CITY OF SURREY

Engineering Department

GUIDELINES FOR THE DESIGN & CONSTRUCTION OF PRESSURE REDUCING VALVE STATIONS

January 2009

1.0 General

1.1 Pressure Reducing Valve (PRV) Station Classification

PRV stations are classified into four categories namely: GVWD Supply, Feeder, Distribution, and Circulating PRV stations.

1. GVWD Supply PRVs will be on GVWD supply connections.
2. Feeder PRVs will be on water mains, 350 mm diameter and larger.
3. Distribution PRVs will be on water mains, 300 mm diameter and smaller.
4. Circulating PRVs are intended to release very small quantities of flow, across two different pressure zones, to maintain water quality in the water mains.

1.2 Data from the City

The City shall provide the following data:

- Intended servicing pressure zones.
- PRV station's priority classification (whether Major, Main, or Important)
- Flow details at current, 10 years, and ultimate conditions, or at operation change stages.
- Need for additional installations such as flow measurement, monitoring and control equipment (via Terms of Reference of the project).

2.0 GVWD Supply, Feeder and Distribution PRVs

2.1 Hydraulic Design

Two (2) or more PRVs shall be designed in a station to serve the low flow and high flow conditions. The low flow PRV shall handle the current (existing) minimum instantaneous low flow, while the high flow PRVs shall handle the peak hour demand or maximum day demand plus fire flow whichever is higher, up to the ultimate built-out condition.

The velocity of water through the PRVs shall not exceed 6 m/s or manufacturer's recommendations, whichever is lowest.

Flow requirements for current (existing), in 10 years, and ultimate built-out conditions shall be analyzed to ensure that the multiple PRVs in a station can effectively be utilized in stages, to deliver flows with the intended pressure settings and losses, and without operational issues such as chattering or cavitation.

2.2 Location Selection

The following criteria shall be taken into account in selecting the location and layout of the PRV station:

1. Pressure zone layout.
2. Proposed flows: present, in 10 years, and ultimate.
3. Elevation of the site in relation to:
   a) static head: a minimum of 35 metres static head at the location and elevation of PRV, unless otherwise approved by the City;
   b) pressure zones;
   c) flood proofing and water table;
   d) site accessibility.
4. Proposed external and internal piping and bypass; existing service utilities and appurtenances around the site.
5. Location of the site in relation to:
   a) safety and hazard: whether the location is in boulevard area, or under sidewalk – the location to be outside vehicle traffic traveled area. The City must approve any station location under current or ultimate (future) pavement;
   b) proximity to any available power source, if power is required;
   c) accessibility – convenience and land ownership.
6. Proximity to drainage main or other approved drainage system to provide drainage for the PRV station.

2.3 Design Requirements

The PRV Station design shall incorporate the following;

2.3.1 Civil Works:

2.3.1.1 Structural

1. The PRV chamber shall be thrust resistant to withstand the pressure exerted by the water main. A minimum factor of safety 2.0 is required.
2. The station structure and lids or hatches shall be suitable for the H20 loading condition. For PRV stations in boulevard areas, occasional H20 loading conditions to be met. A minimum factor of safety 1.5 is required.
3. It is required to confirm with the City Transportation Section of the Engineering Department the ultimate road width and widening plans to ensure the station is not placed under direct wheel loads.
4. The depth of the chamber shall be designed either to allow the operator access to all equipment directly under the hatch without going under the roof slab of the chamber – means shallow chamber of depth approximately 1.4 meters, or chamber that would allow the operator to enter in, stay safe under the roof of the slab to work on the equipment – means deep chamber with the height between the roof slab and the floor slab to exceed 2 meters.
5. The pre-design report shall review the feasibility of a shallow chamber, draining by gravity to an adjacent non-surcharging drainage main, before considering a deep chamber.

2.3.1.2 Drainage & Waterproofing

1. The PRV chamber shall be watertight. All construction joints shall be sealed from both inside and outside. The sealing or caulking compound shall be Mastic or approved equal. Damp proof coatings shall be applied to the chamber: External coating shall be black and internal white, ConSeal CS-55 or approved equal.
2. The station shall have a drain sump, and floor of the station shall be sloped towards the sump. The hatch shall have continuous (right-around) drain gutter on the hatch frame, and the gutter shall be connected through a pipe to the station drain sump or preferably drain away from the chamber.
3. The drainage of the PRV station shall be considered in conjunction with location selection, and depth of the water main and chamber.
4. To drain the drain sump of the PRV chamber, the following shall be practiced:
   a) The preferred option: Wherever grade permits to drain via gravity, the drain sump shall be piped to an adjacent non-surcharged drainage main or other approved drainage systems through a check valve. The pre-design report shall show the hydraulic profile of the drainage main and demonstrate the feasibility of this option before other options are considered.
   b) Wherever grade does not permit such a gravity drain, the station needs to be pumped with a sump pump on a periodic or demand basis, by Operations staff, or
   c) A permanent hydropower fed sump pump may be provided for PRV stations of Major priority classification as directed by the City. Refer to the project Terms of Reference or contact the City to determine the PRV station's priority classification.

2.3.1.3 Access & Safety

1. Hatch or other roof openings shall be placed above the valves, and be sufficiently sized to allow removal of the equipment. The size and location of the hatch shall be designed so that PRVs, all other valves, strainers, flow meter if any are directly below the hatch opening. The minimum sizes of the hatch shall be as follows:
   a) For PRV stations on 200 mm diameter mains: 1525 mm (60 inches) wide and 2750 mm (108 inches) long.
   b) For PRV stations on 300 mm diameter mains: 1780 mm (70 inches) wide and 2750 mm (108 inches) long.
   c) Hatch shall be fitted with at least three (3) sets of springs, and necessary lifting, holding and closing arrangements. The hatch shall have integrally recessed (to avoid trip hazard) padlocks with keys
   d) A dimensioned drawing, and not a typical/standard drawing, is required to demonstrate the above requirements.
2. Aluminum hatch lids shall be factory welded or etched with letters "C.O.S." and painted with etching primer, and grey weather resistant paint.

3. WCB approved equipment and access arrangements, such as a ladder with a telescopic safety pole, handrails, etc., shall be provided to assist personnel when entering and exiting the station.
4. The station shall have at least two vent pipes of minimum 100 mm diameter Galvanized Schedule 40 Carbon Steel pipe, telescoping at least 1 m above the ground and above the flood level with either gooseneck or mushroom head top and vermin-resistant mesh welded at the ends. One of the vent pipes shall extend from the top level of the station while the other pipe extends from the bottom elevation of the station.

2.3.1.4 Vehicle Access and Surface Drainage

1. Sufficient area shall be made available around the station for vehicle access, personnel and equipment, and for the occasional service lifting of components from the PRV Station.
2. The area around the station shall be sloped to drain water away from the station.

2.3.2 Mechanical Works:

2.3.2.1 Piping (refer to attached schematic diagram)

1. All piping shall be at least 0.7 metre below the ground elevation but not deeper than 1.2 metres.
2. The water main shall be anchored to the walls of the station at incoming and outgoing locations by means of thrust blocks or other structurally designed means. These anchors shall prevent the movement of piping within the station, especially when the valves and other parts are removed for maintenance or replacement. Also, it shall prevent any outward movements of the pipes. Any concrete thrust block on the outside wall shall be reinforced and anchored to the structural wall of the chamber. Also, the pipe entry points in the chamber shall be sealed watertight. Details of this anchor shall be provided in the design drawings.
3. A typical 0.4m clearance all around the fittings shall be available for wrench space.
4. A minimum of 0.15 m clearance to the roof shall exist when the strainer basket is raised to remove from its casing.
5. The station shall have a by-pass arrangement for isolation of the station. The bypass main shall be, at minimum, the size of the high-flow PRV piping and shall have a (normally closed) valve, sized per City Design Criteria. By-pass piping shall be outside the station.
6. Dresser type couplings shall be installed in the pipe sections for ease of dis-assembly. Also, pipefitting supports shall be placed to facilitate the removal of sections of piping or equipment.
7. Tappings, connections and valves shall be installed for all the flow measurement and monitoring equipment as per manufacturers' standards. All tappings and connections off the water main shall have valves to open and close the tapping, as needed. Tappings that are not in use shall have plugs installed at the open ends.

8. A ¾" water supply point shall be provided from the downstream (low-pressure) side of the station for station cleaning purposes (refer to drawing PRV.1 for location). The details of the water take-off shall be per the drawing PRV.3.

2.3.2.2 Valves & Fittings

1. System shut-off valves shall be installed at supply inlet and outlet sides of the station. In addition, shut-off valves shall be provided on the inlet and outlet of each PRV (refer to schematic diagram).
2. The PRVs that serve the low flow and high flow conditions must be sized to avoid chattering or cavitation. The PRVs shall be direct acting, spring-loaded valves for low flow rates and pilot operated, diaphragm-activated PRVs for high flow rates.
3. Supply line shall have stainless steel basket strainers and be of the same size as the water main. Strainers shall preferably be 'wye' type up to 200 mm diameter and 'tee' type for larger sizes. Any variations require City approval. Also, water quality and suspended particulate issues shall be considered prior to selecting the supply line and pilot line strainers.
4. Pilots shall have dual parallel strainers with required valving to permit cleaning of strainers while the PRVs are in operation.
5. Pressure gauges shall be installed at both high pressure and low-pressure sides of the piping. Gauges shall be installed in 2 o'clock position of the pipe, its face oriented upwards, to facilitate reading from the ground.
6. The releasing end of air valves/combination air valves shall be plumbed through the vent pipes with a 150 psi rated pipe to above ground and to above flood level.
7. All valves shall be epoxy coated.

2.3.2.3 Markings

1. All piping and valves shall be factory painted in blue. All markings on the pipes or valves shall be in red.
2. All components of the station such as the PRVs, pressure regulator control pilots, strainers, gauges, and isolation valves shall be labeled with weather resistant material. All on-off positions of the valve indicators shall be clearly marked.

2.3.3 Electrical / Instrumentation Works:

1. All GVWD Supply PRV stations shall be equipped with a City approved flow meter and Supervisory Control and Data Acquisition (SCADA) System and appurtenances to relay at least inflow pressure, outflow pressure, and flow data to City standardized SCADA system.
2. All GVWD Supply PRV stations shall be installed with permanent power supply for the instrumentation. The power supply shall be installed on the surface in a metal kiosk.
3. Conduits for electrical cables shall be waterproof to protect electrical components and equipment. All conduits from the station shall have negative

grades to avoid draining back into the station, and shall be sealed watertight at the station wall. Being below grade, all electrical cabling must be suitable for potentially wet conditions.

4. Adequate clearances must be available to allow access to wall mounted instrumentation.

2.4 Acceptable Pressure Reducing Valves and Materials

PRVs manufactured by CLA-VAL Automatic Control Valves and Singer Valve Inc. are acceptable.

The PRVs shall have DI Body, fusion baked epoxy internal and external coating, removable stem cover, stainless steel trim, seat, and bolts, Class 150 flanges, and position indicator. GVRD supply PRVs installed at lower elevations may require Class 250 rating, and the designer shall ensure meeting the rating requirements.

The strainers shall be stainless steel and the strainer body and all other parts shall be DI. The screens shall be easily removable for maintenance purposes.

Any steel pipes in the station shall be Schedule 40 or higher class and shall be epoxy coated, internally and externally.

All other materials shall comply with the Accepted Material List in the City of Surrey Supplementary Specifications, latest edition.

3.0 Circulating PRVs

Wherever a normally closed valve exists between two pressure zones, a circulating PRV station must be designed to allow water flow in small quantities in order to minimize stagnant water and thus minimize water quality impacts.

1. Circulating PRV stations shall use a single PRV.
2. PRV used for circulating purposes shall be 19 mm (3/4”) nominal size, rated for upstream and downstream pressures, and shall allow a maximum flow of 0.5 l/s. Suitable valves include Honeywell Braukmann D 05 or approved equal.
3. The PRV shall be installed in a 1.2 m Service Vault (knock-out) from A.E.Concrete or approved equal.
4. A meter shall be installed in series with, and downstream side of, the PRV.
5. The arrangements of the water meter, strainers, and valves shall be as given in the schematic drawing PRV.2
6. A bypass of the same size as the upstream pipe shall be provided.

4.0 Standards & Specifications

The following specifications apply:

- Workers' Compensation Board of British Columbia, and City of Surrey Safety Regulations.
- City of Surrey Supplementary Standards and Supplementary Specifications
  - City Approved Materials List
- City of Surrey Water Meter Installation Standards & Specifications.
- MMCD Standards and Specifications.
- Canadian Standards Association (CSA)
- American Water Works Association (AWWA) standards.
- American National Standards Institute (ANSI)

5.0 Appendices

Reporting and Documentation guidelines are given in Appendix A.

Appendix A

A.0 General

Appendix A deals with the deliverables - report and document requirements associated with the design and construction of PRV stations. The design shall be certified and sealed by a Professional Engineer of good standing.

A.1 Pre-design Report

A pre-design letter report that addresses the requirements as given below shall be submitted to the City for approval, prior to proceeding with the detailed design. The report shall be complete and supported with all critical calculations, providing the following:

- PRV station operation concepts with details of:
  - Service pressure zones
  - Current, in 10 years, and ultimate flows – with flow details at current, 10 years, and ultimate conditions or at operation change stages.
  - Operating concepts of the station between current, 10 years, and ultimate conditions.
  - Tabulation of PRV sizes, pressure, flow and PRV setting details at every operation change stages.
  - Demonstration of the feasibility of shallower chamber and drainage by gravity.
  - Location plan clearly showing the location of the PRV station in relation to existing and future road right-of-way, pavement, and available area for maintenance.
- Schematic drawing for the station with assessment of location, access path or driveway – for service and retrieval equipment vehicles, landscaping requirements, and security against vandalism.
- Schematic drawing to identify and provide space for monitoring and controls instrumentation, if applicable.
- Schematic drawing to identify the power availability - including identification of the nearest available power source, if applicable.
- Schematic drawing for location and distances for the flow meters per standard manufacturers requirements and power source arrangements, if applicable.
- Floor and top elevations.
- Complete details of drainage works.

A.2 Final Design

The following documents shall be submitted under final design submissions:

- Two sets of sealed design drawings for review by the City.
- Prior to construction, two sets of drawings stamped by the Engineer.
- Summary table showing the rated flows and pressure settings for each PRV on design and shop drawings.
- Two sealed copies of design calculations for documentation.
- Completed tender document

A.3 As-builts and O&M Manuals

Before acceptance of the PRV Station, the Designer shall provide three (3) bound copies of an Operation and Maintenance (O & M) Manual to the City.

The O & M Manual shall contain the following:

1.0 Introduction

- Photographs of the PRV station
- Revision diary for update notes
- Station description and location

2.0 Design Criteria Details

- Surveyed elevations
- Design flows (lower and higher ranges) and design pressures as per setting for each PRV at current to ultimate stages.
- Pressure zone serviced (shown in a map of size 8” x 11”), identifying the location of the station, pressure zones and hydraulic details of other PRVs if applicable.
- Descriptions of major mechanical, ventilation, electrical power and monitoring systems including equipment catalog, charts and graphs - like cavitation and pressure loss charts.
- Details of the flow meter, and equipments including catalogs giving details of the intended flow ranges and accuracies.

3.0 Electrical System, if any

- Electrical power distribution single line diagram and service details, if applicable.
- Programmable Logic Controller (PLC) ladder diagram, and logic if applicable.
- Control telemetry (SCADA) details with all Inputs and Outputs identified
- Wiring diagram(s), if applicable.

- Any additional instrumentation including catalogues of installed systems.

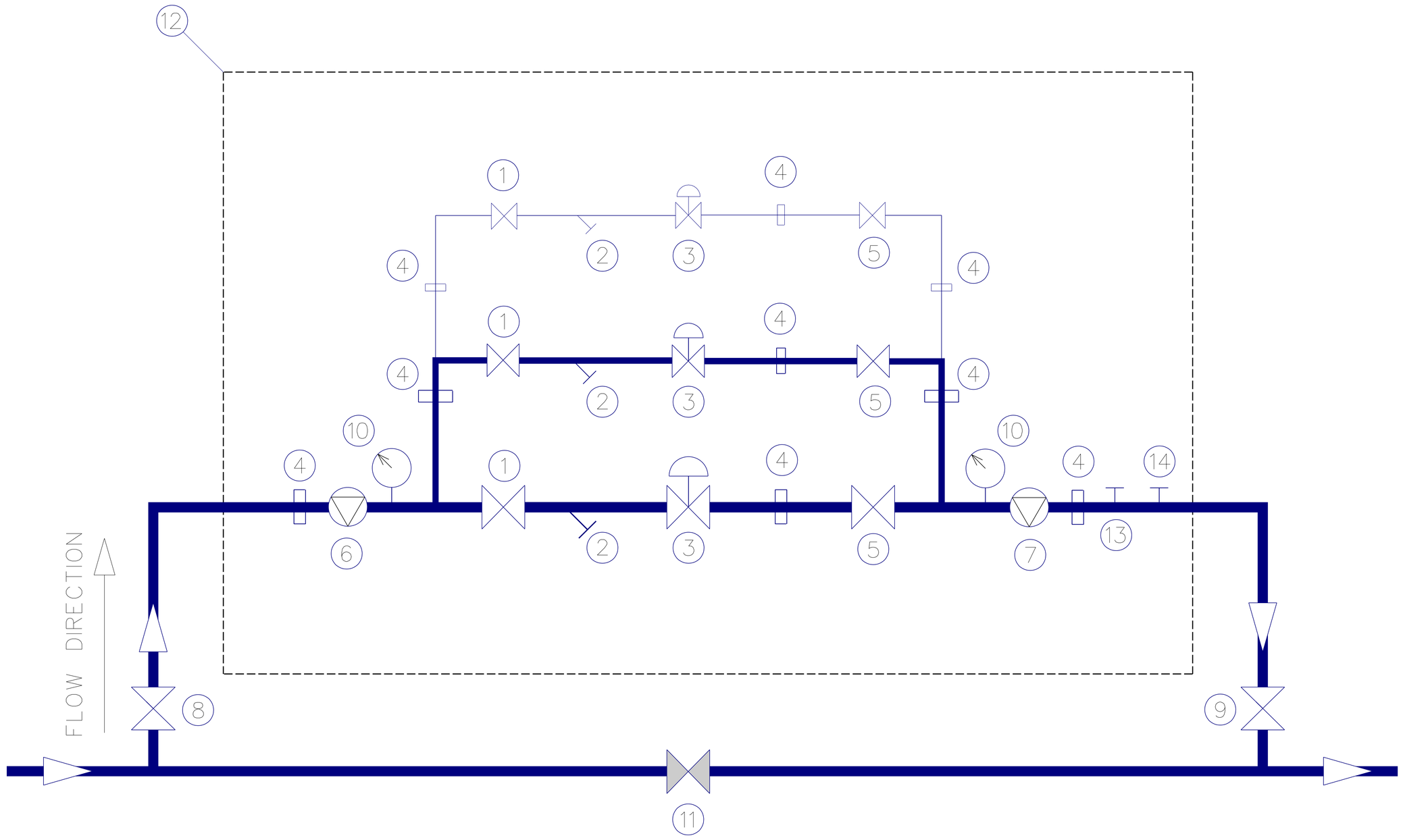
4.0 Suggested Maintenance Program

- List of all major components.
- Routine and preventive maintenance schedule for all systems and equipments.
- Routine and preventive maintenance diary.
- Recommended spare parts, details of suppliers, and order lead times.

5.0 Drawings

- Appendix A - Construction Record Drawings on reduced scale (11" x 17" size format drawings)
- Appendix B - Equipment manufacturers' data and service manuals for major mechanical, electrical, metering, and miscellaneous equipment
- Appendix C - Approved Shop Drawings (Record).
- Appendix D - Laminated wiring diagram(s) and PLC ladder diagrams, if applicable.
- Field pressure test data obtained prior to construction and after commissioning of the PRVs.

The above information shall be provided in suitable sized, Sturdy Three (3)-Ring Binders to ensure that manuals do not become easily damaged during use.



SCHEMATIC OF TYPICAL PIPING WITH 3 PARALLEL PRV'S

LEGEND

1. PRV INLET VALVE
2. STRAINER
3. PRESSURE REDUCING VALVE
4. DRESSER COUPLING
5. PRV OUTLET VALVE
6. AIR VALVE
7. COMBINATION AIR VALVE
8. PRV STATION INLET VALVE
9. PRV STATION OUTLET VALVE
10. PRESSURE GAUGE
11. PRV STATION BY-PASS VALVE (NORMALLY CLOSED)
12. CONCRETE CHAMBER
13. AUTOMATIC SUMP DRAIN EJECTOR
14. POINT FOR FLOW METER INSTALLATION, IF REQUIRED (ADJUST SIZE OF CHAMBER TO ACCOMODATE)

NOTES:

1. THIS SCHEMATIC SHALL BE REFERRED IN CONJUNCTION WITH THE DOCUMENT "GUIDELINES FOR THE DESIGN & CONSTRUCTION OF PRESSURE REDUCING VALVE STATIONS."
2. THIS SCHEMATIC SHALL NOT BE REFERRED FOR CIRCULATION PRV STATIONS.
3. THE SIZE OF THE CHAMBER SHALL BE SELECTED COMPLYING THE REQUIREMENTS OF ANY FLOW MEASUREMENT AND OTHER EQUIPMENT INSTALLED.

3			NOT TO SCALE
2			
1	September 2006	Jude Pillai	Title: SCHEMATIC OF TYPICAL PIPING WITH 3 PARALLEL PRV'S
	Revision Date	Approved	

SURREY CITY OF PARKS

WATER METER INSTALLATION STANDARDS

Approved

Date

Drawn By: Surrey Engineering

DRAWING NUMBER: PRV.1

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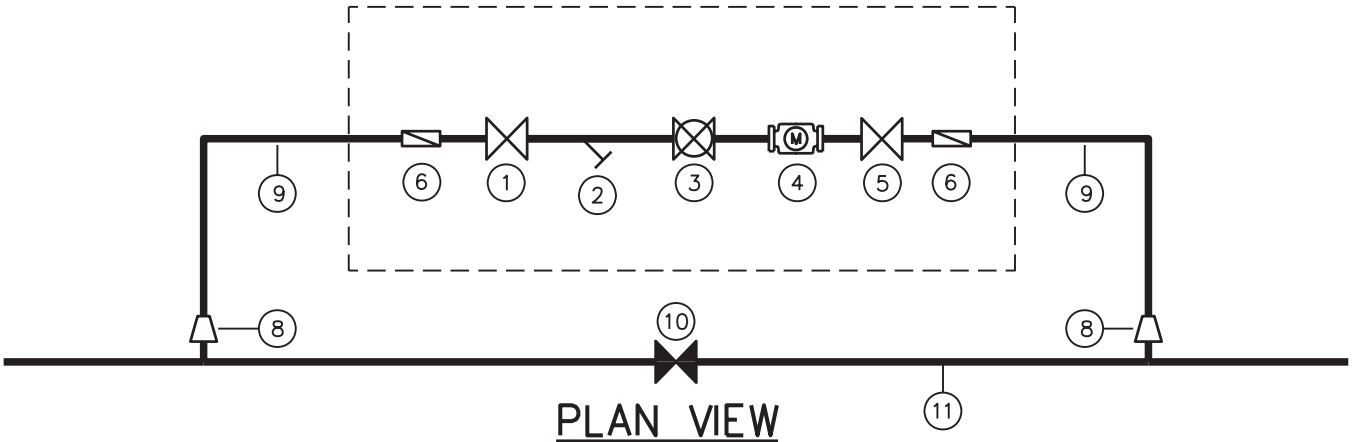
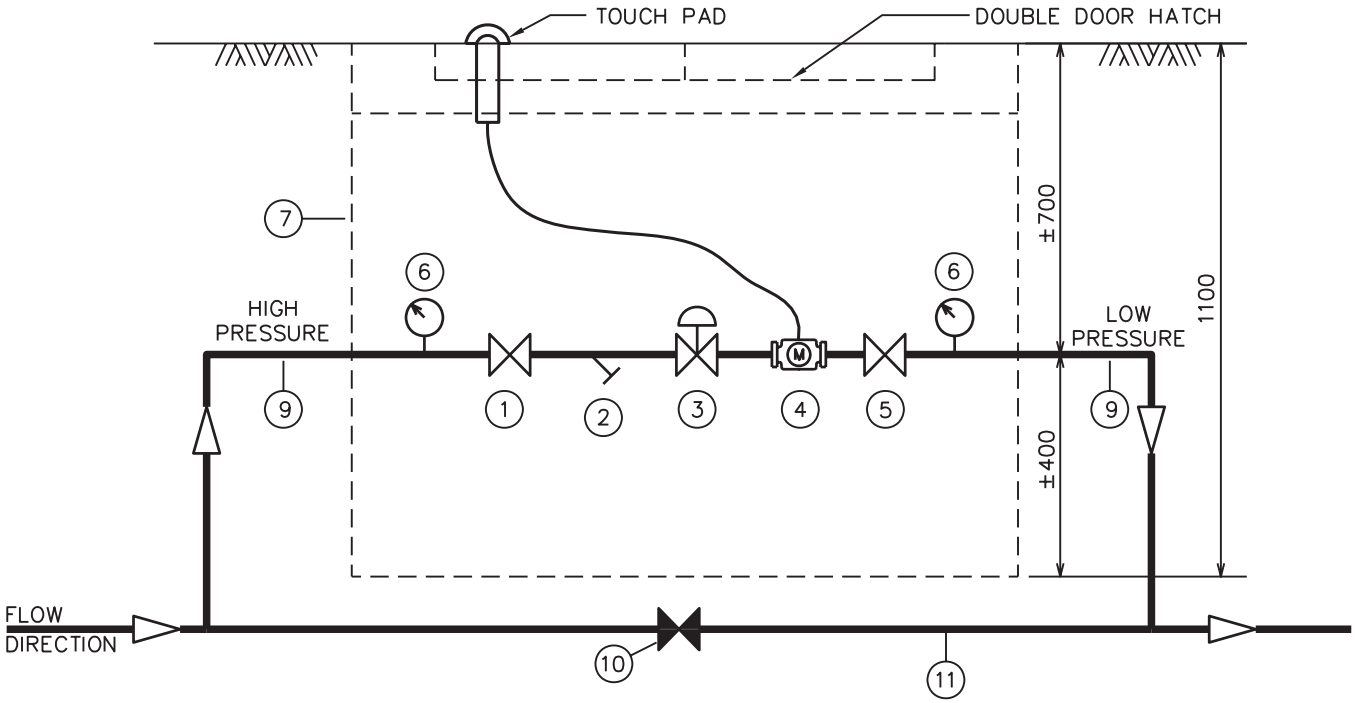


PLAN VIEW



SCHEMATIC OF CIRCULATION PRV

LEGEND:

1. PRV INLET VALVE
2. STRAINER (FOR PRV's WITHOUT A STRAINER BUILT-IN)
3. 19mm (3/4") PRESSURE REDUCING VALVE (HONEYWELL BRAUKMANN D 05 19mm (3/4") OR APPROVED EQUAL)
4. 19mm (3/4") POSITIVE DISPLACEMENT METER
5. PRV OUTLET VALVE
6. PRESSURE GAUGE
7. 1.2m SERVICE VAULT K/O A.E. CONCRETE OR APPROVED EQUAL
8. PIPE REDUCERS
9. 19mm (3/4") PIPE
10. NORMALLY CLOSED VALVE
11. BYPASS PIPE, SAME SIZE AS UPSTREAM PIPE

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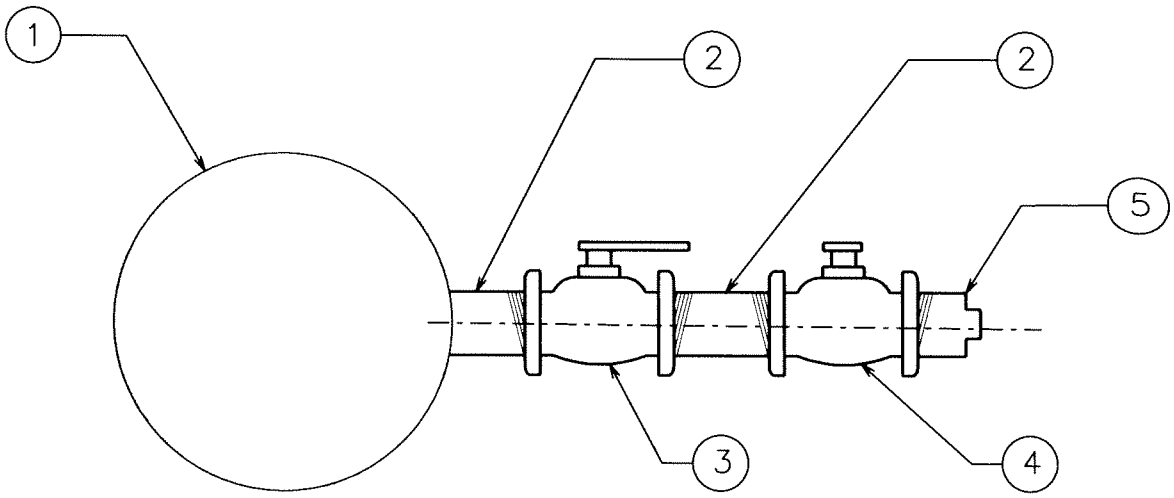
1	NOVEMBER 2008	Jude Pillai	Title: SCHEMATIC OF CIRCULATION PRV
	Revision Date	Approved	

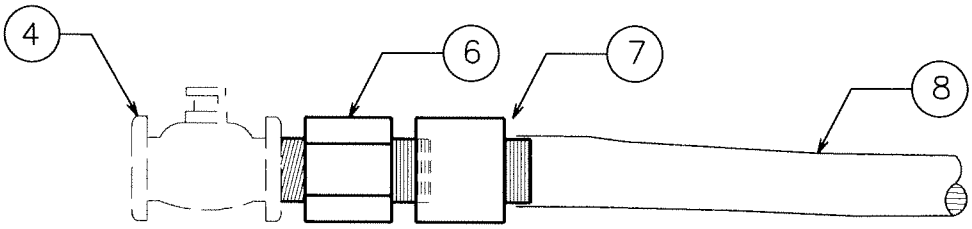
SURREY CITY OF PARKS

WATER METER INSTALLATION STANDARDS

Approved	Jude Pillai	DRAWING NUMBER
Date		PRV.2
Drawn By	Surrey Engineering	



¾" WATER SUPPLY TAKE OFF



¾" HOSE CONNECTION (FOR OPERATIONS)

NOTES:
1. WATER MAIN
2. BRASS NIPPLE
3. BRASS IRON PIPE (THREADED) BALL VALVE - NORMALLY OPEN
4. BRASS IRON PIPE (THREADED) BALL VALVE - OPERATING VALVE
5. BRASS IRON PIPE PLUG
6. BRASS MALE IRON X HOSE BIB CONNECTOR
7. BRASS HOSE CONNECTION VACUUM BREAKER
   (Eg: WATTS Model 8 or 8B ; CONBRACO Model 38-304-cs)
8. HOSE

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1	June 2007	J. Pillai
	Revision Date	Approved

NOT TO SCALE

Title: PRV STATION WATER SUPPY TAKE OFF

SURREY CITY OF PARKS
WATER METER INSTALLATION STANDARDS

Approved
Date
Drawn By: Surrey Engineering

DRAWING NUMBER
PRV.3

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