SECTION 13 1000 – WATER FEATURE PERFORMANCE STANDARD

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the minimum Performance and Design Requirements for Swimming Pools, Spa Pools, Hot Tubs, Decorative Waterfalls, and Fountains. These requirements include the following:

1. Acceptable Bather Load Limits
2. Acceptable Flow Rates and Pipe Velocities
3. Required Turnover Rates
4. Acceptable Filter Flow Rates
5. Design Requirements for Bottom Drains
6. Design Requirements for Skimmers & Gutters
7. Design Requirements for Floor and Wall Inlet Jets
8. Design Requirements for Hydrotherapy Jets
9. Lighting and Grounding Requirements
10. Minimum Reinforcing Requirements and Water/Cement Ratios
11. Pool Finish Requirements
12. Design Requirements for Sloping the Pool Floor & Walls
13. Minimum Requirements for Balance Tanks and Backwash Tanks
14. Minimum Chemical Dosing Requirements
15. Minimum Shop Drawing Submittal Requirements

B. This document does not include specifications for equipment and materials. Refer to “Related Sections” for specific equipment and material requirements.

C. Related Sections:

1. SECTION 13 1305 – WATER FEATURE ACCESSORIES
2. SECTION 13 1401 – WATER FEATURE PIPE AND FITTINGS
3. SECTION 13 1404 – WATER FEATURE WHITE GOODS
4. SECTION 13 1502 – WATER FEATURE PUMPS AND MOTORS
5. SECTION 13 1503 – WATER FEATURE FILTERS
6. SECTION 13 1504 – WATER FEATURE CHEMICAL FEED SYSTEMS
7. SECTION 13 1505 – WATER FEATURE OZONE GENERATION AND INJECTION
8. SECTION 13 1506 – WATER FEATURE UV STERILIZERS
9. SECTION 13 1507 – WATER FEATURE HEATERS
10. SECTION 13 1508 – WATER FEATURE HYDRONIC SYSTEMS
11. SECTION 13 1510 – WATER FEATURE HEAT EXCHANGERS
12. SECTION 13 1511 – WATER FEATURE VALVES, GAUGES, AND METERS
13. SECTION 13 1512 – WATER FEATURE COMPRESSED AIR SYSTEMS
14. SECTION 13 1513 – WATER FEATURE LOW PRESSURE AIR SYSTEMS
15. SECTION 13 1601 – WATER FEATURE GENERAL ELECTRICAL REQUIREMENTS
16. SECTION 13 1602 – WATER FEATURE CONTROLS
17. SECTION 13 1604 – WATER FEATURE FIELD INSTRUMENTS, SWITCHES, AND ALARMS
18. SECTION 13 1605 – WATER FEATURE CONTROL PANELS
19. SECTION 13 1606 – WATER FEATURE INSTRUMENT POWER SYSTEMS
20. SECTION 13 1607 – WATER FEATURE PROGRAMMABLE LOGIC CONTROLLERS
21. SECTION 13 1608 – WATER FEATURE LIGHTING AND CONTROL
22. SECTION 13 1609 – WATER FEATURE DISCONNECTS, MCC, AND STARTERS
23. SECTION 13 1610 – WATER FEATURE ELECTRICAL ACCESSORIES
24. SECTION 13 1611 – WATER FEATURE GROUNDING

1.2 REFERENCES

A. Applicable Standards: The following standards are referenced herein.

1. PVC Pipe Institute
2. Uniform Swimming Pool, Spa, & Hot Tub Code
3. ANSI/NSF International Standard 50 – Circulation System Components and Related Materials for Swimming Pool, Spas/Hot Tubs
4. NFPA 70 – National Electrical Code (NEC)
5. ASME/APSP-16 – a.k.a. the Virginia Graeme Baker Pool and Spa Safety Act
6. 2010 ADA Standards for Accessible Design

1.3 DEFINITIONS

A. Bathing Load: The maximum number of persons allowed in the pool, spa or hot tub at one time

B. Balance Tank: A reservoir, open to the atmosphere, from which the recirculation pump takes suction, which receives the gravity flow from the main drain and surface overflow system

C. Makeup Water: Replacement water removed from the pool by bather drag out, splashing, evaporation, and filter backwash

D. NTU: Nephelometric Turbidity Unit which is a means of measuring water clarity

E. Perimeter Overflow Gutter: A level trough or ledge around the inside perimeter of the pool containing drains to clean the pool water surface

F. Pool Floor: The interior pool bottom surface, which consists of that area from a horizontal plan up to a maximum of a 45-degree slope

G. Pool Wall: The interior poolside surface, which consists of that area from a vertical plane to a 45-degree slope

H. Pool Turnover: The circulation of the entire pool volume through the filter system

I. Recirculation System: The system of piping and mechanical equipment designed to remove the water from the pool filter, disinfect, and return it to the pool

J. Water Quality: The bacteriological and chemical analysis of the pool water that meets the minimum potable water standards as established by the United States Environmental Protection Agency

K. Wet Deck Area: A four foot (1.2m) wide unobstructed pool deck area around the outside of the pool water perimeter, curb, ladders, handrails, waterfalls, water features, planters, starting blocks, or lifeguard chairs

1.4 SUBMITTALS

A. SECTION 01 3300 – SUBMITTAL PROCEDURES

B. Submit Shop Drawings indicating layout and piping plans for swimming pools, spa pools, kiddy pools, and fountains. Drawings to be accurate and precise showing all pertinent information as indicated in this specification. Drawings to be signed and sealed by a professional engineer having an active license within the jurisdiction of the project.

C. Submit Mechanical Shop Drawings indicating mechanical equipment layout and equipment room piping. A process diagram indicating the treatment and circulation of all water features shall also be submitted as a shop drawing. All drawings to be accurately drawn including all mechanical equipment shown at actual size and dimensions

D. Submit Electrical Shop Drawings indicating power loads, one-line diagrams, and controls for all mechanical equipment

E. Submit Shop Drawing details showing the construction of all edges, inlets drains, skimmers, handrails, grounding, lights, methods of waterproofing, finishes, etc.

1.5 WARRANTY

A. Contractors Warranty: Contractor shall warrant the feature against defects caused by faulty workmanship or materials for a minimum period of one (1) year from Date of Substantial Completion. The warranty will cover all surfaces, sub-surfaces, equipment, piping, valves, etc. and will bind the contractor to repair, at his expense, all defects.

1.6 SYSTEM DESCRIPTION

A. Swimming Pool, Spa, & Hot Tub systems include the pool shell, piping, mechanical and electrical equipment necessary to hold, circulate, filter, and treat the water to provide a safe aesthetic environment for bathers and guests to interact with the water element. This includes any waterfalls or fountains that are directly related to the pool.

1.7 DESIGN REQUIREMENTS

A. Pool bather load shall be determined as follows:

1. Pool depth greater than three (3) feet (1.0m): 1 person per every 25 sq. ft (2.5 sq. m)
2. Pool depth less than three (3) feet (1.0m): 1 person per every 15 sq. ft (1.5 sq. m)

B. Pool Recirculation Systems:

1. Pool recirculation systems shall be designed to continuously operate 24 hours a day 7 days per week
2. All pipes associated with the swimming pool, spa, or water feature shall be sized appropriately to maintain the following pipe velocities

   a. Gravity Line: 2.0 to 2.5 ft/s (0.6 to 0.8 m/s)
   b. Direct Suction Line: 2.5 to 3.0 ft/s (0.8 to 1.0 m/s)
   c. Pressurized Discharge Pipe: maximum 5.0 ft/s (1.5 m/s)

C. Water Level Control:

1. Automatic Water Makeup System shall be incorporated with each pool such that water level is constantly maintained at an elevation suitable for continuous skimming without flooding skimmers or gutters during periods of non-use
2. Pool water level shall be controlled by using either skimmers or a continuous perimeter gutter. Skimmers and Gutters shall be constructed so the lip is level within 1/4 inch (6mm) between the highest and lowest point along the entire perimeter of the gutter.

D. Water Treatment System:

1. Turnover rate of two (2) to three (3) hours is appropriate in most pools. Pools with consistently high bather loads such as slide pools and rivers shall be designed with a one (1) to two (2) hour turnover rate. Children’s pools and spa pools shall be designed with a 30 minute turnover rate. See drawings for specific design for each pool
2. The circulation system shall be designed so 100% of the filtered flow rate can be circulated through the skimmer/gutter. Recessed Automatic Skimmers can be utilized on pools under 1,000 sq. ft (100 sq. m) of surface area. Minimum flow rate through a Recessed Automatic Skimmer is 30 gpm (110 lpm). One skimmer shall be provided for every 400 sq. ft (40 sq. m) of surface area. Perimeter gutter shall be installed on all pools over 1,000 sq. ft (100 sq. m)
3. All skimmers and gutters shall discharge by gravity into a balance tank
4. Water Treatment Pumps shall be installed so the inlet is a minimum 24 inches (0.6m) below the surface of the pool water. Basket strainers shall be installed on the suction side of each treatment pump
5. Treatment Pumps shall be designed to circulate the design volume of filtered water when the filter is in a dirty condition. The engineer shall calculate the hydraulic losses of the system and size the pump for the appropriate total head

6. Filters shall be sized to handle the required circulation flow rate at the following allowable filtration rates:
    a. Regenerative Media Filters: 0.5-1.4 gpm/sq. ft (1.22-3.42 cu. m/hr per sq. m) of filter area maximum
    b. High Rate Sand Filters: 15 gpm/sq. ft (36 cu. m/hr per sq. m) of filter surface area maximum

E. Inlets and Drains

1. All pool inlets shall be adjustable. Wall inlets being directionally adjustable and floor inlets having flow adjustment. Maximum design flow through wall or floor inlets is 20 gpm (75 lpm)
2. Wall inlets shall be installed a minimum of 12 inches (0.3m) below normal operating water level
3. Floor inlets shall be spaced maximum of 15 feet (5m) and within 10 feet (3m) of the pool wall
4. All pools shall be provided with at least two main drains in the deepest part of the pool. Drains must be covered by a secured grating, which requires the use of a tool to remove. The open area in the grate shall be such that the maximum velocity through the grate does not exceed 1.5 ft/s (0.45 m/s) at 100% of the designed flow rate of the drain

F. Meters and Instrumentation

1. A flow meter or flow indicator shall be installed on the return line for each pool
2. Pressure gauges shall be installed such that discharge pressure from each pump and filter pressures may be easily read
3. Temperature indicators shall be installed to read pool water temperature (upstream of any heating equipment) and the water temperature returning to the pool

G. Water Quality Control, Sanitation, Oxidation, and pH

1. Ozone generation and injection shall be utilized for its superior sanitation and oxidation performance. Ozone is sized based on the anticipated bather load and total water volume to be treated. Ozone shall be controlled by ORP, separately from the chemical residual ORP
2. Residual Sanitizer (Chlorine) and pH (Acid) adjustment shall be accomplished by the use of a Chemical Controller and Automatic Feeder System for each pool. Chemical containment tanks should be combined into common storage for all pool systems within each given mechanical space

H. Pool System Automation

1. An automation system shall be incorporated into each mechanical room to monitor system performance and allow operations to control functions, such as filter backwash, chemical dosing, water level, safety interlocks, and pool temperature
2. The automation system shall monitor water chemistry parameters and temperature history for each pool and log these for facility records and reporting to the local health department or ministry as required
3. Pool automation system shall interface with ride control systems providing mutual interlocks for guest safety.

I. Access:

1. Each pool shall have means of accessible entry/exit (stair, ladder, or recessed treads) within every 75 feet (25m) of the pool perimeter. A minimum of two accessible entries shall be installed in each pool and located to serve both ends of the pool
2. Stair access into the pool shall have a tread length of 4 feet (1.2m) and tread width of 12 inches (0.3m) minimum and a maximum tread riser height of 10 inches (0.25m)
3. Swim outs shall extend 18 to 24 inches (0.5 – 0.6m) from the pool wall and a maximum of 12 inches (0.3m) below the pool deck. Swim outs shall be provided only in areas where water depth is 5 feet (1.5m) or greater

4. Benches shall extend 14 – 18 inches (0.35 – 0.5m) from the pool wall and shall be located in areas where the water depth is 3 feet (1.0m) deep or less
5. A permanent dark contrasting tile band shall be installed at the edge of each stair, swim out, or bench
6. Handrails shall be provided for all stairs and shall be anchored in the bottom step and the deck. Grab rails must be mounted in the pool deck at each side of recessed steps and ladders. Handrails and Grab rails shall extend at least 28 inches (0.7m) above the step edge or pool deck.
7. A pool lift shall be provided for each pool less than 300 feet (90m) of pool perimeter. Two compliant means of access shall be provided for pool with more than 300 feet (90m) of perimeter, one of which must be a pool lift or sloped entry.

    a. Compliant means of entry include:

        i. Pool Lift
        ii. Slope Entry
        iii. Transfer Wall
        iv. Transfer System
        v. Pool Stair with two handrails space 24 inches (0.6m) apart

J. Pool Shell Construction:

1. Pool shells shall be constructed of concrete or shotcrete and shall be watertight, free from structural cracks, and shall have a nontoxic smooth and slip resistant finish
2. All pool, spa, and hot tub shells shall be constructed of a concrete/shotcrete mixture having a water/cement ratio of 0.40 and 28-day compressive strength of 5,000 psi (34.5 MPa)
3. Pool shells shall be steel reinforced according to the American Concrete Institute (ACI) guidelines for watertight concrete structures
4. Pool walls shall be within 5-degrees of vertical for a minimum depth of 2.5 feet (0.8m) from which point the wall may join the flow with a maximum radius of 2.5 feet (0.8m)
5. Corner intersections of walls that protrude or angle into the pool water area shall be rounded with a minimum radius of 2 inches (50mm)
6. Floor slopes shall be uniform. The floor shall be a maximum 1:12 slope in areas 5 feet (1.5m) or less in depth. Floor slope shall be a maximum of 1:3 in areas more than 5 feet (1.5m) deep
7. Transition in floor slope shall occur only when water is a minimum of 5 feet (1.5m) deep. A slope transition must have a 2 to 6 inch (50 – 150mm) wide dark contrasting tile marking across the bottom and must extend up both sides of the pool at the transition point

K. Pool Finishes and Markings:

1. Finishes shall be white or light pastel in color and shall have characteristics of reflecting rather than absorbing light.
2. Waterline Tile shall be a minimum 6 inches (150mm) tile band installed at the waterline
3. A contrasting tile band shall be installed at all changes in the pool floor including slope changes, stairs, and benches.
4. Any design or logo on the pool floor or wall shall be such that it will not hinder the detection of a human in distress, algae, sediment, or other objects in the pool
5. Permanent depth markers shall be placed at every one (1) foot (0.3m) change in pool depth and spaced no more than 25 feet (8m) apart. Depth markers shall be accurate within 3 inches (75mm) of actual pool depth. Depth markers shall be located on the horizontal deck and on the vertical pool wall in the waterline title. The text height of the marker shall be 4 inches (0.1m) in height
6. No diving markers are only placed on the horizontal deck and should accompany depth markers.

L. Lighting and Grounding

1. Underwater lighting shall provide a minimum 0.5 watt per sq. ft (6 W/sq. m) of pool surface area based upon incandescent light output per watt. The maximum lamp size for underwater fixtures

shall be 300 Watts. Lights shall be located a minimum of 18 inches (0.5m) below water level and provide a protection from overheating when not submerged

2. Reinforcement shall be grounded with all metal finishes, such as light housings, handrails, etc. per the National Electrical Code (NEC) requirements.

M. Special Design Requirements for Spa Pools and Hot Tubs

1. Spa pool bather load shall not exceed one (1) person per 10 sq. ft (1.0 sq. m) of spa surface area
2. Spa pools shall have a maximum water depth of 3 ft and 3 inches (1.0m)
3. The floor of the spa shall have a maximum slope of 1:48 to the bottom drains
4. The spa pool shall have a means of accessible stair entry/exit. Minimum stair length is 4 feet (1.2m). Tread and risers shall meet the requirements above
5. Benches shall be continuous around the perimeter of the spa with a maximum seating height of 20 inches (0.5m) and a minimum seating height of 14 inches (0.35m) measured from the bottom of the spa. Bench seat shall be 18 inches (0.5m) wide.
6. A permanent dark contrasting tile band shall be installed at the front edge of the bench seat at all changes in seating height.

PART 2 - PRODUCTS – Not Used

2.1 SUBSTITUTIONS

A. Substitutions of equipment make and models are only allowed if the substituted equipment conforms to the specifications and is mentioned as an approved manufacturer therein. See “Related Sections” in the summary of this specification for reference to equipment specifications.

PART 3 - EXECUTION

3.1 OPERATION

A. Manual testing of the pool water shall be performed on a daily basis immediately after water is placed in the pool the first time. During this time, it is important to maintain a balanced water condition to prevent damage to the pool shell, finishes, and equipment

B. Daily records shall be kept regarding pool operation, water quality, testing chemical injection, and balanced water chemistry

C. The Contractor is responsible for maintaining balanced pool water and keeping daily records until the system is formally turned over to the owner. Once the system is formally turned over, the owner is responsible for maintaining balanced water and keeping daily records

3.2 DESIGNATION / LABELING

A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer

B. Install tags with corrosion resistant chain

3.3 CONTROLS PROGRAMMING

A. Functional Requirements

1. Controls provide all functions described herein for each individual pool/water feature. Water Feature Controller (WFC) includes controlling and monitoring of pumps, water filtration, chemical feed, and lighting
2. The Contractor shall refer to the Water Treatment Drawings to determine which pumps, filter controller, and chemical controller are associated with a given pool, spa, or feature. The system addressed in this specification include:

B. Pump Control

1. All pump controls include HAND-OFF-AUTO (HOA) selector switch as shown on the drawings at the control center. HAND and OFF positions indicate manual control. AUTO control shall be determined by the PLC. In no case shall the pump operate in over-ride of safety interlocks

    a. Each pump will have a Vacuum Limit Switch (VLS) that will be preset on site during construction to meet each pump's vacuum limit when the suction is restricted. When the VLS is activated the PLC will shut down the associated pump and send a fault signal to the Human Machine Interface (HMI)

2. All pumps with Emergency Stop Controls (E-STOP) shall immediately cease operation when the E-STOP is activated. All pumps receiving water from the same feature as the pump listed above shall also stop. The PLC shall send a fault signal to the HMI. Operation of associated pumps cannot be continued until the activated E-STOP is reset.
3. All feature pumps not associated with water treatment shall also have an operator adjustable timer through the PLC to control hours of operation as set by the operator through the HMI.

C. Water Filtration System Control

1. Monitor and control the Water Treatment Pumps and control the position of the Motorized (actuated) Backwash Control Valves
2. Operation:

    a. General:

        i. Provide for MANUAL over-ride mode using the controller to sequence, but the operator shall initiate filter backwash cycles

        ii. In normal AUTO mode the controller determines when a backwash is necessary, and when it may be allowed

    b. Backwash Sequencing – Regenerative Media Filters:

        i. Regenerative Media filters shall include automated regeneration, precoat, and flushing cycle control on each filter tank
        ii. Controller shall interface with each filter panel to prevent multiple tanks from cycling at the same time

    c. Backwash Sequencing – Sand Filters:

        i. Step 1 – Controller monitors treatment pump operation and shuts down treatment pump(s) when backwash is initiated.
        ii. Step 2 – Controller repositions each of the necessary backwash control valves to allow filter water to flow backwards through the filter at the required flow rate to the waste piping or drain
        iii. Step 3 – After the valve is repositioned, the controller restarts the treatment pump(s)
        iv. Step 4 – The backwash priority valve shall remain in its restricting position until all of the filter tanks in a give grouping have been backwashed
        v. Step 5 – When one tank in a filter grouping has been backwashed for a predetermined time period the controller stops the treatment pump(s) and repositions that tank's backwash valves to normal operating position and the next tank's backwash valves are set to backwash position
        vi. Step 6 – After the valves have been positioned, treatment pump(s) are restarted. This cycle continues until each of the filter tanks in a giving grouping have been backwashed
        vii. Step 7 – When all filters in a given grouping have been backwashed the controller shall stop the treatment pump(s), return the backwash priority valve to full OPEN position, confirm all valves are in normal operating position and restart the treatment pump(s)

D. Chemical System

1. Function: To monitor and control the water pH and ORP of the closed loop water systems
2. Operation:

a. The chemical controller shall sample and monitor the chemical properties of the system water. The controller shall control the feed pumps to dose liquid chlorine and acid via switching relays in the controller
b. The PLC shall monitor treatment pump(s) operation for the system and shall inhibit any chemical injection unless the treatment pump(s) is ON

E. Heater Control

1. Function: In addition to normal thermostat control built into the pool heater the PLC shall monitor the temperature of water leaving the mechanical room and insure that the temperature is never more than 104 °F (40 °C)
2. Operation:

a. The temperature probe shall monitor the temperature of the water going out of the mechanical room and back to the water feature. If the temperature of the water ever exceeds 104 °F (40 °C), the PLC will de-energize the pool heater

3. The maximum temperature set point shall be adjustable on the HMI

F. Water Feature Lighting

1. Function: To automatically turn the feature lights ON and OFF
2. Operation:

a. A photocell will be mounted in a remote area adjacent to the associated water feature. The photocell will activate the lights with a relay through the PLC
b. Hours of operation may also be programmed into the PLC to switch to a low-light (minimum code requirements) condition during non-operating hours

G. System Alarms and Shutdown Trips

1. Mechanical Room High Water Trip

a. Function: To monitor high water levels on the mechanical room floor and shutdown electrical power
b. Alarm Notification on the door of the Control Panel
c. Operation:

i. The switch shall be installed near the floor as shown in the contract documents
ii. Should the water level switch actuate, the main breaker shall trip de-energizing all water feature equipment within the equipment room
iii. Resetting the alarm shall occur when the Motor Control Center (MCC) circuit breaker is reset

H. Pump Restart Time Delay

1. Function: To delay restarting all motors and allow a staggered starting after Utility Power Failure
2. Operation:

a. When the Control Panel is energized, several timing delay relays shall begin timing, each relay shall be set for a five (5) minute cascaded delay
b. Large pump loads (15 hp and greater) shall not be allowed to start until the time delay for that pump is complete
c. The relays shall reset on loss of power at the Control Panel

I. Motor Control Center (MCC) – Phase Failure Trip

1. Function: To monitor the incoming AC power to the 3-phase MCC, and trip all motors on loss of any phase
2. Operation:
    a. The Phase Failure relay shall be installed in the MCC monitoring incoming AC power
    b. Should a low voltage condition on AC power feed occur on any one of three phases, the MCC main circuit breaker shall trip de-energizing the MCC
    c. There is no indicator or horns for this alarm. Resetting the alarm shall occur when the MCC main circuit breaker is reset

END OF SECTION