OFFICE OF THE CITY ATTORNEY
CHARLES PARKIN, City Attorney
333 West Ocean Boulevard, 11th Floor
Long Beach, CA 90802-4664

CONTRACT

34917

THIS CONTRACT is made and entered, in duplicate, as of April 16, 2018 for reference purposes only, pursuant to Resolution No. RES-18-0049, adopted by the City Council of the City of Long Beach at its meeting on April 3, 2018, by and between PURIFICS WATER INC. ("Contractor"), with a place of business at 340 Sovereign Road, London, Ontario N6M 1A8 Canada, and the CITY OF LONG BEACH ("City"), a municipal corporation.

WHEREAS, the City desires to purchase stormwater filtration equipment for the Long Beach Municipal Urban Stormwater Treatment Project; and

WHEREAS, City did by Resolution No. RES-18-0049 determine that the City's need to purchase stormwater filtration equipment for the Long Beach Municipal Urban Stormwater Treatment Project could only be met by Contractor and, by reason of the foregoing, no useful purpose would be served by advertising for bids to purchase stormwater filtration equipment for the Long Beach Municipal Urban Stormwater Treatment Project, and to do so would constitute an idle and useless act and an unnecessary expenditure of public funds;

NOW, THEREFORE, in consideration of the mutual terms and conditions contained herein, the parties agree as follows:

1. Contractor shall sell, furnish and deliver to City stormwater filtration equipment for the Long Beach Municipal Urban Stormwater Treatment Project, attached hereto as Exhibit "A" and incorporated herein by reference, as authorized by Resolution No. RES-18-0049.

2. City shall pay Contractor in due course of payments, following receipt of an invoice from Contractor and upon acceptance from City, for stormwater filtration equipment for the Long Beach Municipal Urban Stormwater Treatment Project, the prices shown in Exhibit "B", a sum not to exceed Four Million Eight Hundred Eighty-Two Thousand Four Hundred Eighty Dollars ($4,882,480).

3. The term of this Contract shall commence on April 3, 2018, and shall terminate at midnight on April 3, 2020 unless sooner terminated as provided herein. The City may terminate this Contract by giving thirty (30) days prior notice of termination to Contractor.

4. Neither this Contract nor any of the moneys that may become due Contractor hereunder may be assigned without the prior written consent of City.

5. Any notices required hereunder or desired to be given by either party shall be in writing and personally delivered or deposited in the U.S. Postal Service, first class postage prepaid, addressed to Contractor at the address stated herein, and to City at 333 West Ocean Boulevard, Long Beach, California 90802 Attn: City Manager. Notice shall be deemed given on the date personal delivery is made or on the date of deposit in the mail, whichever first occurs.

6. City shall have the benefit of any warranty from the manufacturer on the stormwater filtration equipment for the Long Beach Municipal Urban Stormwater Treatment Project, and Contractor warrants that the stormwater filtration equipment for the Long Beach Municipal Urban Stormwater Treatment Project are in good working order and free from defect at the time of delivery.

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OFFICE OF THE CITY ATTORNEY
CHARLES PARKIN, City Attorney
333 West Ocean Boulevard, 11th Floor
Long Beach, CA 90802-4664

IN WITNESS WHEREOF, the parties have signed this document with all the formalities required by law as of the date first stated above.

PURIFICS WATER INC.

April 17, 2018

By Tony Powell
Name Tony Powell
Title CTO & Applications Manager

April 17, 2018

By B Butters
Name Brian Butters
Title President

"Contractor"

CITY OF LONG BEACH, a municipal corporation

4/20, 2018

By
City Manager

"City"

This Contract is approved as to form on April 18, 2018.

CHARLES PARKIN, City Attorney

By
Deputy

OFFICE OF THE CITY ATTORNEY
CHARLES PARKIN, City Attorney
333 West Ocean Boulevard, 11th Floor
Long Beach, CA 90802-4664

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EXHIBIT A – TECHNICAL PROPOSAL

Proposal No. W18032 Rev. 1
February 16, 2018

T.P.

Cuf / PHOTO-CAT

WATER PURIFICATION SYSTEM FOR SURFACE RUN OFF WATER

Technical Proposal

Submitted to:
ATTN: Alvin Papa
<Alvin.Papa@longbeach.gov>

City of Long Beach, CA

City Hall, 9th Floor, 333 W Ocean Blvd., Long Beach CA 90802
Ph: 562-570-6386

For Additional Information Contact:

Purifics

Tony Powell, P.Eng.
Purifics Water Inc.
340 Sovereign Road, London ON
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tpowell@purifics.com
www.purifics.com

EXECUTIVE SUMMARY

This proposal is for an integrated *Cuf* (Ceramic Ultra-Filtration) and Photo-Cat system for the purification of run-off water of TSS, turbidity, oil and grease, metals, pathogens, and dissolved organics to meet TMDL standards. The solution consists of two M48 CUF pallets and two 10DDL rack Photo-Cat pallets.

Purifics has been developing and applying ceramic ultra-filtration and Photo-Cat systems for over 20 years. Purifics has 30 patents / patents pending on its technologies. The technologies are unique, and only available from Purifics. These technologies coupled with Purifics' extensive and unmatched engineering and application experience provides an extremely efficient, sustainable, and robust solution for the client.

The integrated *Cuf* and Photo-Cat solution offered in this proposal offers significant advantages over conventional and chemical based AOP solutions. These proven technology advancements include

- A membrane & process that is an absolute filter for the design life of 25 years. There is no membrane replacement for the life of the application for the *Cuf* and Photo-Cat system.
- *Cuf* and Photo-Cat have no permeate loss, no permeate back flow or no back pulse and no back wash.
- Each *Cuf* and Photo-Cat pallet is complete and operational upon delivery. They do not require any civil works.
- Only a small amount of acid and sodium hypochlorite is required intermittently to remove accumulated foulants in the *Cuf*.
- Photo-Cat has no waste streams, and the blowdown of the concentrated solids in the *Cuf* is anticipated to be 1% of flow.
- *Cuf* and Photo-Cat are fully automated and require no direct operator involvement. The operator only needs to monitor the system.
- The proposed solution is durable, robust, reliable and commercially proven.
- There is no pre-treatment or post-treatment.

The Photo-Cat system is the most cost-effective and efficient solution to destroy contaminates of concern in the water. The Photo-Cat AOP+ solution has no generated waste. The standard off the shelf **chemical-free** Photo-Cat technology

proposed will outperform UV/ H_2O_2 processes, and provide the client with additional key benefits such as long life lamps and instant on-off capability.

This unique Photo-Cat AOP+ technology not only outperforms AOP, but it completely eliminates hazardous chemicals and their associated safety issues, and the need for GAC to quench the high levels of residual H_2O_2.

The described solution is a turnkey water treatment system with remote monitoring and control and data logging. The on board PLC and HMI provide all control requirements and can be expanded to meet all anticipated requirements easily.

This proposal offers a **completely integrated solution** with the benefits of SCADA, self-sufficiency, autonomy of spares sourcing, reduced system complexity, and proven durability. *Cuf* and Photo-Cat are electricity based purification systems that the client will find attractive to operate because of its **simplicity** and **cleanliness**.

Purifics is a knowledge-based company that provides automated water purification solutions since 1993.

TABLE OF CONTENTS

1 CLIENT OBJECTIVES

Efficient, reliable and durable purification of surface run-off water to remove TSS, metals, turbidity, pathogens, oil and grease, and dissolved organics to meet TMDL standards. The design flow rate is 0-2 MGD. The purified water will either be discharged to the river or recycled for irrigation purposes.

1.1 System Objectives

- The system will control feed pumps (supplied by others) to feed the raw run-off water to the *Cuf* units. Each *Cuf* unit will have the capability to drive two 25hp feed pumps (supplied by others).
- Durability: The system will have high reliability and durability and can be serviced by readily available local trades.
- Any steel wetted parts will be constructed out of Stainless Steel resistant to chloride pitting from brackish water.
- Each *Cuf* M48 pallet will be rated for 1 MGD. Each skid will be able to be expanded to a DM48 pallet at a later date simply by adding an additional module.
- Each *Cuf* unit will have an automated flushable strainer with 16 mesh openings.
- The system will have general classification (Not ANSI 61).
- Both *Cuf* pallets will discharge into a common break tank supplied by others. Break tank material of construction to be FRP, stainless steel, or plastic (cannot be concrete or steel). The minimum break tank volume is 5000 gallons.
- Four TMP rinse pumps for each *Cuf* (2 for sulfuric acid and 2 for sodium hypochlorite, providing 100% redundancy).
- Nominal design flux of each *Cuf* is 440 GFD at 1 MGD.
- Two air compressors supplied for the entire plant, each capable of running the entire plant (100% redundancy).
- Each *Cuf* will have dissolved oxygen (DO) addition modules and coagulant addition ports.
- Single HMI and PLC to control all *Cuf* and Photo-Cat operations, and can be expanded to handle an additional *Cuf* and Photo-Cat pallet.
- Single remote plug-in HMI to plug into any *Cuf* or Photo-Cat pallet for troubleshooting.

2 SOLUTION

The solution for the clients' surface run-off water application as per section 1.0 consists of two *Cuf* (Ceramic Ultra-Filtration) M48 platforms and two 10DDL rack Photo-Cat pallets detailed in Section 4.

2.1 CUF Information

Cuf is a cross flow ceramic membrane process that uses a patented dynamic shock process to inhibit fouling and eliminate permeate loss.

The process ensures a high level of reliability, robustness, redundancy, durability and adaptability to changing flow rates and load conditions.

The proposed system uses proven components with extensive field track records, and makes use of fully developed software, sensors, and controls. The practiced process philosophy uses readily available off-the-shelf components available from multiple sources of supply.

Figure 1: Sample DM36 System

2.1.1 Operation Performance Robustness & Durability

The *Cuf* process is unique in that it operates on a continuous duty and unlike other membrane process; in the *Cuf* process Trans-Membrane Pressure (TMP) is modulated (between 0 – 1.5 Bar) in order to maintain the required flow rate set point or flow condition. This way the desired flow rate is always maintained regardless of water temperature or filtration challenges.

The Purifics *Cuf* process has no permeate loss, no back wash and no back pulses are used or required to maintain membrane performance.

2.1.2 *Cuf* Membrane Life

The design life for the membrane is 25 years and there is no need for removal of the membranes for the design life of the component. Integrity tests or inspection would be for Regulatory requirements only. **See Appendix for Purifics *Cuf* system benefits.** This product pedigree has been commercially applied since 1994. Purifics' oldest operating ceramic ultra-filtration system was a 1998 remediation install (17 years) on ground water with continuous duty with regulatory oversight using the same membranes.

2.1.3 Elimination of Bio-Fouling

The *Cuf* process inhibits bio-fouling mechanisms using Purifics' proprietary dynamic shock technology. Purifics has been developing and fielding ceramic membrane systems for over 20 years. Bio-fouling can only occur when the *Cuf* system is shut down for extended periods. Consequently, the *Cuf* system employs an automated 'Extended Shut Down' Procedure that is activated if and when the system is shut down for extended periods.

2.1.4 TMP Maintenance

In-situ citric acid and/or sodium hydroxide rinses will be periodically required to remove inorganic foulants (i.e. calcium carbonate and metal oxides) and organic foulants that will slowly build up in the membrane during groundwater operations. It is anticipated that these rinses will occur on a daily or weekly or monthly basis as circumstances dictate. *Cuf* rinses are an automated process that last about 30 minutes in duration.

2.1.5 Adaptive Control and Diagnostics

The PLC software, sensors, and SCADA are designed to monitor the system's performance in order to allow the system to adapt in real time to changing operating conditions (i.e. daily flow volumes, filter loading) and to flag variances or changes in system operation.

2.1.6 Ready to Operate on Demand

Cuf treatment process is fully tested and operational prior to delivery. It is operational upon power up. The *Cuf* unit will be operated on demand. At times, the system may be shut-down for several hours or months until demand is required.

These shut-down periods will not impact the *Cuf* system, and start-up will occur immediately when needed.

2.1.7 Local & Remote Support

Remote internet support is available directly from Purifics.

2.2 Photo-Cat Information

Photo-Cat is an AOP+ which does not suffer from the limitation of chemical based AOPs. Photo-Cat is a mature, fully developed technology which has been applied to groundwater with these chemical challenges for 20 years. Figure 2 below is a 10DDL rack Photo-Cat pallet, very similar to the two pallets specified in this document. This Photo-Cat pallet operates at 0.5 MGD and destroys 1,4-dioxane and cVOCs below detection limits. Benefits, qualification, technology and specification are detailed further in the relevant sections of this proposal.

Figure 2: Photo-Cat AOP+ Drinking Water System for 1,4-Dioxane and cVOC Destruction

Purifics Systems are of the highest quality materials and construction, with high-end industry standard components, designed and assembled as "off-the-shelf" systems with superior performance.

Photo-Cat is a high-performance, sustainable, chemical-free water purification technology that that provides the lowest life cycle cost to destroy chemicals in the water. Photo-Cat has over a 20 year pedigree, a 25 year design life and a 20,000 hour service interval.

Photo-Cat is a photo-catalytic oxidation and reduction process that utilizes a light activated titanium dioxide (TiO_2) slurry catalyst. This is a low energy, ambient temperature and pressure process that utilizes a self-cleaning ceramic membrane to recover the TiO_2, while the TiO_2 slurry continuously hones the system internals. Photo-Cat is the only chemical-free AOP process, and the only input is electric power.

The Photo-Cat process is fully automated, the TiO_2 catalyst is closed-loop, and it has no generated waste streams. It offers significant advantages in efficiency, process simplicity and life-cycle cost over traditional AOP technologies.

2.2.1 Photo-Cat: How It Works

The fundamental difference between Photo-Cat and other AOP technologies is how the organics are destroyed. The Photo-Cat does not rely on Hydroxyl radical (·OH) chemistry. Photo-Cat generates the most powerful oxidizing species **and** provides a unique reductive pathway.

Photo-Cat utilizes the full UV spectrum of 185 to 388 nm light emitted from a low pressure amalgam UV lamp to activate its TiO_2 catalyst. For this reason Photo-Cat has the highest lamp efficiency.

Referring to Figure 3, once the TiO_2 catalyst adsorbs light energy electrons are shifted into the conduction band of the TiO_2 catalyst creating "conduction band electrons", and "positive holes" are generated at the surface of the TiO_2.

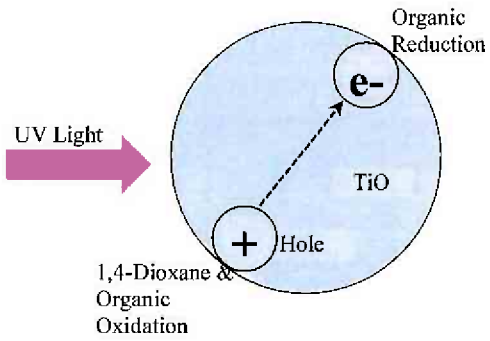


Figure 3: Photo-Cat Chemistry

The conduction band electrons (e-) readily reduce refractive organics (ie. Organics that are difficult to oxidize via hydroxyl radical chemistry). Simultaneously, the positive holes (+) oxidize 1,4-dioxane and other dissolved organics. After the sequential reduction and oxidation reactions, the TiO_2 molecule adsorbs another photon of light energy and the process repeats. The catalyst is a true catalyst in that it is not consumed, lost or degraded in the process.

As shown in Table 1 below, the oxidative power of the positive hole (+) in the Photo-Cat process is significantly stronger than the hydroxyl radical. Due to the high oxidation potential of the positive hole and the unique reduction pathway, Photo-Cat efficiently treats chemicals that UV/H_2O_2 or traditional AOP cannot.

Table 1: Oxidation Potential of Various Oxidants

Oxidizing Species	Oxidization Potential (eV)
* Photo-Cat (+)	3.21
Fluorine	3.05
Hydroxyl Radical ('OH)	2.80
Atomic Oxygen	2.23
Ozone	2.07
Hydrogen Peroxide	1.77
Hydroperoxyl Radicals	1.70
Permanganate	1.67
Chlorine Dioxide	1.50
Chlorine	1.36
*Primary Oxidizing Species Generated by Photo-Cat®	

2.2.2 Why Photo-Cat is AOP+

There are several reasons why Photo-Cat provides superior performance over traditional AOP systems and is called AOP+. Namely, Photo-Cat:

- Does not use hydrogen peroxide or ozone (ie. Operates Chemical Free)
- Has the highest oxidation potential of any AOP technology & provides a unique reductive pathway for efficient destruction of refractive compounds
- This routinely eliminates the need for post treatment technologies
- Destroys contaminants that other AOPs cannot
- Is not impacted by turbidity, color, or UVT
- Has no dependency on UV dose (Does not apply)
- Does not use or require UV wipers
- Is not vulnerable to random lamp failures
- Provides multi-barrier purification

The Photo-Cat process should not be confused with UV/H_2O_2 which is a photolytic process. Photolytic technologies generate hydroxyl radicals by using high energy UV photons to cleave the hydrogen peroxide molecule: $H_2O_2 + UV \rightarrow 2^{\bullet}OH$.

The efficiency of this type of process is greatly reduced by the fact that roughly 75% of the $^{\bullet}OH$ recombine back to H_2O_2 without accomplishing any work. Photolysis can also create organic radicals that readily combine to create random intermediates. Random intermediates are a concern.

Quantum Yield or Quantum Efficiency is used to describe the efficiency of hydroxyl radical (·OH) production and relates to the ratio of ·OH produced per number of UV photons emitted in some Advanced Oxidation Processes. Quantum Yield is quoted and promoted by those who focus on splitting H_2O_2 to produce ·OH radicals. Quantum yield is irrelevant to Photo-Cat and does not apply.

3 SYSTEM OPERATION DESCRIPTION

3.1 Process

Water will be pumped from a sump or equalization tank directly to the *Cuf* unit(s). The flow rate will be dictated by the sump or equalization tank level. The water will be sent through an automated Y-strainer to remove large solids. A pressure transducer will be mounted upstream of the strainer, and once the pressure reaches a setpoint, the strainer blow down valve will be opened to flush the strainer (plumbing by others). The water will pass through a dissolved oxygen (DO) addition system to provide DO for metals oxidation, and then will feed the *Cuf* unit(s). There the oxidized metals, oil and grease, pathogens, and TSS are filtered and the filtered water (filtrate) is discharged to a break tank (supplied by others). A nominal 1% blow down containing concentrated solids from the *Cuf* unit will be discharged to the sanitary sewer.

Separate feed pumps will be supplied by Purifics to pump the *Cuf* filtrate from the break tank to the Photo-Cat systems. Photo-Cat is a single-pass system with no waste streams (100% water through). The discharge of the Photo-Cat systems will be sent to a holding tank (supplied by others).

3.1.1 Configurable System

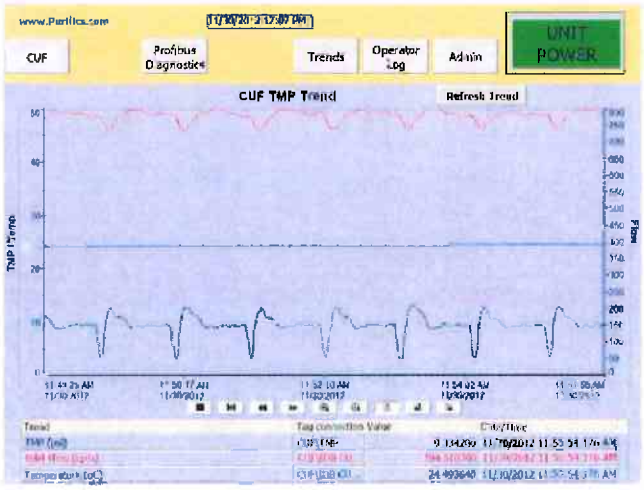
All program system and process parameters are configurable, no need to go into the PLC logic, remote logic updates, individual well configuration.

3.1.2 Access, Security, and Logging

Secure User Logs on all functions, for added security and traceability.

3.1.3 Trending and Data Logging

Real time and historical trending capability for process optimization and verification.



3.2 Operation

All operations are performed through the SCADA system, including system set points, on/off, trending, and data logging. The system can be inspected via remote monitoring.

4 INTEGRATED CUF & PHOTO-CAT SPECIFICATIONS

A preliminary system overview process flow diagram is shown in Section 9. After contract award, detailed design and shop drawings will be generated by Purifics and sent to the client for approval before manufacturing begins.

4.1 *Cuf* System Specifications

Figure 4: Sample *Cuf* DM48 Platform

4.1.1 General

- Two *Cuf* (Ceramic Ultra-Filtration) M48 System platforms, each pallet with a design flux of 440 GFD at 1 MGD flow, expandable to a DM48 pallet at a later date simply by adding a second M48 module.
- Estimated filtrate recovery of 99% with 0 to 100% turndown capability.
- The duplex pallet design allows for any component to be taken off line while the system is in operation for service, inspection, calibration or maintenance.
- Design Life of 25 years with high reliability in a general purpose location.
- All wetted steel parts will be made out of chloride resistant stainless steel to handle brackish water.
- All O-rings, seals and gaskets are viton, unless specified otherwise.
- System fully equipped with ¼" sample ports and valves for ease of sampling and calibration activities.
- Each skid will have its own automated TMP maintenance package using sulfuric acid and sodium hypochlorite. Each skid will have 4 chemical feed pumps for 100% redundancy. Chemicals and totes supplied by client.

- 16 mesh inline strainer on the inlet to the *Cuf* system as a safe guard to prevent oversized foreign objects from entering the *Cuf* system. Pressure transducer installed upstream of the strainer to trigger a blow down or flush of the strainer. Digital blowdown valve installed on the strainer for blowdown of solids (plumbing by others).

4.1.2 TMP Pump

- Paco, Grundfos or equivalent
- Pumps will be vertical, and are totally enclosed, fan cooled (TEFC) drive
- VFD controlled pumps to minimize and optimize power requirements. VFDs are profinet
- Power details to be provided after award

4.1.3 Valves

- Bray Butterfly & Burkert Process valves or equivalent
- Valve Actuators, Burkert or equivalent
- Valve controllers, Siemens, Burkert or equivalent: Profinet compatible

4.1.4 Cabinetry

- Split 24V and power cabinets are of stainless steel, NEMA 4X
- Power cabinets house all 3 phase electrical components and Variable Frequency Drives
- 24V control cabinet house all on board I/O and any 24V supplied electronics

4.1.5 Electrical Power

- Volts, Amps, phases, delta FLA name plate secured to electrical cabinet for easy identification
- Power supply is 480 VAC ± 5%, 3 phase, delta. One drop to each platform with disconnect rated for TBD Amps
- All electrical components will be constructed of UL approved components certified to NFPA70 (NEC) and UL508A. Other electrical inspections CSA or UL available
- Electrical and control wiring drawing supplied in cabinet at time of delivery

4.1.6 Instruments

- Endress + Hauser Mag Flow Meters

- Endress + Hauser Ceramic Pressure Transducers

- Endress + Hauser pH and Temperature Probes

4.1.7 Control Network

- Entire platform is based on Siemens TIA Portal V13 PLC Software
- Profinet communication network between all process valves, flow meters, HMI's, PLC's and on board I/O
- Profinet network allows for bus communication between individual platforms as well as control room HMI's
- Profinet network allows for easily troubleshooting and feedback from individual components
- Siemens Simatic PC PLC used for remote HMI capability in control room. PLC's can be configured to be hot swappable for redundancy
- Siemens Simatic HMI Connection Box allows for Handheld HMI plug in to each unit
- Process tags compatible with clients existing SCADA system

4.1.8 HMI & SCADA

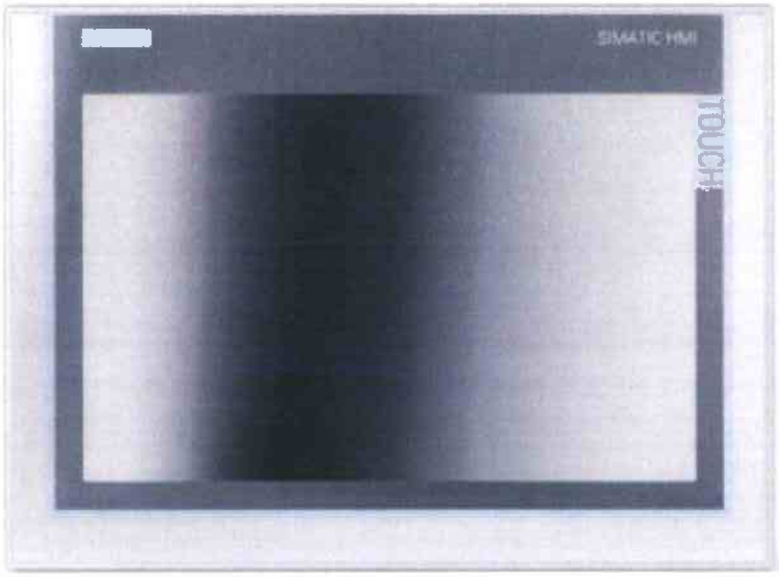


Figure 5: Typical *Cuf* Remote HMI Screen

- The system is supplied with a 22" IPC panel-mounted color HMI / PLC with built in touchscreen interface to be mounted in the plant (location TBD).
- PLC will control all operations of pumping, *Cuf* and Photo-Cat pallets, and is expandable for another *Cuf* and Photo-Cat pallet.
- The system is also supplied with a hand held Siemens remote HMI with Profinet Connection. This handheld remote has full functionality as the control room HMI but allows for machine side process parameter adjustment and troubleshooting, and can be plugged into any platform.

Figure 6: Hand Held Remote HMI

- The SCADA powered by Siemens TIA Portal is adaptable to display & control existing or future equipment with automated reporting capability. It is equipped for **remote** access via the internet/LAN for control, data transfer, report generation, and automation logic upgrades.

- Power monitoring for power usage optimization is off the VFD and can indicate and provide a measure of phase loss detection.
- Automatic features of email and text message alerts for wanted machine conditions or alarms. Remote access is standard with the SCADA. Client must supply email address and connections. Programming is extra.
- Bilingual capability option. Programming is extra.

4.1.9 TMP Maintenance Rinse Chemical System

- All chemical addition pumps will be Grundfos model DDA made of chemical specific wetted materials for sulfuric acid and sodium hypochlorite.
- Included in this proposal are 4 pumps (2 for sulfuric acid and 2 for sodium hypochlorite) per platform (8 total). Each platform will have 100% redundancy. Location of TMP pumps TBD. Pumps will be controlled by the system PLC.
- Chemical and totes supplied by others.

4.1.10 Air Compressors

- Two air compressors each with integrated tank, filtration and dryer to supply instrument quality air.
- Quiet operation (63 dBa)
- Worldwide service centres
- Oil free operation with integrated drain
- A separate 480 VAC 3 phase circuit to be supplied by client to each compressor. Power TBD
- Airline from air compressor to equipment to be installed by client
  - Must be stainless steel, no galvanized or black iron permitted
  - All supplied lines must be clean and dry prior to installation

Figure 7: Atlas Copco Air Compressor

4.2 Photo-Cat Specifications

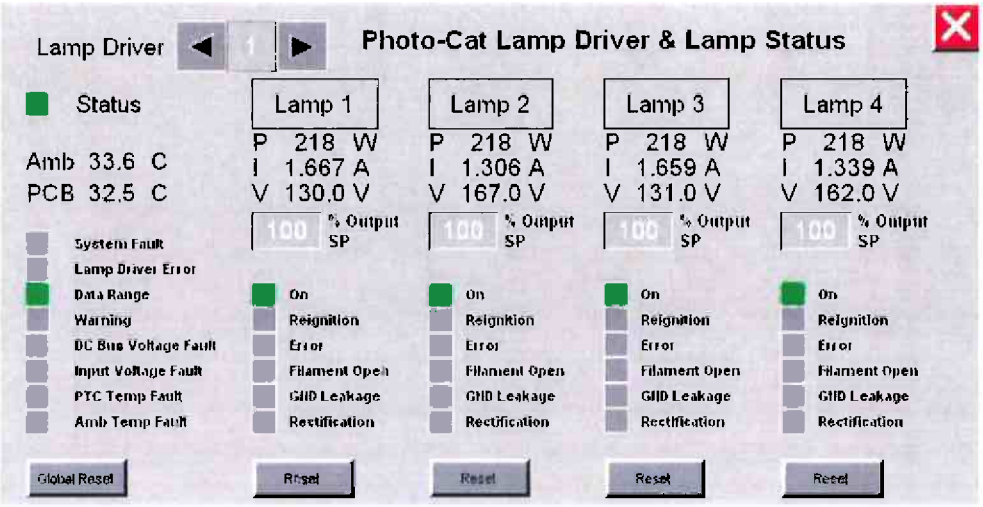
4.2.1 General

- Two Photo-Cat DDL platforms, each consisting of 10 DDL racks. Each DDL rack contains 32 Flex Lamps.
- Each platform with a capacity of 1 MGD and designed with 0 to 100% turndown capability.
- Each Photo-Cat will have its own feed pump, with variable frequency drive, and controlled via profinet.
- Design Life of 25 years with high reliability in a general purpose location.
- Power supply is 277/480VAC, 3 phase 4 wire, + 5%, TBD Amp service connected to main disconnect on each platform.
    - Full power details to be provided after contract award.
- All steel wetted parts will be made out of chloride resistant stainless steel for brackish water.
- All O-ring seals are viton, unless specified otherwise.
- System fully equipped with ¼" sample ports and valves for ease of sampling and calibration activities.
- All electrical components will be constructed of UL approved components and housed in a NEMA 12 cabinets with electrical certification to NFPA70 (NEC) and UL508A.
- Pumps are totally enclosed, fan cooled (TEFC).
- Able to operate with ambient relative humidity of 5-95% and ambient air of 32-104°F.
- Lamps can be changed without draining the reactor and lamp access and wiring is protected by a metal cover/gate.
- There is no limit on the number of ON/OFF cycles per day.

4.2.2 Lamps and Quartz Specifications

Each flex lamp is 440W T5 instant start low pressure high output amalgam lamps. They are nominally 10' long and are made in the USA. Note: Each flex lamp assembly consists of 2 separate lamps connected together by a flex connection.

Each lamp and lamp driver status is provided on the SCADA system as identified below.



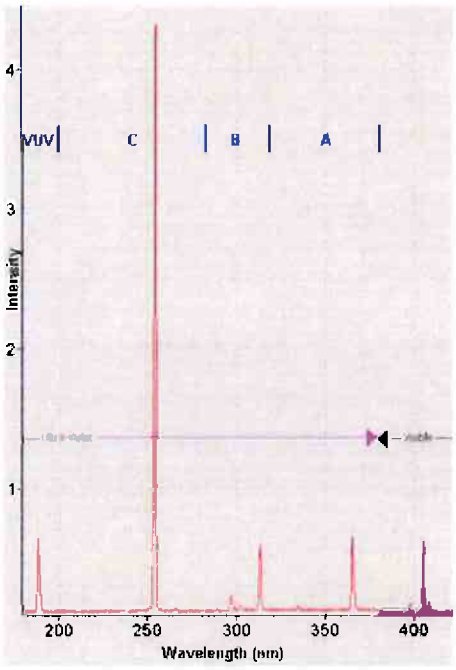


Photo-Cat uses the full UV spectrum and not just the 254nm spike. Consequently as the UV spectrum output shifts with lamp temperature, the same effective UV output is achieved as identified in the UV Spectrum chart at the left of the page.

Prospective Clients with experience in medium/high pressure or low pressure disinfection UV lamps systems frequently raise questions based on their experiences. These questions are collectively addressed as follows.

In a Photo-Cat system lamps can be changed out when the system is flooded (no need to drain) and is essentially a 1 minute process per lamp. Lamps have visible and electronic indicators verification methods for function. The reactor design is not vulnerable to single or multiple lamp failures which are rare occurrences (<1%/year). Lamp replacement is not an annual event. With the advances in lamp technology, the proper lamp specification, duty, and the proper process design, lamp replacement will occur after many years of operation. Lamp life will range from 20,000 to 40,000 hrs.

Quartz tubes are constructed of GE 214 quartz.

4.2.3 Lamp Driver Specifications

The Photo-Cat Process uses the most advanced Electronic Lamp Driver technology with proven performance.

Lamp Driver Versus Ballast

Ballasts are PASSIVE current limiting devices that use resistance, or reactance, to regulate the flow of electricity (current) to a lamp. Ballasts use reactance from a system of inductors (transformers) and/or capacitors to limit the current.

Lamp Drivers are ACTIVE control devices that supply the lamps with the proper current and voltage conditions. They have the Diagnostic capability, as well as the ability to identify fault conditions to protect both the lamp and the driver from harm.

Lamp Driver Benefits

- Ballasts have a peak efficiency of 90%. By contrast, Lamp Drivers exceed 95% efficiency because they can supply the energy to the lamp in the proper form. Lamp Drivers actively control the power to the lamp at proper conditions by supplying high frequency power bursts. This feature lowers the Lamp Driver cooling requirement and increases overall system efficiency.
- Ballasts offer protection for Over Current only. Lamp Drivers protect themselves and the lamps from conditions such as water leakage, end of life failures, filament damage and short circuit.
- Ballasts are on or off. Lamp Drivers have the ability to control the lamps start up and operating characteristics, activate them individually or in combination, and shut down a lamp in a fault condition while maintaining the output to other lamps.
- Lamp Drivers communicate in real time via network to the PLC & SCADA to alert operators in the event of a fault and identify the nature of the fault, saving valuable service time.
- A nominal power switching and control capability of up to 1kW.
- Controls up to 2 flex lamps in parallel.
- Power different lamp types by selecting the proper driver configuration, enabling the use of ongoing advanced lamp technology with increased efficiency, output and life.
- Network access and control with full lamp diagnostic and status capability.
- Voltage supply range 208-480V.
- Instant Start and Preheat Start Up configurations.
- Dimming capability to 50%.

4.3 Raw Water Feed System

- Four feed pumps (2 per *Cuf* skid), each with a nominal 1 MGD capacity will be provided by the client.
- Purifics will supply 4 Siemens G120 variable frequency drives, mounted in a stainless steel cabinet. Cabinet location TBD. Each drive will be a 25hp VFD.
- The VFDs will provide flow control to the *Cuf* units. The raw sump or equalization tank level will dictate flow rate requirements.
- VFDs will be integrated via Profinet, and controlled by the *Cuf*-Photo-Cat system.
- Electrical details to follow after award.
- Feed flow rates to each *Cuf* unit and the totalized flow will be data logged and displayed on SCADA.

4.4 Manuals

- The Operating Maintenance & Support Information (OMSI) manual is comprised of four sections:
  - I. Installation
  - II. Maintenance
  - III. Operation
  - IV. Support
- OMSI on a memory stick in Adobe and resident on HMI.
- PLC program and SCADA backup (on memory stick)
- Component service manuals in Adobe format (pdf) as available.

4.5 Factory Burn In & Factory Acceptance and Training

After in-house assembly is completed, the system will be operated vigorously for mechanical and performance properties (i.e. pressure drops, flow rates, etc.)

Factory Acceptance and Training (FAT) invokes a documented check list, equipment review and inspection during and after the training program before sign off. It is recommended that representatives responsible for the following skill sets attend: Project Engineer, Plant Operator, Electrician, and Pump Operator. Additional details are provided in the Terms & Conditions.

4.6 Commissioning

On-site commissioning support will be contracted separately.

4.7 Remote Monitoring & Support

Purifics will provide, for two months following start up, a limited version of its remote World Wide Support program to appraise and support the client's operations. This service is also available as an extended service options as detailed in our World Wide Support (WWS) After Sales Program.

5 WORK SCHEDULE

A detailed work schedule (Gantt Chart) will be submitted under separate cover.

6 CLIENT DELIVERABLES

- Necessary permitting as local, state or federal requirements dictate.
- Electrical wiring to all cabinets sized for load.
- All internal process plumbing between skids, *Cuf* blowdown lines, and strainer blowdown lines, chemical lines.
- Information sufficient to ensure the proper gateway for network is selected for remote support.
- Foundation; the client will prepare the necessary foundation and building for the *Cuf* and Photo-Cat pallets including power and plumbing.
- Raw water feed pumps, and installation of the VFD cabinet for the raw water feed pumps, including all wiring.
- Offloading and positioning of all equipment and platforms.
- Shelter for the equipment between 10°C - 40°C.
- Adequate raceways for fluid lines and cables.
- Any and all chemicals in appropriate reservoirs.
- Less exercised options.

7 TERMS

7.1 Patent License

The product supplied is protected by the following US Patents as a condition of purchase: **#5,462,674 / #5,554,300 / #5,589,078 / #6,136,203 / #6,215,126B1 / #6,398,971B1 / #7,008,473B2 / #7,326,278B2 / #7,425,272B2 / #7,588,688B2 / #7,800,310B2 / #7,837,952B2.** The purchaser agrees to honour these patents and to not modify the equipment, relocate the equipment, or sell the equipment without the approval of Purifics. This approval is not to be unreasonably withheld.

7.2 Priority

This proposal has priority over other contract wording.

7.3 Validity

This proposal is valid for 60 days from time of issue.

7.4 Disclaimer

Purifics is not the operator of the equipment at the client's location and will not operate the equipment. Purifics will provide technical and application support when clearly directed. Purifics makes no representation concerning the need for a Certificate of Approval or other forms of license to operate the treatment system. The client must determine for itself whether a Certificate of Approval or another form of license or permit is required in the applicable jurisdiction before the operation of this equipment commences. Purifics is not responsible for any compliance monitoring.

8 AFTER SALES SUPPORT

8.1 Spares, Policy & Pricing

Cuf and Photo-Cat systems are built entirely from off the shelf components with long established field histories in related applications. *Cuf* and Photo-Cat components are directly available from Purifics or our vendor's global warehousing and distribution system with typically 24 to 48 hours' notice.

8.2 World Wide Support (Optional)

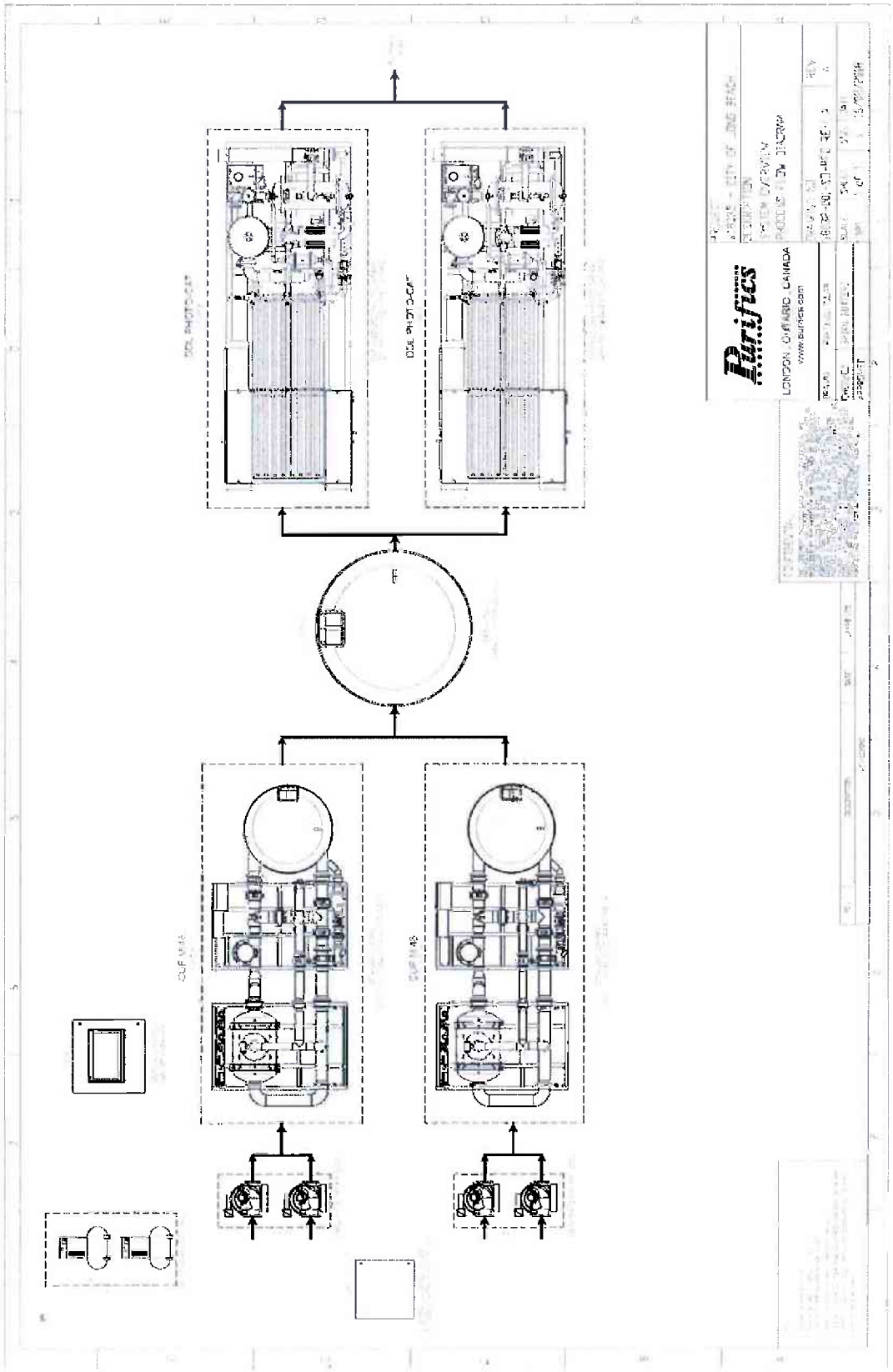
World Wide Support (WWS) is supplied via our remote monitoring and control centre at our London facility. A limited version of this support is provided at no charge during the first two months following system installation. Subject to client requirements, subsequent WWS may consist of:

- Real time remote monitoring.
- Real time remote training of on-site personnel.
- Real time remote software modification.
- Automated compliance monitoring and report generation.
- Automated updates and downloads of bulletin or manual updates.
- Varying levels of security to limit access and control.
- Simple, direct and immediate spares ordering.
- Additional On Site Support

8.3 Warranty

The general Warranty is provided in the Price and Terms section of this proposal.

9 DRAWINGS



M48 & DM48 Platforms

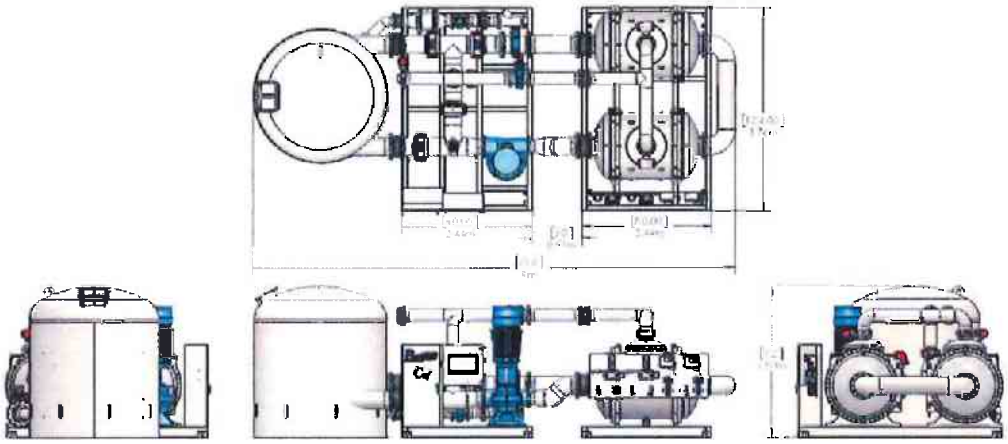
DM: Dual Membrane Module (shown below)
M: Single Membrane Module

Flux vs Capacity *		
FLUX LMH (GFD)	M48 l/s (GPM) MGD	DM48 l/s (GPM) MGD
1300 (766)	76 (1208) 1.7	152 (2416) 3.4
900 (530)	53 (836) 1.2	106 (1672) 2.4
500 (295)	29 (465) 0.67	58.7 (930) 1.3

Performance & Equipment Specifications *			
Duty Capability	>99%	Membrane Life	25 Years
Automatic Turndown	0-100% Flow & Power	Wetted Material	Stainless Steel
Filtrate Loss	0%	TMP Maintenance	Automatic
Operating Modes	Demand Flow	TMP Range	0-15 PSI, 0-1 Bar
Filtration Modes	Pressurized or Gravity Feed	Integrity Testing	Continuous-On-Line
Concentrate	Zero Liquid Discharge Carbon Capture	Gasket Material	Viton Or EPDM
Remote	Internet / WiFi	NEC	NFPA70, NFPA79 NFPA496, UL508A

May very with each application *

Cuf M48 & DM48 Platforms



Application Engineering Data			
Power	480 Volt, 3Ø, 50/60Hz 200 / 240 FLA	Inlet Flange	10" #150 3.4 MGD 8" #150 2.4 MGD 6" #150 1.3 MGD
Network	Profibus/Ethernet	Outlet Flange	10" #150 3.4 MGD 8" #150 2.4 MGD 8" #150 1.3 MGD
Instrument Air	6-10 cfm Oil Free 120 PSI, 8 Bar	Concentrate	2" #150 Flange
Weight Dry/Wet	22,700/30,000 LBS 10,300/13,600 KG	Air Supply	3/4" NPT

Auxiliary Options*			
• Drive & Control Pumps	• Primary & Residual Disinfection	• DO Addition – Metals Removal	• Strainers
• Inline pH Control	• Level & Flow Control	• Coagulant Feed System – DOC Removal	• Transfer & Blending
• Inline Oxidation	• HSC Reactor	• Camera	• Automated DIT

Inlet & Outlet Flange Position are Configurable.

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DOC3055R6
Printed in Canada

10 APPENDIX - CUF

Purifics Cuf

Ceramic Ultra Filtration with Zero Liquid Discharge
Better Water, Safer Water, Lower Cost

Cuf is a 5th Generation Ceramic Membrane Process with proven performance and represents a quantum leap forward in water purification; effectively rendering all other MF/UF membrane processes obsolete in terms of comparative performance. ***Cuf*** has no pre-treatment, no filtrate loss, absolute filtration at its rating over the 25 year design life of the system.

The ***Cuf*** process is a disruptive game changer and challenges conventional engineering, cost structures and performance criteria. ***Cuf*** does more than just filter.

Cuf systems have a much smaller footprint and significant complexity reduction over all other ceramic or polymeric membrane filtration processes. Low TMP (Trans Membrane Pressure) with unmatched flux and duty further contribute to comparable operating and capital cost structure reductions in the 50% range.

Cuf is comprised of patented ceramic membrane and process technology which has been developed and optimized with over 25 years of continuous application and operations experience.

Purification Capability

Removes and/or Recovers Particulate, Color, DOC, Pathogens (> 4 log), TSS, VSS, Radium, Turbidity, Hardness, Oil, Metals, H_2S, P, THM & HAA Precursors, Taste & Odor compounds and Silica. All this is performed in a single ***Cuf*** platform which eliminates conventional pre, auxiliary and post treatments. ***Cuf*** is a complete plant and capable of ZLD (Zero Liquid Discharge).

Applications

- Drinking Water
- Wastewater
- Reuse
- Remediation
- Solvent Filtration
- RO pre-treatment

Process, Complexity & Cost Reduction

Pre-treatment and auxiliary processes such as coagulation basins, flocculation, clarifiers, microfiltration, precipitation reactors, chemical oxidation reactors, back wash, back pulse and CIP cleaning skids, sludge thickening and filter presses are **eliminated** with the ***Cuf*** process. The capital & operating costs and land for these redundant processes is also **eliminated**. As shown below, the ***Cuf*** platform is the entire plant.

Expertise

Purifics has been deploying its proprietary Ceramic Membrane Systems since 1993. Our installed global base (60+) provides unmatched Experience and Leadership in ceramic membrane system technology for Municipal and Industrial applications to Filter, Destroy and Recover (FDR) contaminants in water and other fluids.

Purifics' Experience and Leadership in ceramic membrane technology has led to unique innovations:
1. That Inhibit Fouling
2. Allow Sustained High Flux Rates
3. Continuous Online Duty
4. Marker Based DIT
5. Enhanced Capability, Robustness, Efficiency, Reliability & Durability.

Carbon Capture

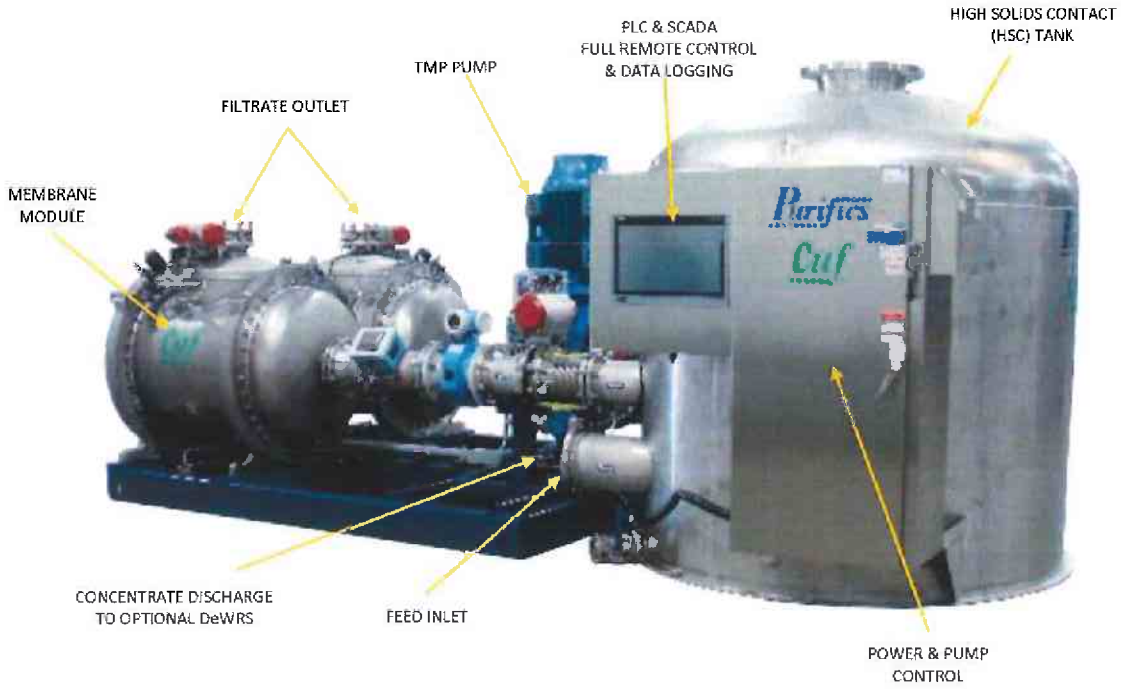
Cuf will capture and reduce your carbon footprint.

Cuf Platform Process Components

Unique Features

- No Fatigue & Abrasion Failure
- No Off Gassing / Leaching
- No Chemical Degradation
- No Backwashing or Back Pulse
- No Membrane Replacement
- No Temperature Constraints
- Sustained Flux with changes in Fluid Temperature
- No Chemical Limitations
- No pH Constraints
- No TMP Constraints
- No Filtrate Losses
- Self-Cleaning/ Inhibits Fouling
- Hydrophilic (resists oil)
- Converts Plant from Chloramines to Free Chlorine
- Product Recovery
- 25+ Year Membrane Life
- Multi Membrane Modules
- Modular Growth & Capacity
- Reduced Trans-Membrane Pressure
- Reduced Cross Flow Pressure Drop
- Lowest Membrane Module Parts Count

Typical Cuf Plant

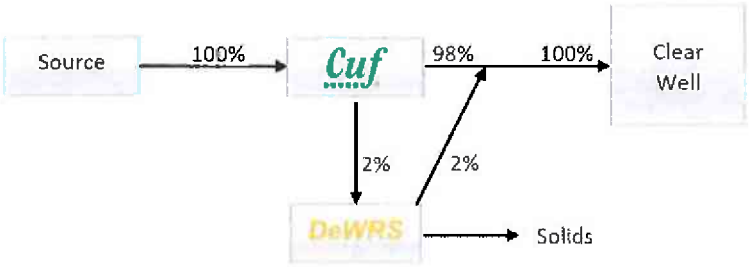


* NOT ALL APPLICATION SPECIFIC FEATURES REQUIRED OR IDENTIFIED

Cuf Platform Process Components

Process Description

Raw water is screened for "frogs and logs," and in a cross flow arrangement, not dead end; TMP is modulated in the ***Cuf*** to maintain constant flux over the performance range to ensure that flow rate requirements are achieved. The membrane module is frequently subjected to a dynamic shock to self-clean the membranes which inhibits fouling, allowing continuous online duty (~99%). Over time the concentrate loop will have highly concentrated levels of filtered material that impacts the TMP.

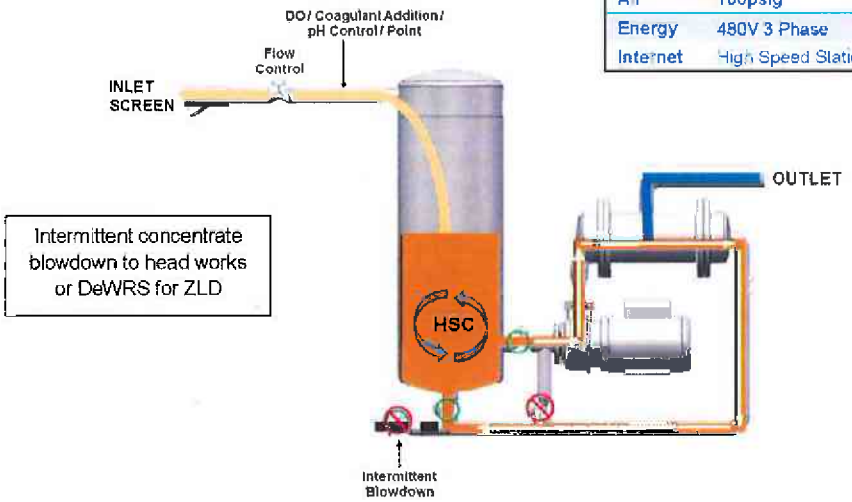


This causes a concentrate blow down or optionally the concentrate is sent to a DeWRS (DeWatering Recovery System) where the concentrated material is dewatered to a wet solid to achieve Zero Liquid Discharge (ZLD).

Cuf is not Trans-Membrane Pressure (TMP) limited like conventional membrane processes. ***Cuf*** is unique and runs at a constant flux and the TMP is modulated to maintain that constant flux. This means that the flux in a ***Cuf*** process is independent of the fluid temperature and the plant is not de-rated as the fluid temperature drops. This means that a ***Cuf*** process can respond to changes in viscosity, load and demand and is only limited by the installed TMP pump's capability.

Process Flow

Process Utilities	
Air	100psig
Energy	480V 3 Phase
Internet	High Speed Static IP



Intermittent concentrate blowdown to head works or DeWRS for ZLD

In certain applications dissolved oxygen or a common coagulant is injected to oxidize or agglomerate dissolved contaminants such as metals or DOC. These reactions occur in the HSC Tank. No upstream coagulation basins or clarifiers pretreatment is required, just the ***Cuf*** platform.

Cuf Platform Process Components

Dynamic Shock

Purifics' proprietary Dynamic Shock process self-cleans the ***Cuf*** membrane in a continuous online operation. The shock is generated and travels through the water, the membrane and the module to drive foulants off the membrane surface.

Remote Access & Control

Cuf utilizes a high speed internet connection with a static IP or VPN access to a client supplied network. This allows Remote Control, remote programming/SCADA updates and remote technical support. The connection allows the ***Cuf*** to automatically message pertinent plant personnel in the event of a fault. If no landline access is available, cellular alternatives are available.

Duplex & Redundancy System Options

For system design and regulatory requirement purposes to retain capacity in the event of a component failure, ***Cuf*** systems are available in a Duplex or Dual Module (DM) platforms. There are two complete and identical membrane module assemblies that operate together or independently in a single platform assembly. To achieve redundancy for pump or PLC related failures, two platforms are required.

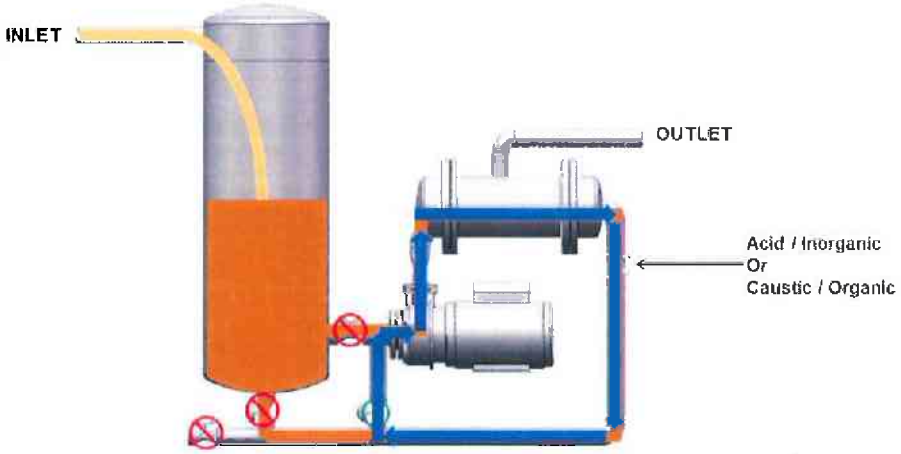
Ratings & Certifications Available

- LT2ESWTR Compliant
- ASME B31.1 & 31.3
- NSF/ANSI 61
- Class I Div 2

Regulatory Compliance

Regulatory Compliance in Multiple Jurisdictions since 2015 with the largest installed base of ceramic drinking water plants in the USA.

TMP Maintenance



There is no Clean-In-Place (CIP) with the ***Cuf*** process. Over time or extended shut down or an upset event the Flux may not be fully recovered by Dynamic Shock alone. When this occurs an automated TMP Maintenance Rinse Cycle (chemical rinse) is activated and the concentrate recirculation loop (in blue) is isolated from the process, the TMP pump recirculates high cross-flow, the temperature may be raised, and the pH shift chemical is injected. Acid is used for inorganic and caustic is used for organic fouling. The combination of heat, cross-flow velocity and pH shift is used to scour and dissolve residual foulants from the membrane. The TMP maintenance fluid is discharged through the blowdown line. When this 20 minute cycle is complete, full TMP recovery is achieved and the system is brought back online.

Platform Process Components

LT2ESWTR Compliance for Membrane Integrity Verification

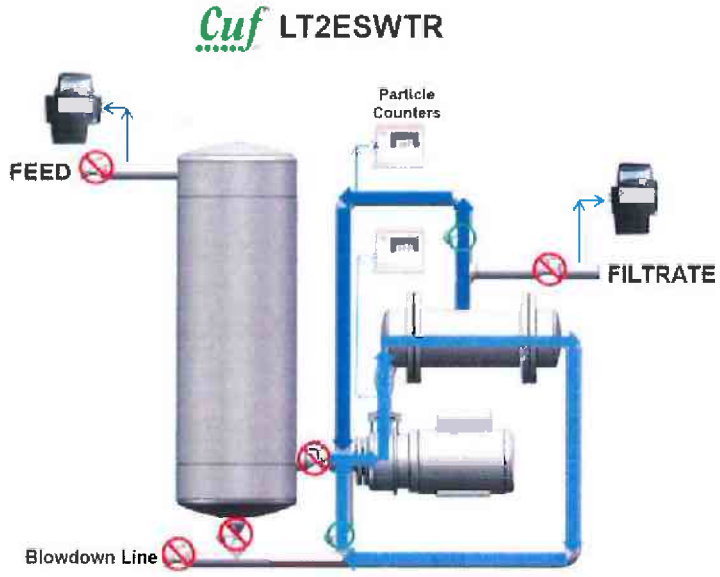
LT2ESWTR "Long Term 2 Enhanced Surface Water Treatment Rule" identifies the requirements for log removal of *Cryptosporidium* and the verification method to ensure the membrane integrity. This is achieved in the ***Cuf*** process by the following procedure.

Challenge Test & Direct Integrity Test (DIT)
A key benefit of the ***Cuf*** process is that the Direct Integrity Test (DIT) is the same test as the Challenge Test therefor no surrogate test (such as bubble decay) is required.

Challenge testing was conducted as per LT2ESWTR using a conservative marker at 1,175 GFD (2,000 LMH) and achieved 4 log removal. The integrity of the membrane is performed using a **Conservative Marker** which is enumerated by a particle counter. This method of membrane integrity testing is compliant with LT2ESWTR. The Conservative Marker, TiO_2 Nano-particulate (1 micron), is added at the required loading and operated at the rated Filtrate flux. A particle counter is used to verify >4 log removal of particles.

The membrane integrity testing process is simple, automated and only takes 15 minutes. Purifics has been using the TiO_2 (Titanium Dioxide) **Marker** test successfully for over 25 years. The TiO_2 marker is NSF/ANSI 61 compliant, as part of the Purifics Drinking Water Systems UL certification, and is very low cost.

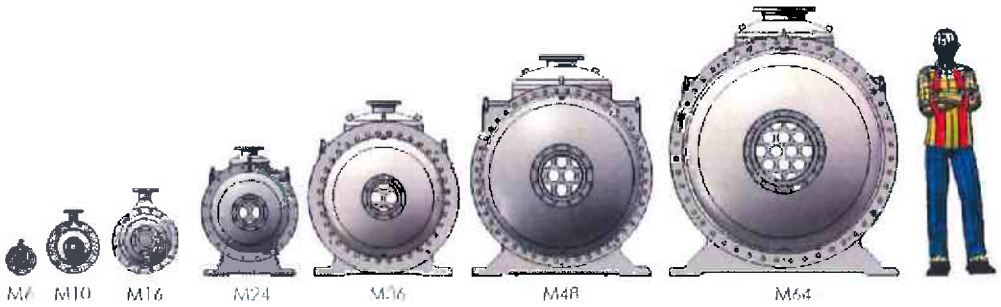
Continuous Indirect Integrity Monitoring (CIIM)
Continuous indirect integrity monitoring is performed using Turbidity monitoring of the influent and effluent stream and is compliant with LT2ESWTR. This is performed using inline turbidity sensors and is monitored and logged by the ***Cuf*** systems PLC. The systems PLC will automatically take the required action if the turbidly limit is exceeded.



Cuf Platform Process Components

Modular Platform Capacity 0→1→2→4→16→32→64 MGD/MLD

Cuf is available in 11 different platforms with single "M" or double "DM" modules to meet your process and capacity requirements. Detailed Platform Specifications Sheets are available in the "Downloads" section at www.Purifics.com. A *Cuf* Sizing and Application document is also available upon request.



Cuf Membrane; Elegant But Tough

Purifics patented & patent pending SiC membrane technologies are unique for unmatched performance, efficiency, strength, durability, flux and anti-fouling properties. Once installed the membranes are **NEVER** removed and will never see the light of day again.

Plant Tours

To fully appreciate the benefits of the *Cuf* process for your application, we highly recommend that you tour an existing installation that meets your requirements. Contact us to arrange a tour at your convenience.

Purifics 340 Sovereign Road, London, ON, Canada, N6M 1A8
Ph: 519-473 5788, info@Purifics.com, www.Purifics.com

11 APPENDIX – PHOTO-CAT

Purifics

PHOTO-CAT AOP+

Chemical-Free Water Purification Since 1993:

Photo-Cat is a photocatalytic, ceramic membrane process that combines the best of "chemical-free" advanced oxidation (**AOP+**) & ceramic ultrafiltration. Benefits of this Photo-Cat AOP+ process include:

- the strongest oxidation potential of all AOPs
- provides a unique reductive pathway
- metals removal
- biological destruction/filtration
- significant advantage in efficiency, cost and complexity reduction

Photo-Cat destroys organic contaminants in water through a TiO_2 slurry-based photocatalytic process to purify or detoxify the fluid stream of concern. It is a unique chemical-free process that removes chemical contaminants, biologicals, NDMA, viruses, cocysts, bromate, EDCs, PPCPs, sub-micron particulate and metals such as manganese, mercury, iron and Cr^6. The process is fully automated, sealed, generates no waste stream, and is fully backed by our World Wide Support Program. Photo-Cat is not OH^- radical dependent, or affected by temperature / UVT. A key element of Purifics photocatalytic process is the patented continuous TiO_2 separation process which allows the catalyst to be completely recaptured and reintroduced into the inlet stream.

Photo-Cat lifecycle costs are significantly less than conventional technologies such as activated carbon, UV ozone, UV peroxide, chemical oxidation, air stripping with off-gas treatment, and reverse osmosis, making Photo-Cat the economical choice for multi-year projects with complex water challenges.

This highly automated process can treat water to very high standards that significantly exceed drinking water standards. Photo-Cat is essentially a solid state, automated device that operates unattended, with lamp life and service intervals exceeding 20,000 hours.

Applications: Municipal, Industrial, Oil & Gas:

- Drinking Water
- Groundwater Remediation
- Disinfection & Sterilization
- Industrial Process Wastewater
- High Purity Water
- Bilge & Ballast Water
- RO Feed & Polish
- Reuse / Recharge
- Zero Discharge / Closed Loop

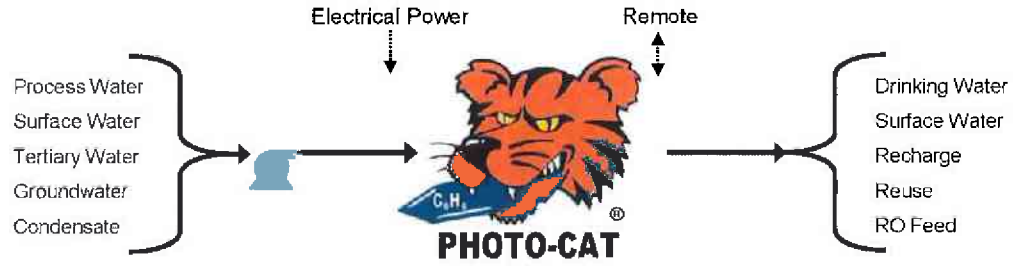
DDL Platform

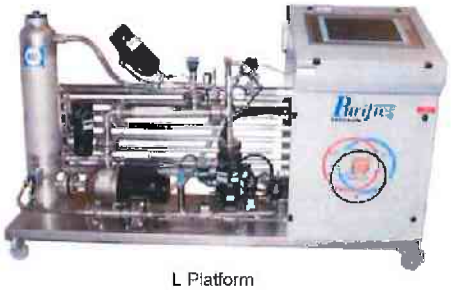
Available UL certified to NSF/ANSI 61

www. Purifics .com

Features & Benefits

Efficient	Low lifecycle cost - 1/4 the O&M of other AOPs Lamp life - >20,000 hrs between service periods Quick lamp changes - 1 min. w/flooded system No catalyst loss - continuously recovers catalyst Continuous 24/7 duty	Automated	Unattended SCADA/PLC programmed operation Digital service and training manual online Remote monitoring, control, and data logging Automatic fault detection and recovery **Smart Access, Service & Sensors**
Ability to Treat	Insensitive to dissolved solids and opaque fluids Not inhibited by turbidity, UVT or pH levels Not affected by pressure, temperature, alkalinity No fouling - operates with water containing iron Advanced coalescer technology	Serviceability	Generic parts, easy service availability No quartz tube wipers or quartz tube service Service can be performed by end-users' staff and trades
Simplicity	No wipers; No membrane cleaning	Turn Down	0% to 100% turn down
Manufacturing Excellence	Corrosion resistant High grade stainless steel construction NEMA 4 rating Plug & Play installations Highly reliable using highly developed standard, off the shelf components	Design Benefits	Created for sustainable development 25 year life expectancy Modular design customized to client requirements No pre-treatment required for removal of metals, dissolved solids or turbidity
Community Acceptance	Extremely low noise No off-gas No waste generated	Permitted Installations	History of efficient permitting by regulators such as the EPA and MOE for surface water discharge
Chemical Free	Operated without H_2O_2 and ozone	High Compliance	Established compliance history of regulated discharge since 1994





L Platform

0.5 MGD System

Purifics
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Ph: 519-473 5788, info@Purifics.com, www.Purifics.com

EXHIBIT B – PRICING

Proposal No. W18032 Rev.2
February 26, 2018

T.P

WATER PURIFICATION SYSTEM FOR SURFACE RUN OFF WATER

Price & Terms

Submitted to:
ATTN: Alvin Papa
<Alvin.Papa@longbeach.gov>

City of Long Beach, CA

City Hall, 9th Floor, 333 W Ocean Blvd., Long Beach CA 90802
Ph: 562-570-6386

For Additional Information Contact:

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Fax: 519-473-0934
tpowell@purifics.com
www.purifics.com

EXECUTIVE SUMMARY

This proposal is for an integrated *Cuf* (Ceramic Ultra-Filtration) and Photo-Cat system for the purification of run-off water of TSS, turbidity, oil and grease, metals, pathogens, and dissolved organics to meet TMDL standards. The solution consists of two M48 CUF pallets and two 10DDL rack Photo-Cat pallets.

Purifics has been developing and applying ceramic ultra-filtration and Photo-Cat systems for over 20 years. Purifics has 30 patents / patents pending on its technologies. The technologies are unique, and only available from Purifics. These technologies coupled with Purifics' extensive and unmatched engineering and application experience provides an extremely efficient, sustainable, and robust solution for the client.

The integrated *Cuf* and Photo-Cat solution offered in this proposal offers significant advantages over conventional and chemical based AOP solutions. These proven technology advancements include

- A membrane & process that is an absolute filter for the design life of 25 years. There is no membrane replacement for the life of the application for the *Cuf* and Photo-Cat system.
- *Cuf* and Photo-Cat have no permeate loss, no permeate back flow or no back pulse and no back wash.
- Each *Cuf* and Photo-Cat pallet is complete and operational upon delivery. They do not require any civil works.
- Only a small amount of acid and sodium hypochlorite is required intermittently to remove accumulated foulants in the *Cuf*.
- Photo-Cat has no waste streams, and the blowdown of the concentrated solids in the *Cuf* is anticipated to be 1% of flow.
- *Cuf* and Photo-Cat are fully automated and require no direct operator involvement. The operator only needs to monitor the system.
- The proposed solution is durable, robust, reliable and commercially proven.
- There is no pre-treatment or post-treatment.

The Photo-Cat system is the most cost-effective and efficient solution to destroy contaminates of concern in the water. The Photo-Cat AOP+ solution has no generated waste. The standard off the shelf **chemical-free** Photo-Cat technology

proposed will outperform UV/ H_2O_2 processes, and provide the client with additional key benefits such as long life lamps and instant on-off capability.

This unique Photo-Cat AOP+ technology not only outperforms AOP, but it completely eliminates hazardous chemicals and their associated safety issues, and the need for GAC to quench the high levels of residual H_2O_2.

The described solution is a turnkey water treatment system with remote monitoring and control and data logging. The on board PLC and HMI provide all control requirements and can be expanded to meet all anticipated requirements easily.

This proposal offers a **completely integrated solution** with the benefits of SCADA, self-sufficiency, autonomy of spares sourcing, reduced system complexity, and proven durability. *Cuf* and Photo-Cat are electricity based purification systems that the client will find attractive to operate because of its **simplicity** and **cleanliness.**

Purifics is a knowledge-based company that provides automated water purification solutions since 1993.

TABLE OF CONTENTS

1 PRICE

1.1 Integrated *Cuf* / Photo-Cat System

- System as per specifications in Section 4 of the Technical Proposal, Rev 1.

PRICE: $4,410,000

1.2 Shipping

- As per Terms Section 2.2

PRICE: $22,500

2 TERMS

2.1 Payment Schedule

- A Progress Payment Schedule acceptable to both Purifics' and the client will be formulated prior to issuance of a contract.
- All prices are in US dollars.
- Inclusive of shipping insurance and brokerage.
- All applicable taxes (if any) are extra.
- Method of payment is electronic funds transfer or wire.

2.2 Shipping

- All prices DDP (destination)
- Client to provide Ultimate Consignee identification in writing, including consignee address and Company identification number, prior to release for shipment.
- Shipping includes the cost of transportation, packaging materials, and loading equipment at Purifics. Offloading of the equipment at the clients' site is not included.

2.3 Factory Acceptance & Training (FAT)

FAT invokes a documented check list, equipment review and inspection during and after the training program before sign off. It is recommended that representatives responsible for the following skill sets attend: Project Engineer, Plant Operator, Electrician, and Pump Operator.

FAT is the client's opportunity:

- To inspect, operate, verify, request changes, identify non-conformance and accept the system prior to shipment and delivery. The client operates the equipment which is exercised over its range of capability and upsets as can be reasonably accommodated at Purifics facility.
- Receive two days of operator training for up to four people. Training involves a number of upsets and "what if?" scenarios to build operator skills and confidence. The training activity significantly reduces installation and start-up cost and time.
- To review shipping arrangements and spares requirements.

If client fails to participate in Factory Acceptance within 14 days, client will be invoiced third progress payment for immediate payment.

2.4 Patent License

The product supplied is protected by the following US Patents as a condition of purchase: **#5,462,674 / #5,554,300 / #5,589,078 / #6,136,203 / #6,215,126B1**

/ #6,398,971B1 / #7,008,473B2 / #7,326,278B2 / #7,425,272B2 / #7,588,688B2 / #7,800,310B2 / #7,837,952B2. The purchaser agrees to honour these patents and to not modify the equipment, relocate the equipment, or sell the equipment without the approval of Purifics. This approval is not to be unreasonably withheld.

2.5 Priority

This proposal has priority over other contract wording.

2.6 Validity

This proposal is valid for 60 days from time of issue.

2.7 Disclaimer

Purifics is not the operator of the equipment at the client's location and will not operate the equipment. Purifics will provide technical and application support when clearly directed. Purifics makes no representation concerning the need for a Certificate of Approval or other forms of license to operate the treatment system. The client must determine for itself whether a Certificate of Approval or another form of license or permit is required in the applicable jurisdiction before the operation of this equipment commences. Purifics is not responsible for any compliance monitoring.

3 WARRANTY

3.1 One Year General Warranty

Subject to the exclusions provided below, Purifics Water Inc. warrants for one year that the new integrated *Cuf* / Photo-Cat system is free from defects in material and workmanship at the time of delivery. Purifics sole liability is to replace, free of charge for parts and labour, *any part that*, within the warranty period following the date of installation of the System that is returned to Purifics Water Inc. prepaid to its facilities in London, Ontario. The part(s) must be accepted as having been defective in material or workmanship. The defective part shall be exchanged for a new or comparable *rebuilt* part and shall be warranted until the end of the warranty period calculated from the date when the System was originally installed. The warranty applies only to defects arising out of the normal and ordinary use of the System.

This warranty is specific to the site location and application indicated in this proposal. Warranty is void if the System is moved from the location or used in an application other than that specified in the proposal.

This warranty does not apply to:

a) Travel and accommodation expenses incurred by Purifics Water Inc. for work performed at the installation site;

b) Use of parts or supplies other than O.E.M;

c) Loss or damage to System due to misuse, abuse, alteration, accident, failure to follow operating or maintenance instructions prescribed in the maintenance manual;

d) Any System from which Purifics Water Inc. identification number has been removed or which Purifics Water Inc. considers in its discretion has been repaired, altered, neglected or used in any such way as to affect the System adversely (reasonable wear and tear accepted) and without limiting the generality of the foregoing. This warranty does not apply to any spare or replacement part used in any Purifics System for which it was not designed.

e) Modifications to the control system and/or its software.

This warranty is void if the client chooses to decline the recommended customer support and training identified in this proposal.

THIS WARRANTY IS GIVEN EXPRESSLY IN PLACE OF AND EXCLUDES ALL OTHER WARRANTIES AND CONDITIONS EXPRESSED OR IMPLIED, INCLUDING IMPLIED WARRANTIES OF MERCHANTIBILITY AND FITNESS FOR A PARTICULAR PURPOSE, WHETHER UNDER COMMON LAW, STATUTE OR OTHERWISE. THERE IS ALSO EXCLUSION IN EVERY FORM OF LIABILITY FOR LOSS OR DAMAGE, DIRECT OR CONSEQUENTIAL, RESULTING FROM DEFECTIVE MATERIAL, FAULTY WORKMANSHIP, OR OTHERWISE.