

SECTION 131100 – SWIMMING POOLS

PART 1 - GENERAL

1.01 STIPULATIONS

- A. The Specification Sections “General Conditions of Contract”, “Special Conditions” and “Division 01 – General Requirements” form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.02 RELATED DOCUMENTS

- A. The BIDDING REQUIREMENTS, CONTRACT FORMS, AND CONDITIONS OF THE CONTRACT and applicable parts of DIVISION 1 - GENERAL REQUIREMENTS, as listed in the Table of Contents, shall be included in and made a part of this Section.

1.03 SUMMARY OF WORK *(for general guidance-not all inclusive)*

A. Introduction

- 1. Provide all labor, materials, equipment and services necessary to construct the following: (1) a competition pool, (2) a recreation pool, and (3) a spa. This work shall include the structure(s) and installation of pool finishes as well as all products listed in Part 2 of Section 131100.

B. Work included in this section

- 1. It is the intent of this section to place the entire responsibility for the construction of the pool(s) (including the construction of the pool shell(s)) under one vested CONTRACTOR. Under this section the Swimming Pool Contractor will provide but is not necessarily limited to the following:
 - a. Provide all equipment and services required for erection and delivery onto the premises of any equipment or apparatus provided. Remove equipment from premises when no longer required.
 - b. Layout, excavate, remove from the construction site, replace and grade materials as required beyond the limits of excavation of the pool shell(s) to complete the work described in this section. Reference Division 31 - Earthwork.
 - c. Grade and replace load bearing or high plasticity index soil, pump and dewater as necessary to keep excavations free from water during construction, and provide sub-surface drainage beneath the surge tank(s) as needed or required in the project geotechnical report. Reference Division 31 - Earthwork.
 - d. Provide and maintain proper shoring and bracing for existing utilities, sewers and building foundations where required for related excavations. Reference Division 31 - Earthwork.
 - e. Provide all electrical conduit, wiring, junction boxes etc. to all low voltage pool equipment within pool filter/chemical rooms per Division 26 - Electrical. (Low voltage is considered less than 110 V.)
 - f. Coordinate for all required bonding and grounding of the pool shell, fittings, and equipment.
 - g. Provide all necessary piping and valving as shown on the drawings and specified herein.
 - h. Provide individually sized housekeeping pads for each pool pump.
 - i. Provide the main drain hydrostatic relief system and a sight sump as shown on the drawings. Reference Division 31 - Earthwork.
 - j. Construct the cast in place or pneumatically applied concrete pool shell(s) and cast in place surge tank(s) as described in these specifications and detailed on the drawings, including reinforcement steel, inserts, fittings, main drain sumps and all embedded items (piping, anchors, etc.) for the pool(s) and spa. Reference Division 3 - Concrete and Structural. Before commencing the placement of concrete, verify electrical bonding of the pool and

spa embedded items and reinforcing steel. Also, coordinate and arrange any required electrical, plumbing and or building inspections. Provide any structure drainage around the pool as shown on the drawings. Backfill and compact fill around the pool structure, piping trenches and excavations required by this work. Reference Division 31 - Earthwork.

- k. Provide a ceramic tile finish in the pool(s) and spa with a slip resistant surface with a vertical tile band. Provide specialty tile for the perimeter tile deck band, gutter nosing, wall targets, recessed steps, floor lane markings, depth markings and warning signs, construction joint installation bands and all other tile installation within the pool structures. Reference Section 093213 - Swimming Pool Tile - including the tolerance requirements for the concrete substrate.
- l. Assemble and install the cleaning and maintenance equipment for the pool(s) as specified herein.
- m. Provide for the storage of all pool related equipment, materials and systems. All items are the responsibility of the CONTRACTOR until accepted by the Using Agency.
- n. Obtain final acceptance by jurisdictional health department(s).
- o. Start, test, calibrate and adjust all mechanical equipment, electrical equipment, recirculation, chemical, and other supplied systems including deck, loose, maintenance, and safety equipment. Instruct the Using Agency's representative in the systems operation and maintenance as described herein.

1.04 Related work specified in other sections

A. Section 093213 - Swimming Pool Tile

B. Section 116643 - Swimming Pool Timing System (Reference Specification)

C. The following work related to the swimming pools shall be completed by other trades.

- 1. Provide, erect and maintain all necessary barricades, signs, lights and flares for pool construction to protect workers and the public.
- 2. Provide and maintain proper shoring and bracing for existing utilities, sewers and building foundations where required for swimming pool related excavations. Reference Division 31 - Earthwork.
- 3. Provide the under drain system beneath the pool(s).
- 4. Provide sub-surface drainage beneath the pump pit and backwash pit. Reference Division 31 - Earthwork.
- 5. Provide housekeeping pad for filter, heater, heater rack, and any other floor mounted piece of pool equipment.
- 6. Construct pump pit and backwash pit including reinforcement, inserts, wall sleeves, anchors, access hatches, and fittings. Reference Division 3 - Concrete.
- 7. Prior to concrete pours, verify electrical bonding of the pool embedded items. Coordinate and arrange any required electrical, plumbing and or building inspections to be performed on embedded items. Reference Division 26 - Electrical.
- 8. Provide sanitary sewer and storm drain connections. Reference Division 22 - Plumbing.
- 9. Provide deck finish beyond perimeter tile band. Reference Division 32 - Exterior Improvements.
- 10. Provide rules and regulations signage as required by code. Reference Division 1 - General Requirements.
- 11. Provide chlorine resistant caulking (sealant) and backer rod on pool decks. Reference Division 7 - Thermal and Moisture Protection.

D. Related work specified in Plumbing section. Reference Division 22 - Plumbing. Work to be completed by other contractors.

- 1. Provide trench drains and area drains on pool deck.

2. Provide sanitary sewer piping from the filter room including floor drains, sumps, and sump pump.
 3. Provide water service to all hose bibbs, flush hydrant boxes and auto-fill bypass to air gap above fill funnel(s). Install the slow closing solenoid valve(s) in the bypass auto-fill piping.
 4. Install Plumbing Contractor supplied water meter on the fresh water supply line upstream of the manual fill valve and the slow closing solenoid valve.
- E. Related work specified in Mechanical section. Reference Division 23 – HVAC. Work to be completed by other contractors.
1. Provide the heating system for the pool(s). Work to include all piping from the installed pool heating loop tees, heaters, booster pumps, controls, gauges, thermostats, control valves and wiring required to draw water from the recirculation line, heat the water and return it back to the recirculation line and interlock with pool recirculation pumps. Provide any related systems for supplemental pool water heating.
 2. Provide air recirculation systems for pool related spaces.
- F. Related work specified in Electrical sections. Reference Division 26 – Electrical. Work to be completed by other contractors.
1. Provide power to the exhaust fans for the chemical rooms.
 2. Provide motor starters, auxiliary contacts, magnetic relays and other electrical control devices necessary for the complete operation of the pool systems. Install power to Variable Frequency Drive pool pump starters and power from VFD to the pool pump motor.
 3. Ground and bond all pool structures, fittings and equipment in accordance with Article 680 of the N.E.C. Test and verify that the system electrical ground is true and solid. Provide certification to this effort.
 4. Obtain permits, inspections, and approvals of all wiring including grounding and bonding of all metal components associated with the pool in accordance with Local, State and National Electrical Codes.
 5. Install power, conduits, electrical boxes, and wiring for the Using Agency furnished electronic timing and scoreboard system with multi-sport capability for race swimming, diving, and pace clock functions.
 6. Confirm all electrical conduits that penetrate the pool shell are watertight and installed per N.E.C. Article 680.

1.05 QUALITY ASSURANCE

- A. The specifications and drawings illustrate and detail three (3) swimming pool systems that shall be utilized for both competitive and recreational use. Certain technical aspects of the design are common only to pool systems planned for public use. Understanding these aspects, their functions and interaction through experience is vital to completing a successful operating system. It is a mandatory requirement that all bidders will have achieved such experience as a prerequisite for bidding this project.
1. The POOL CONTRACTOR must include a performance bond from an approved surety company registered in the State of Pennsylvania certifying that the POOL CONTRACTOR will provide 100% Performance, Labor, and Materials on this Project. The POOL CONTRACTOR must submit a copy of the performance bond for review prior to POOL CONTRACTOR's selection.
 2. If the Contractor has not received prior written approval for this project or has not been included in the pre-approved list of Contractors, they must submit a list of projects meeting the aforementioned qualifications, including contact information of the General Contractor shall be submitted for review and approval at least 10 days prior to bidding of the project. The Contractor must have completed at least five (5) public-use competition/recreation pools with

individual water surface areas in excess of 7,500 square feet and a depth of 14'-0" or more within the past 10 years.

3. The Contractor must submit prior to the start of construction the name of the on-site Project Superintendent including their relevant experience. The Contractor's on-site Project Superintendent must have completed at least five (5) public-use competition/recreation pools with individual water surface areas in excess of 7,500 square feet and a depth of 14'-0" or more within the past 10 years. A list of projects meeting the aforementioned qualifications, including contact information of the General Contractor as well as the Department shall be included with the experience submittal. Project Superintendent must not change on the project unless written authorization has been provided by the Professional and Department.
4. The Department reserves the right to reject any bid if the evidence submitted by, or investigation of, such bidder fails to satisfy the Department that such bidder is properly qualified to carry out the obligation of the contract and to complete the work described or if the bidder does not have the qualifications stated herein. Subject to compliance with item 2 above on this specification.
5. The following bidders have been pre-approved. All bidders shall meet the requirements listed above.

Acapulco Pools
Bernie Gall
1550 Victoria St. N.
Kitchener, Ontario N2B3EZ
Phone: (519) 743-6357
Fax: (519) 743-9698

Aqua Pools, Inc.
Randy Kolson
1438 Electric Ave., P.O. Box L
East Pittsburgh, PA 15112
Phone: (412) 824-6900
Fax: (412) 824-6910

Badger Swimpools
Robert Jelinek
N789 Golf Road - P.O. Box 547
Prairie du Sac, WI 53578
Phone: (608) 643-6440
Fax: (608) 643-3732

Main Line Commercial Pools
Gavin Grimes
441 Feheley Drive
King of Prussia, PA 19406
Phone: (610) 279-9285
Fax: (610) 277-4276

South Shore Gunitite Pool & Spa
Robert Guarino
7 Progress Ave.
Chelmsford, MA 01824
Phone: (978) 250-6845
Fax: (978) 250-5927

Vincent Pools
John Bray
1823 Deep Run Rd.
Pipersville, PA 18947
Phone: (215) 766-7541
Fax: (215) 766-8175

Weller Pool Constructors, Inc.
Nils Erickson
Jack Oren
1821 South Orange Blossom Trail
P.O. Box 16008
Apopka, FL 32703
Phone: (407) 880-8800
Fax: (407) 884-7306

Westport Pools
Jim Bastian
156 Weldon Pkwy, Suite B
Maryland Heights, MO 63043
Phone: (314) 432-1801
Fax: (314) 432-0059

1.06 REGULATORY AGENCY REQUIREMENTS AND ENGINEERING SERVICES

- A. The entire system shall be designed and installed to meet applicable national and local codes and be in compliance with applicable sections of the American National Standards Institute / National Spa and Pool Institute (ANSI /NSPI-1 2003) and the rules and regulations of USA Swimming (USA), National Collegiate Athletic Association (NCAA), and Federation Internationale De Natation Amateur (FINA).
- B. The system shall comply with all necessary approvals obtained by the Professional from local regulatory agencies governing the design and construction of public swimming pools.
- C. The Contractor shall give all necessary notices, obtain all permits and pay all government fees, and other costs in connection with his work; file all necessary drawings, prepare all documents and obtain all necessary approvals of governmental departments having jurisdiction; obtain all required certificates of inspection for his work and deliver same to the Professional before request for acceptance and final payment for the work.
- D. The Contractor shall include in the work, without extra cost to the Department, any labor, materials, services, apparatus or drawings in order to comply with all applicable laws, ordinances, rules and regulations, whether or not shown on drawings and/or specified.

1.07 COORDINATION AND CLARIFICATION

- A. Coordinate with other contractors or subcontractors all work relating to this section.
- B. The Contractor must establish with other contractors or subcontractors, having related work in this section, that all work necessary to complete the pool(s) as shown on the drawings and in the specifications is included in the base bid and alternates to the Department.
- C. If in doubt regarding the responsibility for work covered in this section and/or discovery of errors or omissions in the bidding documents, the Contractor shall notify the Professional through channels established by the specifications and request a clarification ten (10) days prior to the bid date.

1.08 CONTRACTOR'S ALTERNATE PROPOSAL

- A. Contractor shall submit his bid to the Department based on materials, equipment and methods as specified in this Section. No substitutions of material will be allowed.
- B. It is the intent of the contract documents to encourage competition. The base proposal must be on providing the construction methods and equipment as specified and detailed. Any proposed system substitution must have prior written approval by the Professional.
- C. If there is any deviation from the basis of design equipment it is the responsibility of the contractor to confirm that all engineering criteria are appropriate for the substituted equipment.
- D. All proposed substitutions of specified construction methods and equipment shall include a complete submittal as required by these specifications and drawings of appropriate scale incorporating all required changes. The Contractor shall provide a list of at least ten (10) satisfactory installations comparable to this project that have been manufactured and installed under the manufacturer's current legal name. Submit a list of such projects with the name, address and current telephone number of the Using Agency's Operator and Professional of Record to the Professional on the bid date.
- E. Any changes or modifications to the Contract Documents that are not authorized by the Professional shall be the sole responsibility of the Contractor.

1.09 SUBMITTALS

- A. All submittals shall be made in accordance with the requirements of Division 1 - General Requirements and in strict compliance with the following procedures and guidelines.
- B. Six (6) sets of shop drawings and engineering data shall be tabbed, indexed, referenced to the specifications, bound in 3 ring binders and submitted in two stages. Provide 8 1/2" x 11" cover

sheet for each item submitted identifying item and product number. The first stage shall include all embedded items for the pool shell(s) (including piping diagrams) and the second stage shall be for all remaining items. Electronic submittals will be acceptable in lieu of the six (6) hard copies. All electronic submittals shall be organized, numbered, and submitted in the same format as the project specifications. Only complete sets will be reviewed.

1. Engineering data covering all systems, equipment, structures and fabricated materials, which will become a permanent part of the work under this contract, shall be submitted for review. This data shall include drawings and descriptive information in sufficient detail and scale to show the kind, size, arrangement, and operation of component materials and devices; the external connections, anchorage and supports required; performance characteristics; fabrication and dimensions needed for installation and correlation with other materials and equipment. A certification, in writing, shall be provided indicating that all equipment will fit in the space allotted and as shown on the drawings.
2. All submittals regardless of origin shall be stamped with the approval of the CONTRACTOR and identified with the name and number of this contract, CONTRACTOR'S name, and references to applicable specification paragraphs and contract drawings. Each submittal shall indicate the intended use of the item in the work. When catalog pages are submitted, applicable items shall be clearly identified. The current revision, issue number, and date shall be indicated on all drawings and other descriptive data.
3. The submittals will not be accepted from anyone but the CONTRACTOR. Submittals shall be consecutively numbered in direct sequence of submittal and without division by subcontracts or trades.
4. The CONTRACTOR'S stamp of approval is a representation that the CONTRACTOR accepts full responsibility for determining and verifying all quantities, dimensions, field construction criteria, materials, catalog numbers and similar data, and that he has reviewed or coordinated each submittal with the requirements of the work and the contract documents.
5. Each submittal shall include a statement prepared by the originator of the drawings and data, certifying compliance with the contract documents except for deviations, which are specifically identified.
6. All deviations from the contract documents shall be identified on each submittal and shall be tabulated in the CONTRACTOR'S letter of transmittal. Such submittals shall, as pertinent to the deviation, indicate essential details of all changes proposed by the CONTRACTOR (including modifications to other facilities that may be a result of the deviation) and all required piping and wiring diagrams.
7. The CONTRACTOR shall accept full responsibility for the completeness of each submission, and, in the case of a resubmission, shall verify that all exceptions previously noted have been taken into account. In the event that more than one resubmission is required because of failure of CONTRACTOR to respond to exceptions and rejections previously noted, CONTRACTOR shall make all further resubmissions in person at the consultant's office.
8. Any need for more than one resubmission, or any other delay in obtaining review of submittals, will not entitle the CONTRACTOR to an extension of the contract time unless delay of the work is directly caused by a change in the work authorized by a change order.
9. Review of drawings and data submitted by CONTRACTOR will cover only general conformity to the drawings and specifications, external connections and dimensions that affect the layout. Review does not indicate a thorough review of all dimensions, quantities, and details of the material, equipment, device or item shown. Review of submittals shall not relieve CONTRACTOR from responsibility for errors, omissions, or deviations, or responsibility for compliance with the contract documents.

10. When the drawings and data are returned marked REJECTED, REVISE AND RESUBMIT or SUBMIT SPECIFIED ITEM, the corrections shall be made as noted thereon and as instructed and six corrected copies (or one copy and one corrected reproducible copy) resubmitted.
 11. Resubmittals shall bear the number of the first submittal followed by a letter (A, B, etc.) to indicate the sequence of the resubmittal. All resubmittals shall be indexed, tabbed, referenced to the specifications and bound in a three-ring binder and submitted at one time.
 12. When corrected copies are resubmitted, the CONTRACTOR shall, in writing, direct specific attention to all revisions and shall list separately any revisions made other than those called for on previous submissions.
 13. When the drawings and data are returned marked NO EXCEPTIONS TAKEN or MAKE CORRECTIONS NOTED, no additional copies need to be furnished unless specifically requested to do so for record.
- C. Permits, Receipts and Test Reports
1. Provide the Professional with copies of all permits and receipts for fee payments.
 2. Submit a sample format for each test report intended for use. Submit test reports required herein only on approved forms.
- D. Include complete product data indexed, tabbed, and referenced to specifications with 8 1/2" x 11" cover sheet covering:
1. Paragraph 2.01 - Overflow System
 2. Paragraph 2.02 - Pumping Equipment
 3. Paragraph 2.03 - Filtration Equipment
 4. Paragraph 2.04 - Recirculation Fittings
 5. Paragraph 2.05 - Piping Systems
 6. Paragraph 2.06 - Chemical Treatment Systems
 7. Paragraph 2.07 - Chemistry Monitoring and Control Systems
 8. Paragraph 2.08 - Flow Meters
 9. Paragraph 2.09 - Water Level Controllers
 10. Paragraph 2.10 - Inserts and Anchor Sockets
 11. Paragraph 2.11 - Deck Equipment
 12. Paragraph 2.12 - Loose Equipment
 13. Paragraph 2.13 - Maintenance Equipment
 14. Paragraph 2.14 - Safety Equipment
 15. Paragraph 2.15 - Thermometers
 16. Paragraph 2.16 - Swimming Pool Finishes
 17. Paragraph 2.17 - Waterproofing
 18. Paragraph 2.18 - Sealants
 19. Paragraph 2.19 - Underwater Lights
 20. Paragraph 2.20 - Water Features and Support Equipment
 21. Paragraph 2.21 - Movable Bulkhead
 22. Paragraph 2.22 - Swimming Pool Surface Padding
- E. Include engineering/construction drawings for the pool structure.
1. Reference Division 3 - Concrete.
- F. Include engineering construction drawings for all pool piping.
- G. Reference Section 093213 - Swimming Pool Tile
- H. Reference Section 116643 - Swimming Pool Timing System
- 1.10 OPERATION AND MAINTENANCE MANUALS AND CLOSE-OUT SUBMITTALS
- A. Detailed operation and maintenance information shall be supplied for all equipment requiring maintenance or other attention. The equipment supplier and/or CONTRACTOR shall prepare an

operation and maintenance manual for all equipment. Parts lists and operating and maintenance instructions shall be provided:

- B. Each operation and maintenance manual shall include the following:
1. Equipment function and calibration, normal operating characteristics, and limiting conditions.
 2. Assembly, installation, alignment, adjustment and checking instructions.
 3. Operating instructions for start up, routine and normal operation, regulation and control, shut down and emergency conditions.
 4. One (1) copy of all instructional videos.
 5. Operating cycles shall be specifically described in outline format and in referenced detail. A wall-mounted color-coded piping flow diagram shall be provided in the pool equipment room. The diagram shall be engraved on laminated plastic with color-coded piping to match color of coding on piping, and including valves identified with number on tags. The minimum size shall be 11 inch x 17 inch.
 6. Include manufacturer recommended maintenance schedule, parts lists, piping diagram (to agree with wall mounted diagram) and trouble-shooting information for all pool mechanical equipment.
 7. Using reference to keyed valves and wall diagram, include specific written instructions for procedures to be followed for the following:
 - a. Emptying and refilling the pool(s) including de-watering during the period that the pool(s) will be empty;
 - b. Water level control adjustment and chemical control operation;
 - c. Normal surge tank operation and balancing;
 - d. Filter operation and backwashing; and
 - e. Super chlorination.
 8. Lubrication and maintenance instructions.
 9. Guide to "trouble-shooting".
 10. Parts list and predicted life of parts subject to wear.
 11. Outline, cross section, and assembly drawings; engineering data and wiring diagrams.
 12. Test data and performance curves, where applicable.
 13. Specific written instructions for procedure for emptying and refilling the pool(s) including de-watering during any period that the pool will be empty. Include furnishing and installing a yellow warning sign 8-1/2 in. x 11 in., to be mounted in the filter room, that reads:

WARNING

Prior to emptying Pool

Consult O & M Manuals for Procedures

Add another sign shall read:

Keep all Caps, Plugs and Tops Tight Fitting to Prevent Escape of Fumes.

14. One set of applicable submittals shall be included in each manual.
- C. The operation and maintenance manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment when delivered, or which may be required by the CONTRACTOR.
- D. Manuals and other data shall be printed on heavy, first quality paper, 8-1/2 x 11 inch size with standard 3-hole punching and inserted in plastic covers. Drawings and diagrams shall be reduced to 8-1/2 x 11 inches or 11 x 17 inches. Where reduction is not practical, larger drawings shall be folded separately and placed in envelopes that are bound into the manuals. Each envelope shall bear suitable identification on the outside.
- E. Six (6) bound volumes of each manual shall be submitted. All parts lists and information shall be assembled in substantial manuals and permanent, three-ring or three-post binders. Material shall be assembled and bound in the same order as specified, and each volume shall have a table of contents and suitable index tabs.

- F. All material shall be marked with project identification. Non-applicable information shall be marked out or deleted.
- G. Shipment of equipment will not be considered complete until all required manuals and data have been received.

1.11 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver material in manufacturer's original, unopened containers and crates with all labels intact and legible.
- B. Deliver materials in sufficient time and quantity to allow continuity of work and compliance with approved construction schedule.
- C. Handle materials in a manner to prevent damage.
- D. Store all materials on clean raised platforms with weather protective coverings. Provide continuous protection of materials against damage or deterioration.
- E. Remove damaged materials from site.

1.12 WARRANTIES

- A. The CONTRACTOR warrants to the Department, Using Agency and Professional that materials and equipment provided under the contract will be of good quality and new unless otherwise required or permitted by the contract documents, that the work will be free from defects not inherent in the quality required or permitted, and that the work will conform with the requirements of the contract documents. Work not conforming to these requirements, including substitutions not properly approved and authorized will be considered defective. The CONTRACTOR'S warranty will exclude remedies for damage or defect caused by abuse, improper or insufficient maintenance, improper operations, modifications not executed by the CONTRACTOR or improper wear and tear under normal use. If required by the Professional, the CONTRACTOR shall furnish satisfactory evidence as to the kind and quality of materials and equipment. All warranties shall be for a period of one year from the date of substantial completion or the Using Agency begins using the pool unless otherwise specified.
- B. The CONTRACTOR shall agree to repair or replace any defective or non-complying work at no cost to the Using Agency upon written notification from the Using Agency within the warranty period. Pro-rated warranties are not acceptable.
- C. Submit all warranties covering, but not limited to the following:
 - 1. All pool deck equipment and accessories against defects in material, manufacturer and installation for a period of one (1) year.
 - 2. Defects in material, manufacture or installation of the recirculating overflow system and interior coating of the trench for a period of one (1) year.
 - 3. Defects in material, manufacture and installation of the filtration, backwash, chlorination, pH adjustments and cleaning systems, including controls for a period of one (1) year.
 - 4. Defects in material or workmanship of the pool structure causing a loss of water for a period of three (3) years.
 - 5. Defects in material, workmanship, and installation of the pool piping system for a period of three (3) years.
 - 6. Defects in material, workmanship, and installation of the pool pumps for a period of one (1) year.
 - 7. Manufacturer's minimum five (5) year warranty against defective materials, components and workmanship in the pool chemical controller. ORP, pH, flow and temperature sensors shall be covered by a standard two (2) year warranty. All other sensors and flow cell components shall be covered by a standard one (1) year warranty.

8. Manufacturer's minimum eighteen (18) month warranty against defective materials, components and workmanship in the Variable Frequency Drive system effective the date of supply
9. Defects in material, workmanship, and installation of the tile finish against cracking and delamination for a period of five (5) years.
10. Manufacturer's minimum fifteen (15) year warranty on the filter tank and lining against defective materials or workmanship of the tank and components. (Additional warranty time may be purchased from the manufacturer.) Prorated warranties are not acceptable. Flexsol 3000 lined vessels shall carry a fifteen (15) year limited non-prorated warranty. The filter manufacturer shall bear the responsibility for suitability of lining and shall be the sole source for the specified warranty. Internal tube elements shall carry a fully rated 10 year warranty. Valve bodies and the RMF controller shall carry a 5 year fully rated warranty. Valve operators and system accessories including the bump tire, quick exhaust valve and solenoid valve shall carry one year warranty as provided by the product manufacturer. Unless otherwise specified, workmanship is to be guaranteed first class and carry a one (1) year warranty.
11. Manufacturer's minimum one (1) year warranty against defective materials, components and workmanship in the sanitizing feed system.
12. Manufacturer's minimum one (1) year warranty against defective materials, components and workmanship in the pH buffer feed system.
13. Manufacturer's minimum three (3) year warranty against defective materials, components and workmanship in the movable bulkhead. The entire bulkhead shall be guaranteed against delamination or structural defect for a period of twenty-five (25) years.
14. Manufacturer's minimum fifteen (15) year systems warranty against defective materials, components and workmanship in the pool tile setting materials.
15. Manufacturer's minimum one (1) year warranty against defective materials, components and workmanship in the ultraviolet sanitizing system (excluding the UV arc tube). UV arc tubes are warranted to operate for 4000 hours when operated continuously. A continuously operated UV arc tube that fails prior to 4000 hours of operation shall be replaced free of charge. Intermittently operated UV arc tubes (>1 on/off cycle per day) will be replaced free of charge if failure occur prior to 2000 hours and prorated between 2000 and 4000 hours.

1.13 SYSTEM TRAINING

- A. A qualified representative of the CONTRACTOR performing work under this section shall put the equipment into operation and instruct the Using Agency's representatives in the operation of this equipment to the Using Agency's satisfaction immediately after project's substantial completion.
- B. The representative from the CONTRACTOR shall be either a CPO (Certified Pool Operator) or have an AFO (Aquatic Facility Operator) certification.
- C. Training periods shall consist of 32 hours of on-site training and scheduled as follows:
 1. 16 hours of initial training on the complete swimming pool system. The 16 hours of initial training is to be comprised of at least 4 hours of training on water chemistry analysis and adjustment. The water chemistry training will include in depth review of the use of the Langlier index and its computation.
 2. The initial 16 hours of training shall include information on the care, operation, adjustment, and maintenance of all items provided by the CONTRACTOR under the "Part 2 - Products" section of this specification.
 3. 16 hours of training after the Using Agency's staff has had experience operating the system. This time may be requested any time after the pool has been placed in operation within a

period of one (1) year from the time the pool was accepted by the Using Agency. The additional training shall contain at least 2 hours of review of water chemistry.

4. The CONTRACTOR shall provide a project specific video recording instruction manual in addition to the training sessions. The video instructions shall be project specific and shall include information on the care, operation, adjustment, and maintenance of all items provided by the CONTRACTOR under the "Part 2 – Products" section of this specification. This video recording shall be done separate from the Using Agency training.
5. The CONTRACTOR shall include one (1) copy of all video recording instructions in each Operations and Maintenance Manual.

1.14 POOL FILL WATER QUALITY

- A. The Department shall bear the cost of the water required for two (2) complete fillings of the pools and spa (the initial water tightness test and the final filling). Removal of iron or copper (if in excess of .3 ppm) will be required for the final fill to avoid staining of the pool finish. Any subsequent fillings or partial fillings (more than 25%) of the pool shall be by the CONTRACTOR, at its own expense.
- B. The CONTRACTOR shall provide the necessary plant equipment so that the temperature of fill water will be within plus or minus 10 degrees of the ambient air and/or the pool structure at the time of filling. Extreme caution is urged if the temperature variance is greater than 10 degree F.
- C. The CONTRACTOR shall provide the necessary chemicals and to adjust and balance the water chemistry in the pools to the following levels:

pH	7.4 - 7.6
Calcium Hardness	200 - 400 PPM
Total Alkalinity (Calcium Hypochlorite)	60 - 80 PPM
Langelier saturation index	-0.3 - +0.3
Total Dissolved Solids (TDS)	not to exceed 1,500 PPM

1.15 START-UP CHEMICALS

- A. The CONTRACTOR shall maintain the chemical balance of the pool water (including the cost of all chemicals required) until the pool and mechanical system(s) are fully operational and accepted by the Professional, Department, and the Using Agency.
- B. Provide the Using Agency with sufficient quantities of the necessary chemicals to maintain the pool operation for a minimum of thirty (30) days from substantial completion or the Using Agency begins using the pool.
- C. Chemicals to be provided to the Using Agency shall include those required by the chemical feed systems installed.

1.16 RECORD DRAWINGS

- A. Provide a complete set of record drawings of the entire pool system(s) including all sub-systems. All record drawings shall be prepared in accordance with the requirements of Section 017839 and shall be a complete, stand-alone set. The CONTRACTOR shall be permitted to obtain original documents and copy them for this purpose only. Provide the record set on compact disk (AutoCAD Release 2010 or compatible software).

PART 2 - PRODUCTS

2.01 OVERFLOW SYSTEM

- A. It is the intent of the specifications that the perimeter overflow system and surface cleaning be maintained under all conditions of normal operation and that no water be discharged to waste except when cleaning the filters or emptying the pool.
- B. Concrete Perimeter Overflow System (Competition Pool and Recreation Pool)
 - 1. A perimeter overflow system consisting of a continuous concrete and tile overflow channel as detailed and shown on the drawings shall be installed on the pool(s). The bottom of the trough shall be level throughout.
 - 2. The walls and floor shall be coated with epoxy paint. Refer to section 2.16. Areas not meeting the manufacturer's recommended thickness will be recoated without additional cost to the Department.
 - 3. The grating shall be formed of molded PVC sections. Modular, interlocking pieces of UV stabilized PVC grating. The top surface shall have a raised, diamond ridge design to create good friction, wet or dry and be 11/16" wide with an outside depth of 1.0" and a middle depth of 1-3/8" for extra strength. The space between pieces shall not exceed 3/8". Each piece of grate shall have a slotted hole at the ends for insertion of a stainless steel fastener clip and anchor screws every 5 feet and shall be easily removable. Grating surface bars shall run parallel to the pool wall and with the gap, provide at least 35% open space per foot for unrestricted water flow. The color of the grate shall be selected by the Professional. The width of the grating at the competition pool shall allow the insertion of the touchpad holding brackets between the grating and the gutter lip.
 - a. Basis of Design: Grating shall be manufactured by Lawson Aquatics supplied by Neptune-Benson, or approved equal.
 - 4. All materials, anchors and fasteners shall be 316L stainless steel.
- C. Skimmer Overflow System (Spa)
 - 1. Provide skimming system consisting of units as shown on the drawings. Skimmers shall be located to ensure maximum skimming action.
 - a. Basis of Design: Spa skimmers shall be Admiral SC-20 by Pentair Products, or approved equal.
 - 2. The piping and other pertinent components of skimming equipment shall be designed for a total capacity of the required filter flow of the recirculation system, and no skimmer shall be designed for a flow-through rate of less than 30 gallons per minute or 5 gallons per minute per lineal inch of weir.
 - 3. The skimmer weirs shall be automatically adjustable and shall operate freely with continuous action to variations in water level over a range of at least 4 inches. The weirs shall operate at all flow variations. The weir shall be of such buoyancy and design so as to develop an effective velocity.
 - 4. An easily removable and cleanable basket or screen through which all overflow water must pass shall be provided to trap large solids.
 - 5. The skimmer shall be provided with a device to prevent air lock in the suction line. An equalizer pipe shall be used and shall provide an adequate amount of water for pump suction if the water of the swimming pool drop below the weir level.
 - 6. The equalizer piping and fittings shall be sized to meet the capacity requirements of the filter and pump and shall be in no case less than 2 inches in diameter. The pipe shall be connected to the main drains. The equalizer float valve assembly shall remain tightly closed

under normal operating conditions but will automatically open when the water level drops below the lowest weir operating level.

7. The skimmer shall be of sturdy, corrosion-resistant materials.
8. Each skimmer shall be equipped with a variable orifice trimming device to allow balancing of flow.
9. Skimmers shall be NSF approved.

2.02 PUMPING EQUIPMENT

- A. Any proposed substitutions shall include a mechanical drawing incorporating all required changes in layout, piping and valves. The cost of such changes shall be included in the price of the substitute. CONTRACTOR to confirm voltage prior to ordering pump. All motors shall be capable of continuously running without overloading at any point on the characteristic curve of the pump without overload or harm. CONTRACTOR shall confirm by 1/4 inch scale shop drawing that the pumps and filters to be provided will fit in the available space and can be removed for servicing.
 1. Pumps shall be certified by the National Sanitation Foundation (NSF) and bear the certification mark.
 2. Pump casing shall be cast iron fitted with a replaceable bronze case wear ring. Mechanical seals shall be provided specific for a clear, mildly chlorinated water application. Pump impeller shall be enclosed type of cast bronze, statically and dynamically balanced, and trimmed for the specified design conditions. All bronze materials shall be suitable for use in a chlorinated environment. Suction and discharge flanges shall be provided and tapped for gauge connections. Provide steel or cast iron bases.
 3. Pump motor shall be totally enclosed, fan cooled (TEFC) and premium efficiency of the horsepower and speed specified. A pump requiring larger horsepower shall not be acceptable.
 4. Provide a hair and lint strainer, for each pump, of fiberglass or epoxy coated stainless steel construction with a clear observation top in the sizes (or pipe sizes) indicated on the drawings. Verify and coordinate pipe and pump suction sizes in the field. Strainers for recirculation pumps shall be a straight non-reducing type with an approved tapered eccentric reducer at the front of the pump at recirculation pump PP1, PP2, PP4, and PP5. Strainers for feature pump (PP6) shall be of a low pressure drop full-open or a tapered eccentric reducing type. Straight reducing type strainers will not be acceptable without the addition of an approved tapered eccentric reducer between the strainer and the pump (in which case, sufficient space in the pump pit must be verified). Provide a stainless steel basket with at least 4 times the free open area as the inlet pipe, and one spare basket with each strainer.
 - a. Basis of Design: As manufactured by MerMade Filter Inc., Neptune/Benson Inc., Fluidtrol, or Nemato
 5. Provide an emergency shutoff switch for the spa. The system shall include a clearly labeled emergency shutoff switch for all spa pumps per Article 680-38 of the NEC. The Professional shall approve the location of the switch(es). The wiring shall be done per Division 26 and coordinated with the pool wiring.
 6. Provide a 15-minute spa timer for each hydrotherapy pump. The Professional shall approve the location of the timer(s). The wiring shall be done per Division 26 and coordinated with the pool wiring.
 7. Provide a coating to protect all non-bronze pumps from corrosion. Coating shall be fusion bonded epoxy coating on all wetted parts. Sandblast to bare, white metal. Thickness shall be 8 to 12 mils (heavy film). Verify thickness by non-destructive testing. Coat parts as recommended by manufacturer, including preheating parts to 400 degrees and electrostatic deposition or fluidized bed technique. Provide primers if required to resist chlorinated water <10 ppm. Coating shall be Scotchkote 134 manufactured by Fusecote or approved equal, 9658

Alpaca St., South El Monte, CA 91733, 818-443-6760, 213-886-2258, or fax 818-443-9142, or approved equal.

8. Entire pumping unit shall be mounted on a base using cap screws to preserve the back pull-out feature of the pump. Pumps shall not be secured with floor studs. The pump base shall be coated with the same epoxy coating as the pump.

9. Recirculating Pumps and Motors

a. Competition Pool (PP1 and PP2)

- 1) Provide two (2) horizontally mounted centrifugal pump, as shown on the drawings and described in these specifications. Each pump is to be of a straight centrifugal, end suction, bronze fitted, close coupled type, capable of pumping 750 GPM against 70 ft. TDH with an efficiency of no less than 82% and a required net positive suction head (NPSHr) no greater than 9 ft. It shall be provided with a 20 HP, 1,750 RPM, 460 VAC, 3 phase, 60 cycle electrically driven motor meeting these specifications.

a) Basis of Design: The system design is based upon Paco. Pumps manufactured by ITT Marlow, Griswold, or Aurora shall all be considered, provided they meet the requirements.

b. Recreation Pool (PP4)

- 1) Provide one (1) horizontally mounted centrifugal pump, as shown on the drawings and described in these specifications. Each pump is to be of a straight centrifugal, end suction, bronze fitted, close coupled type, capable of pumping 500 GPM against 70 ft. TDH with an efficiency of no less than 77% and a required net positive suction head (NPSHr) no greater than 7.5 ft. It shall be provided with a 15 HP, 1,750 RPM, 460 VAC, 3 phase, 60 cycle electrically driven motor meeting these specifications.

a) Basis of Design: The system design is based upon Paco. Pumps manufactured by ITT Marlow, Griswold, or Aurora shall all be considered, provided they meet the requirements.

c. Spa (PP5)

- 1) Provide one (1) horizontally mounted centrifugal pump, as shown on the drawings and described in these specifications. Each pump is to be of a straight centrifugal, end suction, bronze fitted, close coupled type, capable of pumping 270 GPM against 70 ft. TDH with an efficiency of no less than 75% and a required net positive suction head (NPSHr) no greater than 7.5 ft. It shall be provided with a 7.5 HP, 1,750 RPM, 460 VAC, 3 phase, 60 cycle electrically driven motor meeting these specifications.

a) Basis of Design: The system design is based upon Paco. Pumps manufactured by ITT Marlow, Griswold, or Aurora shall all be considered, provided they meet the requirements.

- d. All recirculation pumps shall be provided by the same manufacturer. Confirm voltages prior to ordering pumps.

10. Other System Pumps and Motors

- a. Provide two (2) portable utility pump(s). The pump(s) shall be a 1 HP, 3600 RPM, 115 volt, 1 phase, 60 cycle unit capable of 60 GPM at 25 ft. TDH.

1) Basis of Design: Pump to be a Godwin GSP10 or approved equal.

b. Water Surface Agitator / Drain Down Pump (PP3)

- 1) Provide one (1) self-priming pump for water surface agitation (and pool draining) as shown on the drawings. Pump to draw water from the deep main drain and deposit water back into the pool at the agitator nozzles (and at the backwash catch basin). The pump shall be 1 HP, 3450 RPM, 230 volt, 3 phase, 60 cycle unit capable of 100 GPM at 25 ft. TDH.

2) Basis of Design: Pump to be a Pentair Whisperflo WFK 4 or approved equal.

11. Feature Pumps and Motors

a. Spa Hydrotherapy Pump (PP6)

- 1) Provide one (1) horizontally mounted centrifugal pump, as shown on the drawings and described in these specifications. Each pump is to be of a straight centrifugal, end suction, bronze fitted, close coupled type, capable of pumping 1,080 GPM against 35 ft. TDH with an efficiency of no less than 87% and a required net positive suction head (NPSHr) no greater than 5 ft. It shall be provided with a 15 HP, 1,750 RPM, 460 VAC, 3 phase, 60 cycle electrically driven motor meeting these specifications.

a) Basis of Design: The system design is based upon Paco. Pumps manufactured by ITT Marlow, Griswold, or Aurora shall all be considered, provided they meet the requirements.

b. Bubble Couch Air Blower (PP7)

- 1) Provide one (1) regenerative air blower in the pool pump pit as shown on the drawings. The blower shall be capable of 70 SCFM at 75 inches of H₂O and include an internal muffler for noise dampening. The construction shall be of cast aluminum housing, impeller and cover. Unit to be a 2 HP, 3 phase, 60 cycle, 230/460 volt as manufactured by Rotron, Inc. Model DR505AS72M (330-673-3452) or approved equal. The motor for the air blower shall be inverter duty rated and compatible to work in conjunction with a VFD. Contractor to confirm motor compatibility with manufacturer prior to purchasing. Provide pressure relief valve (515093), pressure gauge (271949) and a gate valve, which can adjust excess air bleed off.

B. Variable Frequency Drive Starters

1. Provide VFD starters for the competition pool, recreation pool, and spa recirculation pumps and feature pumps. VFD shall be a product of H2Flow Controls, Pentair AcuDrive, Neptune Benson Weg, or approved equal.

a. Basis of Design: Eco-Flo-C by H2 Flow Controls.

2. The IP54 or NEMA 12 enclosure shall be of non-corrosive construction. External enclosure surfaces shall be corrosion resistant. VFD's installed within a supplementary panel shall not be vented or cooled from ambient external air. With the exception of the VFD's heatsink and water-resistant heatsink fan, the VFD's electronics shall be fully sealed within the NEMA 12 enclosure. Vented enclosures are not permitted.
3. The VFD shall convert incoming fixed frequency three phase AC power into a variable voltage and variable frequency three phase output utilizing pulse width modulation. Advanced Space Vector Control will be utilized to reduce motor heating and provide precise control of the AC motor.
4. The VFD shall include a built-in Line Filter to mitigate harmonic distortions being transmitted back through the supply lines.
5. The VFD shall include a full wave diode bridge rectifier. The drive shall maintain a fundamental power factor near unity regardless of speed or load. SCR front ends which produce line notching are not acceptable.
6. The VFD shall utilize DC capacitors to filter out bus ripple and provide smooth DC power to the transistor section.
7. The VFD shall utilize IGBT transistors to produce a pulse width modulated output. SCR's are not acceptable.
8. The VFD shall have a full load amp rating which exceeds or meets NEC Table 430-150. The VFD shall be able to provide full rated output current continuously, and shall be able to provide 110% of its variable torque rating and 150% of its constant torque rating for one minute.
9. The VFD shall utilize space vector control to reduce motor harmonics and torque ripple.

10. The VFD shall include the ability to program Load Curve Monitoring Using Motor Shaft Power, to detect any of the following abnormal pump conditions: Run Dry/Loss of Prime; Cavitation; Dead head/Closed Valve; Worn impeller; Blocked Filter; Bearing Failure/Wear Detection. Protection using measured current (Amps), shall not be acceptable.
11. The VFD shall include Ramping of the DC Bus, to eliminate VFD failures associated with turning supply on and off using a contractor or disconnect, and to detect input phase failure and asymmetries (imbalanced supply).
12. The VFD shall provide a display with selectable readout of parameters, including: Speed; Torque; Motor Shaft Power; Electrical Power; Current; Output Voltage; Frequency; Heatsink Temperature; Motor Temperature; Run Time; Energy Consumed; Mains Time.
13. The VFD shall be capable of interfacing to an analog output signal from a Flow Transducer and displaying measured flow in GPM.
14. The VFD shall include the capability for copying of settings when multiple similar pumps are involved. Settings established in one VFD shall be transferred to the others via a removable keypad.
15. The VFD Control Panel shall include a Programmable Aquatic Controller (Controller) with an operator backlit LCD Graphical / Alpha / Numerical Display, housed in a separate NEMA-4X enclosure. The Controller shall comprise the following features:
 - a. Real Time Clock
 - b. Password protection
 - c. Hard-wired tamper protection feature
 - d. Custom software to control the VFD via a Modbus communication network
 - e. Automatic Flow Control. The Controller and VFD are to automatically adjust the pump's speed in order to compensate for a filter becoming dirty. The system is to maintain a minimum flow (GPM) required to meet State mandated turnover rates.
 - f. Programmable speeds for daytime and nighttime turnover rates.
 - g. Nonvolatile memory. All programmed parameters as well as the real time clock settings shall be maintained in the event of a power outage.
 - h. Manual Backwash Control. Single button control that will ramp the pump's speed to a higher level for backwashing.
 - i. Programable time duration for backwash speed
 - j. Automatic Backwashing. The Controller shall accept an input from an Automatic Backwashing system. The Controller's program shall be written so that such a signal will automatically initiate a higher speed for the pump until the signal is removed.
 - k. The Controller shall be capable of interfacing to an analog output signal from a Flow Transducer and displaying measured flow in GPM
 - l. Password protected reprogram function
 - m. Password protected speed override
 - n. Electronic phase rotational check
 - o. Automatic detection of flow / pressure feedback signal
 - p. Accumulated energy savings screen
16. VFD Control Panel shall include a Lightning Arrestor.
17. Installations that require the VFD panel to be located greater than 300 feet from the Pump Motor shall require the installer to provide a suitably rated Load Reactor.
18. Installations to 460V Non-VFD rated motors shall require the installer to provide a high quality Load Reactor type VIK from Trans Coil Industries.
19. Installations in locations where a Power Disconnect is not within 'line of sight' of the VFD Control Panel, or where deemed necessary by local electrical codes, shall require the installer to provide a suitably rated Circuit Breaker Disconnect.
20. The VFD shall accept a supply voltage of -15% / + 10% of its stated supply rating

21. The Controller and VFD shall be electronically lockable in order to prevent unauthorized or unintended program changes.

22. Motors to which the VFD is to be installed shall have a minimum insulation of "Class F".

C. Pump Gauges

1. Pressure gauges shall be installed on the discharge of the pumps.
2. Compound gauges shall be provided at the intake port of the pumps, after the hair and lint strainer.
3. Gauges shall be liquid filled, 316L stainless steel bourdon tube type with a minimum 2-1/2 inch diameter dial, high impact polypropylene or stainless steel case, corrosion resistant white scale with black divisions and numerals, 300 Series stainless steel heavy duty rotary bushed movement, , black enameled balanced Micrometer pointer.
 - a. Basis of Design: Gauges shall be as manufactured by Weksler Instrument Corporation or approved equal.
4. Scale ranges shall be selected to indicate the normal system operating pressure of each system or location within the system. Pressure ranges shall be calibrated in psig (0-60 psi) and compound gauge shall be calibrated in inches of mercury (0-30 in Hg / 0-60 psi).
5. A stainless steel filter type pressure snubber shall be provided for each pressure gauge installed consisting of a 3/8 inch diameter by 1/8 inch thick micro metallic stainless steel filter and placed in the line just before the pressure gauge. Provide isolation brass valves or brass gauge cocks at each gauge for easy replacement and maintenance.

2.03 FILTRATION EQUIPMENT

A. The Contractor shall provide one (1) of the regenerative media filtration systems specified in this section.

B. Regenerative Media Filters with Pre-Coat in a Closed Loop

1. Filter System

a. Basis of Design: The filter system under this section shall be a Neptune-Benson Defender, or approved equal, as detailed on the drawings.

1) Competition Pool: Model SP-49-48-1548

2) Recreation Pool: Model SP-27-48-487

3) Spa: Model SP-24-42-327

b. It is the intent of these specifications to describe a filter system complete with all accessory items supplied and warranted by one manufacturer.

c. The primary components of the system consist of the main filter tank, flex tube filter elements, element assembly, bump mechanism, vacuum transfer system, sight glass, pressure gauge panel, inspection (viewing) window, valves and automatic filter controller.

d. All components and related subassemblies shall be factory assembled and tested prior to shipment.

2. Filter System Capacity

a. Competition Pool:

1) The filter system shall have a capacity of filtering 479,689 gallons in 5.33 hours at a rate of 1,500 gallons per minute.

2) The filtration system shall consist of one (1) filter tank with a total designed effective filter surface area of 1,211 square feet and operate at a rate of 1.24 gallons per minute per square foot of filter area.

- b. Recreation Pool
 - 1) The filter system shall have a capacity of filtering 69,106 gallons in 2.30 hours at a rate of 500 gallons per minute.
 - 2) The filtration system shall consist of one (1) filter tank with a total designed effective filter surface area of 381 square feet and operate at a rate of 1.31 gallons per minute per square foot of filter area.
- c. Spa
 - 1) The filter system shall have a capacity of filtering 5,213 gallons in 0.32 hours at a rate of 270 gallons per minute.
 - 2) The filtration system shall consist of one (1) filter tank with a total designed effective filter surface area of 223 square feet and operate at a rate of 1.21 gallons per minute per square foot of filter area.
- 3. Filter Tanks
 - a. The filter tanks shall not be less than 55" in diameter (competition pool), 34" in diameter (recreation pool), or 31" in diameter (spa). The filter tanks shall have a 60" side shell, suitable for 50 psi working pressure and hydrostatically tested to 75 psi. Tank shell shall be not less than 1/4" thick. Bottom dished head shall be not less than 1/4" thick. Top flat head shall be not less than 1 1/2" thick. All material to be Type A-36 carbon steel.
 - b. All welding shall be performed by qualified operators. Joints shall be butt or fillet welded inside and out by manual or automatic process. Welded joints shall have complete penetration and fusion with little or no reduction of the thickness of the base metal. Welds shall be free of coarse ripples, grooves, overlaps, abrupt ridges or valleys. All welded surfaces shall be chipped and brushed clean, when necessary, leaving no slag or splatter.
 - c. Tank legs shall be constructed of 6" x 2 1/2" channel legs 1/4" thick. 24", 27" and 33" filters shall have (3) legs. 41", 49" and 55" filters shall have (4) legs. The material shall be Type A-36 carbon steel. Bearing plates shall be 10" x 5" x 1/4" type 304L stainless steel. Each bearing plate shall have (2) 5/8" drilled holes to secure to the floor with the 1/2" x 4 1/2" stainless steel concrete anchors provided. The legs shall be designed with bolted connections to minimize overall tank height for shipping and access into the mechanical room.
 - d. The tank heads shall be bolted to the shell with 7/8" diameter T304 stainless steel threaded rods and nuts, 9" on center around the tank perimeter.
 - e. Tanks shall be equipped with a UL listed grounding lug.
 - f. Tanks shall incorporate connections for filter influent, effluent, drain; 1-1/2" vacuum transfer piping, 4" viewing window, and lift shaft gland. Refer to the drawings for pipe and connection sizes.
 - g. Tanks shall include brackets for mounting of automatic controller, gauge panel, filter / regulator, vacuum transfer blower and vacuum hose rack.
 - h. The competition pool filter tank shall include an integrally mounted hydraulic lifting device (davit). The davit assembly shall be designed to lift the filter head and include a pivot mechanism allowing the head to rotate 180°, for access to the tube sheet.
- 4. Flexsol 3000 Interior Lining
 - a. All interior surfaces shall be grit blasted to white metal condition with a 2-3 mil profile. Blasted surfaces shall be cleaned of all dust or blast residue and primed as soon as is practical on the same day blasting is done.
 - b. When priming has dried the lining process will begin. If prime coat has cured for over twenty-four hours, a refresher coat will be applied.
 - c. Flexsol 3000 shall be an elastomeric polyurethane, 100% solid plural component lining. Hardness shall be 70 durometer on the shore D scale. Break tensile strength shall be 2460 psi with elongation of 25-30%.

- d. Application of Flexsol 3000 lining shall be done by experienced applicators using a high pressure, high temperature plural component system. All wetted surfaces including flange faces, manway rings and manway covers shall be lined to 120 mils +/- 5 mils DFT.
 - e. Hardness shall be verified after curing to ASTM D 2240 standard.
 - f. Flexsol 3000 lining shall meet the NSF toxicity standard unconditionally and shall be approved for use with the NSF approved filter.
5. Exterior Coatings
- a. All exterior surfaces shall be grit blasted to white metal condition with a 2-3 mil profile. Blasted surfaces shall be cleaned of all dust or blast residue and primed as soon as is practical on the same day blasting is done.
 - b. When priming has dried the coating process will begin. If prime has sat for over twenty-four hours, a refresher coat will be applied.
 - c. Two coats of high solids enamel shall be applied for a total developed film thickness of 5-8 mils.
 - d. Manufacturer is to supply min. 16 oz of high solids enamel touch-up paint.
6. Internal Components
- a. The filters shall consist of flex tube elements, filter tube sheet, stainless steel lift shaft and internal flow diversion assembly.
 - b. The filter elements shall be flexible tubes that provide the support structure for the media. The outer wall of each element shall be fabricated of multi-filament high strength polyester braid. Each element shall have an internal T304 stainless steel spring, which acts a support structure for the braided filament.
 - c. The filter element tube sheet shall be fabricated of T304 stainless steel and provide both support for the top of the element assembly as well as water tight seal to prevent media from escaping the filter tank.
 - d. The lifts shaft shall be fabricated from T304 stainless steel and provide the internal connection between the filter element tube sheet and the external bump mechanism.
 - e. The filter influent connections shall be fitted with a T316 stainless steel flow diversion assembly to eliminate disturbance to the filter elements during operation.
 - f. All stainless steel wetted fasteners shall be Type 304.
7. Bump Mechanism
- a. The bump mechanisms shall include a pneumatically operated tire mounted externally on the filter tank heads. The tire is alternately pressurized then depressurized causing the connected filter element assembly to move in an upward then downward fashion. This movement shall provide the means of dislodging the media and accumulated solids, which then recoat the filter element.
8. Vacuum Transfer System
- a. The vacuum transfer systems shall be provided to allow the recharging of media into the filter for either bag or bulk media.
 - b. The vacuum blowers shall include a 1.5 HP TEFC 115/230v single phase motor 50/60 Hz.
 - c. In-line filters with dual connections shall be provided to prevent dust and media from being drawn into the blowers.
 - d. Provide three (3) 1-1/2" SCH 80 PVC ball valves: for the vacuum drain line, the blower inlet and the vacuum hose.
 - e. Provide 10 feet of 1-1/2" vacuum hose with required fittings.
9. Automatic Controller
- a. The automatic controllers shall provide total control of the system's filtration and regeneration cycles, and provide all necessary equipment interlocks and timing mechanisms to execute the filter program.

- b. The controllers shall include an adjustable pressure switch, factory set to 50 psi. The switch shall stop the recirculating pump and close the pneumatic valves if air pressure falls to 50 psi.
 - c. The controllers shall contain a microprocessor that will activate the following functions of the system:
 - 1) Bump cycle / manual or automatic
 - 2) Pre-coating of the filter elements
 - 3) Stopping and starting of the main recirculating pumps
 - 4) Opening and closing of pneumatically operated valving
 - 5) Vacuum transfer system
 - 6) Heater cool down delay
 - 7) Auxiliary contacts to interlock chemical control or other equipment
 - 8) Keyed switch to activate continuous, intermittent bump cycle for flex tube cleaning.
 - d. The controller panel shall display the following functions:
 - 1) Filter status
 - 2) Pre-coat status
 - 3) Recirculating pump status
 - 4) Vacuum transfer pump status
 - 5) System power
 - e. The controller enclosure shall be NEMA 12.
 - f. The RMF automatic controller will provide signal power to the main recirculating pump motor starters. The unit is required to be a device or variable frequency drive (VFD) and is to be installed with control wiring by the electrical contractor.
 - g. The RMF shall be 120V, 1 phase, 30 amp rated and shall be UL labeled.
10. Flow Meter
- a. A digital flow meter shall be included with a 4-20mA 0-10 VDC analog output.
 - b. The flow meters shall be wired into the VFDs to provide automatic speed control of the filter pump motors.
 - c. The VFDs shall compensate for varying filter head losses by maintaining the specified flow rate with the 4-20mA output signal of the flow meters.
11. Filter / Regulator
- a. Each filter shall include a combination filter / regulator. The regulator shall be adjustable from 0 – 120 PSI. 1/2" F.P.T. connections shall be provided for field installation of air lines.
12. Water Separator
- a. One water separator with automatic drain shall be included for each air compressor supplied. 1/2" F.P.T. connections shall be provided for field installation of air lines.
13. Air Compressor
- a. The filtration systems will require (1) air compressor per mechanical room. The following is the minimum requirement: 20 gallon tank, 2 HP 120 V, 1 phase, 15 amp, 5.2 CFM @ 90 psi, air pressure gauge, pressure relief valve, belt guard, pressure switch, air filter.
14. Pneumatic Actuators
- a. Each filter shall include pneumatic actuators for one (1) influent valve, one (1) effluent valve and one (1) precoat valve.
 - b. The actuators shall be double acting with valve mounted drilling to ISO 5211.
 - c. The actuators shall include two (2) 1/4" FPT ports for open / close connections. Flow control valves with quick connect fittings shall be provided at each port to allow speed control adjustment for the open / close function of the actuators.
 - d. Materials of Construction

- 1) Body: aluminum alloy, extruded acc. to ASTM 6063, anodized acc. To UNI 4522
 - 2) Ends: Die-cast in aluminum alloy acc. To ASTM B179, epoxy-polyester coated
 - 3) Pistons: Die-cast in aluminum alloy acc. To ASTM B179
 - 4) Pinion: Nickel-plated steel
 - 5) Slideways: Acetal resin (LAT LUB 731320T)
 - 6) Fasteners: AISI 304 Stainless steel
 - 7) Springs: Epoxy coated steel, pre-compressed
 - 8) Seals: NBR Nitrile rubber
 - 9) Lubricant: MoS2
 - e. The actuators shall be factory lubricated to allow for 1,000,000 maneuvers.
 - f. The actuators shall have adjustable travel stops for both directions.
 - g. Working temperature limits: 4°F to 186°F.
15. Fiberglass Eccentric Reducing Flanged Precoat Tees
- a. Eccentric reducing precoat tees shall be constructed of fiberglass with flanged connections. The tee shall be equipped with influent, effluent connections as well as a precoat line branch connection sized in accordance with the drawings.
 - b. Flanged connections shall be ANSI 125# dimensions.
 - c. Reducing tees shall include a 4" F.P.T. gauge connection.
 - d. Reducing tees shall be designed for 50 psi operating pressure as manufactured by Neptune-Benson.
16. Solenoid Valves
- a. Each filter shall include four-(4) single solenoid, 4-way valves mounted on a multi-station manifold for operation of the pneumatic actuators and bump mechanism.
 - b. The solenoids valves shall include lighted DIN connectors.
 - c. The solenoid valves shall be factory lubricated and shall not require any field lubrication.
 - d. The solenoid valves with multi-station manifold shall be located on the bottom of the automatic controller, factory wired and include quick connect fittings for attachment to the pneumatic actuators and bump mechanism.
 - e. The solenoid valves shall be SMC Series SY 7000.
17. Valves
- a. All valves 3" – 12" shall be constructed with cast aluminum ASTM S12A housing and fully coated with Rilsan on all interior and exterior surfaces. Internal components include EPDM resilient lining, Rilsan coated ductile iron disc and T304 stainless steel shaft. Valves 14" and larger shall be constructed with cast iron housing fully coated with nylon and with nylon coated ductile iron disc.
 - b. Valves shall be butterfly valves and shall be provided for the influent, effluent and precoat lines.
18. Drain Requirements (By Others)
- a. A sump pit or stand pipe is required for dumping spent media and rinsing tube elements.
 - b. To prevent overflow the sump or stand pipe drain piping shall be sized for 300 GPM capacity.
 - c. If drain piping cannot be sized for 300 GPM, or if the sewer is at an elevation higher than the filter tank drain, use the following minimum sump sizes:
 - 1) Model SP-27: 160 gallons
 - 2) Model SP-33: 250 gallons
 - 3) Model SP-49: 620 gallons
 - d. Use a sump pump to transfer waste to sewer.
19. Packaging
- a. For loading and unloading, filter tank diameters 24" – 41" shall be bolted to individual wooden pallets. All tanks shall be shrink wrapped to prevent damage during transport.

- b. The components shall be carefully packaged in a totally enclosed wooden crate to prevent damage during transport.

20. Media

- a. Media shall be expanded perlite with a median particle size of 37 microns. Percentage retained on a +150 Tyler Mesh shall not be less than 8% or more than 25%. Darcy permeability shall be at least 3.25 and have a maximum float of 5%.
- b. The media shall contain no more than 1 tenth of one percent (.001) of crystalline silicate.
- c. The media shall be certified by the manufacturer for use in the filter. The media shall be NSF listed in Standard 61 and Standard 50.
- d. The media shall be Celaperl 1000 as supplied by EP Minerals, or approved equal.
- e. Each Defender filter shall be provided with six (6) charges of perlite media.

21. Quality Assurance

- a. The Contractor shall have documented at least three (3) completed installations of the proposed filtration system or a qualified manufacturer's representative shall be required for on-site installation supervision.

C. Regenerative Media Filters with Pre-Coat in Filter Mode

1. Filter System

- a. The filter system specified under this section shall be of a pressurized design and shall consist of Non-Corrosive Regenerative Media Filter(s) as manufactured by Nemato Corp., or approved equal.

1) Competition Pool: Model NPC-072-1194

2) Recreation Pool: Model NPC-042-0380

3) Spa: Model NPC-034-0223

- b. The filter system shall be of the vertical type requiring precoat media and shall have a maximum flow of 1.35 GPM per square foot of filter area.

- c. The filter tank system shall consist of vertical filter tank(s), internal influent manifold, internal filter tubes, internal tube and pressure plates, slopped self-draining bottom plate, media release accelerator, face piping, davit, 2-body flanges with back-up rings, gauge panel with 2-60 PSIG gauges, external air relief with a manually adjusted shutoff valve, two (2) integrally molded viewing window, integrally molded backwash drain port and FRP saddle support, precoat vacuum transfer system. The filter system shall be fabricated in a fully assembled state by the original equipment manufacturer, with face piping and davit disassembled for shipping to prevent damage.

2. Filter Tank(s)

- a. The vertical filter tank(s) shall be 72" in diameter (competition pool), 42" in diameter (recreation pool), and 34" in diameter (spa).

- b. Each filter tank(s) shall be manufactured in a five-step process comprised of a patented Closed Cavity Bag Molding (CCBM) of the dished heads, filament winding of the body, and rolling of the steel body flange back-up rings. The bottom head shall be joined to the body utilizing a secondary FRP bonding system that creates a lap joint that exceeds the mechanical properties of the frp laminate. The steel body flange back-up rings shall be chemically bonded to the body and top dished head with a compatible structural adhesive system that creates a joint that exceeds the mechanical properties of the FRP laminate. The material used in manufacturing the filter tank shell shall be food grade Isophthalic Resin and three dimensional glass that provides a minimum laminate flexural modulus of 1.82E+06 psi and flexural strength of 36.4 ksi.

- c. The filter shall be designed for a maximum working pressure of 100 PSIG with a Hydrostatic test pressure of 150 PSIG. The body, dished heads and steel back-up rings shall vary in thickness to provide durability at the points of maximum stress and the thickness shall be determined through a Finite Element Stress Analysis. A high quality

professional finish shall be achieved through the application of a smooth, gelcoated or epoxy painted outside surface.

- d. A 6" integral viewing window complete with acrylic cover, o-ring and grooved coupling shall be located in the body of the filter tank(s) on models NPC-030-0088 thru NPC-054-0423. Dual 8" integral viewing windows complete with acrylic cover, o-ring and grooved coupling shall be located in the body of the filter tank(s) on models NPC-060-0475 thru NPC-096-1360. The viewing windows shall be positioned to allow for inspection of the filter tubes during both the filter and backwash cycles. Viewing window ports will be sloped to prevent buildup of media or debris during filter and/or backwash cycle(s).
 - e. A steel davit shall be attached to the side shell body flange of the filter and floor of the equipment room. The davit shall be able to lift, rotate and place the head on the floor in such a manner to allow for removal of the pressure plate/ tube plate while providing complete access to all filter element tubes. The davit shall come complete with an attachment bracket, anchor flange, vertical post, tilting support arm with hydraulic adjustment jack and auto brake cable wench.
 - f. An integrally molded backwash drain port (6" for competition pool, 4" for recreation pool, and 3" for spa) shall come complete with a grooved coupling, 45° elbow and PVC vanstone flange connection located in the bottom head of the filter tank(s) body.
 - g. The filter shall have influent and effluent connections (12" for competition pool, 8" for recreation pool, 6" for spa) that are integrally molded. A continuous, watertight exterior seal at the influent and effluent ports of the filter tank(s) shall be provided with the use of PVC vanstone flange connections. The filter tank(s) shall be mounted on a FRP saddle support, which shall be designed to satisfy Zone 4 earthquake conditions when anchored according to manufacturer's specifications.
3. Internal Distribution/Collection System
- a. Internal filter tank components shall include an influent manifold, filter tubes, pressure/ tube plates.
 - b. The patented influent manifold shall consist of an inlet duct connected to divergent outlet ports with cowls. The ports and cowls shall be hydraulically designed in such manner as to provide precise directional flow control of influent liquids and reduce influent flow velocities as well as the force with which dirt and filtration aid contact the filter tubes. The influent manifold shall provide a uniform flow pattern and reliable dispersion of filtration aid during the precoat cycle.
 - c. The patented filter tubes shall consist of a polyester cloth septum and ABS plastic septum support core. Each filter tube shall have a rigid 2.3" diameter elongated body with 6 longitudinal ribs extending radially from a central hub in the core. All edges of the core coming in contact with the cloth septum shall be rounded to dramatically reduce wear on the filter tube. The septum cloth shall be manufactured of high quality heat set polyester twill that shall provide resistance to movement of the weave while promoting a high degree of permeability.
 - d. The pressure and tube plates shall be manufactured of Vinylester Resin and three dimensional glass utilizing a patented Closed Cavity Bag Molding (CCBM) process that provides a minimum laminate flexural modulus of $1.82E+06$ psi and flexural strength of 36.4 ksi. The filter tube effluent port shall be sandwiched between the pressure and tube plates with an "o"-ring compression seal that prevents filter media escaping from the tank. The tube plate design shall provide a minimum 1.85" filter tube spacing to eliminate bridging during the filter cycle.
 - e. The filter tank drain assembly shall consist of a pipe coupling, tangent and integrated to the bottom of the tank, and engineered to prevent media build-up within the tank. The drain assembly shall provide complete purging of spent media in both the backwash and

rinse cycle. The tank shall be NSF certified for pressure backwashing and/ or gravity draining to purge spent filter media.

4. Face Piping

- a. The filter shall be provided with PVC face piping, including PVC-EPDM butterfly valves and PVC vanstone flanges which shall be pre-assembled by the original equipment manufacturer (12" for competition pool, 8" for recreation pool, 6" for spa).
- b. The influent, effluent and backwash connections for mating to field connected piping shall be PVC vanstone flanges. The operation valves, influent, effluent, backwash bypass and backwash ports shall all be marked with identification labeling.
- c. The face piping kit shall come complete with four PVC butterfly wafer valves installed with "o"-ring seals between companion flanges in the face piping kit. The butterfly valves shall be designed for 150 PSIG (1035 kPa) operating pressures and shall come complete with dynamic dual lip EPDM/ Viton seals for bubble tight shut-off operation. The effluent valve when installed at an operational elevation above 90", shall come with a gear actuator and a chain drive to provide operational control with out standing on a ladder.
- d. The face piping kit shall be certified by NSF International to ANSI / NSF Standard 50 for a maximum working pressure of 100 PSIG with a Hydrostatic test pressure of 150 PSIG.

5. Filter Area

- a. The filter plant shall consist of Non-Corrosive Regenerative Media Filter(s) with a total effective filter area of 1,194 sq. ft. for the competition pool, 345 sq. ft. for the recreation pool, and 223 sq. ft. for the spa.
 - 1) Competition Pool: When operating at 1.26 GPM per square foot of filter area, the filter system will have a capacity of filtering 479,689 gallons in 5.33 hours.
 - 2) Recreation Pool: When operating at 0.72 GPM per square foot of filter area, the filter system will have a capacity of filtering 69,106 gallons in 2.30 hours.
 - 3) Spa: When operating at 1.21 GPM per square foot of filter area, the filter system will have a capacity of filtering 5,213 gallons in 0.32 hours.

6. Filter Media

- a. Filter media shall be of the regenerative type and shall be non-hazardous, non-toxic and non-flammable. The media shall have a minimum permeability of 3.25 Darcy's with a maximum float of 1% and a median pore size of 21 microns. The filter media shall provide a minimum .125" thick filter cake with a precoat coverage of .11 lbs per 1 sq. ft. of filter surface area.
- b. The filter system shall be certified by NSF International to ANSI / NSF Standard 50 for use with either Diatomaceous Earth or Perlite media.

7. Regenerative Cycle

- a. The regeneration cycle shall be 2 to 4 minutes in duration through the use of a centrifugal frequency generator requiring a 120V, 1 phase, and 1.3 amp power supply. The Media Release Accelerator (MRA) enclosure shall be totally enclosed, non-venting with a four bolt mounting pattern that allows for non-invasive external mounting to the filter tank.
- b. The filter tube septum shall be flexible and designed in such a manner to allow for reverse pulse hydraulic bumping to assist in breaking up the filter cake and extend filter cycle without the use of additional mechanical equipment. Filters requiring mechanical actuators whether they are pneumatic, hydraulic or electric will not be deemed acceptable and will not be allowed.

8. Precoat Cycle

- a. The filter shall be certified by NSF International to ANSI / NSF Standard 50 for precoating of the filter in the filter cycle.
- b. The filter shall come with a precoat vacuum media transfer system complete with FRP precoat funnel with clear viewing window, precoat vacuum, vacuum transfer hose and control/ isolation valves. The precoat vacuum shall be integrally mounted on top of the FRP precoat funnel and shall operate at 120V, 1 phase with a maximum amperage draw of 8.2 amps.

9. Automatic Regeneration and Backwashing System

- a. The automatic controller shall have the following product certifications: UL 61010-1, (CSA) C22.2, European Low Voltage Directive 73/23/EEC EN 61010-1, FCC part 15 sub part B and if used as a water chemistry control NSF/ ANSI Standard 50. All product certifications must be conducted by a nationally accredited testing agency certified to conduct the testing. The unit shall have 512K battery backed-up RAM for input level control and data logging of all automatic functions necessary to initiate regeneration and backwash cycles.
- b. The automatic controller shall have the capability of operating a single regenerative media filtration system and shall have an LCD backlit display with 12x40 alpha/numeric, graphical characters that will continuously display information. The controller shall be capable of reprogramming for: time of day, day of week, and mode which initiates regeneration of filter. The controller shall have 120 VAC fused input with line or dry contact solid-state output relays and dry contact mechanical output relays.
- c. Backwashing the regenerative media filter system shall be initiated manually requiring manual inputs of completion for each sequence of the backwash procedure before proceeding to the next operation. Backwash operations would include a firemans cycle and UV cool down cycle. The CONTRACTOR is to provide factory setting and adjustment of controller to suit the requirements described herein and actual field conditions. If a backwash holding tank is required, verify tank capacity and drain down requirements and provide a sensor system and necessary interlocks to lock out continued backwashing of filter unless water level in holding tank has dropped to the low level, and to suspend backwashing of the system in the event of a high level holding tank high water condition, and to provide a high water alarm in the case of overfilling of the tank. The controller shall be able to suspend pump operation and resume operation when low level is attained.
- d. The controller shall have an optional paddle-wheel type flow sensor, flow sensor saddle for effluent pipe size, temperature probe conductivity/ TDS sensor, turbidity sensor, pressure and vacuum transducers and liquid level sensors for possible inclusion during initial installation or future expansion. All monitored levels shall be displayed real-time on the controllers display screen.

10. Pressure Gauge Panel

- a. The pressure gauge panel shall consist of two 2½" diameter gauges scaled from 0-60 PSIG. The pressure gauges shall be mounted in a flat plastic panel suitable for flange or direct pipe mounting and shall come with a printed system nameplate. The pressure gauges shall be connected to influent and effluent pressure points with air relief cocks, compression fittings and semi-rigid PVC tubing.
- b. The filter system shall be certified by NSF International to ANSI/ NSF Standard 50 for pool/ spa and salt water applications. The filtration system shall be manufactured by Nemato Corp., or approved equal. Model numbers are as follows:

- 1) Competition Pool: Model NPC-072-1194
- 2) Recreation Pool: Model NPC-042-0345
- 3) Spa: Model NPC-034-0223

2.04 RECIRCULATION FITTINGS

- A. Main outlets (main drains) shall be concrete sumps with 12 gauge PVC frame and PVC grating and sized as shown on the plan. Grate openings shall not exceed 11/32 inch in width, providing an open flow area to allow water velocity not to exceed 1.0 fps. The grate shall be PVC and fit closely and flush with top surface of frame, and secured to frame with vandal proof fasteners. All exposed edges of main outlets shall be rounded and smooth, free of burrs and sharp edges. All main drain covers shall comply with the Virginia Graeme Baker Act and ASME A112.19.8-2007.
- B. Provide hydrostatic relief valves consisting of a 2" cycolac relief valve connected to a FPT commercial style Schedule 80 PVC collector tube. The collection tube shall have seepage holes, 3/8 inch in diameter, and shall be screwed securely to the valve body. The hydrostatic relief valve shall be designed to seal with minimum pressure and shall have a non-plugging, self-cleaning raised valve seat. Hydrostatic relief valve to be Hayward Number SP1056 with collector tube model Hayward Number SP1055, or approved equal.
- C. Concrete drop out boxes (converters) shall be concrete sumps with 12 gauge 316L stainless steel frame and PVC grating and sized as shown on the plans. Grate openings shall not exceed 11/32 inch in width, providing an open flow area to allow water velocity not to exceed 1.0 fps. The grate shall be PVC and fit closely and flush with top surface of frame, and secured to frame with vandal proof fasteners. Provide no-leak seal flange at the midpoint of the boxes.
- D. Wall inlet fittings shall be Hayward Model SP-1421-E (1 inch opening) cycolac directional inlet mounted in Hayward Model SP-1022S or approved equal from Paddock, Sta-Rite, or Swintime.
- E. Adjustable floor inlet fittings shall be provided each consisting of an ABS plastic body and adjusting top plate with a positive locking device. A spanner wrench shall be provided to facilitate flow adjustment. The inlet body shall be provided with a 2-inch cycolac solvent weld connection and internal NPT threads to facilitate line pressure testing. Floor inlet fittings shall be Sta-Rite No. 8417-0000-White when positioned in white field tile and Sta-Rite No. 8417-0200-Black when positioned in floor lane markings, or approved equal.
- F. Sight sump frame(s) and cover(s) shall be size appropriately to provide access to the vertical sight sump standpipe as indicated in the plans. Frame and cover shall be Zurn model #ZANB-1461-14-VP, nickel bronze with polished scored top, vandal proof screws or approved equal.
- G. Valve box covers and frames that are not specified on the drawings or specifically identified as another size or material shall be Zurn model #ZANB-1461-14-VP, nickel bronze with polished scored top, vandal proof screws or approved equal.
- H. Water surface agitators shall be as detailed on the plans and connected to the PP3 piping piping. Construction shall be machined or cast bronze/brass. Face plates shall be removable for alignment or cleaning by using security key part #WMF082. The water inlet connection shall be 1". The unit shall be the Combination Jet (WMD104) for vertical surface mount (1-meter springboard pedestals) and Stream Jet (WMD105) for deck level (horizontal surface below 3-meter springboards) mounting, by Crystal Fountains (905) 660-6674.
- I. Anti-vortex plates shall be provided at the suction points of the main recirculation pump(s) in the surge tank(s). Each plate shall be connected to the suction pipe via a PVC flange and shall be 1/2 in. thick with minimum dimension of at least 2.5 times the connecting pipe diameter. The plate shall be located 4 inches above the finished floor of the surge tank. Four (4) 3/4 in. stainless steel

threaded rods, nuts, anchor bolts and washers shall be used to fix the offset distance and provide a secure base for the suction pipe.

- J. Hydrotherapy inlet fittings shall be provided consisting of a cast bronze or cyclolac venturi body with 1-1/2 inch water inlet pipe connections and 1/2 inch air intake connection. A 1/8-inch IPS thread shall be provided in the inlet throat to permit hydrostatic pressure testing of piping system. The inlet shall be designed to operate at 25 GPM at a working pressure of 15 PSI and installed as shown on the drawings. Jet Body to be Waterway Model #210-5950 with Waterway Adjustable Fitting Model #210-6040, (Waterway Monster Fitting Model #210-8750 / Waterway Whirlpool Fitting Model #210-9790), or approved equal. Provide fitting adjustment tool from Waterway, Model #210-1770A, or approved equal.

2.05 PIPING SYSTEMS

A. General

1. Provide all recirculating piping between the pool(s) and the filter room, fill receptor and all interconnecting piping to and from the chemical feed systems and chemical controller.
2. Provide all necessary pipe supports and support systems required to support all associated piping and valves.
3. Provide all other tubing, conduit, or piping associated with equipment specified herein. Coordinate with other trades.

B. Pipes

1. Pipe routing as shown and detailed on the contract drawings is diagrammatic only and is not intended to show minor details or exact locations of piping systems. Installation is required to be adjusted to accommodate interference and adjustments anticipated and encountered. Pipe sizes on plans refer to nominal inside diameter of the pipe.
2. All PVC swimming pool piping shall be NSF approved and conform to the requirements of ASTM D-1785.
3. All PVC pipes shall be the product of one manufacturer. Approved manufacturers of PVC piping are Eslon, Harvel, and Chemtrol or approved equal.
4. Swimming pool piping above the floor or deck in the filter room shall be Schedule 80 PVC.
5. Swimming pool piping below the filter room floor or deck shall be NSF approved, Schedule 80 PVC.
6. All swimming pool piping under the pool floor shall be NSF approved, Schedule 40 PVC and concrete encased. All transitions between Schedule 40 and Schedule 80 shall be encased in concrete.
7. All below grade swimming pool piping not located beneath the pool floor can be backfilled with native granular material free of ice, clay, debris, organic matter, and rocks larger than 4" across their greatest dimension, and per recommendations indicated in the project geotechnical report.
8. The influent and effluent lines to the heat exchanger unit shall be CPVC. Connections between metallic piping and/or equipment and PVC shall be flanged.
9. All PVC and CPVC fittings shall be the product of one manufacturer. Molded fittings shall be as manufactured by Asahi, Eslon, Chemtrol, Harvel, Spear, Lasco or acceptable substitute. Fabricated fittings shall be as manufactured by Harrison Machine, Plastinetics, or acceptable substitute.
10. Vertical sight sump piping shall be NSF approved, Schedule 40 PVC. Horizontal sight sump piping shall be NSF approved, Schedule 40 PVC that is perforated and wrapped with fabric and have 3/8" diameter holes located top and bottom on 4 ft centers. Horizontal sight sump piping shall extend 1 ft minimum beyond the main drain.

11. Chemical feed lines from chemical feeders to recirculation piping shall be Schedule 80 PVC piping. Piping shall be hard piped into the recirculation plumbing. All required valves shall be of all PVC construction.
 12. All flanged plumbing connection hardware shall be stainless steel.
 13. All materials shall be installed by workmen thoroughly skilled in their trades and all work shall present a neat and mechanical appearance when complete. The CONTRACTOR, at no additional expense to the Department, shall replace or correct any work not judged acceptable by the Professional, Department's testing agency, or their consultants.
 14. All support hardware, brackets, fasteners, hangers, etc. installed in the surge tank shall be 316L stainless steel.
 15. No installation shall be made that will provide a cross-connection or interconnection between a distributing supply for drinking purposes and the swimming pool, or between the pool and a sanitary or storm water sewer system that will permit a backflow of water into the pool water system.
 16. All piping shall be hydrostatically (water) pressure tested for leaks before and after backfilling to guarantee water tightness. Pneumatic (air) pressure test not allowed.
 17. The CONTRACTOR shall provide 1/4" PVC water stops for this work for watertight penetration of concrete walls. Water stops shall be round and the O.D. shall be sized to 150% of the O.D. of the pipe. The water stops shall be thermo-welded to the pipe from both sides and shall be located at the centerline of the wall being penetrated prior to placing the concrete to assure a watertight seal.
 18. CONTRACTOR must adhere to all the applicable provisions in Division 22 - Plumbing, "General Provisions" and "Basic Materials and Methods" for installation of piping system.
 19. All mechanical equipment to be connected into the recirculation piping system shall be done so using flanged or union connections.
 20. Provisions shall be made to purge all pipes in the system.
 21. Concentric reducers shall be fiberglass by MerMade Filter, Inc., or equivalent reducers of schedule 80 PVC construction.
- C. Pipe Hangers and Supports
1. Manufacturer
 - a. Subject to compliance with these specifications, pipe hanger and support systems shall be manufactured by Cooper B-line (basis of design), Inc, TOLCO, and Anvil International or approved equal.
 2. Hangers
 - a. Pipes 2 inches and smaller
 - 1) Adjustable steel clevis hanger, B-Line models B3100 or B3104.
 - 2) Adjustable steel swivel ring (band type) hanger, B-Line model B3170.
 - b. Pipes 2-1/2 inches and larger
 - 1) Adjustable steel clevis hanger, B-Line model B3100.
 - 2) Adjustable steel yoke pipe roll, B-Line model B3114.
 3. Multiple or Trapeze Hangers
 - a. Trapeze hangers shall be constructed from 12 gauge roll formed ASTM A1011 SS, Grade 33 structural steel channel, 1-5/8 by 1-5/8 inch minimum, B-Line B22 strut or stronger as required.
 - b. Mount pipes to trapeze with 2 piece pipe straps sized for outside diameter of pipe, B-Line B-2000 series.
 4. Wall Supports
 - a. Pipes 2-1/2 inches and smaller
 - 1) Steel offset "J" hook hanger, B-Line model B3600.
 - b. Pipes 3 inches and larger

- 1) Welded strut bracket and pipe straps, B-Line models B3064 and B2000 series.
 - 2) Welded steel bracket B-Line model B3066 or B3067 with roller chair or adjustable steel yoke pipe roll. B-Line model B3120 or B3110.
5. Floor Supports
 - a. Electroplated carbon steel adjustable pipe saddle and nipple attached to steel base stand sized for pipe elevation. B-Line model B3093 and B3088T or B3090 and B8088. Pipe saddle shall be screwed or welded to appropriate base stand.
 6. Vertical Supports
 - a. Steel riser clamp sized to outside diameter of pipe, B-Line model B3373.
 7. Plastic Pipe Supports
 - a. V-Bottom clevis hangers with galvanized 18-gauge continuous support channel, B-Line models B3106 and B3106V, to form a continuous support system for all plastic pipes smaller than 1 inch or flexible tubing.
 - b. A vented and sloped continuous PVC Schedule 40 pipe no smaller than 1-1/2 inch outside diameter will be used to route flexible tubing with the appropriate pipe supports.
 8. Supplementary Structural Supports - Design and fabricate supports using structural quality steel bolted framing materials. Channels shall be roll formed, 12 gauge ASTM A1011 SS Grade 33 steel, 1-5/8 inch or greater as required by loading conditions. Submit design for pipe tunnels, pipe galleries etc. for approval. Use clamps and fittings designed for use with the strut system.
- D. Hanger Attachments
1. Upper Attachments
 - a. Beam Clamps
 - 1) Beam clamps shall be used where piping is to be suspended from building steel. Clamp type shall be selected on the basis of load to be supported, and load configuration.
 - 2) C-Clamps shall be locknuts and cup point set screws similar to B-Line model B351L or B3036L. Top flange c-clamps shall be used when attaching a hanger rod to the flange of structural steel, B-Line model B3034 or B3033 or approved equal. Refer to manufacturers recommendations for set screw torque. Retaining straps shall be used to maintain the clamp position on the beam where required.
 - 3) Center load beam clamps shall be used where specified. Steel clamps shall be B-Line models B3050 or B3055. Forged steel beam clamps with cross bolt shall be B-Line B3291-B3297 series or approved equal as required to fit beams.
 - b. Concrete Inserts
 - 1) Cast in place spot concrete inserts shall be used applicable, either steel or malleable iron body, B-line B2500 or B3014 or approved equal. Spot inserts shall allow for lateral adjustment and have means for attachment to forms. Select inserts to suit threaded hanger rods sizes, B-line models N2500 or B3014N series.
 - 2) Continuous concrete inserts shall be used where applicable. Channels shall be 12 gauge, ASTM A1011 Grade 33 structural quality carbon steel, complete with styrofoam inserts and end caps with nail holes for attachment to forms. The continuous concrete insert shall have a load rating of 2,000 lbs/ft. in concrete, B-Line models B22I, 32I, or 52I or approved equal. Select channel nuts suitable for strut and rod sizes.
- E. Hanger Accessories
1. Hanger rods shall be threaded on both ends or continuously threaded rods of circular cross section. Use adjustable lock nuts at upper attachments and hangers. No wire, chain, or perforated straps are allowed.
- F. Hanger Finish
1. Indoor Finishes

- a. Hangers shall be zinc plated in accordance with ASTM B633 OR shall have an electro-deposited green epoxy finish.
- b. Strut channels shall be pre-galvanized in accordance with ASTM A653 SS Grade 33 G90 OR shall have an electro-deposited green epoxy finish.
- c. Zinc Plated hardware is not acceptable for use in chemical rooms.

G. Valves

1. Valves 3 inches and larger shall be butterfly type valves, with PVC body, 150# SWP with stainless steel shaft, polypropylene disc and replaceable resilient seat bonded to a rigid shaft and guaranteed for bubble tight shutoff from 27 inch vacuum to 150 PSI. Extended neck 2 inch beyond flanges for any insulated piping shall be provided with handle for manual operation. All valve components shall be suitable for swimming pool chlorinated water service. Butterfly valves shall be Georg Fischer Type 563, Asahi/America Type SP Pool-Pro, Chemtrol Model-B, Simtech VP series, Colonial Valve 411 Series, or approved equal.
2. Valves smaller than 3 inches shall be PVC true union ball valves, full port, three-piece construction, blowout-proof stem, Viton seal with socket end connectors.
3. Check valves shall be a quick closing non-slam type, either self-aligning wafer or flanged type, of corrosion resistant materials suitable for use in a swimming pool environment. Install check valves in accordance with the manufacturer's recommendations. Locate check valves at least 5 pipe diameters from pumps and fittings. Provide check valves as indicated, where two pumps are used in parallel. Check valves shall be either by Technocheck Corp., model 5050, with epoxy coated cast iron body and bronze swing plates on a stainless steel spring; or approved equal, for installation between 150 lb flanges.
4. Modulating float valve in the surge tank(s) shall have PVC body and stainless steel wafer disc. All hardware shall be non-corrodible. The float-operated valves shall be provided horizontally on the main drain lines in the surge tank(s). Valve shall consist of all non-corrosion components including shaft, float arm, pins and floats. Valve shall be suitable for mounting on a 125E class standard PVC flange. The float arm-leverage weight and pivot lengths shall be adjustable to obtain desired ratio of surge tank level change to pool gutter overflow level change. Two floats and stabilizer required. Valve shall be Model FV-D XWB (Extra Weight Ball) as manufactured by MerMade Filter, Inc. or approved equal manufactured by EPD.
5. Submerged valves up to 3 inches shall be PVC true union ball valves. Submerged valves over 3 inches shall be PVC bodied, wafer type, butterfly valves with stainless steel handle extensions as required. Valves shall be by approved manufacturers listed above. Submerged valves must be provided with all stainless steel connectors. The stem housing extensions shall be properly supported and braced.
6. All butterfly type valves 8 inches and larger shall be fitted with a water tight gear operator.
7. All valves located 7 feet or greater off the floor shall be fitted with a chain operator.
8. All submerged valves, valves buried below grade, or valves not readily accessible, shall be provided with a stainless steel reach rod and handle.

H. Pipe and valve identification.

1. All exposed pool piping shall be equipped with color coded flow directional arrows at thirty (30) inch intervals per local and state swimming pool health code. The Contractor shall verify that all pool piping identification is in accordance with all local and state health regulations.
2. All valves shall be identified with minimum 1-1/2 inch diameter brass tags stamped with minimum 1/2-inch high numbers and attached to valves with #16 brass jack chain. (Plastic laminate engraved tags with nylon attachment acceptable.) Valves shall be described as to their function and referenced in the operating instruction manual and wall mounted piping diagram to be prepared by the CONTRACTOR.

2.06 CHEMICAL TREATMENT SYSTEMS

A. Calcium Hypochlorite (Chlorinator Briquettes)

1. Shop drawings complete with a piping diagram depicting the location in which the dry chlorination feeder is to be connected to the system shall be provided and approved prior to installation. Installation of the system shall be as specified in the manufacturer's directions and no exceptions shall be taken. CONTRACTOR shall provide either of the calcium hypochlorite systems specified in this section.
2. A factory-authorized representative shall provide training to the Using Agency and the training shall be video recorded per 131100, Section 1.12 of the project contract documents.

3. Pulsar

a. Pulsar I System (Spa)

- 1) The sanitization system shall be a Pulsar 1 system and shall operate in a non pressurized manner to ensure optimum safety and ease of operation.
- 2) A post filter recirculation loop will be added to the main pool recirculation system as part of the Pulsar 1 system. The recirculation loop will provide the vacuum to evacuate the chlorinated solution.
- 3) The sanitization system shall be N.S.F. listed.
- 4) The sanitization system shall incorporate the principle of "Wave" technology. Water shall rise in a "wave" from a submerged nozzle on to the grid of Briquette Tank making contact with Pulsar Plus dry chlorinator briquettes. The briquettes shall be in contact with the water creating a chlorinated solution which will fall into the discharge tank. The chlorinated solution shall be drawn by vacuum from the discharge tank and introduced into the recirculation system. The output shall operate with a vacuum range between 5" and 29" Hg.
- 5) The vacuum is created by an Arch venturi, which is installed in the post filter recirculation loop. The venturi is installed on the pools return line and a valve situated between the inlet and outlet of the venturi loop is partially closed causing a pressure differential thereby establishing flow through the venturi, which provides the suction on the discharge valve evacuating the discharge tank. An emergency shutoff valve shall ensure that water flow to the wave nozzles is shut off in the unlikely event that the discharge tank has not emptied properly.
- 6) The system will operate with an inlet water pressure of 2-20 psig. The inlet water is supplied from the pressure in the pool return line.
- 7) The briquette hopper shall have a capacity of twenty eight (28) pounds of Pulsar Plus dry chlorinator briquettes.
- 8) The chlorine output shall be controlled by the inlet flow rate which has a operating range of 0.2 – 1.05 GPM. In addition an ORP controller will be used for more precise control. The inlet flow rate will allow a minimum available chlorine (AvCl) output of 0.5 lb/day and will allow a maximum available chlorine (AvCl) output of 28 lbs./day.
- 9) The sanitization system shall be capable of functioning in temperature between 40°F and 130°F.
- 10) The sanitization system shall operate with Pulsar Plus dry chlorinator briquettes having 65% minimum available chlorine with a 0.4 to 0.6% scale inhibitor (by weight).
- 11) The sanitization system shall be capable of satisfactory performance if installed as per the manufacturer's recommendations (reference Pulsar 1 installation manual). An Authorized Representative of the manufacturer shall be located within a reasonable

distance of the facility and shall be available to install and service the system as required.

- 12) Manufacturer warrants parts (excluding electrical components) of the sanitization system to be free of defects in workmanship and material for 2 years from date of installation.

b. Pulsar III/IV System

- 1) Provide a Pulsar III system for the Recreation Pool.
- 2) Provide a Pulsar IV system for the Competition Pool.
- 3) The sanitization system shall operate in a non pressurized manner to ensure optimum safety and ease of operation.
- 4) A post filter recirculation loop will be added to the main pool recirculation system as part of the Pulsar III/IV system. The recirculation loop will provide the inlet water supply to the chlorinator as well as the vacuum to evacuate the chlorinated solution.
- 5) The sanitization system shall be N.S.F. listed.
- 6) The sanitization system shall incorporate the principle of spray technology. Water shall spray on to the grids of the briquette tank making contact with the Pulsar Plus dry chlorinator briquettes. The briquettes shall be in contact with the water for a short time creating a chlorinated solution which will fall into the discharge tank. The chlorinated solution shall be drawn by the vacuum from the discharge tank and introduced into the recirculation system. The output shall operate with a vacuum range between 5" and 29" Hg.
- 7) The vacuum is created by a Mazzei venturi, model 1585X, which is installed in the post filter recirculation loop driven by a 1 hp Pulsar pump. The venturi is installed on the discharge side of the Pulsar pump creating a flow through the venturi, which provides the suction on the discharge valve evacuating the discharge tank. An emergency shutoff valve shall ensure that water flow to the spray manifold is shut off in the unlikely event that the discharge tank has not emptied properly.
- 8) The system will operate with an inlet water pressure of 25 - 45 psig (III) / 27-30 psig (IV). The inlet water is supplied from the 1 hp Pulsar pump.
- 9) The briquette tank shall have a capacity of sixty-two (62) pounds (III) / two hundred (200) pounds (IV) of Pulsar Plus dry chlorinator briquettes.
- 10) Pulsar III - The chlorine output shall be controlled by a timer or an ORP controller. The timer has twenty-one settings. One knob controls the off time which ranges from 19 seconds to 53 minutes and is called out from A (19 seconds) to G (53 minutes). The on time is controlled by a second knob, which has 3 settings, ranging from 10 to 30 seconds, low being 22 seconds, normal being 11 seconds and high being 30 seconds. The timer will allow a minimum available chlorine (AvCl) output of 1 lb/day and will allow a maximum available chlorine (AvCi) output of 120 lbs/day.
- 11) Pulsar IV - The chlorine output shall be controlled by a timer or an ORP controller. The timer has twenty-one settings. One knob controls the off time which ranges from 18 seconds to 54 minutes and is called out from A (18 seconds) to G (54 minutes). The on time is controlled by a second knob, which has 3 settings, ranging from 10 to 30 seconds, low being 20 seconds, normal being 10 seconds and high being 30 seconds. The timer will allow a minimum available chlorine (AvCl) output of 1 lb/day and will allow a maximum available chlorine (AvCi) output of 360 lbs/day.
- 12) The sanitization system shall be capable of functioning in temperature between 40°F. and 130°F.

- 13) The sanitization system shall operate with Pulsar plus dry chlorinator briquettes having 65% minimum available chlorine with at 0.4 to 0.6% scale inhibitor (by weight).
- 14) The sanitization system shall be provided with a spare screen.
- 15) The sanitization system shall be capable of satisfactory performance if installed as per the manufacturer's recommendations (reference the Pulsar III/IV installation manual). An authorized representative of the manufacturer shall be located within a reasonable distance of the facility and shall be available to install and service the system as required.
- 16) The manufacturer shall warrant parts of the sanitization system to be free of defects in workmanship and material for 2 years from date of installation.
- 17) The unit shall be provided with an illustrated installation, operating and maintenance manual with drawings and detailed written descriptions of all phases of controller function.
- 18) Final installation, start-up calibration, and instruction of operating personnel shall be performed on-site by an authorized representative of the manufacturer.
- 19) Training sessions shall be video recorded and included with the final O&M manuals.

4. PPG PowerBase

a. General Description

- 1) The system shall be designed to feed low concentrations of calcium hypochlorite in solution intermittently or continuously as required for pool and spa applications. The system shall be a single pre-assembled, package unit with a welded aluminum frame consisting of chlorinator, electrical box, centrifugal pump, and solution tank for ease of installation and operation. The system shall be the PowerBase Model by PPG Industries, Inc. Only Accu-Tab® Blue SI calcium hypochlorite tablets by PPG Industries, Inc shall be used, the patented blue colorant added for safety (to help prevent accidental mixing with other chemicals).
- 2) The base proposal requires providing equipment as specified herein, though substitutions will be considered. The bidder is cautioned that substitutions must meet the quality and operational requirements of each feature specified in Section 2 below. Batch systems with pressure mixing components producing chlorine concentrations exceeding the limits of the specifications will not be considered.
- 3) Any system offered shall use an NSF Standard 50 listed erosion feeder and tablet combination, and shall be capable of meeting all requirements of the Health Department having jurisdiction over the installation.

b. System Features

- 1) A maximum chlorine solution level of 0.05% (500 ppm) shall be maintained to prevent calcification in system components. Systems producing chlorine concentrations higher than 0.05% shall not be acceptable.
- 2) Delivery shall be by erosion feed technology to control accurate and consistent concentration limits in the chlorine treatment solution. Soaking type, spray and/or vortex technology systems shall not be acceptable.
- 3) The chlorinator shall automatically and continuously feed a limited quantity of chlorine in solution as needed; when the system is not running, no more chlorine than that amount which can be fed in one minute or less shall be left in the tank to prevent dilution. Batch systems preparing excess quantities of solution for delivery over an extended period shall not be acceptable.
- 4) A centrifugal pump wired to the system electrical box shall feed freshly mixed chlorine treatment solution only as required for maximum efficiency. Batch systems requiring

the use of a metering pump or pumps to feed pre-prepared standing solution shall not be acceptable.

- 5) All piping in the chlorinator unit shall be Schedule 40 PVC. Systems with flexible tubing shall not be acceptable.

c. System Components

- 1) Tablet Chlorinator. Accu-Tab® chlorinators by PPG Industries, Inc are designed exclusively for Accu-Tab® Blue SI calcium hypochlorite tablets by PPG Industries, Inc. Tablets are placed on a sieve plate inside the chlorinator; as water flows across the sieve plate, the tablets erode at a rate proportional to the flow rate.
 - 2) Inlet Water Supply Connection.
 - a) Model 1030 (Recreation Pool and Spa) - 1" FNPT (water supply of 10 GPM required).
 - b) Model 3140AT (Competition Pool) - 2" FNPT (water supply of 60 GPM required).
 - 3) Inlet Solenoid Valve. Opens and closes on command when the system receives a signal. 110 VAC required from chemical controller. Applicable to models 3140AT and 3500.
 - 4) Inlet Water Strainer. A strainer to protect chlorinator components from start-up debris and sand from broken filter laterals.
 - 5) Flow Meter. A rotameter flow meter, measuring the flow of the water-eroding stream to the chlorinator.
 - 6) Inlet Control Valve. PVC gate valve mounted in line with the flow meter allows operator to adjust flow of water-dissolving stream. Applicable to models 3140AT and 3500.
 - 7) Solution Tank. PowerBase 3500 made of HDPE, all others made of PVC. Capacities:
 - a) Model 1030 7.5 gallon
 - b) Model 3140AT 22 gallon
 - 8) Float Valve. Made from Schedule 80 PVC and 316L stainless steel, this float valve maintains the solution tank level.
 - 9) High Level Switch. Prevents the solution tank from overflowing. High level: when activated, a switch opens the circuit to the solenoid valve, causing the solenoid valve to close. Applicable to models 3140AT and 3500.
 - 10) Solution Delivery Pump. Delivers chlorinated solution to the return line. A single-stage centrifugal pump is provided for systems with pressures up to 20 PSIG. (For systems requiring a discharge pressures greater than 20 PSIG, a custom selected pump shall be utilized.)
 - 11) Discharge Check Valve. A PVC swing check valve prevents reverse flow of water into the system.
 - 12) Discharge Control Valve (manual). Used to balance system output water flow with system input water flow.
 - 13) Outlet Connection
 - a) Model 1030 1" NPT
 - b) Model 3140AT 2" NPT
 - 14) Aluminum Frame. Type 6061-T.
 - 15) Nema 4X Electrical Enclosure
- d. Optional Equipment
- 1) High Pressure Pump. On systems requiring unit discharge pressures greater than 20 PSIG.
 - 2) High-High-Low (HHL) Level Switch. A second high level switch (Hi-Hi) is installed above the high level switch that will run the solution delivery pump in case of an upset

condition in the solution tank. A low level switch will protect the pump by preventing it from running dry.

e. Electrical Requirements

- 1) Two electrical circuits are required for operation: (1) 110v 15 amp power, and (1) 110v control circuit from a pool controller.

B. pH Buffering System (CO₂)

1. Shop drawings complete with a piping diagram depicting the location in which the CO₂ feeder is to be connected to the system shall be provided and approved prior to installation. Installation of the system shall be as specified in the manufacturer's directions and no exceptions shall be taken.

2. Bulk Storage

- a. Provide a system for storing, regulating and feeding carbon dioxide for pH control. The system shall consist of CO₂ storage tanks, a lockable fill box for bulk delivery, a pressure reducing/regulating system, a feed and rate of flow adjustment control system, injection or mass transfer system, and all valves, tubing, fittings and appurtenances required for a complete and operable system. The system is to include the following components.

1) CO₂ Storage Tanks

- a) Provide two (2) 600 lb mass storage tanks (one (1) at Competition Pool and one (1) at Recreation Pool / Spa) meeting ASME requirements, specifically designed and configured for use with CO₂. The tank(s) shall be of an insulated, vacuum-jacketed double wall construction with a rated service pressure of at least 292 psig. The outer shell shall be stainless steel and given a 10 mil dry film thickness epoxy coating, the inner shell shall be of stainless steel.
- b) Each tank shall include shut off and pressure regulating valves, gauges for accurate output pressure control, a 350 psig pressure relief valve, and shall be provided with a dual pressure building/economizer regulator that includes a 7.5 amp, 120 VAC heater extending into the tank and the liquid CO₂.
- c) Usage rate capacity shall have a range of 3.2 pounds per day to 20 pounds per hour. Secure tank to building wall with a coped saddle and a 16 GA x 3" stainless steel strap bolted to wall.
- d) Fill tank with CO₂ for initial testing and operation, and provide full tank(s) at the time of Owner acceptance.
- e) The tank(s) shall be as manufactured by Siemens, Taylor-Wharton, MVE, or approved equal.

2) Remote Fill Box

- a) Provide a remote fill station capable of filling the tank(s) at the rate of approximately 30 to 50 pounds per minute in a manner that does not require entry to the storage room containing the CO₂ tank(s). Length of tubing between remote fill box and bulk storage tank shall not be more than 20', unless otherwise noted. Each fill station shall consist of a flush mounted (recessed) lockable fill box located at the exterior of the building, as indicated, connected to the CO₂ system. It shall include a quick disconnect and automatic closure coupling. Box shall be flush-mounted, 8" x 8" x 2" and constructed of painted 16 gauge galvanized or stainless steel, or sized to module with exterior masonry.
- b) Tanks are to be connected to outside fill station(s), as indicated, with two lengths of 1/2 inch ODT copper for the purpose: one to transfer liquid to the tanks from a bulk delivery vehicle, and the other from the relief valves to the outside of the building. All copper tubing from remote fill box to storage tank shall be fitted with either double ferrule swage fittings, or silver soldered fittings.

3. Mass Transfer System.

a. Provide one mass transfer system, as described below, for each of the system to receive CO₂. Feed is to be totally diffused and made to go fully into solution without evidence of CO₂ bubbling at any point where water is open to atmosphere.

1) Tubing connection between bulk storage tank and mass transfer system shall be one of two methods: pressure rated 3/8" poly/tygon tubing (in runs over 10' enclosed PVC conduit) or 1/2 OD copper double ferrule swage fittings, or silver soldered fittings; refer manufacturer.

a) Provide three (3) systems (one (1) for each body of water); a wet stone diffuser designed for use with CO₂, sized to the pipe in which it is to be inserted and for the maximum anticipated rate of CO₂ flow. Provide with pipe saddle connector and all fittings and connectors required for a complete and operable installation.

4. Adjustable Rate of Flow Feed Unit(s).

a. Provide an adjustable rate of flow feed unit to control the flow of CO₂ from the storage tank(s) to each feature to receive CO₂. The feed unit(s) shall be connected to the storage system with thick wall 3/8 inch OD reinforced braided polyethylene tubing enclosed in schedule 40 PVC. Feed system shall include 120 volt AC solenoid operated valve for remote on/off control of CO₂.

1) Spa requires one (1) Stranco Model # CO2-3, 0-30 SCFH.

2) Competition Pool requires one (1) Stranco Model # CO2-9, 20-200 SCFH

3) Recreation Pool requires one (1) Stranco Model # CO2-9, 20-200 SCFH

C. Ultraviolet Dechloramination and Disinfection System

1. It is the intent of these specifications that the swimming pool water be routinely monitored and treated by UV sterilization in the range of 220nm to 400nm to kill bacteria, viruses, molds and their spores and to continuously remove chloramines. The concentration of free chlorine residual shall at all times meet the requirements of the Health Department authority having jurisdiction over the swimming pool.

2. The method of monitoring and treatment specified and shown on the drawings is intended as the basis for receiving bids. It is not the intent of these specifications to limit competition. The base proposal must be on providing equipment as specified; however, a bidder will at his option offer a substitution. The bidder is cautioned that any substitution must meet the quality and operational requirements of these specifications. Any proposed UV system must have a UL listing on the complete system, and be listed under NSF Standard 50. Any substitute system shall have Health Department approval for this project prior to being offered.

3. The UV system offered under these specifications shall have been used for a minimum of ten years in swimming pool applications and the bidder must supply a list of at least ten satisfactory installations with contact names and telephone numbers.

a. Basis of design: UV system shall be manufactured by Hanovia, Triogen, ProMinent, Engineered Treatment Systems (ETS), or approved equal.

4. Equipment General Description

a. The UV System shall be a complete unit with all necessary controls. The system shall be preassembled and controls packaged for ease of installation at the job site and shall include:

1) the UV chamber with flow and output safety control;

2) a UV medium pressure arc tube modified to emit UV light from 220nm to 400nm;

3) an automatic, adjustable, electric motor-driven quartz sleeve cleaning system;

4) operational and power controls.

5) the ability to dose control the UV delivered to the pool water.

- b. The system for the Competition Pool shall be sized for the recirculation rate of 1,500 GPM with 12" return to pool pipe size and be a model PMD321G3/12AW.
- c. The system for the Recreation Pool shall be sized for the recirculation rate of 500 GPM with 6" return to pool pipe size and be a model PMD200D1/6AW.
- d. The system for the Spa shall be sized for the recirculation rate of 300 GPM with 6" return to pool pipe size and be a model PMD150D1/6AW.

Pool Type	Model Number	Max Flow (GPM)	Lamps	Watts	Power (KW)	Voltage (V) with Breaker Size**
Competition Pool	PMD321G3/12AW	1,520-2,420	3	10500	10.5	480 (30 amp breaker)
Recreation Pool	PMD200D1/6AW	440-670	1	3500	3.5	208 (20 amp breaker) / 480 (15 amp breaker)
Spa	PMD 150D1/6AW	260-440	1	3500	3.5	208 (20 amp breaker) / 480 (15 amp breaker)
* Not to exceed 10'/sec, Schedule 80 PVC						
** All breakers to be 'D' curve type breaker						

5. UV Chamber

- a. The UV chamber shall be pressure rated for continuous operation at 150 psi, tested to 225 psi and constructed of type 316L stainless steel.
- b. It shall be designed for an internal pressure drop not to exceed 2 psi at maximum flow.
- c. The chamber shall incorporate:
 - 1) a temperature sensor to shut off the UV arc tube when there is inadequate flow in the chamber;
 - 2) an UV intensity monitor which alarms when the UV arc tube output drops below the dosing level required for proper operation. The monitor shall be of the wet probe type wavelength specific to 240nm - 280nm with a 4-20mA output. It shall display actual lamp intensity (mW/cm²) on the control cabinet door display.
 - 3) a stainless steel terminal cover fastened to the chamber end plate, to which is affixed the electrical conduit, to protect the lamps and electrical leads.
 - 4) a design for laminar flow to provide maximum efficiency in the transfer of UV to the water
 - 5) Limit switches shall be located to position the wiper, and to prevent the wiper parking over the active arc tube. The switches shall be magnetic type, and shall include visual indication of the wiper position. The wiper mechanism shall be fail safe, and shall shut the system down in the event of failure, as described below.
 - 6) The chamber shall contain a quartz sleeve, which is sealed at both ends by a UV shrouded O ring. The quartz must be annealed for durability and against breakage. Systems that contain a quartz thimble shall not be permitted. The thimble is inherently buoyant and poses a safety risk to operators during annual maintenance.
 - 7) The wetter surfaces shall be chemically passivated and all welds ground to eliminate any potential corrosion mechanisms. Crevices (as found behind a quartz thimble) shall not be permitted under any circumstance.

- 8) A simple strainer to prevent any glass returning to the pool in the event of accidental glass breakage of the quartz sleeve.
 - 9) UV equipment shall be complete with calibrated UV sensors, which record the output of all the UV lamps installed in a system.
6. Automatic Wiper System
- a. For periodic cleaning of the quartz sleeves and the UV monitor probe, the chamber shall be fitted with an automatic cleaning mechanism. It shall consist of a single SS yoke with Teflon bosses and replaceable molded viton wiper rings which travel the full length of the quartz sleeve twice per cleaning cycle. The frequency of the wiper cycle shall be adjustable from 15 to 720 minutes and set for job conditions. The mechanism shall be driven by a two-pole bi-directional electric motor and acme lead screw. Reed type limit switches shall control the length of travel. The wiper mechanism wiper rings in the "parked" position shall not be over the lamp, blocking the transfer of UV light, or creating a "hot" spot on the arc tube.
7. Ultra Violet Lamp
- a. The UV lamp shall be a high intensity, medium-pressure UV arc tube modified to emit a continuous UV spectrum from 220nm to 400nm into the water. Full output must be available from 0 to 200 degrees. The lamp shall be UL approved with one electrical lead at each end.
 - b. Each lamp shall be individually numbered and the manufacturing process shall permit full audit and traceability of assembly. In addition to an individual serial number, the part number shall be displayed on the lamp.
8. UV System Control
- a. The system control cabinet shall be epoxy coated steel, NEMA-12, fan cooled with louvers and replaceable filters. The control system shall be de-energized when the cabinet door(s) are open. All wiring shall be harnessed in DIN channels. The power supply to the UV arc tubes shall be from a constant wattage transformer. The entire system shall be UL listed and there shall be a decal clearing showing this listing displayed in the cabinet. The control cabinet shall display via a back lit liquid-plasma display the following information:
 - 1) Power on
 - 2) UV intensity (% and mW/cm²)
 - 3) UV dose (mJ/cm²)
 - 4) Flow rate in GPM
 - 5) Arc tube ready indicator
 - 6) Any alarm condition
 - 7) Wiper status and alarm
 - 8) Consumable spare parts list with part numbers
 - 9) Local/remote operation switch, door mounted
 - 10) Data logging of UV dose, lamp hours, lamp intensity for regulatory audit.
 - b. The control panel shall contain an Earth Leakage detector, which shall provide fail-safe protection for bathers and those working on the equipment within the pool environment. This requirement is mandatory, as the voltages used within UV systems can pose risk of death.
 - c. The control panel shall be UL LISTED, and in addition shall conform to EN 50081 and EN 61000. The panel and all UV components shall be manufactured to ISO 9001-2000.
 - d. Power Switching - The UV system shall have power switching capability to increase or decrease the power to the lamp as necessary to achieve the proper dose required by the swimming pool. The power switching shall have four (4) power levels capable of automatically adjusting between the four levels, increasing or decreasing, depending on

the quality of the pool water. NOTE: 50% turndown capability shall not be permitted as an equal to power switching.

9. Instructions

- a. The manufacturer (supplier) shall prepare complete drawings for the installation and printed instructions for the operation of the UV system herein specified and shown on the drawings. A qualified factory trained representative of the manufacturer shall install this equipment, put it into operation and instruct the Using Agency's representative in the operation and maintenance of all such equipment.

2.07 WATER CHEMISTRY MONITORING AND CONTROL SYSTEMS

- A. The water chemistry control system for the competition pool, recreation pool and spa shall provide continuous monitoring and control of sanitizers, oxidizers, pH, ORP, free chlorine, total chlorine, combined chlorine, temperature, system flow rate, and water chemistry balance calculations. The controller shall manage the recirculation pump with a programmable Fireman Cycle feature, which automatically turns off the Heater, UV and Auxiliary systems prior to shutting off the recirculation pump. All line-voltage wiring shall be performed in a separate NEMA 4X enclosure that precludes access to the controller electronics. Installation of the system shall be per the manufacturer's specification and no exceptions shall be allowed. A factory trained/authorized representative shall provide training to the Using Agency and the training shall be videotaped per 131100, Section 1.12 of the project contract documents. The specified controller, a BECSys7 manufactured by BECS Technology, Inc. shall be provided or Chemtrol by SB Control Systems, AcuTrol by Pentair, ProMinent, or a technically equal system capable of providing equal performance for all operating functions.
- B. Certifications
 1. The controller shall carry the following product certifications
 - a. NSF/ANSI Standard 50;
 - b. UL 61010-1
- C. Sensors
 1. The controller shall come with the following sensors
 - a. pH - The controller shall provide a measurement of pH by utilizing a sensor with the following characteristics:
 - 1) 0 - 14 sensing range
 - 2) ABS body with 1/2" NPT process connection
 - 3) Minimum of 32 milliliters of inorganic electrolyte gel; organic electrolytes, susceptible to breakdown in the presence of strong oxidants, shall not be considered equal
 - 4) A porous Teflon liquid junction to provide a stable, low impedance reference contact, and to prevent fouling and clogging of the liquid junction
 - 5) A silver/silver chloride (Ag/AgCl) reference element
 - 6) A general purpose glass membrane pH sensing element
 - 7) Operating temperature range of 0 - 80 degrees C
 - 8) Operating pressure range of 0 - 100 psiG.
 - 9) The controller shall continuously monitor, display and data log pH with 0.1 or 0.01 resolution (programmable).
 - b. ORP - The controller shall provide a measurement of ORP by utilizing a sensor with the following characteristics:
 - 1) -1000 to +1000mV sensing range
 - 2) ABS body with 1/2" NPT process connection

- 3) Minimum of 32 milliliters of inorganic electrolyte gel; organic electrolytes, susceptible to breakdown in the presence of strong oxidants, shall not be considered equal
 - 4) A porous Teflon liquid junction to provide a stable, low impedance reference contact, and to prevent fouling and clogging of the liquid junction
 - 5) A silver/silver chloride (Ag/AgCl) reference element
 - 6) A solid platinum or solid gold ORP sensing element with a minimum of 1 cm² surface area; platinum-plated and gold-plated sensing elements, which are susceptible to abrasives, shall not be considered equal
 - 7) Operating temperature range of 0 - 80 degrees C
 - 8) Operating pressure range of 0 - 100 psig
 - 9) The controller shall continuously monitor, display and data log ORP with 1mV resolution
- c. Flow Sensor - The controller shall provide a measurement of pool circulation flow rate and volume by utilizing a flow sensor with the following characteristics:
- 1) 0-8800 gpm (0-33265 liter/min) measuring range,
 - 2) Magmeter flow sensor with a frequency output,
 - 3) Dual O-ring seal,
 - 4) Cable to meet length requirement for installation,
 - 5) Saddle to meet return line size,
 - 6) Flow volume: 999 trillion gallons, 1st gallon resolution; 999 trillion liters, 1 liter resolution.
 - 7) The controller shall continuously monitor, display and data log flow rate with 0.1 gpm resolution.
- d. Temperature - The controller shall provide a measurement of water temperature by utilizing a sensor with the following characteristics:
- 1) 32 - 212°F (0 - 100°C) sensing range;
 - 2) 2 wire, 100Ω resistive temperature detector (RTD) with a 0.00385 Alpha.
 - 3) The controller shall continuously monitor, display and data log temperature with 1°F resolution.
- e. Free Chlorine Sensor - The controller shall provide a measurement of free chlorine by utilizing an amperometric sensor with the following characteristics:
- 1) 0.0 to 20.0 mg/l (ppm) measuring range with fully selectable scale,
 - 2) 32° - 113°F operating temperature range,
 - 3) A PVC body,
 - 4) Replaceable PTFE membrane and electrolyte,
 - 5) Gold cathode and silver/silver chloride anode.
 - 6) The controller shall continuously monitor, display and data log free chlorine with 0.1 mg/l resolution.
- f. 4-20mA Sensors
- 1) Total Chlorine Sensor (with Combined Chlorine Reading) - The controller shall provide measurement of total chlorine utilizing a sensor with the following characteristics:
 - a) 0.0 to 20.0 mg/l (ppm) measuring range,
 - b) 41° - 113°F operating temperature range,
 - c) Replaceable PTFE membrane and electrolyte,
 - d) Gold cathode.
 - e) The controller shall continuously monitor, display and data log total chlorine with 0.1 mg/l resolution. The controller shall also continuously monitor, display and

data log combined chlorine (from the total chlorine and free chlorine sensors) with 0.1 mg/l resolution.

D. User Interface

1. Standard Display - The standard display shall be a backlit transreflective LCD with 14 line x 40 alpha/numeric graphical characters that will continuously display information related to the following:
 - a. All installed sensor readings
 - b. Set points, with current control status
 - c. All active alarms, including time activated
 - d. Smart menus w/ integrated on-screen help
 - e. Contrast adjustment of the backlit LCD shall be provided through clearly marked keys on the front-panel without the need for access to internal controller circuitry. After initial adjustment, controller shall monitor internal temperature and automatically adjust contrast to prevent LCD blackout in extreme ambient temperature conditions. Controllers that do not include front-panel contrast adjustment and automatic temperature compensation shall not be considered equal.
 - f. The standard user interface shall include single-touch access to Set Points, Relay Modes, Calibrations, Backwash status and settings, Menu access, and Reset Fail/Safes. An alphanumeric keypad shall be provided for ease of system configuration.

E. Control Functions

1. Water Chemistry

- a. pH Control: The controller shall continuously control pH. Chemical feed shall be configurable for feed-up, feed-down, or dual feed and either on/off or time-based proportional feed.
- b. Sanitizer Control: The controller shall continuously control sanitizer based upon the ORP reading, the amperometric sensor, or both with a bracketed control program. Chemical feed shall be configurable for either on/off or time-based proportional feed.
- c. Bracketed Sanitizer Control: With the amperometric ppm sensor, the controller shall be configurable for bracketed sanitizer control; The bracketed control algorithm shall allow either the ORP or ppm setpoint to be chosen as the primary control point, while using other parameter to create a secondary boundary (min and max settings) that must be maintained in addition to the primary control point.
- d. Sanitizer Booster Feed: The controller shall have a sanitizer booster program with selectable ORP and/or ppm set points with separate ending set points, allowing the option of the booster sanitizer to control to a lower set point while the primary system can recover.
- e. UV Control: A Fireman Cycle feature shall turn off (ramp down) the UV relay 0 to 60 minutes (settable) prior to backwash initiation or recirculation pump shutdown.
- f. Auxiliary: A Fireman Cycle feature shall turn off (ramp down) the Ozone/Auxiliary relay 0 to 60 minutes (settable) prior to backwash initiation or recirculation pump shutdown. The Ozone Fireman control and relay shall have the ability to be renamed in the menus to provide the Fireman Cycle feature for Auxiliary equipment instead of ozone as needed.
- g. Combined Chlorine UV Control: The controller shall provide turndown control of a UV system based upon combined chlorine set point; when combined chlorine is below set point the UV system will be turned down to decrease energy consumption and extend bulb life.
- h. Superchlorination: The controller shall have a programmable superchlorination function, based upon ORP or ppm superchlor setpoint, which is triggered manually.

- i. Dechlorination: The controller shall have a programmable dechlorination function, based upon ORP or ppm dechlor setpoint, which is triggered either manually or by the completion of the superchlorination function.
 - j. LSI & RSI: The controller shall compute the Langelier Saturation Index and the Ryznar Saturation Index based upon current inputs and the Ca Hardness and Alkalinity entered by the operator.
- 2. Expanded
 - a. Flow Monitoring: The controller shall continuously monitor, display, and datalog system flow, maintaining a total flow volume. A Low Flow Alarm shall be operator settable, which can be programmed to disable chemical feeds. Controller shall also have a Minimum Flow Rate setting to turn off heater whenever system flow is less than this programmed minimum level.
 - b. Heater Control: The controller shall perform on/off control of a heater based upon an operator settable temperature set point. A Fireman Cycle feature shall turn off the Heater 0 to 60 minutes (settable) prior to recirculation pump shutdown. The controller shall immediately turn off the Heater when system flow is less than the heater Minimum Flow Rate setting. The Heater control algorithm shall include an Energy Conservation mode, with on/off set time and secondary temperature set point.
- 3. Energy Conservation
 - a. Alternate Setpoints: The controller shall have alternate Sanitizer, Heater, and Autofill setpoints, based upon a 4 event 28 day timer.
 - b. Energy Conservation Mode: The controller shall have the capability to disable all mechanical and chemical functions during programmed conservation cycle. The Energy Conservation Mode shall include the ability to periodically monitor and satisfy all operation requirements based upon a programmed time schedule.
- F. Main Recirculation Pump
 - 1. On/Off Control with Relay
 - a. Controller shall provide the capability to interface to and control a recirculation pump with a programmable relay. The controller shall provide 3 operator-settable independent Fireman Cycle settings and relays for the Heater, UV and Auxiliary controls. The controller shall include the following capabilities, available as appropriate based upon installed sensors and implemented features:
 - 1) Fireman Cycle: Upon the following events, the controller shall automatically delay recirculation pump shutdown until the Heater, UV and Auxiliary controls have been deactivated and the corresponding Fireman Cycles have expired:
 - a) Backwash Operations
 - b) Energy Conservation mode (24 hr., 7 day function)
 - c) Manual off (per Operator)
 - 2) Immediate: Upon the following events, the controller shall immediately turn off the recirculation pump (and Heater, UV and Auxiliary controls), without first satisfying Fireman Cycle timing requirements:
 - a) Surge Tank Level Low Alarm: Turn off pump immediately (surge tank is almost empty)
 - b) Strainer Vacuum High Alarm: Turn off pump immediately (possible entrapment)
 - c) Emergency shutdown, triggered by front-panel Emergency Off: Turn off pump immediately (per Operator)
 - 2. VFD Interface with 4-20mA signal
 - a. Controller shall provide the capability to interface to and control a recirculation pump equipped with a Variable Frequency Drive (VFD) through a 4-20mA signal. The

controller programming shall allow the operator to manage the VFD entirely from the water chemistry controller, by providing the following capabilities:

- 1) Programmable setpoint specified as either flow rate, effluent filter pressure, or fixed setting,
- 2) Four programmable operator-triggered alternate profiles ("Manual Turndowns"),
- 3) Four programmable scheduled alternate profiles ("Scheduled Turndowns"),
- 4) Override setting for backwash,
- 5) Ramp up and ramp down settings,
- 6) Minimum output setting.
- 7) Remote access to current VFD status and all VFD parameters shall be provided through the BECSys for Windows PC software provided with controller. The name of each alternate profile shall be changeable by the operator, so that VFD menus and data log entries are intuitive and recognizable by the users of the system.
- 8) Systems that do not provide both local and remote management of the VFD through the water chemistry controller shall not be considered equal.

G. Control Outputs

1. Relay Outputs

a. Solid-State Relays

- 1) The controller shall come with a total of 4 integral line or dry contact 5A solid-state relay outputs capable of switching 3A under all normal operating conditions, accounting for the effects of the temperature gradient inside the NEMA 4X enclosure. Systems that utilize relays that are not de-rated must submit an engineering evaluation justifying the use of relays at their full, optimal-condition capacity. All solid-state relays shall have a provision for an electrical interlock with the circulation pump motor starter.

2. Mechanical Relays

a. The controller shall come with a total of 5 mechanical relays:

- 1) 1 integral 8A dry contact mechanical relay, and
- 2) 4 integral 3A dry contact or line powered mechanical relays.
- 3) Since mechanical relays have the inherent risk of failing in the closed (active) position, as a safety measure the controller shall preclude the ability to assign any of the integral mechanical relays to chemical feed functions. Systems that do not preclude mechanical relays from being configured for chemical feeds shall not be considered equal. All mechanical relays shall have a provision for an electrical interlock with the circulation pump motor starter.

3. 4-20mA Outputs

a. The controller shall come with eight separately isolated 4-20mA output signals with a load capacity of 440Ω per output channel. Each output signal shall be independently configurable for either of the following functions:

- 1) Any enabled input, scaled between two operator-defined end points,
- 2) VFD control of recirculation pump.

H. Safety Features

1. Manual-On limit

- a. The controller shall have built-in limits to the amount of time any relay control output may be forced on (i.e. in "Manual On" mode). This is an important safety feature to prevent control outputs from inadvertently being left forced on after service or diagnostics.

2. High/Low Alarm Settings & Control Lockouts
 - a. The controller shall have programmable high and low alarm settings for pH, ORP, PPM, temperature, low flow & no flow and chemical overfeed, turbidity, pressure & vacuum, surge tank levels, chemical inventory. The controller shall have a programmable lockout of sanitizer feed upon pH high or low alarm.
3. No Flow Alarm & Flow Restored Delay
 - a. The controller shall activate a No Flow alarm when the dedicated sample stream flow switch indicates there is insufficient flow through the sample stream. This No Flow alarm shall lockout all chemical feed control operations. The controller shall include a Flow Restored Delay, which shall extend the No Flow lockout user-programmable amount of time after the No Flow alarm ends (i.e. flow is restored). This feature is necessary to assure that the system has valid, stable sensor readings of circulating water prior to making chemical feed control decisions.
4. Feed Limit Alarms
 - a. The controller shall trigger a FailSafe alarm if a chemical feed relay remains on longer than the programmable Feed Limit Timer. Chemical feeds shall automatically be disabled if the corresponding reading goes into a FailSafe alarm condition.
5. Emergency Off
 - a. The controller shall have a dedicated Emergency Off button on the front panel of the system, which immediately halts all chemical feeds and control outputs when pressed. This feature shall be password protectable, which shall require entry of one of the Security passwords.
6. Safety shield
 - a. The controller shall include a safety shield or other mechanism for allowing fuse replacement without access to high voltage circuitry or wiring.
- I. Security
 1. The controller shall have three security password levels: six for operators, two for managers and one for the distributor providing for a history of access identified by the user.
- J. Data Logging
 1. The controller shall have 512K battery backed-up RAM for input level recording and events. All input level shall be recorded for 10 to 56 days depending on sample rate (2 to 10 minutes).
 2. The controller shall record and maintain the latest 1100 events over a maximum of 14 days recording all alarms, parameter changes, user logins, and operational cycles related to all control features.
- K. Local Alarms Indicators
 1. The controller shall signal all alarm conditions with the following indicators:
 - a. A bright red flashing LED on the front of the controller,
 - b. Activation of a master alarm signal provided as a dry contact relay enabling the use of 0-240 VAC alarms, and
 - c. Each active alarm listed on the LCD display along with time activated.
- L. Remote Communication, Access & Alarm Notification
 1. Ethernet
 - a. The controller shall come with a standard, integral 100BaseT Ethernet connection. The controller shall be capable of providing Remote Access via PC with Ethernet connection and Alarm Notification via email or text message via an Ethernet connection to the Internet.

2. Remote Access
 - a. The controller manufacturer shall provide BECSys for Windows™ graphical remote operation software, for interactive connection to the controller from a PC. Remote operation software shall be Vista-compatible, and have all of the following operational modes:
 - 1) Site Data Base – for organizing and accessing multiple controllers on site, or at multiple sites.
 - 2) Graphical Operator's Console – to display current readings, setpoints, alarm points and control status in an easy-to-read graphical mode.
 - 3) Data Log Graphing – to review data logs with time-synchronized event data; data log traces shall be configurable, with color and line style selectable by operator.
 - 4) Full Menu Tree – All system parameters accessible through a full menu tree interface.
 - 5) Auto-Polling – to allow automatic download of data logs from all controllers in site database.
 3. Alarm Notification
 - a. The controller shall be capable of providing alarm notification to 8 different recipients. Each recipient shall be individually configurable to receive alarm notification by one of the following methods.
 - 1) Email: Notification message shall include system type, serial number, location, system ID, and all active alarm including the date and time each alarm was triggered.
 - 2) Text Message: Notification message shall include system type, serial number, location, system ID, and all active alarm including the date and time each alarm was triggered.
 - 3) Fax: Notification message shall include system type, serial number, location, system ID, and all active alarm including the date and time each alarm was triggered.
 - 4) Numeric Pager: Notification message shall include callback number. Controller shall acknowledge pager notification when callback is received, and not notify subsequent recipients programmed for pager notification.
 4. Ethernet with MODBUS TCP/IP: The controller shall come with a standard, integral 100BaseT Ethernet connection that supports a MODBUS TCP/IP connection to 3rd party applications such as EMS, BMS, BAC and SCADA systems. The MODBUS TCP/IP connection shall support access to Inputs (current readings), System Information, Set Points, Alarm Points, Control Status and Alarms. Set Points and Alarm Points shall be modifiable from the 3rd party application via the MODBUS TCP/IP interface.
- M. Enclosures
1. The controller shall be housed in a NEMA 4X polycarbonate enclosure.
 2. Field wiring enclosure: All high voltage field wiring shall be through a separate NEMA 4X enclosure that precludes access to controller electronics. All high voltage connections shall be clearly identified and a field wiring diagram shall be provided with the controller for installer reference. All controller high-voltage relay assignment parameters shall be programmed at the factory prior to delivery to installation location.
- N. Flow Cell
1. PVC flow cell
 - a. The flow cell shall have a PVC body with two ½" NPT ports for pH and ORP sensors, two ¼" NPT ports for temperature sensor and sensor wash acid injection, and a clear acrylic front viewing window. The flowcell design shall provide precise sample flow rate and water velocity regulation past the probes. The flowcell shall come provided with PVC ½" isolation ball valves, PVC ¼" wet test valve and standard reed or optional rotary flow switch.

- b. Each flow cell shall be equipped with a pressure-sensing device. The pressure sensor shall consist of a compound pressure/vacuum gauge manufactured in stainless steel, 2 1/2" diameter, liquid filled with an operating pressure range of 0 to 60 psig and vacuum of 0 to -30 in./ Hg.

O. Start-up and Manuals

- 1. The control system shall be provided with on-site start-up, on-site operator training, and 1 year on-site warranty service performed by a representative trained and authorized by the controller manufacturer.
- 2. Manufacturer shall supply an Operation and Maintenance Manual describing features, operating instructions, maintenance procedures and replacement parts.

2.08 FLOW METERS

A. Flow Meter

- 1. Flow meters (3 required) shall be installed according to the manufacturer in the filtered water return lines to each of the pools. Flow sensor shall be the GF Signet 2551 insertion magmeter. Provide the coaxial cable from the sensor to the display/transmitter. Flow meter accuracy shall be +/- 2% of reading. Display/Transmitter capability will be part of chemical controller function or as separate Signet GF Signet 9900 display/transmitter. Signet GF Signet 9900 display/transmitter shall be powered by 24VDC and provide a 4-20mA output.

B. Refill Flow Meter

- 1. Refill flow meter (3 required) shall be installed on dilution piping to backwash tank. Flow meter shall be one piece meter body of injected molded polysulfone adapters, viton o-ring seals, and 316L stainless steel floats and float guide, impact resistant machined acrylic plastic body. GPM scale to be permanently etched or imprinted on the meter. Flow rate indicator to be of stainless steel material. Scale range to be appropriate for specific flow rate. Manufacturer shall be BLUE-WHITE or approved equal Model F-45750LHN-12, 3/4" M/NPT @ 0.4 to 10.0 GPM.

2.09 WATER LEVEL CONTROLLERS

A. In Surge Tank Water Level Controller (For Competition and Recreation Pools)

- 1. Provide a water level sensing and control system for Competition Pool and Recreation Pool that will monitor the water level in the surge tank and automatically activate the auto water make-up control valve. For sensing water level and activating make-up water control valve for each pool, use Series ELC-810 Controller housed in a watertight NEMA 4X UL94 5V UL flammability rated polycarbonate enclosure to meet IP66 and NEMA 4, 4X, 12 and 13 ratings. The Controller shall utilize two sensor(s) to control water level. ELC-810 series shall have a menu-driven LCD display screen and utilize a five-switch user interface for navigation through the menu. The menu shall allow changing the following settings: delay to shutoff, alternate sensor option, maximum time on, manual override, delay to normal, type of sensor, high level option, flow sensor active, and sounder with alarm. All menu settings shall be capable of password protection. The Controller shall be capable of displaying the following data: last fill time, last drain time, last alarm. The Controller shall be capable of determining the following: maximum time on exceeded, over current to solenoid valve, no valve/valve wiring problem, and sensor not working properly. The Controller shall have a low voltage interlock with auto water make-up solenoid valve, shall provide adjustable time delay for increasing level and manual override; and shall require 115 VAC, 1 phase, 60 Hz power. Manufactured by AquatiControl Technology, Model ELC-810-DS-ST-XXX (Contractor to coordinate the specific length(s) of cable required for each controller prior to ordering). Refer to drawings for additional information. Provided and installed by CONTRACTOR and connected by electrical.

2. Provide a solenoid valve for high level sensor, normally opened, stainless steel fitted, bronze body, 24 VAC slow closing type. Size to pipe. Interlock with automatic water level control system. Refer to the Drawings for additional information. Such as ASCO, or approved equal.
 3. Provide a proximity switch sensor that shall be sensitive to within $\pm 1/8"$ (4mm) of nominal water level. Supply voltage to sensor shall be 12V to 24V DC from Controller. Current consumption shall be $\leq 15\text{mA}$. Response frequency shall be 100Hz. Maximum control output shall be 200mA. Sensor operating temperature shall be -25 Deg. C to 70 Deg. C. Operating humidity shall range from 35% RH to 95% RH. Sensor shall be mounted in a 1" SCH80 PVC pipe (length to be determined by depth of surge tank). Sensing pipe to be mounted to surge tank wall with composite/non-metallic hangers and stainless steel hardware. Sensing pipe shall be capable of being submerged under water safely. Refer to drawings for additional information.
 4. Wiring from the sensor to the Controller shall be provided and shall be connected to the terminal points mounted within a corrosion-resistant, nonmetallic NEMA 4X enclosure. All wiring connections shall be made through the bottom of the enclosure. The enclosure size shall be no less than 8" wide x 5" high x 4" deep. The access door shall be the entire front face panel of the enclosure. Confirm location in field.
 5. Major components shall be plugged in using WAGO terminal blocks for ease of installation and replacement. Unit shall be designed to activate a 24-volt AC solenoid valve.
 6. Provide a make-up water solenoid valve, normally closed, stainless steel fitted, bronze body, 24 VAC slow closing type. Size to pipe. Interlock with automatic water level control system. Refer to the Drawings for additional information. Such as ASCO, or approved equal.
 7. Discharge of make-up water shall be into a fill standpipe and piping to the Competition Pool and Recreation Pool. Refer to the Drawings for additional information.
- B. In Deck Water Level Controller (For Spa)
1. Provide a water level sensing and control system for the Spa that will monitor the water level in a well located in the deck at the side of the pool and which will automatically activate the auto water make-up control valve. For sensing water level and activating make-up water control valve for each pool, use Series ELC-810 Controller housed in a watertight NEMA 4X UL94 5V UL flammability rated polycarbonate enclosure to meet IP66 and NEMA 4, 4X, 12 and 13 ratings. The Controller shall utilize two sensors to control water level. ELC-810 series shall have a menu-driven LCD display screen and utilize a five-switch user interface for navigation through the menu. The menu shall allow changing the following settings: delay to shutoff, alternate sensor option, maximum time on, manual override, delay to normal, type of sensor, high level option, flow sensor active, and sounder with alarm. All menu settings shall be capable of password protection. The Controller shall be capable of displaying the following data: last fill time, last drain time, last alarm. The Controller shall be capable of determining the following: maximum time on exceeded, over current to solenoid valve, no valve/valve wiring problem, and sensor not working properly. The Controller shall interlock with auto water make-up solenoid valve and shall provide adjustable time delay for increasing level and manual override; 115 VAC, 1 phase, 60 Hz. Manufactured by AquatiControl Technology, Model ELC-810-DS-DW-XXX (Contractor to coordinate the specific length(s), "XXX," of cable required for each controller prior to ordering). Refer to drawings for additional information. Provided and installed by CONTRACTOR and connected by electrical.
 2. Provide a solenoid valve for high level sensor, normally opened, stainless steel fitted, bronze body, 24 VAC slow closing type. Size to pipe. Interlock with automatic water level control system. Refer to the Drawings for additional information. Such as ASCO, or approved equal.
 3. Provide a proximity switch sensor that shall be sensitive to within $\pm 1/8"$ (4mm) of nominal water level. Supply voltage to sensor shall be 12V to 24V DC from Controller. Current consumption shall be $\leq 15\text{mA}$. Response frequency shall be 100Hz. Maximum control

output shall be 200mA. Sensor operating temperature shall be -25 Deg. C to 70 Deg. C. Operating humidity shall range from 35% RH to 95% RH. Sensor shall be housed within a fiberglass deck well. The deck well shall consist of two compartments – a wet well connected to the pool via a 1½" static line, and the dry well to consist of a rigid plastic enclosure which houses the sensor and attaches to a ½" static line connected to the wet side. The dry side shall incorporate a 1½" overflow drain and a ¾" female threaded connection to allow connection of sensor cable conduit. Installation of Deck Well at pool side by CONTRACTOR. Coordinate for the provision of conduit from deck well to Controller by Electrical and plug drain from deck well to waste.

4. Wiring from the sensor to the Controller shall be provided and shall be connected to the terminal points mounted within a corrosion-resistant, nonmetallic NEMA 4X enclosure. All wiring connections shall be made through the bottom of the enclosure. The enclosure size shall be no less than 8" wide x 5" high x 4" deep. The access door shall be the entire front face panel of the enclosure. Confirm location of Controller in Field.
5. Major components shall be plugged in using WAGO terminal blocks for ease of installation and replacement. Unit shall be designed to activate a 24-volt AC solenoid valve.
6. Provide a make-up water solenoid valve, normally closed, stainless steel fitted, bronze body, 24 VAC slow closing type. Size to pipe. Interlock with automatic water level control system. Refer to the Drawings for additional information. Such as ASCO, or approved equal.
7. Discharge of make-up water shall be into a fill standpipe and piping to the Spa. Refer to the Drawings for additional information.

2.10 INSERTS AND ANCHOR SOCKETS

- A. Sockets and anchors shall be provided as stainless steel or cast bronze for swimming pool accessories. The CONTRACTOR shall confirm compatibility of deck equipment and deck anchors with the deck equipment manufacturer. All anchors or sockets shall be provided with flush closure caps and escutcheons with set screws where indicated. Escutcheons shall be of the keyhole or oblong shape, similar to the casted, electro-polished stainless steel escutcheon with set screw by Paragon #28303SS, or approved equal.
 1. Anchor sockets for all railings and grab rails shall be of the wedge type, cast bronze, 4 inches in depth and made to receive 1.50 inch OD tubing as manufactured by Paragon #28105, or approved equal. The wedge shall be cast bronze, incorporate a stainless steel tightening bolt and flat washer, and be designed as the sacrificial element to the anchor system. All metallic components shall be passivated, in compliance with ASTM A967-99, incorporating organic acid passivation techniques for maximum corrosion resistance.
 2. Anchor sockets for all stanchions shall be of cast bronze, sized to receive a full 6 inches penetration of 1.900 inch OD tubing as manufactured by Paragon Aquatics Catalog No. 38201TC, Spectrum Products No. 23626, or approved equal. Each anchor socket is to be provided with a flush threaded, vandal proof closure cap Paragon Aquatics Catalog No. 38201TC or Spectrum Products No. 23628, and a grounding lug with screw. Provide Paragon Aquatics catalog no. 38303, Spectrum Products catalog no. 23630, or approved equal spanner wrenches for removing the closure cap.
 3. Cup anchors for racing lane lines, water polo tether and boundary lines etc. shall be incorporated into the perimeter overflow system. Cup anchors shall be chrome-plated cast bronze with chrome-plated bronze threaded eyebolts. The heavy-duty cup anchors shall have a 3-3/8" diameter with a ½"-13 eyebolt and a 3-3/16" deep anchor body. Cup anchors shall be Keifer Commercial cup anchor, catalog no. 700108, or approved equal.
 4. Anchors sockets for single post starting platforms located on the deck level gutter and bulkhead shall be designed to prevent rocking. A stainless steel cap shall be provided to flush mount on the deck when platform is removed. Anchor socket shall be cast T304 stainless steel

with wedge assembly consisting of a bronze wedge and T304 stainless steel hardware. Anchors for starting platforms shall be by the starting block manufacturer - Quickset Dual-wedge anchor by KDI Paragon, SR Smith Rock Solid anchor, Record Breaker anchor by Spectrum, or Riptide anchor by Kiefer.

5. Anchors for the diving board stands shall be all bronze threaded castings for respective 5/8" threaded anchor bolts. The stand shall be designed for mounting with the use of Duraform catalog number 70-231-900 bronze deck anchors.
6. Anchors for bulkhead locations shall be provided by the bulkhead manufacturer and installed into the gutter system by the CONTRACTOR where shown on drawings.

2.11 DECK EQUIPMENT

- A. Grab rails shall be provided as required in the quantities and to the dimensions as shown on the drawings. Grab rails shall be fabricated of one continuous length of polished and buffed tubing. The tubing shall be ASTM-A-554 grade 316L stainless steel, 1.50 inch OD x .120 inch minimum wall thickness, polished and buffed to 320 grit finish and shall be passivated, in compliance with ASTM A967-99, incorporating organic acid passivation techniques for maximum corrosion resistance. All bends shall be smooth and free of wrinkles. Grab rails shall be pretzel bend style with dimensions as indicated in the plans and as manufactured by Spectrum, SR Smith, Paragon, or approved equal.
- B. Entry rails shall be provided as shown on the drawings, fabricated from one continuous piece of polished and buffed ASTM-A-554 grade 316L stainless steel, 1.500 inch OD x .120 inch wall thickness, polished and buffed to 320 grit finish and shall be passivated for maximum corrosion resistance. Bends shall be smooth and wrinkle free. Custom rails shall be as manufactured by Spectrum Products, or approved equal. Custom rail submittal drawings shall be complete with details of custom fabrication and installation information.
- C. Railings for the diving tower and springboard pedestals shall be provided as detailed on the architectural drawings. Rails shall be custom fabricated of one continuous length of tubing wherever possible. The tubing shall be type 316L stainless steel, 1.500 inch OD x .120 inch wall thickness polished and buffed to 320 grit finish with slip resistant finish.
- D. Stanchion posts (backstroke and false start) shall be provided as required and in the quantities shown on the drawings. The posts shall be a straight length of type 316L stainless steel tubing, 1.900 in. OD x .145 in. wall thickness x 8 ft. 0 in. overall length, polished and buffed to 320 grit finish. Stanchions shall be capped at one end with a closure plug containing a U-shaped hook and fitted with a stainless steel eyebolt attached to an adjustable nickel plated bronze sliding collar. Stanchion shall be as manufactured by Paragon Aquatics, catalog no. 38106, or Spectrum Products catalog no. 23614 with Paragon Aquatics catalog no. 38301 or Spectrum Products catalog no. 23625, sliding collar, with eyebolt or approved equal.
- E. Starting Platforms
 1. Single post starting platforms for the deck level gutter and bulkhead (9 required, 8 plus 1 spare) shall have number plates on both sides numbered 1 through 8. Spare block shall not be numbered. Platform block height shall be 29-1/2" inch above water level. The platform top (24" wide x 32" deep) and intermediate rear step (8" x 12") shall be constructed of UV inhibited high density polypropylene. The surface shall have a non-skid dual cross-grooved sand textured finish. The top shall be permanently positioned at a 10° tilt towards the pool. Frames to be 2.5 square inch x .125 inch wall thickness 304 stainless steel tubing with a powder coated finish. Platforms shall be able to utilize anchors in the pool deck and in the bulkhead. Professional/Using Agency to select colors. Verify height of platform above water before ordering. Backstroke bar shall be 1" diameter and allow both horizontal and vertical grab positions. Blocks shall have raised side grip handles and adjustable back plate. Blocks shall have raised side grip handles and adjustable back plate. Platforms shall be custom

blocks as detailed on the plans similar to the Paragon Track Start Quickset, Legacy starting platform by SR Smith, Keifer Riptide, Spectrum Record Breaker, or approved equal. Each starting platform shall have two labels affixed stating "Warning-Execute Shallow Racing Dive - Impact with Pool Bottom can Cause Permanent Injury."

2. Starting platform safety covers (8 required) are designed to keep unwanted users off starting platforms. The cover is made of 1/16" thick tough, lightweight plastic with a UV stabilizer and fits 24" x 32" platform tops. The conical shape and safety orange color act as a deterrent of starting platform use. Each cover is provided with a bungee cord for securing cover platform top.

F. Water Polo Goals (Using Agency Provided)

1. Goals shall be constructed to meet all official regulations of FINA, NCAA, NFSHSA, and USWP. Where a conflict exists between these specifications and the official regulations of FINA, FINA shall govern. Special finishes and backings shall comply with the regulations. Deck-mounted water polo goals shall be adjustable vertically to provide the regulation cross bar elevation in shallow or deep water.
2. Floating water polo goal (2 required) shall consist of a front frame made of non-corrodible 3 inch x 2 inch aluminum with rounded edges and supported by 1 1/4" non-corrodible polished pipe. The flotation unit shall be vacuum formed ABS plastic supported by high-density ethafoam. The floating goal shall be as manufactured by Anti-Wave Club, Anti-Wave Odyssey, Kiefer KAP204, Kiefer WPG1402, or approved equal. The goal shall be provided with mesh netting securely fastened to the cage. Goal shall incorporate attachments for wave quelling cable floats, hooks and take-up ratchet for securing to rope anchors.

G. Lifeguard Chairs

1. Lifeguard chairs (4 required) shall be movable and provided with a molded plastic seat 6 feet above the deck. The seat shall be capable of a 360-degree swivel and shall be supported on a stainless steel tube structure. Platform shall be laminated wood coated with fiberglass and polyester resin, and have a non-skid surface. Access to the platform shall be by means of a sloping front ladder, 26" wide. Ladder steps shall be injection molded ABS, UV stabilized, 26" long x 5" wide with a raised slip resistant tread. The framework of the chair shall be rigidly bolted. Ladder and guard rails shall be manufactured of polished and buffed ASTM-A-554 grade 316L stainless steel, 1.50 inch OD x 0.083 inch wall thickness. All metallic components shall be passivated, in compliance with ASTM A967-99, incorporating organic acid passivation techniques for maximum corrosion resistance. 6" diameter wheels shall be attached to the bottom of the rear legs and means of attaching a rescue tube and umbrella shall be provided. Lifeguard chairs shall be the 6 Ft Discovery, by Spectrum Products, catalog no. 20160 (6-foot), or approved equal.
2. Lifeguard chairs (2 required) shall be constructed of UV inhibited recycled HDPE chairs. Seat height shall be 36" above the pool deck. All joints shall be secured using T- 316L stainless steel screws. All major sub-assemblies shall be secured together with chrome-plated CP18-8SS through bolts and nuts. Chair shall include umbrella guide and holders. Chair color shall be selected by Professional. Lifeguard chairs shall be Mendota #42022 by Spectrum, Tailwind Furniture model no. LG505, or approved equal.

H. Diving Stands

1. Diving stands for the one-meter and three-meter springboards shall be installed as shown on the plans. The diving board stand shall consist of heavy aluminum castings dipped in erudite chromic acid solution, followed by a 20 mil coat of baked epoxy. Finish must be touched up in the field if damaged in shipping or assembly. The roller tube and tracks shall be heat-treated extruded aluminum processed by Alcoa Duranodic hard anodizing process. The bearings for the roller tube and slide shall be nylon with grease fittings, adjustable and field replaceable. The diving board anchor hinges and pins shall be heat treated aluminum forgings with a design

tensile strength of 35,000 psi and shall receive Alcoa Duranodic hard anodizing. Hinges shall be designed to allow 180-deg. rotation of the diving board to the rear of the stand. Hinges shall be mounted on a transverse casting machined to allow 7 leveling positions in one-inch increments. The diving board anchor bolts shall be 5/8-inch diameter by 3-1/2 inch long silicon bronze. The diving stand shall be supplied with top and intermediate guard rails on two sides. The diving stand guard rails shall be stainless steel tubing firmly attached to the guard rail supports with stainless steel band fasteners. The rails shall extend to the edge of the swimming pool and the rail ends shall be fitted with rubber safety tips. Fulcrum shall have an adjusting wheel at one end that can be turned by hand or foot. Diving stands to be as manufactured by Duraflex International Corp.

- a. Short stand (5 required) shall be Durafirm catalog #70-231-524 and included with six (6) bronze deck anchors, Durafirm catalog #70-231-900.
- I. Diving boards (5 required) shall be an aluminum extrusion type springboard. The diving boards shall be a Maxi-Flex Model "B" diving board as manufactured by Duraflex International, Inc., model #66-231-330 or approved equal. The diving board shall be 16 ft long and 19-5/8 inches wide. The top surface shall be finished with three coats combined with a mixture of sand and white aluminum oxide to affect the non-skid surface with 200 perforations.
- J. Surge tank access hatch (2 required) shall be provided as shown on the drawings. The access hatch shall be a single door 3 ft.-2 in. x 2 ft.6 in with 1" fillable pan to receive ceramic tile and grout or concrete fill to match the surrounding deck. The frame shall be 1/4 inch extruded aluminum with built in neoprene cushion and continuous anchor flange. Door shall be 1/4" aluminum plate reinforced with aluminum stiffeners as required. Door shall be equipped with heavy continuous stainless steel hinges and shall have compression spring operators for easy operation. Door shall open to 90 degrees and lock automatically in that position. Door shall be built to withstand a live load of 150 lbs. per square foot and equipped with a continuous Type 316L stainless steel hinge, tubular type, and an automatic hold open arm with release handle. All hardware is to be type 316L, 18-8, stainless steel. A flush lift handle and a snap lock with removable key wrench shall be provided. Factory finish shall be mill finish with bituminous coating applied to the exterior of the frame. The access door shall be Type TER-3 single leaf pan type door as manufactured by the Bilco Company.
- K. Surge tank ladder rungs shall be 1/2 inch Grade 60 steel encased with co-polymer polypropylene plastic as manufactured by M.A. Industries, Inc, phone 770-487-7761.
- L. Pool Lift
 - 1. Pool lift (2 required) shall be a battery powered handicap lift with footrest assembly. Lift shall comply with the Americans with Disabilities Act Access Guidelines (ADAAG), be capable of lifting 400 lbs, and shall include a stainless steel anchor socket, cover, spanner key, and a seat belt assembly. The following accessories shall also be provided: caddy, arm rest assembly, lift cover, stability vest, extra battery, wireless controls, and spineboard attachment. All stainless steel components shall be 316L. Lift to be a Splash Aquatic Lift, model #300-0000, manufactured by S.R. Smith, the Traveler II XRC500 model #27610, manufactured by Spectrum Products, or approved equal. Contractor to confirm pool lift fits on pool perimeter and operates correctly.

2.12 LOOSE EQUIPMENT

- A. Competition floating lane lines shall be as shown on the drawings and described in these specifications. Floating lane lines shall be a non-turbulent type with wave quelling floats and 3/16" stainless steel coated cable. Floats shall be injection-molded polyethylene. Colors to alternate the length of the pool with a contrasting solid color for the final 15 feet (Professional/Using Agency to select colors). All floating lane lines shall be provided as completely assembled and installed with take up reel, type 304 stainless steel spring and cable

lock, hooks, and wrench. 5/8" wrench shall be made of a forged steel shaft with a polished chrome finish. The take up reel shall be constructed of type 304 stainless steel. The spool shall be a bronze nickel-plated casting with a nylon sleeve. Floating lane lines shall be similar to Competitor Swim Products, Competitor Gold Medal 6" Lanes pre-assembled and sized to fit the length of the pool. Floating lane lines with disconnects for shorter distance is acceptable. Provide contrasting disks located 15 meters from each end to meet resurfacing requirement. This requirement shall be met for each possible course length.

Quantities:

Competition Pool: Provide 10 at 25 yards (9 plus one spare).

- B. (Using Agency Provided) Water polo floating lines shall be as shown on the drawings and described in these specifications. Floating lines shall be a non-turbulent type with wave quelling floats and 3/16" stainless steel coated cable. Floats shall be injection-molded polyethylene. All floating lines shall be provided as completely assembled and installed with take up reel, type 304 stainless steel spring and cable lock, hooks, and wrench. Water polo floating lines shall be pre-assembled and sized to fit the length of the water polo course. Provide extension hooks as detailed on the drawings complete with protective sleeve. Floats shall be colored per NCAA and FINA guidelines for each water polo course as shown on the drawings and listed below. Water polo floating lines shall be similar to Competitor Swim Products Water Polo Rink, Anti-Wave Water Polo Course Lines, Kiefer Advantage Water Polo Course Markings, or approved equal.

Colors:

Goal Line	White
2 Meter Line	Red
5 Meter Line	Yellow
Half Distance Line	White

Quantities:

Competition Pool: Provide 2 boundary lines for FINA/NCAA water polo field of play. Provide four (4) goal tether lines with 4" white disks for each goal with a FINA/NCAA field of play. Two (2) tether lines for each goal shall include 2 meters long x 1.08 meters wide area of solid red disks to identify the re-entry area per FINA WP1.2 field of play diagram.

- C. (Using Agency Provided) Water polo ejection board shall be shown on the drawings and described in these specifications. The ejection board shall be capable of displaying both teams' cap numbers, the number of ejections per cap number, and each team's remaining time outs. The board shall be 1/4" aluminum material with attached acrylic tracks that fit 2" high quick change letters and colored circles. The ejection board shall be securely attached to a wall or attached to a moveable stand. The ejection board shall be custom made by All Star Record Boards, call (814) 725-5834, or approved equal.
- D. Backstroke flags shall be made of Nylon material, triangular in shape (12" wide x 17" long), and alternating in color, butted end to end on vinyl covered stainless steel cable. Submit samples for review and approval. The cable shall be attached to a stainless steel take up reel at one end and a stainless steel tension spring end-fitting at the other. Equipment shall be similar to the following items by Kiefer: backstroke flag (product no. 600121), racing lane cable (product no. 210210), take-up reel (product no. 210218S), and spring end fitting (product no. 210219). Provide backstroke flags with team/school name on one side and lane identification on the other.
- E. Recall rope shall be 1/2 inch yellow polypropylene rope complete with weight rings and two quick snap connectors made of chrome-plated brass. The rope shall consist of a neco plate

- constructed of soft aluminum that is crimped and used to connect the two pieces of rope to form the required loops. Recall rope shall be Recreonics, catalog no. 92-967 for a 8 lane pool.
- F. Lane line storage reel shall be fabricated from a heavy-duty aluminum reel joined together by a 1-1/2 inch aluminum axle. This unit must ride easily on four hard rubber wheels. The CONTRACTOR is responsible for assembly. The correct number of storage reels shall be provided to store all lane line markers. Lane line storage reel to be equal to Competitor Swim Products, stor-lane reel, Catalog #200 350 with Competitor storage reel cover, catalog #200 351.
 - G. Lifeline shall be 3/4 inch blue and white polyethylene rope with floats that are 5 inch diameter by 9 inch long. Floats to be spaced on five foot centers. All metallic rope hooks shall be stainless steel. Provide lifeline at five foot break between shallow and deep water as shown on the drawings. Lifeline to be equal to Recreonics no. 14-381.BW or Lincoln Aquatics 44-115 safety line rope, Recreonics no. 14-381 or Lincoln Aquatics 44-190 locking 5" x 9" floats, and Recreonics no. 14-456 or Lincoln Aquatics 44-125 rope end hooks.
 - H. Water Basketball and Water Volleyball
 - 1. Deck mounted water basketball (1 goal required) shall be provided at the locations shown on the drawings. Equipment shall include: 6" slip anchor with lid (2 anchors required per goal), stainless steel posts, backboard, goal, net, and one basketball per goal. The water basketball goals shall be as manufactured by Kiefer catalog #501401 with Kiefer catalog #700103 anchors or approved equal.
 - 2. Deck mounted water volleyball shall be provided at the locations shown on the drawings. Equipment shall include: heavy duty 2 3/8" dia. powder coated aluminum stanchion posts with finishing rings, anchors with caps, heavy duty 24' net with net shortening kit, adjustable height net clamps and hot colored ball. Hardware shall be brass and stainless steel. The water volleyball shall be by Dunn Rite model Deck Volley item no. DMV100 with brass anchored units item no. DMV100BR or approved equal.
 - I. Movable Stanchions and Swag Lines
 - 1. Deck railing with swag line (stanchion posts and anchors) shall be provided as required and in the quantities shown on the drawings. The posts shall be a straight length of 1 1/2" PVC, (1.9 in. OD), 4 ft. 6 in. Stanchions shall be capped at one end and fitted with two stainless steel eyebolts attached to an adjustable sliding collar. Plastic chain shall be connected to each eyebolt to provide a 6 inch maximum vertical swag. Plastic chain shall be Recreonics no. 46-034, Lincoln Aquatics no. 53-135, or approved equal.
 - J. T-wrench for operation of valve extensions shall be fabricated of 3/4" diameter SCH 40 stainless steel pipe. The T-wrench shall be 4'-0" in length with a 24" long welded "T" handle. The wrench shall be fitted with a 3/4" square stainless steel male end, 1" in length, for operation of valve extensions at the surge tank. Two complete T-wrenches shall be provided.

2.13 MAINTENANCE EQUIPMENT

- A. The following items are to be supplied by the CONTRACTOR unless otherwise noted. All proprietary names are to designate performance only. Equal products will be accepted.
 - 1. Wall brush (2 required) - Brush backing shall be a flexible polyethylene material with five (5) rows of nylon bristles. Pool brush holder shall be permanent mold cast aluminum with hydrofoil flap. Holder shall have stainless steel screws to facilitate brush changes. Handle bracket shall be quick detachable mount to fit standard 1 1/4 or 1 1/2 inch diameter handles. Brush to be Recreonics no. 10-135, Lincoln Aquatics 31-020, or approved equal.
 - 2. Skimming net (2 required) - Skimmer head shall consist of one-piece molded plastic frame with a reinforced, integral handle bracket suitable for quick attachment to a standard 1 1/4 or 1 1/2 inch diameter handle using bolts and wing nut. The standard nylon net shall be attached to the frame using the groove and spline method. Net depth shall be 4 inches minimum in the center. Skimmer net shall be manufactured by Skimlife No. SS8, or approved equal.

3. Telescopic Poles (4 required) - Cleaning tool handle shall be of the telescopic design and fabricated from corrosion resistant, high-quality anodized aluminum. Poles shall be fully adjustable, to desired length, with a simple twist of a cyclac threaded locking device. Poles shall consist of a 1 inch tube fitted inside a 1¼ inch tube and be adjustable from a range of 8 ft. to 16 ft. Handle shall be adjustable from 8 ft. to approximately 16 ft. having a threaded bushing type clamp to lock handle at desired position. Poles shall be manufactured by Pool King, or approved equal.
4. Portable Vacuum Poles
 - a. Stainless steel poles (6 required) - Vacuum head attachment poles are to have a heavy duty 1¼ inch stainless steel handle with special brass male and female threaded inserts on the ends. Poles are to be 8 ft. each, totaling a 24 ft. length for vacuum head attachment. Poles are to be Recreonics no. 10-330 with female thread adaptor being Recreonics no. 10-335 or approved equals.
5. Test Kits
 - a. Provide two (2) test kits FOR EACH MECHANICAL ROOM - The first test kit shall feature liquid reagents, color comparator, waterproof instructions and treatment charts, chemistry guide and water gram. Test kit to have the ability to test for free and total chlorine (0.5 - 5.0 ppm), bromine (1-10 ppm), pH (7.0 - 8.0), acid and base demand, total alkalinity, calcium hardness and cyanuric acid. Test kit shall be Taylor Complete 2005 test kit, or approved equal.

The second test kit shall be photometric and utilize tablet reagents for stability that will allow accurate measurement of free and total chlorine (0-10 ppm), bromine, pH, alkalinity, calcium hardness, and cyanuric acid. The test kit shall have solid-state digital electronics and built-in filters. The test kit shall be direct-reading with automatic blank settings, automatic power cut-off, and store the last 10 results in nonvolatile memory. Test kit shall be a Pooltest 6 system based on the Palintest system of water analysis. Provide SPH 006D Pooltest 6 - Hard Carry Case Kit and SPC 006 Check Standard or AquaPRO 6 Test Kit manufactured by Orbeco-Hellige Inc. and Reference Standard Kit (LP275680).
6. Vacuum Cleaner.
 - a. Vacuum cleaner (filtered water return to pool) - (2 required) to be complete with a 36 inch dual manifold head with 50 feet of 2 inch floating hose. Hose to be Recreonics, catalog no. 10-422 or approved equal. 24 ft. stainless steel pole shall be available for attachment. The portable cartridge vacuum cleaner system shall include a 155 square foot T-316 stainless steel up-flow single cartridge filter, a 1 HP self-priming thermoplastic self-priming pump 1-1/2" suction and discharge connection and 110 cubic inch strainer capacity. Cartridge shall be Harmsco no. ST/155 or approved equal. The pump motor shall be 115/230 volt single phase, 60-cycle, open-drip proof and shall be UL and NSF listed. The pump motor shall be provided with a 120-volt Hubbell switch, weather proof switch cover, in-line pre-wired GFCI and a 100' power cord. The cord shall be wired to a 20 amp, 115/230 volt switch which shall be mounted on pump motor. All interconnecting pipe and fittings shall be schedule 40 PVC. The entire assembly shall be bolted to a T-316 stainless steel cart and shall have pneumatic wheels with grease fittings and roller bearing hubs. The system shall be provided with one spare cartridge filter. Unit to be Recreonics, catalog no. 10-806, Lincoln Aquatics no. 27-010, or approved equal. Accessories shall include a 1½ inch x 25 ft. discharge hose with stainless steel hose clamp. Hose to be manufactured by Quaker Plastic Corporation no. QT-131, or approved equal.

7. Robotic Pool Cleaner

a. JetMax Robotic Pool Cleaner

- 1) Provide one pump motor driven automatic swimming pool vacuum device. Cleaner weighs 13½ lbs and has internal oil-cooled, water-cooled, brushless pump motor that filters 4,800 GPH. Jet-drive valve system on top propels the cleaner forward and back by diverting the filtered water expelled by the pump motor. Four non-marring rubber wheels on free-spinning axles guide the cleaner along pool surfaces. Two axle locking pins provide adaptable cleaning patterns for pool shape and size. The cleaner is to have four moving parts only. Cleaners with drive motors, gears, pulleys, belts or tracks are not acceptable. The cleaner to have an automatic program to clean pool floor and radius walls, travelling 1 ft per second, scrubbing pool surfaces with two power-washing jets, vacuuming a 1½ ft wide path using two offset 5½ square inch suction inlets underneath, filtering fine debris <10 microns small and solids as large as 1½ inch into an internal reusable filter bag. Unit comes complete with 75 ft cord, manual guidance attachment, 2 filter bags, digital timer, power supply with 24 volt transformer, operator manual. Requires 110 volt GFCI receptacle onsite, consumes 2 amps electricity. The pool cleaner shall be a JetMax Junior as manufactured by Aqua Products or approved equal.

b. DuraMax Robotic Pool Cleaner

- 1) Provide one motor driven automatic swimming pool vacuum device. Cleaner weighs 41 lbs and has internal water-cooled brushless drive motor with automatic program to clean the pool floor and walls, travelling 1¼ ft per second, scrubbing pool surfaces with onboard rubber brushes. Two separate internal oil-cooled, water-cooled, brushless pump motors filter 12,000 GPH, vacuuming a 2 ft wide path using two offset 7½ square inch suction inlets underneath, filtering fine debris <10 microns small and solids as large as 1½ inch into an internal reusable filter bag. Solid ½" 316 stainless steel axles extend the length of the cleaner connecting to a commercial-grade drive-train with Kevlar reinforced drive belts. Stainless steel reinforced side plates are capped with soft gray tracking wheels for durability and corner and curve tracking agility. Unit complete with remote control, air sensor, UltraKart Junior, 120 ft cord, set of SP3008A PVA brushes (for tile finishes), filter bag, digital timer, power supply with 24 volt transformer, 1 hour cleaning cycle delay option, operator manual. Requires 110 volt GFCI receptacle onsite, consumes 5 amps electricity. The pool cleaner shall be a DuraMax Duo Junior as manufactured by Aqua Products, Inc., or approved equal. Include with 150 ft cord.

8. Stainless Steel Cleaner - Provide a stainless steel cleaner. The cleaner shall comprise of one (1) gallon of organic passivation solution. It shall be complete with instructions for proper maintenance of stainless steel surfaces and material safety data sheets for the passivation solution. The cleaner shall be the Spectra-Clean System 2 as manufactured by Spectrum Products. Product to be applied with 3M scouring pad, or equivalent.

9. Stainless Steel Protective Coating

- a. Provide protective coating on all swimming pool rail goods. The coating shall provide envelope protection. Surfaces coated must be clean and dry and free of any type of oil, films, grease, silicones polishes and waxes, anything that leaves a film on the surface. Care shall be taken not to clean the surface with any type of cleaner or solvent that may leave behind a thin film. The coating shall be applied at approximately ½ mil WFT yielding a dry film thickness of 3-5 microns. Three coats are required. Allow to dry to touch between coats. The coating shall be ProtectaClear-AF as manufactured by Everbrite and distributed by TMI Salt Pure Corporation - 800-818-8266 or Spectra Shield as manufactured by Spectrum Products - 800-791-8056.

2.14 SAFETY EQUIPMENT

- A. The following items are to be supplied by the CONTRACTOR unless otherwise noted. All proprietary names are to designate performance only. Equal products will be accepted.
1. Ring buoy and extension rope (6 required) – Buoy shall be 24 inch diameter vinyl clad PVC foam with a metal ring molded inside. Buoy shall have a 3/8 inch polyethylene rope attached to it at four points and be a minimum 60 feet in length. Preserver shall be U.S.C.G. approved. Buoy and rope to be mounted at each lifeguard chair on hooks. Ring buoy to be manufactured by Cal-June no. G-24-WH or approved equal. Throw rope to be Recreonics no. 12-261, Lincoln Aquatics No. 42-050, or approved equal.
 2. Life hook and pole (3 required) – Life hook shall be an anodized aluminum 3/8 inch OD "shepherd's crook" with a 1-1/8-inch OD handle attachment suitable for a 1 1/4-inch 16 ft. aluminum extension pole. Hook shall be of looped construction. Each pole to be provided with a set of spring type stainless steel pole clamps for mounting on each lifeguard chair. Life hook shall be equal to manufactured by Rainbow no. 153. Pole clamps shall be Recreonics no. 10-353, or approved equal.
 3. Spineboards (2 required) - Spineboard shall be 72" long x 20" wide, constructed of 100% virgin high density polyethylene. The design shall provide stiffness and torsional rigidity while remaining lightweight. The spineboard shall accommodate up to 500 lbs and shall feature customizable buoyancy that allows users to adjust the buoyancy by inserting polyethylene foam rods (supplied with the spineboard). There shall be (10) handholds around the perimeter of the board. The spineboard shall be supplied with one (1) 2-piece head immobilizer, one (1) head strap, four (4) body straps, one (1) head immobilizer with head bed, and two (2) flotation rods. The spineboard shall be CJ Rescue 6 package as manufactured by CJ spineboard at 1-206-824-8886 or approved equal. The CONTRACTOR shall provide one (1) set of heavy duty stainless steel utility hooks per spineboard for storing the spineboard at a convenient and readily accessible location near the pool (Recreonics catalog no. 10-362).
 4. First aid kit (2 required) - First aid kit shall be a 24 unit kit per American Red Cross standards as manufactured by Swift First Aid, or approved equal.
 5. Rescue tube (6 required) - Provide one rescue tube for each lifeguard chair. Rescue tube to be manufactured by Bremen Corporation No. 21414-14, or approved equal.
 6. Safety eyewash station (2 required) - Safety eyewash station shall be a self-contained system in which eyewash bottles are securely positioned in a portable holder. Eyewash bottles shall be 32 ounces and easily removable from case, and shall contain a sterile, saline solution with the ability to neutralize a varying quantity acids or caustics. Eyewash stations shall be equipped with a double back screw and holes for easy mounting in location to be determined by the Professional. Stations shall be Recreonics 12-033, Lincoln Aquatics 49-026, or approved equal.
 7. Safety eyeglasses - Provided a safety eyeglass dispenser station (two (2) required) containing ten (10) pairs of safety glasses. Eyeglasses shall be ANSI/OSHA accepted, and be equal to Lab Safety Supply Inc. (1-800-356-0783) no. WQ-14740B.
 8. Bag Valve Masks – Provide four (4) bag valve mask assistant resuscitation systems, two size Adult (1500ml tidal volume) and two size Infant/Child (450ml tidal volume). Product shall be a latex free disposable bag mask unit with support strap, transparent patient valve, and textured surface to eliminate slipping. Integral swivel valve, available with a closed reservoir system. Standard pack includes resuscitator, oxygen reservoir and a transparent bag for storage. Bag Valve Masks shall be Ambu SPUR II, or approved equal.

2.15 THERMOMETERS

- A. The following items are to be supplied by the CONTRACTOR unless otherwise noted. All proprietary names are to designate performance only. Equal products will be accepted.
1. Portable thermometer (3 required) shall be a molded ABS plastic tube body type with the ability to measure temperature in both degrees Fahrenheit and Celsius. A 3 ft. polyethylene cord is to be attached to thermometer. Thermometer is to be manufactured by Pac-Fab/Rainbow no. R141036 or approved equal.
 2. Inline thermometer to be near the heating loop and shall have a 9 inch adjustable angle with a minimum 6 inch stem. There shall be a minimum of two (2) thermometers per loop, and must have ability to read temperature in both degrees Fahrenheit and Celsius. Thermometers are to be Recreonics no. 32-702, Lincoln Aquatics no. 21-125, or approved equal.
 3. Digital temperature indicator (3 required) shall be a 115 volt, wall mounting case, sensor and a stainless steel immersion well. Weiss Instruments model 20DT or approved equal. Digital thermometer not required if Chemtrol 3000 is used.

2.16 SWIMMING POOL FINISHES

A. Paint

1. The interior surfaces of the gutter trough pit shall be coated with a high build epoxy. The color shall be white or an approved light color.
2. Coating shall be a low VOC compliant polyamidoamine epoxy suitable for chlorinated water below 3.2 ppm for installation on concrete surfaces. CONTRACTOR shall provide on-site technical services and approval from the coating manufacturer prior to application and during the coating application. Coating shall be Tnemec Series L69F Hi-Build Epoxoline II or approved equal. Color shall be white.
3. Surface Preparation
 - a. Cast-In-Place Concrete
 - 1) Allow concrete to cure a minimum of 28 days at 60 deg. F. Brush-off pool interior surfaces, then blast clean to remove laitance and weak surface concrete to produce an anchor profile similar to medium grade sandpaper referencing SSPC-SP13/NACE 6, ICRI-CSP 2-4 Surface Preparation of Concrete. Blasting shall open up surface voids, holes and irregularities. No holes or holidays in the paint membrane will be allowed. Fill with an approved grout or Tnemec Series 215 Surfacing Epoxy any hole or irregularity that cannot be satisfactorily painted. Do not entirely remove the surface or completely expose underlying aggregate. After blasting, neutralize concrete with a solution of 2 cups aqua ammonia per 5 gallons of water. Flush with clean water and allow to thoroughly dry.
 - b. Pneumatically Applied Concrete
 - 1) Allow concrete to cure a minimum of 28 days at 60 deg. F. Prior to applying paint to a pneumatically applied concrete surface, a brown coat plaster leveling surface shall be applied. The pneumatically applied concrete surface shall be prepared for the application of the brown coat by removing all loose materials, laitance, minerals, and chemical traces. If a brown coat has been utilized, provide a clean, firm surface or anchor profile similar to a medium grade sandpaper, suitable for the application of paint. No holes or holidays in the paint surface will be allowed. Fill with an approved grout or Tnemec Series 215 Surfacing Epoxy any hole or irregularity that cannot be satisfactorily painted.

4. Application Procedures
 - a. Before applying any material, measure and record the temperature and relative humidity. Apply only if temperature is above 55 deg. F. and at no lower temperature than 5 deg. F. above the dew point. Do not apply when the relative humidity is greater than 85%. If possible, plan the painting schedule so that all painting is done in the coolest part of the day. Provide proper ventilation so that paint fumes do not become concentrated.
 5. Application of the Primer
 - a. After the pool surface has been thoroughly dried and cleaned the primer coat can be applied. Surface spreading rate shall be observed as not to exceed the recommended manufacturer's rate of application. The primer will be applied at a minimum rate of 200 SF per gallon and shall conform to local VOC requirements. A good heavy coat shall be applied. A rough or porous concrete pool will require more paint than recommended. On particularly rough surfaces two coats are recommended in order to provide a smooth, uniform finish.- Note: Any marks or irregularities that show through the primer will also be apparent when the finish coat is applied.
 6. Application will be made by brush, roll, lambs wool applicator, or spray. When the finish coat is to be a color other than white the primer will be tinted.
 7. Application of the Finish
 - a. After the primer is dry enough to walk on without removing or marking surface, apply the finish coat(s) in accordance with the manufacturer's instructions. Application shall be done by the use of a brush, roller, lamb's wool applicator, or spray methods at a rate of 150-250 SF per gallon. Allow a minimum of 5 hours (at 75 deg. F) drying time between coats. Two coats of finish paint are recommended to improve upon general appearance of pool shell. Allow 7 days curing (at 77 deg. F.) before filling the pool.
 8. Application of pool striping, depth markings, warning signs and wall targets, shall be done after final coat of finish paint has cured for at least 24 hours.
 9. Slip resistant additive shall be applied to the all outdoor areas, entry steps, ramp areas, zero entry and all deck markings.
 10. Final paint coating shall be allowed to dry a minimum of 7 days at 35 degree Fahrenheit or above, before filling the pool.
 - B. Pool Tile – Reference specification section 093213, Swimming Pool Tile.
- 2.17 WATERPROOFING
- A. Products
 1. Interior surfaces of Gutter, Surge Tank Backwash Pit with NO additional finishes: Apply two (2) coats of Aquafin IC (total 100 mil thickness), Xypex, Vandex, Plainseal 88, Thoroseal directly to surface of gutter, surge tank and backwash pit.
 - B. Surface Preparation
 1. Surface shall be structurally sound and free of any foreign substances and debris that could reduce or impair adhesion. Surfaces shall be roughened by sand blasting, water jetting, shot blasting, scarifying, or grinding. Surface defects or holes shall be patched per manufacturer's recommendations.
 - C. Application
 1. Do not apply materials under conditions where the ambient air temperature is less than 40 degrees Fahrenheit, or to a frozen substrate.
 2. At high temperature above 86 degrees Fahrenheit, protect application from direct sunlight and wind to prevent premature surface drying and shrinkage cracks.
 3. Confirm with manufacturer recommendations whether the substrate surface is required to be dampened or dry.

4. Concrete substrate shall be maintained moist a few hours before application of waterproof coating. However, surface shall be free from any standing water. Apply first coat of waterproof coating with a trowel or a brush. First coating shall be worked against the concrete surface as to ensure a uniform coat. Waterproof coating shall be allowed to harden for a time period of at least 5 hours and not to exceed 24 hours before the second coat is applied. Application of the second coat of waterproofing can be done by the use of a trowel.
5. All mixing of products, quantities and application procedures shall be done in accordance with the manufacturer's recommendations.

2.18 SEALANTS

- A. Provide sealed expansion joints as shown on the pool and pool structural drawings or noted on the Contractor's construction/expansion joint layout, and as required. Expansion joints shall be constructed and sealed as indicated and in accordance with the manufacturer's recommendation. Sealant to be Latasil by LATICRETE International, Inc., phone: 1.800.243.4788 x235 or Deck-O-Seal by W.R. Meadows, phone: 817.598.1969.
 1. Latasil, one component, neutral cure, high performance, 100% silicone sealant in the color(s) as selected. Shall be used in conjunction with Latasil 9118 Primer per manufacture's recommendations.
 2. Deck-O-Seal, two component (gun-grade), high resilience, non sag, non flowing, polysulfide-based sealing compound in the color(s) as selected. Shall be used in conjunction with P/G Primer per manufacture's recommendations.
- B. Material Storage
 1. All materials are to be stored in the original unopened factory containers in a cool dry location 60 to 80 degrees F. Protected from the elements and the hazards of construction. Open only as many containers as can be used in any particular period.
- C. Joint Preparation
 1. Clean the joints of all deleterious material, to sound, clean and dry substrate.
 2. Joint is to be formed or filled with an approved, resilient, non-asphaltic, closed cell, polyethylene joint filler material down to firm substrate. Allow space at the top of the joint for the installation of approved closed cell polyethylene backer rod and install same to the required depth below the surface of the slab to control the depth of the sealant bead to within manufacturer requirements.
- D. Surface Preparation
 1. Concrete surfaces to receive sealant must be fully cured, clean, dry and free of dirt, dust and any deleterious material that might compromise the adhesion and performance of the sealant. Curing aids, form release agents and joint former residue must be completely removed, if necessary by sand blasting and/or grinding. Loose dust must be brushed off.
 2. Prime all surfaces to receive Latasil sealant with Latasil 9118 Primer prior to sealant application, and surfaces to receive Deck-O-Seal sealant with P/G Primer prior to application.
- E. Application
 1. Apply sealant in accordance with the manufacturer's recommendations.
 2. Tool the joint immediately after application to insure a firm, intimate contact with the joint interface.
 3. Remove excess sealant and smears from adjacent surfaces with Xylol or Toluol before sealant cures.
 4. After the sealant has fully cured (generally a minimum period of five days at 72 degrees and 50% humidity), paint the surface of the sealant with a chlorine resistant chlorinated rubber or equivalent pool paint, such as Ramuc, in a compatible color as selected by the Professional.

NOTE: Latasil cannot be painted.

2.19 UNDERWATER LIGHTS

- A. Underwater lights shall be equivalent to 500 watts of incandescent light for the Recreation Pool and 108 watts of incandescent light for the Spa. Underwater lights shall be UL listed and in the quantities shown and as detailed in the construction drawings and as described in these specifications. Coordinate for proper installation. Refer to the drawings for quantities and locations.
- B. The pool underwater lights shall be 120VAC or 12VAC, 70 watts LED-type, and equivalent to 500 watts of incandescent light. Fixture housing shall be stainless steel construction with minimum wall thickness of 0.020 inch per UL 676 underwater pool lighting standard. The niche shall be stainless steel with cast brass mounting ring or PVC plastic with stainless steel mounting ring. Brass construction pressure grounding lug on interior and exterior services. Lens shall be 8-3/8 diameter clear tempered heat resistant glass. Gasket to be single-piece "U" shaped santoprene or silicone. Fasteners shall be silicon-bronze or stainless steel. The light fixture shall be supplied with a #16-3 STW (120V) or 12-3 SJTW (12V) submersible cord with ground wire positively grounded inside the fixture. Cord entrance shall be a watertight seal and epoxy encapsulated. Light fixture to be IntelliBrite 5g White LED pool light series by Pentair Commercial Pool and Aquatics or approved equal. Underwater lights shall be provided with cord length as required to allow for deck relamping of all fixtures.
- C. The spa underwater lights shall be 120VAC or 12VAC, 26 watts LED-type, and equivalent to 108 watts of incandescent light. Fixture housing shall be stainless steel construction with minimum wall thickness of 0.020 inch per UL 676 underwater pool lighting standard. The niche shall be stainless steel with cast brass mounting ring or PVC plastic with stainless steel mounting ring. Brass construction pressure grounding lug on interior and exterior services. Lens shall be clear tempered heat resistant glass. Gasket to be single-piece "U" shaped santoprene or silicone. Fasteners shall be silicon-bronze or stainless steel. The light fixture shall be supplied with a #16-3 STW (120V) or 12-3 SJTW (12V) submersible cord with ground wire positively grounded inside the fixture. Cord entrance shall be a watertight seal and epoxy encapsulated. Light fixture to be IntelliBrite 5g White LED spa light series by Pentair Commercial Pool and Aquatics or approved equal. Underwater lights shall be provided with cord length as required to allow for deck relamping of all fixtures.
- D. Junction boxes shall be provided in the quantities required and shall be located at least 8" above the pool coping and 5' from the pool edge. Refer to the Electrical drawings. Cord length shall be sufficient to run from fixture to the junction box with sufficient cable in the niche to relamp the fixture on the deck. The conduit from the niche to the junction box shall be sealed and hydrostatically pressure tested for leaks before and after backfilling to guarantee water tightness.

2.20 WATER FEATURES AND SUPPORT EQUIPMENT

- A. Modular Climbing Wall Feature
 - 1. General: Modular climbing wall feature shall be Model Number AQCL-4H3W as manufactured by Aquaclimb of Pyramide USA, Inc. ((800) 956-6692, www.aquaclimb.com) or approved equal.
 - 2. Materials: Climbing wall framing and all metallic parts shall be stainless steel with corrosion resistant finish. Climbing panels shall be high performance fiberglass finished with a textured non-slip surface.
 - 3. Installation: Contractor shall coordinate installation with manufacturer for specific pool shape and pool edge detail and explicitly follow manufacturer's installation instructions. A thickened deck slab shall be provided as required for proper anchoring of the Aquaclimb climbing wall.

4. Anchors: Two (2) complete sets of anchors shall be provided by Using Agency for installation by Contractor in the locations indicated on the plans. Coordinate anchor layout and installation with manufacturer for specific pool edge profile and gutter type to allow anchoring per manufacturer's requirements.

2.21 MOVABLE BULKHEAD

A. Material

1. The CONTRACTOR shall provide and install a movable bulkhead (1 required) fabricated to match the design of the perimeter gutter system. The bulkhead must span the width of the pool. The dimensions are nominally 6 feet 0 inches wide by 63 feet 0 inches long by 4 feet 8 inches deep. The bulkhead shall have a deck-to-water dimension of 8". The top of the bulkhead shall be designed as a walkway and shall rest on top of the deck level gutter.
 2. Provide a complete fiberglass movable bulkhead that is entirely constructed of materials which are unaffected by corrosion when immersed in chlorinated swimming pool water. Paint or protective coatings on any internal or external areas of the bridge are prohibited.
 3. The movable bulkhead in its original solid state must be permanently compatible with chlorinated swimming pool water. The use of carbon steel, mild steel, aluminum, manganese, copper, brass or wood for any structural section, fasteners, hardware or parts of the bridge will not be allowed.
 4. Bulkhead manufacturer shall supply anchor pin assemblies and support structure integral to the bulkhead, and be responsible for coordinating proper alignment, operation, and support of the bulkheads on the gutter curb, as well as its locking mechanisms that will rigidly set the bulkhead at each course as shown on the drawings.
- B. The bulkhead shall be designed to support 5600 lbs with 1/2" maximum deflection. The safety factor for all live and dead loads shall be at least 10. The bulkhead shall be designed for a uniform lateral live load of at least 30 pounds per linear foot and a point load of at least 500 pounds at the center with a maximum deflection of 1/2 inch. Racing lane cup anchors shall be molded into the structure and be designed to prevent pullout at a load of at least 400 pounds each.
- C. Bulkhead shall feature a toe ledge as shown on the drawings. The toe ledge shall allow water to flow through the bulkhead to ease the moving of the bulkhead.
- D. Bulkhead shall feature additional floating lane line anchors as shown on the drawings for connection of water polo boundary ropes.
- E. Bulkhead shall be fitted with anchors for racing starting platforms in the locations noted and in the positions required by the manufacturer of the selected starting platforms. The anchor installations shall be reinforced to produce negligible deflection under the maximum loading conditions recommended by the starting platform manufacturer.
- F. Removable guard rails shall be provided at both ends of the bulkhead. Rails shall be custom fabricated of one continuous length of tubing. The tubing shall be type 316L stainless steel, 1.900 inch OD x .145 inch wall thickness polished to 320 grit.
- G. Removable railing shall be provided along one side of the bulkhead. Anchors shall be provided to move this railing to either side of the bulkhead depending on the direction of the race course / location of the starting blocks. The railing shall be type 316L stainless steel, 1.900 inch OD x .145 inch wall thickness polished to 320 grit.
- H. The internal air chambers shall be so constructed that when adding air pressure to raise the bulkhead for a change in position it shall be balanced and eliminate the need for removal of the starting platforms. Moving the bulkhead shall be easily accomplished by one person at each end of the bulkhead. Units shall glide freely on corrosion proof guides, or skid plates, both at the gutter lips and side walls. Provide all equipment, including blowers, necessary to operate air flotation chambers.

- I. Suitable means of anchoring the bulkhead shall be provided to resist all dead and live load components. Contractor shall provide and install the anchor plates at the park positions shown on drawings. Install a 1" thick fiberglass pin plate receptacle at each park position similar to Stark Model Number SB051.
- J. Suitable provisions for electronic timing system shall also be provided. Access hatches shall be included at both ends of the bulkheads to facilitate inspection of the interior of the bulkheads, anchor mechanisms, and to allow for installation of future wiring in an existing raceway gutter to carry electronic timing cables and conductors.
- K. Provide factory trained and experienced personnel for coordination, consultation, and instruction for the actual bulkhead delivery and for training of the Using Agency's personnel in the use, operation, and maintenance of the bulkhead. Provide necessary instruction and coordination as required to coordinate anchorage installation.
- L. Provide racing lane line anchors at water line along only those faces of the bulkheads where shown on the drawings.
- M. Lane line and men and women's water polo boundary line anchors shall be included with the pool bulkhead. The cup anchors shall be molded into the structure and supplied with a stainless steel pin for attachment.
- N. Racing lane targets shall be supplied on those sides of the movable bulkhead where shown on the drawings. Lane targets to coincide with lanes on the pool floor and markers on the pool walls.
- O. The entire surface of the bulkhead shall be slip resistant. This shall include the blue wall targets (matching pool lane markings) and white field surface.
- P. Quality Assurance
 - 1. A factory quality control program must be submitted to the Using Agency/Professional with submittals, which ensures that structural tolerances critical for Movable Bulkheads used for competition have been maintained.
- Q. Basis of design: The bulkhead shall be manufactured by Stark Bulkheads, Inc. (360-403-7707), or approved equal.
- R. Guarantee
 - 1. The manufacturer and Contractor shall guarantee that on completion of the installation, the unit will move freely from one location to the other, providing walls are straight and parallel and do not vary more than plus or minus 1/2 inch and will not rack or bind/stop when moved. Bulkhead manufacturer and Contractor shall coordinate the unrestricted travel of the bulkhead the entire length of the pool (unless noted differently on the drawings).
- S. Installation of Bulkhead
 - 1. The installation shall be true, level and plumb with the existing structure to permit full range of movement.
 - 2. The exposed surfaces will be free of all imperfections or irregularities. A field inspection by the Using Agency/Professional will be conducted upon completion of the installation to ensure compliance before acceptance.
 - 3. During installation, protection shall be provided for the existing deck, pool walls, pool floor and general building construction. The Contractor shall bear the costs for replacement or repair as a result of damage by neglect.
 - 4. Support jacks shall be used beneath the bulkhead until the pool is filled and the bulkhead becomes self-supporting.
 - 5. All costs for installation onto the pool gutter, adjustments, certification of dimensions and cleanup upon completion shall be borne by the Contractor.
 - 6. Contractor shall locate the anchor plates at each stop point. Race course dimensions shall be field certified in compliance with the competitive standards having jurisdiction and be submitted to Using Agency/Professional in writing by the certifying engineer or land surveyor.
 - 7. The bulkhead shall not be moved until water is in the pool and at the level of the gutter lip.

8. Provide instruction to the Using Agency's personnel in use, operation, and maintenance of the bulkhead.

2.22 SWIMMING POOL SURFACE PADDING

A. Slip-Resistant Springboard Platform Padded Surfacing

1. This work shall include furnishing and installing a Mondo DIVETEX padded surface for 3-meter springboard platform.
2. Material:
 - a. Rubber surfacing shall be prefabricated, calendered and vulcanized with a particular closed cell structure, based on special isoprenic rubbers, mineral fillers, stabilizing agents and pigmentation, highly resistant to UV rays and atmospheric agents, with system of differential elasticity between top surface and base.
 - b. Surface shall have a thickness of ½" (12mm).
3. Adhesive:
 - a. The adhesive shall be a high performance two-part polyurethane adhesive for both indoor and outdoor installations of the Mondo DIVETEX surfacing. It shall have an excellent resistance to moisture, heat, and water.
 - b. The adhesive shall be PU 105 Polyurethane Adhesive.
4. Installation:
 - a. Installation of the DIVETEX surfacing shall be performed by a flooring contractor experienced in projects of this size and scope.
 - b. The concrete surface shall be clean, and without paint or other contaminants.
 - c. Scarify the concrete surface prior to installation.
 - d. If curing compounds were used, the surface must be thoroughly cleaned prior to installation.
 - e. After installation, add weight around the edges and seams of the surfacing material until the adhesive is completely dry.
 - f. Seal the edges of the surfacing with a bead of clear silicone caulk.
5. Delivery, Storage, and Handling:
 - a. Materials must be delivered in the manufacturer's original unopened and undamaged containers with identification labels intact.
 - b. Store material upright on a clean, dry, flat surface protected from all possible damage, and protect from exposure to harmful weather conditions.
 - c. Recommended environmental condition for storage is a minimum of 55° F.
6. Site Conditions and Installation:
 - a. Maintain a stable room and concrete temperature for a period of 48 hours prior, during, and 48 hours after installation. Recommended range is between 65° F and 86° F.
 - b. Installation to be carried out no sooner than the specified curing time of the concrete.
 - c. Moisture vapor emission content of the concrete slab must not exceed 5 lbs. / 1,000 SF / 24 hours when tested using the anhydrous calcium chloride test as per ASTM F1869.
 - d. Installation of the DIVETEX flooring shall not commence until all other trades in the building are completed.
 - e. Follow manufacturer's installation instructions for both DIVETEX flooring and PU 105 adhesive.
7. DIVETEX padded surface and PU 105 adhesive shall be manufactured by Mondo USA and supplied by Springboards and More (Phone #: 877-348-3246).

PART 3 - EXECUTION

3.01 EXISTING CONDITIONS, INSPECTION AND PREPARATION

- A. Carefully examine all of the contract documents for requirements that affect the work of this section. Prior to starting any work, notify the General Contractor of defects requiring correction. Do not start work until conditions are satisfactory.
- B. Verify that all work by others, related to this section, has been completed. This includes all earthwork, concrete work, and mechanical, electrical and plumbing connections.
- C. Protect all materials and work completed by others from damage while completing the work in this section.

3.02 FIELD MEASUREMENTS

- A. Verify benchmark and pool location prior to layout.
- B. If field measurements differ from the construction drawing dimensions, notification shall be given to the Professional prior to proceeding with work.

3.03 EXCAVATION, REINFORCING STEEL AND SWIMMING POOL PNEUMATICALLY APPLIED OR CAST-IN-PLACE CONCRETE

- A. Reference Division 31 - Earthwork
- B. Reference Division 3 - Concrete
- C. Reference Section 033719 - Swimming Pool Pneumatically Applied Concrete
- D. Reference Section 033053 - Swimming Pool Cast-In-Place Concrete

3.04 TOLERANCES FOR CONSTRUCTION OF THE POOL SHELL

- A. The completed structures shall be constructed level and to the dimensions, elevation, depths and thickness as shown on the plans.
- B. The elevation tolerance of the pool shell and gutter lip shall be plus or minus 1/8 inch.
- C. The vertical wall surface tolerance of the pool shell, for the first 36 inches from the water surface shall be plus or minus 1/4 inch from plumb measured with a 6 foot straight edge.
- D. For competitive race courses, the following pool shell tolerances shall apply:

Course	Tolerance	Minimum	Maximum
25 yard	+ 1 3/16" /- 0"	75' - 3/4"	75' - 1 15/16"

- 1. The above dimensions include allowances for a touchpad at each end of the course. The maximum dimension includes the construction tolerance. These above tolerances also apply to courses utilizing moveable bulkhead(s).
- 2. The above dimensions apply to a vertical plane extending 1'-0" above and 3'-0" below the surface of the water at all points of both end walls.
- E. The CONTRACTOR shall provide the services of a registered engineer or land surveyor who shall measure and certify the elevations of the gutter lip at 10 foot centers as well as the length of each lane for each possible racing course. Course length survey must be made with the pool filled with water between 78 and 82 degrees Fahrenheit. Forms for the lane measurements are available from USA Swimming (719-866-4578) and must be submitted by the Contractor.
- F. Ground wires or grade pins, if used, shall be installed in such a manner that they accurately outline the section of the pool shell as indicated on the plans. They shall be located at intervals sufficient to insure proper thickness throughout and shall be maintained tight. Grade pins or grounding wires shall not be permanently embedded in the pool shell.

3.05 WATER TIGHTNESS TEST

- A. This test applies to the pool(s), the spa, the surge tank(s), and the gutter system(s). The water tightness test shall be completed prior to the application of the pool finish.
- B. Water Tightness Test Procedure
 1. Preparation
 - a. Allow the concrete structure to set 28 days for curing purposes. Once the pool shell has gained sufficient strength to withstand the test load and after all the outlets have been securely sealed, the pool shall be filled with water.
 2. Fill: Fill and then isolate the pool(s), the spa, the surge tank(s), and the gutter system(s). The water tightness test shall begin after the vessel has been filled for a minimum of three (3) days. During the filling, all outlets shall be monitored for water tightness and all concrete joints shall be monitored for any visible leakage. If any visible leakage from the vessel is observed, the condition shall be corrected prior to the start of the test.
 - a. After the initial fill, all ground water shall be removed from the pool sight sump or the pool location de-watering system. This shall be completed prior to the start of the water tightness test. De-watering of the pool sight sump shall be maintained during the entire duration of the test.
 3. Evaporation Measurement Procedure
 - a. Fill a floating, restrained, partially filled, calibrated, open container with water and allow the container to float within the pool during the testing period. This will be used to measure evaporation.
 4. Measurement
 - a. On a separate sheet of paper draw a sketch of the pool. Measurements shall be taken at the pool(s), the spa, the surge tank(s), and the gutter system(s). Multiple test points with averaging are recommended for vessels which will be exposed to wind. Document the separate findings on the chart below. Repeat the measurements and document every 12 hours for a total of three (3) days. The General Contractor shall check the pool(s), the spa, the surge tank(s), and the gutter system(s) for water loss with the Professional or Using Agency's representative every 12 hours.

Total Allowable Water Loss:	Total Gallons:	_____	(0.1%) x 0.001 = _____	Allowable Loss	Pan Depth Per 24 Hrs.
Pool Measurements	Pool	Pool or Spa	Gutter System or	Surge Tank or	Pan Measurements
12 Hrs.					
24 Hrs.					
36 Hrs.					
48 Hrs.					
60 Hrs.					
72 Hrs.					

5. Total Loss = 7.481 x Structure Surface Area (SF) x Total Water Loss per Day (FT) - Evaporation per Day (FT) + Precipitation per Day (FT)
 - a. Day #1 =
 - b. Day #2 =

c. Day #3 =

6. Repair

- a. The allowable leakage rate for an unlined pool structure shall not exceed 0.1 percent of the total water volume in a 24-hour period. (Example: $0.001 \times 200,000$ gallon pool = 200 gallons per 24 hour period.) This excludes the loss/addition of evaporation/precipitation.

7. Absorption

- a. Waiting 3 days after the initial water fill will allow the concrete to absorb water and shall be sufficient to minimize the effect of absorption on the test results.

8. Evaporation

- a. Evaporation shall not have a significant effect on natatoria that are completely enclosed with no air circulation during the water tightness test. However, evaporation will have a significant effect on the water level in natatoria that has air movement across the water surface or are still partially uncovered.

9. If leaks are detected, repair the vessel and make water tight in accordance with these requirements.

10. With regard to this test, the curing requirements, the final fill and the cost of the water for two (2) complete fillings shall be borne by the Department. Any subsequent fillings or partial fillings (more than 25%) of the pool shall be by the CONTRACTOR, at its own expense.

3.06 PIPING INSTALLATION

A. General

1. Provide and erect, according to the best practices of the trade, all piping shown on the drawings and required for the complete installation of these systems. The piping shown on the drawings shall be considered as diagrammatic in indicating the general run and connections, and may or may not in all parts be shown in its true position. The piping may have to be off set, lowered or raised as required or as directed at the site. This does not relieve the CONTRACTOR from responsibility for the proper erection of the systems or piping in every respect suitable for the work intended as described in the specifications and approved by the Professional. In the erection of all piping, it shall be properly supported and proper provisions shall be made for expansion, contraction and anchoring of piping. All piping shall be cut accurately for fabrication to measurements established at the construction site. Pipe shall be worked into place without springing and/or forcing, properly clearing all windows, doors, and other openings and equipment. Cutting or other weakening of the building structure to facilitate installation will not be permitted. All pipes shall have burrs and/or cutting slag removed by reaming or other cleaning methods in strict accordance with the manufacturer's instructions. All changes in direction shall be made with fittings. All open ends of pipes and equipment shall be properly capped or plugged to keep dirt and other foreign materials out of the systems. Plugs of rags, wool, cotton waste or similar materials will not be used in plugging. All piping shall be arranged so as not to interfere with removal and maintenance of equipment, filters or devices, and so as not to block access to manholes, access openings, etc. Flanges or unions as applicable for the type of piping specified shall be provided in the piping at connections to all items of equipment. All piping shall be installed to ensure noiseless circulation. All valves and specialties shall be so placed to permit easy operation and access.

B. Pipe Hangers and Supports

1. Pipes shall be adequately supported by pipe hangers and supports specified in Paragraph 2.05 Pipe, Hangers, and Valves.
2. Horizontal PVC Schedule 80 piping shall be supported in accordance with the manufacturer's recommendations for fluid temperature not exceeding 120 degree F and as listed below:

Nominal Pipe Size (Inch)	Hanger Support Spacing (Feet)	Minimum Rod Size for Single Rod Hanger (Inch)
1-1/4" and less	5	3/8"
1-1/2" to 3"	6	1/2"
4" to 6"	8	5/8"
8" to 12"	10	7/8"
Greater than 12"	12	1"

3. Horizontal CPVC Schedule 80 piping shall be supported in accordance with the manufacturer's recommendations for fluid temperature not exceeding 140 degree F and as listed below:

Nominal Pipe Size (Inch)	Hanger Support Spacing (Feet)	Minimum Rod Size for Single Rod Hanger (Inch)
1/2" and less *	4	3/8"
3/4" to 2"	6	3/8"
2-1/2" to 3"	7	1/2"
4" to 8"	8	7/8"
Greater than 12"	10	1"

- C. Provide means of preventing dissimilar metal contact such as plastic coated hangers, copper colored epoxy paint, or non adhesive isolation tape.
- D. Install hangers to provide a minimum of 1 inch space between finished covering and adjacent work.
- E. Place a hanger within 12 inches of each horizontal elbow.
- F. Support vertical piping independently of connected horizontal piping. Support vertical pipes at every floor. Wherever possible, locate riser clamps directly below pipe couplings or shear lugs.
- G. Where several pipes can be installed in parallel and at the same elevation, provide trapeze hangers as specified in section 2.05.C.3. Trapeze hangers shall be spaced according to the smallest pipe size, or install intermediate supports according to the support spacing schedules.
- H. Do not support piping from other pipes, ductwork or other equipment that is not building structure. Do not modify building structure for hanger installation.
- I. Concrete Inserts
 - 1. Provide inserts for placement in form work before concrete is poured.
 - 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3. Where concrete slabs form finished ceilings, provide inserts to be flush with the slab surface.
 - 4. Provide hook rods to concrete reinforcement section for inserts carrying pipe over 4 inches.
- J. Pipe Hangers and Supports
 - 1. All piping shall be rigidly supported from the building structure by means of hanger assemblies properly selected and sized for the application in accordance with the manufacturer's recommendations and specifications.
 - 2. All piping in a service tunnel, if required shall be supported by a structure of the CONTRACTOR'S design. The structure shall be non-corrodible and shall be of a size and configuration to rigidly support all the piping as shown in the plans at a minimum spacing as shown below.

3. Piping hangers shall be spaced per the below schedule and shall have hangers not more than one foot on each side of every change in direction. The piping systems shall be installed in an approved manner and shall not overload the building structural frame. The CONTRACTOR shall provide additional hangers and miscellaneous steel supports as required to distribute the piping system load over several structural members where required or directed. Maximum allowable spacing for piping shall be as follows:

<u>PVC Piping</u>	<u>Maximum Spacing</u>
3/4" thru 2"	5'-0"
2 1/2" thru 4"	6'-0"
6" thru 10"	9'-0"
12" thru 14"	12'-0"

4. Round rods supporting the pipe hangers shall be of the following dimensions:

1/2" to 2" pipe	-3/8" rod
2-1/2" to 3" pipe	-1/2" rod
4" to 5" pipe	-5/8" rod
6" pipe	-3/4" rod
5. Hanger rods shall be galvanized steel. Provide for controlling level and slope by turn buckles or other approved means of adjustment and incorporate lock nuts.
6. Where piping is installed side by side, the CONTRACTOR will support the piping by utilizing trapeze type hanger assemblies. Horizontal trapeze member shall be non-metallic channel. The CONTRACTOR shall provide heavier members as required for the load to be supported for the entire span distance. Hanger rods shall be as specified above and properly sized for the load supported, but not less than 5/8 inches diameter.
7. The use of pipe hooks, chains, or perforated iron for pipe hanger supports will not be permitted.
8. Attachment of piping hangers to the building structure shall be provided in a manner approved by the Professional. The CONTRACTOR shall provide concrete inserts to be installed by the General Contractor in the building construction at the time the concrete is poured and hangers shall be attached to these inserts.

K. Piping Installation

1. Trench bottoms shall be smooth and free of rocks and debris. If the trench is dug in ledge rock, hardpan or where large boulders are not removed, place 3 inches of sand or compacted fine-grained soil below pipe. Pipe must be supported over its entire length with firm, stable material. Blocking will not be used to change pipe grade or provide intermittent support over low sections in the trench. Surround the pipe with backfill meeting the requirements of Section 312000 with a particle size of 1-1/2 inch or less and in accordance with the project geotechnical report. Compact in layers not to exceed 6 inches with vibratory method. Follow installation methods of ASTM D2774 "Underground Installation of Thermoplastic Pressure Piping".
2. Installations are to be installed in a straight run of pipe, with a minimum 10 pipe diameters upstream and minimum 5 pipe diameters downstream of any pipe fitting.

L. Flushing, Draining and Cleaning Pipe Systems

1. The CONTRACTOR shall flush out all water systems with water before placing them in operation. Other systems shall be cleaned by using compressed air or nitrogen. After systems are in operation and during the test period, all strainer screens shall be removed and thoroughly cleaned.

M. Expansion and Contraction

1. The CONTRACTOR shall make all necessary provisions for expansion and contraction of piping with offsets, loops, flexible connections and anchors as required to prevent undue

strain. The CONTRACTOR shall provide shop drawings for proposed method and arrangement for control of expansion and contraction of piping.

N. Testing

1. All piping installation and pressure testing shall be reviewed by the Department's testing agency before commencement of backfilling. A minimum notice of one (1) week is required prior to review. Results of review shall be documented.
2. All pool related piping, shall be hydraulically pressure tested (with water, not air) to a pressure of not less than 50 PSI for a period of no less than two (2) hours.
3. Contractor is responsible for the maintenance of a sustained 20 PSI pressure on all pool related piping throughout the course of construction.
4. The Contractor shall adhere to the applicable provisions of Division 22 - Plumbing, "General Provisions" and "Basic Materials and Methods" for installation of piping system.

3.07 EQUIPMENT AND SYSTEMS INSTALLATION

- A. The CONTRACTOR shall assemble and install all equipment, special parts and accessories as shown on pool drawings, specifications and shop drawings of the equipment suppliers.
- B. The CONTRACTOR shall provide all anchors and inserts to be imbedded in the deck including all fittings, inserts and structure sleeves and required anchorage as shown on the plans and as indicated in this section of the specifications. Equipment shall be set true and plumb, using factory jigs where available. Removable equipment items shall be easily removable from anchors and shall fit without noticeable wobble.
- C. Provide templates for all equipment anchors. Provide anchor bolts of the size and spacing as required by the equipment manufacturer. All anchor bolts shall be stainless steel Type 316L and of a length capable of adequate anchorage into rough slab-on-grade allowing for finish deck tile and setting bed. Anchors shall be set and cast into place during building concrete work. Inspect all anchor settings for horizontal and vertical alignment prior to placing concrete.
- D. The CONTRACTOR shall install all equipment and systems in accordance with manufacturer's directions. Equipment shall all be assembled and in place for final observation.
- E. All items necessary to complete this section are shown on the plans or described in the specifications including items that may be purchased by the Using Agency. Items are detailed and specified as a guide for dimensional purposes. The CONTRACTOR must make provisions accordingly and submit shop drawings and submittals based on that data.

3.08 START-UP AND INSTRUCTION

- A. The CONTRACTOR shall supply the services of an experienced swimming pool operator/instructor for a period of not less than two days (total 16 hours) after the pool(s) have been filled and initially placed in operation. During this period, the Using Agency's representatives who will be operating the pool(s) shall be thoroughly instructed in all phases of the pool's operation. The CONTRACTOR shall deliver six (6) complete sets of operating and maintenance instructions for the swimming pool, structures, finishes and all component equipment. Prior to leaving the job, the CONTRACTOR shall obtain written certification from the designated Using Agency's representative acknowledging that the instruction period has been completed and all necessary operating information provided. The CONTRACTOR shall, in his contract, include the cost of two (2) additional days (total 16 hours) of instruction and operational check out by the qualified representative of the CONTRACTOR during the first season of operation.
- B. Written reports of each of these visits outlining the pool's operation, competence and performance of the pool's operation personnel, and other pertinent comments shall be submitted to the Using Agency and Professional within one (1) week after each visit.

- C. The CONTRACTOR shall provide specific written procedures to be followed for emptying and refilling the pool as mentioned previously in this section. The procedures must be included in the bound volume of operating instructions and references in the front index with a note headed by the words: "CAUTION – VERY IMPORTANT".

END OF SECTION 131100