RECOMMENDED SPECIFICATION

ChemScan
Multiple Sample Point Nutrient Analysis Systems
To Monitor

Ammonia, Nitrate, Nitrite and ortho-Phosphate

for

_____Wastewater Treatment Plant

ASA Proposal _____
Date _____

1.0 Multiple Sample Point Nutrient Analysis System

1.1 Description

One on-line multiple sample point nutrient analysis systems for detection of ammonia, nitrate, nitrite and ortho-Phosphate shall be furnished in strict accordance with these specifications. A multiple sample point nutrient analysis system consists of a central Process Analyzer Instrument and accessory items designed to operate as a part of an integrated system including sample pumps, a Cross Flow Ultrafilter System and a Sample Sequence Control System. This specification is based on the ChemScan® Process Analyzer system manufactured by Applied Spectrometry Associates, Inc. in Waukesha, Wisconsin.

1.2 Manufacturers Qualifications

The equipment manufacturer shall have installed multiple parameter nutrient analyzers identical to the analyzers proposed to be supplied for this project in at least five (5) municipal wastewater facilities in North America for analysis applications similar to those identified for this project. Each analyzer system shall have been in operation for a period of at least three (3) years prior to the date of bid.

The process analyzer instrument and accessories shall be furnished by a single manufacturer who shall be responsible for proper operation and interfacing of the equipment.

A single process analyzer instrument shall be capable of analyzing ammonia-nitrogen, nitrate-nitrogen, nitrite-nitrogen and ortho-Phosphate. Multiple analyzers or sensors for each sample point and/or each parameter are not acceptable.

1.3 Detection Range and Accuracy

The process analyzer instrument shall be capable of ammonia-nitrogen detection over the concentration range of 0.1 to 20.0 mg/L, nitrate-nitrogen detection over the concentration ranges of 0.1 to 20.0 mg/L, nitrite-nitrogen detection over the concentration range of 0.1 to 5.0 mg/L and ortho-Phosphate detection over the concentration range of 0.05 to 5.0 mg/L. Demonstrated accuracy for all parameters in wastewater will be ±5 % of range or better.

Demonstrated accuracy must be based on field performance as defined in Section 1.4. Accuracy shall be measured using the average absolute error, defined as the sum of the absolute differences between the laboratory value for a sample and the equivalent on-line analysis value at the time of sample extraction, divided by the number of samples.

1.4 Experience Requirement

Detection ranges and accuracy for ammonia, nitrate, nitrite and phosphate must be verified through the availability of data from tests of at least four months duration at a municipal wastewater treatment facility in North America operating a process similar to the process to be operated under this project. Comparison samples from test sites shall have been extracted a minimum of 90 times during the test period and independently analyzed in accordance with a standard laboratory analysis method. The following calculations from the test shall be submitted: average absolute error, variance and standard deviation. In addition, references from a minimum of five municipal wastewater treatment sites in North America using the same analytical method for a period not less than 5 years shall be furnished for each parameter.

1.5 Sampling Requirements

1.5.1 Sample Frequency

The one nutrient analysis system shall be capable of measuring all of the designated parameters from any of the sample points within 9 minutes or less, including sample flush time. The total time required to measure all designated parameters at all sample points, including any time required to flush sample lines and accumulate fresh filtrate for analysis, shall be 40 minutes or less. The analyzer system shall be capable of enabling or disabling parameter selections at each sample point and enabling or disabling analysis of any of the sample points through operator initiated commands on the Sample Sequence Control System touch screen without the need for external software modifications.

1.5.2 Sample Points

One nutrient analysis system shall be configured to monitor eight (8) sample points as shown on the BNR sample location table below. The analyzer shall also incorporate an additional sample port to introduce discrete samples for calibration samples and quality control standards. (NOTE MAXIMUM OF FOUR PARAMETERS AT EACH SAMPLE POINT for UV-4100 systems)

BNR Sample Location Table

#	Sample Point	Ammonia-Nitrogen	Nitrate-Nitrogen	Nitrite-Nitrogen	Ortho-Phosphate	
1	Location 1	X	X	X	X	
2	Location 2	X	X	X	X	
3	Location 3	X	X	X	X	
4	Location 4	X	X	X	X	
5	Location 5	X	X	X	X	
6	Location 6	X	X	X	X	
7	Location 7	X	X	X	X	
8	Location 8	X	X	X	X	

1.6 Process Analyzer Instrument Requirements

1.6.1 Approved Detection Techniques

The process analyzer instrument shall not use ion-selective electrodes or any method that employs reagents for nitrate or nitrite analysis. Nitrate and nitrite analysis time shall be no greater than 1 minute and shall be based on multiple wavelength UV absorbance analysis. The analyzer shall not use ion-selective electrodes or any method that generates a hazardous waste stream including cyanide, phenate, salycalate or mercury based reagents for ammonia analysis. Ammonia analysis time shall be no greater than 3 minutes. The vanadomolybdate method shall be used for orthophosphate analysis. Multiple-wavelength spectrophotometric detection methods shall be used for all parameters, whether or not reagents are employed. The use of deionized water for zeroing and chemical solutions to clean optical surfaces are not prohibited. Submittal data shall specify the detection and analysis technique to be provided for each specified parameter.

1.6.2 Reagent Requirements

Zeroing and cleaning solutions shall not need replenishment more than once every two weeks based on a daily zero interval. Reagents for analysis of ammonia and orthophosphate shall not require replenishment more often than twice each month based on the sample analysis frequency identified in paragraph 1.5.1.

1.6.3 Correction Due To Interfering Substances

The process analyzer instrument shall provide for the elimination of interferences due to background substances present during its analyses. Multiple wavelength ultraviolet absorbance spectrometry using a minimum of 30 wavelengths that allows the elimination of interfering substances shall be used as the detection technique.

1.6.4 Reference Wavelength Adjustment Capability

During each new light absorbance reading, the process analyzer instrument shall compensate for turbidity variations in the sample by measuring light absorbance at a reference wavelength.

1.6.5 Calibration Algorithm Construction and Storage

Calibrations for the calculation of measurements for each analyte and range specified will be site specific and constructed from field and laboratory data. The analyzer shall be capable of maintaining a total of eight calibration files in memory. The sequence control system shall communicate which four of the eight calibrations are used for analysis of the sample to be analyzed with the slope and offset adjustments for each parameter. A backup copy of the calibration algorithms shall be provided on diskette.

1.6.6 Field Calibration File Collection

The process analyzer instrument shall have a dedicated sample port for the introduction of calibration and test samples. A manual signal shall be available on the instrument for initiation by an operator to record absorbance signatures for a calibration or test sample. Software to extract absorbance log files from memory shall be provided.

1.6.7 Zero Adjustment

The process analyzer instrument shall have the capability of being automatically zeroed using deionized water as the zero standard. The analyzer shall be programmed to automatically

initiate zeroing after a specified number of measurements. The analyzer shall automatically zero the instrument using the deionized water standard, automatically check intensity values, signal the need for physical cleaning if intensity values fall below a predetermined standard for reliable analyzer operation, automatically clean the flow cell using a cleaning solution and automatically return the analyzer to on-line operation. The previous 50 auto zero and clean operations shall be logged in internal memory. Software to extract zero log files from memory shall be provided.

1.7 Sample Sequence Controller Requirements

1.7.1 Nutrient Analysis System Control

A Sample Sequence Control System (SSCS) shall be furnished by the nutrient analysis system supplier. The SSCS shall be wired by the supplier to communicate directly with the process analyzer instrument. The SSCS shall also send control signals to the filter accumulator and an individual submersible pump for each of the sample points. The SSCS shall output the analysis results for each parameter at each sample point in MODBUS format for transmission to the operator's console. The installation contractor shall install conduit, wire and cables as appropriate to accommodate communication between the SSCS and the other nutrient analysis system devices. The installation contractor shall also install conduit and cables, as appropriate, to accommodate communication between the SSCS and the operator's console. The SSCS shall be located in a separate NEMA-4 enclosure next to the process analyzer instrument and may share the dedicated power line with this device. The SSCS shall control the selection of sample points for analysis and shall control the timing of sample line flush, sample delivery and filtrate accumulation cycles for each sample point. The SSCS shall also store individual analysis suite and adjustments (slope and intercept) for each parameter in the suite for a specific sample point. The most recent analysis results for each parameter at each sample point shall be displayed on a touch screen panel located on the front door of the SSCS enclosure. The touch screen panel shall also allow the alteration of sample sequences, the option to enable or disable analysis of individual parameters or entire sample points, and the entry of calibration adjustments for each parameter.

1.7.2 Calibration File Library Storage

The SSCS shall be capable of maintaining all necessary data for each sample line plus control instructions for system operation in a nonvolatile memory. In the event of a power loss to the nutrient analysis system, all calibration files and operating instructions shall be held intact. The SSCS shall automatically resume operation upon restoration of power.

1.7.3 Security Code Capability

The SSCS shall contain the capability to deny operational command or menu access through the use of a security code on the touch screen. The SSCS shall also contain the capability for security codes to be changed by an authorized operator.

1.7.9 Slope/Intercept Adjustment

The SSCS shall have the capability for operators to enter calculated slope and intercept adjustments for each analyte calibration, based on laboratory analysis of comparison samples. Software to calculate slope and intercept adjustments shall be provided.

1.7.10 Operator Interface

The SSCS shall be provided with the ability to display and select menu choices, operational commands and other information necessary for operation and control of the nutrient analysis system on a touch screen panel located on the SSCS front door. The SSCS shall also display operating status and the most recent analysis results for each parameter at each sample point.

1.7.11 Data Communications and Display

The SSCS shall be provided with the ability to transmit all concentration readings over MODBUS connection to the plant SCADA system, for display on an existing console in the operations room.

2.0 Equipment Specifications

2.1 Analyzer Electronics Module

2.1.1 Enclosure

The light source and detection system for the process analyzer instrument shall be housed in an electronics enclosure rated NEMA 4 or better. All metallic enclosure materials exposed to the atmosphere will be protected using coatings suitable for use in a wastewater environment or will be fabricated using stainless steel. The enclosure shall be secured with a lock and key that are different from the lock and key used to secure the flow cell enclosure.

2.1.2 Keypad and Display

An externally mounted LCD display shall be provided. The display shall be back illuminated for observation in low ambient light levels. A keypad shall be provided to enter operator-selected variables and menu options necessary for routine operation of the analyzer instrument.

2.1.3 Temperature Control

The analyzer electronics enclosure shall contain an internal temperature measurement and control system capable of maintaining a constant internal temperature.

2.1.4 Power Connection

The electronics module shall contain a terminal block for connection to 120 v, 60 Hz power. Power consumption for the analyzer instrument and SSCS shall be a maximum of 10 amps.

2.2 Analyzer Flow Cell Module

2.2.1 Enclosure

A flow cell enclosure shall be furnished, using the same materials of construction and coating systems as the electronics enclosure. The flow cell enclosure shall be rated NEMA 3R or better.

2.2.2 Flow Cell

Sample flow cell surfaces in contact with the sample flow shall be constructed of corrosion resistant materials. Optical windows in contact with the sample flow shall be quartz. The flow cell shall be sealed to prevent leakage of the sample but shall permit periodic disassembly for physical cleaning of optical surfaces in contact with the sample flow.

2.2.3 Installation

The installation contractor shall secure the process analyzer instrument to a wall using Unistrut mounting channel. An open drain is required in close proximity to the process analyzer instrument to accept an intermittent sample flow from the instrument at a rate of 0.25 gpm. A four plug 120 V, 60 Hz power outlet is required within 15 feet of the process analyzer instrument for use by service personnel. The installation contractor shall also provide dedicated hard-wired 120V, 60 Hz power connection to the process analyzer instrument. This line may be shared with the Sample Sequence Control System, but not with any other device.

2.3 Sample Sequence Control System

2.3.1 Enclosure

The Sample Sequence Control System shall be furnished in an enclosure rated NEMA 4 or better. The enclosure shall house the communication and control modules for nutrient analysis system operation as specified in paragraph 1.7 above.

2.3.2 Power Connection

The enclosure shall contain a terminal block for connection to 120V, 60Hz power, from a circuit that may be shared with the process analyzer system but not with any other device.

2.3.3 Mounting

The process analyzer instrument, cross flow filter and SSCS shall be wall mounted by the installation contractor using stainless steel Unistrut channel in accordance with installation instructions furnished by the nutrient analysis system manufacturer.

2.4 Cross Flow Filter System

A cross flow filter system shall be furnished as a part of the nutrient analysis system. The installation contractor shall be responsible for providing two inch diameter PVC pipe from the sample header outlet to the filter system inlet, two inch diameter PVC pipe from the filter system outlet to the sample flow return point plus conduit and wiring from the accumulator valve to the Sample Sequence Control System. The cross flow filter system shall consist of a series of ultrafilter modules containing 0.1 pore size membranes mounted along the inner circumference of a filtrate collection tube. The minimum membrane surface area in contact with the sample flow shall be 338 in^2 for each ultrafilter module. The filter assembly shall consist of a series of four ultrafilter modules and shall be arranged to allow sample flow to pass through all four ultrafilter modules or to by pass one set of two modules. The filter system shall allow half of the filter capacity to be in use while the other half is in standby. All ultrafilter modules shall be

arranged to deposit filtrate into a central accumulation container. The accumulation container shall be equipped with a valve to allow filtrate to drain to waste, collect within the accumulation container or flow to the process analyzer instrument for analysis, based on signals from the Sample Sequence Control System. The filter system shall contain inlet and outlet pressure gages and hand valves to regulate flow through the filter system and to adjust backpressure across the filter system.

2.5 Filter Cleaning System

A filter cleaning system shall be furnished as a part of the nutrient analysis system. The cleaning system shall consist of a cleaning solution stand containing couplings for two ultrafilter modules. The stand shall contain a 120 V, 60 Hz submersible pump located in a reservoir to hold a supply of cleaning solution. Power to the pump shall be furnished through a timer that will control cleaning solution circulation time. The cleaning solution shall be drained to waste through a pipe connected to a floor drain by the installation contractor, which shall be located in close proximity to the cleaning system.

2.6 Sample Pump

Eight submersible grinder pumps shall furnish for installation by the contractor. The pump shall be ITT Flygt Model MP-3085 or equal. Each pump shall be furnished with type 252 impeller, Motors shall be 3 HP, 480V, 3 phase squirrel cage (NEMA type B, Class F). The pump shall be equipped with a 316L stainless steel stationary cutter and chrome alloy cast iron rotary cutter plus accessory kit, including 2 inch NPT discharge connection, 20 ft stainless steel lifting cable with shackles, upper guide bar bracket, anchor bolts, hex nuts and washers. The installation contractor shall furnish motor starter, local on/off switch and dual guide bars and mounting bracket for each pump and shall furnish a check valve for 2 inch PVC pipe at each sample point drop leg capable of preventing back flow during operation of other sample points.

2.7 Spare Parts and Supplies

The following spare parts and supplies shall be furnished:

Reagent Injector Pump (1)
Tubing for Analyzer Internal Pump (Set of 3)
Reagent Containers (3)
Zero Solution Container (1)
Cleaning Solution Container (1)
Manifold Valve (1)
Dual Ultrafilter Subassembly (1)
Ultrafilter Cleaning Solution (2 Liter)