CITY OF OREGON CITY

PUBLIC WORKS

Sewage Pump Station & Force Main Design Standards

RESOLUTION NO. 04-34
Exhibit A
ADOPTED: August 18, 2004

PREPARED BY

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August 11, 2004

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SECTION I - GENERAL

1.00 PURPOSE

The purpose of these Sewage Pump Station and Force Mains Design Standards (PS & FM Standards) is to provide a consistent policy under which certain physical aspects of design will be implemented. Most of the elements contained in this document are Public Works oriented and most are related to public improvements and City contract projects; however, it is intended that they apply to both public and private work designated herein.

These PS & FM Standards cannot provide for all situations. They are intended to assist but not to substitute for competent work by design professionals. It is expected that land surveyors, engineers, and architects will bring to each project the best skills from their respective disciplines.

These PS & FM Standards are also not intended to unreasonably limit any innovative or creative effort which could result in better quality, cost savings, or both. Departures from these design PS & FM Standards will be considered and may be approved at the sole discretion of the City Engineer. Any proposed departures from the PS & FM Standards will be judged on the likelihood that such variance will produce a compensating or comparable result, in every way adequate for the user and City resident.

Following from the above purpose, the PS & FM Standards have the objective of developing sewage pump stations and force mains which will:

a. Be consistent with the Oregon City Comprehensive Plan, and the Oregon City Sanitary Sewer Master Plan;

b. Be consistent with Tri-City Service District Plans and Policies;

c. Be of adequate design to carry the expected flow, within their design life, and at sufficient location and depth to serve adjacent properties; and

d. Be economical and safe to build and maintain.

Alternate materials and methods will be considered for approval on the basis of these objectives.

1.01 REVISIONS TO THESE PS & FM STANDARDS

It is anticipated that revisions to these PS & FM Standards will be made from time to time. The date appearing on the title page is the date of the latest revision. User should apply the latest published issue to the work contemplated.

1.02 SHORTENED DESIGNATION

These City of Oregon City Sewage Pump Station and Force Main Design PS & FM Standards shall be cited routinely in the text as the "PS & FM Standards".

1.03 APPLICABILITY

These PS & FM Standards, together with all other applicable requirements of federal, state and local laws, shall govern the character and quality of material, equipment, installation and construction procedures related to the design of sanitary sewer pumping stations and force mains within the City of Oregon City.

The design of the following are considered special problems and are not covered in detail in these PS & FM Standards:

a. Siphons
b. Relining of Existing Sewers
c. Internal Sealing of Existing Sewers
d. Treatment Plants
e. Outfall Sewers
f. Energy Dissipators
g. Regulating Devices

Review and approval of the above special problems by the City Engineer shall be required. When requested by the City, full design calculations shall be submitted for review prior to approval.

1.04 REFERENCES

The PS & FM Standards are intended to be consistent with the most currently adopted provisions of:

a. City of Oregon City;
b. Oregon City Comprehensive Plan;
c. Oregon Statewide Planning Goals and Guidelines;
d. Oregon State Plumbing Specialty Code, Chapters 4 and 11;
e. Oregon Administrative Rules, Chapter 340.

Design shall comply with Oregon Department of Environmental Quality design guidelines.

1.05 STANDARD SPECIFICATIONS

Except where the PS & FM Standards provide other design detail, workmanship and materials shall be in accordance with current edition of the "Standard Specifications for Public Works Construction" prepared by the Oregon chapter of APWA, as modified by the City of Oregon City.

1.06 DEFINITIONS AND TERMS

As-Built Plans/Record Drawing – Plans signed and dated by the Project Engineer indicating that the plans have been reviewed and revised, if necessary, to accurately show all known as-constructed details of a particular public works project.

Building Drain – The building drain is that part of the lowest piping of the sewer system which receives the discharge from waste and other drainage pipes inside the walls of the building and conveys it to the building sewer, which begins five feet (5') outside the building wall (building foundation).

Building Sewer – That part of the horizontal piping of the sewer system which extends from the end of the building drain and which receives the discharge of the building drain and conveys it to a public sewer, or privately managed sewage collection system, or other point of disposal.

City – The City of Oregon City, Oregon.

City Engineer – The City Engineer of the City of Oregon City or his or her authorized representative.

Cut Sheets – Sheets of tabulated data, indicating stationings, structures, fittings, angle points, beginning of curve, points on curve, end of curves, sewer slope, staking offset, various elevations, offset cuts, and sewer depths.

Definition of Words – Wherever, in these PS & FM Standards, the words directed, required, permitted, ordered, designated, or words of like meaning are used, they shall be understood to mean the direction, requirement, permission, order or designation of the City Engineer. Similarly, the words approved, acceptable, satisfactory, shall mean approved by, acceptable, or satisfactory to the City Engineer.

Domestic Sewage – The liquid and water borne waste derived from the ordinary living process, free from industrial wastes, and of such character to permit satisfactory disposal, without special treatment, into the public sewer or by means of private sewage disposal system.

Drainage Waste – Storm water, ground water, surface drainage, subsurface drainage, spring water, well overflow, roof drainage, or other like drainage other than sewage or industrial waste.

Dwelling Unit – A facility designed for permanent or semi-permanent occupancy and provided with minimum kitchen, sleeping, and sanitary facilities for one family.

Easement – Easements are areas along the line of all public sewers which are outside of dedicated road or rights-of-way, and shall be prepared on City forms granting rights along the line of the sewer to the City.

Flow – The liquid and water borne waste derived from domestic sewage, industrial wastes, and in some cases drainage waste.

Industrial Waste – A water borne waste and wastewater from other than domestic users.

Lateral Sewer (Service Lateral) – Any sewer line to which a private building sewer connects or may connect. The lateral sewers are located within public right-of-way or easement, and generally connect to the main sewer and extend to the right-of-way or easement.

Main Sewer (Public Sewer) – A public sewer that has been or is being constructed to accommodate more than one lateral sewer or to which a building sewer connects or may connect. (Normally not less than eight inches in diameter).

Manager – The City Manager of the City of Oregon City or his/her authorized representative.

Manufacturer's Name – Any manufacturer's name, specification, catalog number, or type used herein is specified by make and order to establish the standard requirements of the City. Other equivalent makes will be considered for approval, providing they are comparable with this established standard.

Owner – Any individual, partnership, firm or corporation by whom the Project Engineer has been retained or who, as a property owner, is making arrangements with the city.

Person – Individual, firm, corporation, association, agency, or other entity.

Plans – Construction plans, including system plans, sewer plans and profiles, cross sections, detailed drawings, etc., or reproductions thereof, approved or to be approved by the City Engineer, which show the location, character, dimensions, and details for the work to be done.

Plumbing System – All plumbing fixtures and traps, or soil, waste, special waste, and vent pipes within a building and to a point five feet outside the building foundation thereof.

Project Engineer – The engineer, licensed by the State of Oregon as a Civil Engineer, under whose direction plans, profiles, and details for the work are prepared and submitted to the City for review and approval.

Public Sewer – Any sewer in public right-of-way or easement operated and maintained by the City.

Residential User – The owner, lessee, or occupant of a single-family dwelling unit in one structure.

Right-of-Way - All land or interest therein that by deed, conveyance, agreement, easement, dedication, usage, or process of land is reserved for or dedicated to the use of the general public, within which the City shall have the right to install and maintain sewers.

Roadway – All of the right-of-way dedicated, granted, used or to be used, for vehicle movement.

Sewage – The wastewater derived from human habitation and use of buildings for residential, institutional, or commercial purposes, excluding storm waters and industrial waste.

Standard Drawings – The drawings of structures or devices commonly used on City public works and referred to on the plans. These standard drawings are included in Section IV, Standard Drawings.

Streets or Roads – Any public highway, road, street, avenue, alley, way, easement, or right-of-way used or to be used for vehicle movement.

Structures – Those structures designated on the Standard Drawings as manholes, cleanouts, weirs, etc. Detailed drawings of structures or devices commonly used in City work and mentioned in these PS & FM Standards are included in Section IV, Standard Drawings.

Trunk Sewer – A public sewer ten inches or larger which has been or is being constructed to accommodate more than one Main Sewer or lateral sewer.

Uniform Plumbing Code – The Uniform Plumbing Code adopted by the International Association of Plumbing and Mechanical Officials, current edition.

1.07 ENGINEERING POLICY

The engineering policy of the City of Oregon City requires strict compliance with Oregon Revised Statute 672 for professional engineers.

The Project Engineer must have had prior experience in designing similar systems. Unless otherwise indicated by the City, prior to the initiation of study for any new pump station and/or force main project, the Project Engineer shall submit qualifications for review, and those qualifications must meet the approval of the City. For facilities to be owned by the City but funded and/or constructed in part or whole by a developer, the City reserves the right to retain the services of the Project Engineer to prepare construction documents and provide construction inspection and project certification.

1.08 APPROVAL OF ALTERNATE MATERIALS OR METHODS

Any alternate material or method not explicitly approved herein shall be considered for approval on the basis of the objectives set forth in 1.00 PURPOSE. Persons seeking such

approvals shall make application in writing. Approval of any deviation from these PS & FM Standards will be in written form.
Any alternate shall meet or exceed the minimum requirements set in these PS & FM Standards.

The written application shall include, but shall not be limited to, the manufacturer's specifications and testing results, design drawings, calculations, and other pertinent information for the proposed alternative.

Any deviations or special problems shall be reviewed on a case-by-case basis and approved by the City Engineer. When requested by the City, full design calculations shall be submitted for review with the request for approval.

1.09 PROJECT ENGINEER'S SCOPE OF WORK

A. General

Prior to the commencement of design and/or construction of any wastewater pump station and/or force main requiring issuance of a construction permit, the Project Engineer shall contact the City Engineer to set up a project orientation meeting to discuss and review design and equipment requirements. The City will normally assign a staff project team to work with the Project Engineer.

The Project Engineer shall, at a minimum, meet with the City for the following milestones:

- Project orientation;
- Preliminary design;
- Final design
  - 50 percent completion;
  - 90 percent completion;
- Pre-bid conference
- Construction management
  - Preconstruction conference;
  - Weekly (at a minimum) construction meetings;
  - Start-up; and
  - Completion.

Agendas and meeting minutes shall be prepared by the Project Engineer for all project-related meetings unless otherwise directed by the City Engineer. Meetings shall be scheduled at least ten business days in advance unless extenuating circumstances require otherwise. Agendas and supporting information shall be distributed by the Project Engineer through the City Engineer to all invited attendees at least two full business days in advance of any meeting. Meeting minutes shall be distributed to meeting attendees and other interested parties within five business days of the meeting date.

The Project Engineer shall develop and submit to the City a detailed schedule for the entire project (design, property acquisition, permits and construction) showing major tasks and supporting activities for completion of the project. All City review points shall show in the schedule submitted.

B. General Design Requirements

The Project Engineer, after completing the project orientation requirements, may proceed with the design of the project. The intent of these PS & FM Standards and the design process is to produce complete, biddable construction documents.

The design shall provide for the complete construction of a wastewater pump station and/or force main facility including building and associated site improvements; pumps; surge protection; odor control; associated piping and appurtenances; valve vaults; discharge manhole; plumbing; heating, ventilation, and air conditioning (HVAC) system; electrical power; secondary power or emergency power connection to support full station loads and control systems; instrumentation and controls; and other associated work identified by the City as being necessary to make the facility fully functional.

The Project Engineer shall perform the following minimum preliminary design tasks:

- Review applicable City Sanitary Sewer Master Plans and design reports.
- As applicable, perform site selection evaluations and recommend preferred site.
- Perform required design surveys.
- Perform geotechnical investigation work.
- Prepare schematic design documents for review with the City.
- Prepare preliminary design report for submittal to and review by the City and the DEQ.
- Prepare a preliminary engineer's construction cost estimate.
- Identify all permitting requirements and prepare permit applications unless otherwise directed by the City.

The Project Engineer shall perform the following minimum final design tasks:

- Prepare final construction contract documents for bidding purposes, including but not limited to, drawings and technical specifications. Submit documents to the City and the DEQ for approval.
- Prepare an Engineer's construction cost estimate.

- For City projects, provide bidding documents in sufficient quantity for the purposes of obtaining bids for the construction of the improvements.

The Project Engineer shall provide bidding and construction phase services as required by the City. Upon completion of the construction, the Project Engineer shall arrange a meeting with the City, Project Engineer and Contractor for start-up services. The Contractor shall provide start-up of the new facilities. The Project Engineer shall provide certification to the DEQ that all construction was completed per the approved plans and specifications. The Project Engineer shall prepare an Operations and Maintenance manual per the DEQ and City guidelines. The DEQ guidelines are included as Appendix A.

1.10 CONSTRUCTION PLANS

Construction drawings shall include, but not be limited to, the following as deemed applicable by the Project Engineer unless otherwise directed by the City Engineer:

- Cover sheet;
- Legend;
- Location and Vicinity Map;
- Demolition Plan;
- Site Layout, Grading, Drainage, and Paving Plan;
- Site Utilities, Plans, Profiles, and Details;
- Landscaping and Irrigation;
- Exterior Elevations, Sections, and Details;
- Foundation Plans, Sections, and Details;
- Structure(s) Floor Plans, Sections, and Details;
- Architectural/Civil Framing and Roof Plans, Sections, and Details;
- Door and Window Schedules;
- Mechanical Pump and Piping Plans, Sections, and Details;
- Pump Station Design Data;
- Temporary Pumping Plan;
- Piping Schematics;
- HVAC;
- Electrical Site Plan and Power Plan;
- Power Distribution One-Line Diagram(s);
- Lighting Plan(s);
- Motor Control Center (One-Line Diagram(s) and Elevation (Layout));
- Miscellaneous Devices/Panels One-Line Diagram(s);
- Panel Schedule(s) and Layout(s); Circuit Schedule (s);
- Instrumentation Plan; and
- Process and Instrumentation Diagram.

1.11 RECORD DRAWINGS

For the purposes of this section, record drawings will also mean drawings of record, As-Built Plans, or terms indicative of an attempt to record the as-constructed state of the facility.

Following completion of construction, the Project Engineer shall submit two (2) complete sets of mylar Record Drawings. It is recommended that a blue line be submitted first for checking by City staff before sending mylars. Record Drawings shall be the same size and format as the construction plans. They shall be a minimum of 3 mil. thick and suitable for reproduction and archives. Record Drawings shall describe any and all revisions to the previously approved construction plans, and shall be accompanied by a certification letter from the Project Engineer, indicating that the Record Drawings have been reviewed and revised if necessary, to accurately show all known as constructed details, and that the public improvements have been completed in accordance with the City of Oregon City Public Works PS & FM Standards and Specifications to the best of his knowledge. The words "Record Drawing" or "As-Built Plans" shall appear as the last entry in the revision block along with the month, day, and year Record Drawing was prepared. Submission of Record Drawings shall be made within 90 days of acceptance of the Sewage Pump Station or Force Main by the City.

If plans were prepared using Computer Aided Drafting (CAD), the Project Engineer shall work together with the Construction Contractor and submit the following:

a. An AutoCAD compatible digital form (DWG Format) of the as-built drawing.

b. Basic layering scheme.

c. Standard symbols for appurtenances.

SECTION II – PUMP STATION DESIGN

2.00 GENERAL

A. Pump Station Style/Configuration

Self-priming style pump stations shall be the preferred alternative; wetwell-drywell style pump stations shall be a second less desireable alternative. The ultimate selection shall be based on the design factors covered in these specifications and the respective operating limitations of each alternative style, with final approval by the City. Grinder STEP systems shall be approved by the City Engineer on a case-by-case basis. Grinder STEP Systems approved for installation by the City Engineer and serving one property shall be maintained by the owner.

B. Pump Station Building

The Pump Station shall be enclosed in a concrete masonry unit (clay unit masonry) or brick building. Building shall enclose pump station (self priming) or pump station access way (wet well-dry well), standby generator, electrical systems, instrumentation and control systems, hydrogen sulfide control systems and any other components as required by the City. Appropriate design calculations shall be prepared sufficient to meet applicable codes and to obtain building permit(s). Building shall include stainless steel deep sink.

C. Access

Design specifications shall incorporate all applicable and reasonable efforts to maximize close and efficient access for removal, replacement and maintenance of all major and minor equipment. This includes but is not limited to adequate clearances, sufficient anchorage, hoists, hatches and platforms.

D. Design Life

Wetwells and force mains shall be designed and sized to accommodate full build-out within the identified basin(s) contributing to the pump station, unless otherwise approved by the City. Pumps, motors, electrical systems and related components shall be designed and sized for a minimum 25-year service life, unless otherwise approved or required by the City. Structures shall be capable of a minimum 75-year service life.

E. Service Area and Design Population

Service area shall include all land that can be provided with gravity wastewater collection service. Service area shall also include basins, which may discharge wastewater into the subject basin, as identified in the City's master plan and/or by City staff.

Design population shall be calculated per the City's master plan and with additional guidance provided by the City. For facilities being constructed to serve new developments, design population shall be based on planned buildout densities.

F. Design Flow

Pumping stations and related components shall be designed to discharge the Peak Hourly Flow (PHF). Final design PHF shall be reviewed and approved by the City. The PHF shall be calculated using a combination of the following factors, as deemed appropriate by the Project Engineer:

- Average Residential Per Capita Flow per the Master Plan.
- Infiltration and Inflow Allowance per the Master Plan.
- Peak Hour peaking factor per the Master Plan and as approved by the City.

Project Engineer shall also review the City's master plan and the DEQ's guidelines. For industrial and/or commercial development, Project Engineer shall provide the proposed flow factors to the City for review and approval.

G. Receiving System

Project Engineer shall evaluate the downstream sanitary sewer system to determine the impacts of the increase in flow (e.g. peak pumping capacity) from the proposed pump station. Extents of system evaluation shall be as determined by the City Engineer, and shall include existing pumping facilities as required and identified by the City Engineer.

When replacing existing pump station facilities, the Project Engineer shall evaluate the downstream sanitary sewer system in accordance with DEQ requirements to determine the current condition and reliability for extended use. Deficiencies shall be presented to the City Engineer and addressed during the preliminary design phase (Pre-design Report).

H. Hydrogen Sulfide

Evaluate hydrogen sulfide potential per the DEQ's guidelines, and design hydrogen sulfide control systems as appropriate.

I. Reliability/Redundancy

Pumping facilities shall be designed and constructed to meet EPA Class I reliability requirements, which includes pump redundancy, standby power provisions, and a telemetry/SCADA system.

Pump redundancy shall mean adequate pump capacity to discharge the design PHF with the largest unit out of service.

Pumping facilities shall be equipped with a backup control system, which shall operate pumps in the event the primary control system fails.

Standby power and telemetry systems shall be provided per these standards.

J. Pre-Design Report

Prior to beginning final design and preparation of construction documents, the Project Engineer shall submit a pre-design report to the City and the DEQ covering all aspects of the design, as described herein.

2.01 PUMP/MOTOR

A. General

i. Materials and equipment shall be standard products of a manufacturer and distributor regularly engaged in the manufacture and distribution of such products for at least 5 years, and shall be suitable for the service intended. All materials and equipment shall be new and unused.

ii. The pumps shall be supplied by a distributor authorized to service them throughout the warranty period and beyond. The distributor shall be located within a 50-mile radius of the site, and shall be capable of providing 24-hour, 7-day emergency service.

iii. The pumps shall be warranted by the manufacturer for a minimum of two (2) years from the date of installation. Certified pump tests shall be supplied by the manufacturer for each pump provided.

iv. Where two or more pieces of equipment performing the same function are required, they shall be duplicate products of the same manufacturer.

v. Wetted parts shall be compatible and suitable for use with raw wastewater.

vi. Nameplates - Each pump shall be equipped with a stainless steel nameplate indicating serial numbers, rated head and flow, impeller size, pump speed and manufacturer’s name and model number.

vii. Pumps shall be designed for continuous operating service for pumping raw, unscreened sewage, and constructed to meet the intended service.

viii. A spare pump and motor shall be provided with a spare parts kit, consisting of flap valve, belts, gaskets, o-rings, seals and other related appurtenances as determined appropriate by the City Engineer. Start up and build out conditions shall be accommodated, as appropriate for development.

B. Pump Types

i. Self-Priming Pumps:

1. Centerline of pump suction shall be located within a maximum of 15 feet vertically of the lowest water surface in the wetwell.

2. Reprime Performance - Each pump at its rated speed shall be designed to maintain adequate liquid in the pump case to ensure automatic repriming in a completely open system without suction or discharge check valves and with a dry suction leg. Upon repriming, each pump shall deliver full speed rated design capacity. Reprime lift is defined as the static height of pump suction centerline above the minimum operating water level in the wet well. Given that these pumps must handle sanitary sewage, occasionally debris will lodge between the pump suction check valve and seat, resulting not only in the loss of the suction leg, but also in the siphoning of liquid from the pump casing to the approximate center line of the impeller. Such occurrence shall be considered normal with proper installation of an air release valve. Each pump shall be designed to retain adequate liquid in the pump casing to ensure unattended automatic repriming while operating at its rated speed in a completely open system without suction check valves and a dry suction leg.

Priming shall not be accomplished through a secondary vacuum line from the pump to the wetwell.

3. Cover Plate - Each pump shall be designed with a full diameter clean out cover for full access to the interior of the pump to permit the clearance of stoppage and to provide simple access for service without removing suction or discharge piping.

4. Wear Plate and Rotating Assembly - Each pump shall be equipped with a replaceable volute/wearplate and alloy steel seal plate permitting the replacement of the expendable parts without

replacing the pump case. Units with volutes integral (cast) to the casing are not acceptable. Replacement of the volute/wearplate, impeller, seal plate and shaft seal shall be accomplished through the removable end cover without disturbing the piping.

5. Suction Check Valve - The suction elbow shall have an integral neoprene check valve that can be cleaned or replaced through a cover without removing the suction piping.

6. Tools - No special tools shall be required for replacement of any components within the pump. The contractor shall provide the City with a complete set of standard tools for maintenance of the pump station. A tool case or box shall be provided in the pump station to keep all the tools.

7. Impeller - The impeller shall be two vane, semi-open, non-clog type, of ductile iron, with pump out vanes on the back side to reduce pressure on shaft seal and help eliminate buildup of foreign materials. The impeller shall either be keyed or threaded to the pump shaft and secured with a stainless steel lock nut.

8. Seal - The pump shaft shall be sealed against leakage by a spring-loaded double mechanical seal system. The seal system shall meet the following minimum specifications:

   The minimum acceptable materials of construction shall be carbon rotating washer and seat on the wetted end, and ceramic seat with a carbon face rotating on the drive end. The seal shall be commercially available and not a proprietary design of the pump manufacturer. The seal shall be installed in an oil or grease filled chamber. The reservoir shall be separated from the pump pedestal in order to prevent possible pedestal contamination. Seal shall be John Crane type 21, or approved equal.

9. Shaft and Bearings - The shaft shall be high quality alloy steel and protected with a removable stainless steel shaft sleeve. The shaft shall be contained within a bearing pedestal of ample size to contain heavy duty thrust bearing and radial bearings of adequate size to withstand all imposed loads. Bearing shall be greased with the bearing pedestal separated from the pumped liquid to prevent lubricating oil contamination. Pumps allowing direct contact of bearings to the pumpage are not acceptable.

10. High Pump Temperature Protection - Each pump's case shall be fitted with a thermal switch wired to the pump motor control

circuit so that in the event of excessive temperature within the pump, the pump will shut off.

11. Power shall be transmitted from the motors to the pumps by means of V-belt drive assemblies. Each drive assembly shall have a minimum of two V-belts.

ii. End Suction Centrifugal Pumps:

1. The pump shall be a vertically mounted, single stage, non-clog, end-suction centrifugal sewage pump. The pump shall be designed for continuous operating service and shall be constructed to meet the intended service.

2. The pump shall be coupled to modular style ASTM A48 Class 30 fine grain Grey Iron bearing frames. The bearing frames shall be line bored for exact concentricity and be provided with anti-friction style bearings to accommodate both radial and axial loading. The bearing frames shall be designed for captured bearing positioning and will not require any field axial adjustment. They will be designed for use with a separately mounted driver and shall be connected by means of a flexible shaft.

3. Motor bases shall be provided for the mounting of the motors. The bases shall be of adequate height to permit access to the coupling between the motor and intermediate shafting. The motor mounting surface shall be designed for a Standard NEMA "P" Base motor. The motor bases shall be constructed of ASTM A48 Class 30 Grey Iron.

4. The pump casings shall be of back-pullout design allowing for removal of rotating element without disturbing piping connections. The casings shall be constructed of fine grain Cast Iron of ASTM A48 Class 30. All casing sections shall have heavy wall thickness to provide long life under abrasive and corrosive operating conditions. All mating surfaces shall have register fits to ensure proper alignment. Piping connections shall be ASA 125# flat face drilled flange. Flange face surface finish shall be within a minimum of 250 micro-inches.

5. Suction wear rings shall be the peripheral type requiring no axial adjustment. They shall be press-fit into position and easily replaceable in the field. The rings shall be constructed of ASTM A48 Class 30 Grey Iron.

6. The impellers shall be of heavy section Cast Iron ASTM A48 Class 30 with the two-port design. Internal vane edges shall be well rounded to present smooth flow. Impellers shall have a straight non-tapered bore, dynamically balanced, keyed to the shafts, and further secured with stainless steel washers and heat treated alloy steel impeller lockscrews. The impellers shall be fixed at location with no required adjustment. Back vanes shall remain at full diameter to reduce axial thrust.

7. Dished style backplates constructed of ASTM A48 Class 30 Grey Iron shall be provided including a single mechanical seal, John Crane Type 1 or 2 of material code $BO_{15}10_{58}1$ (Tungsten Carbide VS Silicon Carbide). The design shall allow for continuous or intermittent operation without the need for external flush or seal water, or for the external circulation of pumpage to the seal for either pressurization, cooling or lubrication. Depending on conditions, design shall consider providing external seal flush.

8. The bearing frames shall be constructed of fine grain ASTM A48 Class 30 Grey Iron. The bearing frames shall be line bored for exact concentricity and be equipped with anti-friction style bearings. The bearings shall be either ball or roller style, properly sized to accommodate all thrusts, both mechanical and hydraulic, imposed upon them. The frames shall be designed for captured bearing positioning and shall not require any field axial adjustment. The bearings shall have a minimum calculated B-10 bearing life rating of 20,000 hours at the stated design condition. A complete bearing life stress and loading calculation shall be provided by the pump manufacturer to illustrate compliance with this requirement. Bearing lubrication shall be either grease or oil with proper provisions, drains, vents or reliefs to facilitate easy re-lubrication in the field.

9. The pump shafts shall be of high strength ANSI 1144 Stressproof Alloy Steel. The shafts shall be accurately machined and polished and of sufficient size to transmit full driver output without excessive flexure or stressing. All steps in the shafts shall be radiused to reduce stress concentrations. Shaft deflection shall not exceed 0.008 inch, measured at end of shaft when operating at the specified design conditions. A complete shaft stress analysis calculation shall be supplied by the pump manufacturer to illustrate conformance with this requirement.

10. The shafts shall be protected by renewable shaft sleeves which extend beyond the gland. The sleeves shall be grooved on the inside for an 0-ring to prevent leakage along the shaft and shall be

positively locked to prevent rotation. The sleeve shall constructed of 416 Stainless Steel.

11. The base elbows shall be of cast iron, heavy section construction, with a bolted and contoured cleanout port. The bases shall be of sufficient strength to support the entire weight of assembled pump and motor and of sufficient height so that no part of the elbow will touch the floor. The flanges shall be 125# ANSI standard.

C. Compatibility - Pumps and pump station equipment shall be selected considering compatibility with other City pumping stations, and final selection shall be approved by the City.

D. Solids Handling - Pumps shall be capable of handling and passing minimum 3-inch spherical solids and any trash or stringy material.

E. Pump and System Curves - The Project Engineer shall develop system curves that indicate the required pump operating conditions. System curves shall be developed for suction and discharge piping, and shall include all valves, fittings and other items that may cause energy loses. System curves shall be developed using the Hazen-Williams equation, and for "C" factors of 100, 120 and 150.

The Project Engineer shall select pump(s) that will operate under the determined system curve conditions and at the highest efficiency possible. Pump(s) shall operate within the manufacturer's recommended limitations.

The Project Engineer shall provide pump and system curves for the selected pump(s) to the City for review and approval.

F. NPSH –At the design operating point and at the "pumps off" water level the NPSH available shall be at least 1.1 times the NPSH required, or 2 feet, whichever is greater.

G. Piping and Valving – Pump inlet elbow shall be long radius reducing elbow. For end suction pumps, each pump suction shall be equipped with a plug valve. For all pump types, each pump discharge shall be equipped with an outside spring and lever check valve and a plug valve. Check valves shall be installed horizontally.

H. Motor - The pump motors shall be horizontally or vertically mounted, TEFC, premium efficiency, induction type with normal starting torque and low starting current characteristics, suitable for the electrical power available. The motors shall not be overloaded at any point on the pump curve. Motors shall be of NEMA design B, Class F insulation, rated for continuous duty, with a 1.15 service factor.

2.02 WETWELL

A. Capacity

The wetwell shall be sized to maintain individual pump cycle times that meet NEMA and pump manufacturer requirements for motor starts per hour.

B. Configuration/Sump

For duplex and triplex pumping stations, the wetwell shall be a circular configuration. The floor shall be sloped for proper installation and function of the pump inlet. The wetwell, inlet piping and suction piping shall be designed to minimize the potential for vortexing, rag and debris build-up, and other possible inlet problems. Flow divertor shall be installed on all inlet pipes. Sump design shall be in accordance with Hydraulic Institute Standards and meet pump manufacturer's recommendations.

Pump inlets shall be sized to provide a velocity of 3.0 to 5.5 ft/s at the entrance to the suction piping. Inlets shall use flange-and-flare elbows.

Sump bottom shall be grouted to provide inclined surfaces to direct solids to the inlet piping.

C. Materials

Wetwells shall be constructed of reinforced concrete per ASTM standards. Joints shall be rubber ring per ASTM C 443 or mastic gaskets.
All equipment and fixtures in the wetwell shall be explosion proof.

D. Buoyancy

Project Engineer shall evaluate the buoyancy potential for the wetwell (and drywell, for wetwell-drywell pump stations). Project Engineer shall perform evaluations assuming ground water level at ground surface and wetwell levels at "pumps off." Factor of safety against buoyancy shall be a minimum of 1.25 under gravity conditions and as deemed appropriate by the Project Engineer.

E. Washdown System

Wetwell shall be constructed with a permanent washdown system. The system shall be for cleaning the wetwell walls, positioned for maximum coverage, and shall be operated automatically on pump call. The system shall be installed 1-to 2-feet above the "pump #1 on" operating level, and shall include a minimum of two nozzles (Rokon #D26984-1/2-PVDF/SS-939, as supplied by Spraying Systems Co., or approved equal). Nozzles shall be spaced to evenly spray the wetwell. Control of system shall be with a solenoid valve, and a timer, with a ball valve installed for manual operation. System shall be supplied with water from a main

piping header, and shall include an approved reduced pressure back flow device. All materials shall be stainless steel or Schedule 80 PVC.

F. Wetwell Access

Access shall be provided through a minimum 3-foot square aluminum, diamond plated, hot dipped galvanized, H20 rated, spring assisted hatch. Hatch shall be provided with a recessed padlock clip for locking with a standard padlock. All hardware shall be stainless steel. Access shall be located outside building.

G. Overflow

As approved by the City and the DEQ, provide a wetwell overflow pipe. Overflow location shall be as approved by the City and the DEQ.

H. Coating

After completion of construction, wetwell interior shall be coated with one coat of Strong-Seal High Performance Mix or equivalent. See engineer's specifications.

I. Wetwell Venting

See HVAC standards.

2.03 FORCE MAIN

A. Size/Capacity

Force Main shall be designed as an integral component of the pump station, and shall be sized to meet the "Design Period" requirements herein.

Force Main shall be sized with a design velocity of 4 to 6 feet per second. Force Main shall be a minimum of 4-inches in diameter.

Pump suction lines shall be sized with a design velocity of 3 to 5 feet per second.

B. Configuration/Layout

Force main shall be designed to be continuously ascending from the pump station to the discharge point, unless otherwise approved by the City. Force main shall be constructed inside public right-of-way or an adequately sized construction and maintenance easement (minimum 15' wide). Horizontal bends shall be minimized, and right angle bends shall be constructed with two 45-degree bends separated by a short (3-foot minimum) straight section.

C. Materials

Force main shall be constructed of AWWA C151 Class 52, cement lined, asphaltic coated Ductile Iron Pipe (DIP) or C900 (DR-14)/C905 (DR-18) PVC. Pipe and fittings shall be flanged, mechanical joints, or push-on as required. PVC pipe shall be of integral bell design with elestomeric gasket.

Pipe fittings shall be gray-iron or ductile iron and shall conform to either AWWA C110 or AWWA C153. Fittings shall be mechanical joint or flanged only in vault or above ground. Mechanical joint fittings shall be restrained. Joint restraint shall be by mechanical means or concrete thrust blocking. For joints restrained by mechanical means, push-on joints upstream and downstream of the subject fitting shall also be appropriately restrained.

For PVC pipe, tone wire shall be installed along the top of the pipe, extended into valve boxes for access with pipeline locating equipment. Tone wire shall be #12 THHN standard copper wire with green insulation.

Marking tape (minimum 3" wide, green) bearing the statement "CAUTION – BURIED SEWER LINE BELOW" shall be installed 18" to 24" above the centerline of the pipe.

D. Discharge Configuration

Force main shall discharge into a manhole. Flow shall be discharged within 12-inches of the manhole invert.

Force main discharge manhole shall be coated per the WETWELL standards.

E. Force Main Pigging

Pig launch and retrieval system shall be provided for force mains over 1,000 feet long and as required by the City. Pig launch systems shall utilize the station-installed sewage pump(s), where possible. When adding a pig launcher to a remodeled station, old pressure lines having 90 degree elbows shall be replaced with two 45 degree elbows where practical. Pig launcher shall be protected from freezing. Undrained portions of piping shall be buried, enclosed in a building or, for very small lines, wrapped with heat tape.

2.04 STANDBY POWER

A. Type

Permanent standby power shall be provided for each pump station and shall be approved by City Engineer. Generator systems shall be natural gas powered, unless otherwise approved by the City. Engine shall be equipped to start

automatically when City power fails. Generator sets shall be Katolight, Kohler, or approved equal and engineered to run the station with two pump operations.

B. Size

Generator shall be sized to operate the entire pump station. Generator shall be sized to allow stagger start of pumps, with no more than a 25% voltage dip.

C. Transfer Switch

Pump station shall include an automatic transfer switch (ATS) to activate the generator upon line-power failure. Transfer switch and related equipment shall be as manufactured by the generator set manufacturer.

D. Miscellaneous

Generator shall be installed inside the pump station building on a suitably sized concrete pad. Sound attenuating equipment, including acoustical dampers, shall be installed per City building code requirements. Exhaust piping shall be plumbed through building wall, with appropriate heat thimble.

Generator system shall include built-in automatic system to exercise generator weekly.

Other equipment shall include:

1. Standard configuration – 60Hz standby.
2. Engine water jacket preheater, 1500 w 120 v (TPS).
3. Engine coolant and oil shall be specified by engine manufacture.
4. Silencer, critical grade, approximately 35dBA attenuation.
5. Flexible stainless steel exhaust connection.
6. Engine shall exhaust thru the wall with Hapco Wall thimble by Harco Manufacturing.
7. Air cleaner, standard normal duty, single stage.
8. Battery shall be heavy duty, 134 AH at 29 hours @80 degrees fahrenheit.
9. Sens BC 120V in, 12VDC out, 3.5 a. 2 rate. 0 alarm.
10. Testing a full load for 30 minutes.
11. 1 year warranty (750 hours on engine): warranty period will begin after completion of any punch list, and acceptance by the City.

2.05 SITE IMPROVEMENTS

A. Parcel Size

The minimum parcel size shall be based on the need to provide parking for maintenance equipment, accommodate the pump station structure, support

enclosures or substructures and observe the Building Code Requirements for lot coverage.

B. Parcel Ownership

If the selected location is not currently owned by the City, the City's acquisition process must be started as soon as the parcel is defined.
In the case of a pump station being planned/designed as a condition of a private development, it shall be the developer's obligation to see that the appropriate site needs are acquired and conveyed to the City. If the pump station is a City driven project, the City will purse the parcel needs.

C. Access

A paved access road for maintenance vehicles shall be provided. The access road shall be at least 12 feet wide. Access roads longer than 50 feet shall supply an additional paved area for turning around maintenance vehicles. The maximum access road grade shall be 12 percent. The maximum turning area grade shall be 2 percent. Transition from the access road grade to the turning area and street access shall be accomplished with minimum 50-foot vertical curves. Pervious pavement materials shall be considered when designing access road. Pavement section shall be approved by City Engineer.

D. Zoning Requirements

Current zoning for the site must be determined. Pump stations are defined as a basic utility compatible with industrial zones without further zoning action. In all other zones, a conditional use permit may be required. The Project Engineer shall verify zoning requirements and complete any permitting requirements.

E. Flood Plain

The pump station shall be protected from the 100-year flood. In order to ensure adequate floor elevation of the building shall be set at least 1.0 ft above the 100-year flood level.

F. Geotechnical Report

A geotechnical study shall be completed for any work requiring greater than 8 feet of excavation and subsurface construction or where located in unstable soils/steep slopes overlay zone. This geotechnical study shall include an analysis of the expected range of groundwater levels over time and determine allowable soil bearing pressure, appropriate construction method, dewatering limitations and other design factors. The geotechnical study and conclusions shall be documented in a geotechnical report.

G. Drainage

Surface water shall be directed away from the pump station. Floors should be sloped to prevent ponding and to direct water to drains and sumps. Catch basins, area drains and roof drains shall be connected to the storm drain systems. Wash water from the sewage pump maintenance shall be discharged into the wetwell.

H. Lighting

Motion activated area lighting shall be provided to the entrance.

I. Security

Access gates shall allow for padlocking. An intrusion alarm system shall be required. The alarm components shall be compatible with the City's SCADA notification system.

J. Landscaping and Fencing

The pump station building and associated site improvements must blend-in with the character of the surrounding properties. The landscaping shall be designed by a registered landscape architect and include low maintenance and little irrigation types of trees and shrubs. Permanent automatic irrigation shall be provided to all planted areas.

The site shall be fenced with a minimum six-foot high chain link fence. A minimum of one locking access gate shall be provided, consisting of rolling gates 16 feet in width or per City Engineer approval. Fence material shall be No. 11 gauge galvanized steel fabric with bonded vinyl coating. Vinyl coating shall be a color designed to blend with the surrounding area (likely green, brown, or black). Fence posts shall be coated galvanized steel, with top caps, and set a minimum of three feet deep in concrete. Crossbars shall connect adjacent fence posts, with diagonal braces at corners and ends. All posts, cross bars and gates shall be painted or coated the same color as the vinyl clad fence.

2.06 BUILDING DESIGN

Building shall be a low-maintenance above-grade structure that is architecturally compatible with the surrounding area and constructed using materials approved by the City Engineer. All structures shall be of adequate size with interior and exterior clearances to facilities for ease of operation and maintenance of all systems.

A. Building Codes

The pump station shall be considered a major structure with a minimum 75-year design life. Structures and site layouts shall be designed in accordance with

current Uniform Building Code (UBC) standards. Buildings shall be designed in conformance with applicable energy codes and noise codes.

B. Confined Space Entry

A confined space is one that:

- Is large enough to enter to perform work;
- Has limited means of entry or exit; and
- Is an area not designed for continuous employee occupancy.

Confined spaces shall be eliminated wherever practical, and provided with proper safety precautions and equipment where unavoidable. Buildings shall be designed to allow for access with a truck-mounted lifting system to remove equipment and personnel from the wet well and dry well.

C. Backfill

Structural base fill shall consist of ¾-inch minus crushed rock compacted in 6-inch lifts. A minimum of 6-inches shall be placed where the subgrade is undisturbed and 12 to 18-inches shall be placed where the subgrade disturbance has occurred. Prior to placing backfill around poured concrete structures, remove forms, temporary construction and debris below grade. Backfill shall not be placed against poured concrete until 28 days have passed from completion of original concrete pour. Heavy compactors and large pieces of construction equipment shall be kept away from any embedded wall a distance of a least 5 feet in order to avoid the build-up of excessive lateral pressures. Compaction within 5 feet of the walls shall be accomplished using hand operated vibratory plate compactors or tamping units. Particular care must be taken to avoid damage to the pipe connections and to the structure.

D. Building Materials

Pump station housing shall be of concrete masonry or brick unit construction with a frame truss rafter system. Flat built-up roofs will not be allowed. The appearance of the pump station housing shall consider surrounding neighborhood architecture. Doors shall be metal and any glazing shall be safety glass. Exposed metal shall be stainless steel. The structure shall be secure and resistant to vandalism. Buildings shall be insulated in accordance with the State code. Roofing shall be standing seam anodized aluminum.

E. Architecture

i. Exterior

Appropriate architectural treatment shall be designed. The City's approval of architectural designs will vary depending on the complexity of the facility and applicable city codes.

ii. Overhead Door

Overhead doors shall be of heavy-duty construction, roll-up style, with insulated panels. Doors shall be sized to accommodate all equipment that will be required to pass through them. In general, doors shall provide a minimum of 9-feet vertical clearance. Adequate clearances, sufficient anchorage, hoists and hatches must be provided to remove, replace and maintain all major and minor equipment.

iv. Noise

Pump station noise sources that may create noise problems are electric motors, pumps, engine-generator sets, fans and air compressors. Project Engineer shall incorporate all applicable and reasonable control measures to keep noise levels lower than existing levels in surrounding areas, and comply with applicable City codes.

v. ADA

Buildings shall be designed to conform with the current Americans with Disabilities Act regulations.

2.07 MECHANICAL

A. Materials

Exposed piping shall be ductile iron pipe. Buried pipe shall be per the force main requirement herein. Where joint restraint is required use mega-lug type restraints and/or thrust blocks. No accessory equipment shall be mounted on the floor.

B. Valves

Check valves shall be swing check valves with external arm and spring, mounted in the horizontal position. Dampening devices shall be installed on check valves to prevent slamming. Isolation valves shall be eccentric plug valves. Plug valves 6-inches and larger in diameter shall be gear driven. If these valves are more than 5 feet above the floor, they must be equipped with a special operator, such as a chain wheel, that allows easy operation without climbing on top of piping or pumps to gain access to the valve. The valve operators and their orientation shall be drawn to scale on the drawings to clearly identify conflicts or lack of operating space.

C. Flow Meter

The pump station shall be equipped with an electromagnetic flow meter (Dan Foss or equal) with remote flow indicator and totalizer mounted in the pump station's control panel. The transmitter shall be submergence-proof and be NEMA-6P rated. The flow indicator and totalizer shall read in gallons per minute and total gallons. The meter shall be equipped with a liner compatible with raw sewage and shall be sized to maintain a velocity of four to six feet per second.

D. Pressure Gauges

A pressure gauge shall be installed on each pump's suction and discharge line. Gauges shall be 3-1/2-inch diameter with stainless steel case, oil filled polycarbonate glass window, stainless steel movement, blowout disc and 1/4-inch NPT stainless steel lower connection. Gauge shall be selected such that, under normal operating conditions, the gauge will read from 40 to 70 percent of full scale. Gauges shall be mounted to a pressure sensor installed in the force main, mounted between two flanges. Pressure sensor shall be Red Valve, series 40, or approved equal.

E. Hydrogen Sulfide Control

An evaluation of the potential development of hydrogen sulfide in sewers shall be performed per DEQ guidelines. If hydrogen sulfide is determined to be a potential problem, a control system shall be installed. Acceptable systems include air or chemical injection.

i. Air Injection

Air injection shall be accomplished using an air compressor. The compressor shall be a rotary screw type. The compressor and motor shall be mounted on an ASME Coded, receiving tank. The size shall be as required to meet the operating conditions. The receiver shall include safety relief valve, automatic drain and service valves, and a pressure gauge (compressor and gauges need to be isolated by shut-off valves and union connections for R&R maintenance). Unit shall be furnished with a dual control package, to allow operation in either a continuous run or start/stop mode. The control package shall allow for an automatic re-start after power failure. In continuous mode, compressor shall run continuously, at measures to be determined by the system head. In start/stop mode, a pressure switch shall start and stop the motor. Low oil and low oil pressure protection shall be a standard feature of compressor with this regulation.

The compressor shall be driven by an electric motor suitable for continuous operation on 230/460 volt, 3-phase, 60 hertz power supply. Motor shall be NEMA frame, squirrel cage induction type with open dripproof enclosure. The service factor on the standard motor shall be 1.15.

The motor starter shall be manual or across-the-line magnetic contactor in NEMA 1 or NEMA 12 enclosure, and equipped with properly sized thermal overload protectors. Motor starters shall be "soft start" as required.

An air-cooled aftercooler shall be mounted to the compressor, supplying cooling air flow. Included in the piping shall be a moisture separator and trap to automatically dump the accumulated condensate. The aftercooler shall cool the air to within 20°F of the ambient air temperature.

A pressure regulating valve shall be installed on the air supply line, upstream of the connection to the pump station Force Main, to control compressor operation for the operating shown on the drawings. Pressure gauges shall be glycerin filled, bronze socket with stainless steel tube, 1/4" NPT connection, polycarbonate window, 2 1/2-inch dial, rated at 1% accuracy.

Vertical Air Flowmeter shall be acrylic tube with an acrylic housing, 316 stainless steel fittings, 316 stainless steel float material, Viton o-rings, with a rated capacity as required. Flowmeter shall be equipped with internal needle valve on the inlet side of the flow meter.

A double check valve shall be installed between the flow meter and the ball valve.

ii. Chemical Injection

Chemical injection is a least preferred alternative for hydrogen sulfide control however, as an alternative to air injection, chemical injection systems may be utilized as approved by the City Engineer. Project Engineer shall review proposed chemical system with City prior to approval, and shall include appropriate MSDS information. Chemical injection systems shall be housed in a separate room in the pump station building. Systems shall consist of dual storage tanks and feed pumps. Tanks shall be placed in a containment area that drains directly to the wet well to control release of chemicals into the environment. Design shall incorporate HVAC systems as required by the applicable codes.

2.08 ELECTRICAL

All electrical work shall be done in strict compliance with the requirements of the National Electrical Code, National Electrical Safety Code, and Oregon City codes. All components shall be UL listed. Electrical conduit connections between the wetwell and building shall be sealed off outside the building and in such a manner so as to allow ease of access for maintenance. No conduits shall be allowed inside the building or wetwell that have not been properly sealed. All floats and transducers shall have a connection box outside the building with terminal strip.

A. Electrical Service

Project Engineer shall coordinate with power company to provide electrical service to the pump station. Contractor shall be responsible for paying all fees.

B. Motor Starters

For motor sizes 30 horsepower and larger, or as otherwise required, the project Engineer shall design solid state "soft start" motor starters. Equipment shall be consistent with motor starters utilized at other City sewage pumping stations.

C. Pump Station Control System

Pump station level sensing and control shall be provided by an integrated controller and level transducer in addition to a back-up level control system. All pump station control systems must be recognized and listed as intrinsically safe by a nationally recognized testing laboratory.

i. Primary Controls

Transducer - Wet well level sensor shall include a Miltronics or equal ultrasonic transducer to measure wet well levels. Transducer shall operate based on non-contacting ultrasonic technology. It shall be self-cleaning, hermetically sealed and FM approved for explosive environments, with a measurement range of 1 to 33 feet with 1% accuracy. Transducer shall be fitted with a submergence shield.

Controller - Controller shall be designed to operate integrally with the transducer. Controller shall have a minimum of 5 relay contacts assignable as alarms and pump controls. Programming shall be accomplished via a programmable keypad and protected using an EEPROM storage system. Display shall be in 4-digit 18 mm LCD. Controller shall be enclosed in a NEMA 4 enclosure.

ii. Back-up Controls

Provide floats for high level wet well and low level wet well for use in the event of primary level control system failure. High level float shall signal

high water alarm and a call for both pumps; low level float shall signal low water alarm and turn both pumps off. Intrinsically safe relays shall be supplied in a separate enclosure.

D. Telemetry

The pump station shall be equipped with telemetry/SCADA per City standards and as approved by the City. At a minimum, the following alarm signals shall be made available from the pump station control panel to the telemetry/SCADA system: pump #1 on, pump #2 on, pump #1 fail, pump #2 fail, motor #1 high temperature, motor #2 high temperature, phase fail, low water alarm, high water/pumps call (float), station flood, intrusion and smoke detector. For stations with more than two pumps, alarm signals shall be expanded to include all pumps.

E. Control Panel

Electrical panel construction, electrical wiring, and equipment shall be in strict conformance with the National Electric Code, State and Local Codes, and in conformance with applicable specifications of NEMA, ANSI, UL, and ICEA. Inside panels shall be NEMA 12; outside panels shall be NEMA 4X. All electrical equipment shall be mounted inside an electrical panel that is placed at safe operating levels and shall not be subjected to flooding. Panels shall be located so they are out of the way of any washdown or splashing hazards, and out of the way of any maintenance operations.

Control panel shall include the following monitoring devices: phase monitor (with switch to allow for checking all three phases); elapsed time meter; pump start counter; voltmeter and ammeter. Indicating light shall be provided for each pump/motor for the following: high temperature shutdown; pump running; and pump fail (based on check valve limit switch). Provide reset buttons (one per pump/motor) for pump high temperature and motor overload. Provide H-O-A switches for each pump.

Uninteruptable Power Supply (UPS) - Install a UPS in the control panel to prevent control system failure in the event of a voltage dip (up to 35%) at generator startup. The UPS must be compatible with the generator operations.

F. Alarm Light

Pump stations shall be provided with a red alarm lamp mounted to be visible from the nearest public roadway. If the station is equipped with a dry well, provide a float level switch to alarm at a dry well water level of 6-inches above finished floor. Red alarm lamp shall be energized in conjunction with any pump station alarm. Alarms sending signals via telemetry shall do so as required by the City. No local audible alarms shall be installed. A red light test switch shall also be installed.

G. Electrical Outlets

Convenience outlets with ground fault protection shall be provided and shall be rated to supply not less than 15 amps.

H. HVAC

Heating is required to maintain temperatures between 45 and 55 (°F) degrees in buildings and the dry well. The energy source for heating the space shall be either natural gas or electrical resistance heating. The wet well side of the pump station requires no heating, but pipes in the wet well or route piping in the wet well walls that can be damaged by freezing conditions shall not be exposed to such conditions..

Cooling shall be maintained through ventilation only unless otherwise required by the City or for any special equipment.

Ventilation of electrical spaces in the dry well shall consist of both supply and exhaust fans capable of 12 air changes per hour continuously. For self-priming pump stations, a passive wetwell ventilation system shall be provided. Vent piping shall extend above the building roof line and be outside the building. In wet well/dry well systems the wet well system shall be completely isolated from the dry well side. This implies that no ducting, fans or any part of the two systems shall provide a cross connection. Ventilation of areas that are not likely to contain noxious, hazardous or flammable gases must be ventilated continuously at the rate of 6 air changes per hour and must also have independent supply and exhaust fans. When the light is turned on it should turn on the blower and open the louvers.

I. Materials

All conduit shall be placed to minimize tripping or other safety hazards. All buried conduit shall be rigid and nonmetallic and exposed conduit shall be rigid metal. Flexible connections shall be made with liquidtite flexible metal conduit. DC level signals shall not be run in the same conduit as power conductors.

2.09 WATER SUPPLY

A. Water Supply for Pump Station

Wash water with a backflow preventer and 3/4-inch hose bib shall be required. All hose bibs and hydrants in exposed locations subject to freezing shall be of the non-freeze type. Back flow device shall be installed inside the building, mounted to 3/4-inch ACX plywood and to a building wall.

B. Wet Well Washdown System

See the section on wet well.

C. Backflow Prevention

A reduced pressure backflow device must be installed on potable water piping entering the pump station site. This device is a three-fold method of protection against contaminating city water supply systems. This device must be approved by the Oregon State Health Division. Double check valve assemblies are not acceptable.

D. Meter

The water supply shall be metered as required by the City.

2.10 TESTING

A. Pumps

The Contractor shall furnish a representative of the manufacturer to perform inspection, start-up and training services. The manufacturer's representative shall be experienced in the operation and maintenance of the equipment and shall instruct the Owner's personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment. The representative shall check the installation and supervise initial start-up of the equipment, and shall perform, at a minimum, the following tests on each pump:

- Measure and record shutoff head and power draw at shutoff head.
- Measure and record actual operating head, and power draw at actual operating head.
- Measure and record static head.

For all pump tests, ensure that the force main is full of liquid during the testing. The manufacturer's representative shall provide written certification that the installation is correct and that the equipment has operated satisfactorily, verifying the complete assembly for proper alignment and connection, and quiet operation. This service shall be provided for a minimum period of one trip and one day. After the installation and operation of the equipment has been certified, the manufacturer's representative shall train the Owner's personnel in the proper operation and maintenance of the equipment.

A start-up report, acceptable to and approved by the Engineer, shall be completed by the manufacturer's representative before final acceptance of the pumps.

Operations and Maintenance manuals (three copies) shall be provided at acceptance.

B. Generator

i. Prior to installation of the engine generator set, a factory test shall be performed and a logged test report issued to the Owner. A resistive load bank shall be connected to the load side of the standby generator. The load bank shall be used to test the generator set for full load and half load. The log shall include the length of time for generator set for full load and half load. The log shall include the length of time for generator set start-up after the commercial source is interrupted, the length of time for the generator set to reach frequency stability after zero to half load and from half load to full load switching. The generator set shall be run for a minimum of four hours at full load. All the temperatures of the engine and the voltages, frequency and amperages shall be recorded on every 15 minute interval during the test.

ii. A site load test shall be performed, logged and witnessed by the Owner's representative. The total facility standby load shall be connected to the unit for one full hour. Each breaker shall be used to approximate half and full load. The log shall indicate the same information contained in the pre-installation test. Notify the Owner 72 hours in advance so that his representative can be present at the test.

C. Wet Well

Conduct hydrostatic test per City standards. City representative shall witness all hydrostatic tests.

D. Force Main

Conduct hydrostatic test per City water system standards for pressurized pipelines. City representative shall witness all hydrostatic tests.

E. Gravity Sewers

Test per City standards. City representative shall witness all hydrostatic tests.

F. Electrical

The Contractor shall perform voltage, current and resistance tests. Testing shall not take place unless the Owner representative is present.

i. Conductor Tests

Following the completion of installation, test the following:

1. All 480 volt power feeders.

2. Pump feeder power cabling.

3. All new grounding; measure ground resistance at each ground rod.

ii. Visual and Mechanical Inspections

1. Inspect expose section for physical damage.

2. Verify cable is supplied and connected in accordance with specifications and one line diagram, and that phases are labeled correctly.

iii. Electrical Tests

1. Perform insulation resistance test on each cable with respect to ground and adjacent cables.

2. Perform continuity test to ensure proper cable connection.

iv. Test Values

1. Insulation resistance tests shall be performed at 500 volts DC for one-half minute.

2. Minimum megger readings at 20 degrees C shall be 10 megaohm.

3. The maximum acceptable reading for an individual ground rod shall be 25 ohms as required by the NEC and measured by the three-rod method. The composite ground electrode shall have a maximum acceptable reading of 15 ohms.

SECTION III – PROJECT COMPLETION

3.00 FINAL INSPECTION

Project Engineer shall coordinate and conduct final inspection with Owner, Contractor, and other interested parties. Project Engineer shall prepare "Punch List" and transmit to Contractor with cc: to Owner and other interested parties, along with cover letter documenting final inspection.

3.01 OPERATIONS AND MAINTENANCE MANUAL

Project Engineer shall prepare Operations and Maintenance (O&M) Manual for the completed project (including generator). All required information shall be provided in both a bound manual and an electronic file. The Operations and Maintenance Manual (three copies) shall be reviewed and accepted by the City and DEQ prior to initial station startup. The City project number and the name/address of the pump station shall be noted on each manual. Binding shall be by locking three-ring binder or some other binding method to prevent accidental opening. Binding shall be sized to prohibit a "bulged" condition. System operation and equipment literature shall be in separate volumes. Three copies of each volume shall be provided to Oregon City Public Works.

A table of contents shall be included.

The Contractor shall be required by the project specifications to include, but not be limited to, the following information in the operations and maintenance section:

- Sequence of operations including description of the operation and interaction of systems and subsystems during startup, operation in automatic mode, operation in manual mode, and operation with backup power. This includes, but is not limited to, equipment, pumps, piping, valves, HVAC, electrical, controls, and instrumentation;

- Station operation including updated information on the actual pumps installed;

- Utilities;

- A consolidated summary of required routine scheduled maintenance and scheduled preventative and predictive maintenance for all station equipment along with references to the location within the manual where detailed information may be found;

Safety;

- Spare parts kit containing including name, address, and telephone number of supplier, flat valve, belts, gaskets, all o-rings, and seals.

- Emergency plans and procedures.

The Contractor shall be required by the project specifications to include, at a minimum, the following information in the equipment literature section:

- Disassembly and reassembly instructions;
- Parts, lists, by generic title and identification number;
- Name, location, and telephone number of nearest supplier and spare parts warehouse;
- Manufacturer's certifications, including calibration data sheets and specified calibration procedures and/or methods for installed equipment;
- Warranty forms and information for all installed equipment as provided by the contractor.

3.02 WARRANTY PERIOD

All equipment at the station shall include, at a minimum, a one-year full parts and service warranty from the date of acceptance by the City.

The contractor and/or equipment vendor who is fulfilling the manufacturer's warranty shall commence all required warranty repairs within 24 hours or as soon as practicable of notification by the City of the requirements for warranty service.

The manufacturer's warranty documentation shall name both the Contractor and the City as holders of the warranty.

APPENDIX A

State of Oregon

Department of Environmental Quality Guidelines

Guidelines for Making Sewage Pump Station Plan-Review Submittals

1. To help expedite DEQ's OAR 340-52 review, sewage pump station plan/specification submittals should include:

Copy of any predesign report or study that may have been performed. Copy of system sizing and design basis calcs. For example, normally force-main velocity of 4 to 6 ft/sec should be used to assure pickup and scour of keyed grit, with 3.5 ft/sec as a minimum.

Hydraulics/ headloss calcs, pump curve, and system head curve. The curves should reflect both old pipe conditions and new (C-factors of about 100-120 for old pipe, and about 150 for new pipe at start-up). Pump motors need to be sized to preclude overloading in low-head or zero-head start-up situations.

The pump starts-per-hour calculation should be based on an inflow rate of 50% pump design capacity. The result should be used to calculate the minimum operating pool.

Wetwell buoyancy calculations.

For any uncommon equipment design or sizing calculations, provide manufacturer's curves, cut-sheets, or specs where applicable (such as blowers and airflow meters, electronic level controllers, variable-speed drives, dual force mains, chemical feeders, generators, compressors, etc.).

Plan and profile sketch of force main, unless shown in plans. Show profile and connection details at discharge point. Show any air valves and what type (vacuum release, air release, or combination, with sizing, material specs, cutsheet, housings, and any water hammer calcs).

Wetwell and force main detention time calcs, based on initial conditions at station start-up and at buildout.

Engineer's description of sewage overflow point and subsequent drainage when station or power fails. Describe potential for human

or household pet contact, discharge to creek, well contamination, etc.

Describe type of standby power and type of alarm telemetry equipment required or approved by city to assure EPA Reliability Class I with respect to sewage overflows.

If city does not desire to have standby power or telemetry of alarms with 24-hour response at the station, or available on call, then provide copy of city's evaluation and rationale for lesser reliability. Class II station reliability may be justifiable considering available storage and the power utility's maximum outage for the service grid, or considering the absence of adverse health or environmental impacts due to a sewage overflow.

If the city does not desire to have a water service at the station, then provide a copy of letter or memorandum stating city's waiver of the water service requirement along with city's proposed program or method for maintaining wetwells and cleaning contaminated equipment at the station.

2. A schedule of design data needs to be listed in the plans. Tabulation should be similar to "Pump Station Design Data Example" (attached).

3. A schedule of alarm elevations and alarm conditions needs to be listed in the plans. Include dedicated alarm for the sewage overflow elevation. If a dedicated overflow alarm is not desired, provide copy of city's proposal or method for achieving compliance with DEQ's requirements on reporting raw sewage overflows from the station.

4. The plans should also provide a site plan and electrical/control drawings, including a one-line power supply diagram.

5. Provide copy of engineer's evaluation of capacity of downstream sewers to accommodate pumpage without surcharging.

6. Where an existing pump station is being refurbished, expanded, or evaluated, the engineer needs to conduct a corrosion check of the discharge manhole. Often the manhole and nearby concrete sewer are on the verge of collapse by the time a station is upgraded.

A visual check from street level will not be conclusive. A corrosion check will involve kneeling by the open manhole and probing around the inside cone with a knife or screwdriver blade to determine the extent of concrete deterioration inside the roof of the manhole. The transmittal letter should describe the date, type of tool or probe used, and results.

If significant corrosion is found, then further investigations are warranted. For example, measurement of the extent of crown loss will require a manned descent. To determine the extent of corrosion damage downstream may require TV'ing.

Critical repairs should be made immediately. Sulfide controls may also have to be designed into the project. Discharges of H2S into a gravity sewer should not exceed 0.1 mg/l, in accordance with our guideline for H2S field testing (available on request).

7. Engineer's statement regarding project inspection per OAR 340-52-015(1)(e).

8. Engineer's statement regarding O&M manual. The final O&M manual is due by 50% construction, after which it must be reviewed and approved prior to start-up per OAR 340-52-040(4). Cities in Oregon have had several operational problems including failures and constant callouts due to allowing start-up without an approved manual. The design engineer is the logical author of the manual, and plan transmittals should state whether the engineer has been retained to write it.

9. Copy of city's statement regarding approval of plans, signifying the city engineer's review and concurrence on items 1 - 6 above. We do not want to be reviewing plans without knowing whether they meet city requirements.

10. Technical activities fee for station of $500 per OAR 340-45-075(3)(b). Alternatively we can invoice the responsible city or utility through our Business Office. As plans with checks may be diverted to our Business Office, it may often expedite the review process to mail the fee in a separate envelope.

INQUIRIES

Inquiries about these guidelines should be directed to DEQ regional water-quality plan review engineers.

Attachment: Design Data "Example"

SEWAGE PUMP STATION DESIGN DATA EXAMPLE

In plans and reports, print a tabulation of the following items for all sewage pump stations:

PUMP STATION	**Location @ ?**
Type	Duplex self-priming? Submersible?
Pump Type	Constant-speed non-clog? VS?
Capacity	?? gpm @ ?? ft Total Dynamic Head

Pump HP (each)	?? HP
Level Control Type	Bubbler w/ duplex compressors??
Overflow Point	Overflow elevation and location
Overflow Discharge	Trout Creek? Playground? Sinkhole?
Avg. Time to Overflow	?? hours @ zz gpm design avg Q
Auxiliary Power Type	Portable diesel generator?
Location	City Shops? STP?
Output	?? KW?
Fuel Tank Capacity	? hours ?
Transfer Switch	Auto? Manual?
Alarm Telemetry Type	Autodialer ? Radio telemetry?
EPA Reliability Class	I ? or II (if no back-up)?

FORCE MAIN

Length, Type	x00' of ?" PVC?
Profile	Continuously Ascending & z%?
Discharge Manhole	28th and Nobby?
Air Release Valves	None?
Vacuum Release Valves	One at high point, 28th & Annie???
*Average Detention	xy? min @ start-up, yz min @ ult.
Sulfide Control System	Backdrainage? Aeration? None?

AIR INJECTION SULFIDE CONTROL SYSTEM (only if any)

Compressor HP, Type	4.5 HP receiver-mounted reciprocating?

Standard Injection Rate	8 SCFM?
Actual Air Rate	3.2 SCFM @ 50' TDH?
Air Flowmeter Capacity	0.5 - 5 CFM? 30 - 300 CFH?

CHEMICAL FEED SULDFIDE CONTROL SYSTEM SYSTEM (if any)

Type	50% Peroxide? Permanganate?
	12% Hypochlorite?
Pump Type	VS Diaphragm?
Capacity	x gph?
Reaction time	y minutes available
Dose control	meter? stroke counter?

BACKDRAINAGE SULFIDE CONTROL SYSTEM (only if any)

Control Valve Type	Pneumatic Pinch? Knife-gate?
Valve Size	4"?

*If average detention in the main exceeds 25 to 30 minutes between pump cycles at start-up, sulfide controls are probably be needed. (Calculation: detention time, minutes = average gpm daily flow tributary to station / total volume contained in force main, gallons.)

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APPENDIX A CONTINUED

State of Oregon

Department of Environmental Quality Guidelines

Guidelines for Writing Pump Station O&M Manuals

GENERAL

An operations and maintenance manual should aid understanding in situations where time may be critical. For example:

1. To present information in the most accessible manner possible, include less narrative and more drawings, schematics, tables, schedules, and checklists. An operator looking for a specific piece of information should not have to read an essay to find it.

2. Avoid boilerplate language in favor of information that is specific to the pump station. A manual should be complete and thorough, but not too bulky. All of the manufacturers' literature should be bound separately.

FORMAT

Use labelled tabs to separate various sections of the manual, and bind it in a 3-ring binder to accommodate future revisions. Provide a spine label. One copy needs to be slipped into a large plastic envelope or baggie for storage at the pump station.

CONTENTS

1. Table of Contents. This should correspond to the tabs, in case the tabs get torn out, and to save time in reference.

2. Introduction and Use of Manual. Provide a brief narrative on the background and history on the facility. The level of description in DEQ's approval letter for the station is a minimum.

3. General Description. Include plan-view diagrams of the station and force main, indicating locations of the discharge manhole and the wetwell overflow point. Show location of power drop, backflow preventer, and any auxiliary equipment. Include the design data in tabular form.

Design data may normally be copied directly from the schedule of data that was printed in the approved plans. The attached design data "EXAMPLE" generally indicates the level of detail and items to be covered for both plans and manuals. The actual items listed should be tailored to fit the situation.

4. Diagrams. Include a sufficient number of diagrams to illustrate the electrical controls and circuits, and also the mechanical controls. These may include valves, meters, seal water, compressors, and so on. Manufacturer's standard diagrams are seldom sufficient to provide enough pertinent information. The engineer will normally have to develop some customized operational drawings for each station, in addition to the design drawings.

5. Pump Operation and Control. Provide a troubleshooting guide for the electrical and mechanical features of the pump station. Often manufacturers have developed general guides, which can easily be adapted to a particular station. This section should also include the pump curve showing actual impeller trim and motor HP installed.

Either this section or an appendix should also include forms for recording startup conditions. Forms may be developed by the engineer or adapted from the manufacturer's standard forms. The shutoff head, discharge head, and suction head should be measured and recorded to create a basis for maintenance and also to estimate the actual pumping rate. A copy of the engineer's theoretical system-head design curve should be included in this section, with actual measured operating points entered at the time of start-up.

Initial vibration levels should also be measured, diagrammed, and recorded. Power draws for each pump at startup should be measured and recorded, including normal and shutoff, for future reference.

6. Operation and Control of Other Mechanical Systems. Such systems may include alarms, telemetry, emergency power, landscaping irrigation, sulfide controls, HVAC, seal water, level controls, and so on. Provide information on how these systems work, and their operation and maintenance requirements. Supplement with appropriate diagrams as necessary. Any of these may be sufficiently complex to warrant a separate section in the manual.

7. Utilities. Include or reference a plan that shows how the station is served with water, electricity, phone, etc. The map should show the location of isolation valves, access points and other pertinent features.

8. Safety Requirements. The manual should make reference to hazards and safe practices throughout. There should also be a separate section in the manual on safety. As a minimum, the safety section should include information on specific hazards with electrical switchgear and confined spaces at the station, and should refer to the safety training program and standard safety procedures handbook followed by the sewer utility.

9. Emergencies. This is a separate section listing emergency phone numbers, including the DEQ Regional Office to be called to report any sewage overflow.

10. Maintenance of Equipment Provide schedules that list periodic maintenance requirements for the various pieces of equipment. Include record-keeping forms as necessary. The engineer must normally extract these items from the manufacturer's O&M information provided with each item of equipment.

11. Storeroom and Spare Parts Inventory. Include a list of critical replacement parts that may have long delivery times associated with them. Normally the manufacturers of various equipment in the station can make helpful recommendations. Indicate where the spares are to be stored.

12. Manufacturer's O&M Literature. In the manual, only provide a list of manufacturers/suppliers and phone contacts for ordering equipment and spare parts. Provide a pump curve. Other cut-sheets and manufacturer's literature should be contained in a separate binder. Do not send them to DEQ for review.

SUBMITTALS

Submit a complete draft O&M manual to the sewer utility and to DEQ for review well in advance of scheduled start-up (at least 60 days). Sewer utilities are not authorized to accept or use a pump station without an approved manual, per OAR 340-52. Late submittal may delay start-up.

INQUIRIES

Inquiries about these guidelines should be directed to DEQ regional water-quality plan review engineers.

Attachment: Design Data "Example"

SEWAGE PUMP STATION DESIGN DATA EXAMPLE

In plans and reports, print a tabulation of the following items for all sewage pump stations:

PUMP STATION	**Location @ ?**
Type	Duplex self-priming? Submersible?
Pump Type	Constant-speed non-clog? VS?
Capacity	?? gpm @ ?? ft Total Dynamic Head
Pump HP (each)	?? HP
Level Control Type	Bubbler w/ duplex compressors??
Overflow Point	Overflow elevation and location

Overflow Discharge	Trout Creek? Playground? Sinkhole?
Avg. Time to Overflow	?? hours @ zz gpm design avg Q
Auxiliary Power Type	Portable diesel generator?
Location	City Shops? STP?
Output	?? KW?
Fuel Tank Capacity	? hours ?
Transfer Switch	Auto? Manual?
Alarm Telemetry Type	Autodialer ? Radio telemetry?
EPA Reliability Class	I ? or II (if no back-up)?

FORCE MAIN

Length, Type	x00' of ?" PVC?
Profile	Continuously Ascending & z%?
Discharge Manhole	28th and Nobby?
Air Release Valves	None?
Vacuum Release Valves	One at high point, 28th & Annie???
*Average Detention	xy? min @ start-up, yz min @ ult.
Sulfide Control System	Backdrainage? Aeration? None?

AIR INJECTION SULFIDE CONTROL SYSTEM (only if any)

Compressor HP, Type	4.5 HP receiver-mounted reciprocating?
Standard Injection Rate	8 SCFM?
Actual Air Rate	3.2 SCFM @ 50' TDH?

Air Flowmeter Capacity	0.5 - 5 CFM? 30 - 300 CFH?

CHEMICAL FEED SULDFIDE CONTROL SYSTEM SYSTEM (if any)

Type	50% Peroxide? Permanganate?
	12% Hypochlorite?
Pump Type	VS Diaphragm?
Capacity	x gph?
Reaction time	y minutes available
Dose control	meter? stroke counter?

BACKDRAINAGE SULFIDE CONTROL SYSTEM (only if any)

Control Valve Type	Pneumatic Pinch? Knife-gate?
Valve Size	4"?

*If average detention in the main exceeds 25 to 30 minutes between pump cycles at start-up, sulfide controls are probably be needed. (Calculation: detention time, minutes = average gpm daily flow tributary to station / total volume contained in force main, gallons.)

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APPENDIX B

RAW SEWAGE LIFT STATIONS

(1) MINIMUM REQUIREMENTS FOR RAW SEWAGE LIFT STATIONS

(a) Capacity:

Stations shall pass peak hourly flow including domestic, industrial and infiltration/inflow allowance.

(b) Solids Handling:

Pumping equipment shall pass at least 2-1/2 inch spheres. Valves, fittings etc., shall be capable of passing at least 3 inch spheres. Minimum force main size shall be 3 inches.

(c) Reliability:

(A) Mechanical reliability shall be achieved by redundant lift units such that the peak hourly flow can be passed with the largest unit out of service. Redundancy shall include check and gate valves and other 'common mode' failure sensitive items such as vacuum pumps or compressors on control systems.

(B)(i) Power outages shall result in no raw sewage discharges or bypasses to waters of the state based upon a predictable maximum period of power outage which will occur from year-to-year. Where such reliability does not exist, facilities and/or procedures shall be provided to prevent the discharge or bypass.

(C) Failure of prudent Operation and maintenance shall not be considered a valid reason for a station failure and resultant discharge or bypass.

(D)(i)Alarms shall be provided to all stations to announce at least high wet well conditions.

(ii) Telemetering to location with a 24-hour attendant shall be required in sensitive areas.

(d) Operation and Maintenance:

(A) Lift equipment shall be easily removable. Screwed fittings shall not be used for equipment removal. Lifting eyes or hoists shall be provided for equipment removal as appropriate.

(B) (i) A means to wash down wet wells shall be provided for all stations.

(ii) Potable water piped into wells or dry wells shall be equipped with a reduced pressure backflow prevention device.

(C) Wet wells shall have 'hopper bottoms' at a slope of no flatter than one to one (1: 1), and flat bottom area shall be minimized to prevent deposition of solids.

(e) Safety:

(A) Wet and dry wells of all lift stations shall be considered manholes which will be entered by the owner's personnel.

(B) Each dry well shall have permanently installed ladder, lights, and forced fresh (out-side) air supply to the bottom of the well. Air supply shall be activated with light switch and intermittently operated with a timer.

(C) Wet wells including single well lift stations, shall have either installed or portable equipment for access, lighting, ventilation, etc., to be used when entered.

(2) GUIDELINES FOR RAW SEWAGE LIFT STATIONS

(a) Capacity:

Lift stations should be sized for the immediate flow requirement and expandable to the long range (ultimate) requirement. Alternatively interim lift stations may be proposed if the date of expansion is unknowable or beyond the useful life of the lift station.

(b) Solids Handling:

All equipment should be sized to handle at least a 3-inch spheres. Force mains should be at least 4 inches in diameter.

(c) Reliability:

(A) Where no specific records exist, a four (4) hour minimum electrical power outage should be assumed.

(B) Events which should be excluded from design considerations are those which are rare, unusual, and cataclysmic in nature. Means to prevent discharge or by pass include, but are not limited to, the following:

(i) Electric generator:
- Stationary or portable.
- Automatically or manually started.

(ii) Auxiliary fuel fired pump:
- Stationary or portable.

(iii) Storage:
- Sewer lines and manholes.
- Wet well.
- External basin.

(iv) Water supply reduction.

(C) (Future)

(D) (i) Alarms signals should be relayed to the sewer system owner in an effective manner.

(ii) Alarm should be actuated independently of the station control system. Example: Pumps are controlled by pneumatic system and separate float actuated alarm is provided.

(iii) Alarm power should have a battery powered backup electrical source.

(d) Operation and Maintenance:

(A) Flanged or bolted compressions fittings should be used for pump removal.

(B) Frequent wet well washdown should be assumed for all stations. A source of high volume wash water through a nozzle should be provided for this purpose at or on finish grade.

(e) Safety:

(A) No amount of safety equipment should replace basic safety procedures, knowledge, training and precautions.

(B) (i) Designers should follow appropriate safety codes.

(ii) Air supply should be sized for a least 30 air changes per hour where installed.

(C) (i) Frequently entered wet wells should have permanently installed equipment for access, lighting and ventilation, etc.
(ii) Infrequently entered wet wells may be served with portable equipment.

OAR52 (September, 1981)