 20 min
- c. Perform air scrub (AS) and reverse filtration (RF)
- d. Soak for 20 min
- e. Flush with water for 5-10 min

- Microza is a trademark of ASAHI CHEMICAL INDUSTRY CO. LIMITED



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1.4 Process Design and Equipment Selection

We propose our standard microfiltration membrane system consisting of an 800 GPM Mobile ARIA Microfiltration System.

The equipment proposed is designed for simplicity of operation. All plant operations are automatically controlled via a PLC. There are no routine operations that require manual operation of valves etc. The system design philosophy is to reduce as far as possible the potential for system problems caused by operator error.

Pall Microfiltration System Components

The following outlines the general scope of supply for the proposed microfiltration system: (See section 3.1.1 for complete Scope of Supply)

- One 53' Trailer
- One Mobile ARIA Microfiltration System
- Hollow-Fiber Modules
- Feed Strainers
- Reverse Filtration System Components
- Instrumentation
- Automated Enhanced Flux Maintenance System
- (2) Turbid Meters:
 - (2) Hach 1720E for the Inlet and Effluent
- Start-up and Training Services

1.5 Features & Benefits of the Pall Microfiltration System

- **High Quality Treated Water**

Pall's Microfiltration System is a cost effective method for the removal of micro-solids and is particularly recommended for treatment of the following contaminants in water:

Feed Water Element	Treated Water Quality
<i>Giardia</i> and <i>Cryptosporidium</i>	Undetectable
Suspended Solids	Undetectable
Turbidity	< 0.1 NTU

- **Filtered Water Quality**

Pall has successfully completed the test program for certification by California Department of Health Services of its 0.1 micron microfiltration system. NSF has also certified our microfiltration system under **Standard 61**.

- **Advantages of Microza Microfiltration (MF) "Outside-In" Membrane**

1. The 0.1-micron rating of the medium assures the finest protection for the downstream systems, reduced downtime and maintenance costs and extended service life of the possible future reverse osmosis modules. Provides narrow pore size distribution for excellent effluent quality.
2. The hollow fiber membranes have extremely high permeability, which facilitates automated, clean-in-place regeneration via reverse flushing, and permits operation at high flux thereby reducing equipment cost.
3. The membranes permit operation at high chlorine residuals to minimize biofouling rates and extend process time between chemical cleanings.

- **Chemical Resistance**

The MF membrane is resistant to chlorine in concentrations as high as **5,000 mg/L** during cleaning. Pre-chlorination of the raw water is acceptable. This precludes the need for adding chemical such as bisulfite in a subsequent de-chlorination step. Chlorine resistance also allows for easy disinfection of the membrane and the system should this be required.

Pall Microfiltration / Membrane Compatibility

Chemical	Condition		Compatibility
	Concentration	Temperature	
Sodium hypochlorite	1 %	25	Excellent
Hydrogen peroxide	2 %	25	Excellent
Formaldehyde	3 %	25	Excellent
Ethanol	100 %	25	Good ¹
Caustic soda	1 N	25	Excellent ²
Caustic soda and sodium hypochlorite	NaOH (1N) NaClO (0.5%)	25	Excellent
Nitric acid	1 N	25	Excellent
Hydrochloric acid	1 N	25	Excellent
Sulfuric acid	1 N	25	Excellent
Glycerin	100 %	25	Excellent
Chlorinated solvents		25	Not compatible
Aromatic base solvent		25	Not compatible
Ester base solvents		25	Not compatible
Ether base solvents		25	Not compatible
Ketone base solvents		25	Not compatible

NOTE: 1 Compatible up to 30 days exposure

2 Use of caustic soda alone will result in the slight discoloration of the membrane and extraction of F⁻ ion, however, there is no deterioration in the physical properties of membrane. Therefore, the cleaning of module by caustic soda alone should be limited and use of caustic soda with sodium hypochlorite is recommended.

SECTION TWO

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Technical Specifications

2.0 TECHNICAL SPECIFICATIONS

2.1 Scope of Supply

2.1.1 Scope of Supply - PALL

PALL's scope of supply includes the following items:

The main equipment included with the Mobile Membrane Water Treatment Plant System is listed briefly as follows. Detailed equipment specifications are included in Section 3.2 of this proposal.

The MF System includes:

- (1) Mobile ARIA Microfiltration System
- Microfiltration Hollow Fiber Modules (80 modules / full complement)
- One 53' Trailer
- EFM and CIP Transfer System
- Air Compressor System
- Feed Pumps with VFDs (built into the Microfiltration Unit)
- Pre-filter System (built into the Microfiltration Unit)
- RF Pumps with VFDs (built into the Microfiltration Unit)
- Controls & Monitoring Equipment
- Equipment Layout Drawing
- Operating & Maintenance Manuals
- Equipment Delivery (FOB Jobsite)
- Field Service Assistance & Training
- Start-Up Assistance

2.1.2 Scope of Supply - OTHERS

The following items are for supply by others and includes but is not limited to:

- Overall plant design.
- Feed Booster Pumps (supply water to unit – 5 to 30 psig)
- Unloading of delivered equipment mutually agreed FOB point.
- Receiving and safe storage of equipment until ready for installation.
- Raw water piping to MF feed header and treated water discharge piping from MF system filtrate header.
- Drain water piping from the systems to disposal.
- Electrical wiring, conduit and other appurtenances required to provide power connections as needed from the electrical power source to the PALL control panels, VFDs and other equipment and from the terminal boxes on the skids to the main plant panels.
- Conduit and other appurtenances required to provide connections as needed.
- Installation of Pall supplied field mounted valves and instruments, including wiring and tubing.
- Installation of Pall supplied equipment.
- Pipe supports.
- Raw materials, chemicals, and utilities during equipment start-up and operation.
- Laboratory Services, Operating and Maintenance Personnel during equipment Checkout, Start-Up and Acceptance Testing.
- Any on-site painting or touch-up painting of equipment supplied.
- Approval Permits

General Assumptions:

- 80 Modules
- Daily EFM
- Monthly CIP

- 1.0MGD Filtrate
- 27GFD
- >95% Recovery
- 90% On-line time

2.2 Equipment Scope

The following sections provide a description and specifications of major components incorporated into the Microfiltration system.

2.2.1 Membrane Systems

The membrane system sub-component consists of the membrane modules, module rack, Membrane Aria Units, and all necessary gauges, monitoring and control devices, and local instrumentation for each individual block.

The Aria mobile units are supplied complete with pre-filters, feed and RF tanks, feed and RF pumps, valves, controls, instrumentation and other associated ancillary equipment and instruments.

Standard Components:

- Painted Carbon Steel Frame
- 316 SSH Pumps w/TEFC Motors and VFDs
- Keystone Butterfly Valves (manual & air operated)
- Metering Pumps
- Strainers
- PE Tanks
- PLC Software & Controls
- NEMA 4 electrical enclosures
- NSF-61 Certified
- EFM / CIP Transfer Skid
- Air Compressor System

Aria Specifications

Type:	Aria Microfiltration Package Plant
Manufacturer:	Pall Corporation
Model:	Mobile ARIA MF System
Quantity:	1
Maximum Flow:	800 GPM

Strainer Specifications:

Type:	Auto-Self Cleaning
Manufacturer:	Amiad
Model:	8 in. SAF-4500
Quantity:	1 per Aria unit

Feed Pumps Specifications:

Type: 316L Stainless Steel SSH
Manufacturer: Goulds
Model: 23SH
Quantity: 1 per Aria unit
Horsepower: 30
Voltage: 460 V, 3 phase, 60 Hz.

RF Pumps Specifications:

Type: 316L Stainless Steel SSH
Manufacturer: Goulds
Model: 6SH
Quantity: 1 per Aria unit
Horsepower: 10
Voltage: 460 V, 3 phase, 60 Hz.

RF Tank Specifications:

Type : HDLPE
Manufacturer: Snyder
Quantity: 1 per Aria unit
Volume: TBD

Analyzers:

Turbid Meter: 1720E Hach, (2) Feed and Filtrate

Module Racks

Mobile ARIA MF System

- (2) Module Rack
 - Model Number: PMDM 152-2-304L
 - Dimensions: 4'-7" x 13'-10" x 10'-8"
 - Material: 304L SS and NSF listed PVC wetted piping

Microza Microfiltration Modules

- Dimensions: 6" diameter x 80" long
- Removal Rating: 0.1 µm
- Membrane Material: PVDF

Air Compressor System

- Manufacturer: Atlas Copco
- Type: Oil Flooded, Rotary Screw
- Model: GA7
- Horsepower: 10hp
- Voltage: 460VAC, 3 phase
- Capacity: 27 scfm @ 175psig
- Receiver: 500 gallon, 175psi rated, ASME code stamp.

2.2.2 Control & Monitoring Equipment

Pall's standard controls package is designed to offer flexibility, and robustness. The system is designed around hardware and software from the same manufacturer to reduce compatibility issues and eliminate confusion with technical support issues. Pall has invested heavily in developing this architecture and standard software for the PLC and HMI. All of Pall's Controls Engineers and Field Service personnel are familiar with this design allowing the best possible customer support, fastest commissioning and startup time and less down-time. The following describes the architecture, hardware, and software of Pall's standard membrane filtration system.

1. Control System Overview

1.1. Control System Architecture – Pall's standard membrane filtration system is based on a master PLC with distributed I/O. The master PLC controls all aspects of system operation including compressors, VFDs, and other ancillary equipment as required. The distributed I/O approach offers more reliability and easier software maintainability over a distributed control approach. Refer to figure 1.1 for a simplified network diagram of the control System.

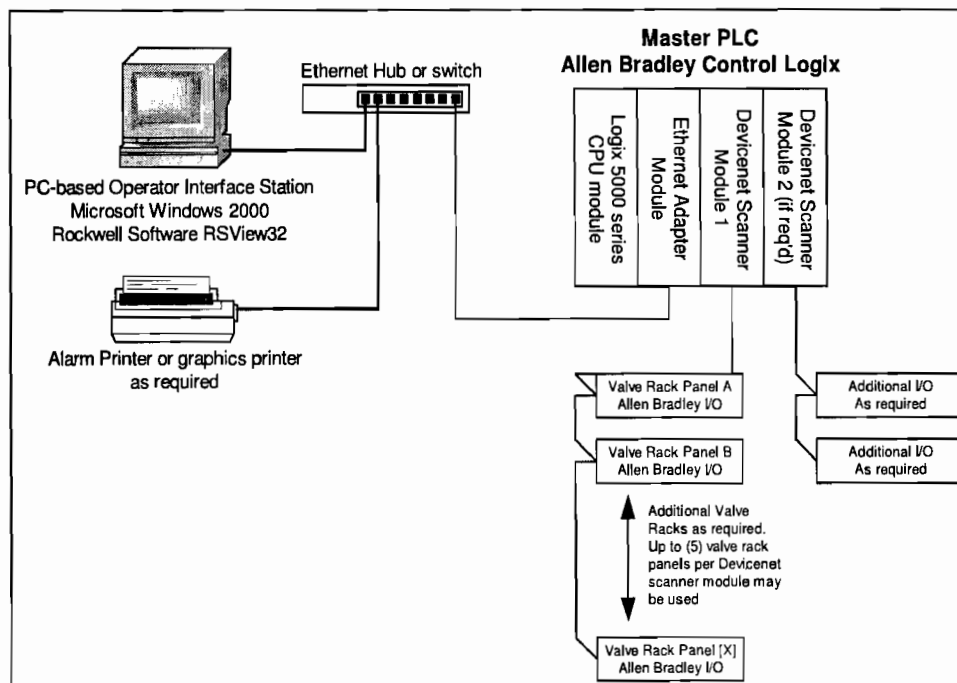


Figure 1.1

- 1.2. Control level communications – Control-level communications is defined to be any communication between master PLC and distributed I/O or any other piece of equipment that is critical to the operation of the system such as variable frequency drives. Communications for this purpose is handled via Device net.
 - 1.3. Information level communications – Information level communications is defined as communications that is not absolutely critical to operation of the filtration system. Small interruptions in this communication link will not cause the filtration system to stop processing. Typically, communication between the master PLC and HMI computers and supervisory control system (if applicable) is considered information level communications. This type of communications is handled via Ethernet.
2. Control System Hardware – Pall has chosen Allen Bradley for all programmable logic controllers, distributed I/O, and industrial networking equipment whenever possible. This approach helps assure compatibility between hardware and software and allows Pall to better support the filtration system.
 - 2.1. Programmable Logic Controllers – Pall's standard system is based on a single master PLC that controls all aspects of system operation and provides a means for communication with other equipment. The master PLC is an Allen Bradley Contrologix 5000 series programmable logic controller. Various types of I/O cards and network interface cards are installed in the PLC chassis.
 - 2.1.1. I/O hardware – Various types of I/O modules are installed in the master PLC chassis. High-density I/O cards are used when possible to reduce enclosure size and wiring. Specific types of I/O card chosen depend on the application.
 - 2.2. Distributed I/O – Distributed I/O is used where appropriate to reduce field wiring and troubleshooting time. Whenever possible, Devicenet is used to communicate with remote I/O products.
 - 2.3. Networking hardware
 - 2.4. Control Enclosures – While the number and type of control enclosures may vary based on building layouts, environmental conditions, and customer requirements, Pall's standard control system will include as a minimum the following control enclosures.

2.4.1. Main Control panel – The main control enclosure will house the master PLC and will handle all I/O not directly associated with another control enclosure.

2.4.2. Valve Rack Control panels – The valve rack control panel is designed to control only individual membrane valve racks. Each valve rack enclosure is identical with the exception of labeling. There is one valve rack control panel for each valve rack.

2.4.3. CIP I/O panel – The CIP I/O panel is used as a marshalling panel for all I/O associated with the CIP system. This provides a convenient place to terminate field wiring and reduces the amount of cabling between the CIP system and the main control enclosure.

3. Control System Software – To assure the best compatibility between hardware and software, Pall has chosen Rockwell Software products for PLC program development software as well as HMI software. Rockwell's RSView offers reliability and features of a high-level SCADA system.

4. Communications with customer equipment

5. Remote Access

