



KRUGER INC.
SCOPE OF SUPPLY
FOR THE
SOUTH DURHAM WASTEWATER TREATMENT FACILITY
LOCATED IN
DURHAM, NORTH CAROLINA
FOR
ANITA™ MOX MOVING BED BIOFILM REACTOR SYSTEM

CONSULTING ENGINEER:

Hazen and Sawyer
4011 Westchase Blvd., Suite 500
Raleigh, NC 27607

Kruger Project No.: 42331105

DOCUMENT DATE:

December 05, 2012

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SECTION 1

Pricing and Schedule

1.1 DESCRIPTION OF WORK

I. Kruger Inc. (Kruger), an equipment supplier, proposes and agrees to furnish all labor services, materials, equipment, and all other items and facilities necessary to supply and deliver the equipment items as detailed in this Scope of Supply document and the ANITA Mox Technical Specification included in Attachment B.

The ANITA Mox System herein is proposed according to Kruger's design, and Kruger is not transferring any Intellectual Property Rights, patent rights, or licenses for the goods delivered.

1.2 PROPOSAL PRICE

Price includes AnoxKaldnes™ ANITA™ Mox Moving Bed Biofilm Reactor (MBBR) equipment as detailed herein. The price excludes sales and/or use taxes and is contingent upon the attached Kruger Standard Terms of Sale and exceptions/clarifications stated herein. Buyer agrees to provide the necessary tax-exempt certification or Reseller documentation for sales taxes exemption within thirty (30) days after receipt of a purchase agreement executed by all parties. Furthermore, Buyer accepts responsibility for all applicable state and local sales taxes as Supplier is not registered to collect or remit NC sales and/or use taxes.

Kruger has agreed to offer a discounted price to the Buyer in exchange for the successful execution of a separate agreement between Kruger and Buyer that allows Kruger periodic access to the SDWRF to harvest biomedica from the ANITA Mox reactor. If such Agreement for Harvesting Biomedica is not fully executed prior to or in conjunction with the Buyer's issuing a fully executed Purchase Order for the equipment described in this Scope of Supply document, the offer of a discounted price may be withdrawn by Kruger at its sole discretion.

Kruger shall furnish and deliver (FOB Jobsite) AnoxKaldnes ANITA Mox equipment, including submittals, start-up and other services, in conformance to the requirements set forth in this document for the Lump Sum price of:

| | |
|--------------------------------------|----------------------------|
| STANDARD LIST PRICE: | \$700,900.00 |
| DISCOUNTED AMOUNT: | \$53,800.00 |
| <u>DISCOUNTED SALE PRICE:</u> | <u>\$647,100.00</u> |

The price is valid for 45 Days from the date of this document.

1.3 LIQUIDATED DAMAGES

Kruger shall not accept liquidated damages.

1.4 TERMS OF PAYMENT AND CONDITION OF SALE

The terms of payment are 10% upon receipt of a fully executed contract, 15% upon delivery of submittal of shop drawings, and 75% upon delivery of equipment to the site.

Payment shall not be contingent upon receipt of funds by the CONTRACTOR from the OWNER and there shall be no retention in payments due to Kruger. All other payment terms as defined in Kruger's Standard Terms of Sale.

All payment terms are net 30 days from date of invoice. Final payment shall not exceed 120 days from delivery of equipment.

1.5 BONDS

Pricing does not include bonds.

1.6 DELIVERY SCHEDULE

The following equipment delivery schedule is approximate and based on expected availability of materials. This delivery schedule can be confirmed at the time of an order.

| | |
|---|----------------|
| Submittal of Approval Drawings | 6-8 weeks* |
| Delivery of In-Basin Aerators, Screens, Piping and Supports | 10-14 weeks** |
| Delivery of New Carrier Media | 10-14 weeks ** |
| Delivery of Instrumentation and Control Equipment | 10-16 weeks** |

- Aeration system, screens, and media will be shipped via exclusive/dedicated freight.
- IF KRUGER IS ABLE TO SHIP EQUIPMENT SOONER THAN THE ABOVE SCHEDULE, CONTRACTOR MUST ACCEPT DELIVERIES AND PROVIDE ADEQUATE STORAGE ON-SITE FOR SUCH EQUIPMENT.

* AFTER RECEIPT OF A FULLY EXECUTED PURCHASE ORDER

** AFTER RECEIPT OF APPROVED SUBMITTAL DRAWINGS AND RELEASE TO MANUFACTURER

1.7 THIS PROPOSAL IS RESPECTFULLY SUBMITTED BY:

CONTACT NAME: Brian Frewerd (Vice President Strategic Planning)
SUPPLIER: I. Kruger Inc. (Kruger)
BUSINESS ADDRESS: 401 Harrison Oaks Blvd.
Suite 100
Cary, NC 27513
TELEPHONE: (919) 677-8310

1.8 PROPRIETARY INFORMATION

The information or data contained in this proposal is proprietary to Kruger and should not be copied, reproduced, duplicated, or disclosed to any third party, in whole or part, without the prior written consent of Kruger. This restriction will not apply to any information or data that is available to the public generally.



SECTION 2

Kruger Inc. Standard Terms of Sale

I. KRUGER INC. - STANDARD TERMS OF SALE

- 1. Applicable Terms.** These terms govern the purchase and sale of the equipment and related services, if any (collectively, "Equipment"), referred to in Seller's purchase order, quotation, proposal or acknowledgment, as the case may be ("Seller's Documentation"). Whether these terms are included in an offer or an acceptance by Seller, such offer or acceptance is conditioned on Buyer's assent to these terms. Seller rejects all additional or different terms in any of Buyer's forms or documents.
- 2. Payment.** Buyer shall pay Seller the full purchase price as set forth in Seller's Documentation. Unless Seller's Documentation provides otherwise, freight, storage, insurance and all taxes, duties or other governmental charges relating to the Equipment shall be paid by Buyer. If Seller is required to pay any such charges, Buyer shall immediately reimburse Seller. All payments are due within 30 days after receipt of invoice. Buyer shall be charged the lower of 1 ½% interest per month or the maximum legal rate on all amounts not received by the due date and shall pay all of Seller's reasonable costs (including attorneys' fees) of collecting amounts due but unpaid. All orders are subject to credit approval.
- 3. Delivery.** Delivery of the Equipment shall be in material compliance with the schedule in Seller's Documentation. Unless Seller's Documentation provides otherwise, Delivery terms are F.O.B. Jobsite.
- 4. Ownership of Materials.** All devices, designs (including drawings, plans and specifications), estimates, prices, notes, electronic data and other documents or information disclosed by Seller or prepared solely by Seller or Buyer or jointly by Seller and Buyer in connection with this Agreement, and all intellectual property rights therein, shall be and remain the confidential and proprietary property of Seller, whether or not patented by Seller ("Work Product"). Buyer hereby irrevocably assigns all rights in any Work Product to Seller. Seller grants Buyer a non-exclusive, non-transferable (except to a successor-in interest to the ownership of the Equipment), paid-up license to use the Work Product solely in connection with Buyer's use, operation, repair and maintenance of the Equipment at the Jobsite defined in this Agreement. Buyer may not disclose, share, transfer, or sell any such Work Product to third parties without Seller's prior written consent, and such consent may be arbitrarily withheld. Buyer agrees not to resell, transfer or give any of the biologically colonized media or bacteria from the system to any party other than Seller or any of Seller's affiliates without the prior written consent of Seller for a period of fifteen (15) years from the effective date of this Agreement. Buyer shall not cultivate bacteria or use biomass carriers retrieved from the ANITA Mox system for any research or non-research purposes. Any new developments, discoveries, or inventions resulting from the operation of the ANITA Mox system in which the ANITA Mox process is a component or is in any way incorporated in whole or in part shall be owned solely by the Seller.
- 5. Changes.** Seller shall not implement any changes in the scope of work described in Seller's Documentation unless Buyer and Seller agree in writing to the details of the change and any resulting price, schedule or other contractual modifications. This includes any changes necessitated by a change in applicable law occurring after the effective date of any contract including these terms.
- 6. Warranty.** Subject to the following sentence, Seller warrants to Buyer that the Equipment shall materially conform to the description in Seller's Documentation and shall be free from defects in material and workmanship. The foregoing warranty shall not apply to any Equipment that is specified or otherwise demanded by Buyer and is not manufactured or selected by Seller, as to which (i) Seller hereby assigns to Buyer, to the extent assignable, any warranties made to Seller and (ii) Seller shall have no other liability to Buyer under warranty, tort or any other legal theory. If Buyer gives Seller prompt written notice of breach of this warranty within 18 months from delivery or 1 year from beneficial use, whichever occurs first (the "Warranty Period"), Seller shall, at its sole option and as Buyer's sole remedy, repair or replace the subject parts or refund the purchase price therefore. If Seller determines that any claimed breach is not, in fact, covered by this warranty, Buyer shall pay Seller its then customary charges for any repair or replacement made by Seller. Seller's warranty is conditioned on Buyer's (a) operating and maintaining the Equipment in accordance with Seller's instructions, (b) not making any unauthorized repairs or alterations, and (c) not being in default of any payment obligation to Seller. Seller's warranty does not cover damage caused by chemical action or abrasive material, misuse or improper installation (unless installed by Seller). THE WARRANTIES SET FORTH IN THIS SECTION ARE SELLER'S SOLE AND EXCLUSIVE WARRANTIES AND ARE SUBJECT TO SECTION 10 BELOW. SELLER MAKES NO OTHER WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR PURPOSE.
- 7. Indemnity.** Seller shall indemnify, defend and hold Buyer harmless from any claim, cause of action or liability incurred by Buyer as a result of third party claims for personal injury, death or damage to tangible property, to the extent caused by Seller's negligence. Seller shall have the sole authority to direct the defense of and settle any indemnified claim. Seller's indemnification is conditioned on Buyer (a) promptly, within the Warranty Period, notifying Seller of any claim, and (b) providing reasonable cooperation in the defense of any claim.
- 8. Force Majeure.** Neither Seller nor Buyer shall have any liability for any breach (except for breach of payment obligations) caused by extreme weather or other act of God, strike or other labor shortage or disturbance, fire, accident, war or civil disturbance, delay of carriers, failure of normal sources of supply, act of government or any other cause beyond such party's reasonable control.
- 9. Cancellation.** If Buyer cancels or suspends its order for any reason other than Seller's breach, Buyer shall promptly pay Seller for work performed prior to cancellation or suspension and any other direct costs incurred by Seller as a result of such cancellation or suspension.
- 10. LIMITATION OF LIABILITY.** NOTWITHSTANDING ANYTHING ELSE TO THE CONTRARY, SELLER SHALL NOT BE LIABLE FOR ANY CONSEQUENTIAL, INCIDENTAL, SPECIAL, PUNITIVE OR OTHER INDIRECT DAMAGES, AND SELLER'S TOTAL LIABILITY ARISING AT ANY TIME FROM THE SALE OR USE OF THE EQUIPMENT SHALL NOT EXCEED THE PURCHASE PRICE PAID FOR THE EQUIPMENT. THESE LIMITATIONS APPLY WHETHER THE LIABILITY IS BASED ON CONTRACT, TORT, STRICT LIABILITY OR ANY OTHER THEORY.
- 11. Miscellaneous.** If these terms are issued in connection with a government contract, they shall be deemed to include those federal acquisition regulations that are required by law to be included. These terms, together with any quotation, purchase order or acknowledgement issued or signed by the Seller, comprise the complete and exclusive statement of the agreement between the parties (the "Agreement") and supersede any terms contained in Buyer's documents, unless separately signed by Seller. No part of the Agreement may be changed or cancelled except by a written document signed by Seller and Buyer. No course of dealing or performance, usage of trade or failure to enforce any term shall be used to modify the Agreement. If any of these terms is unenforceable, such term shall be limited only to the extent necessary to make it enforceable, and all other terms shall remain in full force and effect. Buyer may not assign or permit any other transfer of the Agreement without Seller's prior written consent. The Agreement shall be governed by the laws of the State of North Carolina without regard to its conflict of laws provisions.

SECTION 3

Design Summary

3.1 DESIGN SUMMARY

The AnoxKaldnes ANITA Mox equipment is designed per the following design summary:

Table 1: Influent Values

| Parameter | Units | Value |
|---------------------------------|-------|---------|
| Flow, Design | MGD | 0.08 |
| Flow, Peak Centrate* | MGD | 0.16 |
| Flow, Max Hydraulic Flush | MGD | 0.6-0.7 |
| BOD, Design Flow | mg/L | 85 |
| COD, Design Flow | mg/L | 500 |
| TSS, Design Flow | mg/L | 250-500 |
| NH ₃ -N, Design Flow | mg/L | 1000 |
| TKN, Design Flow | mg/L | 1100 |
| Alkalinity, Design Flow | mg/L | 2500 |
| pH | SU | 7.4 |
| Min. Temperature | °C | 24 |

**Table 2: ANITA Mox MBBR
Percent Removal Guarantees
(90-Day Average)**

| Parameter | Units | Guarantee Value | Expected Value |
|---------------------------------------|-------|-----------------|----------------|
| NH ₄ -N Removal Efficiency | % | ≥ 75% | 80-85% |
| Total Nitrogen Removal Efficiency | % | ≥ 65% | 70-75% |

NOTES:

- The running 7-day average reactor temperature shall not be lower than the minimum design temperature, and any daily temperature shall not be less than 20°C.
- The 7-day average applied loads shall not exceed the design loadings by more than 10%.
- The 7-day average applied NH₄-N concentration shall not be less than 400 mg/L.

Table 3: ANITA Mox Basin Design Summary

| Parameter | Units | Value |
|--|-----------------------|-----------------------|
| Number of Process Trains | - | 2 |
| Number of Reactors per Train | - | 1 |
| Reactor Dimensions (Each) | ft | 27' x 26' x 16' (SWD) |
| Each Reactor Volume | ft ³ | 11,232 |
| Total Reactor Volume (All Trains) | ft ³ | 22,464 |
| Type of Biofilm Carriers | - | K5 |
| Fill of Biofilm Carriers, All Reactors | % | 38% |
| Total Bulk Volume of Carriers | ft ³ | 8,477 |
| Total Effective Surface Area | ft ² | 2,066,671 |
| Aeration System | - | Medium Bubble |
| Design Residual D.O. Level | mg/L | 2.0 |
| AOR | lb-O ₂ /hr | 59 |
| Total Oxygen Transfer Efficiency | % | 17.6 |
| Total Air Requirement, Design Flow | SCFM | 714 |

3.2 PROCESS PERFORMANCE GUARANTEE

Kruger will provide a process performance guarantee as defined in the ANITA MOX MOVING BED BIOFILM REACTOR (MBBR) SYSTEM SPECIFICATION, Section 1.08.

SECTION 4

Equipment Scope of Supply

4.1 GENERAL

Kruger will supply the following equipment as described below:

- a. Biofilm Carrier Elements
- b. In-basin Aeration System
- c. Reactor Mixers
- d. Screen Assemblies
- e. Controls
- f. Instrumentation
- g. Ancillary Equipment

4.2 PROCESS DESCRIPTION

The ANITA Mox MBBR process is a continuous flow through, non-clogging bio-film reactor containing “carrier elements” or media with a high specific surface. The media does not require backwashing or cleaning.

The biomass that treats the wastewater is attached to the surfaces of the media. The media is designed to provide a large protected surface area for the biofilm and optimal conditions for biological activity when suspended in water. Media of different shapes and sizes provide flexibility to use the most suitable type depending on wastewater characteristics, discharge standards and available volumes. AnoxKaldnes media is made from polyethylene and has a density slightly less than water.

The ANITA Mox process is a single-stage nitrogen removal process with low carbon footprint based on the MBBR platform. The process is specifically designed for treatment of waste streams with high ammonia concentrations. The system uses a single MBBR reactor with a unique control strategy. It can achieve ammonia removals around 80% and total nitrogen removals of 70-75%. The treatment method requires no external carbon source.

The ANITA Mox process consists of an aerobic nitrification reaction and an anoxic ammonia oxidation (anammox) reaction. The two steps take place simultaneously in different layers of a biofilm. Nitrification occurs in the outer layer of the biofilm. Approximately 55% of the influent ammonia is oxidized to nitrite (NO_2^-). Anammox activity occurs in the inner layer. In this step, the nitrite produced and the remaining ammonia are utilized by the anammox bacteria and converted to nitrogen gas (N_2) and a small amount of nitrate (NO_3^-).

The aerobic and anoxic reactions occur in a single MBBR reactor. The combined biomass grows attached to the AnoxKaldnes media and is retained in the reactor by media screens. This biomass retention is an important characteristic of the system, since the anammox bacteria growth rate is extremely slow, when compared to conventional wastewater bacteria growth rates.

The calculation for the amount of biofilm carrier elements required is based upon the SALR selected & the effective surface area of biofilm carrier elements in the basin. The effective surface area of AnoxKaldnes K5 carriers for biomass growth is $800 \text{ m}^2/\text{m}^3$ ($243.8 \text{ ft}^2/\text{ft}^3$).

4.3 BIOFILM CARRIER ELEMENTS

Kruger will supply the biofilm carrier elements as described herein:

- A total of 8,477 ft³ (all trains) of AnoxKaldnes K5 Type carrier elements, providing a minimum of 2,066,671 ft² of effective surface area for biological growth.
- Kruger will provide media seeded with anammox organisms to accelerate the startup of the facility. Approximately 5% of the media volume of one reactor (~200 ft³ or ~5.5 bags, each 1 m³) will be provided from the AnoxKaldnes ANITA Mox biofarm system in Malmo, Sweden. Please refer to Section 5.4 of this document for Kruger's recommended start-up procedure.
- Carrier elements will be delivered, FOB Jobsite included in this Scope of Supply, to the South Durham Wastewater Treatment Facility.
- New media will be delivered in a total of at least seven (7) covered trailers each containing between 45-60 bags, typically. If alternate shipping methods are requested by the Buyer, additional charges may apply.
- For reference, Contractors at other projects have typically installed three (3) trailers per day.
- Neither on site storage nor near-site storage of media by the Contractor is necessary. Within limits described in this Scope of Supply, media can be delivered to the site as the Contractor is able to install it in the basins.
- Each bag is approximately 3.5 ft x 3.5 ft x 3.0 ft, or 35 ft³ per bag (1.0 m³) and has at least two (2) handles on the top side, which can be used to remove the bags from the trailers. Bags weigh approximately 270 lbs each.
- Media bags will be shipped individually or shrink-wrapped 2-3 to a pallet.
- The bags will require removal from trailers and field placement or storage by the Contractor. The Contractor will have 2 hours to unload each container, after it arrives on site, before demurrage charges are assessed. The Contractor shall be responsible for any demurrage charges.



For example only. Actual shipment could vary on media type and origin.

Storage of Media

- The media bags can be stored outside pending installation, if necessary. However, they need to be covered to minimize any degradation of the bag itself due to sunlight.
- The media bags can be stored in a pyramid style using 3 - 4 bags as the height of the pyramid. UV-resistant blue tarps can be used to cover the bags of media until such time they are loaded into the reactor. Pictures below show storage of the bags prior to being covered with tarps.
- The Contractor shall be responsible for supply, installation, maintenance, and repair of protective tarps or covers.





4.4 AERATION SYSTEM

Kruger will supply the aeration system as described herein:

| Parameter | Reactor 1 |
|--------------------------------------|-----------|
| Reactor Description | Aerobic |
| # Grid Assemblies per Reactor | 2 |
| # Grid Assemblies Total (All Trains) | 4 |
| Manifold Diameter, inches | 4 |
| Grid Length, feet | 24 |
| Grid Width, feet | 8.5 |
| # Laterals per Grid | 9 |
| Lateral Diameter, inches | 1 |

- Two (2) aeration grids for the aerobic reactor of each train, for a total of four (4) grids. Each aeration grid will consist of one (1) 4" diameter Schedule 10 drop pipe, a 4" diameter Schedule 10 central manifold, and nine (9) diffuser lateral pairs of 1" diameter and Schedule 5. Approximate module dimensions are 8.5 ft wide x 24 ft long.
- All laterals will consist of 4 mm holes drilled at equally spaced intervals.
- All aeration assembly piping and supports will be of 304 or 304L stainless steel.
- All interconnecting hardware provided by Kruger, with the exceptions listed below. Hardware will be of 304 stainless steel or higher grade.



- The aeration system & supports will require unloading & field erection by others.
- AERATION GRID FLANGE BOLTS, NUTS AND GASKETS AT THE KRUGER / CONTRACTOR INTERFACE ARE **NOT PROVIDED**. ALL OTHER HARDWARE FOR THE SUPPORTS AND IN BASIN FLANGE CONNECTIONS **ARE PROVIDED** BY KRUGER.
- Please note that all connecting materials provided by Contractor must be of compatible material to the AnoxKaldnes system. If not compatible, the contractor is responsible for providing necessary provisions to prevent the potential of galvanic corrosion.
- Kruger will provide necessary anchor bolts, nuts, and washers. Contractor shall supply epoxy anchor chemicals and applicators. All hardware will be 304 stainless or higher grade. Kruger recommends Red Head Epcon C6 or similar epoxy anchor product.

4.5 MIXERS

Kruger will supply one (1) top entering mixer with VFD for each ANITA Mox reactor, for a total of two (2).

| | |
|------------------------|---------------------------|
| Total Number of Mixers | Two (2) |
| Make | STAMO |
| Type | HH08-2GN320-2GN260 |
| Motor | 10 HP |
| Explosion Proof | No |
| Power | 3 phase, 60 Hz, 480 Volts |

| | |
|------------------------------------|----------|
| Number of Impellers per mixer. | Two (2) |
| Total Number of Impellers | Four (4) |
| Minimum impeller (A) diameter, in. | 102 |
| Minimum impeller (B) diameter, in. | 126 |
| Total Shaft Length, in. | 174 |
| Shaft diameter, in. | 3.15 |

4.6 CYLINDRICAL SCREEN ASSEMBLIES

Kruger will supply the cylindrical screen assemblies as described herein:

- A total of four (4) cylindrical screen assemblies, each three (3) feet long and 19" inch diameter. Two (2) screens shall be installed in each ANITA Mox reactor.
- Screens shall be perforated plate with minimum of 50% open area.



- The screens will require unloading & field erection by others.
- SCREEN MOUNTING FLANGE, FLANGE BOLTS, NUTS AND GASKETS AT THE KRUGER / CONTRACTOR INTERFACE ARE **NOT PROVIDED**. ALL OTHER HARDWARE FOR THE SUPPORTS **ARE PROVIDED** BY KRUGER.
- Kruger will provide necessary anchor bolts, nuts, and washers. Contractor shall supply epoxy anchor chemicals and applicators. All hardware will be 304 stainless or higher grade. Kruger recommends Red Head Epcon C6 or similar epoxy anchor product.
- Wall inserts will not be necessary as the screens will bolt into each tank wall.
- All hardware will be 304 stainless or higher grade.

4.7 CONTROLS

Allen-Bradley Control PLC processor based control panel will be supplied as described herein to control the Kruger ANITA Mox system based on operator set points. All I/O will be wired to field terminations as required. The control panel will be completely assembled, tested, and programmed for the required functionality. The U.L. labeled panel will be comprised of the following:

MBBR Control Panel

| Qty | Description | Manufacturer |
|-----|---|------------------------|
| 1 | NEMA 12 Painted Carbon Steel 72" x 36" x 24" Panel (SCE723624FS) Panel for use in a indoor climate controlled environment | Saginaw |
| 1 | Back Panel for Control Panel 60" x 32" (SCE72P36F1) | Saginaw |
| 1 | Panelview Plus 1000 Color Touchscreen Operator Interface (2711P-T10C4A6) | Allen Bradley |
| 1 | Control Logix Processor (1756-L62) | Allen Bradley |
| 1 | Control Logix 10 Slot Chassis (1746-A10) | Allen Bradley |
| 1 | Control Logix Ethernet Module (1756-EN2T) | Allen Bradley |
| 1 | Control Logix Power Supply (1756-PA72) | Allen Bradley |
| 3 | Control Logix Digital Input Module 16PT 24VDC (1756-IB16) | Allen Bradley |
| 1 | Control Logix Digital Output Module 16PT 24VDC (1756-OB16) | Allen Bradley |
| 1 | Control Logix Analog Input Module 16PT 4-20mA (1756-IF16) | Allen Bradley |
| 1 | Control Logix Analog Output Module 8PT 4-20mA (1756-OF8) | Allen Bradley |
| 1 | 120 VAC Surge Protector (SFP1-20/120AC) | Phoenix Contact |
| AR | Circuit Breakers | Square D or Equivalent |
| 1 | 24VDC 5A Power Supply (QUINT-PS-100-240AC/24DC/5) | Phoenix Contact |
| 16 | 4-20mA to 4-20mA Analog Isolator (MINI MCR-SL-I-I) | Phoenix Contact |
| 12 | 4-20mA Analog Surge Arrestor (PT2x2 24DC ST) | Phoenix Contact |
| 12 | 4-20mA Analog Surge Arrestor Base Element (PT2x2 24DC BE) | Phoenix Contact |
| 64 | Double Level Field Terminal Block (UTTB4) | Phoenix Contact |
| 16 | Interposing Relay w/Base for Digital Outputs | Allen Bradley |
| 1 | Uninterruptible Power Supply UPS750VA | APC |
| 1 | Ethernet Switch 5 Port 10/100 Base T (SFN5X) | Phoenix Contact |
| 1 | Cabinet Light & Convenience Outlet | Leviton or Equal |
| AR | Misc. Wire and Panduit | |
| 1 | Completed panel shop tested and UL Labeled | Kruger |
| 1 | PLC/Operator Interface Programming | Kruger |

NOTE: AR means As Required. The quantity of these items will be determined at the time of panel construction.

Each PLC Control Panel will include the necessary input/output plus twenty percent (20%) “Live” spare wired signals for future or additional signal interface.

All PLC and Operator Interface programming is based on Kruger standards, any requests or requirements that would deviate from this standard will result in additional costs. Kruger will be providing PLC/Operator Interface programming only for the Kruger supplied PLC Control Panel.

The PLC Program and Operator Interface Program and its associated Graphic screens developed by Kruger, are for use on the Kruger supplied PLC and Operator Interface only. It is understood the Kruger panel interface screens will be accessible from other compatible interface terminals via the South Durham WWTP Ethernet Network, and any additional configuration programming to facilitate this is not included in this proposal. The Kruger supplied PLC Program and Operator Interface Program and its associated Graphic screens cannot be used, whole or any part for other uses or at other treatment plants.

Kruger will use Allen Bradley development software for PLC Programming and Operator Interface Programming; the development software is licensed to Kruger and will not be provided as part of this scope. Kruger will not be providing any PLC, Network, Operator Interface, SCADA, or Alarm Notification software.

Kruger will supply copies of the completed PLC and Operator Interface programs at job completion. Prior to supplying completed PLC and Operator Interface programs, Kruger requests that a non-disclosure agreement be signed and returned to Kruger.

Factory testing of the Kruger PLC Control Panel will be conducted by Kruger personnel at a Kruger selected Panel Facility. Kruger reserves the right to conduct this testing when it is deemed appropriate in regards to Kruger personnel. Kruger has an established Panel testing criteria and will conduct all Panel and Software testing per Kruger standards. When said Panel/Software testing is complete a Test Report will be generated per Kruger standards. Other party’s are welcome to witness panel testing at no expense to Kruger, testing can be witnessed at an agreed upon date that does not impact delivery or start-up schedules.

No other Instruments, Control Panel Components (PLC or other components) will be supplied unless they are explicitly listed in this Scope of Supply.

4.8 INSTRUMENTATION

Kruger shall supply the field instruments as detailed herein.

Field Instruments

| Qty | Description | Manufacturer |
|-----|---|--------------|
| 2 | Dissolved Oxygen Probe Immersion Mounting (57900-00 LDO). Analyzer (SC200) and Temperature Output | Hach |
| 1 | Model sc200 Field Transmitter, to combine output from both DO probes. | Hach |
| 2 | pH Probe Immersion Mounting (DPDD1) /w Analyzer (SC200) and Temperature Output | Hach |
| 3 | ISE Ammonium Probes, Model NH4D sc | Hach |

| | | |
|---|--|-------------------|
| 3 | ISE Nitrate Probes, Model NO3D sc | Hach |
| 3 | Model sc200 Field Transmitter, to combine output from each pair of ammonia/nitrate probes. | Hach |
| 2 | High Level Float Switch (GP10NO) | Anchor Scientific |

Kruger will calibrate and start-up Instruments supplied by Kruger. Instruments supplied by others will require calibration and start-up by others.

4.9 AIR LIFT PUMPS (FOAM SUPPRESSION)

Kruger shall provide the following:

- Two (2) air lift pumps for foam suppression shall be provided for each train for a total of four (4) air lift pumps.
- Each air lift pump shall draw water from each aerobic MBBR reactor to be spread on the reactor water surface to control surface foam.
- System shall consist of in-tank piping and supports.
- Aeration supply shall be by others. Air requirement is ~6 scfm per pump for a total of 24 scfm.
- System designed to run continuously, but can be stopped when needed by shutting off air supply.

4.10 FLAT SCREENS FOR TANK DRAIN PORTS

Kruger shall provide the following:

- A total of four (4) flat screens, each nominally 1 ft x 1 ft. Two (2) screens shall be installed in each ANITA Mox reactor.
- Screens shall be perforated plate with minimum of 50% open area.
- The screens will require unloading & field erection by others.
- Kruger will provide necessary anchor bolts, nuts, and washers. Contractor shall supply epoxy anchor chemicals and applicators. All hardware will be 304 stainless or higher grades. Kruger recommends Red Head Epcon C6 or similar epoxy anchor product.
- Wall inserts will not be necessary as the screens will bolt into each tank wall.
- All hardware will be 304 stainless or higher grade.

IMPORTANT NOTE: NO ADDITIONAL TOOLS AND/OR SPARE PARTS OTHER THAN LISTED ABOVE WILL BE PROVIDED AS PART OF KRUGER'S SCOPE OF SUPPLY. FURTHERMORE, THERE ARE NO PREVENTATIVE MAINTENANCE REQUIREMENTS OR REPLACEMENT PARTS NECESSARY DUE TO THE MEDIA, AERATION SYSTEM, AND SCREENS BEING MAINTAINANCE FREE COMPONENTS.

SECTION 5

Scope of Work

5.1 SCOPE OF WORK

Kruger is responsible for process design and equipment procurement required for the AnoxKaldnes ANITA Mox process. Kruger's scope of work does not include any equipment, materials or other services not specifically defined in this proposal.

5.2 PROCESS DESIGN AND ENGINEERING

Kruger will perform engineering in accordance with the applicable national codes, standards, and/or regulations (except where otherwise noted) in effect at the time of this proposal. Additionally, Kruger will provide all necessary design, installation, and operating information for equipment within its stated scope of supply. Kruger is not responsible for the design, selection, installation, operation, or maintenance of any material, equipment, or services provided by others.

Kruger will provide process engineering and design support for the system as follows:

1. Equipment specification for all equipment supplied by Kruger
2. Technical instruction for startup and operation of the system
3. Equipment layout drawings
4. Equipment installation instructions
5. O&M manuals

5.3 FIELD SERVICE AND PROCESS START-UP

Kruger will provide field services for inspection during equipment installation, advisory participation during process startup, and on-site training for plant operators. The following list summarizes field time included in this Scope of Supply. The startup timeline below provides more detail of startup phases and anticipated support.

- Five (5) man-days for equipment inspection during installation.
- Fifteen (15) man-days (cumulative) for assistance during process start-up.
- Three (3) man-days for process training of plant operators.
- Ten (10) man-days (cumulative) for observation during process performance.

Kruger has developed the following start-up concept for the South Durham, NC facility:

- Kruger will provide media seeded with anammox organisms to accelerate the startup of the facility. Approximately 5% of the media volume of one reactor (~200 ft³ or 5.5 bags, each 1 m³) will be provided from the AnoxKaldnes ANITA Mox biofarm system in Malmo, Sweden. One reactor will initially be seeded. The other reactor will be offline. Once the first reactor develops a productive biomass, Kruger recommends the effluent of the first reactor be directed to the second reactor to accelerate biological startup in the second reactor. Alternatively, some media from the first reactor may be transferred to the second reactor (approximately 5%) to seed the second reactor. The second reactor may then be started in a similar ramp-up manner. Note this second method may require different feed flow rates to reactors 1 and 2.

- Prior to introduction of centrate or seed media, a nominal flow of main plant wastewater (ideally primary influent, after the headworks) is passed through the reactors with the new media for a period of 3-4 weeks. This period allows the new media to lose its slight hydrophobic property and mix normally while also permitting a thin biofilm to develop on the media to aid in the attachment of anammox organisms.
- At the end of the soak period with primary influent, Kruger recommends a temporary closed loop recycle pump and water heater be used to bring the water closer to the temperature of the centrate prior to introducing centrate. The system shall be provided by the Contractor or the Owner. Heating will limit the temperature drop of the centrate as it is introduced into the reactor, since the initial feed rate will be low. The target temperature is ~20-25°C. The target flow should allow for ~1-2 exchanges of reactor volume per day (~65-130 gpm).
- After the soak period, the anammox seed media is added to the startup reactor and centrate is introduced. During startup, the ammonia loading rate is controlled by varying the centrate flow to the ANITA Mox system. Initially, the influent flow will be low or intermittent, with the goal of providing just enough ammonia so that the anammox population that is present is sufficient to remove the nitrite produced by the aerobic biofilm fraction. This strategy minimizes nitrite accumulation in the reactor.
- Occasionally during startup of the ANITA Mox process, it may be necessary to apply a temporary higher flow from another water source to flush the reactor. This flush would occur as a remedy to excess concentrations of ammonia or nitrite. The sources of this temporary flush are, in preferential order, secondary effluent, primary effluent, primary influent, or centrate. This flush flow will ideally be in the range of 5-10 times the centrate flow, for a maximum total flow through the reactor of 0.6-0.7 mgd. The Contractor or Owner shall supply the temporary pump and piping.

Approximate Timeline for ANITA Mox Process Startup at South Durham WWTP, NC

| Week | Task Name | Description of Task | Typical Kruger Support |
|--|---|--|--|
| 1 st week | Media Installation | Adding about 100 bags (1 m ³ /bag) of new media into one of the two reactor tanks. This can be done within a week. | Kruger will be available on-site to initially advise the contractor when media installation commences. |
| 2 nd – 4 th weeks | Media Acclimation | Feeding screened and de-gritted raw sewage or primary effluent for 2-3 weeks continuously at about 100 - 200 gpm to grow thin heterotrophic layer on media carriers. Aeration is on during this phase. | Kruger staff will be onsite periodically to determine when the biofilm layer is adequate. |
| 5 th week | Increase Temperature of Reactor Content | Adding hot water to increase the temperature of reactor content to above 25°C. The temperature increase should be slow so one week time is allocated for that. | Kruger Staff will be onsite initially to help determine the heat input and location, and periodically to determine when to stop the external heating. |
| 6 th week | Seeded Media Installation | Adding about 5 bags of seeded media into the tank. This will only take less than half day. | Kruger Staff will be onsite for this operation to make sure all equipment is working before adding the seeded media and to advise the proper handling of the media by the Contractor. |
| 6 th - 20 th Weeks | Startup Operation | <p>The addition of seeded media begins the process startup period. Intensive monitoring both online and lab, will be needed. Daily lab analyses include: ammonia, nitrate, nitrite, pH, and BOD.</p> <p>Based on the analytical results, Kruger staff will determine the operation mode</p> <ul style="list-style-type: none"> - Phase 1 – batch feed with intermittent aeration - Phase 2 – continuous feed with intermittent aeration - Phase 3 – Increasing the feed load with reduction of air-off periods - Phase 4 – Increasing the feed load with continuous aeration | Lab analysis can be conducted by the plant staff. Kruger staff will be onsite approximately 2 hours each day for the first 4 weeks to provide instructions about operation. Kruger staff will check on-line process parameters daily via remote access to provide assistance until the completion of the startup period. On-site visits will be periodic, but not necessarily daily. |

SECTION 6

Scope of Work by Others

6.1 SCOPE OF SUPPLY BY OTHERS

Unless otherwise indicated in this Scope of Supply document, the Contractor shall furnish the following items. The Contractor's scope is not necessarily limited to this list:

1. Others shall provide access to the basins and facilities for Kruger field personnel to inspect the installed Kruger equipment. This access shall include, but not be limited to, the following:
 - a. Safe ingress and egress at the basins.
 - b. Equipment, personnel, assistance, training and permitting for confined space entry, if applicable.
 - c. Tank dewatering and sludge removal, if necessary.
 - d. Provisions, such as scaffolding or lifting devices, to allow the Kruger inspector to gain close access to installed equipment for a complete and proper inspection.
 - e. Sufficient lighting for safety and inspection visibility purposes.
 - f. Provisions for atmospheric monitoring and ventilation, if necessary.
 - g. Personnel available to provide remedy for items that can be corrected during or just after the inspection.
2. Receiving (preparation of receiving reports), unloading, storage, maintenance preservation and protection of all equipment, and materials provided by Kruger Inc.
3. Installation of all equipment and materials provided by Kruger Inc.
4. Supply, fabrication, installation, cleaning, pickling, and/or passivation of all stainless steel piping components not provided by Kruger Inc.
5. Supply and installation of all flange gaskets and bolts for all piping components not supplied by Kruger Inc.
6. Supply and installation of all pipe supports not supplied by Kruger Inc.
7. Provide, install and terminate all motor control centers, motor starters, panels (other than the supplied PLC panels), transformers, and VFD's.
8. Provide, install and terminate all variable frequency drive units as required by Kruger Inc.
9. Installation and termination of all control panels and instrumentation supplied by Kruger Inc.
10. Supply and install all electrical power and control wiring and conduit to the equipment served plus interconnection between Kruger's furnished equipment as required, including wire, cable, junction boxes, fittings, conduit, etc.
11. Provide all anchor bolts and mounting hardware not provided by Kruger Inc.
12. Provide and install all piping required to interconnect to the Supplier's equipment.
13. Provide all nameplates, safety signs and labels.
14. The Contractor shall coordinate the installation and timing of interface points such as piping and electrical with the Supplier.
15. Supply and install all sunshields and/or additional enclosures as needed when installing equipment and instrumentation outdoors.
16. All other necessary equipment and services not otherwise listed as specifically supplied by Kruger Inc.

SECTION 7

ANITA Mox Technical Specification

ANITA™ MOX MOVING BED BIOFILM REACTOR (MBBR) SYSTEM

PART 1 - GENERAL

1.01 GENERAL CONTRACTOR SCOPE OF WORK

- A. Installation of all equipment and materials as provided by the ANITA MOX SYSTEM SUPPLIER.
- B. Supply and installation of all embedded pipe sections.
- C. Supply all wall inserts.
- D. Supply and installation of all sample pumps and sample piping as required for the instrumentation provided by the ANITA MOX SYSTEM SUPPLIER.
- E. Provide all labor materials, supplies and utilities as required for startup, adjustment and performance testing including laboratory equipment, laboratory facilities, analytical work and chemicals.
- F. OWNER shall provide all chemicals, lubricants and other supplies required for equipment startup and adjustment.
- G. Provide all anchor bolts for equipment and piping, including those provided by the ANITA MOX SYSTEM SUPPLIER.
- H. Assist the ANITA MOX SYSTEM SUPPLIER with process startup activities.
- I. Supply and installation of all insulation and heat tracing for all tanks and piping subject to freezing temperatures.
- J. Provide and install all piping required to connect to the ANITA MOX SYSTEM SUPPLIER'S equipment.
- K. Provide all support beams and/or slabs, platforms, grating, floor plate, handrails, hatches, ladders and platforms as required.
- L. Supply and install all motor control centers, motor starters, panels, transformers and variable frequency drives (VFD's) in compliance with Division ___.
- M. Installation of all control panels and instrumentation provided by the ANITA MOX SYSTEM SUPPLIER in compliance with Division ___.
- N. Supply and install all electrical power, control wiring and conduit to the MBBR equipment, including wire, telephone lines, cable trays, cable, junction boxes, fittings, disconnects, conduit, etc. in compliance with Division ___.

- O. The CONTRACTOR shall coordinate the installation and timing of all interface points such as piping and electrical tie-ins with the ANITA MOX SYSTEM SUPPLIER.
- P. All other work not included in the ANITA MOX SYSTEM SUPPLIER SCOPE OF WORK

1.02 SUPPLIER SCOPE OF WORK

- A. The ANITA MOX SYSTEM SUPPLIER shall furnish the process equipment for a biological wastewater treatment system, as shown on the Contract Drawings and specified herein. The process equipment shall include AnoxKaldnes media, a medium bubble aeration system, cylindrical screen assemblies, a process control panel, instrumentation, seed media, technology licenses and patent infringement indemnification. A single PROCESS EQUIPMENT SUPPLIER shall supply the Biological Treatment System in order to establish system performance responsibility.
- B. Mechanical and electrical process equipment to be furnished under this section includes, but is not limited to, the following:
 - 1. Plastic media
 - 2. Cylindrical screen assemblies (screens and support system)
 - 3. AnoxKaldnes Medium Bubble aeration grids
 - 4. Mixers for ANITA Mox Reactors
 - 5. Process Control Panel
 - 6. Instrumentation
 - 7. Air Lift Pumps for foam control

1.03 DESCRIPTION OF OVERALL SYSTEM

- A. The ANITA Mox Moving Bed Biofilm Reactor (MBBR) process allows carrier elements to move about freely within a reactor using the ANITA MOX SYSTEM SUPPLIER'S standard aeration system in aerobic reactors. Screen assemblies shall be used to retain the carrier elements within each reactor. Wastewater is fed to the biofilm reactor(s) on a continuous basis.
- B. Moving Bed Biofilm Reactor treatment systems shall be installed in existing basins and shall be designed to remove ammonia-nitrogen and total nitrogen (TN) contained in wastewater.
- C. The ANITA Mox MBBR design shall be based on the flow and load conditions summarized in the table below.

| ANITA Mox MBBR Design Basis | | |
|------------------------------------|-------|---------|
| Parameter | Units | Value |
| Flow, Design | MGD | 0.08 |
| Flow, Peak Centrate* | MGD | 0.16 |
| Flow, Max Hydraulic Flush | MGD | 0.6-0.7 |
| BOD, Design Flow | mg/L | 85 |
| COD, Design Flow | mg/L | 500 |
| TSS, Design Flow | mg/L | 250-500 |
| NH ₃ -N, Design Flow | mg/L | 1000 |
| TKN, Design Flow | mg/L | 1100 |
| Alkalinity, Design Flow | mg/L | 2500 |
| pH | SU | 7.4 |
| Min. Temperature | °C | 24 |

*Assumed

- D. The ANITA Mox performance is summarized below
1. Guaranteed Percent Removals.

| ANITA Mox MBBR Percent Removal Guarantees (90-Day Average) | | |
|---|-------|-------|
| Parameter | Units | Value |
| NH ₄ -N Removal Efficiency | % | ≥ 75% |
| Total Nitrogen Removal Efficiency | % | ≥ 65% |

2. Notes.
 - a. The running 7-day average reactor temperature shall not be lower than the minimum design temperature, and any daily temperature shall not be less than 20°C.
 - b. The 7-day average applied loads shall not exceed the design loadings by more than 10%.
 - c. The 7-day average applied NH₄-N concentration shall not be less than 400 mg/L.

E. The ANITA Mox Moving Bed Biofilm Reactor treatment system shall be designed for operation in a reactor as indicated on the drawings. Equipment shall be designed for the following:

| ANITA Mox MBBR Basin Design Summary | | |
|--|-----------------------|-----------------------|
| Parameter | Units | Value |
| Number of Process Trains | - | 2 |
| Number of Reactors per Train | - | 1 |
| Reactor Dimensions (Each) | ft | 27' x 26' x 16' (SWD) |
| Each Reactor Volume | ft ³ | 11,232 |
| Total Reactor Volume (All Trains) | ft ³ | 22,464 |
| Type of Biofilm Carriers | - | K5 |
| Fill of Biofilm Carriers, All Reactors | % | 38% |
| Total Bulk Volume of Carriers | ft ³ | 8,477 |
| Total Effective Surface Area | ft ² | 2,066,671 |
| Aeration System | - | Medium Bubble |
| Design Residual D.O. Level | mg/L | 2.0 |
| AOR | lb-O ₂ /hr | 59 |
| Total Oxygen Transfer Efficiency | % | 17.6 |
| Total Air Requirement, Design Flow | SCFM | 714 |

1.04 QUALIFICATIONS

- A. The ANITA Mox SYSTEM SUPPLIER shall be I. Kruger, Inc. of Cary, NC.
- B. All equipment furnished under this specification shall be new and unused, unless otherwise noted in this specification.
- C. The CONTRACTOR shall assume responsibility for the satisfactory installation and initial startup of the entire MBBR treatment system.

1.05 SUBMITTALS

- A. Submittals shall include at least the following:
 - 1. Equipment drawings showing all important details of construction and dimensions.
 - 2. Descriptive literature, bulletins, and/or catalogs of the equipment.
 - 3. Data on the characteristics, features, and performance of the equipment.
 - 4. The total weight of the equipment including the weight of the single largest item
 - 5. Motor drive data.
- B. The SUPPLIER shall furnish operation and maintenance manuals. The manuals shall be prepared specifically for this installation and shall include all required catalog cuts, drawings, equipment lists, descriptions, and other information that is required to instruct operation and maintenance personnel unfamiliar with such equipment.

1.06 QUALITY ASSURANCE

- A. The installations shall conform to all applicable codes that are typical and reasonable for the type of installation.
- B. Requirements of the following organizations shall be considered minimum:
 - 1. OSHA - Occupational Safety and Health Act
 - 2. ANSI - American National Standards Institute
 - 3. ASTM - American Society for Testing and Materials
 - 4. AISI - American Iron and Steel Institute
 - 5. AIWC - American Institute of Steel Construction
 - 6. AWS - American Welding Society

1.07 EQUIPMENT WARRANTY

SYSTEM SUPPLIER shall warrant to the OWNER that the Equipment shall materially conform to the description in SYSTEM SUPPLIER's Documentation and shall be free from defects in material and workmanship. The warranty shall not apply to any Equipment that is specified or otherwise demanded by OWNER and is not manufactured or selected by SYSTEM SUPPLIER, as to which (i) SYSTEM SUPPLIER hereby assigns to OWNER, to the extent assignable, any warranties made to SYSTEM SUPPLIER and (ii) SYSTEM SUPPLIER shall have no other liability to OWNER under warranty, tort or any other legal theory. If OWNER gives SYSTEM SUPPLIER prompt written notice of breach of this warranty within 18 months from delivery or 1 year from acceptance, whichever occurs first (the "Warranty Period"), SYSTEM SUPPLIER shall, at its sole option and as OWNERS's sole remedy, repair or replace the subject parts or

refund the purchase price therefore. If SYSTEM SUPPLIER determines that any claimed breach is not, in fact, covered by this warranty, the OWNER shall pay SYSTEM SUPPLIER its then customary charges for any repair or replacement made by SYSTEM SUPPLIER. SYSTEM SUPPLIER's warranty is conditioned on OWNER's (a) operating and maintaining the Equipment in accordance with SYSTEM SUPPLIER's instructions, (b) not making any unauthorized repairs or alterations, and (c) not being in default of any payment obligation to SYSTEM SUPPLIER. SYSTEM SUPPLIER's warranty does not cover damage caused by chemical action or abrasive material, misuse or improper installation (unless installed by SYSTEM SUPPLIER). THE WARRANTIES SET FORTH IN THIS SECTION ARE SYSTEM SUPPLIER'S SOLE AND EXCLUSIVE WARRANTIES. SYSTEM SUPPLIER MAKES NO OTHER WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR PURPOSE.

1.08 PROCESS PERFORMANCE GUARANTEES

- A. The effluent quality performance of the MBBR system will be demonstrated via one (1) ninety-day performance test during the first twelve (12) months of operation, following stabilization of the process. The performance test will demonstrate that the ANITA MOX SYSTEM SUPPLIER has complied with the effluent quality criteria specified herein.
- B. Guaranteed Performance is based upon a process designed in accordance with the influent and effluent wastewater criteria from Sections 1.03.C and 1.03.D. Additionally, the following conditions shall be met:
1. There will be sufficient alkalinity, either present in the wastewater or by means of chemical addition, to maintain a pH in the range of 6.5 - 8.0 in the process tanks.
 2. With the exception of temperature, all values listed are maximum values, including all recycle streams.
 3. The minimum and maximum temperatures are based upon a seven (7) day average.
- C. Process Performance Testing.
1. The OWNER shall be responsible for carrying out the performance testing, for collecting all samples, for carrying out all laboratory tests and for keeping such detailed records as may be necessary for determining whether the performance guarantees have been met. The said records shall be retained until the performance guarantee has been satisfied or until expiration of the period during which the performance test is to be performed whichever occurs earlier, and such records shall include all daily log sheets, operator notes, sample inspections, and instrument charts produced in operation of the plant. The OWNER shall provide one copy of such records to the ANITA MOX SYSTEM SUPPLIER free of charge. The OWNER shall make copies of such records available to the ANITA MOX SYSTEM SUPPLIER for inspection or copying at the ANITA MOX SYSTEM SUPPLIER'S expense.
 2. The performance test shall be subject to the following general conditions:
 - a. All volumes specified shall be measured by tank gauges or calibrated meters acceptable to the Process Supplier and corrected to 60 °F (15.6 °C).
 - b. All analyses, data reduction or tests not otherwise specified shall be carried out by procedures furnished or approved by the ANITA MOX SYSTEM SUPPLIER. (The publication, Standard Methods for Examination of Water and Wastewater, most

- recent edition, shall be the primary procedure source unless a different source is agreed upon by OWNER and the ANITA MOX SYSTEM SUPPLIER.)
- c. The OWNER shall furnish all materials, utilities, services and personnel as required to operate the plant during the performance tests.
 - d. The OWNER will notify the ANITA MOX SYSTEM SUPPLIER in writing thirty (30) days in advance of beginning the performance test.
3. The following are specific responsibilities of the ANITA MOX SYSTEM SUPPLIER and OWNER with respect to the performance test and guarantees:
- a. OWNER shall be obligated to carry out the performance test at such conditions and at such time as the ANITA MOX SYSTEM SUPPLIER may reasonably request (or ANITA MOX SYSTEM SUPPLIER and OWNER mutually agree) for purposes of determining whether guarantees are met. The time within which the performance test is to be carried out may be extended by the length of any period of down time required for correcting any failure or deficient performance.
 - b. The OWNER shall provide the labor required to obtain samples and measurements and shall pay for all laboratory analyses of the samples.
 - c. If during the performance test it appears that the process guarantees are not being met, the ANITA MOX SYSTEM SUPPLIER shall have the right to have the plant operated at such reasonable conditions as it may deem necessary or advisable for the purpose of determining the nature or cause of the failure of the plant to meet such guarantee, provided such operating conditions are in accordance with good engineering practice and OWNER'S operating rules enforced at the plant site. Thereafter, the ANITA MOX SYSTEM SUPPLIER shall have the right to make or have made such adjustments in order to meet such guarantee and the right to make or have made such alterations or modifications to the plant necessary to correct deficiencies in the process design basis as it deems necessary or advisable. Such alterations or modifications shall be subject to review and approval by the OWNER.
 - d. The following recordings and samples shall be taken and analyzed. The samples shall be taken at the MBBR influent and effluent, unless noted otherwise. The following are the minimum samples and recording points:
 - i. Flow, instantaneous and averages (MGD)
 - ii. Influent TSS (mg/l)
 - iii. CBOD (mg/l)
 - iv. Soluble CBOD (mg/l)
 - v. TKN (mg/l)
 - vi. NH₄-N (mg/L)
 - vii. NO₃-N
 - viii. NO₂-N
 - ix. Temperature
 - x. Dissolved Oxygen (DO) (mg/L)
 - xi. pH
4. The ANITA MOX SYSTEM SUPPLIER and OWNER will jointly review performance of the process system to determine compliance with performance guarantees. Review will include, but not be limited to, a comparison of influent and process design basis with the actual performance results.
5. The OWNER will promptly notify the ANITA MOX SYSTEM SUPPLIER of the failure to meet any process guarantee and specify the respect in which such guarantee has not been met.

6. If the SUPPLIER disputes any claimed failure, notice of such dispute shall be furnished promptly to OWNER.
 7. The ANITA MOX SYSTEM SUPPLIER shall not be responsible for non-fulfillment of guarantees or the cost of alterations or modifications to the plant due to deficiencies in the plant beyond ANITA MOX SYSTEM SUPPLIER'S control, such as the design by the ENGINEERS, materials or equipment, workmanship (other than that of the ANITA MOX SYSTEM SUPPLIER) or services beyond the control of the ANITA MOX SYSTEM SUPPLIER, including, but not limited to:
 - a. Defective materials or mechanical conditions or deficient performance of equipment utilized in parts auxiliary to the Technology not supplied by the ANITA MOX SYSTEM SUPPLIER.
 - b. Noncompliance with the process design basis for said plant and/or noncompliance with operating instructions, or reasonable revisions of either of these consistent with the Specifications, furnished or approved in writing by the ANITA MOX SYSTEM SUPPLIER to OWNER or defective conditions or performance of any materials, equipment or work supplied by or contracted for by OWNER, other than those provided or supplied by the ANITA MOX SYSTEM SUPPLIER, provided that the ANITA MOX SYSTEM SUPPLIER has given OWNER notice of such noncompliance or defective conditions or performance promptly upon discovery of the same.
 - c. Failure of OWNER to furnish adequate utilities such as, but not limited to electricity, air, water, etc., as set forth in the O & M Manual supplied by the ANITA MOX SYSTEM SUPPLIER: an adequate operating staff; or mechanical failure of any of the equipment of component parts thereof due to ordinary wear and tear.
 - d. Failure of OWNER to perform any of the responsibilities and obligations assumed by it in accordance with the provisions hereof.
 - e. The failure of the OWNER substantially to comply with any or all of the foregoing conditions which impairs the ANITA Mox SYSTEM SUPPLIER'S ability to satisfy its guarantee shall constitute a waiver of the requirement of performance test to which such conditions are applicable and thereupon the ANITA Mox SYSTEM SUPPLIER guarantees relating to such tests shall be deemed to have been met.
- D. Performance Standards and Exclusive Remedy
1. In the event that the MBBR system does not achieve the required level of performance during the test period, the ANITA Mox SYSTEM SUPPLIER shall be permitted to conduct two additional tests to meet the specified process guarantee criteria.
 2. If the biological treatment system fails to achieve the required effluent quality during the performance test period and fails any additional tests, the ANITA Mox SYSTEM SUPPLIER shall pay for modifications to improve effluent quality.
 3. The total amount of all costs, including but not limited to modifications and retesting, expended by the ANITA Mox SYSTEM SUPPLIER to satisfy all equipment and performance warranty and guarantee obligations shall not exceed 1.0 times the amount paid for the ANITA Mox SYSTEM SUPPLIER'S scope.
 4. Upon successful completion of the specified testing requirements, the ANITA MOX SYSTEM SUPPLIER'S total liability, with the exception of equipment warranties, under this Agreement shall be discharged.

1.09 PATENTS

The ANITA MOX SYSTEM SUPPLIER shall indicate if any patents or licenses are involved because of equipment furnished, or process employed. The ANITA MOX SYSTEM SUPPLIER shall assume all costs of patent fees or licenses for equipment or processes, and shall safeguard and save harmless the GENERAL CONTRACTOR, OWNER and ENGINEER and their agents from damages, judgments, claims and expenses arising from license fees or claimed infringements or any letters of patent or patent right, or because of royalty or fee for the use of any equipment or process, structural feature or arrangement of any of the component parts of the installation; and the price stipulated for all such patent fees, licenses, or other costs pertaining thereto.

PART 2 – ANITA MOX MBBR EQUIPMENT

2.01 MANUFACTURERS/SYSTEM SUPPLIERS

- A. The ANITA Mox System Supplier shall be I. Kruger Inc. of Cary, North Carolina

2.02 GENERAL

- A. The work shall generally comprise the supply of an ANITA Mox Moving Bed Biofilm Reactor treatment system complete with process design, biofilm carrier media, AnoxKaldnes Aeration System, AnoxKaldnes Screen Assemblies, ANITA Mox Reactor Mixers, instrumentation, and other related appurtenances required for a complete and operable system.
- B. License fees or royalties required in connection with use of the Moving Bed Biofilm Reactor treatment system shall be included in the Contract Price. The ANITA MOX SYSTEM SUPPLIER shall indemnify and hold harmless OWNER against all claims, damages, losses and expenses arising out of any infringement of patent rights or copyrights incident relating to this project.

2.03 BIOFILM CARRIER ELEMENTS

A. GENERAL

1. The ANITA MOX SYSTEM SUPPLIER shall provide media that meets the design quantity, media dimension, and specific gravity, specified for the design conditions stated herein.
 2. Engineer may reject media if field inspection during final placement of the media reveals non-conformity in terms of media shape, size, or stock material integrity.
 3. Media shall be contained in bags. The media in each bag shall be of known volumetric quantity such as to facilitate accurate inventory control during final placement of the media. Each bag shall have handles on the topside to assist in moving the bags from the storage location to above the basins for final placement of the media.
 4. The CONTRACTOR shall install the media into the reactors and maintain an accurate inventory of the number of bags installed in each reactor. These records shall be made available to the ENGINEER or ANITA MOX SYSTEM SUPPLIER upon request.
- B. The ANITA MOX SYSTEM SUPPLIER shall provide 8,477 cubic feet of carrier elements for the MBBR system. Material shall be an extruded, white, virgin high-density polyethylene. The density of the biofilm carrier elements in bulk is a minimum of 7.0 lb/ft³. The specific gravity of the biomedial shall be nominal of 0.96 and a minimum of 0.94. Minimum effective surface area for biofilm carrier elements in bulk for biomass growth is 800 m²/m³. The diameter shall be 25 mm with a height of 3.5 mm.

2.04 AERATION SYSTEM (MEDIUM BUBBLE)

A. DEFINITIONS

1. SCFM: A standard cubic feet per minute is understood to be air at 68°F, 14.7 PSIA and 36% relative humidity flowing at a rate of 1 cubic feet per minute.
2. SOTR: Standard oxygen transfer rate is understood to be the rate of oxygen transferred to tap water (pounds of oxygen per hour) at standard conditions of 20°C, 0.0 mg/l

residual dissolved oxygen concentration, and a barometric pressure of 760 mm Hg (dry air).

3. SOTE: Standard oxygen transfer efficiency is understood to be the fraction of oxygen transferred under standard conditions of 20°C, 0.0 mg/l residual dissolved oxygen concentration, and a barometric pressure of 760 mm Hg (dry air).
4. SWD: Side water depth is understood to be the overall dimension from the high point of the basin floor to the water surface.

B. GENERAL

The CONTRACTOR shall install aeration grid(s) supplied by the ANITA MOX SYSTEM SUPPLIER in the basin(s) as shown and specified below:

1. Drop Pipe(s)
2. Aeration Grids and Assemblies
3. Supports

C. EQUIPMENT

1. Drop Pipe
 - a. A 304/304L stainless steel drop pipe(s) shall be provided for the aeration grid(s) to a point approximately 3' above the SWD. The drop pipe shall be schedule 10 pipe and connect to the CONTRACTOR supplied out-of-basin pipe. Kruger Inc scope ends with **125lb plate flange with ANSI bolting pattern**.
2. Aeration Grids
 - a. A 304/304L stainless steel aeration grid(s) shall be provided for the basin(s) as shown on the contract drawings. The aeration grid(s) shall be comprised of; an aeration grid manifold of schedule 10 pipe with Ø1" laterals of schedule 5 pipe. The laterals shall be uniformly spaced along the length of the aeration grid manifold. Each lateral will have a series of 4mm (5/32") holes uniformly spaced along the bottom. The lateral pipe shall include a crimped drop pipe at the end, to provide for easy drainage, and to prevent entry of media. Each aeration grid shall be supplied with all necessary gaskets and hardware.
3. Supports
 - a. Drop Pipe Supports: Drop pipe supports to be fabricated from 304/304L stainless steel. The supports shall be a minimum 3" x 3" x 1/4" angle with a minimum 1/4" thick anchor plate. The support shall be secured by two (2) 18-8 stainless steel threaded rods with a minimum diameter of 1/2". Each rod will be anchored to the concrete by chemical anchors. The drop pipes shall be secured to the support by a u-bolt. Supports shall have a maximum spacing of 9'-0". All interconnecting hardware required to secure the support to the drop pipe shall be provided. No field welding shall be required.
 - b. Aeration Grid and In-Basin Manifold Supports: Aeration grid and in-basin manifold supports to be fabricated from 304/304L stainless steel. Each support shall consist of a minimum 2" bearing contact between the pipe and support. The support shall be secured by two (2) 18-8 stainless steel threaded rods with a minimum diameter of 3/4". Each rod will be anchored to the concrete by chemical anchors. The aeration grid and in-basin manifolds shall be secured to the support by a u-bolt to prevent lateral movement. Supports shall be designed to allow for on-site height adjustment. Supports shall have a maximum spacing of 9'-0". All interconnecting hardware

required to secure the support to the aeration grid shall be provided. No field welding shall be required.

4. Construction
 - a. Welding: All welding shall conform to Kruger Inc Welding Fabrication Procedures. All factory welding shall undergo pickling/passivation to prevent rust and corrosion.
 - b. Bolting: Where nothing to the contrary is indicated, bolts, screws, nuts, and washers shall be 18-8 stainless steel.
 - c. Installation: The installation of the aeration equipment shall be such that upon completion of installation, all diffusers are level to $\pm 1/4''$ of a common horizontal plane.
5. Design
 - a. The system shall be designed to be submerged within the tank basin without deforming any component.
 - b. All welded parts and assemblies shall be shop fabricated from 304L stainless steel with a 2D finish. Unless otherwise specified, all non-welded parts and pieces shall be shop fabricated from type 304 stainless steel with a 2D finish.
 - c. All flanged joints shall have 45 to 55 durometer, Shore A, neoprene gaskets.
 - d. All aeration grid and in-basin manifold supports shall be designed to compensate for a maximum floor elevation difference of $\pm 3''$.
 - e. All supports shall be designed to resist the load of the media in the event the tank is drained.

2.05 CYLINDRICAL SCREEN ASSEMBLIES

A. GENERAL

The CONTRACTOR shall furnish and install cylindrical screen(s) for media retention in the basin(s) as shown and specified. The Equipment Manufacturer shall furnish the items listed below:

1. Cylindrical Screens

B. EQUIPMENT

1. Cylindrical Screen
 - a. Cylindrical Screen (Perforated Plate): 304/304L stainless steel cylindrical screens shall be provided for the basins as shown on the contract drawings. The cylindrical screens shall be constructed of a minimum 14 gauge sheet and have a perforation pattern of a $5/8''$ dia. with $13/16''$ centers on a staggered spacing. Each screen will have a minimum $1/4''$ thick plate mounting flange with two sets of anchor holes for wall mounting.
2. Construction
 - a. Welding: All welding shall conform to Kruger Inc Welding Fabrication Procedures. All factory welding shall undergo pickling/passivation to prevent rust and corrosion.
 - b. Bolting: Where nothing to the contrary is indicated, bolts, screws, nuts, and washers shall be 18-8 stainless steel.
 - c. Installation: Each cylindrical screen shall be mounted by either (4) 18-8 stainless steel threaded rods with a minimum diameter of $1/2''$ (direct wall mounting), or with a minimum of (4) bolts (mating flange mounting). The installation of the cylindrical

screen shall be such that upon completion of installation, all cylindrical screen are level to $\pm 1/4$ " of a common horizontal plane.

4. Design
 - a. The system shall be designed to be submerged within the tank basin without deforming any component.
 - b. All welded parts and assemblies shall be shop fabricated from 304L stainless steel with a 2D finish. Unless otherwise specified, all non-welded parts and pieces shall be shop fabricated from type 304 stainless steel with a 2D finish..
 - c. Maximum headloss through the cylindrical screens shall not exceed 3" in each basin at peak hydraulic flows.

2.06 MIXERS

A. GENERAL

The CONTRACTOR shall install mixers(s) for the ANITA Mox Reactor(s) as shown and specified. The ANITA MOX SYSTEM SUPPLIER shall furnish the items listed below:

| | |
|------------------------------------|---------------------------------|
| Total Number of Mixers | Two (2) |
| Make | STAMO |
| Type | HH08-2GN320-2GN260 |
| Motor | 10 HP |
| Explosion Proof | No |
| Power | 3 phase, 60 Hz, 480 Volts w/VFD |
| Number of Impellers per mixer. | Two (2) |
| Total Number of Impellers | Four (4) |
| Minimum impeller (A) diameter, in. | 102 |
| Minimum impeller (B) diameter, in. | 126 |
| Total Shaft Length, in. | 174 |
| Shaft diameter, in. | 3.15 |

B. EQUIPMENT

<FULL SPECIFICATION TO FOLLOW>

2.07 ANCHORS

A. GENERAL

1. The ANITA MOX SYSTEM SUPPLIER shall furnish anchoring hardware for the supplied equipment.
2. The CONTRACTOR shall furnish all epoxy and dispensing equipment for chemical anchoring.

PART 3 - INSTRUMENTATION AND CONTROLS

3.01 MBBR CONTROL PANEL – GENERAL

- A. The ANITA Mox System Supplier shall provide a PLC-based control panel to monitor and control the ANITA Mox process. The PLC-based control panel shall include the PLC, operator display, control relays, push buttons and selector switches, indicating lights, power supplies, incoming power surge protector, analog isolators, signal conditioners, circuit breakers, and terminal strips.
- B. The Contractor shall furnish and install all required equipment, including signal wiring, piping, terminations, incidental conduits, and necessary mounting and accessory equipment to provide a complete and operational system.
- C. Quality Assurance. All wiring and piping shall be installed in compliance with the best standard practices and in accordance with the recommendations as set forth by the ANITA Mox System Supplier.
- D. The Contractor will terminate all wiring within instrument cabinets at terminal blocks.

3.02 PLC CONTROL PANELS

- A. Control Panel System Cabinets
 1. The MBBR Control Panel (MBBRCP) shall be located in climate controlled room at the WWTP and shall be supplied in a NEMA 12 carbon steel enclosure suitable for inside use. The front panel of the cabinet shall contain operator interface and push buttons, as detailed within this specification. The PLC based control panel shall also include an operator interface display mounted on the front of the control panels. The internal portion of the cabinet shall contain all rack mounted PLC equipment, power supply, processor and interface cards. Relays, terminal strips and surge suppressors shall also be contained within the cabinet. Terminal strips for all field wiring shall be furnished within the panel. The panels shall be manufactured by Saginaw, or an approved equivalent.
 2. An alarm horn shall be provided loose with the MBBRCP. The contractor shall mount this horn adjacent to the MBBRCP. The horn shall be manufactured by Federal Signal or an approved equivalent. A horn disconnect switch/circuit breaker shall be provided inside the MBBRCP panel.
 3. Circuit breakers shall be provided within the panel. A duplex outlet and fluorescent panel light shall be included within the panel.
 4. One surge suppression device on the 120 VAC main supply line shall be installed. The power surge suppressor shall be equivalent to part #2856702 by Phoenix Contact.
 5. On all analog input signals, current isolators shall be installed to galvanically separate external and internal 4-20 mA current loops. Current Isolators shall be equivalent to Phoenix Contact part #2864150.
 6. All analog inputs and outputs shall also be protected from surges. The surge-arresting module shall combine coarse, medium and fine protection elements such as gas filled arrestors, varistors and suppressor diodes. The surge arresting modules shall be plug-in style allowing replacement of arrestors without removing field or panel wires. The analog surge arrestors shall be equivalent to Phoenix Contact part # 2838228.

7. Field I/O shall be terminated to field terminal blocks located inside the MBBRCP. Terminal blocks shall be double level configuration, rated for 600VAC, 30Amps and accommodate wires sized 26AWG to 10AWG. The terminal blocks shall be Phoenix Contact UTTB4 3044814.
 8. All digital outputs shall be provided with isolated relay contacts.
- B. Devices for Operator Interface. External face mounted devices for operator interface shall be as follows:
1. Push buttons and selector switches shall be SQ-D class 9001 30 mm, Telemecanique XB2 22 mm, or Allen Bradley series 800.
 2. A Color Touchscreen Operator Interface Display shall be included and mounted on the front of the enclosure. The Display shall allow the operator to view and modify system variables within the PLC. The display shall be a minimum of 6", and be capable of communicating via Ethernet to the PLC located within the MBBRCP. The unit shall include a real-time clock with battery back-up, color touchscreen or keypad / touchscreen combination, color active matrix thin film transistor display, and minimum resolution 320 x 240 pixels. The unit shall be manufactured by Allen Bradley or approved equivalent.
- C. PLC-based Control Panel I/O Field Interface Signals
1. All PLC ladder logic shall reside within the PLC based control panel. The PLC ladder logic shall perform all necessary process monitoring and control for the Oxidation Ditch System and associated equipment.
 2. All necessary I/O cards shall be supplied to monitor and control the field signals listed within the IO list at the end of this specification. All PLC and I/O racks shall be supplied with 10% spare I/O.
- D. Control Panel Components. The PLC-based Control Panel supplied shall consist of the following components
1. NEMA 12 freestanding control panel
 2. PLC CPU Card
 3. PLC I/O Racks
 4. PLC Field Interface Cards
 5. Operator Interface Display
 6. Power Supply
 7. Alarm Horn
 8. Signal Isolators
 9. Surge Protectors
 10. Circuit Breakers
 11. Terminal Strips
 12. Miscellaneous Wire and Panduit

3.03 PROGRAMMABLE LOGIC CONTROLLER SUBSYSTEM

- A. Programmable Logic Control System Submittals shall include
1. Block Diagram: A diagram showing all major PLC components. Identify components by manufacturer and model number. Show interconnecting cables diagrammatically.
 2. Bill of Materials: A list of all PLC components. Group components by type and include:

- a. Component manufacturer, model number and part number.
 - b. Component description.
 - c. Quantity supplied.
 - d. Reference to component catalog information.
3. Descriptive Information: Catalog information, descriptive literature, performance specifications, internal wiring diagrams, power and grounding requirements, power consumption, and heat dissipation for all elements of the PLCS. Clearly mark all options and features proposed for this project.
 4. Interconnecting Wiring Diagrams: Diagrams shall show all PLC elements, their interconnecting cables, wiring terminations, and terminations to all interacting elements and subsystems. Terminations shall be numbered. Terminations for circuits extending outside PLC assemblies and/or having housing panels shall be labeled with circuit names corresponding to the Circuit and Raceway Schedule. The external circuit portion of this diagram shall be coordinated with the Electrical Subcontractor and shall bear his mark showing that this work has been done.
 5. Outline Drawings: Equipment envelope drawings showing: external dimensions, enclosure materials, conduit connections, and installation requirements.
 6. Installation Details: Any modifications or further details as may be required to supplement the Contract Documents and adequately define the installation of the PLC elements.
 7. Input/Output List: For each I/O point list point type, tag number of the source or final control element, equipment description, PLC number, PLC terminal identification, and PLC address.
- B. Factory Testing. All non-loop specific functions shall be tested, including, but not limited to
1. Failure mode and backup procedures: power failure, auto restart, disk backup and reload, and retentive outputs.
 2. Operator Interface (Located at MBBRCP)
 3. All IO (Analog Inputs, Analog Outputs, Digital Inputs, and Digital Outputs) will be confirmed for proper operation from the PLC to the terminals within the PLC Control Panel.
 4. Programming and documentation methods and features.
- C. Functional Requirements.
1. The PLC system shall be used for monitor and control of the Oxidation Ditch process. The operations described herein are intended to identify minimum acceptable performance. The Contractor shall provide all hardware and software features required to make the PLC panel totally operational.
- D. MANUFACTURERS
1. Allen-Bradley.
 2. Substitutions with Engineer's approval only.
- E. PRODUCT DESCRIPTION
1. Programmable Logic Controller with the required memory and functional capacity to perform the specified sequence of operation with the scheduled input and output points.
- F. COMMON HARDWARE RATINGS
1. Operating Temperature of range of 0 degrees to +60 degrees C (+32 degrees to +140

degrees F)

2. Storage Temperature range of minus 40 degrees to +85 degrees C
3. Humidity range of 5 to 95% non-condensing
4. Vibration Rating of 2.0G maximum peak acceleration for 10 to 500Hz
5. Operating shock rating of 30G peak for 11 milliseconds. Storage shock rating of 50G for 11 milliseconds
6. Hazardous Environmental Rating: Class 1, Division 2

E. CONFIGURATIONS

1. The controller's programming environment must be a pure "tag-based" environment, not requiring the use of controller memory addressing. The programmer must not be burdened with mapping/organizing memory addresses.
2. The "tag-based" environment must be created only once, and available to the HMI/EOI interface...not requiring any import/export.
3. The development environment should automatically create device (I/O and network devices) and logic instruction "tag structures", consisting of related command, status, and diagnostic information.
4. One must be able to access a device on a network(s) multiple levels removed without having to develop communication logic or network tables.
5. The programmable controller, associated I/O, chassis and power supplies shall be of a modular design. The programmable controller and I/O modules shall mount into the chassis. Fixed block control modules are not acceptable
6. Processor Systems shall include processor, power supply, input/output modules, communication modules and remote interface modules as required to meet system requirements.
7. Remote Input/Output Units shall include input/output modules, interface modules, communication modules, and power supply to meet system input and output requirements.
8. Modules are to be supplied as specified unless system requirements dictate the use of alternative modules.

F. SELECTION

1. The programmable controller shall be selected from a family of programmable controllers with memory capability ranging from 64Kbytes to 7.5Mbytes.
2. All system and signal power to the Controller and support modules shall be distributed on a single motherboard or backplane. No interconnecting wiring between these modules via plug-terminated jumpers shall be acceptable.
3. All system modules including the processor shall be removable from the chassis or inserted in to the chassis while power is being supplied to the chassis without faulting the processor or damaging the modules.
4. All system modules, local and remote chassis shall be designed to provide for free airflow convection cooling. No internal fans or other means of cooling, except heat sinks, shall be permitted.
5. Modules shall be designed to plug into a chassis and to be keyed to allow installation in only one direction. The design must prohibit upside down insertion of the modules as well as safeguard against the insertion of a module into the wrong slot or chassis via an electronic method for identifying a module. Electronic keying shall perform an electronic check to insure that the physical module is consistent with what was configured.

G. PROGRAMMING LANGUAGE

1. Ladder Logic.

H. PROGRAMMING SOFTWARE

1. Include one licensed programming package for use with general purpose microcomputer and Microsoft Windows NT, Windows 2000 or Windows XP operating systems.
2. Provide one licensed communication package.
3. Programming Package: RSLogix5000 Standard, CD ROM.
4. Communication Package: RSLinx for Allen-Bradley, CD ROM.
5. Network Package: RSNetWorx for ControlNet.

H. MINIMUM PROGRAMMING INSTRUCTION SET

1. Language Characteristics: Ladder diagram.
2. Logic Operations: AND, OR, XOR, NOT.
3. Register Operations: Store, recall.
4. Math Operations: Addition, subtraction, multiplication, division, square root, matrix operations.
5. Process Control: Proportional-Integral-Derivative.

3.04 PROCESSOR UNIT

A. MANUFACTURER

1. Allen-Bradley Model 1756.
2. Substitutions: Not Permitted.

B. PROCESSOR MEMORY

1. Program memory of 64 Kbytes to 7.5 Mbytes Words.
2. The CPU shall be a self-contained unit providing control program execution and supporting remote or local programming. This device shall supply I/O scanning, inter-processor communication functions and peripheral communication functions.
3. Base memory shall be available for user program and data. The base memory will exclusively contain all I/O tags even if expansion memory is installed. Non I/O tags and ladder logic shall be stored in base memory and optional expansion memory.
4. Memory capacity shall be configurable to allow for the most economical match to the intended application. It shall be possible to upgrade to a processor with a larger memory size simply by saving and downloading the program to the new system without having to make any program changes.
5. The operator should be able to backup volatile memory, including data and program logic onto a personal computer storage disk.
6. All user memory in the processor not used for program storage shall be allocable from main memory for the purpose of data storage.

C. PERFORMANCE

1. The Programmable Controller shall use multiple independent, asynchronous scans. These concurrent scans shall be designated for processing of input and output information, program logic, and background processing of other processor functions. Input and output devices located in the same backplane (local I/O) as the CPU will produce at the rate of configured RPI Requested Packet Interval), and for inputs enabled for Change Of State (COS), at the time any point changes state.

2. Bit Execution Time of less than 0.15 microseconds.
3. Proportional Integral Derivative Control with an execution time between 310 to 425 microseconds.
4. Online programming including runtime editing.
5. The Programmable Controller system shall have the ability to communicate with multiple remote I/O racks or devices configured with multiple I/O modules. The remote I/O networks shall include RIO, Ethernet, ControlNet, and DeviceNet.
6. The Programmable Controller shall have the ability to support multiple data communications links by using Ethernet, DH+, ControlNet, and DeviceNet modules.
7. The user program and data shall be contained in non-volatile battery backed memory. The operating system shall be contained in non-volatile firmware. The memory containing the operating system shall be field updateable via a separate update tool.
8. The Programmable controller shall have the ability to be updated electronically to interface with new modules.

D. FEATURES

1. The program storage medium shall be of a static battery backed RAM type.
2. The front panel of the Controller shall include a holder and a connector for a lithium battery. The battery shall provide power backup for user programs and data when the main power supply is not available.
3. The front panel of the Controller shall include a mounted keyswitch with the following control modes:
 - RUN – No control logic edits possible, program always executing.
 - PROGRAM – Programming allowed, program execution disabled.
 - REMOTE – Programming terminal can make edits and change processor mode, including test mode, whereby the logic executes and inputs are monitored, but edits are not permanently active unless assembled.
4. The front panel on the Controller shall include color indicators showing the following status information:
 - Program or Run mode of the controller
 - The fault status of the controller
 - Input and output status
 - RS-232 activity
 - Battery status
5. The CPU within the system shall perform internal diagnostic checking and give visual indication to the user by illuminating a “green” (OK) indicator when no fault is detected and a “red” indicator when a fault is detected.
6. The front panel of the Controller shall include a 9-pin D-shell serial RS232 port, which supports DF1.
7. Real Time Clock.
8. Processor shall be capable of supporting a back-up scheme if specified.

3.05 CHASSIS-BASED DISCRETE INPUT AND OUTPUT MODULES

A. MANUFACTURER

1. Allen-Bradley Model 1756.
2. Substitutions: Not Permitted.

B. SELECTION

1. All digital input and output modules shall be manufactured and supplied by the manufacturer of the programmable controllers.
2. Modules shall support producer / consumer communications. Digital modules shall multicast their data either upon Change of State or periodically depending upon configuration.
3. Digital input and output modules shall provide ON/OFF detection and actuation. They shall utilize the producer consumer network model to produce information when needed while providing additional system functions.
4. The controller shall not poll digital input modules; instead, the modules shall multicast their data either upon Change of State or periodically based upon configuration. The frequency shall depend upon the configuration and where in the control system that input module physically resides.
5. When a digital output module receives data from the controller, it shall immediately multicast the output commands to the rest of the system. The digital output modules shall utilize Output Data Echo (the output module shall echo the output data as input data and multicast it back out onto the network.)

C. MODULE FEATURES

1. Modules shall be connected directly to the ControlBus backplane via a ControlBus Connector.
2. Modules shall have a locking tab to anchor the removable terminal block (RTB) or Interface Module (IFM).
3. Modules shall have slots for mechanically keying the RTB to prevent making the wrong wire connections to the module.
4. Modules shall be designed to be installed or removed while chassis power is applied.
5. Modules shall have indicators to display the status of communication, module health and input / output devices.
6. Each module shall have the following status indicators.
 - Yellow display to indicate the On/Off state of the field device.
 - Green display to indicate the module's communication status.
 - This display shall be available on diagnostic modules to indicate the presence or absence of various faults.
7. Each digital module shall maintain the following identification information.
 - Modules product type such as analog or digital
 - Modules catalog number
 - Modules major revision number
 - Modules minor revision number
 - Module manufacturer vendor
 - Module serial number
8. Each digital module shall maintain the following status information.
 - Controller ownership
 - Configuration status
 - Device specific status information
 - Minor and major recoverable and unrecoverable faults.
9. Each digital module shall provide the following fault reporting.
 - On diagnostic modules, hardware indication shall be provided through
 - module's LED fault indicator

- Modules shall have an input data tag, Fault, which indicates that a point is faulted and input data or output data for that point may be incorrect. If communication to the module is lost, then all points for the module will be faulted.
 - The programming package shall graphically display the fault and shall include a fault message describing the nature of the fault.
10. Module features shall be enabled or disabled through the I/O configuration portion of the programming package.
 11. Programming package shall be capable of interrogating any module in the system to retrieve serial number, revision number, catalog number, vendor identification, error/fault information and diagnostic counters.
 12. Electronic Keying shall be available through configuration to allow the system to control what modules belong in the various slots of the configured system. The following keying options shall be available.

D. MODULE SPECIFICATIONS (120Vac DIAGNOSTIC INPUT MODULE)

1. Quantity of eight, sixteen or thirty-two inputs
2. On-State Voltage Range of 79-132V ac, 47-63Hz
3. Nominal Input Voltage of 120V ac
4. On-State Current of 16mA @132V ac, 47-63Hz maximum
5. Maximum Off-State Voltage of 20V
6. Maximum Off-State Current of 2.5mA
7. Maximum Input Impedance of 8.25kOhm @60Hz
8. Input Delay Times
 - Off to On - Programmable Filter, 1ms and 2ms
 - Hardware Delay - 10ms maximum plus filter time
 - On to Off - Programmable filter, 9ms and 18ms
 - Hardware Delay - 8ms maximum plus filter time
9. Diagnostic Features
 - Open Wire - Off state leakage current of 1.5mA minimum
 - Loss of Power - Transition range 46 to 85V ac
 - Time Stamp Diagnostics of +/- 1ms
 - Change of State - Software Configurable
 - Time Stamp of Inputs of +/- 200 microseconds
 - Fault Data Tag to indicate that point is faulted
10. Isolation Voltage
 - Group to Group - 100% tested to 2546V dc for 1s
 - User to System - 100% tested to 2546V dc for 1s

E. MODULE SPECIFICATIONS (120Vac ISOLATED INPUT MODULE)

1. Quantity of eight, sixteen or thirty-two individually isolated inputs
2. On-State Voltage Range of 79-132V ac, 47-63Hz
3. Nominal Input Voltage of 120V ac
4. On-State Current of 15mA @132V ac, 47-63Hz maximum
5. Maximum Off-State Voltage of 20V
6. Maximum Off-State Current of 2.5mA
7. Maximum Input Impedance of 8.8kOhm @60Hz
8. Input Delay Times
 - Off to On - Programmable Filter, 1ms and 2ms

- Hardware Delay - 10ms maximum plus filter time
 - On to Off - Programmable filter, 9ms and 18ms
 - Hardware Delay - 8ms maximum plus filter time
9. Diagnostic Features
- Change of State - Software Configurable
 - Time Stamp of Inputs of +/- 200 microseconds
 - Fault Data Tag to indicates that point is faulted
10. Isolation Voltage
- Group to Group - 100% tested to 2546V dc for 1s
 - User to System - 100% tested to 2546V dc for 1s

F. MODULE SPECIFICATIONS (120Vac DIAGNOSTIC OUTPUT MODULE)

1. Quantity of eight or sixteen Outputs
2. Output Voltage Range of 74-132V ac, 47-63Hz
3. Output Current Rating
 - Per Point - 1A maximum @ 30 degrees C; 0.5A maximum @ 60 degrees C; Linear Derating
 - Per Module - 8A maximum @ 30 degrees C; 4A maximum @ 60 degrees C; Linear Derating
4. Surge Current Per Point of 8A for 43ms each, repeatable Every 2s @ 30 degrees C; 5A for 43ms each, repeatable every 1s @ 60 degrees C
5. Minimum Load Current of 10mA per point
6. Maximum On-State Voltage Drop of 2.5V peak @0.5A and 3V peak @1A
7. Maximum Off-State Leakage of 3mA per point
8. Output Delay Time
 - a. Off to On - 9.3ms @ 60Hz, 11ms @50Hz
 - On to Off - 9.3ms @ 60Hz, 11ms @50Hz
9. Diagnostic Features
 - Short Trip - 12A for 500microseconds minimum
 - No Load - Off state detection only
 - Output Verification - On State detection Only
 - Pulse Test - On and Off State Detection
 - Field Power Loss - Detects at 25V peak minimum
 - Time Stamp Diagnostics - + / -1ms
 - Fault Data Tag to indicate that point is faulted and data may be incorrect
10. Configurable States
 - Fault Per Point - Hold Last State, ON or OFF
 - Program Mode Per Point - Hold Last State, ON or OFF
11. Scheduled Outputs - Synchronization within 16.7s maximum, reference to CST
12. Isolation Voltage
 - Group to Group - 100% tested at 2546V dc for 1s
 - User to System - 100% tested at 2546V dc for 1s

G. MODULE SPECIFICATIONS (CONTACT OUTPUT MODULE)

1. Quantity of eight or sixteen (Individually Isolated) Outputs
2. Output Voltage Range of 10-265V ac, 47-63Hz
3. Output Current Rating:

- Resistive - 2A @ 125V ac
- Inductive - 2A Steady State, 15A make @125V ac
- 4. Power Rating (Steady State) of 250VA maximum for 125V ac inductive output
- 5. Maximum Off-State Leakage of 1.5mA per point
- 6. Output Delay Time
 - Off to On - 10ms maximum
 - On to Off - 10ms maximum
- 7. Diagnostic Feature - Fault Data Tag to indicate that point is faulted and data may be incorrect
- 8. Configurable States
 - Fault Per Point - Hold Last State, ON or OFF
 - Program Mode Per Point - Hold Last State, ON or OFF
- 9. Scheduled Outputs - Synchronization within 16.7s maximum, reference CST
- 10. Isolation Voltage
 - Group to Group - 100% tested at 2546V dc for 1s
 - User to System - 100% tested at 2546V dc for 1s

3.06 CHASSIS-BASED ANALOG INPUT AND OUTPUT MODULES

A. MANUFACTURER

1. Allen-Bradley Model 1756.
2. Substitutions: Not Permitted.

B. SELECTION

1. All digital input and output modules shall be manufactured and supplied by the manufacturer of the programmable controllers.
2. Modules shall support producer / consumer communications. Digital modules shall multicast their data either upon Change of State or periodically depending upon configuration.
3. Analog input modules shall convert an analog signal that is connected to the module's screw terminals into a digital value. The digital value representing the magnitude of the analog signal shall be transmitted on the backplane. Analog output modules shall convert a digital value that is delivered to the module via the backplane into an analog signal on the module's screw terminals.

C. MODULE FEATURES

1. Modules shall be connected directly to the ControlBus backplane via a ControlBus Connector.
2. Modules shall have a locking tab to anchor the removable terminal block (RTB) or Interface Module (IFM).
3. Modules shall have slots for mechanically keying the RTB to prevent making the wrong wire connections to the module.
4. Modules shall be designed to be installed or removed while chassis power is applied.
5. Modules shall have indicators to display the status of communication, module health and input / output devices.
6. Each analog module shall have the following status indicators:
 - Calibration Status – Indicates when your module is in the calibration mode.
 - Calibration Status – Indicates when your module is in the calibration mode.
7. Each analog module shall maintain the following: serial number, vendor, product type, catalog number, major revision and minor revision.

8. Each analog module shall provide both hardware and software indication when a module fault has occurred. Each module shall have an LED fault indicator and the programming software shall display the fault information.
9. Electronic Keying shall be available through configuration to allow the system to control what modules belong in the various slots of the configured system. The following keying options shall be available. Each digital module shall maintain the following identification information.
 - Exact match – Parameters (Vendor, Product Type, Catalog Number, Major Revision and Minor Revision) must be an exact match for the module
 - Compatible match – Parameters (Vendor, Product Type, Catalog Number and Major Revision) must be an exact match for the module to allow a connection to the controller. The parameter minor, revision must be greater than or equal to that of the configured slot
 - Disable keying – The inserted module will accept a connection to the controller regardless of its type.
10. Analog modules shall be software configurable through the I/O configuration portion of the programming software.
11. Modules shall be capable of being configured to access the controllers system clock to timestamp input data or to output echo data when the module multicasts to the system.
12. Analog modules shall multicast status / fault data to the owner / listening controllers with their channel data. The following tags shall be capable of being examined in ladder logic.
 - Module Fault Word – Provides fault summary reporting.
 - Channel Fault Word – Provides under-range, over-range and communications fault reporting.
 - Channel Status Words – Provides individual channel under-range and over-range fault reporting for process alarm, rate alarms and calibration faults.

D. MODULE SPECIFICATIONS (ISOLATED ANALOG INPUT MODULE)

1. Quantity of six (Individually Isolated) Inputs
2. Input Range of +/-10.5V, 0-10.5V, 0-5.25V, 0-21mA
3. Resolution of approximately 16 bits across range
4. Input Impedance of Greater than 10Mohms Voltage, 249Ohms Current
5. Open Circuit Detection - Positive full scale reading within 5s
6. Overvoltage Protection
 - Voltage Range - 120V ac/dc
 - Current Range - 8V ac/dc with on-board current resistor
7. Normal Mode Rejection of 60dB at 60Hz
8. Common Mode Noise Rejection of 120dB at 60Hz, 100dB at 50Hz
9. Isolation Voltage
 - Channel to Channel - 100% tested at 1700V dc for 1s based on 250V ac
 - User to System - 100% tested at 1700V dc for 1s based on 250V ac

E. MODULE SPECIFICATIONS (ISOLATED ANALOG OUTPUT VOLTAGE MODULE)

1. Quantity of six (Individually Isolated) Outputs
2. Output Voltage Range of +/- 10.5V maximum
3. Voltage Resolution of 13 bits across 10.5V; 14 bits across 21V
4. Data Format - Integer mode; Floating Point IEEE 32 bit

5. Open Circuit Detection – None
6. Output Overvoltage Protection - 24V ac/dc maximum
7. Output Short Circuit Protection - Electronically current limited
8. Calibration Accuracy of - Better than 0.1% of range
9. Calibration Interval - 12 months typical
10. Isolation Voltage
 - Channel to Channel - 100% tested at 1700V dc for 1s based on 250V ac
 - User to System - 100% tested at 1700V dc for 1s based on 250V ac

F. MODULE SPECIFICATIONS (ISOLATED ANALOG CURRENT VOLTAGE MODULE)

1. Quantity of six (Individually Isolated) Outputs
2. Output Current Range of 0 to 21mA
3. Current Resolution of 13 bits across 21m
4. Data Format - Integer mode; Floating Point IEEE 32 bit
5. Open Circuit Detection – None
6. Output Overvoltage Protection - 24V ac/dc maximum
7. Output Short Circuit Protection - 21mA or less (electronically limited)
8. Calibration Accuracy - Better than 0.1% of range from 4mA to 21mA
9. Calibration Interval - 12 months typical
10. Isolation Voltage
 - Channel to Channel - 100% tested at 1700V dc for 1s based on 250V ac
 - User to System - 100% tested at 1700V dc for 1s based on 250V ac

3.07 CHASSIS-BASED HIGH SPEED COUNTER MODULE

A. MANUFACTURER

1. Allen-Bradley Model 1756.
2. Substitutions: Not Permitted.

B. SELECTION

1. The high-speed counter module shall provide high speed counting.
2. The high-speed counter module shall interface to the controller through the ControlNet network.

C. MODULE FEATURE

1. The module shall periodically multicast its status to the controller. The owner controller shall not scan the high-speed counter module
2. Utilizing the programming software, it shall be possible to configure additional controllers in a “Listen Only” mode for the high-speed counter module. In this mode the controllers shall be capable of receiving the data multicast from the high-speed counter module.

D. MODULE SPECIFICATION

1. Quantity of two counters
2. Inputs Per Counter - Three (3) – A, B, Z for Gate/Reset)
3. Maximum Input Frequency
 - 1 MHz in counter modes (A Input)
 - 500KHz in rate measurement mode
 - 250KHz in encoder mode

- 50Hz with debounce filter enabled
- 4. Count Range of 0 – 16,777,214
- 5. Input Voltage Range of 4.5-5.5V dc for 5V inputs; 10-26.4V dc for 12-24V inputs
- 6. Input Current - 15mA (Typical); 4mA (Minimum)
- 7. Number of Outputs - Four (Two Outputs/Common)
- 8. Output Voltage Range of 4.5-5.5V dc; 10-31.2V dc
- 9. Output Current Rating of 20mA per point @4.5-5.5V dc ; 1.0A per point @ 10-31.2V dc
- 10. Surge Current Rating of 2A for 10 ms every 1s @ 60 degrees C
- 11. Minimum Load Current of 3mA per point for 5V operation; 40mA per point for 12- 24V operation
- 12. Maximum On-State Voltage of 0.55V (Drop/Output)
- 13. Maximum Off-State Leakage of 300 microAmp/point (Current/Output)
- 14. Output Delay Time
 - Off to On - 20 microseconds typical; 50 microseconds max.
 - On to Off - 60 microseconds typical; 300 microseconds max.
- 15. Current Limit of Less than 4 Amps
- 16. Output Short Protection – Electronic
- 17. Reverse Polarity Protection – Yes
- 18. Isolation
 - Group to Group - 100% tested at 1700V dc for 1s
 - User to System - 100% tested at 1700V dc for 1s

3.08 POWER SUPPLIES

A. MANUFACTURER

1. Allen-Bradley Model 1756
2. Substitutions: Not Permitted

B. SELECTION

1. All power supplies, in local and remote chassis, shall be mounted on side of chassis.
2. Choose the power supplies to meet the current requirement based on the maximum draw of the modules plus (10) percent spare.
3. The modules shall include processors, all input / output modules, specialty modules and spare requirements.

C. FEATURES

1. Line Voltage rating of 85 to 265Vac, 47-63Hz
2. Automatically shut down the Programmable Controller system whenever its output power is detected as exceeding 125% of its rated power
3. Provide surge protection, isolation, and outage carry-over up to 2 cycles of the AC line
4. Provide a failsafe fuse that is not accessible by the customer
5. Green LED indicator that is ON during normal operation
6. Accept number 14 AWG (single wire only)per terminal maximum

3.09 CHASSIS

A. MANUFACTURER

1. Allen-Bradley Model 1756
2. Substitutions: Not Permitted

B. SELECTION

1. Provide panel mounted chassis as required for the project.
2. A maximum of (2) chassis configurations shall be utilized on the project.

C. FEATURES

1. Panel Mount Chassis Size: 4, 7, 10, 13 or 17 slot as required to meet Project Requirements
2. No tools shall be required for insertion of modules

3.10 COMMUNICATION INTERFACES

A. CONTROLNET NETWORK

1. Each I/O and Controller chassis shall interface to the ControlNet network through a ControlNet Interface Module located in the chassis.
2. The module shall provide connection to a redundant ControlNet network.
3. The module shall meet the following minimum specifications
 - The module shall be capable of being located in any slot in the chassis.
 - The module shall have two (2) BNC connectors for redundant media operation.
 - The module shall have one Network Access Port (RJ-45, 8-pin with shield)
 - The acceptable cable shall be Quad-shield RG-6 coaxial cable

B. DEVICENET NETWORK

1. When required for DeviceNet network communications, provide a DeviceNet Interface Module mounted in the chassis.
2. The module shall communicate with a ControlLogix controller via the chassis backplane.
3. The module shall communicate with DeviceNet devices over the network.
 - The module shall read and write inputs and outputs to and from a device.
 - The module shall download configuration data to a device.
 - The module shall monitor operational status of a device.
4. The module shall meet the following minimum specifications.
 - The module shall support 125Kbps, 250Kbps or 500Kbps communications rates.
 - The module shall allow for two (2) connections to a dedicated ControlLogix controller.
 - The module shall have an operating shock rating of 30g peak for 11ms.
 - The module shall have a storage shock rating of 50g peak for 11ms.
 - The module shall have a vibration rating of 10 to 150Hz, 5.0G maximum peak acceleration.

C. ETHERNET NETWORK

1. When required for Ethernet network communications provide an Ethernet Interface Module mounted in the chassis.
2. The Ethernet module shall support gateway communications of control and information through Ethernet to the ControlNet network.
3. The module shall support AUI, 10 Base-T media, and 100 Base-T media.
4. The module shall use standard TCP/IP protocol.

5. The module shall support gateway communications to and from other modules in the same chassis.
6. The module shall mount in an I/O chassis.
7. There shall be no limit on the number of modules per chassis.
8. The module shall meet the following minimum specifications
 - Ethernet Connection shall be provided by an AUI or RJ45 connector
 - Conductors shall be 802.3 compliant, twisted pair or AUI, Category 2
 - Communication shall be Standard TCP/IP, BOOTP Enabled, SNMP protocol at the MIB II level
 - Configuration shall be done through Gateway Configuration Software
 - Indicators shall be provided to indicate Module Status, Data Transmission and Data Reception
 - The module shall have an unpackaged shock rating of 30g operational and 50g non-operational.
 - The module shall have an unpackaged vibration rating of 5g from 10-150Hz

D. REMOTE I/O AND DATA HIGHWAY PLUS NETWORKS

1. When required for Remote I/O and Data Highway Plus communications, provide a Data Highway Plus and Remote I/O Communication Interface Module.
2. The module shall support messaging between devices on Data Highway Plus networks and those on Ethernet, ControlNet or DeviceNet.
3. The module shall act as a Remote I/O scanner to allow for transferring discrete and block-transfer data to and from Remote I/O devices.
4. The module shall meet the following minimum specifications.
 - The module shall support a communication rate of 57.6Kbps for Data Highway Plus and communication rates of 57.6Kbps, 115Kbps or 230Kbps for Remote I/O.
 - The module shall allow for (32) connections per Data Highway Plus channel.
 - The module shall allow for (32) logical rack connections per Remote I/O channel and (16) block-transfer connections per remote I/O channel.
 - The module shall have an operating shock rating of 30g peak for 11ms.
 - The module shall have a storage shock rating of 50g peak for 11ms.
 - The module shall have a vibration rating of 10 to 150Hz, 5.0G maximum peak acceleration.

E. RS-232 NETWORK

1. When required to communicate with RS-232 devices, provide an RS-232 Interface Module
2. The module shall support custom application C language programming to enable the module to send, receive and process ASCII strings to an RS-232 device
3. The module shall be capable of being installed in any location in the chassis. Remote mounted devices are not acceptable
4. The module shall meet the following minimum specifications.
5. The module shall have one (1) non-configurable RS-232 port.
6. The module shall have two (2) RS-232 ports configurable for RS-232/RS-422/RS-485
7. The module shall have the following status indicators.

- The module shall have Port Activity status indicators to indicate if serial activity is detected at a port. Indicators shall exist for each port.
 - The module shall have a quantity of two (2) user definable status indicators.
 - The module shall have an indicator to indicate if the battery voltage is low.
 - The module shall have an indicator to indicate that either Power is ON, Power is OFF or the Module has failed.
 - All indicators shall be LED.
8. The module shall have an operation shock rating of 30g and a non-operational rating of 50g.
 9. The module shall have a vibration rating of 2g from 10 to 500Hz

3.11 DISTRIBUTED I/O - DISCRETE INPUT AND OUTPUT MODULES

The Distributed I/O Sub-System shall be networked to the Control Processor over ControlNet, Devicenet or Ethernet/IP.

A. MANUFACTURER

1. Allen-Bradley Model 1734 (Point I/O)
2. Substitutions: Not Permitted

B. SELECTION

1. All digital input and output modules shall be manufactured and supplied by the manufacturer of the programmable controllers.
2. Modules shall be designed to support DeviceNet, ControlNet and Ethernet/IP. The Distributed I/O System shall support producer / consumer communications, and shall support Change of State reporting to the POINT I/O network interface (adapter).
3. Digital input and output modules shall provide ON/OFF detection and actuation. They shall support producer consumer network model (via the 1734 adapter) to produce information when needed while providing additional system functions.
4. The ControlNet adapter shall not poll digital input modules; instead, the modules shall report their data upon Change of State.

C. MODULE FEATURES

1. Modules shall be connected directly to the Control Logix network via a POINT I/O Control Net Adapter with Redundant media (using COS, change of state) or a POINT I/O DeviceNet Adapter with configurable POINT Bus communications, or a POINT I/O Ethernet/IP Adapter (using COS, change of state).
2. Modules shall have a locking tab to anchor the removable electronics module
3. Modules shall have slots for mechanically keying the electronic module to prevent inserting an incorrect electronic module.
4. Modules shall have electronic IDs for electronic keying the electronic module to prevent the operation of a module inserted incorrectly into a slot where the mechanical keying has been incorrectly set.
5. Modules shall be designed to be installed or removed while I/O system power is applied (Removal and Insertion Under Power – RIUP).
6. Modules shall have indicators to display the status of communication, module health and input / output devices.
7. Each module shall have the following status indicators.
 - Yellow display to indicate the On/Off state of the field device.
 - Green/Red display to indicate the module's communication status.
 - Green/Red display to indicate the module's fault status.

- This display shall be available on all modules to indicate the presence or absence of various faults.
8. Each digital module shall maintain the following identification information.
 - Modules product type such as analog or digital
 - Modules catalog number
 - Modules major revision number
 - Modules minor revision number
 - Module manufacturer vendor
 - Module serial number
 9. Each digital module shall maintain the following status information.
 - Controller ownership
 - Configuration status
 - Device specific status information
 - Minor and major recoverable and unrecoverable faults.
 10. Each digital module shall provide the following fault reporting.
 - On diagnostic modules, hardware indication shall be provided through module's LED fault indicator
 - Modules shall have an input data tag, Fault, which indicates that a point is faulted and input data or output data for that point may be incorrect. If communication to the module is lost, then all points for the module will be faulted.
 - The programming package shall graphically display the fault and shall include a fault message describing the nature of the fault.
 11. Module features shall be enabled or disabled through the I/O configuration portion of the programming package.
 12. Programming package shall be capable of interrogating any module in the system to retrieve serial number, revision number, catalog number, vendor identification, error/fault information and diagnostic counters.
 13. Electronic Keying shall be available through configuration to allow the system to control what modules belong in the various slots of the configured system. The following keying options shall be available.
 14. Field wiring shall be connected to the digital input modules through a wiring system provided by the manufacturer of the modules. Fault protected (reverse polarity, short circuit) interface modules shall be provided as standard. If protected interfaces are not available for the specified module, feed-through interface modules shall be provided. The wiring system shall consist of the following.
 - Protected/Current Limiting Digital Interface Module
 - 1.) Thermally activated current limiting devices
 - 2.) Current Limiting active indication
 - 3.) Diagnostic bit available to the controller
 - 4.) UL Component Recognition
 - 5.) Wire Range of #22 to #14 AWG

D. MODULE SPECIFICATIONS (24VDC DIAGNOSTIC INPUT MODULE)

1. Quantity of eight, sixteen or thirty-two inputs
2. On-State Voltage Range of 10-28.8V dc
3. Nominal Input Voltage of 24V dc
4. On-State Current of 4mA nominal @24V dc or 6.3ma nominal @24Vdc
5. Maximum Off-State Voltage of 5V dc

6. Minimum Off-State Current of 1.5mA
7. Nominal Input Impedance of 3.6kOhm
8. Input Delay Times
 - 0.5 millisecond hardware filter plus 0ms to 64ms programmable digital filter
9. Diagnostic Features – LEDs
 - Input status
 - Module Status
 - POINTBus Status
10. Diagnostic Features – LEDs
 - Input status
 - Module Status
 - Fault Status
11. Isolation Voltage
 - User to System - 100% tested to 1250V rms/V ac
 - Group to Group - not required on 2 and 4 point modules

E. MODULE SPECIFICATIONS (120VAC DIAGNOSTIC INPUT MODULE)

1. Quantity of eight, sixteen and thirty-two inputs per electronic module
2. On-State Voltage Range of 65-132V ac, 60Hz
3. Nominal Input Voltage of 120V ac
4. On-State Current of 6.9mA nominal @120V ac, 60Hz maximum
5. Maximum Off-State Voltage of 43V ac
6. Maximum Off-State Current of 2.5mA
7. Nominal Input Impedance of 10.6kOhm @60Hz
8. Input Delay Times
 - Off to On - Programmable Filter, 1ms to 64ms, increments of 1ms
 - Hardware Delay - 20ms maximum plus filter time
 - On to Off - Programmable Filter, 1ms to 64ms, increments of 1ms
 - Hardware Delay - 20ms maximum plus filter time
9. Diagnostic Features
 - Change of State – Pre-programmed
 - Fault Data Tag to indicate that point is faulted
10. Isolation Voltage
 - Group to Group - 100% tested to 2546V dc for 1s
 - User to System - 1250V rms/V for 1 second

F. MODULE SPECIFICATIONS (24VDC DIAGNOSTIC OUTPUT MODULE)

1. Quantity of eight, sixteen or thirty-two Outputs
2. Output Voltage Range of 10 to 28.8V dc
3. Output Current Rating
 - Per Point - 1Amps maximum per output
 - Per Module – 2Amps maximum per module.
4. Surge Current Per Point of 2A for 10ms each, repeatable every 3 seconds
5. Minimum Load Current of 1.0mA per point
6. Maximum On-State Voltage Drop of 0.2V
7. Maximum Off-State Leakage of 0.5mA per point
8. Output Delay Time

- Off to On – 0.1ms
- On to Off – 0.1ms

9. Diagnostic Features

- Short Circuit for On State
- Open Circuit for Off State
- Over Current for On State
- d. Fault Data Tag to indicate that point is faulted and data may be incorrect

10. Configurable States

- Fault Per Point - Hold Last State, ON or OFF
- Program Mode Per Point - Hold Last State, ON or OFF

11. Isolation Voltage

- User to System - 1250V rms/V ac

G. MODULE SPECIFICATIONS (120V/220VDC DIAGNOSTIC OUTPUT MODULE)

1. Quantity of eight or sixteen Outputs

2. Output Voltage Range of 74 to 264V ac

3. Output Current Rating

- Per Point - .75Amps maximum per output
- Per Module – 1.5 Amps maximum per module.

4. Surge Current Per Point of 16A for 100ms each, repeatable every 10 seconds

5. Minimum Load Current of 10.0mA per point

6. Maximum On-State Voltage Drop of 1.0V Maximum @ .75A

7. Maximum Off-State Leakage of 2.75mA per point

8. Output Delay Time

- Off to On – ½ cycle maximum
- On to Off – ½ cycle maximum

9. Diagnostic Features

- Short Circuit for On State
- Open Circuit for Off State
- Over Current for On State
- Fault Data Tag to indicate that point is faulted and data may be incorrect

10. Configurable States

- Fault Per Point - Hold Last State, ON or OFF
- Program Mode Per Point - Hold Last State, ON or OFF

11. Isolation Voltage

- User to System - 1500V rms/V ac dc for 1 second

H. MODULE SPECIFICATIONS (CONTACT OUTPUT MODULE)

1. Quantity eight or sixteen Form C (Individually Isolated) Electromechanical Outputs

2. Output Voltage Range of 5-141V dc; 120/220 V ac

3. Output Current Rating:

- Resistive - 2A @ 125V ac
- Inductive - 2A Steady State

4. Power Rating (Steady State) of 250VA maximum for 125V ac inductive output

5. Maximum Off-State Leakage of 2.0mA per point @240V ac

6. Output Delay Time

- Off to On - 10ms maximum
- On to Off - 10ms maximum

7. Diagnostic Feature – LED
 - Module Status
 - Network Status
 - Channel Status
8. Configurable States
 - Fault Per Point - Hold Last State, ON or OFF
 - Program Mode Per Point - Hold Last State, ON or OFF
9. Isolation Voltage
 - Group to Group - 100% tested at 2550V dc for 1s
 - User to System - 100% tested at 2546V dc for 1s

3.12 DISTRIBUTED I/O - ANALOG INPUT AND OUTPUT MODULES

(The Distributed I/O Sub-System shall be networked to the Control Processor over ControlNet, Devicenet or Ethernet/IP.)

A. MANUFACTURER

1. Allen-Bradley Model 1756
2. Substitutions: Not Permitted

B. SELECTION

1. All analog input and output modules shall be manufactured and supplied by the manufacturer of the programmable controllers.
2. Modules shall be designed to support the DeviceNet, ControlNet and Ethernet/IP networks. Modules shall support producer / consumer communications. Analog modules shall support Change of State.
3. Analog input modules shall convert an analog signal that is connected to the module's screw terminals into a digital value. The digital value representing the magnitude of the analog signal shall be transmitted on the backplane. Analog output modules shall convert a digital value that is delivered to the module via the backplane into an analog signal on the module's screw terminals.

C. Module Features

1. Modules shall be connected directly to the Control Logix network via a POINT I/O Control Net Adapter with Redundant media, via a POINT I/O DeviceNet Adapter with configurable POINT Bus Communications, and a POINT I/O Ethernet/IP Adapter.
2. Modules shall have a locking tab to anchor the removable electronics module
3. Modules shall have slots for mechanically keying the electronic module to prevent inserting an incorrect electronic module.
4. Modules shall have electronic IDs for electronic keying the electronic module to prevent the operation of a module inserted incorrectly into a slot where the mechanical keying has been incorrectly set.
5. Modules shall be designed to be installed or removed while I/O system power is applied (Removal and Insertion Under Power – RIUP).
6. Modules shall have indicators to display the status of communication, module health and input / output devices.
7. Each module shall have the following status indicators.
 - Yellow display to indicate the On/Off state of the field device.
 - Green/Red display to indicate the module's communication status.
 - Green/Red display to indicate the module's fault status.

- This display shall be available on all modules to indicate the presence or absence of various faults.
8. Each analog module shall maintain the following identification information.
 - Modules product type (such as analog or digital)
 - Modules catalog number
 - Modules major revision number
 - Modules minor revision number
 - Module manufacturer vendor
 - Module serial number
 9. Each analog module shall maintain the following status information.
 - Controller ownership
 - Configuration status
 - Device specific status information
 - Minor and major recoverable and unrecoverable faults.
 10. Each analog module shall provide the following fault reporting.
 - On diagnostic modules, hardware indication shall be provided through module's LED fault indicator
 - Modules shall have input data tags, Status Byte Channel, that indicates that a point is faulted and input data or output data for that point may be incorrect. All possible faults shall be supported as follows: Fault (general), Calibration, Low Alarm, High Alarm, Low Low Alarm, High High Alarm, Under range and Over range. If communication to the module is lost, then all points for the module will be faulted.
 - The programming package shall graphically display the fault and shall include a fault message describing the nature of the fault.
 11. Module features shall be enabled or disabled through the I/O configuration portion of the programming package.
 12. Programming package shall be capable of interrogating any module in the system to retrieve serial number, revision number, catalog number, vendor identification, error/fault information and diagnostic counters.
 13. Electronic Keying shall be available through configuration to allow the system to control what modules belong in the various slots of the configured system. The following keying options shall be available.
 14. Field wiring shall be connected to the analog input modules through a wiring system provided by the manufacturer of the modules. Anomaly detection Loss of field power, Open Wire, Calibration Status, short) shall be provided as standard.
- D. MODULE SPECIFICATIONS (NON-ISOLATED ANALOG INPUT MODULES)
1. Quantity of eight or sixteen (single-ended, differential) Inputs
 2. Input Range of Current Input: 4-20mA, 0-20mA; voltage input: 0-10V, +/- 10V
 3. Resolution: 16 bits across range
 4. Input Impedance of Greater than 100K Ohms Voltage, 60 Ohms Current
 5. Open Circuit Detection
 6. Normal Mode Rejection of -60dB
 7. Common Mode Noise Rejection of 120dB
 8. Isolation Voltage
 - User to System – 1250V rms/V ac

E. MODULE SPECIFICATIONS (NON-ISOLATED ANALOG OUTPUT MODULE)

1. Quantity of four or eight Outputs
2. Output Range
 - Current Output: 4-20mA, 0-20mA
 - Voltage output: 0-10.5V, +/- 10.5V.
3. Voltage Resolution of 13 bits (plus sign) across 10.5V; 13 bits across 21mA
4. Open Circuit Detection
5. Calibration Accuracy of - Better than 0.1% of full scale
6. Calibration Interval - 12 months typical
7. Isolation Voltage User to System – 1250V rms/V ac 2.09

3.13 FIELD INSTRUMENTATION

A. Dissolved Oxygen Probes

1. The interface unit shall convert the sensed dissolved oxygen concentration to an analog electrical signal.
2. The wetted probe shall sense the dissolved oxygen concentration via a luminescent sensor. The signal from the sensor shall be tied to the interface unit that will convert the sensor signal to a 4 to 20 mA signal that will interface with the PLC. The dissolved oxygen transmitter shall be utilized for monitoring the dissolved oxygen concentration in the tank.
3. The measuring principle shall be based on luminescent material that is sensitive to oxygen.
4. Sensor replacement shall not require factory service personnel to be present. Calibration shall be accomplished in free air and will not require special chemical baths.
5. The interface unit shall be housed in a NEMA 4X/IP66 metal enclosure with a corrosion-resistant finish. The panel must be complete with terminal strips and wire ducts (if needed).
6. Operation characteristics
 - a. The dissolved oxygen probe shall be a continuous-reading probe that utilizes luminescent sensor technology.
 - b. The probe will not require calibration more frequently than once every six months.
 - c. The probe material shall be formed Noryl[®] and 316 Stainless Steel. All parts of the probe shall be corrosion resistant and fully immersible
 - d. The sensor material shall be polybutyl methacrylate.
 - e. The measurement range shall be 0.00 to 20.00 mg/L dissolved oxygen
 - f. The operation of the analyzers shall not be affected by H₂S, pH, K⁺¹, Na⁺¹, Mg⁺², Ca⁺², NH₄⁺¹, Al⁺³, Pb⁺², Cd⁺², Zn⁺², Cr (total), Fe⁺², Fe⁺³, Mn⁺², Cu⁺², Ni⁺², Co⁺², CN⁻¹, NO₃⁻¹, SO₄⁻², S⁻², PO₄⁺³, Cl⁻¹, anion active tensides, crude oils, or Cl₂.
 - g. The probe shall provide electrolyte-free operation without the requirements of sample conditioning.
 - h. The probe shall be furnished with a mounting kit.
7. The analyzer shall be HACH LDO[®] Probe and sc200 Controller interface unit

B. Float Switch

1. The unit shall be a direct acting float switch, non-mercury switch, switch contacts rated for 5 Amps at 125/250VAC.
2. The float switch contacts shall have the ability to be wired for either normally open or normally closed activation.

3. The float switch housing shall be polypropylene or an equivalent material, and shall be for use in potable water as well as non-potable water and wastewater applications.
 4. The float switch shall include an integral, flexible, water resistant 18-gauge conductor available in various lengths up to 50 Feet.
 5. The float switch shall be UL listed, and manufactured by Anchor Scientific, SJE Rhombus or equal.
- C. Combination pH/Temperature Probe
1. pH Sensor
 - a. The pH sensor shall be of Differential Electrode Technique design which uses two electrodes to compare the process value to a stable internal reference standard buffer solution. The standard electrode shall have non-flowing and fouling resistant characteristics.
 - b. The sensor shall have a measuring range for pH of 0.00 to 14.00.
 - c. The sensor shall be manufactured by Hach, model number DPD1P1 or Engineer approved equal.
 2. pH Analyzer
 - a. The microprocessor-based analyzer shall accept any Hach Differential Technique Digital or Analog pH or ORP sensor or any conventional combination electrode.
 - b. The analyzer shall have a measuring range for pH of 0.00 to 14.00.
 - c. The analyzer shall be NEMA4X rated, 120VAC and shall offer two 4-20mA output signals.
 - d. The analyzer shall be Hach model SC200 or equal.
- D. Ammonia Probe
1. Sensor
 - a. The NH4D sc Ammonium Sensor consists of a digital sensor with integrated, replaceable sensor cartridge.
 - b. The integrated sensor cartridge includes ammonium ISE, differential pH electrode, potassium ISE., and temperature sensor.
 - c. The sensor shall be designed to connect to a universal digital controller.
 - d. The sensor cartridge shall be factory calibrated with all electrodes individually calibrated and also calibrated to each other.
 - e. The sensor shall not require sample conditioning.
 - f. The sensor can perform one- or two-point inline matrix corrections to adapt it to a wastewater matrix.
 - g. The sensor is corrosion resistant and fully immersible.
 - h. The sensor model shall be Hach NH4D sc or equal.
 2. Ammonia Analyzer
 - a. The analyzer shall be Hach model SC200 or equal.
- E. Nitrate Probe
1. Sensor
 - a. The NO3D sc Nitrate Sensor consists of a digital sensor with integrated, replaceable sensor cartridge.
 - b. The integrated sensor cartridge includes nitrate ISE, differential reference system, chloride ISE., and temperature sensor.
 - c. The sensor shall be designed to connect to a universal digital controller.

- d. The sensor cartridge shall be factory calibrated with all electrodes individually calibrated and also calibrated to each other.
 - e. The sensor shall not require sample conditioning.
 - f. The sensor can perform one- or two-point inline matrix corrections to adapt it to a wastewater matrix.
 - g. The sensor is corrosion resistant and fully immersible.
 - h. The sensor model shall be Hach NO3D sc or equal.
3. Nitrate Analyzer
- a. The analyzer shall be Hach model SC200 or equal.

PART 4 - EXECUTION

4.01 SHIPMENT, HANDLING AND STORAGE

- A. The CONTRACTOR shall be responsible for receipt, protection and storage in accordance with manufacturer's recommendations of all items shipped to the site from the time of delivery until installation is completed and the units and equipment are ready for operation. The equipment shall be suitably covered and protected at all times. Sufficient blocking shall be provided to prevent noticeable sagging of stored materials between supports and to prevent permanent distortion of the equipment. No iron or steel tools shall be allowed to come into contact with stainless steel components during handling and storage of the equipment. The CONTRACTOR shall follow manufacturers' instructions to exercise any stored rotating equipment.

4.02 SYSTEM START-UP, TESTING, AND CERTIFICATION

- A. The ANITA MOX SYSTEM SUPPLIER shall provide fifteen (15) days of service in not less than three (3) trips by a fully qualified service engineer to inspect the installed equipment, assist the CONTRACTOR to start the equipment operation.
- B. The ANITA MOX SYSTEM SUPPLIER in conjunction with the installing CONTRACTOR shall inspect equipment furnished by the ANITA MOX SYSTEM SUPPLIER and provide certification on the installation. This certification shall be limited to the visual inspection and known quantitative aspects of the ANITA MOX SYSTEM SUPPLIER's equipment.
- C. The ANITA MOX SYSTEM SUPPLIER shall provide the services of a factory trained I&C engineer to check and verify the PLC program functionality (Dry testing).
- D. Instruments and other devices that require calibration and checkout will be carried out after the CONTRACTOR has the equipment installed and verified continuity. Instruments and devices shall be configured and demonstrated to function prior to start-up. A document indicating the set points and calibration shall be furnished for documentation records.
- E. The CONTRACTOR shall furnish all consumables, including oil and grease prior to operation of equipment. All consumables after beneficial occupancy will be by the OWNER.
- F. Operation, maintenance and installation manuals shall be provided for the supplied equipment. A total of five (5) copies shall be furnished.

4.03 TRAINING

- A. The ANITA MOX SYSTEM SUPPLIER shall provide on-site training to the OWNER plant personnel.
- B. Kruger shall supply two (2) training sessions. The first session shall be during start-up and will consist of one (1) trip of two (2) days. The second training session shall occur within 6 months of startup and will consist of one (1) trip of two (2) days.

- C. The training services shall comprise of a qualified representative to instruct and train plant personnel in the proper startup, operation, shutdown, maintenance, repair and troubleshooting of the system. The O&M Manual shall be the primary training tool with supplemental training provided from a presentation. Mechanical equipment suppliers will also provide training on their specific equipment.
- D. A training outline shall be submitted to the ENGINEER for approval including the credentials of the training staff.
- E. The training shall include the following topics:
 - 1. Theory of Operation
 - 2. Actual Operation
 - 3. Mechanical Maintenance
 - 4. Electrical Maintenance
 - 5. Instrumentation
 - 6. Optimum Operation
 - 7. Troubleshooting
 - 8. Hands-on
 - 9. Question and Answer Session

END OF SECTION



ATTACHMENT

Sample Insurance Certificate



CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY)
07/05/2012

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

| PRODUCER Marsh USA, Inc. Two Logan Square Philadelphia, PA 19103 Attn: Veolia.CertRequest@marsh.com / F: 212-948-5053 90213 -All-Poll-12-13 | CONTACT NAME: _____ PHONE (A/C, No., Ext): _____ FAX (A/C, No): _____ E-MAIL: _____ ADDRESS: _____ | | | | | | | | | | | | | | | | | | | | |
|---|--|-------------------------------|--|--------|------------|--------------------------------------|-------|------------|-----|-----|------------|-----|-----|------------|--|--|------------|--|--|------------|--|
| | <table border="1"> <thead> <tr> <th colspan="2">INSURER(S) AFFORDING COVERAGE</th> <th>NAIC #</th> </tr> </thead> <tbody> <tr> <td>INSURER A:</td> <td>Insurance Company Of The State Of PA</td> <td>19429</td> </tr> <tr> <td>INSURER B:</td> <td>N/A</td> <td>N/A</td> </tr> <tr> <td>INSURER C:</td> <td>N/A</td> <td>N/A</td> </tr> <tr> <td>INSURER D:</td> <td></td> <td></td> </tr> <tr> <td>INSURER E:</td> <td></td> <td></td> </tr> <tr> <td>INSURER F:</td> <td></td> <td></td> </tr> </tbody> </table> | INSURER(S) AFFORDING COVERAGE | | NAIC # | INSURER A: | Insurance Company Of The State Of PA | 19429 | INSURER B: | N/A | N/A | INSURER C: | N/A | N/A | INSURER D: | | | INSURER E: | | | INSURER F: | |
| INSURER(S) AFFORDING COVERAGE | | NAIC # | | | | | | | | | | | | | | | | | | | |
| INSURER A: | Insurance Company Of The State Of PA | 19429 | | | | | | | | | | | | | | | | | | | |
| INSURER B: | N/A | N/A | | | | | | | | | | | | | | | | | | | |
| INSURER C: | N/A | N/A | | | | | | | | | | | | | | | | | | | |
| INSURER D: | | | | | | | | | | | | | | | | | | | | | |
| INSURER E: | | | | | | | | | | | | | | | | | | | | | |
| INSURER F: | | | | | | | | | | | | | | | | | | | | | |
| INSURED I. Kruger Inc. 401 Harrison Oaks Boulevard, Suite 100 Cary, NC 27513 | | | | | | | | | | | | | | | | | | | | | |

COVERAGES **CERTIFICATE NUMBER:** CLE-003705520-10 **REVISION NUMBER:** 5

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

| INSR LTR | TYPE OF INSURANCE | ADDL SUBR INSR WVD | POLICY NUMBER | POLICY EFF (MM/DD/YYYY) | POLICY EXP (MM/DD/YYYY) | LIMITS |
|----------|--|--------------------|---|--|--|---|
| A | GENERAL LIABILITY <input checked="" type="checkbox"/> COMMERCIAL GENERAL LIABILITY <input type="checkbox"/> CLAIMS-MADE <input checked="" type="checkbox"/> OCCUR GEN'L AGGREGATE LIMIT APPLIES PER: <input checked="" type="checkbox"/> POLICY <input type="checkbox"/> PROJECT <input type="checkbox"/> LOC | | GL 1929555 | 07/01/2012 | 07/01/2013 | EACH OCCURRENCE \$ 1,000,000 DAMAGE TO RENTED PREMISES (Ea occurrence) \$ 1,000,000 MED EXP (Any one person) \$ 10,000 PERSONAL & ADV INJURY \$ 2,000,000 GENERAL AGGREGATE \$ 2,000,000 PRODUCTS - COMP/OP AGG \$ 2,000,000 |
| A | AUTOMOBILE LIABILITY <input checked="" type="checkbox"/> ANY AUTO <input type="checkbox"/> ALL OWNED AUTOS <input type="checkbox"/> SCHEDULED AUTOS <input checked="" type="checkbox"/> HIRED AUTOS <input checked="" type="checkbox"/> NON-OWNED AUTOS | | CA934823 (AOS) CA934824 (MA) | 07/01/2012 07/01/2012 | 07/01/2013 07/01/2013 | COMBINED SINGLE LIMIT (Ea accident) \$ 1,000,000 BODILY INJURY (Per person) \$ BODILY INJURY (Per accident) \$ PROPERTY DAMAGE (Per accident) \$ |
| | UMBRELLA LIAB <input type="checkbox"/> OCCUR EXCESS LIAB <input type="checkbox"/> CLAIMS-MADE DED \$ RETENTION \$ | | | | | EACH OCCURRENCE \$ AGGREGATE \$ \$ |
| A | WORKERS COMPENSATION AND EMPLOYERS' LIABILITY ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? (Mandatory in NH) If yes, describe under DESCRIPTION OF OPERATIONS below | Y/N N/A | 15683932 (AOS) 15683933 (CA) 15683934 (FL) 15683935 (MA/WI/Mono) | 07/01/2012 07/01/2012 07/01/2012 07/01/2012 | 07/01/2013 07/01/2013 07/01/2013 07/01/2013 | <input checked="" type="checkbox"/> WC STATUTORY LIMITS <input type="checkbox"/> OTHER E.L. EACH ACCIDENT \$ 1,000,000 E.L. DISEASE - EA EMPLOYEE \$ 1,000,000 E.L. DISEASE - POLICY LIMIT \$ 1,000,000 |

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (Attach ACORD 101, Additional Remarks Schedule, if more space is required)
 Re: Evidence of Insurance.

| | |
|---|---|
| CERTIFICATE HOLDER I. Kruger Inc. 401 Harrison Oaks Blvd., Suite 100 Cary, NC 27513 | CANCELLATION SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS. AUTHORIZED REPRESENTATIVE of Marsh USA Inc. Manashi Mukherjee <i>Manashi Mukherjee</i> |
|---|---|

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ACORD 25 (2010/05)

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