City of Portland, Oregon

Design Guidelines for Interactive Fountains

PORTLAND WATER BUREAU
FROM FOREST TO FAUCET

PORTLAND PARKS & RECREATION
Healthy Parks, Healthy Portland

CONTENTS

APPENDIXES

1. INTRODUCTION

1.1 Background and Purpose of the Design Guidelines

1.1.1 Background

The Portland Water Bureau (PWB) maintains an inventory of 29 decorative and interactive fountains throughout the City. Currently, 23 fountains are decorative and 6 are licensed by the State of Oregon to operate as interactive fountains. Originally, all decorative and interactive fountains were the responsibility of the Portland Parks & Recreation (PP&R). In 1988, responsibility for maintaining all major fountains was transferred to PWB.[1]

Interactive fountains are significantly different from decorative fountains because people interact with and play in the water in an interactive fountain. Interactive fountains must therefore be designed to recirculate and treat the water to protect the health of the public. Decorative fountains are designed for visual appreciation, not for public play and interaction. Although some decorative fountains have water basins, the PWB discourages the public from getting in the water. Recent additions to the City's fountain inventory have all been interactive fountains that have included a recirculating feature which makes them more complicated. Therefore, these design guidelines are written for interactive fountains and all references in these guidelines are to interactive fountains.

Over the past twenty years the PWB has developed a comprehensive operations and maintenance (O&M) program for the fountains to enhance the public's enjoyment and well being. Whenever possible, the PWB has standardized the equipment used to operate the fountains. The equipment used for remote operation and monitoring of the fountains is the same as, or is compatible with, the system the bureau uses for its other facilities. The operating equipment has proven to be the most efficient and reliable available through 20 years of fountain operations. Standardized equipment and procedures leads to the most efficient and effective O&M program possible.

A minimal O&M workforce effectively maintains the bureau's fountains through established procedures that can be duplicated throughout the system. Staff familiarity with equipment and procedures minimizes fountain down time when repairs are required.

[1] See City Ordinance No. 161007, Appendix C of this document.

1.1.2 Purpose

The purpose of these Design Guidelines is as follows:

- To provide designers and project managers in consulting firms and other city bureaus with PWB's design requirements for interactive fountains
- To leverage the benefit of PWB's proven maintenance program city wide
- To demonstrate how PWB's long-term maintenance requirements establish the basis for design and equipment selection for new fountain projects
- To define minimum requirements to meet health and safety codes

Adherence to the guidelines at all stages of design will minimize the number of corrections and changes to be made to the design products prepared for bidding and reduce the number of changes in the field during construction.

The PWB has no interest or role in defining or interfering in the waterscape design consultant's conceptual design and intent for the water feature. The appearance of the water containment and display areas, the aesthetics of the surrounding park, and how the water feature program performs is not a PWB concern as long as the public is safe and the experience is enjoyable. The PWB's purpose in providing these guidelines is to ensure that the fountain is reliable for the long term, can be integrated into the bureau-wide remote operation and monitoring system, and can be easily maintained and operated.

The PWB strongly recommends that the guidelines be incorporated into future requests for proposals for fountain design.

1.2 Waterscape Design—Public Expectations and Regulation

The current trend in waterscape design is to build interactive fountains. These waterscape elements are a combination of water feature and park that includes artistic elements and fulfills the public's expectations of interaction. Many people enjoy the interactive nature of these water features and they make certain fountains a destination on hot summer days. This can sometimes be the case even when these fountains were never intended for interactive use.

In 2006 and 2007, the Oregon Department of Human Services Public Health Division changed the Oregon Administrative Rules (OAR) related to swimming and wading pools.[2] The revised OAR clarifies that if the design of a fountain has an interactive element; the fountains are regulated by the State of Oregon and must be licensed

[2] OAR Chapter 333–Division 60, Public Swimming Pools. For a more detailed description of the regulation, see Section 4. Fountain Regulations and Treatment Requirements.

through Multnomah County. The depth of the pool determines whether it is licensed as a swimming or wading pool. A wading pool designation has safety and equipment requirements that would not be necessary for a fountain designed solely for the purpose of visual enjoyment. The overall permitting process for a wading pool can also be more lengthy than permitting for a non-interactive fountain. Section 4 contains more information relative to fountain regulations.

1.3 Historical Background

Since 1988 when PWB assumed responsibility for maintaining the City's fountain inventory, the number of fountains has grown. The list below shows significant dates in PWB's responsibility for some of the City's fountains.

Date	Event
1988	City Ordinance 161007 assigns responsibility to PWB for maintaining fountain inventory. See Attachment 1 for the full text of the ordinance.
1998	City's Parks Bureau transferred responsibility for the Shemanski Fountain to PWB
2004	City Ordinance authorized an inter-agency agreement that adds Elk, Jamison Square, and Skidmore fountains to PWB's list. See Attachment 2 for full text.
2005	PWB assumes responsibility for McCoy Fountain
2007	Two fountains in downtown transit mall (Bathtub and Commonwealth) are permanently decommissioned
2011	PWB assumes responsibility for Teachers and Bill Naito Legacy Fountains.

The inter-agency agreement created through the 2004 ordinance not only added new fountains under PWB's responsibility but also articulated the following terms and conditions:

- Definition of the responsibilities and boundaries for operation, maintenance, and repair of the fountains
- Terms for ingress and egress to the fountains for maintenance purposes, utility costs, notifications, and special events
- Clarification that new fountain designs will be reviewed and accepted by the PWB at the various levels of development and that the PWB's Chief Engineer must sign off on the final drawings and specifications (100%) before the project goes out to bid for construction.

1.4 Design and Construction Memorandum of Understanding

The PP&R, PWB, and any other participating City agency will establish a memorandum of understanding (MOU) for the design and construction of each new fountain. This MOU will be drafted and approved by the administrators or directors of all agencies named in the MOU as soon as possible but before final design drawings are completed and the project is bid. The PWB will provide Not to Exceed (NTE) staff costs for the MOU of staff time to review and approve the design drawings and specifications and for construction management and inspection of the fountain-related work. The NTE costs will be based on City-accepted hourly rates that include overhead rates established by the City Council. The PWB's staff costs will be the responsibility of the Parks Bureau and must be included in the overall project cost estimate.

1.5 Transfer of Assets Ordinance and Fountain Intergovernmental Agreement (IGA)

When fountain construction and commissioning have been completed, PP&R will initiate the transfer ordinance and IGA amendment, with Water Bureau input. After all Operations and Maintenance Manuals, as-built drawings, guarantees, warranties, and replacement parts and materials pertaining to the fountain have been delivered to the PWB, a City Ordinance will be submitted for approval by the Portland City Council. Approval of this Ordinance by the Council transfers asset ownership and maintenance responsibility from Portland Parks and Recreation to the Portland Water Bureau. It also amends the 2004 fountain interagency agreement to add the new fountain into the City's fountain inventory.

1.6 Art/Architectural Elements and RACC

Some of the City's fountains have designated art elements. The Regional Arts and Culture Council (RACC) has jurisdiction over the art element. It is possible that the City could maintain a fountain and surrounding area and RACC would help maintain the art element that resides within the confines of the fountain. The Fountain Designer and Project Manager need to be aware of this potential relationship so that a determination of responsibilities can be established early in the design phase of the new project. The RACC staff can provide assistance with a determination of eligibility for an art designation. The PWB is responsible for maintaining flexible service contracts with qualified art conservators so that the conservator can be brought in for repairs and rehabilitation to the exterior fountain elements when they are damaged due to vandalism or weathering. Some fountains are not designated as art works, but nevertheless they are rehabilitated by conservators. RACC also provides assistance when sculptures are damaged.

Several citizen groups have vested interests in several of the City's fountains. Members of the public have formed committees to express interest in facilities for architectural, philanthropic, familial, and historical reasons. The members of these committees are stakeholders in any project that might affect the fountains or their surroundings.

2. PROJECT MANAGEMENT AND PROCESS

2.1 General

This section sets out the project management steps and processes for interfacing between PP&R (or other City agencies) as the fountain design and construction manager and the PWB as the eventual fountain owner and operator. These steps and processes include establishing responsibilities, timelines, and quality assurance and quality control (QA/QC) reviews and creating a work plan that provides for product and materials approvals and acceptance.

2.2 Design Narrative and Schematic Design

2.2.1 Design Narrative

PP&R, or the design consultant working through PP&R, is responsible for providing a copy of the design narrative and the schematic design to the PWB. PP&R will request the PWB's input on the design narrative as applicable. The design narrative is a general description of the fountain, including the fountain pool and jet display and how the fountain fits into the surrounding park and landscape. The design narrative is the first work product, developed before the fountain is designed. The design narrative should inform PWB staff and others regarding the architect's intent, concept, and the overall complexity of the fountain. The design narrative should include a description of the intent behind the public's interface with the fountain. This will help determine the type of permitting and complexity of treatment and public health monitoring required.

The fountain description in the design narrative should include location, size, shape, general layout, type and number of jets, height of spray, arrangement of jets, water pooling, lighting, and other significant features.

The fountain display description should explain the intended artistic effect and operational display including programs and cycles of the fountain display, such as jets, misting, and pooling. The description should include the choreography of the jets (if any), the sequencing, the dimensions and length of the water throw or movement, and any other display element that might affect the mechanical or electrical equipment needed for the fountain.

2.2.2 Schematic Design

A second work product at this early stage is schematic plans and drawings (conceptual design) of the park, its amenities, and the fountain. PP&R will request the PWB's input on the schematic design as applicable. This schematic design should illustrate how the fountain is expected to fit into the park and its surrounding landscape. Of particular interest is the fountain's location and layout in the park, surrounding flat work and other structures, and adjacent landscaping.

2.3 Work Plan

Parks or the design consultant working through PP&R is responsible for providing a copy of the work plan to the PWB. The work plan describes how the project will be accomplished, who will do the work, and how long it will take to design and construct the project. The work plan must include the project scope, schedule, budget, team members, permitting needs, plans for coordination with other agencies, and applicable design standards.

- The **project scope** should include identification of any special technical analysis or engineering and design studies needed to support design and construction of the project such as contamination assessments, geo-technical assessments, site studies, pilot studies, or similar technical studies. The scope should also include information about the anticipated size of the water service so that the PWB can begin evaluating the water service and connection and associated costs. PP&R will need to include the cost of the water service in their budget.
- The **schedule** needs to identify the key project elements and tasks, work products, review times and completion dates
- The **budget** should include the costs expected to be incurred by the PWB and reimbursed by PP&R for the PWB's involvement in the design and construction of the project. Of importance to the PWB is the overall budget for the project but more importantly, detail on the fountain portion of the project. The fountain budget is needed so that the PWB can determine the size and complexity of construction and fountain operation for calculating personnel hours for assisting in design/construction and for future operations/maintenance.
- The **project team** identifies the design and construction team members involved in the project and its management from Parks, the Design Consultant/Engineer/ Architect, the PWB, and the construction contractor. Every effort will be made to retain these team members but circumstances may require changing them during the course of the project. A matrix of agency responsibilities is shown on page 14.
- The **permitting needs** should identify permitting requirements for land use, environmental, public works, building, public health, and any other special permitting.
- The applicable **design standards** should conform to the guidelines delineated in this manual. If the design standards fall outside guidelines in this manual, the work plan should specify this so that PWB staff can adjust the estimated time required for reviewing the project.

The PWB assumes that the project will be managed in a traditional Design-Bid-Build process with full design completed prior to bidding and construction. If alternative project delivery methods are planned such as Design-Build, this will be spelled out in the

work plan so that the PWB can make adjustments to their cost estimates for supporting PP&R in completing the project. The discussion that follows assumes Design-Bid-Build project delivery.

2.4 Design Review Process

2.4.1 Design Development (similar to Site Plan in engineering project terms)

The Design Development phase focuses on refining the Schematic Design to 100% Design Development drawings and specifications table of contents. The PWB will require 2 printed review copies and a 2-week period to review, consolidate comments and provide to Parks.

- The PWB CIP Facilities Program Manager will provide comments on the design in the form of a spreadsheet table in a format provided by PP&R for the project with references to design drawings by sheet numbers. The comments will be provided to PP&R on or before the 2-week review deadline. The comments will be framed around constructability, maintainability, and operability but may also include comments seeking more information to understand the fountain design.
- PP&R will forward comments to the Design Consultant to incorporate into the next submittal.

2.4.2 30% Construction Documents

- The 30% CDs focus on providing a Mechanical Room Schematic Plan to identify key equipment layout, including pumps, filters, treatment equipment, electrical control panel, valves and piping. The PWB will require 3 review copies and a 2-week period to review and consolidate comments to Parks.
- The PWB will provide comments on the design in the form of a spreadsheet/table in a format provided by PP&R for the project with references to specification sections and pages, and to the design drawings by sheet numbers. The comments will be provided to Parks on or before the 3-week review deadline. The comments will be framed around constructability, maintainability, and operability but may also include comments seeking more information to understand the design.
  - PP&R or its design consultant will provide written responses to the previous review comments, showing how they were addressed or why they could not be incorporated into the design, drawings, and specifications. Plan review meetings or conference calls should be scheduled by PP&R to work out any discrepancies.

2.4.3 60% Construction Documents

- The 60% CDs focuses on refining the Design Development drawings to the 60% CD level. The PWB will require 5 review copies and a 3-week period to review and consolidate comments to Parks.
- The 60% CDs should include drawings, specifications, and an engineering report as defined below.
  - Drawings that provide the final layouts without details finalized including final site layouts, locations, plans and elevations, fountain features, mechanical layout, reservoir layout, piping alignment and size, appurtenances with clearances such as location of valves, jets, drainage, return lines, check valves, regulators, and any other layout feature or piece of equipment integral to the fountain design.
  - A mechanical room size and layout including pumps, filters, treatment equipment, monitoring equipment, electrical, control, piping plans and elevations, and other equipment including elevation of walls, floor and ceiling with key dimensions to demonstrate clearances and access. Include a preliminary operation and maintenance plan that demonstrates removal and replacement of equipment.
  - Preliminary process, instrumentation and control diagrams, and preliminary electrical diagrams
  - Specifications should include a description and listing of all equipment and materials.
  - An engineering report defining the pressures, size of equipment, performance criteria such as flow rates and recycling rates, related design assumptions and calculations, the filtration and water treatment processes, the control logic and capabilities, logic, interfaces and processes, and the overall function requirements of the fountain
- The PWB will provide comments on the design in the form of a spreadsheet/table in a format provided by PP&R for the project with references to specification sections and pages, and to the design drawings by sheet numbers. The comments will be provided to Parks on or before the 3-week review deadline. The comments will be framed around constructability, maintainability, and operability but may also include comments seeking more information to understand the design.
  - PP&R or its design consultant will provide written responses to the previous review comments, showing how they were addressed or why they could not be incorporated into the design, drawings, and specifications. Plan review meetings or conference calls should be scheduled by PP&R to work out any discrepancies.

2.4.4 90% Construction Documents (Similar to Final Design Review In engineering project terms)

The 90% Construction Documents level focuses on finalizing the design, drawings and specifications to 90%. The PWB will require 5 review copies and a 3-week period to review and consolidate comments to Parks.

- The PWB will provide comments on the design in the form of a spreadsheet/table in a format provided by PP&R for the project with references to specification sections and pages, and to the design drawings by sheet numbers. The comments will be provided to PP&R on or before the 3-week review discussed previously. The comments will be framed around constructability, maintainability, and operability but may also include comments seeking more information to understand the design.
- The 90% CD design review product should include drawings, specifications, and other products as described below.
  - PP&R or its design consultant will provide written responses to the previous review comments, showing how they were addressed or why they could not be incorporated into the design drawings and specifications. Plan review meetings or conference calls should be scheduled by PP&R to resolve any discrepancies.
  - Drawings and specifications representing 90% completion including all details ready for final review.
  - 90% CD construction cost estimate and estimated contract time

2.4.5 Final Approval (100% Construction Documents)

Final approval is the last step in the design phase. The PWB will require 3 review copies and a 2-week review period. This step concludes with approval of the project drawings and specifications by the PWB's Chief Engineer. The final approval review product should include the following:

- Responses to the previous review comments, showing how they were addressed or why they could not be incorporated into the design, drawings and specifications. Plan review meetings or conference calls should be scheduled by PP&R to work out any discrepancies.
- Coordination with other agencies and application for permits completed so that input can be incorporated into the design
- Final drawings and specifications incorporating any permit revisions.
- From PP&R a descriptive statement and agreement on how construction management will be coordinated with the PWB. Construction management includes items such as contractor qualifications, communication with contractor, addenda, Requests For Information (RFI), change orders, inspection role, submittal review, placing facilities

into service, start-up, commissioning, closeout, and Operations and Maintenance Manuals.

- Bidding and construction schedule

2.4.6 Construction Management

The construction phase of the project involves the bidding, pre-construction, construction, inspection, commissioning and final acceptance of the fountain.

Within the PWB, the project management role will be transitioned from the Design Project Manager to the Construction Manager (PWB-CM). PP&R will also transition the project to a CM, or Owner's Representative, with the PM remaining heavily involved.

The PWB-CM will provide assistance as requested for reviewing documents during the bidding process. Additionally, the PWB-CM will have a direct role and responsibility in the inspection of the fountain, commissioning, start-up, final acceptance, and warranty administration. PP&R will have direct responsibility for bidding, awarding, managing construction, administering all contracts, and warranty administration.

The PWB will be involved in the fountain component of the project, the water service for the fountain, and any water service for associated buildings. Additional detail on applying for a water service for the fountain from the PWB is described in Chapter 9, Fountain Utilities. The rest of the project including the park component will be managed by PP&R or its designated authority.

The PWB's CM will communicate any concerns related to the construction of the project directly to the PP&R CM or designee. PWB inspectors will conduct inspections at the agreed-upon milestones and will communicate any concerns directly to the PWB CM, who will in turn communicate to the PP&R CM. The PP&R CM will discuss these concerns with the contractor and report back to the PWB CM.

The anticipated roles are outlined in Table 1.

Table 1. Agency Roles During Project Construction and Post Construction

Role	Parks or Designee[a]	Water Bureau
Bid phase and pre-construction		
Bidder Prequalifications and Document Review	Lead	Assist
Preconstruction Conferences	Lead	Assist
Bidder Questions and Clarifications	Lead	Assist
Bid Addenda	Lead	Assist
Construction		

Table 1. Agency Roles During Project Construction and Post Construction

Role	Parks or Designee[a]	Water Bureau
Contract Administration	Lead	—
Communicating with Contractor	Lead	—
Contractor Meetings	Lead	Assist
Contract QA/QC	Lead	—
Submittal Review	Lead	Assist (Review and Respond)
Requests for Information	Lead	Assist
On-Site Inspection	Co-Lead	Co-Lead
Accept or Reject Work Products	Lead	Assist
Create Punch Lists	Lead	Assist
Post-Construction and Project Acceptance		
Assessing Substantial Completion	Lead	Assist
Commissioning	Co-Lead	Co-Lead
Start-Up	Co-Lead	Co-Lead
Final Acceptance	Lead	Assist
Developing As-Built Drawings	Lead	Assist
Review of O&M Procedures & Documentation	Co-Lead	Co-Lead
Review of Operating Display Program	Lead	Assist
Review of Instrumentation and Controls	Lead	Assist
Warranty Administration	Lead	Assist

[a]Designee may be contractor or Portland Development Commission staff

3. CITY SUSTAINABILITY POLICIES

3.1 Background

Several City policies related to integrating sustainable practices and resource efficiency should be integrated into the design, procurement, and construction of fountains. These policies govern waste reduction and pollution prevention, energy conservation and renewable energy, and purchasing practices. The policies are integrated into four major efforts: the Portland Recycles! Plan, the Sustainable Procurement Policy, the City Energy Challenge Program, and the City's Sustainability Vision. The City's web site at www.portlandonline.com/bps provides more detail about these policies.

3.2 Plans and Policies

The **Portland Recycles! Plan** is a set of recommendations and supporting research designed to reach new city-wide goals for recycling and waste prevention set by City Council. The plan guides the City's solid waste and recycling initiatives through 2015. It includes a recycling requirement for permitted jobs valued at over $50,000 to recycle 75% of waste materials including wood, concrete/rubble, metal, land clearing debris and cardboard.

In 2008 the Portland City Council passed the **Sustainable Procurement Policy**, which is an effort to spend public funds on goods and services that minimize negative environmental impacts, are fair and socially just, and make economic sense, now and in the long-term. The Sustainable Procurement Policy complements and builds on many other environmental and social programs in the City. In developing plans, drawings, work statements, specifications, or other product descriptions, the City requires the purchase of environmentally preferable, recyclable, reusable, readily biodegradable, energy-efficient, made from recycled materials, and nontoxic. Furthermore, the City requires that decisions for purchasing products and services are based on long-term environmental and operating costs and include environmental and social costs in short-term prices.

In 1991, the City created the **City Energy Challenge Program** to cut energy use—and save money—in City operations. The program is a response to the City Energy Policy. The policy's goal is to "Promote a sustainable energy future by increasing energy efficiency in all sectors by ten percent by the year 2010." Purchased products shall meet or exceed Energy Star® criteria for energy efficiency. This applies to any equipment that uses electricity, natural gas, or fuel oil, and products that indirectly impact energy use—such as but not limited to—windows, doors and skylights.

Additionally, the PWB adopted a **Sustainability Vision** in January 2004. Some of the fountain-related goals endorsed in the vision include the following:

- Reduce operating costs by purchasing materials that are durable and reusable

- Change work processes as needed to make more efficient and cost-effective use of materials, equipment, and natural resources
- Improve health and safety for employees by reducing or eliminating use of, and exposure to, hazardous and toxic materials
- Change work processes to reduce exposure to fossil fuel exhaust, noise, and other related hazards
- Provide training, information and tools for employees to enable them to provide water services in a sustainable manner
- Enable use of alternative energy
- Encourage efficient use of water

4. FOUNTAIN REGULATIONS AND TREATMENT REQUIREMENTS

4.1 Background

Prior to the 2006/2007 change in regulations, the City has operated its fountains as decorative fountains, not public swimming or wading pools. In the late 1980s, public health incidents in fountains in other cities prompted PWB to provide chlorine disinfection, sand filtration, and pH adjustment for fountains that recirculated water and where there was known human contact with the water. This decision met the existing swimming pool health regulations even though the City's decorative fountains were not categorized in state health codes as wading or swimming pools.

Fountain water quality is monitored and adjusted. The analyzer monitoring output is recorded for control. The PWB's SCADA system stores fountain water quality data in a retrievable database.

4.2 Current Status

In July of 2007, the Oregon Department of Human Services (DHS) published significant revisions to OAR Chapter 333 - Division 60, "Public Swimming Pools." These rules govern the licensing, construction, and operation of public swimming and wading pools. For the PWB, the most significant impact of the revisions was the inclusion of interactive fountains in the definition of a public wading pool. The regulation makes the following distinctions in the definition of a wading pool:

- **"Public Wading Pool"** means an artificial structure, and its appurtenances containing water less than two feet (600 millimeters) deep which is expressly designated or used with the knowledge and consent of the owner or operator for wading or recreational bathing and is for the use of any segment of the public, whether limited to patrons or a companion facility or not.
- **"Spray Pool"** or **"Water Playground"** meaning a wading pool containing spray features intended for recreational use, that does not allow water to pond in the basin. Spray pools or water playgrounds that do not pond water and use potable water once then send it to waste are not regulated by these rules.
- **"Interactive Fountain"** meaning a wading pool designed for esthetic appreciation, expressly designated or used with the knowledge and consent of the owner or operator for wading or recreational bathing by any segment of the public. Interactive fountains are a type of wading pool. Interactive fountains that do not pond water and use potable water once then send it to waste are not regulated by these rules.

- **"Non-Regulated Fountain"** means a fountain designed and operated solely for visual appreciation and for that function only. The State of Oregon does not license or regulate this type of fountain.

4.3 Compliance

OAR Chapter 333 - Division 60, "Public Swimming Pools" includes several stipulations that are specific to interactive fountains constructed after July 1, 2006. The following is a summary of some of the requirements for new fountains (wading pools) per the revised OAR dated 2011. It is the Designer's responsibility to use the most current OAR:

- Any person planning to construct a new wading pool must receive a permit for construction by submitting complete plans and specifications, receiving a written plans approval, paying a construction permit fee, and receiving a permit to construct.
- Drawings and specifications shall be prepared by a professional engineer or landscape architect registered in the State of Oregon.
- No person shall operate a fountain (wading pool) without securing a final construction inspection, making application for a license to operate, paying the fee, and securing a license every year renewable on December 31.
- All pools shall have continuous recirculation and filtration systems with piping, pumps, filters, disinfection and other equipment to maintain pool water quality. The system shall be sized to recirculate water consistent with a turnover rate so that the water spends less than 60 minutes on the wetted surface and in the piping system before it is filtered and dosed with chlorine.
- Inlets and outlets shall be sized and arranged to produce a uniform circulation of water so as to maintain a uniform disinfectant residual throughout the pool. The fountain shall be designed to have at least one inlet per 400 square feet or 10,000 gallons of water, whichever is greater. There will be at least one inlet at the lowest point in order to drain the entire pool using gravity. Total velocity through outlet grate openings shall not exceed 2 feet/second.
- The pool shall be designed with automatic disinfection equipment with controls capable of fine feed rate adjustments for the chlorine which will meet OAR 333-060-0200 and OAR 333-060-0515.
- Flow meters shall be installed in all recirculation systems and pressure gauges shall be installed on the influent and effluent lines of filters.
- Wading pool equipment shall be installed in a room or building large enough to permit ready access to all equipment for both operation and maintenance. Ready

access is defined as a minimum of 3 feet of unobstructed access to all equipment. Equipment rooms shall be adequately ventilated and shall have a floor drain. Equipment rooms shall be lighted, will be locked, and will protect the equipment from the elements.

- A certified ground-fault-interrupter shall be provided on all branch circuits involved in lighting or receptacle outlets.
- Provide skimmers or gutter/trench drains.
- All wading pools must provide entrapment, hair entanglement and evisceration protection of all suction fittings with two forms of protection. These forms of protection include multiple suction fittings, anti-entrapment drain covers, drain grates, gravity return to a surge tank, safety vacuum release system, or other means of passive protection.
- If the interactive fountain is designed with a basin, it must have a slope less than 1 in 12 and the maximum allowed water depth is 8-inches or stairs and handrails must be provided.
- At least 6 feet of unobstructed decking must be provided around the wading pool perimeter.
- Enclose the wading pool. Fountains that do not pond water don't require an enclosure.
- Depths must be indicated on signs near the entrances if the water ponds in the fountain.
- Install slip-resistant, easy-to-clean and water-impervious surfaces that are resistant to bacteria, algae growth, and vandalism/damage.
- All wading pools must maintain good water quality in accordance with OAR 333-060-0200 Table 3.
- All wading pools must provide safety signage in accordance with OAR 333-060-0515.

This list is not all-inclusive and is not intended to represent all the requirements in the regulation. The fountain designer should refer to the regulation during the design phases to ensure that nothing is overlooked which could impede obtaining the license to operate. As the PWB obtains clarification from the State of Oregon and Multnomah County on the applicability of the regulations to the current inventory of fountains, it will update this manual and communicate the clarifications to PP&R staff.

The contractor must obtain a permit to construct. The contractor or the Owner's Representative during construction must also obtain the license to operate the fountain. The license request must indicate that the PWB will be the licensed operator of the new interactive fountain. The requirements within the regulation must be met unless

variances are granted. It is very important that the fountain designer provide detailed design documents so that PWB staff can help the project meet all regulations. The Portland Water Bureau's Regulatory Compliance group is working closely with the State of Oregon on interpretations of these fountain regulations. PWB's Regulatory Compliance group must be consulted when considering variance applications during design.

5. SITE SELECTION

5.1 Site Selection and Layout

Site selection for the park and the fountain layout is an important element to consider during conceptual design. Site layout provides the best opportunity to situate a fountain that will be easy to maintain and operate for the next several decades. Fountains that are difficult to maintain may remain out-of-service longer than fountains that have easy access. A balance between the artistic and the functional requirements of the fountain is essential; a fountain that has been shut down cannot be enjoyed by the public.

The fountain should not be located in an area that is subject to flooding. Any element that can clog a drain or filter jeopardizes fountain operations. For example, leaf fall from trees increase the operating costs of the fountains because leaves clog drains, strainers, and display jets. In addition, organic material from leaves can adversely affect a fountain's water quality. Proximity to bark dust, sand, gravel, and loose rock impacts the operation of the fountain because these materials can be carried into equipment that is not designed to handle it. Finally, the park and fountain should be situated and designed in order to maximize water return to the fountain and minimize the impact of the chlorinated water to the surrounding hardscape and landscape.

Consideration should be given to providing a restroom for the public's use if there is not a public restroom in close proximity to the park.

5.2 Safety

The interactive fountain should be designed and laid out in such a way that the public's safety is the primary goal of the project. The project includes the water feature, its associated park features, and landscaping. If there are display jets, the resultant force of the water from the jet should be minimized to reduce the possibility of injury to the public. If there is a pond, the depth of the water should be kept to a minimum. Wading pools require special design considerations because their smaller water depths and volumes draw younger users. Sharp edges, drop-offs, large openings on drain grates, slick surfaces, and other potentially unsafe features should be avoided.

The Water Bureau has two operating requirements for all interactive fountains:

- Shut down the fountains in the winter to decrease the possibility of the water freezing and people falling on the ice. This is especially important if the fountain has jets or nozzles that throw the water into the air where the wind might carry the water spray onto an adjacent area where the water can't drain.
- Shut down the fountain at night to prevent injury.

Any fountain design based on operating the fountain in the winter or after 10 p.m. must be approved by the Portland Water Bureau's Administrator.

Additionally, the project should embrace and include design concepts like "Crime Prevention Through Environmental Design." The fountain and park should be an inviting place for the general public but discourage or prevent illicit or potentially damaging behaviors and activities. For example, the designer should incorporate skate board deterrents on benches, bench-like seating areas, and handrails. The park area should be open with no walls or structures that can hide illicit activity. The public should have a clear view through the park. The project should also include adequate lighting for public safety and so that local law enforcement can monitor activities.

The park safety features should also support a safe working environment for the fountain maintenance and operations staffs. Staff should be able to drive into the park or onto the fountain area without having to park on the street. This reduces the likelihood of injury from carrying heavy tools and equipment to the fountain and reduces staff exposure to adjacent traffic.

A fountain emergency shutdown switch should be located in the park and be easily accessible by PP&R or PWB staff. The switch should not be accessible to the public and should be locked to avoid nuisance shutdowns. Consideration should be given as to whether the public has access to a phone close-by in case of an emergency.

5.3 Security

Equipment rooms or buildings must be hardened with locks and good-quality doors in order to minimize the ability of the public to gain entry. The doors should be equipped with door position switches/alarms that communicate the open/closed status of the door to the PWB's security personnel. If written pre-approval from the Portland Water Bureau's Chief Engineer was received as described in 6.1, then the vault access hatches must be designed and installed in such a way as to minimize the ability of the public to gain entry.

6. OPERATIONS & MAINTENANCE

The PWB has a comprehensive operations and maintenance program for the City's fountains which has enhanced the public's experience of, interaction with, and appreciation for the fountains for the last several years. The operational policies for the fountains are very conservative. Fountains are shut down when water quality is in question or there are unsafe conditions. Several times in the last few years the PWB has elected to shut down a fountain rather than continue operations that might put the public at risk. These issues have included broken light lens covers, leaks from water piping, and foreign materials in the water. This conservative approach has resulted in no illnesses or injuries due to unsafe conditions since the PWB started keeping records.

Consequently, the PWB requires that any new fountain must be designed to minimize the long-range costs for operating and maintaining them. The PWB has primary responsibility for the wetted surfaces and the fountain operating equipment and therefore the requirements in these guidelines are targeted to those areas.

6.1 Mechanical and Control Rooms

The PWB requires that the fountain mechanical and control equipment be installed in an accessible above-ground equipment room. Installation in a below-ground equipment vault will require the written pre-approval of the Portland Water Bureau's Chief Engineer during the schematic design phase of the project. It should not be assumed that a vault is acceptable until this approval is received through an inter-bureau memorandum.

If a vault is specified and approved, consideration should be given to its location so that it is not at the low point of the park or fountain. The equipment room, building or vault shall be accessible to PWB authorized personnel only and not allow access by other bureaus due to control and regulatory compliance issues. Accessible is defined as locating the building or vault in an area of the park that allows the PWB to use heavy equipment or cranes to remove and install equipment, drive maintenance vehicles to the building or vault, and have chemicals delivered. The PWB shall have access to the fountain and the equipment at all times. Access shall not be impacted by adjacent activities or festivals, locked gates and garages. If this access is not provided 24 hours a day and 7 days a week, the fountain will be shut down remotely until access is granted.

The equipment room shall be adequately ventilated, have a floor drain, and be sufficiently lighted to allow for operation and maintenance activities. The ventilation system shall be equipped with a manual on/off switch near the access door or hatch in order to turn on the ventilation system prior to entry into the equipment room or vault. The ventilation piping should have bug screens to prevent nests from being built inside them and to keep insects from entering the equipment room. The vent piping must be equipped with a screen or device to prevent unwanted items from being placed into the vent.

The mechanical equipment shall be installed in a room, building, or a vault large enough to permit "ready access" to the equipment for maintenance and operation, required by Oregon Building Codes Division & National Electric Code (NEC). Ready access is defined in the wading pool regulations as "a minimum 3 feet of unobstructed access to all operational and maintenance portions of the equipment." The 3 feet of clearance allows the operator to work on the equipment and remove the equipment if it needs to be replaced. This clearance is also a requirement of the Occupational Safety and Health Administration (OSHA) and electrical codes. Doors for equipment rooms or hatches for vaults shall be sized appropriately to allow the removal of the largest piece of equipment. Additionally the PWB requires 4 feet of clearance for all electrical equipment.

In addition to the emergency shutdown switch mentioned previously in 5.2, the fountain equipment room or vault will have an aboveground electrical disconnect switch and ground fault indicator. A communication data port shall be provided in a protected and secure above-ground location, for trouble-shooting RTU & operation of the fountain by Instrument Technicians.

Additionally, the PWB requires that the electrical power supplier's meters be installed in a separate room or vault or on the exterior of the equipment building or room so that the meters are not in close proximity to the mechanical equipment. Water treatment chemicals are highly corrosive to metals. The PWB will not allow the power supplier's meter readers to enter the equipment room due to the toxicity of the chemicals. All electrical equipment shall be provided with a separate space apart from chemicals.

The fountain electronics and controls should be also located in a separate room from the water treatment equipment. Water quality and treatment devices like monitors, analyzers, and chemical dosing devices, however, may be located in the same room as the water treatment equipment. There should be a sealed door between the electrical equipment and the water treatment equipment. If a vault has been approved, the areas need to be separated by a wall with a door.

6.2 Fountain Wetted Surfaces

Fountain wetted surfaces include anything that contains water or is wetted by the fountain, including the actual fountain area and deck, tanks, piping, and equipment. The following guidelines related to the wetted surfaces shall be followed:

- The fountain surfaces shall be designed with low-maintenance materials that are easy to clean.
- Fountain surfaces should be coated with vandal-resistant coatings.
- All surfaces shall be sealed, joints grouted or caulked, and reservoirs equipped with liners.
- The fountain wetted surface should be gravity-drained with the drains in close proximity to the display jets where applicable and near the perimeters of the wetted surface.

- Lights and spray jets shall be recessed and not accessible to the public and potential vandalism.
- The PWB requires access to a hose bibb within 20 feet (or the nearest point practicable outside the limits of paving) of the fountain surface so that it can be sprayed down and cleaned.
- The fountain fill piping shall be sized adequately to limit the fill time for the holding tank to less than 2 hours.
- Holding tanks and fill piping shall be designed to allow 100% pump capacity to perform periodic vibration analysis. Pump discharge during vibration analysis may flow to drain to accommodate fountain pool capacities.
- The project shall be designed to allow easy access to the fountain strainers so that the operator can easily check them and remove debris.

6.3 Water Quality and Water Treatment

The PWB treats the water at interactive recirculating fountains by filtering the water, dosing it with chlorine and adjusting the pH as necessary. There are strict requirements within the health codes for water treatment and monitoring including that the fountain design shall provide an automatic means of disinfecting the water, and the chemical treatment equipment shall be equipped with suitable controls to allow for fine feed rate adjustments.

The PWB uses sand filters equipped with backwash equipment to filter out debris and dirt. The Water Bureau uses water quality analyzers which continuously measure pH and free chlorine. The analyzers have output signals that control CO_2 and the chlorine dosing equipment. The output signal is wired to the chemical treatment system which automatically doses the water with chlorine. The chlorinator uses calcium hypochlorite tablets in an erosion feeder system and the CO_2 is fed from a pressurized cylinder. Every sixty seconds, the monitor/analyzer sends data to the PWB's system control and data acquisition (SCADA) system. The SCADA system data is stored in a retrievable database. In addition, a fountain operator collects samples once a week for analysis in a laboratory.

The OAR requires that new monitoring equipment must use oxidation-reduction potential (ORP) for measurement of the disinfectant with a readout in millivolts (mv) of potential. Readings in parts-per-million (ppm) are no longer required per the rules. The ORP signal must also be stored in a retrievable database via SCADA for regulatory reporting purposes.

The PWB has strict criteria for the water quality in interactive fountains and consequently the treatment chemicals, instruments, equipment, and analyzers used in maintaining that water quality. Details on the PWB's requirements for the equipment are listed in Sections 7 and 8.

Fountains designed recently have included ultraviolet (UV) light disinfection equipment. UV treatment is not required to meet the State of Oregon's water quality requirements. Although UV treatment is effective for inactivating *Cryptosporidium*, *Giardia,* and pathogenic bacteria, unlike chlorine, it provides no disinfectant residual and is not as effective for inactivating viruses. For this reason, UV disinfection should always be used in combination with chlorine so that a disinfectant residual can act on waterborne pathogens that are introduced and retained in ponded areas of a fountain. Fountains that pond water increase the possibility of transferring a disease between users because of the possibility of immediate exposure to the contaminated water and the residence time in the pond before contaminated water can be drained and treated. On the other hand, the chances of exposure are reduced when the fountain is set up as a spray park style interactive fountain that does not pond water. In this type of interactive fountain, water quality can be improved through the use of UV because the water is immediately drained and recirculated through the UV system, thus inactivating contaminants such as *Cryptosporidium* before other users can be exposed.

6.4 Documentation

PP&R shall provide the PWB with the following documents:

- O&M Manuals that will include
  - procedural steps for all operating scenarios including cold start-up with water filling, start-up after short shutdown, sustained operations, normal shutdown, emergency shutdown
  - catalog cut sheets for equipment, instruments, and controls
  - fountain-cleaning procedures
  - maintenance procedures
  - equipment, instruments, and controls repair and replacement
  - graffiti-removal techniques
  - vandalism repair techniques
  - programmable logic controller (PLC) program on CD
  - Instrumentation setup and programmed parameters on CD and paper copies
- Material Safety Data Sheets
- Warranties and Bonds
- Process Flow Diagrams and Schematics
- Piping and Instrumentation Diagrams

- As-built mechanical, piping, electrical, control, and instrumentation drawings
- Copies of all manuals of Computer-Controlled equipment, i.e. Power Meter, VFDs, RVSS, etc., including software necessary to communicate via laptop computer by PWB Operations staff.
- Provide Electrical System Analysis studies performed using SKM PowerTools analysis software. Studies to include: General Utility & Equipment Data section, Short-Circuit, TCC Coordination curves & Arc-Flash Hazard analysis. One-line diagrams will be included for each of the 4 sections of the study and Arc-Flash warning labels will be provided using SKM to label each component of the electrical system. PWB will receive 4- hard-copies & 4- electronic copies, in 4 separate labeled new 3-ring binders, including the SKM files from the study. Study will be performed by State of Oregon licensed Professional Engineer.
- Provide written test data from all equipment and wiring startup and verification

7. PIPING and EQUIPMENT

7.1 Materials Standards

Appendix A, section A.1, Materials, provides general and specific requirements for materials typically not specified by brand name or supplier such as pipe, valves, vaults, concrete, or other large structural elements. These standards and requirements shall be listed in the project design specifications. The specifications should define special materials not commonly used for general industry construction and describe where certain materials are and are not acceptable.

7.2 Equipment Standards

Appendix A, section A.2, Equipment, provides general and specific equipment standards to meet the requirements of the PWB. Equipment consists of pumps, spray jets and nozzles, blowers, instruments, filters, water treatment equipment and associated monitoring and reporting instruments and controls, dehumidifiers, and sump pumps. These standards and requirements shall be listed in the project design specifications. The specifications should define special standards when alternative brands or suppliers are possible and also specific equipment by brand and model to be used as called out in Appendix A. The fountain designer is responsible for determining the availability of the specified equipment and proposing suitable substitutions where appropriate. However, the PWB prefers the listed equipment and may not choose to accept proposed substitutions. PWB requires all equipment shall be new. PWB will not accept refurbished or rebuilt equipment.

7.3 Design and Construction Requirements

Appendix A, section A.3, Design and Construction Requirements, provides the general, special, and specific design and construction requirements for plumbing and mechanical work.

8. ELECTRICAL EQUIPMENT, INSTRUMENTATION, and CONTROLS

8.1 Materials Standards

Appendix B section B.1, Materials, provides general and special requirements for electrical materials typically not specified by brand-name or supplier such as conduit, conductors, connectors, hangers, switches, receptacles, junction boxes (J-boxes), or similar materials. The specifications should define special materials not commonly used for general industry construction and describe the limitations under which certain materials are or are not acceptable.

8.2 Equipment Standards

Appendix B section B.2, Equipment, provides general and specific electrical equipment requirements for the PWB. Equipment consists of motor controllers, motor control consoles (MCCs), programmable logic controllers (PLCs), remote telemetry units (RTUs), sensors, transmitters, and other components. The most important part of this section is to define the equipment that must meet special requirements and is required by the PWB without alternatives or equals. The specifications should define special equipment specification or standards for which alterative brands or suppliers are possible, and specific equipment by brand and model to be used without exception.

8.3 Design and Construction Requirements

Appendix B, section B.3, provides the general, special, and specific design and construction requirement for electrical, instrumentation, and control work.

8.4 Instrumentation and Control Integration

Appendix B, section B.4 provides the requirements for how the instrumentation and controls are to integrate to operate, control, and monitor the fountain systems. The piping, process, control and instrumentation integration requirement should be defined and a typical piping and instrumentation diagram (P&ID) should be provided to clarify the design intent.

9. FOUNTAIN UTILITIES

9.1 General

- Utilities for the fountain are to be individually and separately metered from other associated park utilities such as lighting, irrigation, data communication lines, and sewer systems for park landscape, structures and restrooms.
- Utility services for the fountain are to be arranged by PP&R, the engineer/architect, or the fountain construction contractor.
- Responsibility for the ongoing payment of fountain utilities will be turned over to the PWB after the fountain construction is completed and accepted by the PWB. PP&R will be responsible for utilities for associated park features including landscaping, structures, and restrooms.
- State regulations for fountains require that the public has access to a drinking fountain. If there is not one in close proximity, a drinking fountain will be included in the park project.
- It is highly recommended that the park/fountain project include the installation of a public restroom or that the public has access to a facility that is clearly signed and in close proximity to the park.
- Sub-metering or proportional cost-sharing of utilities is discouraged. Any proposal to sub-meter or proportionally share utilities must be negotiated and arranged in the design process and agreed by the Portland Parks & Recreation Director and Portland Water Bureau Administrator through an inter-agency memorandum of understanding.

9.2 Water Service

- PP&R has the responsibility to obtain (and to pay all costs to obtain) the water service for the fountain from the Portland Water Bureau Development Services Section.
- PP&R or the engineer/architect will make application for the new water service early in the design process in order to determine the meter location, size, pressures, backflow requirements, main extension requirements, and any other special requirements, and include the requirements in the design and in the review drawings, specifications, and costs estimates.
- Arrangements for scheduling and payment for the water service are the responsibility of PP&R and must be paid before the installation of service is scheduled or installed.

- The cost of the water service shall include the installation costs, meter costs, system development charges, and any water system modifications such as main upsizing or extensions.
- The water meter must be located in the right-of–way, fronting on the property parcel on which the fountain is located, and in a location such that the backside piping (piping from the meter to the private property side) follows a straight and easily locatable alignment to the fountain mechanical building, room, or vault.
- The service backside pipe is to be copper pipe and fittings or schedule 80 PVC pipe and fittings with locating wire or tape.
- Installation of the portion of the water service located in the right-of-way shall be constructed by PWB crews, including tapping the main, the meter, meter vault, water main extension(s) or other improvements in the public right-of-way.
- The water service is to be sized such that the fountain's water reservoir will have no more than a 2-hour fill time from empty to the operating water level.
- A backflow device is to be located directly behind the meter on the property side of the public right-of-way. The type of backflow device, manufacturer, and model must be approved by the Portland Water Bureau Water Quality Section. Typically a reduced pressure (RP) backflow device, located in an aboveground, tamper-proof and freeze-resistant enclosure or vault is required for regulated (wading pool) fountains. A double-check backflow device in a buried vault may be allowed for all other types of fountains. Deviations from the required location of the backflow device must also be approved by the Portland Water Bureau Water Quality Section.
- Wash-down hose bibbs may be tapped off of the service back pipe (downstream of the backflow device) for cleaning and maintenance of the external fountain surfaces.

9.3 Electrical Service

- PP&R has the responsibility of applying for the electrical service and coordinating with the local power supplier.
- Location of the electrical service drop, meter, transformer, and conduit routes are to be shown on review drawings, including a separate service panel for control of exterior lighting.
- Electric meter locations are preferred to be aboveground locations. Confined-space locations are to be avoided and must be arranged with the electrical provider.

- Electric meters may not be located in fountain electrical or mechanical/treatment rooms for safety and security reasons.

9.4 Lines for Data Communications

- Data-grade phone lines or fiber optic lines are required for remote monitoring and control of the fountain using SCADA technology.
- Telephone drop conduit layouts will be provided in the design. PP&R or its contractor shall coordinate nearest service location and conduit size with the local telephone service provider.
- A telephone cable drop into the mechanical room will be provided by the contractor during fountain construction.
- PWB will order and pay for the phone service to PWB specifications during testing/commissioning after the contractor startup is complete.

9.5 Sewer Service

- Drains, overflows and sumps are to drain by gravity into sanitary sewers.
- PP&R or PP&R's consultant will make application for the new sewer connections early in the design process to determine sewer tap locations, line sizes, site piping locations, and other requirements for inclusion in the design and in review drawings and specifications for general review and comment.
- On an exception basis, non-wading pool recirculating and non-recirculating fountains may be allowed to drain into storm sewers with dechlorination prior to entering the sewer.
- The sewer drain lines should be oversized so that they are capable of draining the full flow of the water inlet flow and sump pump capacity.
- Site stormwater collection, piping, and drainage are the initial and ongoing responsibility of PP&R.

10. TESTING, COMMISSIONING and OWNER TRAINING

10.1 General

Project specifications and contracts shall provide adequate testing, commissioning, and operational start-up steps to ensure a fully operational fountain. These criteria generally include:

- Construction testing for proper assembly and material soundness.
- Starting, testing, proofing, adjusting and break-in of individual components.
- Testing, adjusting, calibrating, controller programming; running and finalizing operational displays and routines per the fountain narrative, water treatment processes, instrumentation and monitoring, and safety features of the entire fountain.
- Validating O&M documentation, operating display program documentation and instrumentation and control documentation.
- Training PWB staff in the start-up and operations of the new systems.

10.2 Testing

Component testing is required on all fountain components to ensure all equipment and materials are installed as specified and operating correctly in order to proceed with commissioning and start-up of systems. The following items and procedures will be addressed before start-up with specific start-up steps and checklists. All activities shall be observed by appropriate owner's representatives and designees. Test results and component documentation will be provided to PWB with O&M manuals and operational descriptions. Assure through the testing that the performance and appearance of the fountain meets the Designer's intent.

1. Pipe Testing; This testing will occur during the construction process and will be complete prior to functional testing of the fountain.
   - Test all piping before concealment, coating, painting, wrapping, or insulating.
   - Hydrostatically test all piping with water. Do not test with air or compressed gases.
   - Test all piping to at least 1.5 times the design operating pressure. Test pipe (except drainage system) to no less than 150 psi. Test drainage system piping to be no less than 10 psi.
2. Pumps: This will include operational testing of the pumps but may require further testing when the entire system is run as a whole.

- Correct motor rotation
- Operational parameters per pump curves .

3. Valve and Valve Controls
   - Actuators working correctly
   - Regulators working correctly
   - Manual valves operable
4. Water Treatment Systems Installation
   - Leakage
   - Regulating/pumping
5. Filtering Systems
   - Sand
   - Pumping
   - Leakage
   - Auto/manual backwash
   - Operating characteristics
6. Electrical System
   - Lighting for the fountain features
   - Lighting for the equipment room
   - Power to the equipment
7. Instrumentation and Controls
   - Sensor and monitor signals
   - Fountain display and controls status
   - Programmable controller
   - SCADA signal integrity
   - Safety alarms and signals
   - Security alarms and signals

10.3 Commissioning

Commissioning is the process of correcting, adjusting, calibrating and demonstrating that all the systems (i.e. mechanical, plumbing, electrical, safety, security, treatment) are operating and performing in compliance with the design performance requirements and as designed. Commissioning shall last a minimum of 30 days and if any defects are found in those 30 days, the 30-day period shall start over. The 30-day period shall not start until the County operating permit has been issued, regardless of whether or not all other commissioning requirements have been met.

The following items and procedures will be addressed before commissioning with specific commissioning steps and checklists. All activities shall be observed by appropriate owner's representatives and designees.

1. Initial Commissioning
   - Observation of all commissioning activities by PP&R's Owner's Representative and construction staff from the PWB is required.
   - Initial start-up plan and procedures shall be performed
   - Component installation review — verify equipment has been installed per drawings, specifications, and state and local codes
   - Equipment to be commissioned by equipment manufacturers' technical representative
   - Identification tags with appropriate text are hung on appropriate equipment
   - Confirm that initial trash removal, cleaning, and check for obstructions and subsequent checks after initial start-up has been performed
   - Electrical equipment has been checked according to start-up checklist
   - Fill and air purging performed
   - Valve, regulator, and flow setting and adjustments after initial operation have been checked and performed
2. Normal Operating Procedures
   - Demonstrate normal start-up procedures to be followed when the fountain is already filled, including the following
     - Filter circulation operation
     - Backwash operation
     - Water effects pumping operation
     - Treatment operation

    - Sump pump operation
    - Motor temperatures
    - Water feature programming
    - Electrical start up checklist
  - Chemicals to be provided by contractor during the entire testing and commissioning period.
3. Demonstrate procedures for alarms and troubleshooting
4. Demonstrate normal fountain operations including
  - Fountain and pump strainers cleaning procedures
  - Fountain draining and shutdown procedures
  - Fountain filling, trash removal, cleaning and air-purging procedures
  - Operation and maintenance for electrical equipment
  - Water treatment chemical refill procedures
  - Electrical setting time clock procedure
    - Water feature programming setting procedures
    - General cleanup procedures and requirements
  - Physical clean up of the deck surface, wetted surfaces, fountain perimeter area and fountain pool areas are routine maintenance work.
  - Graffiti removal and vandalism repairs essential to the preservation of the aesthetic and recreational function of the water feature.

10.4 Owner Training

- Training for owner operators and maintenance personnel to occur during commissioning period. Additionally, PWB Operations Electrical Group to be provided with a total of 2 separate 4-hour training sessions.
- Validation of the Operations and Maintenance manuals, including documentation on all settings and components, and startup/shutdown procedures.

11. FINAL ACCEPTANCE, WARRANTY, and POST-PROJECT PROCESSES

Final project acceptance by the Owner or Owner's Representative ensures completion of the project work according to the contract documents and to ensure that what was constructed meets the needs of the end users. It includes the completed final punch list, certificate of occupancy, final inspection and sign-off, and certificate of completion, copies of all required permits.

The warranty covers the two-year period that the PWB will use to evaluate the system and identify any warranty work that would need to be corrected. The PWB will communicate in writing all warranty work items to PP&R, and PP&R will be responsible for warranty administration.

Post-project processes include a number of steps to measure, evaluate and document project performance after project completion. These steps include conducting an inspection prior to expiration of the two-year warranty period, notifying the contractor of any needed warranty repairs as they arise during the warranty period, coordinating repairs with the Portland Water Bureau Operations division, and authorizing release of the bond when the warranty period is complete.

Appendixes

CONTENTS

A. PIPING AND EQUIPMENT

A.1 Materials

All products and materials must meet PWB standards. Submittals must be submitted for review and approval by the Water Bureau.

1. Pipe and Fittings. All pipe and fittings for conveyance of chemicals must be compatible with that chemical.

   a) PVC

      – Schedule 40 and 80, Type 1, normal impact, conforming to ASTM D 1785-73 and D 2241-73, D 2466-69 and D 3036-72.

      – Solvent cement shall conform to ASTM 2564-73

      – Rubber gasket bell and spigot joints shall conform to ASTM D-3139.

      – Exposed PVC piping and fittings in equipment rooms and equipment vaults shall be Schedule 80.

      – PVC pipe installation shall conform to the requirements of Technical Report PPI-TTR13 (8/73), Plastics Pipe Institute; all solvent cement jointing conforming to ASTM D-2855.

   b) Steel (other than stainless steel)

      – Schedule 40, galvanized.

      – Provide corrosion resistant wrapping for underground piping installation.

   c) Ductile Iron

   – AWWA C 150

   – Class 52 pipe

   – Class150 fittings

   d) Copper

      – conform to ASTM B-88

      – Type K, soft temper for buried tubing

      – Hard drawn for aboveground application

      – Fittings soldered or sweated on and shall be of wrought copper conforming to ANSI B16.22.

      – Soldered joists shall contain 95% tin and 5% antimony.

- No solders or fluxes containing more than 0.2% of lead shall be used.

e) Stainless Steel

- Type 304, Schedule 10 conforming to ASTM A-312 with stainless steel threaded fittings, or with stainless steel welded fittings.

2. Valves – All valves shall have a minimum 150 psi rating.

- Stainless steel valves shall be Type 316, ASTM A-351 CF8M, and ASTM A276.
- Wafer-type spring-loaded check valves – Center Line, Marlin Valve Co. Duo-Check II #12 MMP, Stockham Valve and Fitting # WG-970 series.
- Wafer-type Butterfly Valves, Bray Valve & Control USE, INC Series 30-113, Center Line series “A”, Crane Co. series 12BXZ, Stockham Valve and Fitting # KG 512-BS3-D wafer-style or # LG712-BS3 E-lug style.

3. Concrete

- Portland Cement conforming to ASTM C 150, Type V
- Concrete shall be the product of one manufacturer.
- City of Portland-approved design mix list.
- Reinforcing steel conforming to ASTM A-615, Grade 60.
- Aggregates conforming to ASTM C 3.
- Tie wire shall be soft annealed steel, l8-gauge minimum.
- Formwork shall be construction-grade Douglas-fir lumber for studs and whalers. Plywood for forms shall be of the grade "Exterior B-B" (concrete form), conforming to the latest product standard for soft plywood, construction, and industrial, of the National Bureau of Standards. Form plywood shall bear grade marks and be 5-ply type, minimum 5/8" thick for studs or joists spaced not more than 12" center to center, otherwise 3/4" thick.
- Air-placed concrete shall be used for water feature construction. The Contractor shall provide Owner with concrete supplier's statements of materials, admixtures, mix proportions, anticipated 28-day compressive strength and test reports.
- Concrete for purposes not otherwise specified shall be 3000-psi minimum 28-day compressive strength. A trial design mix shall be submitted for the Owner’s representative or designee’s approval.
- Joint sealant shall be either fiber expansion joint type conforming to ASTM D 1751 or closed cell neoprene sponge rubber conforming to ASTM D-1752.

4. Joint Sealant (Elastomeric)
   - Elastomeric joint sealant shall be chemical cure, non-sag, permanently flexible polyurethane sealant conforming to U.S. Federal Specification TT-S-00227E, Types I and II, Class A, ASTM C-920-79, Type M, Class 25, Grade P and NS.
5. Vaults
   - Precast concrete vaults are preferred but poured in place plans can be submitted to the Water Bureau for review and acceptance.
   - Floor to have 3'-2" x 2'-2" cut out for poured in place sump.
   - Opening to be minimum 4'-0" by 4'-0" square clear opening for double-leaf access hatch cover installed in grade rings to fit site grade. Submit shop drawing for review prior to ordering.
   - Base wing extensions required if vault is within seasonal groundwater levels.
   - Access hatch to be 48" by 48" double-leaf H-20 rated aluminum access hatch with pan type lid for finish to match surrounding deck with keyed lock and safety chain at 21" and 42" elevation to prevent public access, Bilco or equal. Include hydraulic door hinges.
   - Ladders to be fiberglass or galvanized ladder with manufacturer's recommended extendable bar anchored with 5/8" Hilti Kwik bolt II (stainless steel or equal min 4 places).
   - Interior waterproofing:
     - Coat interior double doors with bituminous corrosion-resistant coating.
     - Interior concrete surfaces to be coated with concrete waterproofing system
   - Exterior vault waterproofing of Hydrotech® #6125 215mil hot rubber waterproofing (or equal).
   - Penetrations to be Link Seals Type C for Corrosive Service with EPDM sealing elements and stainless steel nuts and bolts. Number and size per manufacturer's specifications. Wall opening per Link Seal requirements.

A.2 Equipment

1. Water Level Sensors
   - Reservoir elevation and high accuracy pressure transmission - Rosemount 3051TG1AS5B4M5. With Rosemount isolation and test valve 0306RT22BA11
     - 1A = 30 PSI
     - 2A = 150PSI
     - 3A = 800PSI
   - Standard pressure transmission - Dresser-Ashcroft model 2279ssh, with 24vdc power supply - C&D technologies sm2410 part #100-3574-28
2. Reservoir or Surge Tank
   - Sized to hold the entire volume of fountain water per the project requirements.
   - Equipped with a floor drain or sump pump in order to remove all the water for maintenance activities.
3. Chemical Controller
   - Chlorine and pH chemical controller - Wallace & Tiernan Depolox 3 plus
   - Free CL_2 / pH controller – dual-input electronic package (115 volt)
   - Including a bare electrode wet-side kit for free chlorine
   - Provide a pH measuring kit with a range of 4 to 10
   - Provide 2 isolated 4-20Ma outputs for SCADA interface and 4 dry-relay output contacts for chemical pacing control
   - Controller to be programmed to control fountain CL_2 and pH chemical systems
   - Controller 4-20Ma signals will be integrated into the PLC control / SCADA system for monitoring CL_2 and pH levels.
4. Eyewash
   - Haws portable eyewash unit with potable water piped to it.
5. Pumps
   - Vertically mounted, closed-coupled end-suction type
   - Cast iron, bronze fitted, closed-coupled pumps, vertically or horizontally mounted on stand or base
   - Capable of stable, continuous operation at the specified operating condition
   - Motors non-overloading throughout the entire performance curve

- Pump casings shall be close grain cast iron fitted with a replaceable bronze case wear ring.
- Back pullout design so that the rotating element can be removed from the casing without disconnecting the suction or discharge piping
- Cast bronze, enclosed-type impeller trimmed for the specified design conditions
- Shafts fitted with a mechanical seal with a carbon rotating element and ceramic stationary seat and Buna N elastomer seals, stainless steel springs and retainers
- Pumps shall be fitted with external seal vent lines to allow for vertical operation without formation of an air pocket at the seal.
- Motors – closed-coupled motors, with open drip-proof (ODP) enclosure, fitted with a drip canopy for vertical installation
- Exposed motors are to be totally enclosed fan cooled (TEFC).
- Vertically mounted end-suction pump configuration with stand or base shall be standard cataloged product. Custom or modified pump configurations shall not be accepted.
- Provide with inverter-rated premium efficiency motor suitable for variable frequency drive (VFD) operation where specified
- Pumps to be sized for 100% of maximum expected flow requirements.
- Pumps shall be self-priming.

6. Sump Pumps
   - PACO Submersible Pump model #PIP-702B, 0.33hp, 30gpm at 20tdh
   - Two pumps typical for each vault for fail-safe operation
   - Powered by dedicated circuits (non-GFCI)
7. Equipment Room(s)/Vault(s) Exhaust Fan(s)
   - DAYTON Tube axial Fan with aluminum spark-resistant blades
   - Provide with Fan Guard Models if specified
   - Exhaust fan and vent piping sized to turn over air in vault every 5 minutes
8. Dehumidifier
   - Capacity capable of range up to 80%
9. Filter Pumps
   - End-suction centrifugal pumps
10. Sand Filters
    - Purex Triton sand filter or equivalent

- National Sanitation Foundation Standard #50 for safety performance
- Sized to filter at a rate to meet the regulations
- Filter tanks to be one-piece, fiberglass reinforced tanks with UV-resistant surface, and heavy duty lids
- Pressure gauges on influent and effluent
- Manual air-release valves
- 360˚ diffuser, swing-away type to allow instant access to sand media and internal parts
- Internal parts to be threaded
- Drain to be combination sand and water
- Equipped with backwash controls

11. Chlorine Feed System
    - Pulsar System chlorination or equivalent with 3/4 hp booster-feed pump
12. CO_2 Feed System
    - Siemens Strantrol CO_2 feeder system or equivalent
    - Taylor-Wharton easy CARB EC Series CO_2 Tank or equivalent
13. Motorized Control Valves
    - 3-Way Valves - KOEI UNIC ESD-BBL 3-way actuator butterfly valve (24VDC supply), size per project requirements
    - 2-way valve - KOEI UNIC 2-way actuator with butterfly valve (24VDC supply), size per project requirements
14. Strainers
    - US FILTER National NSS Series or equivalent
    - Non-corrosive fluid straining system
    - Size per project requirements
15. Pressure or Vacuum Gauges
    - Liquid filled pressure gauges, S.S. CASE, WIKA MODEL #233.53 or equivalent
    - size and range per project requirements
    - Liquid filled vacuum gauges, S.S. CASE, WIKA MODEL #233.53, size and range as specified
16. Air Vents
    - Waterman Industries, size and range as specified

A.3 Design and Construction Requirements

This section provides general, special, and specific design and construction requirements for plumbing and mechanical work.

1. Piping Installation

   Buried piping

   – Pipe runs shall be installed to minimize the number of fittings.

   – No pipe installation underneath the water feature unless shown on plan.

   – Install piping without air-entrapping high points or reverse slopes, i.e. on discharge lines, no descending runs beyond horizontal or ascending runs; on suction lines, no descending runs beyond ascending runs

   – Pipe trenches shall be excavated to full width and depth required for proper installation and in accordance with the requirements of pipe manufacturer and applicable codes. Trench bottom shall provide uniform bearing and support for the entire length of the pipe. Use sand or ¾-inch diameter material for bedding.

   – Horizontal separation between pipes in common trenches (and between pipes and trench walls) shall be a minimum of 4" horizontally and 8" vertically. All backfill material and methods shall be submitted to the water feature engineer for review and approval.

   – Provide minimum 30-inch cover for all piping installation using suitable backfill material, approved by the construction manager or designee. Backfill material in trenches shall be compacted to 95 percent of standard Proctor density

   – Thrust blocks shall be provided to prevent movement of piping under pressure at bends, tees, caps and valves. Concrete for thrust blocking shall have a minimum compressive strength of 4,000 psi. Concrete shall be placed against undisturbed material and shall not cover joints, bolts or nuts, or interfere with the removal of any joint. Wooden side forms shall be required for thrust blocks where trench conditions require. Thrust blocks shall be properly set and adequately cured prior to pressurizing the system. Wrap pipe/fittings with plastic where it is in contact with concrete.

   – All piping shall be installed so that it can be drained by gravity.

   Piping in Equipment Rooms and Vaults

   – Provide supports and hangers for all piping in equipment rooms and vaults in accordance with the Uniform Plumbing Code, Section 316; Plastic Pipe Institute Technical Report

PPI-TR-August 1973, "PVC Plastic Piping Design and Installation," and applicable local codes.

- All pipe supports shall conform to the latest requirements of the ANSI Code for Pressure Piping B 31.1 and Manufacturers Standardization Society documents MSS SP-58 and MSS SP-69.
- All piping shall be adequately supported to eliminate visible movement during system operation.
- All pipe systems and pipe connections to equipment shall be properly supported to prevent deflection, vibration, and stresses on piping, equipment and structures.
- All supports shall conform to ANSI/ASME B 31.1, except as supplemented or modified by the specifications. Supports for plumbing piping shall be in accordance with the latest edition of the applicable plumbing code or local administration requirements. The pipe supports and pipe support system shall comply with the Uniform Building Code Seismic requirements.
- Appearance: Pipe supports and hangers shall be positioned in such a way as to produce an orderly, neat piping system. All hanger rods shall be vertical, without offsets. Hangers shall be adjusted to line up groups of pipes at the proper grade for drainage and venting, as close to ceilings or roofs as possible, without interference with other work.
- Separate hangers and supports shall be provided at valves. Provide one hanger or support at each end of the valve body or on the adjacent connecting pipe within one pipe diameter of the valve end.
- Separate hangers and pipe supports shall be provided at each pipe elbow, tee, or fitting. Provide separate hangers and supports on both sides of each non-rigid joint or flexible pipe coupling.
- Install piping without springing, forcing, or stressing the pipe or any connecting valves, pumps or other equipment to which the pipe is connected
- All piping shall be rigidly supported and anchored so that there is no movement or visible sagging between supports. Rubber hose and flexible tubing shall be provided with continuous angle or channel support.
- Pipe clamps or other devices relying entirely on the application of a clamping force to the supported pipe in order to maintain the clamp position or location in a prefabricated channel or track will not be acceptable for use with non-metallic pipe or tubing.
- Unless otherwise approved by the construction manager or designee, piping shall be supported approximately 1-1/2" away from the face of walls and at least three inches below ceilings

- Adequate pipe supports shall be installed to resist lateral forces and prevent lateral or longitudinal movement of pipe runs.
- All flexible chemical feed line tubing shall be shrouded along its full length by either Schedule 80 PVC pipe or Schedule 10 Gr. 304 stainless steel pipe, in conformance with applicable code requirements. The shroud piping shall be supported per the requirements of this section.
- Contact between dissimilar metals, including contact between stainless steel and carbon steel shall be prevented. Those portions of pipe supports that contact dissimilar metals shall be rubber- or vinyl-coated. Dissimilar metals shall be separated by dielectric material.
- All piping shall be installed so that it can be drained by gravity.

Pipe Hangers and Supports in Equipment Rooms and Vaults

- Pipe support and hanger components shall withstand the dead loads imposed by the weight of the pipes filled with water, plus any insulation, plus the dynamic loads imposed by the system during operation, and shall have a minimum safety factor of 5 based on material ultimate strength.
- Loads on inserts, brackets, clamps and other items shall not exceed the manufacturers' recommended loads.
- Supports for piping with the longitudinal axis in approximately a horizontal position shall be spaced to prevent excessive sag, bending, and shear stresses in the piping, with special consideration given when components such as flanges and valves impose concentrated loads.
- If no spacings are given on the drawings, or specified elsewhere for a particular piping system, the support must be spaced so that the stress on steel pipes does not exceed 5,000 psi.
- Pipe supports and hangers shall be manufactured for the size and type of pipe to which they are applied.
- Straphangers will not be acceptable.
- Threaded rods shall have sufficient thread to permit the maximum adjustment available in the supporting item. Continuously threaded rods are not acceptable.
- All hangers shall have a means of vertical adjustment.
- Hangers shall be designed so that they cannot become disengaged by any movement of the supported pipe.
- All hanger rods shall be subject to tensile loading only.

- Contact between dissimilar metals, including contact between stainless steel and carbon steel, shall be prevented. Those portions of pipe supports that contact dissimilar metals shall be rubber or vinyl coated. Dissimilar metals shall be separated by dielectric material.
- Protective coatings shall be provided for all supports, i.e. hot-dip galvanized as approved by PWB
- All pipe supports, other than stainless steel or non-ferrous supports, shall have the welds ground smooth, be sand blasted after fabrication, and hot-dip galvanized in accordance with ASTM A 123

Exposed Pipe Hangers Subject to Movement

- Pipe hangers shall be capable of supporting the pipe in all conditions of operation. They shall allow for free expansion and contraction of the piping and shall prevent excessive stress on the equipment.

Manufactured Supports

- Designs generally accepted as exemplifying good engineering practice, using stock or production parts, shall be utilized wherever possible. Such parts shall be locally available, new, of best commercial quality, designed and rated for the intended purpose.
- All pipe support material shall be packaged as necessary to ensure delivery in satisfactory condition.

Hanger Manufacturers, or equivalent as approved by PWB

- Basic Engineers, Pittsburgh, PA
- Bergen-Paterson Corp., Boston, MA
- Elcen Metal Products Company, Franklin Park, IL
- ITT-Grinnell Corp., Warren, OH
- NPS Industries, Inc., Secaucus, NJ

Hanger Anchor Bolts

- Anchor bolts, anchors, nuts, washers, screws and other appurtenances for attaching pipe supports and hangers shall be stainless steel in accordance with ASTM A-276, Type 316.

Piping Identification

- All metal piping shall be identified by painting the entire outer surface with the specified color, a lettered label, and a directional label

- All plastic piping shall be identified by using tags and lettered labels with directional arrows.
- Each pipe identification shall consist of a printed label identifying the name of the pipe and a flow arrow to indicate direction of flow in the pipe. All labels shall be preprinted on pressure-sensitive adhesive-backed vinyl cloth or plastic tape. Letter sizes and colors for lettering, arrows and background shall comply with ANSI A13.1
- Preprinted identification devices shall be a manufactured by W.H. Brady; Seton Nameplate Corp. or equivalent as approved by PWB
- All valves shall be identified by a tag permanently attached by means of two stainless steel bolts or screws. The wording on the valve tags shall describe the exact function of each valve.

Joint Welding Requirements

- All welding procedures used to fabricate pipe shall meet the provisions of ANSI/AWS D 1.1 and all welders shall be qualified under the provisions of ANSI/AWS D 1.1 by an independent, local, approved testing agency.
- All metal edges shall be accurately cut for a good fit whether they are sheared, machined, or cut by a thermal process.
- Pipe that is thermally cut shall be machined or ground to remove scales and contaminants.

B. ELECTRICAL EQUIPMENT, INSTRUMENTATION, and CONTROLS

In general, all electrical equipment, instrumentation, and controls must adhere to the following guidelines:

- All materials and equipment shall be new and must bear the U/L (Underwriters Laboratories) markings and be installed per manufacturer's recommendations.
- All materials and installation shall conform to the current National Electrical Code and all applicable codes.
- As a minimum, comply with the following regulations:
  - NEPA 70, National Electric code (NEC), Article 680, Swimming Pools, Fountains and Similar Locations
  - Amendments by the Authority having jurisdiction (AHJ)
  - NEPA 70E, Standard for Electrical Safety Requirements

B.1 Materials

1. Conduits
   - Rigid Metal Conduit (RMC) – Steel used for underground installations must be wrapped or coated with a corrosion-protection product
   - Aluminum RMC shall not be used in areas containing treatment chemicals (chlorine, bromine, bleach, acid, etc.)
   - Rigid non-metallic conduit (RNMC) shall be polyvinyl chloride (PVC), Schedule 40 or Schedule 80 in underground installations and in areas subject to physical damage.
   - RNMC may be used for wiring surface in the underground vault, underground 18”depth in landscaping and walks, 24” depth under vehicular roadways or under 4”concrete slabs.
   - Convert to RMC risers before emerging to the surface grades.
   - Maintain a minimum of 5’ from water features. FMC fittings must be steel or malleable iron.
   - Conduit from underwater lighting housing to underwater J-boxes must be either brass or schedule 40 RNMC with a #8 copper ground conductor

2. Boxes

- Outlet boxes in wet locations shall be Crouse hinds “FD” series or equal

3. Conductors
   - Aluminum conductors are not allowed
   - GFCI circuit conductor, if over 50 feet, shall have low-leakage insulation with a dielectric constant of 3.5 (MAX) which is cross-linked polyethylene-type XLP, Rome XHHW-2, or equal, shall be twisted at one twist per foot. Ground wire to remain separate and untwisted
   - Conductor slices of #12AWG or smaller should be made with waterproof wire nuts

B.2 Equipment

1. Motor Controllers

   a) General

   – Motor starters are to be of the size and type and rated for short circuit current available and the service to be performed and conform to all applicable requirements of the National Manufacturers Association (NEMA) and the National Electrical Code (NEC).

   – Motor starters are to be complete with the accessories necessary for operation as specified and include a minimum of 2 sets of contacts normally open and 2 sets normally closed.

   – All starters shall be horsepower-rated and have thermal overloads in each phase leg. The overload relay assembly is to be of the thermal bimetallic type.

   – Overload relays reset must be accessible from outside the enclosure by means of an insulated button.

   – Provide units manufactured by Square D, Allen-Bradley, ABB or an equivalent manufacturer approved by the Water Bureau.

   b) Manual Motor Starters

   – Both single- and three-phase starters must be capable of opening all underground conductors simultaneously.

   – Single-phase starters shall be of the tumbler switch type, clearly indicating the "On," "Off," and ''Tripped" positions

   – Three-phase starters shall be push-button operated with "Start" and "Stop-Reset" buttons on the enclosure, rated 3-phase, 208 or 480 volts.

   c) Magnetic Motor Starters

   – Magnetic motor starter shall be equipped with a "hand-off-auto" heavy-duty selector switch in the cover and a 120-volt operating coil.

   – Provide starter with a minimum of six auxiliary contacts (3-N.O, 3-N.C., or more if required) and with pilot lights with a push-to-test feature.

   – Three pilot lights shall be provided for each starter; pilot lights shall be low-voltage transformer-type. Green shall indicate that starter is in the closed position; white shall indicate that power is available; red shall indicate that the starter is in the open position. Include all accessories as required to meet requirements of mechanical control diagrams.

d) Combination Motor Starters

– Combination motor starters shall conform to all of the requirements for magnetic starters, plus have a circuit breaker for branch circuit protection and disconnection in the same enclosure conforming to NEC requirements for motor operation.

– Disconnect shall be sized for fault current available at panel boards, and as a minimum, 208-volt circuit breakers shall be rated 10,000 amperes symmetrical. Circuit breakers for the 480/277 voltage ratings shall be minimum 14,000 ampere interrupting rating. Available fault current shall be as determined by the SKM-Electrical System Study performed for each electrical service installation.

– The disconnect shall be interlocked with the cover door to prevent opening the door unless the disconnect is in the open position. A mechanism for defeating the door interlock shall be included so that maintenance can be performed.

– Multiple starters in one enclosure shall have one main disconnect on door.

– The connection starter unit disconnect shall be of the high-speed instantaneous magnetic trip motor circuit breaker protector type, designed to suit motor characteristics.

– Units shall be Square D, Allen-Bradley, ABB, or an equivalent product approved by the Water Bureau

– Enclosure for separately mounted starters shall be suitable for the environment for which it is installed (i.e. wet- or corrosion-resistant)

e) Variable Frequency Drives (VFD) & Reduced-Voltage Solid-State (RVSS)

-- Shall have the ability to communicate in ModBus Plus using PWB's ION Enterprise, power monitoring software and shall be networked with all computer controlled motor protection equipment associated with fountain operation.

2. Motor Control Centers

– Motor control centers (MCC) are to be integrated, pre-wired, unit construction with all parts designed, manufactured, assembled, and tested by a single manufacturer to assure complete and proper coordination among all items

– MCC shall include Power Monitor meter (i.e. Square D, Powerlogic PM-870, CM-4000) in a separate cubicle, networked with RTU and all other computer controlled equipment and shall have a data communications port mounted on the external door face of the Power Meter cubicle.

– MCCs are to be in a minimum NEMA 12 enclosure, suitable for mounting all necessary components

- Allow 20% space for future expansion, including 20% extra terminal blocks
- MCCs must be UL listed
- Provide cabinet air conditioning if MCC contains solid-state or other temperature-sensitive equipment, and if mechanical room is not air-conditioned
- Starter units shall be combination type with components and wiring readily accessible for ease of maintenance
- Provide auxiliary contacts on starter units, 2 sets normally open and 2 sets normally closed on each circuit breaker for any external control circuit
- External operating handles of circuit disconnect shall be interlocked with door so handle must be in the "Off" position before door can be opened, handle arranged for padlock either in "On" or "Off" position, with up to three padlocks
- MCC transformer must be sized to accommodate all control loads plus 25% contingency
- Provide control relays and interlocking as required by the mechanical sequence of operation and control diagrams
- Type B with plug-in wiring terminations for control wiring.
- Provide a separate source disconnect switch for each circuit brought into a starter or relay enclosure from a voltage source external to the starter
- Acceptable manufactures are Square D, Cutler Hammer, Allen Bradley or an equivalent that has been approved by the Water Bureau

3. Fountain Control and SCADA Monitoring Equipment
   - Hoffman NEMA 4X fiberglass enclosure – approximate size 3'W X 5'H X 16" D with internal mounting panel and external mounting holes, A60H3616GQRLP with A-60P36 panel
   - Sola 24vdc power supply — part # STV25k-10S, stackable if more than 5a load rating is required.
   - Sola 120vac power conditioner / surge protector, part # SDN5-24-100P
   - Power fail backup batteries — quantity 2 – 12vdc 7.2AH sealed lead acid batteries wired in series for 24vdc or larger depending on load requirements.
   - PLC Components -- Snider Electric (SQUARE D) M340, with 2 COMM Ports and Modbus capacity
   - Wire Terminal Connection Blocks — PHOENIX
   - Control System voltage — 24VDC

- Provide a complete full-function integrated control program. The program is to be designed written tested and debugged to provide all fountain control functions as designated by the design engineer. Electronic copy of program is to be provided to Water Bureau.
- Water Bureau will perform SCADA integration, programming and testing after contractor has completed the project.
- Provide detailed operating and performance criteria to PWB and the system integrator for programming and operation needs.
- Provide vault entry detection, entry switch — Sentrol model #2700A
- Provide vault flood detection, flood switch — Madison model #M8000
- Provide "emergency stop" pushbutton, hard-wired into the MCC control wiring to shut down all fountain operations at indicated location.
- Provide a high pressure switch -- ASCO model PB10A or equal for high filter pressure alarm and control indication.

4. Programmable Logic Controller (PLC) Components are listed in Table 1, RTU Components on page B-9.

B.3 Design and Construction Requirements

This section provides general, special, and specific design and construction requirement for electrical, instrumentation, and control work.

1. Installation Requirements

- Submittals of shop drawings must be prepared by a licensed Electrical Engineer
- Floor-mounted MCCs must be firmly bolted on 3" high concrete housekeeping pads.
- Conduit entering MCCs must be grounded, with conduit entering the bottom grounded to the MCC ground bus.
- Contractor shall provide the electrical service, main circuit breakers, and transformers and will coordinate with the utility provider.
- Contractor shall provide the following for each motor (or group of motors):
  - Combination starters with thermal magnetic protection
  - For motors 25 H.P. and less, full-voltage magnetic type
  - For motors more than 25 H.P., solid-state reduced voltage or VFD required with communications ability with PWB's ION Enterprise Power Monitoring software.
  - Hand-off-auto (HOA) switch(es) and running lights
  - NEMA 3R enclosure(s), vandal-resistant, dead front construction for outdoor installation only
  - Time Clocks: 24-hour, Skip-A-Day, for control, Astrodial for lighting
  - Auxiliary contactors for interconnection of equipment and controls, relays, programmable solid-state time clocks and/or other timing devices and interconnection to project Energy Management System
  - NEMA 3R remote disconnect per NEC 430-H, 430-102

a) Interconnects

- Interlock recalculating pump motors starters with filter console for control from the console
- Interlock automatic chemical controller with filter console for control from the console
- Interlock automatic chemical feed pumps with the filter console for control from the console

b) Bonding

In accordance with Section 680-22 of the current edition of the NEC Handbook, the following parts shall be connected to a common bonding grid:

- All metallic parts of the water feature structure including the reinforcing parts of the water feature shell, coping stones and deck
- All forming shells
- All metal fittings within and attached to the water feature structure
- Metal parts of electric equipment associated with the water feature water circulating system, including pump motors
- Metal-sheathed cables and raceways, metal piping, and all fixed metal parts that are within 5 feet horizontally of the inside walls of the water feature, and within 12 feet above the maximum water level of the water feature, or any observation stand, towers or platforms, or from any diving structures, and that are not separated from the water feature by a permanent barrier
- Safety rope hooks are also required to be bonded
- The bonding grid used may be the structural reinforcing steel of a concrete water feature where the reinforcing rods are bonded together by the usual steel wire ties, or a No. 8 or larger solid copper conductor, insulated, covered or bare.

c) Grounding

In accordance with Section 680-24 of the current edition of the National Electrical Code Handbook, the following equipment shall be grounded:

- Wet-niche and dry-niche underwater lighting fixtures
- All electrical equipment located within 5 feet of the inside wall of the water feature
- All electrical equipment associated with the recirculating system of the water feature
- Junction boxes
- Transformer enclosures
- Ground-fault circuit-interrupters
- Panel boards that are not part of the service equipment and that supply any electric equipment associated with the water feature

  Grounding conductors must terminate at the grounding bus of a service panel or sub-panel, and the conductor must not be smaller than No.12 AWG. For underwater lighting, grounding conductors must be run in rigid metal, intermediate metal, or rigid non-metallic conduits

B.4 Instrumentation and Control Integration

This section provides the requirements for how the instrumentation and controls are to integrate to operate, control, and monitor the fountain systems. The piping, process, control and instrumentation integration requirement should be defined and a typical piping and instrumentation diagram (P&ID) should be provided to clarify the design intent. The Contractor should provide the following:

- Process and instrumentation integration
- PLC and system control integration
- SCADA system integration
- Treatment and water quality monitoring systems control and operation
- Automatic, programmed, timed, and manual start-up and shutdown control
- Emergency shutdown control
- Safeguards
- Water feature programming

Table 1. RTU Components

Part Number	Description	Manufacturer	Vendor
BMXP342020	Ethernet Processor	Schneider Electric	CED
BMXNOE0100	Ethernet Comm Card	Schneider Electric	CED
BMXDDI1602	16 DI 24VDC SINK Input Module	Schneider Electric	CED
BMXDAI1602	16 DI 24VDC SOURCE Input Module	Schneider Electric	CED
BMXDRA0805	8 DO relay Output Module	Schneider Electric	CED
BMXDDM16025	8 DI / 8 DO In/Out Module	Schneider Electric	CED
BMXAMI0410	4 Al Analog Input Module	Schneider Electric	CED
BMXAMO0210	2 AO Analog Output Module	Schneider Electric	CED
BMXAMM0600	4 AI / 2 AO Analog Input/Output Module	Schneider Electric	CED
BMXFTB2010	20PT SCR TERM STRIP	Schneider Electric	CED
BMXXEM010	PROTECTIVE COVER (QTY 5)	Schneider Electric	CED
DAH1001A	100 Watt resistive heater	Hoffman	NCE
ALF16M12R	Enclosure Light Illuminaire	Hoffman	NCE
F8TS/CW	Florescent tube	Sylvania	NCE
3001501	Terminal Block	Phoenix	URS
2812018	Terminal Block Accessory Receptacle	Phoenix	URS

Table 1. RTU Components

Part Number	Description	Manufacturer	Vendor
921011	20mm Fuse Holder	Phoenix	URS
2802316	Accessory Holder (diode/special need)	Phoenix	URS
0441504	Grounding Terminal	Phoenix	URS
0800886	End Block	Phoenix	URS
3003224	Terminal Block Spacer (tall)	Phoenix	URS
3003020	Terminal Block Spacer (short)	Phoenix	URS
2303137	Terminal Block Jumper	Phoenix	URS
270642	Terminal Block Jumper (Screw in type)	Phoenix	URS
200mA	20mm glass fuse	Little Fuse	URS
500mA	20mm glass fuse	Little Fuse	URS
2A	20mm glass fuse	Little Fuse	URS
5A	20mm glass fuse	Little Fuse	URS
8A	20mm glass fuse	Little Fuse	URS
10A	20mm glass fuse	Little Fuse	URS
TMC 42-01-5A	5A DIN Mount Circuit Breaker	Phoenix	URS
TMC 42-01-15A	15A DIN Mount Circuit Breaker	Phoenix	URS
STV25K-10S	DIN Mount TVSS	Sola	URS
SDN5-24-100P	120AC to 24vDC 5A output	Sola	URS
SCD30 S12-DN	24vDC to 12vDC 2A output	Sola	URS
SM2410 100.2574.28	120AC to 24vDC 10A output	C&D Technologies	Industrial Battery SYS
782xBxM4L-24vDC	24vDC Relay	Magnecraft	URS
27E895	8-PIN Relay Base (Magnacraft relay base)	P&B	URS
CSL-38-30010	24vdc adjustable voltage dropout relay	P&B	URS
27E891	8-PIN Relay Base (dropout relay base)	P&B	URS
			NCE
ACSHELF18	Folding computer shelf	Hoffman	NCE
ACSHELF12	Folding computer shelf	Hoffman	

ORDINANCE No. 161007

161007

* Transferring assets at no cost from the General Fund to the Water Operating Fund, effective July 1, 1988 (Ordinance).

The City of Portland ordains:

Section 1. The Council finds:

1. During the FY 88-89 budget process, the City Council voted to transfer responsibility for twenty-five decorative fountains from the Bureau of Parks to the Bureau of Water Works, effective July 1, 1988.

2. In order for the Bureau of Water Works to assume maintenance and repair responsibilty for the fountains, as well as to provide water for them, it is necessary that the capital assets be transferred from the General Fund to the Water Operating Fund.

3. The assets in question include the following twenty-five fountains: Ira Keller Forecourt Fountain, Central Waterfront Park Fountain, Pioneer Courthouse Square Fountain, Transit Mall Animal Fountains (12), Holiday Park Fountain, Lovejoy Fountain, Pettygrove Fountain, O'Bryant Square Fountain, Carwash Fountain, Bathtub Fountain, Kelly Fountain, Commonwealth Fountain, Chimney Fountain, and Park 51 Fountain.

NOW, THEREFORE, The Council directs:

a. The following twenty-five fountains are transferred at no cost from the General Fund to the Water Operating Fund as of July 1, 1988: Ira Keller Forecourt Fountain, Central Waterfront Park Fountain, Pioneer Courthouse Square Fountain, Transit Mall Animal Fountains (12), Holiday Park Fountain, Lovejoy Fountain, Pettygrove Fountain, O'Bryant Square Fountain, Carwash Fountain, Bathtub Fountain, Kelly Fountain, Commonwealth Fountain, Chimney Fountain, and Park 51 Fountain.

b. The Administrators of the Bureau of Parks and the Bureau of Water Works are directed to reach agreement regarding the responsibilities of the respective bureaus for maintenance of the fountains and the parks in which they might be located.

Section 2. The Council declares that an emergency exists because it is necessary to effect the transfer as of July 1, 1988, in order for the Water Bureau to assume responsibility; therefore, this ordinance shall be in force and effect from and after its passage by the Council.

Passed by the Council.

BARBARA CLARK
Auditor of the City of Portland
By _____ Deputy

Commissioner Koch

MR:djs FAS:8806C315

C-1

THE COMMISSIONERS VOTED AS FOLLOWS:		
	Yeas	Nays
[illegible]	✓	
BOGLE	✓	
KOCH	✓	
LINDBERG	—	—
CLARK	✓	

FOUR-FIFTHS CALENDAR	
[illegible]	EB / bg
BOGLE	DB / DC
KOCH	BK
LINDBERG	6/22/88
CLARK	JDC / CS

APPENDIX C

Calendar No. 1232

ORDINANCE No. 161007

Title

*Transferring assets at no cost from the General Fund to the Water Operating Fund, effective July 1, 1988 (Ordinance).

Filed JUN 29 1988

BARBARA CLARK
Auditor of the CITY OF PORTLAND

By Mary L. Hough
Deputy

INTRODUCED BY
MAYOR CLARK

NOTED BY THE COMMISSIONER
Affairs
Finance and Administration
Safety
Utilities
Works

BUREAU APPROVAL
Bureau: WATER WORKS
Prepared By: MICHAEL ROSENBERGER — Date:
Budget Impact Review: ☐ Completed ☐ Not required
Bureau Head: EDWARD TENNY, ADMINISTRATOR

CALENDAR	
Consent	Regular

NOTED BY
City Attorney
City Auditor
City Engineer