Regional Municipality of Halton

Water and Wastewater Facilities Design Manual

January 2012
Version 1.0

Table of Contents

List of Tables and Figures

SECTION 1 GENERAL INFORMATION

1.1 Introduction

1.1.1 Halton Region's Water & Wastewater Facilities Design Manual has been developed for use by consulting engineers and Regional staff involved in the implementation of water and wastewater facility capital projects for the Public Works Department. The manual provides design details, technical specifications, process requirements as well as material and equipment standards that are the requirements of the Region of Halton.

1.1.2 Halton Region retains the services of Consultants to provide the required engineering expertise to design facility capital projects including water treatment plants, wastewater treatment plants, wastewater pumping stations, water booster stations, reservoirs, septage unloading and bulk water loading stations.

1.2 Standard of Uniformity

1.2.1 This manual provides details on the design of Regional facilities so that a standard of uniformity will be achieved for water and wastewater facilities throughout Halton Region.

a. Architectural standard
b. Structural standard
c. Electrical standard
d. Mechanical standard
e. Instrumentation and control standard
f. Equipment redundancy
g. Preferred layouts
h. SCADA standard
i. Emergency standby diesel generator standard
j. Equipment and piping colour coding standard
k. Equipment coding system standard
l. Approved equipment
m. Operation manual standard
n. Operation & maintenance Manual standard

1.3 Dispensation

1.3.1 The requirements of this manual must be complied with and may only be changed with the written approval of the Manager of Water Design & Construction or the Manager of Wastewater Design & Construction, or his/her designate. When approved in writing, the Consultant may deviate from the standard and only for the specific project where dispensation has been granted to that project. The proponent must fill in the Design Deviation Memo (Appendix 8 of the Capital Project Procedure Manual for Consultants) and submit to the Regional Project Manager for circulation and approval.

1.4 Other Applicable Acts, Legislations, Design Guidelines etc.

1.4.1 This standard does not supersede, nor replace any legislation governing the design of such facilities. The Consultants must be fully familiar with legislation such as the Ontario Water Resources Act, Safe Water Drinking Act, Environmental Assessment Act, Environmental Protection Act, Ontario Building Codes, Ontarian's with Disabilities Act (ODA), etc, when carrying out the design of Regional facility capital projects.

SECTION 2 DESIGN REFERENCE STANDARD

2.1 General

2.1.1 Halton Region requires and expects that the Consultant will comply with the requirements as specified herein at a minimum standard and shall not relieve the Consultant of the responsibility of ensuring the completeness of their design to Halton's requirements.

2.1.2 It is the Consultant's responsibility to ensure they have fully understood the requirements of the project as detailed in the Request for Proposal, as they will be required to provide their service to fulfill the specified scope of work.

2.2 Acts, Codes Standards and Guidelines

2.2.1 This document, Water & Wastewater Facilities Design Manual, is one within a series of Regional Design Standards and Guidelines. The manual herein is complemented by the following related documents:

a. Consultants Procedure Manual – Facilities
b. Linear Design Criteria, Specifications and Standard Drawings
c. SCADA Standards Manual
d. Uniform Traffic Signal Specifications
e. Construction Services Manual for Pre-Engineering Surveys, Construction Layout and Inspection
f. Standards for the Production of Engineering Contract Drawings
g. Sewer Use By-law
h. Water Works By-law
i. South Halton Water & Wastewater Master Plan Update
j. Halton Aquifer Management Plan
k. Urban Service Guideline

2.2.2 Please refer to the Standard Drawings in Appendix C.

2.3 Specifications

2.3.1 The Sections referring to Specifications provide information on the requirements of Halton Region's General Conditions, Information for Vendors, Form of Tender as well as requirements for each division of the technical specifications 16 Divisions. It also includes the specifications for the Pre-Selection of Equipment.

Abbreviations

AC	Alternating Current
ACI	American Concrete Institute
AFBMA	American Friction Bearing Manufacturers
AGMA	American Gear Manufacturers Association
AISI	American Iron and Steel Institute
AMCA	Air Moving and Control Association
ANSI	American National Standards Institute
ASA	American Standards Association
ASC	Application Specific Controller
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWWA	American Waterworks Association
BOD	Biochemical Oxygen Demand
BUNA-N	Nitrile
C.T.	Current Transformer
CAN/CGA	National Standard of Canada/Canadian Gas Association
CGA	Canadian Gas Association
CGSB	Canadian General Specification Board
CPM	Critical Path Method
CPU	Central Processing Unit
CRI	Colour Pendering Index
CRN	Canadian Registration Number
CSA	Canadian Standards Association
CT	Concentration Time
CVCA	Credit Valley Conservation Authority
DC	Direct Current
DIN	Deutsches Institut für NorMung e.v.
DO	Dissolved Oxygen
DTC	Direct Torque Control
E.T.M.	Elapsed Time Meter
EEMAC	Electrical and Electronics Manufacturers Association of Canada
EEPROM	Electrically Erasable Programmable Read-Only-Memory
EEROM	Electrically Erasable Read-Only-Memory
ESA	Electrical Safety Authority
FRP	Fibreglass Reinforced Plastic
GAC	Granular Activated Carbon
HMI	Human Machine Interface
HVAC	Heating, Ventilation and Cooling
I/O	Input/Output
IEEE	Institute of Electrical and Electronic Engineers
IGBT	Isolated Gate Bipolar Transistor
ISO	International Standard Organization
MCC	Motor Control Centre
MNR	Ministry of Natural Resources
MOE	Ministry of the Environment
MOL	Ministry of Labour
MOV	Metal Oxide Varistor
MTBF	Mean Time Between Failures
MTO	Ontario Ministry of Transportation
N.C.	Normally Closed
N.O.	Normally Open
NPC	Noise Pollution Control
N.P.T.	Nominal Pipe Thread
NEC	Niagara Escarpment Commission
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NSF	National Sanitary Foundation
OHSA	Occupational Health and Safety Act
OPS	Ontario Provincial Standards
PCB	Polychlorinatedbiphenols
PID	Process and Instrumentation Drawing
PLC	Programmable Logic Controller
PTC	Positive Temperature Coefficient
PVC	Polyvinyl chloride
R.R.O.	Revised Regulations of Ontario
RAM	Random Access Memory
RLC	Resistive Capacitance Inductance
RMS	Root Mean Square
RPM	Rotations Per Minute
RPU	Remote Programmable Unit
RTD	Remote Temperature Detectors
SAE	Society of Automotive Engineer
SCADA	Supervisory Control and Data Acquisition
SI	International System of Units (Le Système International d'Unitès)
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
TC/TC	Tungsten Carbide/Tungsten Carbide
THD	Total Harmonic Distortion
TSE	Technical and Scientific Equipment
TSSA	Technical Standards and Safety Authority
TWL	Top Water Level
USD	Ultimate Strength Design
UV	Ultra-Violet
VFD	Variable Frequency Drive
WHMIS	Workplace Hazardous Material Information System
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant
XO	Neutral

SECTION 3 KEY DESIGN CONCEPTS

3.1 General

3.1.1 Consultants are responsible to ensure that the facilities designed by them comply with all applicable Acts, Codes or Design Guidelines including Halton Region's:

a. Sustainability Standards

b. Accessibility Standards

c. Consultants must design facilities and systems to incorporate adequate redundancy and safety features.

3.1.2 Where feasible, equipment should be standardized and common throughout the facility.

3.2 Wastewater Certificate of Approval & Drinking Water License Criteria

3.2.1 To ensure that the plant's treated wastewater effluent and drinking water quality will be in compliance with the Wastewater Certificate of Approval or the Ontario Ministry of the Environment Drinking Water License criteria or objectives at all times, the following minimum level of redundancy for equipment and treatment process shall be provided, thereby ensuring that:

a. the process train is available to meet the wastewater treatment plant's treatment capacity requirements, the minimum availability of unit processes such as aeration tanks, shall be equal to 75% of installed capacity with largest unit processes out of service for maintenance.

b. the water treatment plant's equipment capacity will be available to meet the required hydraulic throughput, equipment such as pumps, shall be sized and installed equal to 100% of plant's hydraulic throughput capacity for each unit process with the largest equipment unit out of service for maintenance or repair.

3.3 Treatment Process Redundancy and Optimization

3.3.1 The provision for process and equipment redundancy depends on the process and/or the functionality of the associated process equipment. In the design of these facilities, Consultants must ensure that the level of redundancy for process and/or equipment at these facilities is provided such that the treated wastewater effluent or quality of the drinking water will be in compliance with the Ontario Ministry of the Environment Certificate of Approval criteria or objectives at all times.

3.3.2 For processes, such as scum removal or flights and chains, that contribute to the optimization of the operation of the facility but can be bypassed when the facility is not operating at rated capacity:

a. Minimum available process units equal 50% of installed capacity with largest process unit out of service for maintenance.

b. Minimum equipment available equal 50% of hydraulic capacity with largest capacity unit out of service for maintenance.

3.4 Standardization of Equipment

3.4.1 Halton Region maintains a list of equipment approved for use in its water and wastewater facilities. Refer to the Approved Equipment List in Appendix A & B. The Consultant is to comply with this requirement, unless market conditions dictate that a review of particular item of equipment is required and with Regional approval.

3.4.2 For each process, the variety of major equipment should be limited to a maximum of three. This reduces:

a. Time to review design information

b. Minimize the inventory of spare parts

c. Time for staff to become fully familiarized with new equipment and facility

3.4.3 In general, consideration shall be given for new equipment to be from the same manufacturer as equipment already installed in the same unit process train. This requirement will be reviewed at the detailed design stage and alternate equipment or technology will be considered at that time.

3.4.4 Approved and alternate equipment shall be specified in the tender document such that Halton Region has the right to accept or reject any equipment that the Contractor proposes to supply under the contract.

3.4.5 Within any pre-packaged equipment, the PLC hardware and software as well as the local OIT hardware and software must be limited to equipment that is in compliance with Halton Region's SCADA Standards

SECTION 4 SITE DESIGN STANDARDS

4.1 General

4.1.1 This section covers the general details regarding the overall facility site.

4.2 Driveways

4.2.1 Halton Region has no unique requirements

4.3 Fencing

4.3.1 Fencing is not required for wastewater pump stations and other remote facilities

4.3.2 Fencing is required for water and wastewater plants.

4.4 Gates

4.4.1 Halton Region has no unique requirements

4.5 Landscaping

4.5.1 Landscapes should adopt innovative sustainable designs with drought tolerant plants that are native to Ontario and reduce or eliminate irrigation requirements in landscaping, minimize maintenance work and meet Municipal Site Plan Approval requirements.

4.5.2 If grass is required for the proper functioning of the plant, hearty drought tolerant types of grass should be used. The use of sod should be minimized.

4.6 Exterior Lighting

4.6.1 Yard lighting must be provided at all facilities

SECTION 5 ARCHITECTURAL STANDARDS

5.1 General

5.1.1 Buildings are to be designed to:

a. Be energy efficient;

b. Have minimal maintenance requirements;

c. Withstand vandalism; and

d. Complement the surrounding areas

5.1.2 Further requirements will be defined by the local municipality, as well as Halton Region during the design process.

5.2 Roofing Design

5.2.1 Roofing systems shall be warranted for a minimum of 25 years, non-prorated for both material and labour.

5.2.2 The installation of the engineered roofing system shall be performed by applicators approved by Halton Region and the Consultant and is to be specified in the tender Specifications.

5.2.3 Flat roofs are to be precluded from designs.

5.3 Windows

5.3.1 Where possible, design facilities with minimal number of windows on the ground floor level unless on a secured site. For pumping station or other such facilities, introduction of natural lighting set a least 3.0 metres above final grade.

5.3.2 Where windows are identified, specify in the contract document that the exterior pane shall be non-breakable.

5.4 Doors

5.4.1 All exterior doors shall be insulated metal doors complete with touch-bar device and concealed vertical rod device.

5.4.2 The minimum width of all doors shall be equal to or greater than 900 mm (36 inches) and shall be provided with a minimum of four hinges.

5.4.3 All exterior doors shall be provided with extra heavy-duty closer mechanism.

5.4.4 All exterior doors shall be keyed to Halton Region's master key lock system.

5.4.5 Where space provides installation of truck access doors shall be included.

5.4.6 All interior doors shall be painted metal.

5.4.7 The door and window hardware are to be reviewed during design.

5.5 Ceiling

5.5.1 Where ceilings are specified, provide drop-in ceiling tiles having high sound-transmission resistance characteristics selected for the use intended.

5.5.2 Ceiling tile shall be washable matte white finish with light reflectance of LR-1 (over 75%).

5.5.3 Install fire resistant suspension system in accordance with Underwriters Laboratories of Canada Ltd.

5.6 Wall Finishes

5.6.1 Interior and exterior walls shall be provided with the following finishes:

a. All exterior exposed concrete walls shall be given a sack rub finish and comply with the required wall finish schedule. Blockwall is to be parged.

b. All interior walls shall be architecturally coordinated to provide a level of finish for the use or service intended. Provide schedule for wall finishes.

c. For bathrooms and washrooms, provide ceramic tile finishes on the wall not exceeding 1,800 mm (six feet) in height. For a washroom located in normally unoccupied facilities, such as pumping stations comply with the required wall finish schedule.

5.7 Floor Finishes

5.7.1 Floor to be finished in accordance with the following usage criteria

a. Office floor finishes shall be finished with ceramic tile.

b. Laboratories, computer control rooms and lunchrooms and other general use shall be provided with ceramic tile floor finishes.

c. Concrete floor that are subjected to continuous flow of dirty water shall be given an epoxy finish with anti-slip additive.

d. Exposed formed concrete walls shall be provided with a Class 3 finish, complying with Clause 24.2 and 24.3 (b) "Sand Floated Finish" of CSA A23.1M.

e. All other formed concrete finish shall be at the discretion of the Consultants.

5.8 Light Fixtures

5.8.1 Mercury vapour light fixtures should not be specified unless the lighting requirement makes it absolutely necessary. In all lighting requirement, high bay metal halide and/ or florescence light fixtures are preferable. Hypress Sodium fixtures are not to be used.

5.8.2 Locate ceiling light fixtures in readily accessible locations. Do not locate fixtures directly over tall equipment such as a chemical tank or in the middle of open tank's ceiling such as a water filtration basin. Location shall be selected to provide (a) the required illumination intensity level in accordance with current legislation and (b) easily accessibility for changing of light bulbs. Fixtures may be located on walls to provide the required illumination intensity level and for maintenance accessibility.

5.8.3 For light fixtures that must be located in very high ceiling, provide access for servicing by crane or other practical alternate means of accessibility.

5.8.4 Observe current legislation/regulations on emergency lighting.

5.9 Energy Management Control System

5.9.1 Provide a centralized energy management control system for manual and automatic control of heating, ventilation and cooling (HVAC) system. The building HVAC shall be designed to provide the heating, ventilation and heating for each zone in the facility. The temperature for any zone may be set by a controller provided for that zone but this can be overridden by the centralized energy management and control system.

5.9.2 The centralized energy management and control system cannot override ventilation system designed to meet process requirement. However, the status of the ventilations system must be monitored by the plant's SCADA system at all times.

5.9.3 All zones lighting fixtures must be capable of being controlled by local switches or by the centralized energy management and control system.

5.9.4 Where room/zone is used on an intermittent basis, provide automatic detection system to turn lights on and off automatically for energy conservation.

5.9.5 Provide an all-electronic centralized energy management and control system. Pneumatic control systems will not be accepted.

5.9.6 The centralized energy management and control system may be required to be integrated to the plant's SCADA system for monitoring or control purposes. This requirement will be determined at the pre-design stage of the project.

5.10 Administration

5.10.1 Sizing of Offices should conform to Halton Region's Corporate Standard and should consider future expansions and the design life of the facility

SECTION 6 STRUCTURAL STANDARDS

6.1 General

6.1.1 For all non-water retaining structures, design structures in accordance with Ultimate Strength Design (USD). For water retaining structures, design structures in accordance with Working Stress Design (WSD).

6.2 Design of Water Retaining Structure

6.2.1 Non-water retaining structure shall be designed in accordance with CSA 23.3, “Design of Concrete Structures”, and using limit state design method. Water retaining structure shall be designed in accordance with CSA A23.3 with consideration for crack control design using ACI-350R-(Latest Edition), “Concrete Sanitary Engineering Structures”.

6.2.2 Design walls as propped cantilevers, permitting any combination of internal and external load (such as reservoir full, without backfill and vice-versa), thus transferring loading to roof slab and reducing wall thickness and the need for internal wall support struts. Design reservoir perimeter wall with reduced water depth.

6.2.3 Design efficient structure to minimize the number of internal columns. For cast in place reservoir’s roof, design capital integral with column. As a rule, the use of cast in place roofing is preferred for reservoirs, the use of a pre-cast roofing structure will only be considered after obtaining approval by the Project Manager. All reservoirs roofs are to have a fully adhered membrane system and a minimum of 50 mm of HL 40 Insulation.

6.2.4 Ground storage reservoirs shall be designed with a minimum of two or more cells. Each cell must be capable of being isolated for inspection and maintenance purposes without affecting the operation of the other cell(s). Entry to reservoir cells shall be through submarine hatches. Each cell shall be provided with a minimum of two entry/exit points.

6.2.5 Calcium chloride as an accelerant will not be permitted.

6.3 Concrete Curing Requirements

6.3.1 Interior surfaces of new reservoirs shall be smooth.

6.3.2 Consultant shall specify wet curing period requirement for a minimum of seven (7) days as opposed to CSA code’s wet cure minimum requirement of three (3) days.

6.3.3 Concrete additives proposed to be used for the construction of reservoir shall comply with ANSI NSF 60 and ANSI NSF 61.

6.3.4 If using an approved curing compound, the required days for the formwork to be in place i.e. before stripping shall be three (3) days.

6.4 Concrete Mix Design

6.4.1 Consultant to provide the concrete mix design to be included in the tender documents specifications for the proposed works. Consultant will also review and provide comment on the mix design submitted by the contractor at the ‘Concrete Pour Site Meeting’.

SECTION 7 MECHANICAL STANDARDS

7.1 General

7.1.1 Mechanical systems shall be designed to provide ease of operation and maintenance. Choice of material and equipment shall be based on Region standard and where such standard has not been provided; it shall be based on the track record of the material or equipment in a similar municipal facility.

7.2 Piping

7.2.1 Selection of piping for potable water shall comply with Halton Region's List of Approved Manufacturers. Also refer to Halton Region's standards for Linear (Water and Wastewater piping) systems.

7.2.2 All piping used for potable water supply system shall be certified to meet National Sanitation Foundation – ANSI NSF 61.

7.2.3 All pipes shall be colour coded in compliance with the latest edition of the MOE Standard for Pipe Identification in Water and Wastewater Treatment Plants in Ontario. Provide arrows indicating the direction of flow.

7.3 Valves

7.3.1 Valves shall comply with AWWA Specifications and Standards. All AWWA valves and actuators shall have at least 5 years of operating service in Ontario, and to be supplied by an Ontario based vendor.

7.3.2 All valves used for potable water supply system shall be certified to meet National Sanitation Foundation – ANSI NSF 60 / 61.

Valve Type	Purpose	Colour Schedule
Manually operated butterfly valves	Cell isolation	light blue CGSB Code: 502-106
Electrically operated butterfly valves	Automatic reservoir level control	light blue CGSB Code: 502-106
Check valves with lockable device	Direction of flow control, lockable device to keep valve open for reverse flow application	light blue CGSB Code: 502-106
Gate valves	Reservoir drainage	light grey CGSB Code: 501-108
Valves	Chemical solution	light grey CGSB Code: 501-108
Valves	Plumbing and drainage system	light grey CGSB Code: 501-108
Altitude valves	Automatic shut off	

7.3.3 Orient valves and valve operators to meet the following requirements:

a. Ease of operation.

b. Limit interference with structures and with any other equipment or piping.

c. Space allowance requirement for maintenance and disassembly.

d. Valves mounted higher than 2 m shall be provided with chain for opening or closing.

7.3.4 Specify valve operators, for both manual and electric valves, with indicator to clearly indicate whether the valve is in the opened, closed or partially opened/closed position. The indicator must be visible from 3 meters away, under normal plant operating conditions.

7.4 Pumps

7.4.1 All equipment and motors shall be supplied with corrosion resistant metal nameplates fitted securely in a location, which can be easily read, complete with stamped inscriptions of the following information where applicable.

a. For electric motors, nameplate marking which meets the requirements of CSA 22.2, Nos. 10, 11, 54, 77.

b. For pumps, fans, valves, valve operators, instruments, etc.:

i) Model Number

ii) Serial Number

iii) Head

iv) Capacity

v) Impeller Diameter

vi) Efficiency

vii) Performance rating

viii) Other information required to uniquely identify the equipment

ix) All data in SI metric units

7.4.2 Bearings requirement:

a. All rotating equipment shall be provided with bearings selected on the basis of a B-10 life expectancy as defined by the Anti-Friction Bearing Manufacturers Association at rated conditions of service of at least 100,000 working hours.

b. Bearings for electric motors shall be constructed so that no oil or grease can escape from them.

c. Alemite-type or button head grease fittings shall be provided for bearing lubrication.

7.4.3 Equipment Operating Characteristics:

a. Mechanical equipment furnished shall operate satisfactorily without excessive wear, excessive lubrication or undue attention required by the operating staff. All rotating parts shall be in true dynamic balance and operate without vibration caused by mechanical defects, faulty design or misalignment of parts. In general, the limit of vibration velocity is 1mm/sec for equipment. A more stringent requirement may be specified in the detailed equipment specifications.

7.4.4 Equipment Guards:

a. To be provided for all couplings, belts, chain drives and extended shafts.

b. It shall be securely mounted, suitably reinforced and neatly formed of at least 12 gauge steel perforated sheet or expanded sheet metal.

c. It shall be hot-dip galvanized after fabrication or fabricated from stainless steel.

d. It shall be painted red in colour

7.4.5 Base Plates:

a. Equipment base plates shall be of heavy cast iron or of welded structural steel with a minimum thickness of 13 mm. For mounting equipment and driver base, the plates shall be at least 20 mm thick. Surfaces for mounting equipment and driver shall be machined to an arithmetical average roughness height of less than 0.03 mm.

b. For equipment where leakage or condensation may occur, provide base plates with a drip lip and drain connections to the exterior of the base. Piping shall be provided from the drain connections to the building drainage system. Bossed connection to drip lips shall be below the gutter invert and shall be at least 25 mm N.P.T.

c. In general, equipment shall be installed directly on machined bases without shims. Where shims are required, provide stainless steel shims under driver mounting feet.

7.5 Equipment Noise Level

7.5.1 Equipment shall be designed for quiet operation with the overall sound pressure level at any equipment not exceeding 85 decibels when measured on the “A” weighting network using survey and field methods conforming to ANSI S1.13 and CSA Z107.2. A more stringent requirement may be specified in the equipment specifications.

7.6 Vacuum Priming Units

7.6.1 All High-Lift and Low-Lift Pumps will require priming equipment. Priming equipment shall consist of “Liquid Ring Vacuum Priming Pump System”. All priming equipment and motors shall be supplied with corrosion resistant metal nameplates fitted securely in a location, which can be easily read, complete with stamped inscriptions of the following information where applicable.

7.6.2 For electric motors, nameplate marking which meets the requirements of CSA 22.2, Nos. 10, 11, 54, 77.

7.6.3 For pumps, fans, valves, valve operators, instruments, etc.:

a. Model Number

b. Serial Number

c. Head

d. Capacity

e. Impeller Diameter

f. Efficiency

g. Performance rating

h. Other information required to uniquely identify the equipment

i. All data in SI metric units

7.7 Equipment Maintenance Requirements

7.7.1 Provide a minimum of one (1) meter of clear, accessible space around all equipment for maintenance work.

7.7.2 For equipment that requires replacement in the future, it shall be provided with electrical and mechanical isolation devices to permit removal without interfering with the operation of the process or facility. Isolation devices shall be as close to the equipment as possible and shall not require the use of a ladder for access. Isolation devices must be visible from the equipment to be removed.

7.7.3 In designing the layout of the equipment, the Consultant shall make provisions for its removal. No equipment shall be designed such that it cannot be removed and if it is to be designed in that manner, the intention must be identified by the Consultant and accepted by Halton Region. In addition, all required lifting devices for removal of equipment must be in place or can be put in place to facilitate its removal. All lifting device shall be engineered for the purpose intended.

SECTION 8 HEATING, VENTILATING & AIR CONDITIONING

8.1 General

8.1.1 Comply with the most current, applicable Acts, Codes or Design Guidelines and also with the following Codes and Standards:

a. The Ontario Building Code-

b. Canadian Standards Association (CSA).

c. Air Moving and Control Association (AMCA).

d. Sheet Metal and Air Conditioning Contractors National Association (SMACNA) – HVAC Metal Duct Construction Standards.

e. National Standard of Canada CAN/CGSB-41.22-93 Fibreglass Reinforced Plastic (FRP) Corrosion-Resistant Equipment.

f. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE) – Systems and Equipment Handbook

8.1.2 Refer to Section 5.9, Energy Management Control system.

8.1.3 Refer to Technical Specifications for other HVAC requirements.

8.2 HVAC System

8.2.1 Controls for the HVAC system shall be digital with individual Application Specific Controllers (ASCs) for each zone. Avoid the use of pneumatic control systems unless absolutely necessary.

8.2.2 The requirements for Application Specific Controllers (ASCs) shall be as follow:

a. Each ASC shall be a microprocessor based multi tasking, real time digital control processor.

b. Each ASC shall operate as a stand-alone controller capable of performing its specified control sequences.

c. ASCs shall support all the necessary point inputs and outputs to perform the specified control sequences in a totally stand alone fashion.

d. Each ASC shall have sufficient memory to support its own operating system and databases, including control processes, energy management applications, operator I/O and local alarm management.

e. Each ASC shall be provided with the following power fail protection:

i) All controller set points, proportional bands, control algorithms, and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate reprogramming the ASC.

ii) All controller memory containing program configuration and control parameters shall be either non-volatile EEPROM/EPROM memory or shall be provided with battery back-up sufficient to sustain the contents of RAM memory for a minimum of one (1) year.

f. Design the system to permit verification of heating and cooling demand of the HVAC system and provide all necessary field instrumentation.

8.3 Verification of HVAC System

8.3.1 On completion of the installation of the HVAC system and submission of the Performance Testing Report to the Contract Administrator, Halton Region after having reviewed the report, may retain the services of an independent HVAC mechanical contractor to confirm the results of the Performance Testing Report. Cost for the services of the independent HVAC mechanical contractor will be borne by Halton Region and the cost of any subsequent verification work shall be borne by the contractor.

8.4 HVAC Master Control

8.4.1 The heating and cooling requirements for each zone shall be achieved by a dedicated control unit linked to the master control system. However, the zone control unit must be capable of being over-ridden manually from the HVAC master control system.

8.4.2 Separate climate and environmental control is particularly required for Control and / or Electrical Rooms.

8.4.3 The HVAC communication must not be put on the plants Ethernet network. The communication of the HVAC must be of a proprietary nature. No standard desktop work station will be permitted as part of the HVAC system.

SECTION 9 ELECTRICAL STANDARDS

9.1 Equipment Identification Nameplates Requirements

9.1.1 Identify electrical equipment with lamacoid nameplates, 3 mm thick plastic engraving sheet, white face, black core, and mechanically attached to the equipment with self-tapping screws. Self-adhesive nameplates are not permitted. Use rivets and/or nut & bolts to fasten nameplates to the equipment where access is not available.

9.1.2 The general requirements and characteristics of nameplates shall be as follow.

9.1.3 Size of nameplate shall be as follow:

Table 9-1 Nameplate Sizes

NAMEPLATE SIZES			
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

9.1.4 In general, the Consultant shall allow for an average of twenty-five (25) letters per nameplate.

9.1.5 Nameplates for terminal cabinets and junction boxes are to indicate system and/or voltage characteristics.

9.1.6 Nameplates for disconnect switches, starters and contactors shall indicate the equipment being controlled and the operating voltage and shall be mounted externally on switch box cover. Typical identification – “Pump No. 1, 575 V, 3 phase”. Plates shall be installed and secured with self-tapping screws except on the inside of panel doors where gluing will be permitted.

9.1.7 Nameplates for terminal cabinets and pull boxes shall indicate system and operating voltage.

9.1.8 Nameplates for transformers shall indicate capacity, primary and secondary voltages.

9.1.9 Nameplates for lighting panels shall be mounted on inside of door, typical identification “Lighting Panel ‘A’ 120/208 V, 1 phase, 3 wire”.

9.1.10 The requirements for mechanical equipment nameplates are specified elsewhere in this manual and shall be compiled with by the Consultant.

9.2 Wiring Identification

9.2.1 Identify all wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring. Maintain phase sequence and colour coding throughout. Comply with CSA C22.1 colour code.

9.2.2 Control wiring to have identical tag at both ends. Tagging must conform to Regional standards. For wire labeling on control loops that terminate inside the PLC control panel, refer to Halton Region's SCADA Standards Manual.

9.3 High Efficiency Electrical Motors

9.3.1 All electric motors greater than 10 HP shall be high efficiency motors. For motors greater than 120HP, the minimum efficiency shall not be less than 94% at the specified operating point. However, the final determination shall be made based on life cycle costing analysis.

9.4 Motor Control Centre

9.4.1 The Motor Control Centres (MCC) and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of NEMA ICS 2-322. All motor control centre cubicles shall be 500 mm (20") deep, 2286 mm high and 500 mm wide except for the control and transformer sections, which shall be 750 mm wide.

9.4.2 The motor control centre shall consist of vertical sections fabricated of gauge steel as required by Halton Region, shaped and reinforced to form a continuous rigid free standing, enclosed, completely dead front EEMAC 1, gasketted panels. The panels shall be Type "B" construction with all units having individual line and control leads brought to terminal boards suitably located in each starter, and wiring shall conform to EEMAC Class II requirements.

9.4.3 The complete panels shall have adequate ventilation to limit the internal temperature rise to 55 degrees C. There shall be a continuous ground bus with accessible external connection for bonding to the station ground.

9.4.4 All necessary control transformers, switches, indicating lights, wiring, fuses, interlocks, terminal boards, etc. shall be provided to suit the power and control requirements.

9.4.5 All indicating light lamps shall be long life LED type.

9.4.6 The MCC shall be complete with a neutral assembly to receive the grounded wye secondary conductor from the transformer.

9.4.7 All compartmentalized vertical sections shall be provided with common power bus bars. Each vertical section of the MCC to be designed to permit readily removal or addition of motor starters and control units as required.

9.4.8 MCC shall be floor mounting, freestanding, dead front, completely enclosed control assembly and accommodating front mounting combination starters and circuit breakers.

9.4.9 Cubicles housing the Service Entrance Main Breaker shall be provided with a full width front door complete with locking handle and shall be compartmentalized as required.

9.5 Variable Frequency Drives

9.5.1 Variable Frequency Drives shall have the following features.

a. Suitably matched with the pump motor

b. EEMAC 1 gasketted and ventilated enclosure designed to prevent EMI emissions, free standing and complete with floor stand.

c. Input voltage: 600 V with 10% voltage variation
d. Input frequency: 60 Hz with 5% frequency variation
e. Thermistor operated relay
f. Enhanced input surge and transient protection
g. Relays and devices to incorporate overprotection device
h. Fast acting input fuses
i. Interlock, with suitable time delay, to stop VFD if grinder is not running
j. Input line reactor
k. Complete motor protection
l. Enhanced door mounted operator display and programming keypad
m. Door mounted Local-Remote selector switch with overlapping contacts and following functions:
    i) Local operation from operator display station
    ii) Remote Stop/Start control from three (3) wire control from PLC
    iii) Remote speed control from 4-20 mA signal from PLC
n. Signals for remote monitoring detailed as follows:
    i) Isolated contact to indicate 'Remote' status
    ii) Isolated contact to indicate 'Running' status
    iii) Isolated contact to indicate 'Failure' alarm
    iv) Isolated contact to start the grinder
    v) Isolated contacts to indicate dry run shutdown
    vi) Isolated contacts to indicate overpressure shutdown

9.6 Co-ordination Studies of Protective Devices Report

9.6.1 The study report shall be presented in tables and on composite charts and shall include but not be limited to the following:

a. Maximum available short circuit current of systems.
b. Maximum available ground fault current of systems.
c. Feeder cables thermal short circuit damage curve.
d. Primary fuse to power the transformer.
e. Power transformer thermal short circuit damage curve, 3 phase, phase to ground.
f. Main 4160 volt system circuit breakers.
g. Main secondary 600 volt system circuit breakers.
h. Largest 600 volt molded case distribution breaker and characteristics.
i. Largest distribution transformer thermal short circuit damage curve.
j. Maximum available fault current, 3 phase and phase to ground for the 600 volt system.
k. Main 120/208 volt breaker and characteristics.

l. Largest 120/208 volt distribution breaker and characteristics.

m. Maximum available fault currents, 3 phase and phase-to-ground for the 120/208 volt system.

n. Maximum available fault current RMS symmetrical at each panel.

o. Establish the required settings for all ground fault relays.

9.7 Short Circuit and Protective Device Evaluation and Co-ordination Study

9.7.1 In the short circuit study, provide:

a. Calculation methods and assumptions, the base per unit quantities selected, one-line diagrams, source impedance data including power company system characteristics, typical calculations, tabulations of calculation quantities and results, conclusions, and recommendations.

b. Calculate short circuit interrupting and momentary (when applicable) duties for an assumed 3-phase bolted fault at each supply switchgear line-up, unit substation primary and secondary terminals, low-voltage switchgear line-up, switchboard, motor control centre, distribution panel board, pertinent branch circuit panel board, and other significant locations throughout the system.

c. Provide a ground fault current study for the same system areas, including the associated zero sequence impedance data. Include in tabulations fault impedance, X to R ratios, asymmetry factors, motor contribution, short circuit kVA, and symmetrical and asymmetrical fault currents.

d. The short circuit study shall be performed with the aid of a digital computer program and shall be in accordance with the latest applicable IEEE and ANSI standards.

9.8 Protective Device Co-ordination Study

9.8.1 In the protective device co-ordination study, provide:

a. Time-current curves graphically indicating the co-ordination proposed for the system, centered on conventional, full-size, log-log forms. Include with each curve sheet a complete title and one-line diagram with legend identifying the specific portion of the system covered by that particular curve sheet.

b. Include a detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics.

c. Tabulate recommended device tap, time dial, pickup, instantaneous, and time delay settings.

d. Include on the curve sheets power company relay and fuse characteristics, system medium voltage equipment relay and fuse characteristics, low voltage equipment circuit breaker trip device characteristics, pertinent transformer characteristics, pertinent motor and generator characteristics, and characteristics of other system load protective devices.

e. Include at least all devices down to largest branch circuit and largest feeder circuit breaker in each motor control centre, and main breaker in branch panel boards.

f. Include all adjustable settings for ground fault protective devices.

g. Include manufacturing tolerance and damage bands in plotted fuse characteristics.

h. Show transformer full load and 150, 400, or 600% currents, transformer magnetizing inrush, ANSI transformer withstand parameters, and significant symmetrical and asymmetrical fault currents.

i. Terminate device characteristic curves at a point reflecting the maximum symmetrical or asymmetrical fault current to which the device is exposed.

j. Select each primary protective device required for a delta-wye connected transformer so that its characteristic or operating band is within the transformer characteristics, including a point equal to 58% of the ANSI withstand point to provide secondary line-to-ground fault protection.

k. Where the primary device characteristic is not within the transformer characteristics, show a transformer damage curve. Separate transformer primary protective device characteristic curves from associated secondary device characteristics by a 16% current margin to provide proper co-ordination and protection in the event of secondary line-to-line faults.

l. Separate medium voltage relay characteristic curves from curves for other devices by a least 0.4 second time margin.

m. Include complete fault calculations for each proposed and ultimate source combination. Note that source combinations may include present and future supply circuits, large motors, or generators as noted on drawing one-lines. Include fault contribution of all motors in the study.

n. When an emergency generator is provided, include phase and ground co-ordination of the generator protective devices. Show the generator decrement curve and damage curve along with the operating characteristic of the protective devices. Obtain the information from the generator manufacturer and include the generator actual impedance value, time constants and current boost data in the study. Do not use typical values for the generator.

o. Evaluate proper operation of the ground relays in 4-wire distributions with more than one (1) main service circuit breaker, or when generators are provided, and discuss the neutral grounds and ground fault current flows during a neutral to ground fault. For motor control circuits, show the MCC full load current plus symmetrical and asymmetrical of the largest motor starting current and time to ensure protective devices will not trip during major or group start operation.

9.9 Power System Study Report

9.9.1 The results of the power system study shall be summarized in a final report and shall include the following sections:

a. Description, purpose, basis and scope of the study.

b. Tabulations of circuit breaker, fuse and other protective devices ratings versus calculated short circuit duties, and commentary, and commentary regarding same.

c. Tabulations of all protection and configuration settings for each microprocessor based protection relays including multifunction protection relays for branch feeders and motor protection relays.

d. Protective device time versus current co-ordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.

e. Fault current calculations including a definition of terms and guide for interpretation of computer printout.

9.10 Insulation Resistance Test

9.10.1 Insulation resistance tests shall be performed for all wiring and equipment installed. Insulation resistance tests shall be performed with a 500V megger instrument for equipment up to 350V and with 1000V megger for 350-600V circuits and recorded in log book for reference. Lighting and power circuit feeders shall be meggered and the insulation resistance between live parts and ground shall not be less than that specified in Table 24 of the Ontario Hydro Electrical Safety Code.

9.11 Standby Power

9.11.1 Whenever feasible, power supply to Region's water and wastewater facilities shall be provided with dual feed from local power supplier grid network from a distinct transfer substation.

9.11.2 Standby power shall be provided for the following plant key process system:

a. Wastewater treatment plant
   i) Raw Sewage Pumping
   ii) SCADA System
   iii) Plant HVAC System
   iv) Plant disinfection system
   v) Inlet gates
   vi) Screens

b. Water Treatment Plant
   i) All equipment that is required to be operational to enable the water treatment plant to meet average day demand is to be provided with standby power or alternate source of power. This also includes the support systems such facility heating (some), SCADA, etc.

c. Water Booster Pumping Station

d. Sewage Pumping Station

9.11.3 Fuel Source- Halton Region will consider Natural Gas and Diesel as fuel sources for the standby power system.

SECTION 10 INSTRUMENTATION & CONTROL

10.1 General

10.1.1 Conform to the design standard as stipulated herein to ensure that the design of all instrumentation and control systems are consistent with Halton's standard, thus allowing for seamless integration to the existing system.

10.1.2 Where applicable, the major components of the instrumentation and control system within a facility shall be interconnected so as to provide a complete functional and automated system. The consultant is to ensure that all process parameters, status indication, and control is available through the effective design of the instrumentation and control system.

10.2 Local Control Switch

10.2.1 Refer to SCADA Standards Manual for an explanation of the SCADA system control hierarchy.

10.2.2 Each piece of equipment shall be provided with a local control switch with LOCAL-REMOTE positions. The LOCAL position overrides all other control modes including PLANT and REGION. When in the LOCAL position, the equipment is activated based on START/STOP pushbuttons. When in the REMOTE position, the equipment is controlled in either PLT-MANUAL or PLT-AUTO mode. The switch is to be a make-before-break type switch, thus allowing for bumpless transfer of control from one mode to another.

10.3 Instrumentation & Control General Information

10.3.1 The main components of the instrumentation and control system are listed below:

a. Local Control Panels (which provide the means of operating and monitoring the equipment in LOCAL mode of control). Local Control Panels (LCPs) will include a LOCAL-REMOTE switch and all associated LOCAL control functions. These switches are generally located at the equipment MCC or on a local control panel located next to the piece of equipment. LCPs may be located in close proximity to the MCC for the respective equipment that the LCP is controlling.

b. Junction boxes and interface cabinets as required to allow for integration of the equipment into the SCADA system, including interconnection to the PLC and all necessary communication cabling.

c. All field instruments, and the installation, testing and commissioning of these instruments.

d. Fire Alarm System.

e. Security System.

f. Connection of common alarms and status signals from HVAC and other process areas to/from the PLC Control Panel for connections into the PLC, and the SCADA system.

10.3.2 A detailed engineering specification for all major components, and all associated instrumentation for each process area shall be included as part of the engineering assignment.

10.3.3 The engineering will include detailed drawings showing connection of the instruments and equipment status signals to/from the Local Control Panels to/from the PLC panel dedicated to the process area. The signals will connect to the SCADA system through the PLC. Every piece of equipment will have it's own electrical schematic. Every input to a LCP or out of a LCP will have it's own loop drawings. Every LCP will have it's own layout drawing and its own electrical schematic. No typical drawings will be allowed. Drawing templates for all of these drawings are included in the SCADA Standards Manual. The level or detail on these drawings is such that the contractor should be able to use them as the template for shop drawing submissions with very little change required. It should be included in the contract specifications that the drawings for the LCP are available to the contractor to use for development of their shop drawings. Halton Region strongly advises that the designer use these template drawings.

10.3.4 Control actions and the philosophy for control of the process will be defined by means of Process & Instrument Diagrams (P&ID's) and initially process narratives which will form the basis for the Control Narratives. Templates of each of these are included in Halton Region's SCADA Standards Manual. These will be reviewed for conformity with the guidelines contained within Halton Region's standards. They will also form an integral part of the documentation package.

10.3.5 A review of the SCADA system will be undertaken to ensure conformance with Halton Region's SCADA standards.

10.4 Design of Instrumentation & Control System

10.4.1 The PLC shall only control equipment associated with the local area of the process, but may provide limited status monitoring of other associated areas. The field controller will provide a means of integrating all field devices, i.e. pumps, valves, flow meters, switches, etc. to the SCADA system. For each project, the consultant will review the necessity for a local operator interface at the PLC with Halton Region. The display may be an HMI workstation or local operator interface, depending on the system architecture design. LOCAL OPERATOR INTEFACES ARE TO BE AVOIDED WHENEVER POSSIBLE.

10.4.2 All automatic control shall be achieved by auto-programs in the PLC. The process control system shall include varying levels of hardwired and software interlocks to ensure safety of the personnel and process equipment. Normal operation shall be in AUTO mode, and the PLC programming will ensure fail-safe conditions result, as defined during the design stage, in the event of equipment or instrumentation failure. In MANUAL modes of control, the same equipment and safety interlocks will still apply (when hardwired), but operator action will be required to initiate equipment control. For programming requirements and standard modules, refer to Halton Region's SCADA Standards Manual.

10.4.3 In some cases, the Contractor may attempt to supply equipment which utilizes small platform PLCs which are not part of the original design documents. Examples of this may be PLC to conrol the reversing feature of a grinder or the local control of a bar screen. These are typically related to the control of major mechanical equipment. In all cases, the PLC hardware and software must be supplied in compliance with Halton Regional standards. When completing shop drawing reviews consultants must be cognisant of the fact that these may be included in the shop drawings and not approve any shop drawings with these type of PLCs in them without consultation with and approval from Halton Region's SCADA group.

10.5 Interlocks

10.5.1 In LOCAL, the PLC software interlocks shall no longer be functional. Any personnel or equipment safety interlocks must be protected by means of hardwired interlocks, which will interrupt operation of the equipment until the condition is reset in the field. The following list of interlocks is intended solely to provide a guideline to consultants in the design and implementation of hardwired protective interlocks. Several of these interlocks are intrinsic to the design of motor control systems and as such each equipment sub-system must be evaluated on an individual basis. In several instances, software interlocks are sufficient to provide adequate protection. All interlocks are to be reviewed with Halton Region.

10.5.2 Hardwired protective interlocks shall be provided in accordance with the following table:

Interlock	Application
Pressure	Protection of piping, valves, pumps from high pressures (pipe blockages, closed valves, etc.); and, Low pressure protection for run out conditions
Temperature	High temperature protection against overheating (motors, pumps, etc.).
Level	Low level cutouts of pumps; and, High level overflow protection (chemical tanks, reservoirs, etc.).
Flow	No flow conditions - running pumps dry.
Vibration/Motion	Damage to motor/pump/piping from excessive vibration.
Torque	Valves - end of travel protection; and, Pump shafts.
Current	Motor over current protection.
Voltage	Motor over/under voltage protection.
Prime/Seal	Pump protection.
Limit	Pump/valve operation in combination (pump discharge valves).
Gas Detection	Personnel protection against hazardous and/or explosive gases and lack of oxygen.

10.6 Field Instrument

10.6.1 Field instruments shall be standardized to a minimal acceptable number of different vendors equipment to minimize the stocking of different spare parts for Halton Region's water and wastewater facilities. During preliminary and detailed design, Halton Region will review the tender documents for the specified instruments and models.

10.6.2 Field instrument enclosures shall be rated in accordance with the area classification. For hazardous areas, limit the number of instruments that are located in these areas when suitable locations are available in non-hazardous locations.

10.6.3 All instruments mounted outdoors shall be in EEMAC 4X enclosures and should be suitable for operating temperatures from -30 to +50 deg. C. Provide heater complete with thermostat where required.

10.6.4 All instruments mounted outdoors shall be provided with hoods formed by three sides and a sloping roof, to provide protection against sun, and ice/snow. Those with viewing dials, or that require access for routine calibration, shall be provided with tip-up type hoods.

10.6.5 All instruments shall be provided with isolation devices.

10.6.6 Valves must be installed on all instrument lines to allow for calibration and removal without disruption to the process. Block and bleed valving configurations should be used where ever possible. Electrical switches must be located near the equipment to allow for isolation while servicing or installing instruments.

10.6.7 Local indicators shall be provided for all transmitters. Where manual operation of valves or other equipment is required, based on a transmitter signal value, the indicator shall be located adjacent to the valve or equipment local control panel.

10.7 Indicators

10.7.1 Local indicators shall read as follows:

a. Temperature- direct reading in ^{o}C
b. Level- 0-100 uniform as % of calibrated range
c. Flow- direct reading in units that are appropriate to provide 2 to 5 whole numbers an a maximum of 2 decimal places.
d. Pressure- direct reading in kPa

10.7.2 Unless specified otherwise, or required due to process conditions, calibrated instrument ranges shall be selected such that the normal operating value will be between 50 and 75 percent of scale, taking into account both minimum and maximum values.

10.7.3 Dedicated or conventional analog panel instruments such as chart recorders or indicators are not required unless specifically stipulated by Halton Region.

10.7.4 Nameplates carrying instrument/equipment number and service shall be provided for all equipment requiring manual operation (located locally at the equipment controls). Field mounted instruments generally require an identification number only.

10.8 Instrument Loops (Analog)

10.8.1 All analog instrumentation loops shall be 4-20 mA current loops (and 2 wire wherever possible). There shall be no dedicated or conventional analog panel instruments such as chart recorders, indicators unless specifically stipulated.

10.8.2 DC power supplies within the PLC Control Panel shall be provided with power to the transmitters via fused terminal blocks or mini-circuit breakers.

10.8.3 The signal cables should be shielded twisted pairs and should run through metal conduit which is not located in close proximity to high voltage power cables. The shields should be terminated and grounded to a dedicated instrument ground bar at the PLC Control Panel end only.

10.8.4 Where field instruments such as analyzers require a 120V AC power supply, this must be run in separate conduit from the signal cables. There should be a switch a the instrument which allows the 120 vac power to the instrument to be shut off. The output of the transmitter should be 4-20 mA, and must be electrically isolated from the power supply.

10.8.5 See the SCADA Standards Manual for sample drawings for instrument loops.

10.9 Control Circuits

10.9.1 Control circuits shall use normally open push-buttons and avoid the use of switches to simplify the interface to the PLC. The PLC will utilize either momentary or maintained contacts for the control of the process equipment, based on the failure scenario defined in the control narrative in the event of a PLC failure. Where equipment is to remain running in the event of a PLC failure, the design is to incorporate momentary start/stop contacts from the PLC. Refer to the control schematic drawings in the SCADA Standards Manual for further details.

10.10 Automation

10.10.1 Automation, when the process is under PLT-AUTO control, refers to the use of events, timing intervals or other trigger actions to affect control output to field devices in response to process changes.

10.10.2 Provide automatic control for equipment that is operated on a frequent basis. (Initial plant start-up, and commissioning modes should be considered here.)

10.10.3 Equipment used infrequently will not be automated but shall be provided with full manual control unless stipulated otherwise.

10.10.4 Where the increased downtime required by a manual changeover is not important, and the level of the manual operation required is not significant, do not implement automation.

10.10.5 For manually operated valves whose position is required to be known by the SCADA system, position indication via limit switches shall be provided.

10.10.6 Where motorized valves are installed, the valve position (limit switches) and its service status (local/remote) are required.

10.10.7 For manually operated valves whose position is required to be known by the SCADA system, position indication via limit switches shall be provided.

10.10.8 Where motorized valves are installed, the valve position (limit switches) and its service status (local/remote) are required.

10.10.9 Typically Halton Region uses a motor protection relay where limiting the number of starts is critical to the protection of the equipment.

10.11 VFD Control

10.11.1 All VFD's shall be provided with a local digital operator control module for control and indication of the following:

a. Start/Stop.
b. LOCAL-REMOTE.
c. Manual speed adjustment.
d. Speed indicator 0-100%.
e. Run indicator.
f. Power-on indicator.

10.11.2 For a VFD/motor control system, in the event of a shutdown of the variable frequency drive due to a fault condition, the drive shall remain shut down until the fault is removed and the drive reset locally at the starter.

10.12 Services

10.12.1 Electrical supplies for the PLC panel shall be provided. A minimum of three 120V AC, 15 A lighting panel supplies, from the same phase, shall be allowed for, and conduit and wiring installed from the panel to the PLC cabinet location.

10.13 Documentation

10.13.1 Documentation and drawings for the instruments are to be included as part of the complete Instrumentation & Control/SCADA package in the O&M Manuals.

10.13.2 Process & Instrument Diagrams (P&ID's) showing tag numbers of all inputs and outputs in compliance with Halton Region's standard tagging/coding system.

10.13.3 Loop drawings for all devices that connect to the PLC showing tag numbers of all inputs and outputs in compliance with Halton Region's standard tagging/coding system, all terminals, wire tags, etc.

10.13.4 Provide control narratives which clearly define the operation and control of the process area using clear and concise English language descriptions.

10.13.5 Interface wiring definition in tabular format, providing the following information with the following headings:

a. Instrument/signal identification number.

b. Process function or service.

c. Instrument range, and engineering units.

d. Calibrated range.

e. Setting. (as required for function - alarm, safety, interlock)

f. Software function required (alarm, monitor, control, interlock).

10.13.6 The tabular format shall be produced in a MS-Excel (latest version in use by Halton Region) file format, for ease of update and for continued development into an as-constructed document. Information shall be provided on CD-ROM .

10.13.7 Local control panel(s) loop drawings, power schematics, showing field and interface terminations and incompliance with the template drawings in Halton Region's SCADA Standards Manual.

10.13.8 Dimension layout drawings of local panel(s) with full legend plate and bill of material information for internal and panel mounted equipment.

10.13.9 Record drawings for all modifications within existing panels or cabinets, showing interface terminations between old and new equipment.

10.13.10 Completed instrument verification record sheets, or field loop calibration sheets with signatures of acceptance.

10.13.11 Appropriate certification approval documents for all equipment for use in hazardous areas.

10.13.12 Calculation record sheets for control valve sizes, relief valve sizes, flow elements (venturi, orifice plate, etc.).

SECTION 11 SCADA STANDARDS

11.1 General

11.1.1 Halton Region has developed a separate manual related to SCADA standards which also applies to all designs, as required.

11.1.2 In general, this document addresses all of the field equipment and wiring, the control panels, PLC hardware and software, PLC programming, HMI programming, networking, and SCADA computers.

SECTION 12 DIESEL GENERATOR STANDARDS

12.1 General

12.1.1 This section covers the requirements for the design and installation of diesel generator and all related ancillary equipment.

12.1.2 Comply with the most current, applicable Acts, Codes or Design Guidelines and also with the following Codes and Standards:

a. Standard Specification for Diesel Engine Generators Set, MOE Spec No. 2
b. CSA B139 Installation Code for Oil Burning Equipment
c. NFPA 37 Stationary Combustion Engines and Gas Turbines
d. NFPA 30 Flammable and Combustible Liquids
e. Ontario Building Code
f. Noise Control Bylaw
g. NPC 205 Sound Level Limits for Stationary Sources in Class 1 and Class 2 Areas Urban
h. NPC 206 Sound Levels Due to Road Traffic
i. NPC 233 Information to be submitted for Approval of Stationary Source
j. MOE Application for Approval Air,
k. EPA Regulation 308/346 Procedure for Preparing an Emission Summary and Dispersive Modeling Report,

12.2 Power Supply

12.2.1 It is Halton Region's preference that all water, wastewater, and waste management facilities shall be provided with two feeds from local power supplier grid network from a distinct transfer substation.

12.2.2 Where required by Halton Region, the Consultant shall specify the required synchronizing equipment to permit the generator to synchronize with local power supplier grid network for peak shaving.

12.3 Approvals

12.3.1 The Consultants are responsible for securing of all required approvals including the Ministry of the Environment and/or any other such regulations or Acts, etc. that are in force at the time of award of the engineering assignment.

12.3.2 Select the output capacity of the generator in accordance with MOE Standard Specification.

12.3.3 Prepare, submit and obtain MOE – Certificate of Approval (Air & Noise) for the proposed emergency diesel generator, which will meet the requirements of the Environmental Protection Act under R.R.O. 1980, Regulation 308 and Noise Attenuation Requirements in accordance with NPC-133, Assessment of Planned Stationary Sources of Sound.

12.3.4 Design and Certificate of Approval application submittal required for parallel switch gear installation for continuous power generation. Details of such requirement will be set out in Request for Proposal.

12.3.5 Prepare Emission Summary and Dispersion Modeling Report, including a plant wide emission inventory, for submission to the MOE for approval.

12.4 Environmental Protection Act

12.4.1 Comply with the requirements of the Act with respect to R.R.O. 1980, s.5, s.6 and s.8.

12.4.2 The concentration of a contaminant at a point of impingement shall be calculated in accordance with Appendix R.R.O. 1980.

12.5 Noise Attenuation

12.5.1 Arrange for a qualified Acoustics Engineer to prepare a noise attenuation report in accordance with MOE requirements.

12.5.2 Determine noise attenuation requirements for implementation in the project in accordance with MOE and NPC-133 for the project.

12.6 Parallel Operation with Local Hydro/Ontario Hydro's Power Supply Network

12.6.1 Where required by Halton Region, the Consultant shall design the diesel generator to operate in parallel and to be synchronized with local power supplier grid network for the supply of power to the facility for peak shaving.

12.6.2 Under peak shaving operation, the diesel generator shall start to begin peak shave operation, from a local manual signal or an automatic signal. The automatic start signal shall be from the PLC or Power Generation Un-interruptible Power Transfer system controls based on the Utility kilowatt load and a preset import level setpoint.

12.6.3 Once the diesel generator receives a peak shave mode start signal, the engine shall immediately start and once the correct voltage and frequency levels have been reached, the diesel generator shall automatically synchronized to the utility supply. When the generator has achieved synchronism, the generator breaker shall automatically close to connect it to the utility supply. At the same time, the Kilowatt and Kilovar load shall be automatically controlled to prevent overloading or reverse power condition.

12.6.4 The control system shall provide automatic frequency and voltage matching synchronizers. The generator power factor shall be set to maintain a 0.9PF loading on the generator to attain maximum power capacity. When the peak shave mode is terminated via local manual command or through the PLC, the generator shall automatically ramp down its Kilowatt load via controlled ramp rate and when a zero power setpoint is reached, the generator breaker shall trip open. The engine shall continue to operate on its cool down mode before stopping.

12.6.5 Where such power generation for peak shaving is required, ensure that this is fully integrated to the SCADA system for monitoring and control operation. The PLC and associated controls must comply with Halton Region's SCADA Standards.

12.7 Diesel Generator Power Requirements

Water Supply System

12.7.1 For potable water supply pumping stations, where the water distribution system floats on a storage reservoir, the diesel generator shall be sized to meet the pump(s) electrical power requirement for the maximum day demand for residential and / or average day demand for ICI.

12.7.2 Ensure that the generator is capable of meeting the inrush power demand under all operating conditions. Specify reduced voltage starting for electric motors. Sequence the pumps to come on-line one at a time when power fails and power supply is from the generator.

12.7.3 In a closed loop system where system storage is not available, the standby power shall be sized to meet the pumping system power requirement for maximum hour plus fire flow demand.

Wastewater Pumping Station

12.7.4 For sewage pumping stations, the standby power generator requirements are identical to the water supply system requirements and it shall be sized to meet the pumping system power demand under peak flow conditions, unless otherwise stated in Request for Proposal.

Ancillary Electrical and Mechanical Equipment

12.7.5 In addition to the above, provide electrical power from the diesel generator to the following during power outages:

a. Heating and ventilation system
b. SCADA system
c. Chemical system (where applicable)

12.8 Diesel Generator System Operation

12.8.1 The diesel generator is required to meet the power demand of the facility in the event of power outages in order to maintain minimum operation services. The equipment that is to be maintained in service by the diesel generator will be reviewed and finalized at the Pre-Design stage.

12.8.2 An automatic transfer switch shall be included as part of the diesel generator power supply system. The automatic transfer switch senses power outage; initiates start-up of the diesel

generator; automatically transfers power supply to the emergency generator; on resumption of normal power supply, transfers load back to hydropower supply; times the engine running without load and allows it to cool down and then shuts it off.

12.8.3 A three-position switch shall be included for “TEST – OFF – AUTO”, where “TEST” will permit the starting of the diesel engine manually with the generator operating with or without load. In the “OFF” position, the engine cannot be started and in the “AUTO” mode, the engine is enabled to start-up on power outage.

12.8.4 For testing purposes the local plant PLC is to be wired directly to the transfer switch voltage-sensing unit so that a signal can be sent by the PLC or from SCADA to simulate Hydropower outage. This will start the diesel engine and the load is transferred to the generator. The load will remain transferred as long as the PLC output remains energized.

12.8.5 The emergency diesel generator control panel shall be provided with a three positions, ‘AUTO – OFF – TEST’, switch, which shall function as follows:

a. In the ‘AUTO’ mode, the diesel engine starts on hydropower outage or when the main power supply switch has been manually turned off. Under this condition, the generator will be running with live connected load. While in this mode, the plant PLC can send a signal to the transfer switch which will simulate a power failure and therefore cause the generator to be running with live connected load.

b. In the ‘OFF’ mode, the diesel engine cannot be started by any means.

c. In the ‘TEST’ mode, the diesel engine can be started at the diesel engine control system panel.

12.8.6 Under normal routine maintenance, with both the generator and the transfer switch in AUTO the sequence of operation shall be as follows:

a. Disconnect incoming hydropower supply.

b. Timer at the engine control panel monitor power outage. At the end of the time setting sequence for power outage, engine starts.

c. Transfer switch automatically transfer power supply from hydropower supply to the emergency generator.

d. On completion of routine maintenance work, re-connect power supply to hydropower.

e. Generator continues to supply power until timer reaches pre-set point.

f. Transfer switch then automatically transfers power supply to incoming hydropower supply.

g. Engine continues to run on cooling mode until timer again reaches pre-set point and turns the engine off.

12.8.7 Under ‘AUTOMATIC’ mode, the two-control mode of operation is as follows:

a. Upon hydropower outage, the sequence of operation will be as noted above except for the manual disconnection and connection of incoming hydropower supply.

b. Starting of engine for routine maintenance work can be initiated from the PLC through the HMI without physically disconnecting the incoming hydropower supply. Similarly, the engine can be turned off at the PLC at the end of the maintenance work.

12.8.8 Under normal mode of operation, the setting of the switch shall be as follows:

a. Switch at the engine control panel shall be in the ‘AUTOMATIC’ mode.

12.9 Diesel Generator and Transfer Switch I/O Requirements

12.9.1 The minimum inputs for the generator to the local plant PLC for alarming and monitoring are as follows;

a. Generator not in Auto
b. Generator Running Status
c. Generator Breaker Closed
d. Generator E-stop Alarm
e. Generator Warning Alarm
f. Generator Fault Alarm

12.9.2 The minimum inputs for the transfer switch to the local plant PLC for alarming and monitoring are as follows;

a. Transfer Switch not in Auto
b. ATS on Normal Power
c. ATS on Generator Power
d. ATS Fault
e. Standby Power Function Test

12.9.3 The minimum inputs for the fuel system to the local plant PLC for alarming and monitoring are as follows;

a. Diesel storage tank level
b. Containment Flood Alarm (where applicable)
c. Storage Tank Vacuum Alarm (where applicable)
d. Fuel Transfer Pump Alarm (where applicable)

12.10 Diesel Engine Requirements

General

12.10.1 The diesel engine net continuous power output at the engine flywheel, including de-rating and deductions, shall be equal to the generator net input power.

12.10.2 Diesel engine operating speed shall not exceed 1800 revolution per minute, unless approved by Halton Region.

12.10.3 Engine shall be naturally aspirated or turbo charged, two or four stroke cycle with pressurized induction having a minimum of four cylinders and removable wet liner. It must be suitable for operation on commercial Grade No.2 diesel fuel oil by direct injection cold starting at an ambient temperature of zero degrees Celsius, without using battery supplied heaters.

Flame Detection System

12.10.4 Dedicated infrared flame detector sensors shall be supplied and installed for each diesel generator and integrated into the fire alarm panel and monitored as individual alarm zones.

12.10.5 Infrared flame detector sensors shall also be monitored by the PLC and an alarm shall be sent to the SCADA.

Fuel System

12.10.6 Fuel system shall include injection equipment including fuel pump(s) and injectors with fuel rack or shutdown solenoid, energized to run (maximum fuel at start) and lift pump with the required minimum suction lift capability with check valves to maintain prime.

12.10.7 It shall be supplied with factory installed primary filter(s) and a secondary fuel filter/water separator. Fuel filter(s) shall be of the replaceable element type.

12.10.8 Fuel line piping shall be fully secured to the engine for the fuel supply, injector and bleed return. Provide flexible connectors, bronze corrugated type for the suction and return lines, located in a horizontal plane and secured at one end to the engine base.

12.10.9 Fuel line shall be provided with automatic shut-off system, which will be energized by signal from the Infrared Flame Detector.

Speed Govenor

12.10.10 Diesel engine speed governor shall be mechanical or hydraulic type and shall be provided with micrometer screw type manual speed adjustment, shutdown lever and over speed stop.

12.10.11 Engine speed shall be maintained at plus or minus two (2) percent regulation, steady state, and at eight (8) percent speed regulation, transient peak no load to full load and full load to no load and at plus or minus one (1) percent stability at any constant load and free from further hunting or oscillation.

12.10.12 The recovery time, from start of load to steady state condition, shall be better than three (3) seconds.

Fuel Tank

12.10.13 All diesel fuel tanks shall be located indoors.

12.10.14 Vent fuel tank to the exterior of the facility as required by TSSA.

12.10.15 The fuel tank shall be sized to provide 48 hours of continuous operation of the emergency standby diesel engine operating under full load.

12.10.16 Fuel tank shall be of the double walled type and shall be floor mounted, with tapped connections for fill, vent, supply, return and drain, UL approved. It shall be provided with a sight-glass for fuel level indication and condensate drain and cock. Spill containment enclosing the fuel tank to be designed as per requirement of TSSA.

12.10.17 Provide fuel level indicator(s) at the loading station.

12.10.18 Fuel level in tank shall be monitored by field instrumentation and connected to the SCADA system to permit monitoring of fuel level from PLANT.

12.10.19 All required fuel line accessories shall be provided including manual shut-off valve and primary fuel filter, all with nipples required for connection.

12.10.20 Where more than one fuel tank is provided, ensure that each tank is vented separately to the exterior. Each tank supply fuel line shall be provided with manual shut-off valve for isolation. Direct cross connection between tanks is not permissible.

12.10.21 Flood alarm field instrumentation detection system within the fuel tank containment area to be provided to detect leakage of fuel from tank. Connect flood alarm instrumentation to SCADA system.

12.10.22 Fuel spill containment volume shall be equal to 100% of the volume of the installed fuel tank(s). Spill containment enclosures are to be tested for water tightness.

Oil Lubricating System

12.10.23 Oil pump shall be engine driven gear type, with strainer and adjustable pressure relief valve, full pressure lubrication system complete with oil filter(s) full flow element type and a sump drainpipe with gate valve and plug to extend 100 mm beyond bedplate.

Intake and Exhaust System

12.10.24 Air intake filter shall be of the dry replaceable element type located close to the inlet manifold.

12.10.25 The exhaust pyrometer dial with rigid stub bulb type shall be located in the common exhaust manifold. Provide two (2) pyrometers for separate manifolds.

12.10.26 For connection from silencer to the exhaust manifold, use flexible connector; bellows type, 600 mm length, and ASA flanges.

12.10.27 Exhaust silencer shall be provided with condensate cock, plug and ASA flanges. Silencer capacity to be sized so that the backpressure at the engine when loaded at 110% capacity shall not exceed the manufacturer's recommendation.

12.10.28 The noise emitted from the exhaust pipe shall not exceed the limits for the stationary engines recommended by the Environmental Protection Act, which requires that the noise at the property line shall not exceed 50 dbA in residential areas. This will dictate the type of silencer that will be required for the diesel engine.

Cooling System

12.10.29 Cooling of diesel engine by municipal water is not permitted under any circumstances and engine shall be cooled by radiator complete with fan, shroud, fan guard and air duct adaptor flange. Interlock damper with the engine starting system to prohibit engine from starting when the damper fails to open.

12.10.30 A 150 mm long sight-glass shall be provided, in a metal housing, for monitoring of the top 150 mm of the coolant level.

Ventilation System

12.10.31 Ventilation system shall be complete with fans; dampers, etc. to meet the required air volume for engine combustion and ventilation requirements.

12.10.32 Design engine ventilation system to operate with and without hydropower and also for testing of the various mode of operating conditions.

12.10.33 Ventilation fans and dampers must be operating before the diesel engine is permitted to start.

Gauges

12.10.34 Gauges shall be circular scale, flush mounted, easily visible from floor level and mounted on a meter panel (except as noted) and shall be readily removable. Gauges shall be identified on scale plate or “lamacoid” nameplate. Meter panel shall be located on engine with vibration isolators.

12.10.35 The following gauges shall be provided as a minimum:

a. Lube oil pressure gauge
b. Lube oil temperature gauge
c. Coolant temperature gauge
d. Electrical tachometer gauge, scaled in rpm to approximately 120 percent of rated speed
e. Exhaust pyrometer(s)

Batteries

12.10.36 Diesel engine shall be started by electrical cranking motor with power provided from storage batteries, which may either be 12 or 24 volts system.

12.10.37 Cranking motor(s) shall be axial type with positive engaging gears and solenoid.

12.10.38 Storage batteries shall be lead acid type, hard rubber cased. The battery capacity shall be sufficient to crank the engine at 10 degrees Celsius for 60 seconds continuously without the voltage dropping below 75 percent of nominal rating during the period of crank. Provide battery rack with support legs, coated with acid resistance paint.

12.10.39 Insulate the positive posts of diesel generator storage batteries regardless of the total number of batteries involved. Insulation shall be rubber case installed on the positive terminals for all the connecting wire lugs joining to the positive terminals.

12.10.40 Provide a hydrometer and wall bracket.

12.10.41 Battery charger to be specified for 120 volts AC input, automatic boost and float rates charging with electronic voltage control and recycle timer, boost and float rates separately adjustable, input and output breakers, manual/automatic switch, current limit protection, 5 percent voltmeter and ammeter. Recharge time for charging a dead battery to full charge shall not exceed 8 hours. Locate charger outside the control panel.

Failure Annunciator

12.10.42 Annunciators shall be individual visual type with long life lamp(s) removable from the panel front complete with manual alarm reset features and clearly labeled.

12.10.43 Battery drain during engine failure shall not exceed 0.3 A.

12.10.44 Relays shall be dry relay contacts with 120 V, 3 A minimum contacts. Relay shall be normally closed and to open under alarm conditions. Provide a common alarm relay for:

a. Over-crank – nominal setting 20 seconds
b. Over-speed – nominal setting 110 percent rated speed
c. Low oil pressure – nominal delay 10 seconds
d. High engine temperature

Engine Control Panel

12.10.45 Engine control equipment requirements:

a. Control switch selector, rotary positive action type with wiping contacts and screw terminals, door mounted with non-removal handle, marked 'TEST-OFF-AUTO'.
b. Cranking control circuit to operate with electronic speed sensitive cutout switch at engine, complete with oil pressure backup sensor but without thermal time delay, electronic over-crank timer adjustable from 3 to 30 seconds minimum single function with lockout on failure to start.
c. Cranking solenoid and fuel rack solenoid control relays to be heavy-duty industrial type, contact rating 30 amperes minimum.
d. Engine shutdown control circuit on engine failures actuated by safety switches.

12.10.46 Provide one service relay for external control and alarms – heavy-duty power type with DC operating coil and 4PDT contacts 120 V, 10 A minimum AC rating with screw terminals and removal relay cover. All contacts shall be wired to a terminal strip for field connections.

12.11 Generator Requirements

General

12.11.1 Generator shall be CSA approved, sized to meet the continuous power loading requirements and to have voltage dip less that 25 percent while starting equipment. Generator output supply shall be 600/347 V, 3 phase 60 Hz, unless specified otherwise. It shall be horizontal synchronous type in protected enclosure with ground lug and readily accessible terminal box.

12.11.2 The generator revolving field shall be of amortisseur winding and have brushless exciter connected directly to the generator shaft, with easily removal bolt-on diodes.

12.11.3 It shall be provided with Class H insulation or better. Temperature raise shall not exceed EEMAC MG1-22.40 for the insulation class used and in the 40 degrees Celsius ambient temperature.

12.11.4 It shall be provided with protective devices to sense generator overload condition and supply output contacts for SCADA and/or generator trip function.

12.11.5 It shall be housed in a drip proof screened enclosure.

12.11.6 Bearings shall be anti-friction type, minimum B-10 rating.

Voltage Regulator

12.11.7 Voltage regulator shall be automatic, static type with 'Fail-safe' features, i.e. no excess voltage if the regulator fails when located on the engine control panel.

12.11.8 Control potentiometers arranged for clockwise rotation to increase the related function. Control rheostat or tapped choke, voltage range shall be plus or minus 5 percent of nominal volts.

12.11.9 Steady state regulation shall be better than plus or minus 1.5 percent at no load to full load between unit and 80 percent power factor lag. The recovery time from load change to steady state regulation shall be better than two (2) seconds.

12.11.10 It shall be capable of generator voltage build-up without batteries and protected against fault during under speed running.

Generator Control Section

12.11.11 Generator control equipment requirements are as follow:

a. Ammeter shall be provided with 5 A coil, scaled 0-200 A, 100 mm square, 240 degrees movement, 1 percent accuracy.

b. Voltmeter shall be provided with 150 V coil, scaled 0-750 V, 100 mm square, 240 degrees movement, 1 percent accuracy.

c. One frequency meter 120 V coil, reed type (5 reed minimum) scaled 58-62 Hz.

d. One hour-meter (E.T.M.) 5 digit, hours and tenths.

e. Two selector switches, for ammeter and voltmeter phase selector, three position and off, rotary action type, wiping contacts and screw terminals.

f. One circuit breaker, 3 pole molded case type, thermal magnetic trips, screw terminal lugs, suitably sized for the generator.

g. Two current transformers, 5 A secondary, 1 percent ratio error class.

h. Two voltage transformers, ratio 600/120 V, 1 percent accuracy class.

i. One power factor meter.

j. Synchronizing meter.

12.12 Generator and Engine Control Panel

12.12.1 The generator and engine control panel shall be constructed with a single front door, continuous hinge type to open over 120 degrees for full inside access.

12.12.2 Provide mounted sub-bracket for generator circuit breaker, arranged to permit the handle to project through a slot in the door (but not located on the door).

12.12.3 The assemblies shall be arranged as follows:

a. Engine controls and alarm annunciators in the upper portion.

b. Generator controls in the middle portion.

c. Accessories on the panel to include:

d. Terminal blocks, tubular screw type with barriers and labels.

e. Control fuses in barrier type mounts. Ground connection lug.

f. Schematic wiring diagram, and located in the drawing pocket inside the door.

g. Labels for components on and inside the panel to identify or indicate the operating routine shall be lamacoid, with 6 mm minimum letters.

h. Safety and warning label(s) on panel door, red labels with 15 mm approximately, white letters, e.g. 'DANGER EQUIPMENT CAN START AUTOMATICALLY AT ANY TIME'.

12.13 Safety Switches

12.13.1 Safety switches shall be adjustable snap action type (except as noted) with settings sealed by locknuts or "sealtite" and it shall be directly accessible for easy servicing or removal.

12.13.2 Centrifugal speed switch, when supplied, shall be of the two-element unit with independently adjustable sets of contacts for the cranking cut-out (normally closed) and over speed cut-out (normally open) functions.

12.13.3 Solid-state speed control switch shall direct the mechanical drive of generator. Solid-state speed sensors and relays in control panel for cranking cut-out and over speed protection. Cranking cut-out to have oil pressure sensor back-up protection.

12.13.4 Wire for connection between safety switches and control devices shall be oil and heat resistance type. Run the wire neatly in a harness, secured to the engine and terminate at the engine terminal box.

12.13.5 Provide the following switches:

a. Lube oil low pressure safety switch

b. Over speed safety switch

c. Cranking cut-out switch

12.14 Transfer Switch Assembly

12.14.1 Transfer switch requirements:

a. The transfer switch shall be housed in a separate cabinet and shall be mounted on the cabinet door; fully visible in the closed position.

b. Transfer switch shall be suitable for 4160 V or 600 V (as applicable), 3 phase, 60 Hz and sized for generator full output, fully automatic in action. Main switches shall be permanently held (latch type) without automatic trips, single electric operator, energized only during the transfer operation (in both direction) and capable of manual transfer facility for maintenance tests and shall have one set of contacts, for external connection, to close after the failure of the Hydro supply to initiate the engine start sequence.

c. The transfer switch shall have voltage sensing and time delay relays.

d. Inherent time delay during transfer sufficient to cause dropout of motor starter, i.e. load bus disconnect for a minimum of 12 cycles.

e. Sensing relay(s) shall be arranged to prevent transfer from normal to emergency until the generator voltage and frequency have reached at least 90 percent of rated capacity. Monitor all three phases. Drop out at 70 percent of nominal voltage (or 78 percent of pick-up voltage). Sensing relay(s) shall be accurate within plus or minus 2 percent of nominal voltage.

f. The time delay relays for the operation sequence with the following minimum ranges:

i) On failure of hydropower. Starting of diesel engine. Adjustable, minimum range 1-5 minutes. Set at 2 minutes.

ii) From normal to emergency power. Adjustable, minimum range 5-50 seconds. Set at 15 seconds.

iii) On restoration of hydropower, from emergency back to normal. Adjustable, minimum range 0.5-3 minutes. Set at 1.5 minute.

iv) Engine cool off. Adjustable, minimum range 0.5-5 minutes. Set at 2.5 minutes interval.

12.15 Diesel Engine and Generator Construction Requirements

12.15.1 Construction of the diesel engine and generator shall comply with the following requirements:

a. The engine and generator shall be directly connected through a flexible coupling, mounted on a common base and supported by vibration isolators.

b. The engine and generator to be horizontally and vertically aligned to within plus or minus 0.05 mm, using steel shims where required. Provide machine bolts to secure the units to the base. Dowel the feet of both units on two bearing generator assemblies.

c. Drive coupling, torsionally rigid flexible steel disc type, for connecting a single bearing generator to an engine via an S.A.E. housing. For two bearing generator, use flexible grid spring type.

d. The base shall be rigid heavy-duty fabricated steel type with machined pads and capable of maintaining alignment during shipping and operational service. Provide crankcase oil drainpipe.

e. Base shall be mounted on vibration isolators complete with sound dampening pads, visible steel spring type with leveling bolts and externally adjustable mechanical side snubbers. Vibration transmission to be limited to three (3) percent or better.

f. Provide safety guards around rotating equipment for personnel protection.

12.16 Accessories, Special Tools and Spare Parts

12.16.1 The following accessories, special tools and spare parts are to be supplied as part of the diesel generator:

a. Provide engine oil drip tray, 1.5 mm minimum, galvanized steel with 50 mm lip suitable for location on the concrete pad. The tray shall extend completely under the generator

set, between the vibration isolators and easily removable without disturbing any components.

b. Maintenance and operation instruction sheets, mounted on steel back plates with glass front or clear varnish protection, suitable for mounting on the wall.

c. Provide one wall mounted steel cabinet. Cabinet shall be provided with front hinged door(s), padlock and hasp. Cabinet to accommodate tools, spares and one set of manuals.

d. All special tools and spare parts, where called for in the technical specifications, required for the operation and maintenance of the diesel generator, must be specified and standard clauses will not be permitted.

12.17 Field Inspection Reports and Acceptance of Equipment

12.17.1 Field inspection reports, demonstration of the operation and maintenance of the equipment, acceptance reports, etc. shall comply with Project Implementation Procedures Manual, latest version.

SECTION 13 WATER TREATMENT FACILITIES

13.1 General

13.1.1 In the absence of MOE standards for alternative technologies and the specified requirements of the Safe Drinking Water Act, Ontario Regulation 170, the Consultant must abide by the 10 States Standards and any associated Environmental Protection Agency design guidelines.

13.2 Facility Security (Applicable to all facilities)

13.2.1 The security system should be designed to incorporate an integrated networked Access Control and Video Assessment System (ACAVAS) that will control personnel access, provide real time intrusion detection alarm monitoring and provide alarm driven CCTV assessment for the designated buildings and operations. The security system includes, but is not limited to, the following:

a. A PC based, modular, integrated management system that will allow system operators to control and maintain the security of the facilities from multiple designated workstations.

b. Doors and locking hardware to enable proximity card reader access at designated doors. The doors designated with proximity card reader access shall also allow manual unlocking using the master key system identified within these specifications.

c. Intrusion detection alarms at designated facilities.

d. Interior and exterior motion detection devices to provide alarm coverage at designated facilities.

e. CCTV systems that provide alarm driven assessment for the intrusion detection equipment at designated facilities.

f. Exterior lighting to provide adequate illumination for the CCTV systems.

g. Motorized gates at designated facilities.

h. Control, signal, lighting and power distribution cabling as required for the security equipment including any trenching work required for the completion of the project.

13.2.2 All of the existing Water Facilities have an existing system as described above. Any new facilities security system must integrate into the existing system rather than be a separate stand alone system. The contractor is to be responsible for the supply and installation of the entire system as well as the software programming required to add the new facility to the existing system configuration. Halton Region has sample specifications that can be supplied by the project manager upon request to used as template for preparing the contract specifications.

13.3 Low Lift Pumping

Table 13-1 Low Lift Pumping Station Design Guidelines

	EQUIPMENT	COMMENT
1	Design Standard	Hydraulic Institute Standards
2	Number of Pumps	Minimum - 2
3	Capacity of Pumps	Maximum Day Demand
4	Preferred Type	Vertical Turbine Pump
5	Pump's Standard	American Standards for Vertical Turbine Pumps
6	Drive Unit Special Characteristics	Motor rating to ensure less than full load at any point on the pump curve up to the run out condition
7	Drive Unit Starter	Reduced Voltage Starter
8	Variable Frequency Drive	To be provided, except for Standby Pump
9	Number of Standby Pump	Minimum - 1
	EQUIPMENT	COMMENT
10	Capacity of Standby Pump	Equal to capacity of largest pump
11	Drive Unit Starter	Solid State Reduced Voltage Starter
12	Equipment Monitoring Requirement	1. RTD connections for windings, minimum one per phase 2. RTD for motor inboard and outboard bearings 3. RTD connections for pump inboard and outboard bearings.
13	Instrumentation & Control	Programmable Logic Controller c/w all required field instrumentation hardware.
14	Emergency Standby Power	Provide power to meet average day demand to meet pumps' motor inrush current requirements plus station power demand.

13.4 Sedimentation Tanks

13.4.1 Provide two trains of sedimentation tanks, each shall be sized on the basis of average day demand.

13.4.2 Each train of the sedimentation tank shall be fully capable of operating independently of each other.

13.4.3 Mechanical cleaning device for removal of sediments is not required.

13.4.4 Ensure that provision are made for the installation of laminar plates.

13.4.5 Provide complete by-passing of the sedimentation tank

13.4.6 Provide adequate flushing water for cleaning of sedimentation tank

13.5 Flocculation Tanks

13.5.1 Provide two trains of flocculation tanks, each train to meet average day demand.

13.5.2 Design flocculation tank to provide the required G^{-1} without electrically driven mechanical devices.

13.6 Filters

13.6.1 Filter shall be designed in accordance with the latest standard for direct filtration and shall in no case have a throughput greater than the nominal capacity of 8.95 m/h ($m^3/m^2.h$) and a maximum capacity of 12 m/h ($m^3/m^2.h$) for pre-treated water.

13.6.2 Filter underdrain system shall be Lepold Underdrain system or approved equivalent.

13.6.3 For each filter, provide indication of the filtration rate. In PLT-Manual mode provide the capability on the respective filter menu such that a filtration rate setpoint can be entered (0 - 100%)

13.6.4 The filtration rate for all filters shall be maintained at all times until the clearwell level (or other restricting condition) reaches 90% full. At that point, the Low Lift VFD pump(s) shall reduce its pumpage rate to match the clear well level such that when the water level is near the top water level, the VFD pump will be at its lowest operating speed.

13.7 Filter Backwash System

13.7.1 Filter shall be provided with air scour and backwash water system.

13.7.2 Do not use surface sweep cleaning system.

13.7.3 The volume of water required to wash a filter shall be determined on the basis of the turbidity of the wastewater generate during the backwash cycle. Backwash shall be terminated when the wastewater turbidity is equal or less than 10 NTU or as specified by Halton Region.

13.7.4 Turbidity of wastewater shall be monitored by a turbidity meter.

13.7.5 Backwash system shall be controlled by PLC and fully automated.

13.8 Membranes

13.8.1 To be added in the future

13.9 High Lift Pumping

13.9.1 Design high lift pumping station in accordance with the following guidelines. Where there are more stringent design standards, comply with the higher standard.

Table 13-2 High Lift Pumping Station Design Guidelines

	EQUIPMENT	COMMENT
1	Design Standard	Hydraulic Institute Standards
2	Number of Pumps	Minimum - 2
3	Capacity of Pumps	Maximum Day Demand
4	Preferred Type	Centrifugal Pump
5	Pump's Standard	
6	Drive Unit Special Characteristics	Motor rating to ensure less than full load at any point in the pump curve up to the run out condition
7	Drive Unit Starter	Reduced Voltage Starter
8	Variable Frequency Drive	To be provided, except for Standby Pump
9	Number of Standby Pump	Minimum - 1
10	Capacity of Standby Pump	Equal to capacity of largest pump.
11	Drive Unit Starter	Solid State Reduced Voltage Starter
12	Equipment Monitoring Requirement	1. RTD connections for windings, minimum one per phase 2 RTD for motor inboard and outboard bearings 3. RTD connections for pump inboard and outboard bearings.
13	Instrumentation & Control	Programmable Logic Controller c/w all required field instrumentation hardware.
14	Emergency Standby Power	Provide power to meet average day demand to meet pumps' motor inrush current requirements plus station power demand.

13.10 Zebra Mussel Control

13.10.1 To be added in the future

13.11 Chlorination, Ammoniation, and Sulphur Dioxide Systems

13.11.1 Chlorinator shall be sized for maximum day demand and a minimum of two (2) chlorinators shall be provided for Pre-Chlorination and Post chlorination.

13.11.2 One Standby Chlorinator sized for maximum day demand shall be provided for Post Chlorination.

13.11.3 All chlorinators shall have the capability of being controlled:

a. Locally at the equipment

b. Remotely through the SCADA system PLT-MAN mode through the entry of setpoints at the HMI, or in PLT-AUTO mode based upon the automatic program within the PLC.

c. Provide required switches at equipment to carry out this function.

13.12 Coagulant Systems

13.12.1 Metering pump shall be sized for maximum day demand and a minimum of two (2) shall be provided.

13.12.2 One standby metering pump sized for maximum day demand shall be provided.

13.12.3 All equipment shall have the capability of being controlled:

a. Locally at the equipment
b. Remotely through the SCADA system PLT-MAN mode through the entry of setpoints at the HMI, or in PLT-AUTO mode based upon the automatic program within the PLC.
c. Provide required switches at equipment to carry out this function.
d. With stroke control as well as speed control and the equipment should therefore have the required switches installed to be capable of performing this function.

13.13 Fluoride System

13.13.1 Metering pump shall be sized for maximum day demand and a minimum of two (2) shall be provided.

13.13.2 One standby metering pump sized for maximum day demand shall be provided.

13.13.3 All equipment shall have the capability of being controlled:

a. Locally at the equipment
b. Remotely through the SCADA system PLT-MAN mode through the entry of setpoints at the HMI, or in PLT-AUTO mode based upon the automatic program within the PLC.
c. Provide required switches at equipment to carry out this function.
d. With stroke control as well as speed control and the equipment should therefore have the required switches installed to be capable of performing this function.

13.14 Powder Activated Carbon System

13.14.1 Required only if raw water has high odour and taste problem.

13.14.2 Where provided, use bulk delivery of PAC to eliminate the involvement of Operator for the mixing, cleaning etc of the PAC. The PAC system must be sealed off in a separate room with an appropriate separate ventilation system for the containment of PAC dust.

13.14.3 Loading of PAC into the mixing chamber shall be fully automated

13.14.4 Metering pump shall be sized for maximum day demand and a minimum of two (2) shall be provided.

13.14.5 One standby metering pump sized for maximum day demand shall be provided.

13.14.6 All equipment shall have the capability of being controlled*:*

a. Locally at the equipment
b. Remotely through the SCADA system PLT-MAN mode through the entry of setpoints at the HMI, or in PLT-AUTO mode based upon the automatic program within the PLC.
c. Provide required switches at equipment to carry out this function.
d. With stroke control as well as speed control and the equipment should therefore have the required switches installed to be capable of performing this

13.15 pH Adjustment

13.15.1 To be added in the future

13.16 UV System

13.16.1 To be added in the future

13.17 Ozonation System

13.17.1 To be added

13.18 Actiflow

13.18.1 To be added

13.19 Wastewater Handling System (Residue Management)

13.19.1 To be added

SECTION 14 GROUNDWATER PUMPING STATIONS

14.1 General

14.1.1 Design well pumping station in accordance with Potable Water Pumping Stations.

14.1.2 Well shall be designed and constructed in accordance with AWWA Standards and 10 States Standards and with Section 3 of this manual.

Water Supply

14.1.3 A well evaluation report prepared by a Qualified Professional (either Engineer or Geoscientist) must be submitted for all wells which will become part of the municipal system.

14.2 Well Construction

14.2.1 Well shall be designed, constructed and tested in accordance with AWWA Standards and 10 States Standards and with Section 3 of this manual unless otherwise approved by Halton Region or specified in the following.

Pilot hole

14.2.2 A pilot hole is to be drilled at the site of a proposed municipal well.

14.2.3 If the overburden is the target aquifer, samples will be collected from the proposed screened interval throughout the formation to enable design of the well screen length and slot opening. Upon completion of the drilling the hole is to be geophysically logged (hole caliper, resistivity and natural gamma). Grain size analysis of formation samples and the geophysical logs are to be submitted to Halton Region, along with the proposed well design, prior to commencing work on the production well.

14.2.4 If the bedrock is the target aquifer, temporary casing is to be set to the top of the bedrock. Upon completion of the hole, geophysical logging consisting of: a dynamic flow distribution profile, pumping video survey, hole caliper, resistivity and natural gamma) is to be conducted to characterize the formations and to identify the location, nature and quantity of water produced from each significant water producing zone. The geophysical logs, along with the proposed well design, are to be submitted to Halton Region, prior to commencing work on the production well.

Well Construction

14.2.5 The minimum casing diameter is to be at least 150 mm larger than the anticipated pump diameter. Casings are to extend a minimum of 300 mm above the pump house floor or, where outside the pump house, at least 1,000 mm above ground level and completed using a pitless adaptor. Each well in the overburden shall be equipped with a stainless steel well screen with slot openings designed for the aquifer material and/or gravel pack in which the screen is placed. Highly fractured rock wells may require screening.

14.2.6 An approved tamper-proof well seal shall be provided to prevent contamination. Each well shall be equipped with a 25 mm minimum diameter threaded and plugged access hole for

introduction of a measuring tape. Attached to this access hole will be a 25 mm I.D. plastic tubing terminating 300 mm above the base of the screen. Also, a 32 mm diameter threaded and plugged access hole is to be provided for semi-permanent water level monitoring equipment.

14.2.7 Each well shall be equipped with a water level transmitter as approved by Halton Region. When wells are located outside the confines of the pump house, the well level transmitters shall be terminated within the pump house.

14.2.8 A low level cut-off shall be installed in each well to prevent the operation of the well pump if the water level in the well reaches a set point that is 1.5m above the top of the well pump. . A light is to be installed on the control panel to indicate that the lower level cut-off has been activated. This light must be manually re-set, and shall be independent of power failures.

14.2.9 Flow control valves are to be provided on the well discharge lines upstream of the waste discharge pipe to ensure that the maximum production capacity of the well is not exceeded.

14.2.10 Each well is to be equipped with a suitable vent terminating sufficiently high to be above the Regional Flood Line.

14.2.11 Overburden wells shall be have an outer protective casing that is grouted in place from the top of the ground to the bottom of the casing.

14.2.12 The inner casing will extend from at least 300 mm above the pump house floor to the top of the well screen. The inner casing, well screen and bottom plate shall be stainless steel.

14.2.13 Provide silica gravel of appropriate effective size in the annular space around the screen to the top of the annular space between the inner casing and the outer casing.

14.2.14 Bedrock wells shall have an outer protective casing only, set from at least 300 mm above the pump house floor to 1,500 mm above the top of the first major producing zone. The casing shall be grouted from the base of the casing to ground surface. The casing shall be stainless steel.

14.2.15 Plumbness and alignment shall be in accordance with AWWA Standard A100-06, latest revision. Demonstration of well alignment shall be made by passing a 12 m long dummy through the inner casing.

14.2.16 The well shall be developed until it achieves an efficiency of at least 95% and produces water that is clear and sediment free with a turbidity of less than 1NTU.Sand content shall be checked in accordance with AWWA procedures using the Rossum Sand Sampler.

Well Materials

14.2.17 The well screen is to be stainless steel, wire wound, with a wire size that maximizes the flow of water into the well. All fittings attached to the screen are to be stainless steel. A 1000 mm long blank pipe is to be attached to the bottom of the screen with centralizers attached to the blank pipe. The blank pipe is to be sealed at the top and the bottom

14.2.18 The well casing is to be Type 316 L with a minimum wall thickness of 9.5 mm.

14.2.19 The filter pack is to consist of well rounded grains of silica material.

14.2.20 The grout/sealant is to be Type 10 Portland Cement and water, mixed to a density of 1,800 kg/m^3 and pumped through a tremie pipe that is set to the bottom of the zone to be sealed.

Well Development

14.2.21 The well is to be developed using methods appropriate for municipal wells, in accordance with the recommendations of the Contractors Consultant until the following criteria are met:

14.2.22 Turbidity less than 5 NTU after 1 minute of pumping at the design rate of the well and less than 1 NTU after 10 minutes of pumping at the design rate of the well

14.2.23 Efficiency greater than 95% at the design flow rate of the well.

14.2.24 Sand content less than 5 mg/L after 1 minute of pumping at the design rate of the well and less than 1 mg/L after 10 minutes of pumping at the design rate of the well.

Well Testing

14.2.25 Upon completion of the development, a variable rate test of the well is to be conducted. Pumping rates are to be 1/3, 2/3 and 3/3 of the design rate. The pumping period is to be 60 minutes, followed by 60 minutes of recovery between steps. At each rate during the variable rate test, a dynamic flow distribution profile is to be conducted.

14.2.26 Depth discrete water quality sampling is to be conducted to obtain water samples throughout the well screen or, in the case of a bedrock well, from each major producing interval that produces more than 5% of the flow to the well at the design flow rate.

14.2.27 Conduct colour static video survey of the well. Use vertical view for down run. Use horizontal view for up run. Raise and lower camera at a maximum of 2m/min. Conduct the down run of the video log without stopping. Provide detailed observations of selected zones during the up run.

14.2.28 Repeat video survey while pumping at the design flow rate. Complete one down run with vertical view and complete one up run in side-scan mode without rotation of the camera. After completion of initial pumping video survey examine all significant features, as directed by Halton Region, with the camera using side-scan mode. Stop at each feature and rotate 360 degrees while well is pumping. Provide colour copies of video's using DVD format.

14.2.29 Conduct pumping flow distribution profile of the well. Pump the well at the three rates used during the variable rate test, with the bottom of the well pump motor 2 m above the top of the well screen. Measure flow velocity using a spinner flow meter, every 0.3 m from 1 m above the top of the well screen to the bottom of the well. Repeat the flow distribution profile two additional times before increasing flow to the next pumping rate.

14.2.30 Conduct stop/start pumping test by pumping the well at the design flow rate for 3 periods or more, and demonstrate that the requirements for turbidity and sand content are met

14.2.31 Prepare an application and supporting documents for Halton Region to apply for a Permit to Take Water to allow a 72 hour aquifer test. Conduct 72 hour aquifer test of the well at the design flow rate. No recovery measurements are necessary. Do not remove pump until at least 24 hours following end of test. Use water level transmitters and data loggers to monitor water level response to pumping in appropriate monitoring wells. Manually monitor water levels during the test in selected wells to confirm data logger observations.

Well Quality Testing

14.2.32 Collect water samples during at 24, 48 and 72 hours and submit analysis to Halton Region for calcium, magnesium, sodium, potassium, chloride, bicarbonate, sulphate, nitrate, iron and manganese. Collect water samples at 72 hours of pumping and submit analysis to Halton Region for Tables 1, 2, 3 and 4 from the Technical Support Document for the Ontario Drinking Water Standards, Objectives and Guidelines, revised June 2006 or as updated.

14.3 Groundwater Pumping Station

Pumping Equipment – Servicing Up to 100 Lots

14.3.1 Providing sufficient well capacity is available, direct pumping systems may be permitted.

14.3.2 The minimum well capacity for this system is 0.15 l/s continuous production per lot (estate lots) and a minimum of 0.225 l/s continuous production. Pump cycling shall be controlled by pressure bladder tanks set on concrete pads with tank supports to allow circulation of air under the tanks. The tanks shall comply with the Ontario Ministry of Consumer and Commercial Relations - "The Boilers and Pressure Vessels Act".

14.3.3 The configuration and valving of the "bank" of pressure tanks shall be such as to allow the removal of any one tank without interruption of service to any other. A pressure relief valve with discharge directed through the pump house wall shall be provided on the main header

Pumping Equipment – Servicing More than 100 Lots

14.3.4 Storage must be provided when serving more than 100 lots. See Section 13 - Reservoirs, Elevated Tanks & Standpipes for more details.

14.3.5 The minimum well capacity for this system is 0.075 l/s continuous production per lot. Level transmitter, monitoring full depth of reservoir, with 4-20 MA output shall be provided. Pumping from the wells to the storage reservoir shall be accomplished with approved submersible pumps.

14.3.6 Suitable controls shall be provided to operate each well independently or in conjunction with other wells through Halton Region's SCADA System and backup controls. Each well pump shall be equipped with a foot valve.

14.3.7 A conduit from the low-lift discharge to the exterior of the pump house shall be provided for pumping to waste. The waste discharge is to be at least 300 mm above ground level and adequate drainage away from the site will be required. A graduated manometer shall be provided for well testing.

Electrical Equipment

14.3.8 All electric motors shall be 575 volts, 3-phase, 60 Hz. Overload protection is to be provided on each phase. All motor starters are to be combination type molded case breaker. Breakers are to be equipped with adjustable magnitude trip or "soft" start/stop ramped starters. Reduced voltage starters or "soft" start/stop ramped starters are to be provided on all motors over 15 kW. Where 120 volts control is required with a 575 volt starter, each starter will include an integral control transformer with a fused secondary. All electrical apparatus is to be located in an accessible location with a clear access of at least 0.90 metres around all pumps and motors. All panels and controls are to be moisture resistant.

14.3.9 Pump house heating shall be by gas, where possible, or electrical unit heaters with individual built-in thermostats. Fluorescent lighting shall be provided in all pump houses, and a weather-proof switch and electrical outlet GFI breaker type shall be placed inside the pump house immediately adjacent to the access door. A single outside light is to be provided over or adjacent to the access door and its operation is to be regulated by a photo-electric cell. This light is to be protected against vandalism. Emergency lighting is to be provided inside the pump house. Lightning arrestors shall be provided at the 600 volt terminals at the hydro terminal pole.

14.3.10 Note: If one or more production wells are located external to the pump house, lockout disconnect switches must be provided for each submersible pump and these switches are to be located in the pump house.

Water Treatment Equipment

14.3.11 The degree of water treatment required will depend on the chemical and bacteriological quality of the raw water. Chlorination facilities will be required on all systems. Solenoid driven, self de-airing chemical feed pump shall be installed and connected with plastic tubing to the well discharge line. Chemical feed pumps shall have adjustable stroke length, equipped with a pressure relief valve (acting on the hydraulic fluid) and an anti-siphon/back pressure valve on the pump discharge. Sodium Hypochlorite shall be dosed at full strength. Chemical storage tanks will be 200 - 400 L non-returnable tanks equipped with piping and low level lockouts suited to the design.

14.3.12 The chemical feed pumps shall be wired through the circuits of the production wells and/or high lift pumps so that the chemical is only added when the pumps are operating and that the dosage is proportional to the pumpage rate.

14.3.13 The well pumping station shall be equipped with the following:

a. Turbidity meter
b. Particle counter
c. Automatic chlorination equipment using sodium hypochlorite solution
d. Chlorine residual analyzer
e. Emergency standby diesel generator

14.4 Preferred Layout

14.4.1 Well pumping unit shall be located in the centre of the room. Install a skylight immediately over the centre of the pump to facilitate removal of pumping unit.

14.4.2 All electrical control panels and MCC panels shall be located in a separate room.

14.4.3 All chemical systems shall be located in a separate room.

14.4.4 All equipment shall be accessible for repair and or replacement and shall have a minimum clearance of one meter from the nearest obstruction.

14.4.5 Design of the well pumping station must allow for the removal of all equipment at all times when the work has been constructed. Provide skylight on roof to permit the removal of well pump.

14.4.6 For each water supply installation a suitable structure of brick or concrete block shall be constructed to blend in with the surroundings. The building must conform to local building and zoning by-laws as well as Ministry of Labour requirements. The building is to be completely insulated to a minimum of R30 in the roof and R20 in the walls, and be sized so that all equipment is accessible for maintenance. At least 3.5 square metres must be provided for the storage of chemicals. A hatch shall be provided in the roof of the pumping station over each well situated therein.

14.4.7 No windows are to be installed and ventilation shall be accomplished by an exhaust fan operated by a thermostat. The exhaust fan capacity shall be sufficient to provide five to six air changes per hour. The exhaust outlet is to be located near the pump house ceiling with inlet louvres located near the pump house floor on the opposite side of the building. The inlet

louvres shall be controlled to open when the exhaust fan is operating and to close when the exhaust fan is off. All louvres shall be high quality insulated vane type.

14.4.8 The entrance doors shall open outwards and be sized to be wider than the largest piece of equipment in the pump house (minimum 0.91 m wide). Double doors are to be used when the pump house contains a standby diesel generator. All doors are to be insulated metal doors. All building locks are to be keyed to Halton Region's specifications.

14.4.9 All floor mounted equipment shall be placed on concrete bases at least 100 mm above floor level. Pump house floors shall be at least 300 mm above the external ground surface and/or any potential flood level. Floors must be of poured reinforced concrete and slope to a floor drain which discharges to a ditch.

14.4.10 All interior and exterior wall surfaces, door and trim shall be painted to a colour scheme approved by Halton Region. All facia, soffit, and eaves trough to be pre-painted aluminum. All interior paint to be an epoxy base.

14.4.11 Raw and treated water sampling taps shall be provided on the discharge lines of the low lift and high lift pumps. Treated water taps are to be located at a sufficient downstream distance from chemical application points to ensure that complete mixing has occurred prior to withdrawal of samples.

14.4.12 At least one pump facility per system shall have backup power capable to supply minimum day well production and average day on larger systems

14.5 SCADA System

14.5.1 Connect the pumping station PLC to the SCADA system.

14.5.2 Provide all field instrumentation for local and remote control and monitoring of all equipment in the pumping station.

14.5.3 Provide fully automated chemical feed system with the capability of PLANT manual control through the SCADA HMI software.

14.5.4 Provide a PLC for local and remote control and monitoring of all equipment through the SCADA HMI software.

14.5.5 Refer to SCADA Standards Manual for details on instrumentation and controls requirements.

SECTION 15 POTABLE WATER PUMPING STATIONS

15.1 General

15.1.1 In the absence of MOE standards for alternative technologies and the specified requirements of the Safe Water Drinking Act, Ontario Regulation 170, the Consultant must abide by the 10 States Standards and any associated Environmental Protection Agency design guidelines.

15.2 Layout of Facilities

15.2.1 Consultants retained by Halton Region to provide engineering services for the expansion or upgrading work will be working in existing facilities. When designing the expansion works, comply with the following:

a. Provide adequate space between existing and new equipment for operation and maintenance requirements.

b. Maintain similar type of existing equipment, where possible, for new works.

c. Provide flexibility for incorporating modification to facility to meet more stringent water quality requirements.

d. Ensure that the facility is designed to allow for future expansion works.

e. Incorporate roll garage doors, overhead cranes and / or mono rails were feasible.

15.3 Alarms

15.3.1 The following equipment or logic-defined alarms shall be generated for the following:

i) Building – Temp High and low temperature in building
ii) Building – Smoke Smoke in building
iii) Building – Flood Flooding in basement

SECTION 16 RESERVOIRS, ELEVATED TANKS & STANDPIPES

16.1 General

16.1.1 The design guidelines as provided herein are for the design of new or rehabilitation of existing reservoirs and shall be read in conjunction with the guidelines and codes noted in Chapter 2.0 Design Standards. Where the higher standards have been specified or required, comply with such requirements.

16.2 Design

16.2.1 All inlet, outlet and piping within the reservoir cells shall be designed to allow the circulation of fresh potable water within the reservoir cells. All necessary piping and valving shall be provided to allow for the bypassing of any reservoir's cell to be taken off-line for maintenance work. No submerged valves will be allowed as part of the design. All valves should have ease of access for future maintenance.

16.2.2 To ensure an adequate chlorine level in the storage tank the design of static mixing system may be required. Static mixing system is preferred over baffling system.

16.2.3 Wash down piping inside the reservoir shall be sized for two hoses operating at any one time with a flow rate of 4.5 L/s at 740 kPa. Provide connection points at 30-meter interval to cover the entire reservoir floor area.

16.2.4 Interconnecting piping between reservoir cells shall be equipped with manually operated butterfly valves to permit isolation of cell or cells.

16.2.5 All pipes inside the valve house shall be colour coded to comply with the latest edition of the MOE Standard for Pipe Identification in Water and Wastewater Treatment Plants in Ontario. Provide arrows indicating the direction of flow.

16.2.6 All inlet, internal and outlet piping for pumping station shall be provided with isolation valve(s) to permit isolation/removal of pump(s) for maintenance work without impacting on the integrity or operational capability of the pumping station itself.

16.2.7 The reservoir shall be designed to meet the following criteria:

a. Locate inlet/outlet pipe to promote circulation of fresh water and minimize dead spots. All inlet/outlet piping is to be installed be floor level of reservoirs.

b. Ensure that the full depth of the reservoir is available for operation.

c. Provide isolation valve(s) and piping to permit the isolation of reservoir cell(s) for maintenance or construction work without having to shut the entire reservoir down.

d. Provide isolation valve(s) and piping to permit pump(s).

e. Allow for future expansion of reservoir capacity to its ultimate capacity in an orderly manner.

f. Reservoir's inlet valve chamber shall be provided with sump pump and a second duty pump with check valves, for drainage where gravity drain cannot be provided.

g. Connection for pumps and wash down pump shall be made to the reservoir's fill line.

16.2.8 Overflow from the reservoir is not generally permitted at any time unless emergency conditions arise. The overflow is to be designed to the firm capacity of upstream station. A separate instrumentation and control system shall be provided exclusively for this function to prevent overflow. When the water level reaches the high high level (HHL) condition, the instrumentation and control system shall initiate the primary inlet valve to shut off to prevent further water supply into the reservoir and at the same time activate the reservoir high high level (HHL) overflow alarm condition to the operator through the SCADA system.

16.2.9 Provide reservoir with an overflow piping capable of discharging the designed maximum inflow of water to the reservoir. Design overflow capacity from each cell to meet maximum pumped input and combine discharge with reservoir drain. Design drain to permit discharge of water in a controlled manner to the site drainage system and/or storage lagoons sized for a 2 hour duration flow from the largest upstream pump. Provide perimeter drainage system.

16.3 Capacity

16.3.1 Where available, this information will be provided to the Consultant for the design and construction of the reservoir.

16.4 Re-Chlorination System Requirements

16.4.1 Where specified, design and provide the required chlorination system at the reservoir with the following operating characteristics:

a. The re-chlorination system shall be based on the application of sodium hypochlorite for the disinfection system.

b. Provide a minimum of two metering pumps sized for max day requirement.

c. The re-chlorination system shall be sized to provide an increase to the total chlorine residual to 0.5 mg/l at the maximum inflow of water into the reservoir.

d. The liquid sodium hypochlorite shall be injected into the common inlet/outlet pipe by a metering pump and shall be controlled by the chlorine residual analyzer. Isolation valves shall be provided so that the analyzer can sample water from the reservoir inlet pipe only. The chlorination system shall only operate when the water is flowing into the reservoir and the reservoir inlet valve is in the open position.

e. Isolate sodium hypochlorite tank(s) in a separate containment area. Volume of containment area is to be equal to volume of hypochlorite tank(s). Separate ventilation should also be supplied to keep sodium hypo chlorite fumes out of the rest of the facility.

f. Flood alarm field instrumentation detection system within the containment area to be provided to detect leakage of sodium hypochlorite from tank(s). Connect flood alarm instrumentation to SCADA system.

g. Provide electronic read-out of sodium chlorite liquid level indicator(s) at the loading station.

h. The sealed sodium chlorite tank(s) shall be vented to the exterior of the building.

i. Locate chlorine analyzers and metering pumps in a separate room. Separate ventilation should also be supplied to keep sodium hypo chlorite fumes out of the rest of the facility.

16.5 Emergency Eye-wash and Deluge Shower

16.5.1 Provide an emergency eye-wash and deluge shower station in the vicinity of the sodium hypochlorite tank and also close to the metering pump(s) and analyzers room. Provide tempered water to the eye-wash station. Eye wash station status is to be connected to the local PLC for alarm annunciation.

16.6 Site Access Road and Security

16.6.1 Unless otherwise specified by Halton Region, approval agencies or area municipality, the reservoir access road shall be fenced off with 1800 mm high galvanized steel chain link fence and gate. In rural locations, while a post and wire fence may be acceptable, chain link fence may be preferable.

16.6.2 Access gate(s) to the property shall be 7000 mm wide and 1800 mm high, galvanized iron chain link gate. The location of the gate(s) may be required to comply with the requirements of the approval agencies and or area municipality.

16.6.3 Design reservoir exterior exposed surfaces such as access hatches, doors, etc. to be vandal resistant. Ensure that all ventilation louvers to the reservoir are properly secured to prevent entry of foreign material. All hatches to be lockable and keyed to Halton Region master lock system.

16.6.4 The exterior of reservoir shall be provided with high pressure sodium vapour light fixtures (vandal and tamper resistant) with high power factor ballast and lamps suitable for horizontal, base up or base down operation. Lights shall be automatically turned on or off by motion sensors or light sensors and shall be capable of being manually turned on or off from a designated central location.

16.6.5 All exterior access such as the valve house doors and reservoir roof access shall be provided with intrusion alarm detection device.

16.7 Architectural

16.7.1 Design reservoir with valve chamber in front with access door and retaining walls.

16.7.2 The reservoir shall be architecturally designed to ensure that the exterior complements with its surrounding environment. The exterior material and or finishes shall be designed to be completely maintenance-free wherever possible. It shall be provided with two entrances and to be without any windows. All openings in the exterior walls shall be equipped with insect screens and vandal-proof louvers.

16.7.3 All roof drains shall have a dome protection. Drains inside the valve house shall have easily accessible traps.

16.7.4 Roof access hatches shall be fabricated of aluminum frame with insulated cover and watertight. It shall be provided with a snap lock with a removable handle for topside hardware, and recess padlock complete with cover.

16.7.5 Floor layout shall allow for an easy access to all equipment inside the Valve House. Floor areas shall be sealed with a waterproofing membrane and shall have a slip resistant finish. Interior finish shall require minimum maintenance. Walls shall be treated with a waterproofing membrane. Unless it is absolutely necessary, do not paint interiors surfaces of Valve House.

16.7.6 All electrical equipment including control panel shall be located on the main floor. Interior lighting shall be wall mounted fluorescent light fixtures, and readily accessible for replacement/ maintenance purposes.

16.7.7 Landscaping within the property limits shall comply with the Area Municipalities Site Plan Approval requirements. It shall complement with the surrounding environment and require minimum maintenance or watering. Select plant species that are native to the project site.

16.8 Structural

16.8.1 For new reservoir, provide a minimum of two cells with isolation valve between the cells.

16.8.2 For expansion of existing reservoir, design new cell(s) capable of being isolated from existing cell(s) for repair and or cleaning or to float independently on the water supply distribution system.

16.8.3 Reservoir to be designed with the structure half in and half out of the ground with the roof slab sloped to promote drainage, including granular zone at base of cover material.

16.8.4 The design of the reservoir roof shall be based on a cast-in-place concrete structure with a membrane overlay. The roof to be covered by earth for insulation to sufficient depth to sustain growth of grass and landscape planting, consistent with minimizing structural needs to carry the load. Where necessary, supplement earth insulation with additional insulating material to prevent freezing of reservoir's ceiling during the wintertime.

16.8.5 Provide access and ventilation shafts, two for each cell.

16.8.6 All water retaining structures to be designed to ACI 350 (R).

16.9 Mechanical

16.9.1 Where isolation valve(s) are required to isolate cell(s), provide valve box as required on top of reservoir. Valve box shall be cast in place concrete with a lockable stainless steel cover. Ensure that the stainless steel cover is designed to prevent water from entering into the reservoir from the valve box.

16.9.2 The overflow pipe shall be secured with a non-corrodible mesh screen (size 25 mm) installed within the pipe at a location least susceptible to damage by vandalism.

16.9.3 Hardware inside the reservoir, ladders, handrails, etc. shall be stainless steel Type 304 or 316L.

16.9.4 Internal manway from valve chamber to the reservoir, if provided, shall be Type 304 stainless steel.

16.9.5 Hardware inside the valve chamber shall be stainless steel for such equipment as ladders, handrails, safety chains and rails, equipment hatches, gratings, etc.

16.10 Surge Control

16.10.1 Provide surge relieve on pumps discharge header and re-circulate water to suction header. Open Status of the Surge Relief valve should be wired to the local PLC for monitoring.

16.11 Heating and Ventilation

16.11.1 Provide dehumidification equipment in Valve House to reduce humidity below dew point.

16.12 Instrumentation and Control

16.12.1 Provide one ultrasonic level sensors in each reservoir cell. Control of the inlet valve and monitoring of the reservoir water level shall be through either ultrasonic level sensor, which has been selected and placed on line by the Operator through the SCADA system..

16.12.2 Provide a backup level sensing probe which will detect the reservoir water level at the overflow water level condition and initiate the inlet control valve to shut off further water supply into the reservoir and at the same time activate the reservoir high high level (HHL) overflow alarm condition on the applicable SCADA system.

16.12.3 As a minimum the following should be connected to the SCADA system for reservoir monitoring and control:

a. Reservoir Cell duty selection
b. Reservoir Level
c. Reservoir flow direction (filling or discharging) detection
d. Chlorine Residual
e. Chlorine metering pumps running status
f. Chlorine metering pumps speed
g. Chlorine metering pumps duty selection, manual or automatic mode (where required)
h. Chlorine residual set point, manually set by operator
i. Reservoir inlet/outlet control valve
j. Sodium Hypochlorite Storage Tank Level

16.13 Alarms

16.13.1 The following alarm points shall be monitored at the reservoir by the Halton SCADA System:

a. Fire Alarms
b. Smoke Alarm
c. Low ambient air temperature in sodium hypochlorite metering and analyzer room
d. Flooding of containment area
e. Eye-wash and deluge shower

SECTION 17 BULK WATER LOADING STATIONS

17.1 General

17.1.1 The design guidelines as provided herein are for the design of new or rehabilitation of existing bulk water loading stations

17.2 Design

17.2.1 All inlet, outlet and piping shall be designed to allow the circulation of fresh potable water. All necessary piping and valving shall be provided to allow for the bypassing for off-line for maintenance work. No submerged valves will be allowed as part of the design. All valves should have ease of access for future maintenance.

17.2.2 All pipes shall be colour coded to comply with the latest edition of the MOE Standard for Pipe Identification in Water and Wastewater Treatment Plants in Ontario. Provide arrows indicating the direction of flow.

17.2.3 All inlet, internal and outlet piping for pumping station shall be provided with isolation valve(s) to permit isolation/removal of pump(s) for maintenance work without impacting on the integrity or operational capability of the pumping station itself.

17.3 Mechanical

17.3.1 The overflow pipe shall be secured with a non-corrodible mesh screen (size 25 mm) installed within the pipe at a location least susceptible to damage by vandalism.

17.3.2 Hardware ladders, handrails, etc. shall be stainless steel Type 304 or 316L.

17.4 Surge Control

17.4.1 Provide surge relieve on pumps discharge header and re-circulate water to suction header.

17.5 Access and Billing

17.5.1 To be added

SECTION 18 WASTEWATER TREATMENT FACILITIES

18.1 General

18.1.1 These design standards have been prepared to assist the Consultants in the design of wastewater treatment facilities for Halton Region and do not supersede the requirements of the Ministry of the Environment and or any legislations relating to the design and operation of wastewater treatment plants.

18.2 Security Systems

18.2.1 To be added

18.3 Plant Layout

18.3.1 In designing the layout of wastewater treatment plant, consideration shall be given for future expansions of the plant to its ultimate site capacity in order to maximize the utilization of the available space of the property. The staging of each expansion phase is tied to the servicing of new development areas as well as growth in the existing urban designated areas.

18.3.2 In this regard, consideration should be given at the design stage of the requirements for future expansion as well as the economical and practical sizing of plant process requirements.

18.3.3 The Consultants should in all cases maximize the site ultimate capacity in planning the plant layout. Design of the expansion works should be carried out to permit the orderly construction of the facility economically with minimal disruption of the existing facility.

18.4 Plant Design Capacity

18.4.1 Comply with MOE design guidelines for conventional, or tertiary, activated sludge wastewater treatment plant. When construction has been completed and the plant placed in operation, perform plant wastewater process optimization to establish the nominal treatment capacity. Ensure that each unit process of the plant has the required throughput capacity.

18.5 Inlet Works

18.5.1 Inlet Works shall be sized to handle peak flow into the facility. Peak flow is defined as the average dry weather flow multiplied by the peak flow factor plus the allowance for infiltration in the wastewater collection system.

18.5.2 The Inlet Works shall be housed in a building and designed for ease of operation for the removal of grit bin(s), screen, and cleanup of the facility so as to promote a positive working environment for the Operators and as a minimum, shall include the following:

a. In general, for smaller wastewater treatment plants, a minimum of two automatic screens shall be provided; each screen shall be sized to handle peak flow. However, for large plants, the screen shall be of the biggest size possible with the required number of screens to meet maximum inflow into the plant. Screen shall be provided with electronic trip relay shock sensor based on current overload draw and shall have reverse jogging capability. In all cases, provide a manually operable bypass gate for emergency operation.

b. Provide screening compactor for the compaction of screening waste material. The compacted waste material shall be disposed into a waste material bin, which is then disposed into the grit holding bins. Provide additional compactor only where the service dictates the needs to meet the service requirement.

c. Provide grit removal equipment sized to meet service requirement.

d. All wastewater originating from the grit cyclone and classifier, automatic screen waste material bin, compactor and grit bins shall be piped for return to the plant process stream.

e. Provide odour control with appropriate ventilation system designed to minimize the odour level in the Inlet Works working area. Odour control may be achieved by isolation of the areas having odour problem and ventilating it separately or by providing directing ventilating capability at the source of odour. Alternatively, the air blower(s) air intake can be connected to the Inlet Works ventilation system for the removal of the odour and the air is used in a separate coarse air bubble aeration system in the aeration tank.

f. Design the Inlet Work's heating and ventilation system, including all necessary interlocks, for proper operation of the system. Control and instrumentation for the heating and ventilation system shall be explosion-proof for all electrical equipment and system. Prepare all required control schematic; include a process narrative in the Specifications for the operation and performance of the heating and ventilation system to be installed by the Contractor.

g. Where odour control is not feasible, provide as an alternate odour treatment with gas scrubbing system, which may be chemical or biological unit.

h. Provide instrumentation for monitoring of the operation of the grit cyclone and classifier, automatic bar screens and compactor equipment in the Inlet Works. All monitoring and alarming methods shall be fail-safe.

i. Provide metering of wastewater entering the Inlet Works or Outlet, depending on the hydraulics of the headworks.

j. Provide measurement of pH and temperature connected to the plant SCADA system.

18.6 Primary Clarifier (Primary Settling Tank)

18.6.1 Primary Clarifier shall be sized to handle the surface overflow rates under different diurnal peaking conditions and shall not exceed the MOE design guidelines. Provide a minimum of two primary clarifiers, each sized to handle average day flow unless specified otherwise. Average day flow is defined as the average of the diurnal flow. No additional standby primary clarifier is required. All channels conveying wastewater from the headworks to the primary

tanks shall be aerated to keep solids in suspension. Provide surface scum collector trough. Where the design calls for flight and chain collector system, provide non-metallic chain.

18.7 Secondary Clarifier (Final Settling Tank)

18.7.1 Secondary clarifier shall be sized to handle the surface overflow rates under different diurnal peaking conditions and shall not exceed the MOE design guidelines. Sludge return capacity shall be designed for 100% return sludge capacity and all activated sludge flows, both return and waste, shall be metered and recorded. Provide surface scum collector trough.

18.8 Scum Collector Troughs

18.8.1 Scum trough shall be lubricated 200 mm diameter all stainless steel rotating trough in each tank, operated manually by a lever mechanism at one end. Lever design shall permit trough rotation in either direction, and shall be generally as shown on the drawings or otherwise approved. Trough shall be 200 mm 316 stainless steel pipe with 10 mm stainless steel plate skirts and gusset plates as detailed. Slope the troughs towards the outlet end. Provide bearings at each wall location suitable for operation in primary or final tank effluent, and capable of accepting slight misalignment whilst providing smooth trough rotation.

18.9 Positive Displacement Pumps

18.9.1 Provide pump and variable frequency drives together by the pump manufacturer. The pump manufacturer to be responsible for coordinating, supplying, testing and commissioning of the pumping units, variable frequency drives and accessories as a package. The VFDs must comply with all Regional standards for VFDs. Consultant is to review those sections when preparing the specification for the these pumps.

18.9.2 Pumps must be suitable for handling sludge concentration 3 – 7% and of heavy, gritty material. Ensure all passages have long sweeping curves and are free from any projection tending to catch solid material in suspension and cause clogging. The pump to have a minimum of two (2) stages with a maximum operating speed for the pump shall be 300 RPM. The pump shall be of compact, close-coupled design equipped with single mechanical seal with flush connection. Pump casing to be grey cast iron with hand hole clean-outs and a drain plug located in the suction casing. Casing to be tapped to accept appropriate gauges.

18.9.3 Rotor shall be AISI D-6 air hardened tool steel with Duktil non-porous coating (defused deep into the base metal) to a hardness of 1750 Vickers or AISI 4150 with hard chrome plating Stator shall be vulcanized in individual metal tube, have a shore hardness of 70 and to be BUNA N, individually molded to extend beyond the stator sleeve ends, forming a collar to prevent the material from contacting the metal stator sleeve. Acceptable Alternative shall be the same as above but stator rubber to have replaceable gaskets at the ends.

18.9.4 Pump to be provided with dry run protection device which includes a thermal sensor installed in the stator sleeve, measuring the temperature between the rotor and stator, complete with digital controller to automatically shut down the drive motor in the event of a dry run situation, TSE 120 or Princo adjustable presence/absence detector.

18.9.5 Over-pressure protection device shall be wafer style consisting of a BUNA module, end plates, pressure gauge on a dual mounting tree, with a pressure switch for High/Low pressure setting to shut off the pump in the event of an over- pressure/under-pressure situation. Sensor to be flow through design with flexible rubber sleeve filled with silicone fluid to transfer pressure to the gauge. All pressure instruments attached to the sensor to be rigidly supported by a post at least 22 mm diameter welded to the isolator. The sensor to be vacuum filled and permanently sealed at the factory with a modular seal consisting of a rubber membrane and needle fitting to allow removal and replacement of pressure instruments without compromising the vacuum fill. The pressure isolator to be capable of operating under pressure with all instruments removed with no loss of fill fluid, without isolating valves. Over-pressure protection device to be ONYX, Series PSW or Moyno RKL. Provide each pump with adequately sized pressure relief valves.

18.9.6 Universal joints shall be oversized hardened pin and companion bushing assembly, hardened to 70 and 74 HRc, respectively. The joint to be so designed that only replacement of the pins and bushings are required. The pin joints to be a grease lubricated type, totally enclosed by an elastometric seal. Each joint to be designed to transmit the maximum torque at the maximum speed and at the maximum pressure rating of the pump.

18.9.7 Pump shaft shall be solid bar stock of 420 Chrome Steel, incorporating a plug-in arrangement to allow replacement of the rotating assembly through the gland area without disturbing the suction piping or pump driver. Disassembly to be front pull-out design, allowing rotor, both ‘U’ joints and shaft to be removed as one unit.

18.9.8 Single type mechanical seals for service with/without external water source, John Crane or Bergman, single type, with solid tungsten carbide to tungsten carbide mating surfaces. Provide removable plugs for water and drain connections, as well as grease fittings.

18.9.9 The motor to be adequately sized to withstand the total loads during starting and pump operation and totally enclosed fan cooled, high efficiency, 1800 rpm, 575V, 3 phase, 60 Hz, 1.15 S.F., Class F insulation, temperature switch for overload protection and suitable for Variable Frequency Drive operation (Inverter Duty Motor). Range of adjustment 30 to 80 Hz.

18.9.10 Raw sludge pump shall be provided with variable frequency drives (VFD’s).

18.10 Sludge Grinders

18.10.1 The sludge grinding device shall be suitable for continuous operation, processing wet or dry, grinding plastic, wood, rubber, hair, rope and other foreign material contained in municipal sewage treatment plant raw sludge. The unit shall be capable of passing 3-8% solids by weight at flows up to 20 l/s passing through 15 mm openings.

18.10.2 Each grinder to consist of a main housing, cutter cartridge and drive assembly. The cutter cartridge and drive assembly to be two-shaft design. Each shaft to be provided with 11-tooth cam cutters.

18.10.3 The main housing to be a solid cast structure made of ASTM A 536-84 ductile iron. The one-piece flanged body to be capable of remaining in-line if removal of the cutter cartridge and drive assembly is required for service. The main housing shall be provided with a covered access port for inspection ASTM A 536-84 ductile iron, an easy access opening in the base

of the grinder to allow external tightening of the cutter stacks and a maintenance bar screen allowing temporary resumption of flow during routine maintenance.

18.10.4 Cutters and spacers shall be AISI 4130 Heat Treated Alloy Steel hardened to a min 45-50 Rockwell C. Drive and driven shafts shall be AISI 4140 Heat Treated Hexagon Steel with a tensile strength of not less than 1000 Mpa.

18.10.5 Bearings and Seals shall be four sealed oversize deep-groove ball bearings per shaft protected by a replaceable and independent tortous path device and end face mechanical seals. Face materials – tungsten carbide to tungsten carbide, not requiring an external flush or any type of lubrication. O-rings – Buna-N elastomers.

18.10.6 The sludge grinding device to be powered by the required service electric motor for 575V, 3 phase, 60 Hz, TEFC motor, high efficiency 1.15 S.F. operation.

18.10.7 Grinder Control Panel shall be equipped with a LOCAL/REMOTE two position selector switch. In LOCAL the operator controls the operation of the grinder using a start and stop push button... In REMOTE, the grinder starts and stops, controlled by the raw sludge pump VFD panel so that the grinder runs when the raw sludge pump runs. When a grinder jam condition occurs, while running either the LOCAL or REMOTE mode, the motor controller stops the grinder and reverse its rotation to clear the obstruction. If the jam is cleared, the controller to return the grinder to normal operation. If the jam condition still exists, the controller to go through two additional reversing cycles within 30 seconds before signaling a grinder overload condition.

18.10.8 When a grinder overload condition occurs the controller to shut the grinder off and activate a FAIL indication, and stop the relevant raw sludge pump. If the grinder is stopped due to a fail condition and a power failure occurs, the fail indicator to reactivate when power is restored. Provide normally closed contact to open if the grinder is stopped. This contact will be interlocked to stop the raw sludge pump. Controller reset to be from local panel controls only.

18.10.9 The controller to have indicator lights for POWER ON, RUN, and FAIL conditions and to provide over current protection through an overload relay mounted directly on the contactor. Starter to be full voltage reversing type. The overload relay to be adjustable.

18.10.10 Provide isolated auxiliary contacts for the following conditions:

a. Grinder RUN condition

b. Grinder FAULT condition

18.11 Aeration System

General Description

18.11.1 Design aeration tank for plug flow, complete mix and step feed capability with tapered aeration or modified aeration system. Aeration system shall be high efficiency fine pore disc air bubble aeration system. Fine air bubble shall be achieved by the use of dome ceramic diffusers arranged for plug flow, complete mix and step feed capability. Cleaning of the fine pore disc air bubble aeration system shall be performed with gas-cleaning system for the removal of bio-fouling of fine pore aerators.

18.11.2 The aeration system shall consist of grids of disk type diffusers with screwed-on disk retainers including all diffuser assembly components, compatible with cleaning gas to be used with in-place cleaning system. The aeration system shall be of tapered design such that the diffuser density varies from inlet to outlet.

18.11.3 Generally, blower shall be positive displacement blower for smaller blower while the larger unit shall be centrifugal type. Type of blower to be used shall be reviewed at the Pre-Design stage to ensure conformity with operation requirements.

18.11.4 Provide one air-metering device at the main air header. For all branch air headers, provide each branch with a manual measuring device.

18.11.5 Provide field instrumentation for the measuring of dissolved oxygen levels in each tank. The field instrumentation and related control system shall be tied to a fully automated dissolved oxygen control system which link actual oxygen demand level to blower(s) capacity which will automatically vary the air output from the blower(s) in direct response to process oxygen demand.

18.11.6 Selection of duty blower(s) shall be fully automated by the SCADA system to match process oxygen demand and the output must be as linear as possible to match process oxygen demand. Each aeration tank shall be provided with one DO sensor. The SCADA system shall provide the following information for the aeration system:

a. DO level in each tank

b. Valve position set point and feedback for the valve on each aeration drop leg

c. Identification of duty blower(s) on

d. Volume of air supplied by the blowers system

e. Running time of duty blower(s)

f. Graph of DO level and volume of air on a continuous basis

g. Supply header pressure with a redundant sensor.

Aeration System Operating Requirements

18.11.7 The aeration system is required to meet the minimum oxygen concentration at any point in the aeration tanks at 2.0 mg/L at any time of the day and to provide sufficient mixing to maintain all mixed liquor solids in suspension.

18.11.8 Total oxygen requirements shall be determined based on the plant process requirements. For nitrification process, the total oxygen requirements shall be as follow:

a. 1.1 Kg of oxygen per Kg of BOD5

b. 4.6 Kg of oxygen per Kg of ammonia applied

18.11.9 The minimum clean water oxygen transfer efficiency shall be 29.9% at standard conditions based on the design condition. This oxygen transfer efficiency is to be the average transfer efficiency within the tanks at the average flow.

18.11.10 Certified data from a shop clean water performance test to be submitted to demonstrate the capacity of equipment to meet the specified oxygen requirements. Tests shall have been conducted at the manufacturer's facility by independent testing firm. Tests shall have been conducted in accordance with ASCE Clean Water Test Procedures. At least (3) test runs each at both average and peak design conditions shall be included. Testing shall have been conducted in a tank having a surface area greater than 18.6 m² to eliminate the potential of wall effects, and at the specified submergence and a diffusers density equivalent to the actual project tank configuration. Diffuser density is defined as the ratio of the total tank surface area to the total combined diffuser surface area. Data from all tests to be submitted following the completion of the testing and prior to equipment shipment. Submissions of certified oxygen transfer test results must include all data sheets, calculations, plots and a written explanation of all information regarding testing and analysis of test data.

Diffuser Assemblies

18.11.11 Air diffuser assemblies shall consist of porous ceramic, circular disk diffuser, diffuser holder, retainer and top gasket, and flow control orifice. Diffusers to be constructed of aluminum oxide with a suitable bonding material. Diffusers are to be uniform throughout, without holes, impervious material, cracks, soft spots, chipping, spalling or other defects. Diffusers are to have constant and uniform distribution of the emergent air bubbles across the entire active surface. The aluminum grains shall be thoroughly joined together with the bonding material to form a strong homogeneous structure which is uniformly porous.

18.11.12 Element holders are to be complete with peripheral edge support for the diffuser element and screw on retainer rings with a positive "O" ring seat to securely hold the diffuser element in place. Gaskets to be suitable for use in sewage and for providing a tight seal between retainer and the diffuser. Gaskets are to be of neoprene and of proper durometer to seal properly.

18.11.13 Each diffuser assembly to be supplied with an air flow control orifice and to be interchangeable between Sanitaire and Enviroquip system.

Ceramic Aeration System Equipment Components

18.11.14 Drop pipe to be 304 L stainless steel or PVC. Stainless steel portion shall extend from the air main connection, located at the inside tank wall to a point 900 mm above the manifold, and shall include vertical risers and vacuum breaker. PVC manifolds to be perpendicular to the air distribution headers. Manifold to be supported with a minimum of two stainless steel supports. Maximum spacing between supports shall not exceed 2.5 meters. Manifold, connections and supports to resist thrust generated by expansion or contraction of the air distribution headers. Manifolds shall be designed for long term exposure to 55°C mean-wall temperatures. Fabricate manifolds with fixed joint connection to each air distribution header.

18.11.15 Air distribution headers shall be perpendicular to the air manifold and joined with positive fixed threaded union or flange type joints to prevent blow apart. All underwater joints shall be positive locking type. Push on, bell in spigot or expansion type joints will not be permissible. Distribution headers shall be fabricated with diffuser element holders factory solvent welded to the crown of the header. Diffuser element holders to be attached to the distribution headers to resist dead load applied vertically to the outer most edge of the diffuser holder. Support each section of distribution header with a minimum of two supports having a maximum spacing 2.3 metres. Distribution header supports, or guides, shall allow longitudinal movement of the header section to prevent stress build-up in the header due to thermal expansion/contraction forces. Guide supports that clamp or grip the header will not be permissible.

18.11.16 Manifold supports to include manifold hold-down, guide straps, anchor bolts and supporting structure. Guide straps to be a minimum 50 mm wide. Provide supports with a mechanism to provide for vertical adjustment of manifold alignment in the field. Supports shall be designed to allow for complete removal from the tank (less anchor bolt) to facilitate cleaning and maintenance of tank bottom.

18.11.17 Provide air distribution header supports with the following features:

a. Stainless steel air distribution header supports of both guide and fixed type to allow for expansion of the system and to allow for complete removal from the tank (less anchor bolt) to facilitate cleaning for maintenance of tank bottom.

b. Guide supports shall consist of self-limiting hold down and sliding mechanism. Sliding mechanism shall provide minimum resistance to movement of the air distribution header under full buoyant up-lift load. Worm gear clamps shall not be utilized for attaching header pipe to supports.

c. Fixed supports shall consist of a hold down mechanism and self limiting clamp device. Clamping device shall positively grip the air distribution header when tight and be self-limiting to prevent overstressing the header if the clamp is over tightened. Worm gear clamps shall not be utilized for attaching header pipe to supports.

d. Adjusting and aligning mechanism shall be infinitely adjustable within its limits to allow precise leveling of the air distribution headers and diffuser assemblies of a common horizontal plane without removing the header from the support.

e. Attach supports to tank floor with one stainless steel expansion type anchor bolt designed for embedment in concrete. Size anchor bolts with pull-out strength, design safety factor of four (4) or more.

18.11.18 A PVC drain line, sump, airlift purge eductor line and eductor carrier column to be provided to drain the entire submerged aeration piping system for each aeration grid. Each aeration grid integral drain line to terminate at a sump. The sump bottom elevation shall be lower than the invert of the air distribution headers and drain line.

18.12 Aeration Blower

Centrifugal Blower

18.12.1 Centrifugal blower shall be multistage centrifugal type, with outboard mounted bearing construction in which the impellers are keyed to a heavy ground steel shaft and supported by anti-friction type bearings. Housing/Casing shall be diaphragm cast integrally with casing, two piece fabricated construction with rope packing is not acceptable. Compressor casing shall be rated to 174.4 kPa. Inlet and outlet connections shall have class 125 bolt pattern and be an integral parts of the head. Impellers – cast #443 aluminum alloy, statically and dynamically balanced prior to mounting, keyed and locked to a shaft. Impeller assembly shall be dynamically balanced to insure mechanical operation of not more than 1.5 mils (peak to peak) vibration amplitude when measured on the bearing housing in either the horizontal, vertical or axial direction. Vibration readings will be taken with the compressor operating at 3600 rpm. Tip speed of the impellers shall not exceed 140.8 m/s. Compressor operating speed shall be a minimum of 20% below its first critical speed. Shaft – heavy ground steel shaft supported by anti-friction type deep groove bearings. The shaft shall be of sufficient diameter to operate below the first critical speed. Shaft speed shall not exceed 3600 rpm. Bearings – anti-friction ball type, oil lubricated, B-10 bearing rating (as per AFBMA B-10 Standard) bearings at each end of the shaft, outboard mounted in cast iron bearing housings bolted to end head casings, isolated from the air stream by means of a carbon ring seal

package, readily replaceable without disassembly of the blower or disconnection of inlet or discharge piping, and complete with grease injection and relief ports.

18.12.2 The blower-motor unit shall be mounted on a structural steel base plate, set on vibration isolation pads manufactured by Korfund to prevent vibration transmission to the structure. Reinforced Flexible Expansion Joints – one (1) for each of the inlet and outlet piping connections, single arch molded type suitable for 121 degree C. service, each complete with ASA125 drilled flanges and equipped with 10 mm thick galvanized steel retaining rings, equal to Mason or Mercer. Air Intake – Silencer shall be equal to Stoddard model C23-14 with drain plug, and 350 mm dia. ASA 125 flanged inlet and outlet end connections.

18.12.3 Surge Control Panel shall be factory pre-wired shutdown control panel, consisting of an EEMAC 12 surface wall mounting dead front enclosure with start delay timer, single setpoint meter relay, protection 'ON' and surge shutdown LED indicator, off/reset-on selector switch, and adjustable setpoint with normally closed contacts which open to trip the blower motor starter at surge conditions (under setpoint) and complete panel and panel component identification. Provide a 150:5 current transformer and normally open auxiliary interlock with starter for enabling surge control.

Positive Displacement Blower

18.12.4 Blowers shall be positive displacement blowers with the following characteristics:

a. Rotary with three lobe design and built in pulsation interference system, manufactured from grey cast iron ASTM A48, Class 25, in accordance with ISO 9001 standards.

b. Each lobe to be statically and dynamically balanced by metal removal not by adding counter weight.

c. Housing, casings and covers to be heavily ribbed and manufactured from grey cast iron ASTM A48, Class 25.

d. Timing gears of helical tooth design mounted onto the impeller shaft by means of a taper interference fit.

e. Shafts to be manufactured from SAE1045.

f. Each blower to have four low friction/wear sealing system at each rotor end designed to guarantee long term oil free conveying, located between the conveying chamber and the oil casings. Drive shaft seal to include a lip seal and replaceable shaft sleeve.

g. Anti friction type bearings rated by AFBMA at minimum service life of 40,000 hours at the blower's maximum load, speed pressure, and temperature design condition.

h. Bearings and timing gears must be splash oil lubricated on both sides. Provide site glass on each casing and top-fill reservoir C/W with vent and drain connection. Fill and drain connections to be easily accessible.

Inlet Silencer and Filter

18.12.5 Provide each blower with an inlet silencer-filter with the following features:

18.12.6 A combined inlet silencer-filter flanged directly to the blower inlet.

18.12.7 Shell manufactured from a cast aluminum, Class 25 with eyebolt for handling of entire unit.

18.12.8 A design permitting remote air intake (inline silencer-filter) via inlet piping and filter access without tools.

18.12.9 Filter medium consisting of a dry, cleanable filter element retaining 99% of particles having a minimum size of 10 microns.

18.12.10 Sized to handle the maximum flow capacity of the blower with the filter element downstream of the silencing section.

18.12.11 The absorption silencer featuring a labyrinth air path arrangement using acoustic absorption foam, lining a formed, galvanized sheet metal frame.

18.12.12 Each filter provided with a filter contamination indicator mounted on the inlet silencer housing. When the filter becomes clogged (resulting in an inlet pressure drop of 50 mbar), the indicator is to actuate and reveal a “maintenance required” zone. Following filter cleaning/replacement, the indicator must be manually reset.

Base Frame and Discharge Silencer Dampener

18.12.13 Structural steel mounting frame shall be designed to support both the static and dynamic loads of the blower, its accessories, and the motor. The blower shall be directly flanged to the machined frame inlet flange, eliminating the need for noise radiating transition piping. The base frame shall be supported on four flexible machine mountings, absorbing at least 70% of machine induced vibrations, and eliminating dynamic foundation loads. The motor is to be mounted on base plate hinged to the blower base frame via a bearing.

18.12.14 Resonance type silencer shall conform to the following requirements:

a. Integrated to the base frame.

b. Integral metal construction, 100% free of absorption materials. The design must guarantee zero degradation of acoustic performance and structural integrity, over time.

c. Silencer internals accessible for inspection and cleaning purposes via a flanged, sealed plate.

Ancillary Equipment

18.12.15 Drive Guard

a. Drive guards shall be installed with the following features:

i) Drive guard meeting OHSA requirements.

ii) Guard to be steel plates having perforated drive inspection sections in order to ensure sturdiness and durability.

iii) Drive guard not to restrict access to lubrication fitting on equipment or motor bodies.

18.12.16 Check Valve

a. Check valve shall conform with the following requirements:

i) Double gate, wafer type check valve installed at the silencer discharge.

ii) Flanges to ANS1 B16.5, Class 150.

iii) Pin and springs to be stainless steel.

18.12.17 Safety Relief Valves

a. Safety relief valves shall conform to the following requirements:
   i) A vertically mounted, spring loaded and adjustable safety relief valve, aluminum bell, a brass piston, a steel spring rod, and a cast aluminum or fabricated steel valve cover.
   ii) Valve capable of blowing-off the total flow generated by the blower.
   iii) Set valve to relieve the flow at a pressure 10% or 50 mbar above the maximum operating pressure specified.
   iv) Locate safety relief valve on the discharge silencer.

18.12.18 Flexible Pipe Connections

a. Install flexible pipe connections with the following features:
   i) Single arch type, canvas reinforced rubber with galvanized steel retaining rings.
   ii) Temperature and pressure ratings to suit blower.

18.12.19 Expansion Joint

a. Expansion joint shall be of a flanged or stub type, installed between the blower package and the discharge piping to hinder the transmission of vibrations and structure borne noise, and to permit some pipe expansion without adding stress to the blower package connection points. Expansion joint capable of resisting pressures up to 1000 mbar gauge and temperatures of 150°C.

18.12.20 Oil Drain System

a. The oil drain system for the blower shall be fabricated with ball valves and quick couplings for the installation of a drain tube. The drain tube is supplied with the machine, and is secured on the belt guard. Oil drain system to be easily accessible for maintenance.

b. The oil level must be easily visible sight glass complete with top mounted cleanout.

Instrumentation

18.12.21 The following instrumentation shall be provided with the blower:

a. Vibration switch
b. Inlet pressure (vacuum) switch
c. Discharge pressure gauge with isolation ball valve
d. Inlet filter maintenance indicator
e. Temperature switch
f. Unloading valve with solenoid control for variable speed units only
g. Surge protection

Sound Pressure Level with Acoustic Hood

18.12.22 The sound pressure level of the entire blower package (i.e. not only the blower housing) must not exceed 82 dB(A) with a tolerance of ±2 dB(A). The noise level guarantees are per DIN 45635, and represent the average value of the noise readings recorded from all sides at a distance of 1 m in free field.

18.12.23 The acoustic hood is to cover the entire blower package. The sound pressure level of the entire blower package with acoustic hood, measured in free field at 1 m around the hood

perimeter, must not exceed 82 dB(A) as noted in 2.14. The entire package shall comprise of a steel skid/oil-drip pan on which the entire blower package and galvanized steel hood panels lined with non-flammable polyether absorption material, are fastened. Provide access for maintenance. The hood shall be supplied with ventilation fan sized to ensure a temperature differential not exceeding 10°C over ambient temperature. Mount all indicators, except oil gauge, externally independently of the hood and piping.

18.13 Chemical System

18.13.1 For all chemical system, provide a minimum of two metering pumps for each process train. Pump shall be sized to meet maximum day demand and standby pump is not required.

18.13.2 The chemical pump feed rate speed and stroke shall be fully automated and controlled by the SCADA system. For alum, ferrous or ferric chloride, the feed rate shall be based on flow-proportional requirements. For chlorination system, the feed rate will be based on a closed feedback loop.

18.13.3 The following chemical addition points may be required to improve treatment process:

a. Primary clarifier influent channel

b. Aeration tank effluent channel

c. Combined secondary clarifier effluent channel

18.13.4 Chemical storage tank shall be fibre reinforced plastic (FRP) composite tank. Inner and outer shell shall be FRP with insulation sandwiched in between. Tank shall be heat traced to prevent freezing of chemical in the winter. Outer FRP shell shall be manufactured with Ultra-Violet (UV) inhibitor. Vertical sight-glass shall be provided to indicate level of chemical in the tank. Provide ultra-sonic level probe for monitoring of chemical level in the tank by the SCADA system. Feed chemical directly from storage tank to metering pump – day tank is not required. Install tanks outside in a containment area to contain chemical spill. Provide a minimum of two chemical tanks for each chemical required for treatment process.

18.13.5 As a minimum, instrumentation and control required for the chemical system includes:

a. Speed and stroke length for chemical metering pump

b. In-line metering device of chemical feed rate

c. Ultra-sonic level measuring device for chemical tanks

d. Flood alarm in containment area

e. Temperature of chemical in tank

18.14 Digesters

Primary Digester

18.14.1 Where required, design primary digester in accordance with MOE design guidelines.

18.14.2 Primary digester shall be circular reinforced concrete tank with conical floor with one sidewall access bulkhead into the digester for inspection and cleaning. Exterior of tank shall be complete with brick veneer or aluminum cladding. Provide insulated fixed steel cover for primary digester.

18.14.3 Provide mechanical mixing equipment for primary digester.

Secondary Digester

18.14.4 Where required, design secondary digester in accordance with MOE design guidelines.

18.14.5 Secondary digester shall be circular reinforced concrete tank with conical floor with one sidewall access bulkhead into the digester for inspection and cleaning. Provide insulated steel floating cover for secondary digester.

Heating Digester

18.14.6 Halton Region has no unique requirements

Mixing: Mechanical and Chemical

18.14.7 Halton Region has no unique requirements

Waste Gas Burners

18.14.8 Halton Region has no unique requirements

18.15 Sludge Loading Station

18.15.1 The consultant must consult biosolids staff and/or the biosolids haulage contractor to ensure current equipment can be utilized at any new or upgraded existing facilities

18.15.2 Sludge loading station shall be designed for minimum interference to the operation of the plant during sludge loading operation.

18.15.3 Access to the sludge loading station shall be shall be designed to permit trucks to enter and leave the station directly. Provide a sludge containment area at the loading station with a catch basin in the middle of the containment area with concrete curbs. Drain sludge from containment area to holding tank. Provide a hosing station for cleaning of spilled sludge off the truck or the containment area.

18.15.4 Each sludge loading station is to have a display that is visible to the driver when filling the truck which shows the volume of sludge loaded for the current load. The value will reset to 0 when a new load starts.

18.16 High Pressure Effluent Water System

18.16.1 Provide high pressure effluent water system for cleaning of inlet works, primary and secondary clarifiers, aeration tanks and for lawn watering. The high pressure effluent water system shall consist of a minimum of 2 pumps and an air pressure tank to maintain system pressure when the pumps are not running. System shall be fully automatic with the pumps delivering the required flow and pressure at the furthest post yard hydrant of the high pressure effluent water system.

18.16.2 Install non-freeze type post yard hydrants at appropriate locations to facilitate cleaning of facility process structures and or equipment, complete with removable keys, and supply each

with a 35 x 25 hose adapter. Hydrants shall be Zurn Z-1390 or Wade Series W8610, 35 mm dia. (1.5" dia.).

18.16.3 Provide new and existing effluent service water valves (yard hydrants and hose bibbs) with nameplates reading 'Caution Non Potable Water' fastened on or near each valve. Nameplates to be of the lamacoid type, 15 mm high white letters on black background.

18.17 Sampling Stations

18.17.1 Automatic sampling stations are required to perform discrete or composite, flow proportional and time proportional sampling. Flow proportional or interval time sampling to function based on constant volume/variable time interval cycles initiated by external 4-20 mA flow meter signal or a pulsed signal where each pulse represents a fixed volume of flow. The signal type depends on the capability of the sampler. In either case the signal will come from the SCADA system. Interval time sampling initiated by integral timer, maximum interval time 99 hr, 59 min, 59 sec. Sampling sequence to begin with high pressure air purge of intake assembly to clear obstructions. Sampling then takes place. Should the sampler not be able to draw enough volume to obtain a required sample, the unit to initiate a second and third attempt, as necessary, automatically increasing the duration of purge and vacuum cycles. Should a sample not be possible after the third attempt the sampler to abort the sequence. If a second unsuccessful sampling sequence occurs, sampler to initiate a fault alarm. Provide red signal light and audible alarm at the unit for this purpose.

18.17.2 The sampler shall include a thermostatically controlled sample compartment which is MISA accepted wetted parts and built-in data logger with sampling mode indicator lights and adjustable pre sample and post sample purge. The sampling pump shall be corrosion resistant peristaltic sample pump with suction line fault indicator and sized to maintain a minimum of 12.0 m/s intake velocity. Sampler shall be powered by 110 VAC, 60 Hz.

18.17.3 Sampler enclosure to be weatherproof, corrosion resistant, insulated and c/w forced air heater and thermostat, locking door and bolt down base. Refrigerated sample compartment to be lockable. Controller to be programmable with LCD display. In the event of power failure, program settings and stored information to be maintained by an internal lithium battery.

18.17.4 For discrete sampling, three (3) sets of the following items are required:

a. Distribution assembly with 24 bottle arm

b. Set of 24 polyethylene bottles (1 L) with lids

c. Retainer and bottle tray for 350 mL bottles

18.17.5 For composite sampling provide one (1):

a. 1. Plastic composite container

b. 2. Automatic shut off with full sample container

18.18 Non-metallic Chain and Flight Longitudinal and Cross Sludge Collectors

Sludge Collector Mechanism

18.18.1 Longitudinal and cross collector mechanisms shall be of the drag scraper type and the complete systems shall include drive units, chains, flights, wear strips, return rails, anti float tracks, supports and brackets, shafts and sprockets. The collector mechanisms will be used in the primary and final settling tanks to remove sludge to cross collector channels, which will then remove the sludge to hoppers. The collector mechanism will also be used to convey scum across the tank surface to the scum trough. The collectors will be installed in rectangular concrete tanks for continuous or intermittent operation under all climatic conditions. Particular attention shall be given to winter operating conditions with provisions included for handling ice, snow and low temperatures, which would otherwise interfere with the desired operation. The sludge collector mechanisms shall be designed for continuous and uninterrupted service and provision shall be made for easy adjustment, lubrication and replacement of all parts.

18.18.2 A calibrated shear pin shall be installed in each drive sprocket designed to be the weakest part of the mechanism. Design the shear pin to fail before the drive unit or the collector chain and/or drive chain is damaged. Steel members less than 10 mm in thickness or bolts less than 12 mm in diameter shall not be used in the mechanisms.

18.18.3 Sprockets shall be molded from solid Nylon 6 material, polyurethane with minimum hardness of 80 Durometer, with chain saver rims. Sprockets shall be of the hunting tooth design with teeth width sized to engage the entire length of the chain link barrel. The driven bull sprocket shall be of a pitch diameter of 845 mm. The driven sprockets shall be designed such that they can be mounted in the recesses in the tank walls.

18.18.4 Head shaft sprockets shall be of a minimum of 23 tooth design with key way molded into the hub and locked onto the shaft. Locate sprockets on shafts using split collars. Install 17 tooth corner and idler sprockets revolving freely on polyurethane bearing sleeves clamped to a static shaft. Install sleeves of split construction with shoulder or collars on each end to restrict lateral movement of the sprocket. Provide sleeves compatible with the sprockets.

18.18.5 Like pieces shall conform to exact dimensions so that no fitting or adjusting will be necessary in assembling the entire mechanism. Similar parts shall be interchangeable so that defective pieces of equipment may be readily replaced by a new piece made in accordance with the drawings.

18.18.6 The collectors shall travel at the following speeds:

a. Primary settling tank longitudinal collector – 600 mm/minute.

b. Primary settling tank cross collector – 1200 mm/minute.

c. Secondary settling tank longitudinal collector – 300 mm/minute.

d. Secondary settling tank cross collector – 600 mm/minute.

18.18.7 Collector chains manufactured of molded thermoplastic polyester resin or high strength polymeric having 150 mm links with an average weight of not less than 1.93 kg/m. The chain shall have a working load of not less than 10.8 kN based upon strength, fatigue, and wear considerations. Barrel and ribbed side bars to be integrally molded to ensure squareness and strength of the links.

18.18.8 Connecting pins to have full load bearing capacity through the entire length of the barrel and link side bars. Pins, of reinforced acetal resin or other glass reinforced polymer, shall have a T head feature to seat in the link to prevent pin rotation, and shall have self-locking feature.

18.18.9 Attachment links or flight brackets, of the same material as the chain links, shall be provided for flight attachment. The links or brackets shall extend the full flight depth. Bolt pattern shall be industry standard and shall accommodate four 9.5 mm diameter, type 316 stainless steel bolts.

18.18.10 Two wear strips to be installed fastened to the concrete floor for the full length of each pass of the tanks and cross collector channels. Wear strips shall be of ultra high molecular weight polyethylene, 76 mm wide and 9.5 mm thick. Anchor wear strips to the floor at minimum 500 mm centres. Predrill the wear strips with through holes and counter bore. Provide expansion bushing plastic plugs and 316 stainless steel anchors minimum 50 mm long.

18.18.11 For the return runs of the sludge collector mechanisms, install return rails of fibreglass reinforced plastic, angle shape of at least 76 x 76 x 9 mm thick. Locate top return rails, where indicated, at uniform elevation to convey surface scum to the scum trough. Provide sufficient supports for the return rails to support a minimum load of 3.7 kg/m. Cut, drill and fit return rails in the field according to field measurements. Splice rails at expansion joints with the rails cut at a 45° angle to the axis and with a clearance of 3 mm between ends. Install brackets at each end. Chamfer edges for smooth transfer of the wearing shoes. Install wear strips attached to the return rails with slotted pan head machine screws. All hardware to be 316 stainless steel. Mount return rails with the wearing surface level across the pass.

18.18.12 Wall brackets shall be of cast Nylon 6 material of Type 316 stainless steel pre drilled for attachment to walls and for attachment of run shoes and return rails with 316 stainless steel hardware.

18.18.13 Install in each tank pass two (2) anti float tracks located as required at a level to ensure that the longitudinal collector mechanisms do not rise and interfere with effluent channel, weir troughs, scum collector, etc. Tracks, wear strips and supports shall be of same materials as return tracks. Tracks shall be installed with curvature and rounded ends to ensure a smooth uninterrupted flight path.

Flights

18.18.14 Flights shall be fibreglass longitudinal flights 75 x 200 mm pultruded channel section having continuous fibreglass filaments in addition to a fibreglass mat running the full length of the member and a scraper lip on the flights to ensure cleaning of the tank floor.

18.18.15 Use filler blocks for bolting to the chain attachment links with 9.5 mm diameter, 316 stainless steel bolts. All flights shall be drilled and notched for all attachments. Attach longitudinal and cross collector flights to the chains at intervals of approximately 3 metres and 1.5 m, respectively.

18.18.16 Flights to be installed with approved wearing shoe properly attached at the points where the flights ride on the wear strips on the tank floors and on the return rails mounted on the tank walls. Wearing shoes shall be of Nylon 6 or UHMW – polyurethane material and not less than 13 mm thick and approximately 125 x 75 mm. Wear shoes shall be integrally cast with guide lugs for the return rails. Install using 316 stainless steel bolts for fastening the wearing shoes in place during operation of the collectors.

Shafting

18.18.17 Shafting shall be of cold rolled steel straight and true, and of ample diameter to transmit the power required without undue stresses. Shaft deflection shall be limited to 2.0 mm per metre of length between bearings at the maximum chain pull of 8.0 kilo Newtons per strand times the chain pull factors listed below:

a. Head shaft 1.0

b. Lower shaft at hoppers 1.5

c. Tail shafts 1.0

d. Idler shafts 0.5

18.18.18 Mount all shafts in any one pass parallel to each other and perpendicular to a centre line along the length of the pass.

18.18.19 All shaft bearings shall be installed with an approved pressure type grease lubrication system with buttonhead fittings for dry running of the system. Bearings shall be fabricated with stainless steel tubing to lubrication fittings fastened with stainless steel fasteners to a stainless steel bracket mounted in an accessible location. Install babitted bearings of ample length, self-cleaning, self-aligning type mounted in cast iron housing. Arrange bearing housings for bolting directly to the concrete walls of the tanks. Place split collars on shafts at the bearing to maintain the shaft in position.

Drive Mechanism

18.18.20 Drive each longitudinal collector by its own motor coupled to a speed reducer and non-metallic chain drive to the head shaft. Non-metallic driving chains shall be fabricated with stainless steel pins. Chain shall consist of about 66 mm pitch links and have a working load of 7.7 kN. Provide an idler on each chain drive for slack take up for proper and smooth operation. Make provision to grease lubricate idlers from an accessible point. Provide each collector mechanism with a suitable safety shear pin or other approved device to limit the torque on the drive shaft.

18.18.21 Speed reducers shall be weatherproofed and designed for operation under climatic weather conditions typical of the area. Protect all chains and sprockets above settling tank walls with totally enclosed, hinged, anodized aluminum guards.

18.18.22 Speed reducers shall be of the helical gear type having an overall efficiency of not less than 90 percent and sized for continuous service under full load conditions. Rate the speed reducers for an AGMA load classification II. Fabricate all gears from steel with teeth cut to accurate shape. All shafts shall run in anti friction bearings.

18.18.23 Enclose the gears in a heavy moisture and oil proof case. Gears shall run in oil. Provide accessible inspection opening and separate oil, fill and drain in each gear casing.

18.18.24 Motors shall be mounted on the speed reducers which shall be installed on heavy structural steel or cast iron bases arranged for bolting onto the concrete.

18.18.25 Provide aluminum hinged covers to cover drive chain. Fabricate cover from 14 gauge aluminum complete with lifting handle for each drive. Design guards to be readily removable for inspection of the drive, chain and sprocket fling one end of the guard for the concrete. Use stainless steel hinge pin and fastener, minimize size of openings in the cover for maximum protection of the equipment from the elements.

18.19 Hydraulic Heating Systems

Piping

18.19.1 Layout of piping to provide expansion and contraction allowance of 100°C water temperature to ambient at a working pressure of 860 kPa.

18.19.2 Slope horizontal piping mains to provide a minimum continuous up-grade of 25 mm in 6 m to high points. Slope branch supply and return piping connections to equipment a minimum of 25 mm in 1.2 m. Leave sufficient room at high points for installation of air vents. Install all heating pipes in such a way that all high points are vented and all low points are drainable. Provide a drain valve at the base of each piping riser, in drain connections to equipment, in low points of horizontal piping with hose end adapters, screw caps and retainer chains. Install piping so that there will be no interference with the installation of equipment, other piping systems, ducts, etc. Install piping to ensure noiseless water circulation. Make changes in pipe sizes and connections to valves and equipment with eccentric reducers to maintain uniform invert slopes and to prevent air pockets. In general piping should be run at high level along ceiling or inside suspended ceiling space for serving wall fin convectors and baseboard heaters on the next floor above unless otherwise indicated on the Drawings. Avoid running pipes over electrical panels/ transformers. Provide link seals at all pipes penetrating through walls and slabs that are below grade.

18.19.3 Provide balancing and flow control valves on hot water return piping from each heating unit or equipment and on the supply and return of each primary and secondary circuit. After installation and system is put in operation, balance valves.

Circulating Pump

18.19.4 Provide centrifugal or close coupled vertical in-line circulating pumps. Provide a shut-off valve and suction guide in pump suction piping, and a combination check-balance-shut-off valve assembly in pump discharge piping.

Testing

18.19.5 Hydraulic leak test piping systems in accordance with ANSI B31.9 937.3 using potable water. Isolate all equipment that may be damaged during testing of pipe. Check each joint and weld using a leak detection compound such as “SNOOP” supplied by Avon Valve and Fitting Limited, Scarborough. Test randomly selected valves as directed, to demonstrate drip tight shut off. Test and correct before pressure sensitive devices are installed in the pipe work. Any leaks found shall be made tight under pressure. If this is not possible, piping shall be removed, refitted and retested. Caulking of threaded joints is not permissible.

Cleaning

18.19.6 Following completion of hydrostatic testing, drain the test fluid at a rate of flow sufficient to flush from the system any debris or foreign material. Clean pipeline strainers after circulating test fluid. Provide anti corrosion chemicals for all new hot water recirculating system. Chemically flush system to degrease and remove mill scale and iron oxide particles. Solutions may be mixed on site or delivered premixed by an approved cleaning contractor.

18.20 UV Disinfection

18.20.1 To be added

SECTION 19 SEWAGE PUMPING STATIONS

19.1 Introduction

19.1.1 The focus of this section is to describe, in general terms, the design and construction requirements for Halton Region Wastewater Pumping Stations. It is considered to be both a "standard" and "guideline" for use by experienced designers. The designer is still responsible for the quality of their designs and meeting all regulatory requirements.

19.1.2 This manual is intended for use by designers working for Halton Region for both new facilities, and upgrades to existing facilities.

19.2 General Wastewater Pumping Station Layout and Design

19.2.1 The design of wastewater pumping station shall conform to the Ministry of Environment Design Guidelines as a minimum. In addition, the design shall comply with Halton Region's design standards or guidelines where Halton Region's design standard or requirement is higher and/or has additional standards not included in MOE guidelines. The Consultant shall observe all of the above considerations in executing design works for Halton Region.

19.2.2 Design configuration of the pumping station shall be based on one of the four "Designs" of stations defined by a number of key factors such as flow, land available, depth of wet well, flow variation etc. (Refer to the attached Table, following)

19.2.3 The most efficient layout of pumps and equipment for safe and cost effective operation and maintenance of the facility shall be considered.

19.2.4 Emergency overflows on pumping stations are a Council requirement. A report to Council is required indicating that the pumping station has an emergency overflow. An emergency overflow pipe shall be provided for all wastewater pumping station wet wells. Flow measurement on the emergency overflow is required.

19.2.5 Where the provision of the emergency overflow pipe is not possible a deviation memo must be produced that includes the consideration of permanent or portable emergency standby power and increased retention time options and how risks are being managed.

19.2.6 Pumping functionality has to be maintained in flooded condition. All electrical & control equipment shall be located above emergency overflow/flood line with the exception of emergency stops and local start stop push buttons which shall be located next to the pump and shall be submersible. Operator control vs. operability in a flood situation – pumps continue to run in the event of a dry well flood.

19.2.7 Station to be designed and configured for confined space entry and retrieval. Where possible, minimize or eliminate confined spaces and minimize the equipment contained in these areas, to reduce maintenance effort and costs.

19.2.8 Provide lifting and lateral transfer devices for the removal and installation of equipment including removal from the station.

19.2.9 Provide a minimum of one (1) metre clear unobstructed space around equipment for servicing.

19.2.10 Ensure backflow preventers are installed in accordance with the cross connection Bylaw and linear design standards. For reference, this includes isolation valves and testing ports. Do not install any of the related equipment in the wet well area.

19.2.11 To ensure safe access, provide a minimum of 1 metre concrete area as a level walking area around openings for tanks and hatches

Table 18-1 Wastewater Pumping Station Design Table

DESIGN STYLE	GENERAL LAYOUT	TYPICAL STATION FLOW RANGE SIZE (BASED ON PEAK INSTANTANEOUS FLOWS AS A MINIMUM)	ON-SITE WET WELL STORAGE CAPACITY	NUMBER, SIZE & WEIGHT OF PUMPS	GEN SET REQ'D
1	Submersible pumping station separate electrical panel located above grade	Inflow less that 5.3 L/s	Minimum 4 hour storage capacity based on peak flow	Two constant speed pumps (1 duty & 1 standby)	No, but a plug in provision for a portable generator is required
2	Submersible pumping station with separate building for controls, MCC, and standby generator	Inflow greater that 5.3 L/s but less than 26 L/s (0.5 migd)	Minimum 1 hour wet well storage capacity based at peak flow and preferred 4 hour system storage capacity	Two constant speed pumps (1 duty & 1 standby)	Yes - sized for all connected loads
3	Submersible pumping station with separate building for controls, MCC, standby generator with a basement or vault to house valves so confined space entry not required	Inflow greater than 26 L/s but less than 53 L/s	Minimum 1 hour wet well storage capacity based at peak flow and preferred 4 hour system storage capacity	Minimum of 3 pumps one lead, one lag and one standby, Consideration should be given to VFD and soft starts	Yes – sized for all connected loads
4	Dry/wet well Pumping Station with superstructure above the dry well that housed controls, MCC, standby generator, etc.	Inflow greater than 53 L/s (1 migd)	Split wet well Minimum 1 hour wet well storage capacity based at peak flow and preferred 4 hour system storage capacity	Minimum of four pumps configured as 3 duty & 1 standby. Consideration should be given to VFD and soft starters. Locate pumps in dry pit	Yes – sized for all connected loads

19.2.12 In general, the station is sized based on the average day, while the pumps are sized to handle the peak flow. These different pumping station design "types" were developed to reflect the four options available to the designer, while generally matching Halton Region's existing pumping station base designs.

19.3 Sketches of Typical Layouts

19.3.1 Refer to Appendix C: General Overview of Four Typical Stations, showing the typical layout for all four station designs.

19.4 Pumping Station Design I

19.4.1 These are generally small in-ground submersible pumping stations. Refer to Appendix C: Typical Station 1 Arrangement

19.4.2 Provide on-site wet well storage capacity for four hour retention based on peak flow.

19.4.3 Provide an emergency overflow pipe for the pumping station.

19.4.4 Design pumping station for operation with two constant speed submersible pumps in a single wet well configuration; with each pump sized for peak flow.

19.4.5 To address the situation when all pumps are out of service for repair, or in an emergency, provide a piping/valve arrangement that will enable staff to temporarily drop in spare pumps and connect the discharges to the existing forcemain. To address the similar situation where there is a problem with the downstream forcemain, provide a piping/valve arrangement that enables staff to use the existing pumps to either fill a truck or pump to a downstream manhole, beyond the forcemain failure. All piping, valves, etc, must be a minimum 150mm. Refer to Appendix C: Piping Bypass Arrangement.

Wet well design requirements-

19.4.6 The pumps must be no larger than 20 HP and/or 270 kg (600 lb) to enable O & M staff to use the in-house trucks to lift and remove pumps.

19.4.7 The station shall be designed such that the top of the wet well extends a maximum of 600 mm above ground level for snow clearance. Where such requirement is not approved by the Area municipalities, it shall extend a minimum of 150 mm above finished ground level.

19.4.8 A concrete ring with a minimum of 1 metre width must be installed around the top of the wet well, so that it is wide enough to install a tripod for confined space entries. Flush mounted sockets for davits to enable personnel retrieval and equipment hoisting shall be provided.

19.4.9 Influent pipe to in-ground pumping station shall be positioned to ensure that the wastewater does not flow directly over the pump(s). It shall be designed with a minimum distance of two volute diameters away from the pump centre line.

19.4.10 All operator access into the station shall be made through an access hatch with minimum dimensions of 915 mm by 762 mm. The access hatch cover shall be hinged and lockable by padlock and shall be made of non-corrosive material. Lock port shall be recessed and provided with drainage pipe. The cover shall be provided with the necessary hold open arm to keep the cover in the vertical position once it is opened.

19.4.11 Access opening for pump shall be sized for pump installation or removal. It must also be sized to permit the entry of personnel wearing retrieval equipment harness without undue

difficulties. Design access and movement of staff in the station to move freely without the need to disconnect their safety line.

19.4.12 Provide a union box equipped with terminal strip in the wet well to facilitate changes of the float switches. Provide a separate union box for pump power supply and to enable the removal and installation of the pump.

19.4.13 Do not provide any continuous ventilation for the purposes of reducing the classification of the area

19.4.14 Exterior lighting to be considered, for illuminating the wet well access area, if site location permits. The light switch to be mounted inside the electrical panel (or building).

19.4.15 Vertical access ladder shall be non-slip aluminum.

19.4.16 Hardware (e.g. mounting hardware) inside the station shall be 304 stainless steel.

19.4.17 The area is defined as Class 1, Group D, Division 1 so all electrical items must meet this requirement.

19.4.18 The Fire Protection Measures indicates a combustible gas detection system is required. Install a combustible gas sensor in order to meet the legal requirements of the code. For reference, NFPA 820 page 37, item 7.4.5.2 states that the operating authority can set the alarm limit higher than 10% where experience indicates that the ambient levels would produce spurious alarms. Therefore the device should be set at a higher level to eliminate the “spurious alarms”. To reduce the ongoing maintenance costs, the sensor should be accessible without having to enter a confined space. Therefore the sensor should be installed near an access hatch, near the top of the wet well, which will hopefully also reduce the spurious alarms. Depending upon the site specific details, there may also be other fire prevention measures that the designer should take into account, and all applicable codes should be consulted.

Electrical Junction Boxes

19.4.19 Provide different boxes for different voltages (lockable).

19.4.20 To meet the code requirements and for ease of maintenance, all wiring from the wet well must be terminated in junction boxes that are located outside the wet well, above or beside it, but within the Zone of Influence. Then, the EYS seals and any other related components should be installed between this junction box and the control panel. Refer to Appendix C: Electrical Box Locations.

19.4.21 Electrical & process controls equipment to be above grade in a standalone control panel with the following design requirements-

19.4.22 Ensure that the panel is a minimum distance of 1.5m away from the wet well entry or venting system, so that according to NFPA 820, the area is not classified.

19.4.23 The panel must be mounted a minimum of 1m height above the ground to preclude snow entry, while also providing good working height and complement the aesthetics of the location.

19.4.24 Size cabinet to permit safe maintenance work, as it must include the facility power feed and manual transfer switch, pump controls, SCADA and networking hardware, plus a location for the hydro meter. Cabinet shall be located to permit the removal of the pump without undue difficulties.

19.4.25 Provide a vandal proof lockable electrical hook-up connector on the panel exterior designed to permit supply of electrical power to the station by a portable electric generator. Provide the

necessary electrical hardware and switch gear to accomplish this requirement. Type and model of lock will be provided by Halton Region.

19.4.26 Vehicular access to the wet well shall be provided. Provide a paved surface that permits the vehicle & portable generator trailer to be entirely off the main road and be able to sustain vehicular weight without damage. Design must accommodate a fully loaded vacuum truck.

19.5 Pumping Station Design II

19.5.1 Provide a minimum 1 hour wet well storage capacity based at peak flow and also a preferred minimum 4 hour system storage capacity. Refer to Appendix C: Typical Station II Arrangement.

19.5.2 Provide an emergency overflow pipe for the pumping station.

19.5.3 Design pumping station for operation with two constant speed submersible pumps in a single wet well configuration; with each pump sized for peak flow.

Wet well design requirements-

19.5.4 The wet well design requirements are the same as noted for the Design I.

19.5.5 Provide electrical junction boxes for all power and control cabling from the wet well to the building, as described for Design 1 stations.

19.5.6 Vehicular access to the wet well area shall be provided. Provide a paved surface that permits the vehicles to be entirely off the main road and be able to sustain vehicular weight without damage. Design must accommodate a fully loaded vacuum truck.

19.5.7 Provide emergency standby diesel generator. Generator shall be designed to run all connected loads.

19.5.8 The emergency standby generator, electrical, and process controls equipment to be located in a building with the following design requirements-

19.5.9 The building must be sized to permit safe maintenance work, including appropriate clearance around the generator. It must include the facility power feed and automatic transfer switch, pump controls, SCADA and networking hardware, plus a location for the hydro meter. The building shall be located to permit the removal of the pump without undue difficulties.

19.5.10 The building shall be a minimum distance of 1.5m from wet well. The designer should ensure that any air flow between the wet well and the building does not create a problem with area classifications. A good design practice is to ensure that the wet well exhaust vent is not pointing towards the building, and any air intakes for the building are not near this exhaust. Ventilation for the building should be on the opposite of the building from the wet well so that fresh air can be drawn into the ventilation system. Consider the impact of the vacuum created by the intake of the ventilation system.

19.5.11 No windows.

19.5.12 Minimal exterior lighting, to illuminate the wet well access area.

19.6 Pumping Station Design III

19.6.1 Provide a minimum 1 hour wet well storage capacity based at peak flow and also a preferred minimum 4 hour system storage capacity. Refer to Appendix C: Typical Station III Arrangement.

19.6.2 Provide an emergency overflow pipe for the pumping station.

19.6.3 Design pumping station with three constant speed submersible pumps in a single wet well configuration; design firm capacity for peak flow. If any single pump is over 270 kg (600 lbs) then you are required to use a Design IV station with a dry well.

19.6.4 For station with three pump operating system, determine the most efficient pumping configuration for the station based on:

19.6.5 Three equally sized pumps or

19.6.6 Three unequally sized pumps or

19.6.7 Combination of the above .01 and .02.

19.6.8 Combination of .03 with variable frequency speed pump(s).

19.6.9 Wet well design requirements-

19.6.10 The wet well design requirements are the same as noted for the Design I.

19.6.11 Vehicular access to the wet well area shall be provided. Provide a paved surface that permits the vehicles to be entirely off the main road and be able to sustain vehicular weight without damage. Design must accommodate a fully loaded vacuum truck.

19.6.12 Provide electrical junction boxes for all power and control cabling from the wet well to the building, as described for Design 1 stations.

19.6.13 Provide emergency standby diesel generator. Generator shall be designed to run all connected loads.

19.6.14 The emergency standby generator, electrical, and process controls equipment to be located in a building with the following design requirements-

19.6.15 The building requirements are the same as noted for Design II stations.

19.6.16 Valve Chamber design requirements-

19.6.17 Provide a “split” building with a wall separating the chamber from the generator area, and separate entrance doors for each area. For reference, this also means that a superstructure would be above the valve chamber, to provide better access in the winter. On small sites, this superstructure may only be a doorway then stairs into the basement area- without creating a confined space.

19.6.18 Do not provide any permanent ventilation for NFPA 820 compliance for fire code protection.

19.6.19 To reduce the ongoing O&M effort and costs, install a permanent ventilation system, as per NFPA 820 to temporarily declassify the area when performing maintenance activities. This will allow maintenance staff to use electrical equipment, such as drills, in the area.

19.6.20 The area is defined as Class 1, Group D, Division 2 so all electrical items must meet this requirement.

19.6.21 The NFPA 820 Fire Protection Measures indicates a combustible gas detection system is not required

19.6.22 The chamber should be a minimum distance of 1.5m from the wet well, to be outside the Zone of Influence, as described elsewhere.

19.6.23 Within the basement include the second set of pump isolation valves, discharge flow meter, and forcemain connection,

19.6.24 Permanent recirculation piping with a valve must be installed to allow for Maintenance and Operations performance testing.

19.6.25 The design intent is to ensure that the pumps can continue to operate even if/when the basement area is flooded. All electrical devices (i.e. receptacles, plugs, controls, etc.) are to be located above the basement flood level.

19.6.26 Provide variable frequency drive(s) where there is a need for continual flow from one pumping station to the next pumping station or wastewater treatment plant. The final design decision shall be based on good engineering practice. In no case shall the minimum designed discharge velocity be less than 0.8 m/s. See Halton's Design Manual - latest revision.

19.7 Pumping Station Design IV

19.7.1 Provide a minimum 1 hour wet well storage capacity based at peak flow and also a preferred minimum 4 hour system storage capacity. Refer to Appendix C: Typical Station IV Arrangement.

19.7.2 Provide an emergency overflow pipe for the pumping station

19.7.3 Design pumping station with at least four constant speed submersible pumps located in the dry well, with an associated split wet well. For four pump configurations, each pump to be sized to handle 50% of the peak flow. The pumps are to be located in a dry well, with the pipe suctions directly from the wet well.

19.7.4 Wet well design requirements-

19.7.5 Provide a split wet well with isolation gate. The top of the split wet well wall is to be located at least 0.2m above the station emergency overflow.

19.7.6 If no superstructure, the wet well shall be designed such that the top of the wet well extends a maximum of 600 mm above ground level for snow clearance. Where such requirement is not approved by the Area municipalities, it shall extend a minimum of 150 mm above finished ground level.

19.7.7 If no superstructure, a concrete ring with a minimum of 1 metre width must be installed around the top of the wet well, so that is wide enough to install a tripod for confined space entries. Flush mounted sockets for davits to enable personnel retrieval and equipment hoisting shall be provided.

19.7.8 Influent pipe to in-ground pumping station shall be positioned to ensure that the wastewater does not flow directly over the pump(s). It shall be designed with a minimum distance of two volute diameters away from the pump centre line.

19.7.9 If no superstructure, all operator access into the station shall be made through an access hatch with minimum dimensions of 915 mm by 762 mm. The access hatch cover shall be hinged and lockable by padlock and shall be made of non-corrosive material. Lock port shall be recessed and provided with drainage pipe. The cover shall be provided with the necessary hold open arm to keep the cover in the vertical position once it is opened.

19.7.10 Access openings must be sized to permit the entry of personnel wearing retrieval equipment harness without undue difficulties. Design access and movement of staff in the station to move freely without the need to disconnect their safety line.

19.7.11 Provide a union box equipped with terminal strip in the wet well to facilitate changes of the float regulators. Provide a separate union box for pump power supply and to enable the removal and installation of the pump.

19.7.12 If no superstructure, exterior lighting to be considered, for illuminating the wet well access area, if site location permits. The light switch to be mounted inside the electrical panel (or building).

19.7.13 Vertical access ladder shall be non-slip aluminum.

19.7.14 Hardware (e.g. mounting hardware) inside the station shall be 304 stainless steel.

19.7.15 Vehicular access to the wet well/dry well area shall be provided. Provide a paved surface that permits the vehicles to be entirely off the main road and be able to sustain vehicular weight without damage. Design must accommodate a fully loaded vacuum truck.

19.7.16 Provide electrical junction boxes for all power and control cabling from the wet well to the building, as described for Design 1 stations.

19.7.17 Dry well design requirements-

19.7.18 Provide a “split” building with a wall separating the dry well from the generator area, and separate entrance doors for each area. For reference, this also means that each area has completely independent, permanent ventilation systems. A superstructure would be above the dry well, to provide better access in the winter. On small sites, this superstructure may only be a doorway then stairs into the basement area- without creating a confined space. Taking this approach, the dry well design requirements are the same as for the Design III Valve Chamber.

19.7.19 No windows.

19.7.20 Minimal exterior lighting.

19.7.21 Within the basement include the pump isolation valves, discharge flow meter, and forcemain connection piping.

19.7.22 Air release piping from pump discharge pipes shall not be P.V.C.

19.7.23 Provide a crane within the building, for lifting and removing the pumps.

19.7.24 A 37.5 mm water service shall be provided for flushing and cleaning purposes, with taps at key locations.

19.7.25 The design intent is to ensure that the pumps can continue to operate even when the dry well is flooded. All electrical devices (i.e. receptacles, plugs, controls, etc.) are to be located above the dry well flood level. The local pump control hand switches to be submersible.

19.7.26 Provide an emergency overflow pipe for the pumping station

19.7.27 Provide variable frequency drive(s) where there is a need for continual flow from one pumping station to the next pumping station or wastewater treatment plant. The final design decision shall be based on good engineering practice. In no case shall the minimum designed discharge velocity be less than 0.8 m/s. See Halton's Design Manual - latest revision.

19.7.28 Provide a pressure gauge at each pump discharge pipe.

19.7.29 Vertical access ladder shall be non-slip aluminum.

19.7.30 Provide emergency standby diesel generator. Generator shall be designed to run all connected loads.

19.7.31 The emergency standby generator, electrical, and process controls equipment to be located in a building with the following design requirements-

19.7.32 The building requirements are the same as noted for Design II stations.

19.8 Wet Well

19.8.1 Wet well shall be designed to suit the pump capacity which should in turn be matched to the station design flow rate, and flow variation. The size of the wet well in relationship to the suction pipe(s) shall be in accordance with the Hydraulic Institute to prevent hydraulic interference. The depth of the wet well shall be sufficient to ensure adequate control bands for each pump.

19.8.2 In no case shall the wet well be designed which will result in the pump(s) cycling more than six (6) times per hour for a station with motor of less than 40 HP and not more than two (2) times per hour for a submersible station with motor greater than 40 HP. In no case shall this exceed that as recommended by the manufacturer but in all cases, the more stringent criteria shall apply.

19.8.3 All wet wells shall be provided with water service to enable flushing or cleaning of the wet well. Water service shall be provided with backflow preventer and sized not smaller than 37.5 mm and shall be metered in accordance with Halton Design Manual, latest revision. For the all stations, a yard hydrant complete with back flow preventer with a 37.5 mm water service shall be provided for flushing and cleaning purposes. The water service shall be connected to a non-freezing post hydrant provided adjacent to the station for flushing and cleaning purposes. For Design II, III, and IV stations, the water service shall also be plumbed into the building.

19.8.4 Benching in the wet well shall be steep and close to the pump inlet to prevent sediment build-up on the wet well floor.

19.8.5 Where possible, provide benching at 60° slope or greater around the pump suctions to prevent the build-up of solids in the wet-well. As a minimum, adhere to the MOE standard of 45°

19.8.6 Benching of a lesser slope may be provided where additional means of solids re-suspension are provided, such as pump recirculation valves or piping, or alternate mixing systems.

19.8.7 Within the benching, for larger wet wells, provide steps within the concrete, at the bottom of the access ladder, to enable staff to safely get down to the level of the pumps.

19.8.8 Ensure that with the selected benching, the station still has sufficient vertical working space for the level transmitter and back up floats to operate properly.

19.8.9 All electrical equipment in the wet well shall be explosion-proof Class 1 Division 1 in accordance with applicable codes and/or standards.

19.8.10 Provide adequate pump operating range within the wet well, as per the MOE guidelines as well as the following.

a. Minimum distance between start and stop levels for each pump must be at least 0.5m, for each pump.

b. As the backup pump control floats are above and below the normal ultrasonic operating range, also provide a minimum distance of 0.3m between the normal pump start level and the high level backup float.

c. Refer to the SPS SCADA Standards for further details on the control and monitoring of the facility.

19.8.11 All metal components installed in the wet well must be anodized aluminum or 304 stainless steel to reduce the rate of corrosion.

19.9 Wet Well Vertical Access Ladders

19.9.1 Vertical access ladders shall be anodized aluminum and designed to the requirements of the Ontario Minister of Labour OHSA. All other components, such as mounting hardware, must be at least 304 stainless steel.

19.9.2 Ladder for access to the well shall be mounted on the wall of the well and centered under the access hatch. The top of the ladder shall be 150 mm below the slab and the bottom shall not be more than 300 mm above the finished floor level.

19.9.3 Ladder for access from service platform shall be extend from the bottom of the well to the grab bars, 900 mm above the service platform with a safety chain across it.

19.9.4 Provide ladder with assists rail that can extend above the platform for safe entry and can be lowered when not in use.

19.10 Service Platform

19.10.1 Design service platform for wet well at a maximum of 300 mm above the top of the influent sewer. All others shall be located to meet operating, servicing or safety requirements.

19.10.2 Provide anodized aluminum grating in all areas requiring grating.

19.10.3 Designed grating for H-20 live load and the maximum permissible deflection shall not be more than 3 mm.

19.10.4 Provide all opened edges of the service platform with one metre high anodized aluminum handrail.

19.11 Screening

19.11.1 Where required as dictated by the characteristics of the wastewater flowing into the pumping station, provide screening as appropriate

19.11.2 Provide removable manual screens for pumping stations located near or within all new land developments.

19.12 Forcemain Design and Maintenance

19.12.1 Design the Forcemain in accordance with Halton Region's linear Design Criteria Contract Specifications and Standard Drawings.

19.12.2 Access points for swabbing and investigations are required for all station Designs.

19.12.3 Forcemains must be twinned for all station Designs. Flow velocities with both forcemains in service shall be between 0.8 and 2.5 m/s, per existing Region criteria. In a dual forcemain system, flow velocities through one forcemain shall not exceed 3.5 m/s at peak flow while the other forcemain is out of service.

19.13 Pump Design

19.13.1 Halton will not consider the use of screw or suction style pumps.

19.13.2 Dry well pumps shall be provided with an inspection port to check impeller condition or to unclog pump.

19.13.3 Provide piping flushing connections to facilitate the cleaning of plugged lines or pumps.

19.13.4 Provide an air vent pipe from high point on pump volute discharging to wet well above emergency overflow level to facilitate priming after wet well pump down. Air release piping from pump discharge pipes shall not be P.V.C.

19.13.5 Mechanical Seals-

19.13.6 Provide mechanical seal faces of tungsten carbide/tungsten carbide (TC/TC) as a minimum.

19.13.7 Halton Region's preference is to not require seal water.

19.14 Piping and Valve Design

19.14.1 Stainless steel piping will not be permitted for use in the wastewater pumping station forcemain. Only ductile iron pipe is permitted.

19.14.2 Butterfly valves shall not be used in the forcemain.

19.14.3 Depending on the size of the forcemain, isolation valves shall be knife gate or gate valves.

19.14.4 Sluice gates shall be fabricated from 316L stainless steel. Operators shall be located on ground level.

19.14.5 The piping from the pump to the forcemain shall be designed for horizontal connection and not vertically.

19.14.6 Design piping layout with "Y" configuration and not "T".

19.14.7 All valves shall be located in the horizontal position. Valves are not permitted to be installed in the vertical position.

19.14.8 Depending on size, all check valve shall be of the swing flex type with rubber flapper or conventional swing check valve with counter weight if required.

19.14.9 Provide air/vacuum valves where required.

19.14.10 Provide flushing connections to facilitate cleaning of the piping, where required.

19.14.11 Provide isolation valve on the discharge header prior to it leaving the pumping station.

19.14.12 For Design I and II stations, within the design, plan for facility bypass pumping connections, from the wet well to a downstream location. For Design III, and IV stations, provide piping and valves to allow recirculation of pumped wastewater into wet well to stir up any solids on the bottom of the well and prevent sedimentation, on the bottom of wet well. Also consider for Design II stations.

19.14.13 For Design II, III, and IV, provide recirculation piping and valves into the wet well to allow for Maintenance and Operations performance testing, including the pump flow tests. This arrangement will also be used during the 14 day trial test at the end of construction. Refer to Figure 15-8: Design II, III and IV Station Recirculation Piping

19.15 NFPA 820 Compliance and Heating & Ventilation

19.15.1 The requirements for NFPA 820 requirements are specified under each station Design.

19.15.2 Ventilation requirements for pumping stations are spelled out in various reference literature, including the MOE Design Guidelines, ASHRAE Standard 62 Ventilation for Acceptable Indoor Air Quality, and the WEF Manual of Practice 8 – Design of Municipal Wastewater Treatment Plants. Designers should reference these standards when designing facilities. However, it is important to note that NFPA 820 allows the use of increased ventilation rates to allow the de-rating of the electrical classification. Due to the additional operating costs, and the requirement to ensure continuous ventilation to achieve this de-rating, Halton Region does not prefer this technique.

19.15.3 Ventilation of wet well under normal operating condition is not required.

19.15.4 Ventilation ducts shall be maintenance free and the material shall preferably be fibreglass or plastic with unpainted finished surface. All ventilation equipment such as damper, fan or motor shall be readily accessible for maintenance and servicing.

19.16 Electrical Design

19.16.1 Consultant shall consult with Local Hydro authorities on the preferred location of the hydro meter. See preferred location and detail.

19.16.2 Provide a junction box equipped with terminal strip on the exterior of the wet well to facilitate changes of the electrical equipment in hazardous locations. See standard detail for location of EYS.

19.16.3 The process designer should review the benefits of Variable Frequency Drives (VFD's) and Soft Starters with Halton staff and document the decision (in a project memo) on whether these are required, or not.

19.16.4 The following design criterion applies to VFD's and Soft Starters.

19.16.5 For small stations, only use across the line starters.

19.16.6 For the larger sites, provide soft starters on any motors greater or equal to 75 KW (100 HP).

19.16.7 Also consider the use of soft starters on smaller size motors whenever there are concerns about voltage drops caused by motor starting or when trying to minimize the hydraulic surging in the pipelines.

19.16.8 VFD's should be selected over soft starters when the flow range analysis by the designers indicates that VFD's would provide a significant advantage, as noted in a project memorandum.

19.16.9 For both soft starters and VFD's, also provide independent, back up across the line starters so that staff can still operate the pumps when the soft starter or VFD has failed, under emergency conditions.

19.16.10 Based on the above, the cabling, generator, and associated components must be sized to accommodate starting/running all pumps using across-the-line starting.

19.17 Pump Control

19.17.1 Read this Section in conjunction with the Wastewater Pumping Station SCADA Standards and Guidelines.

19.17.2 The pumps are to be controlled by the PLC, with the level transmitters and backup floats, according to the standardized pump control schematics.

19.17.3 The PLC for the pumping station shall be designed for integration to Halton Region's Supervisory Control and Data Acquisition (SCADA) system for the operation of the waste water collection systems and treatment plants.

19.17.4 Programming of the software for the PLC shall be the responsibility of the consultant retained by Halton Region for the design of the facility. It is also the responsibility of the consultant to ensure that the station PLC is properly integrated into Halton Region SCADA system and that all required changes to the SCADA system software and/or data base(s) shall be carried by them in order to ensure seamless control and operation. This is the sole responsibility of the consultant providing engineering services for the design of the pumping station. Verification will be required prior to the station being placed into operation.

19.18 Instrumentation and Controls

19.18.1 Design control system wiring in the failsafe mode.

19.18.2 Pumps that are located out of visual sight from the MCC shall be provided with two start/stop controls. However, these must be located above the overflow level in the Design IV dry well.

19.18.3 All pumping stations except Design I and II shall have a permanent flow meter on the outlet pipe. Design I and II must have a "virtual" flow meter with the appropriate calculations in the SCADA software.

19.18.4 Provide a Region approved pressure gauge at each pump discharge pipe, for Design IV only. Provide taps and isolation valves for temporarily installing gauges in the other station Designs.

19.18.5 An ultrasonic transmitter is to be used as part of the pump(s) control system, with the following requirements-

19.18.6 The transducer head is to be installed with a submergence shield

19.18.7 The transducer head is mounted where it is easily accessible and removable

19.18.8 The sound beam angle shall not be obstructed

19.18.9 The transducer head is at least 300 mm higher than the operating span of the transmitter

19.18.10 Where required, provide a stilling well

19.18.11 Transducer head shall be mounted away from the influent pipe

19.18.12 Dead band of the ultrasonic equipment is less than the turbulent waves in the wet well.

19.18.13 For Design I, II, III, and IV stations, provide explosive gas monitoring in the wet well only.

19.19 SCADA System

19.19.1 Refer to Section 8 Wastewater Pumping Stations of the SCADA Standards Manual.

19.19.2 In general, operation of pumps shall be fully automated using a local PLC.

19.20 Site Security

19.20.1 Provide a facility access security system delivered through the SCADA system as noted in the SCADA Standards Manual, Section 8 Wastewater Pumping Stations.

19.20.2 In general, security fences around the entire site are required. Minimum 1.8m (6 foot) chain link and 4 cm (1.5 inch) opening.

19.20.3 Provide locks on all access hatches and other potential entrance areas.

19.20.4 Door locks to match Halton Region's standards

19.20.5 A security gate required for the parking area

19.20.6 The security design requirements should be reviewed with Regional staff, as this can be a site specific concern depending upon the site location, structures such as schools nearby, etc.

19.21 Hatches and Guards

19.21.1 All hatches must be 304 stainless steel with removable pin hinges for ease of greasing and removal

19.21.2 Provide guards as required under the various regulation.

19.22 Odour Control

19.22.1 Install in all wastewater stations Design 3&4

19.22.2 Install in wastewater stations Design 1&2, where odour control is known or there are odour problems are anticipated .

19.23 Buildings

19.23.1 To reduce the ongoing maintenance effort and costs, for the buildings, basements, dry wells, and wet wells, minimize or eliminate confined spaces as much as possible and minimize the activities within any confined spaces as much as possible. As part of the design process, identify all confined spaces and the equipment within these areas.

19.23.2 Provide an area within the building for storing drawings and manuals. For Design IV stations also provide an area for a 1m x 2m desk for the staff to lay out the documentation.

19.23.3 For Design 2, 3&4 provide washrooms for staff

19.24 Equipment Redundancy

19.24.1 For Design IV stations plus all stations with a split wet well, provide a redundant level transmitter, located in the other wet well.

SECTION 20 SEPTAGE UNLOADING FACILITIES

20.1 General

20.1.1 Halton Region has no unique requirements.

SECTION 21 BIOSOLIDS MANAGEMENT

21.1 General

21.1.1 Halton Region has no unique requirements.

SECTION 22 WASTE MANAGEMENT FACILITIES

22.1 General

22.1.1 Halton Region has no unique requirements.

SECTION 23 TECHNICAL SPECIFICATIONS

23.1 Overview

23.1.1 The following requirements, as specified in the following Division, are to be included in the relevant sections of the 17 Division Specifications. These are not intended to replace the Specifications that are normally prepared by the Consultant for the contract documents. Rather, these are to enhance Halton Region requirements and shall be included as part of the Specifications that the Consultant prepare for the Technical Specifications.

23.1.2 Section 4 Structured Cabling of the SCADA Standards Manual has Technical Specifications that apply to Division 17 Structured Cabling that are to be included in all appropriate Contract Specifications.

23.2 Division 1 – General Requirements

Site Specific Health and Safety Plan

23.2.1 Contractor shall submit a site specific Health and Safety Plan within five (5) working days after date of Notice to Proceed and prior to mobilization on site. The site-specific Health and Safety Plan must address the requirements of the Acts.

Health & Safety

23.2.2 The Contractor shall meet the requirements of the following:

a. Occupational Health and Safety Act, Regulations for construction projects, Part II General Construction, latest edition.

b. Occupational Health and Safety Act, Industrial Establishments Regulation, Part I Safety Regulations, latest edition.

c. Canada Labour Code, Canada Occupational Health and Safety Regulations, Part XI – Confined Spaces.

Work in Hazardous Locations/Confined Spaces

23.2.3 Comply with the requirements of CAN/CGA B-105-M-93 when working in and around hazardous locations/confined spaces.

23.2.4 Conform to Ministry of Labour requirements for work in hazardous locations. Establish and implement written procedures to assure compliance.

23.2.5 Construction activities, except wire pulling and cleaning, that occur in hazardous locations require continuous combustible gas monitoring, by the Contractor.

23.2.6 Provide documentation of tests for gas and oxygen deficiency prior to starting work in hazardous locations.

23.2.7 Ensure that all personnel engaged in confined space work or work in hazardous locations that require the use of respiratory equipment, comply with the requirements of the Ministry of Labour and must be clean shaven.

23.2.8 It is the Contractor's responsibility to provide all necessary gas detector equipment, ventilation, other safety devices required by law.

23.2.9 Smoking is not permitted in hazardous areas or other areas as designated by Halton Region. Post "No Smoking" signs as required.

Site Occupation/Mobilization and Demobilization – General Requirements

23.2.10 The Contractor and sub-contractors to observe and ensure the following:

a. Set up offices in neat and orderly fashion where noted on drawings.
b. Shall not occupy any areas outside those described on the contract document and not in the way of operational requirements.
c. Areas occupied by the Contractor and sub-contractors to be kept neat and tidy – garbage not to be stored.

Contamination Protection

23.2.11 The Contractor and sub-contractors shall not contaminate the site and comply with the following:

a. Dispose of materials as required by law.
b. Protection to existing services, land, watercourses.

Parking Facilities

23.2.12 Contractor to build and maintain temporary roads and parking areas. Where the site has insufficient parking area, Contractor is required to obtain temporary parking facilities.

Environmental Protection

23.2.13 The requirements for environmental controls including:

a. Control of noise from construction equipment.
b. Dust control and approved methods.
c. Surface water control and erosion.
d. Pollution control methods.
e. Handling of designated substances.
f. Sensitive Areas.
g. Removal and disposal of hazardous material from site.
h. Compliance with the Occupational Health and Safety Act and site safety including Contractor being deemed as "Constructor" under the Act.

Salvaged Equipment

23.2.14 Equipment removed during the construction work shall be protected from damages so that it may be reused. Any equipment so removed shall be subjected to the following:

a. Region's first right of refusal for salvaged equipment.

b. No equipment may be removed off-site without the written authority of the Contract Administrator/Resident Engineer.

c. Contractor to dispose of surplus or equipment not required by Halton Region and shall keep site in a neat and tidy manner.

Temporary Facilities

23.2.15 Contractor to provide all temporary utilities and controls to execute work expeditiously including:

a. Provision of all temporary telephone, water, wastewater, power and light required during construction.

b. Temporary heating and ventilation.

c. Dewatering to keep site and excavations from standing water.

d. Provide and maintain fire protection equipment.

Construction Schedule

23.2.16 The Contractor shall submit three (3) hard copies and two (2) CD-ROM copies in Microsoft Project 2000 of the tendered construction schedule, based on the tender and all required schedules, to the Engineer for review and co-ordination within 5 working days of award of the Contract. The Consultant shall review and comment on the budget and scheduling of the works as proposed by the Contractor.

23.2.17 During the construction of the works, the Contractor shall provide a two-week (for regular two-week interval site meeting) rolling window schedule of the work planned to be completed the following two-week at each site meeting. At the next site meeting, a review of the Contractor's progress will be reviewed by comparing activities actually completed the previous two week versus the planned activities. Submission shall be provided to Halton Region no later than 1:00 p.m. of each Friday. If the progress of the construction work is falling behind schedule as noted from the results of the site meeting's rolling schedule, take appropriate action or actions to correct construction method(s) and bring the schedule back to the tendered construction schedule.

Shop Drawings

23.2.18 Provide an additional 2 copies of all equipment shop drawings depicting material, equipment, erection diagrams and all other items to be incorporated into the work for Halton Region review and records.

23.2.19 The Contractor shall identify all shop drawing as follow:

a. Civil Shop Drawings"
   - C-1001
   - C-1002
   - C- (etc.)

b. Architectural Shop Drawings:

- A-1001
- A-1002
- A- (etc.)

c. Structural Shop Drawings:
- S-1001
- S-1002
- S- (etc.)

d. Mechanical Shop Drawings:
- M-1001
- M-1002
- M- (etc.)

e. Electrical Shop Drawing
- E-1001
- E-1002
- E- (etc.)

f. Instrumentation Shop Drawing
- I-1001
- I-1002
- I- (etc.)

g. General Shop Drawing
- G-1001
- G-1002
- G- (etc.)

h. Structured Cabling
- SC-1001
- SC-1002
- SC- (etc.)

Project Sign Board

23.2.20 Region will provide the required project signboard free of charge to the Contractor and the Contractor shall pick the sign up, install, remove and dispose of at project end.

23.3 Division 2 – Site Works

23.3.1 The Specifications for Site Works shall include the following:

Excavation, Trenching and Backfilling

23.3.2 Requirements for excavation, trenching and backfilling include:

a. Clearing and grubbing of site

b. Excavation, backfilling and compaction for structures, manhole chambers, utilities, electrical cables and duct banks

c. Subgrade preparation

d. Supply and placement of engineered fill
e. Protection of foundation and structures
f. Rough site grading
g. Dust control
h. Foundation drainage

Dewatering

23.3.3 Section to include:

a. Control of groundwater and surface runoff during construction including demolition work
b. Design, construct and maintain dewatering system
c. Installation of markers for monitoring movement of existing structures
d. Discharge of drainage water from construction site, including installation and maintenance of discharge pipe and siltation ponds
e. Coordinating dewatering work with requirements of other trades and units of work affected by dewatering operation
f. Contractor to apply to MOE for Permit To Take Water in excess of 50,000 L/d from any ground water source

Excavating and Backfilling Around Structures

23.3.4 Comply with the following requirements when excavating around structures:

a. Provide necessary measures to protect properties, structures, and existing utilities adjacent to works and provide a monitoring program to monitor any settlement of existing structures during the course of excavation works.
b. Excavate and remove all materials to depths and dimensions necessary to provide adequate space for structural foundation, bracing, supporting formwork, piping and drainage.
c. In addition to the requirements of the Occupational Health and Safety Act, protect excavation faces against erosion or sliding.

23.3.5 Backfilling around structures shall comply with the following requirements:

a. Use Granular ‘B’ fill for filling an area within 600 mm of any structures, including manholes and catch basins. Selected fill shall be used for remainder of the area to be filled.
b. Backfill evenly in 300 mm lifts.
c. Compact lifts to 97% Standard Proctor Maximum Dry Density.
d. Moisture content within 2% of optimum.

Excavation and Backfilling in Trench

23.3.6 Trenches shall be dug to the alignment and required depth and only so far in advance of pipe laying.

23.3.7 Material removed from trench to be piled neatly along the side of the trench which will minimize interference with traffic.

23.3.8 Width of trench shall be sufficient to permit proper laying and joining of the pipe and shall not be less than 400mm greater than the external diameter of the pipe barrel. Where sheeting or shoring is used, the width shall be measured between the interior faces.

Demolition – As Required by Project

23.3.9 Comply with the requirements of CSA S350 – M Code of Practice for Safety in Demolition of Structures, NFPA 241 Safeguarding Construction Alteration and Demolition Operations and all applicable Municipal Regulations and Requirements.

Restoration

23.3.10 Restoration of works and other disturbed areas comprised of the permanent restoration of surfaces of roadways, surface and bass courses of roadways, shoulders, lanes, footpaths, driveways, ditches, catch basins, and any other areas or existing facilities disturbed or damaged during construction along and in the general vicinity of the Works to the same or better conditions as existed previous to the Contract.

Yard Piping

23.3.11 Works includes the supply and installation of all necessary piping, fittings, and appurtenances both inside and outside of all structures within the limit of yard piping.

23.3.12 Installation of yard piping shall follow the same procedure for the installation of watermains and piping as the procedure set out for the installation of pressure and potable water pipes.

Roads, Sidewalks, Curbs and Gutters

23.3.13 Contractor responsible for building of all new roads, parking areas, ditches, concrete and unit paving, steps and pads to the grade, cross-section and lines as specified.

23.3.14 The Contractor shall restore all existing roads, parking areas, walks and steps, which have been removed, or disturbed during construction to their original condition.

23.3.15 Road filled materials shall consist of well mixed hard, durable particles of granular aggregates mixed with sand, clay, silt, stone dust and/or other cinder material.

23.3.16 Sub-base course material shall be uncrushed pit run material conforming to Class ‘B’ M.T.O. Specification Form No. 314.

23.3.17 Base course material shall be crushed and screened pit run material conforming to Class ‘A’ M.T.O. Specification Form No. 312, latest revision.

23.3.18 Asphalt cement shall be penetration grade 150-200 and conform to M.T.C. Specification Form 1101 and aggregates shall conform with M.T.O. Form 1003.

23.3.19 Asphalt base and surface courses shall conform to M.T.O. Specification Form No. 310.

23.3.20 Asphalt emulsion shall conform to M.T.O. Specification Form No. 1103.

23.3.21 All culverts shall be galvanized corrugated metal, circular or pipe-arch as manufactured by Armco or approved equal, with a minimum thickness of 1.6 mm.

23.3.22 Concrete for sidewalks, pads, curbs and gutters shall conform with C.S.A. Specifications A-23 for "Controlled Concrete". Proportions shall be in accordance with C.S.A. Specifications A-23, to produce a concrete with compressive strength of 27.5 MPa. Maximum slump of concrete shall be 75 mm using maximum aggregate size of 20 mm and with air content between 5 to 7% by volume.

23.3.23 Unit paving shall be Brussels Block 210 x 175 x 70 mm pavers by Unilock or approved equal.

Landscaping

23.3.24 The landscaping work includes the supply of equipment and materials for tree transplanting, rough grading to within 10 cm of finished surface, placement of topsoil, fine grading, sodding, seeding, planting and maintenance until accepted by Halton Region.

23.3.25 Sub-grade under all soft landscape areas shall be compacted between 80-85% Standard Proctor Density and under hard landscaped areas such as road, etc. to 98% Standard Proctor Density.

Fencing

23.3.26 Contractor to supply and erect construction fencing and gates around the construction site. Fence fabric shall be 1.8m (72") or 1.2m (48") wide with a uniform 50 mm (2") diamond pattern chain link mesh closed at one edge of knuckling and at the other edge by twisting to form a barb.

23.3.27 Post and rails shall be galvanized steel pipe, "Standard Weight", conforming to the requirements of the current specification for Black and Hot-dipped Zinc-Coated Welded and seamless Steel Pipe for Ordinary uses, A.S.T.M. Designation A120.

23.3.28 Gates shall be constructed from 43 mm O.D. galvanized steel pipe frames and 33 mm O.D. galvanized steel pipe braces. Gates shall be constructed with the fabric on the inside and with the barbed edge on top.

Sewer System Facilities

23.3.29 Work under this section includes the construction of sewers and manholes in accordance with the specifications and as shown on the drawings.

23.3.30 The pipe material used for the construction may be concrete or polyvinyl chloride and shall conform to A.S.T.M. C-14, C-76 and C-443.

23.3.31 Only pipes produced by a supplier who has been prequalified by the Ontario Water Resources Commission or by the Ontario Ministry of the Environment in the sizes and classes required by the contract shall be used on the project.

23.3.32 Testing for infiltration or exfiltration shall be carried out in section of sewer not less than 90 m in length. Where the ground water level is 600 mm above the crown of the pipe, an infiltration test is required. The leakage rate shall not exceed 0.05 L/mm of diameter per 30 m of sewer per hour. In testing for exfiltration the above allowable leakage shall be increased by 25%. When testing for exfiltration, the minimum net internal head on the section of sewer pipe being tested shall be 600 mm measured from the crown of the pipe provided that the maximum net internal head on the line shall not be greater than 7.6 m. Leakage up to 25

percent in excess of the above limits will be approved in any test section provided that the excess is off-set by lower leakage measurements in adjacent sections such that the total leakages is within the amount allowable for the combined sections.

Watermains

23.3.33 Watermains shall be constructed from Ductile Iron, Polyvinyl Chloride, Polyethylene and Concrete Pressure Pipe.

23.3.34 Ductile Iron Pipe, joints and fittings shall ductile iron Class 52 and comply with CSA B131.13, CSA B131.10 and AWWA C110. Ductile iron pipe and fittings shall be coated internally with a cement mortar lining in accordance with AWWA C104/A21.4 and externally with a bituminous lining in accordance with AWWA C-106 with a thickness of 25 µm. The ductile iron pipe and fittings shall be encased in a 200 µm thick polyethylene encasement in accordance with ANSI A21.5-1982. Pipe shall be pressure tested for leakage for one hour at a minimum hydrostatic field test pressure of 1035 kPa. No pipe installation will be accepted if the leakage is greater than 222 litres / 100 mm diameter/km/day.

23.3.35 Polyvinyl pipe and fittings shall be pressure pipe series 160 in accordance with CSA B137.3 or Class 100 (AWWA C900-75) and shall contain ingredients, which are approved by the National Sanitation Foundation. Pipe shall be supplied in maximum length of 12.0 m. All fittings for PVC pipe shall be cast iron or ductile iron compatible with size of pipe and shall conform with AWWA C110. Tracer wire shall be a 3.15mm dia./12 gauge Canada Wire stranded, Type TWU 75C 600V or approved equal. Pipe shall be pressure tested for leakage for one hour at a minimum hydrostatic field test pressure of 1035 kPa. No pipe installation will be accepted if the leakage is greater than 222 litres / 100 mm diameter/km/day.

23.3.36 Polyethylene pipe and fittings shall be pressure pipe series 160 in accordance with CSA B137.0 and B137.1, ASTM D3035 and D3350, and CGSB41-GP-25M and shall contain ingredients, which are approved by the National Sanitation Foundation. Pipe shall be supplied in maximum length of 12.0 m. All fittings shall be cast iron or ductile iron compatible with size of pipe and shall conform to AWWA C110 flanged. A tracer wire must be installed with the pipe and brought to the surface at each valve box. Tracer wire shall be a 3.15mm dia./12 gauge Canada Wire stranded, Type TWU 75C 600V or approved equal. Pipe shall be hydrostatic field tested at 1.5 times the rated pressure of the pipe. Pipe shall be pressurized for an initial period of 4 hours prior to commencing of pressure testing and for a period not exceeding 3 hours. No pipe installation will be accepted if the leakage is greater than 222 litres / 100 mm diameter/km/day.

23.3.37 Concrete pressure pipe shall be CSA certified and contain ingredients, which are approved by the National Sanitation Foundation. All fittings shall conform to AWWA C301. Pipe shall be hydrostatic tested at 1.5 x working pressure or 150 psi as specified. No pipe installation will be accepted if the leakage is greater than 222 litres / 100 mm diameter/km/day.

23.3.38 Pipes shall be flushed and disinfected with a strong solution of chlorine at 50 mg/L for a minimum period of not less than 24 hours. At the end of the 24-hour testing, the concentration of the chlorine residual shall not be less than 25 mg/L. If chlorine residual is less than 25 mg/L, the system shall be recharged with additional chlorine solution. If the result shows that the chlorine residual has been maintained for more than 25 mg/L during the 24-hour period, the Contractor may release the disinfection water from the watermain provided that the chlorine residual is less than 0.5 mg/L. The disinfection water shall be disposed of in a manner, which will not adversely affect the area of discharge. The watermain is then recharged and samples shall be taken and sent to the department of Health Laboratory for testing, test results obtained and clearance given by the local Health Unit.

Forcemains

23.3.39 Piping material shall conform to the same requirements as for watermains except for polyethylene pipe where joints may be welded by thermal butt fusion.

23.3.40 For polyvinyl or polyethylene pipe, a 12 gauge TWH solid copper, light coloured plastic coated tracer wire must be installed with the pipe.

23.3.41 Testing of forcemain shall be carried out for section not exceeding one (1) kilometre. Pipe crossing under railway tracks, Provincial roads, etc. shall be tested separately.

23.4 Division 3 – Concrete

Concrete Finishes

23.4.1 The quality of concrete finishes inside and outside the facility shall be as follows:

a. Formwork lining for all interior surfaces of water containment concrete structures: to be Zemdrain (Type II) formwork liner, manufactured by Dupont.

b. After stripping wall forms apply a non-toxic curing compound meeting the requirements of ASTM C309. Curing compound used for potable water storage structure should be ANSI NSF 60/61 approved. Apply curing compound at the thickness recommended by the manufacturer after a minimum of 24 hours of moist curing. If a curing compound is not applied, continue moist curing for an additional six (6) days.

c. All exterior walls of concrete structures that are buried shall be left in its rough form finish.

d. All other finishes with respect to floor, walls, etc. shall be project specific.

23.5 Division 4 – Masonry

23.5.1 The requirements for this Division shall be determined on a project by project basis.

23.6 Division 5 – Metals

23.6.1 The requirements for this Division shall be determined on a project by project basis.

23.7 Division 6 – Wood and Plastics

23.7.1 The requirements for this Division shall be determined on a project by project basis.

23.8 Division 7 – Thermal and Moisture Protection

23.8.1 The requirements for this Division shall be determined on a project by project basis.

23.9 Division 8 – Doors and Windows

Finishing Hardware

23.9.1 The locks for all doors shall conform to Halton Region's master key system. Halton Region will provide all cylinders and padlocks, to be used for the facilities, at the end of substantial completion. The Contractor will be responsible for installation of the cylinders and padlocks.

23.10 Division 9 – Finishes

General

23.10.1 The labeling of all pipes shall conform to the Ministry of Labour's "Workplace Hazardous Material Information System" (WHMIS) Policy.

23.10.2 All piping, fittings and valves, mechanical and electrical equipment including sleeves through floors, shall be painted.

23.10.3 Piping and equipment shall be properly identified as provided herein.

23.10.4 All existing equipment, piping, etc. shall be protected from paint splashes when new equipment or piping is painted.

Paint Specifications

CGSB #508-103	CGSB #501-103
Sherwin-Williams	Sherwin-Williams
Safety Orange	MC65 Tower Gray
CGSB #509-102	CGSB #501-108
Sherwin-Williams	Sherwin-Williams
Safety Red	MC69 Pewter
CGSB #505-110	CGSB #504-102
Sherwin-Williams	Sherwin-Williams
Safety Yellow	MC37 Sienna
CGSB #502-103	CGSB #504-107
Sherwin-Williams	Sherwin-Williams
MC90 Indigo	MC55 Clove
CGSB #502-208	CGSB #505-206
Sherwin-Williams	Sherwin-Williams
MC88 Harbor Blue	MC10 Light Buff
CGSB #502-106	

Sherwin-Williams

MC87 Grey Blue

Piping Identification Labels

23.10.5 All piping shall be labeled to conform to ministry of Labour's Work Place Hazardous Material Information System (WHMIS) Policy – October 31, 1988 or latest revision. Identify exposed piping and ductwork in locations as follows:

Group #1 Colour Legend

Piping System	Label Band Background	Letter/ Colour	CGSB	Max. Label Intervals	Max. Band Intervals
Flammable Materials Propane Gas Natural Gas Hydraulic Oil Fuel Oil Digester Gas	Orange	Black	508-103	3 m	3 m

Group #2 Colour Legend

Piping System	Label Band Background	Letter/ Colour	CGSB	Max. Label Intervals	Max. Band Intervals
Fire Fighting (Protection) Standpipe System Sprinkler System Halon Fire Protection Carbon Dioxide Fire Protection	Red	White	509-102	3 m	3 m

Group #3 Colour Legend

Piping System	Label Band Background	Letter/ Colour	CGSB	Max. Label Intervals	Max. Band Intervals
Dangerous Substances Boiler Feed Boiler Blow Off Acid Drain Compressed Air > 670 KPa Ferric Chloride (High Temperature Domestic Water) (Hot Water) Low Pressure Stream Low Pressure Condensate High Pressure Steam High Pressure Condensate	Yellow	Black	505-101	3 m	3 m

Group #4 Colour Legend

Piping System	Primary Colour	Secondary Colour	CGSB	Max. Label Intervals	Max. Band Intervals
Other Chemical Substances					
Alum		Light Green	-		
Chlorine Gas		Yellow	-		
Polymer Solution		Light Green	Grey	3 m	3 m
Lime Solution		White	Orange		
Sodium or Calcium Hypochlorite Solution		Yellow	White		
Potassium Permanganate		Purple	-		
Fluoride Chemicals		Purple	Red		
Ammonia		Bright Blue	-		
Glycol Solution (Heating)		Red	-		
Diesel Exhaust		Vine			

Group #5 Colour Legend

Piping System	Piping Colour	Label Band Back-ground	Letter/ Colour	CGSB for Piping Colour	Max. Label Intervals	Max. Band Intervals
Drainage						
Raw Water	Dk Blue	Green	White	502-103	6 m	
Domestic Cold Water	Lt. Blue	Green	White	502-106	6 m	
Domestic Hot Water Supply	Lt. Blue	Green	White	502-106	6 m	
Domestic Hot Water Ret.	Lt. Blue	Green	White	502-106	6 m	
Tempered Domestic Water	Lt. Blue	Green	White	502-106	6 m	
Chilled Water	Lt. Blue	Green	White	502-106	6 m	
Condenser Water	Lt. Grey	Green	White	502-108	6 m	
Hot Water Heating	Lt. Grey	Green	White	502-108	6 m	
Storm Drain	Lt. Grey	Green	White	502-108	6 m	
Plumbing Vent	Lt. Grey	Green	White	502-108	6 m	
Effluent Water	Blush Yellow	Green	White	504-107	6 m	
Compressed Air 670 kPa	Lt. Green	Green	White	503-323	6 m	
Instrument Air	Lt. Green	Green	White	503-323	6 m	
Vacuum	Lt. Green	Green	White	503-323	6 m	
Nitrogen	Lt. Green	Green	White	503-323	6 m	
Sanitary Drain	Dk. Grey	Green	White	501-103	6 m	
Filtrate (San)	Dk. Grey	Green	White	501-103	6 m	
Return Sludge	Mid-Brown	Green	White	504-107	6 m	
Waste Sludge	Mid Brown	Green	White	504-107	6 m	
Raw Sludge	Dk. Brown	Green	White	504-102	6 m	
Scum	Dk. Brown	Green	White	504-102	6 m	
Supernatant	Lt. Brown	Green	White	505-206	6 m	

Not Required

Method of Application

23.10.6 On painted piping system (pipes up to and including 45 mm o.d.), labels shall be Direct Model 77 Std. Or approved equal 2 mil vinyl/polyester of sufficient lengths to wrap completely around the pipe with a minimum of 8 mm overlap. Colours to meet CGSB Standards. Label complete with permanent adhesive.

23.10.7 On painted piping system (Pipes over 45 mm o.d.), labels shall be direct Model 102 Perma Seal or approved equal 10 mil PVC sleeve complete with two-sided permanent tape and liquid weld. PVC to be 25/50 fire rated. Sleeve shall be of sufficient length to wrap completely around the pipe with a minimum 25 mm overlap. Colours to meet CGSB Standards.

23.10.8 On unpainted piping systems (pipe up to and including 45 mm o.d.), labels shall be Direct Model 77-4 std. or approved equal vinyl/polyester of sufficient length to wrap completely around the pipe with a minimum 8 mm overlap. The label shall be 300 mm long complete with 100 mm colour banding at each end with colours to meet CGSB Standards and Ministry of Environment Standards for colour banding. The labels shall be supplied as a one-piece unit and permanently self-adhesive.

23.10.9 On unpainted piping systems (pipe over 45 mm o.d.), labels shall be Direct Model 102-4 Perma Seal or approved equal. 10 mil PVC sleeve complete with two-sided permanent tape and liquid weld. PVC to be 25/50 fire rated. Sleeve shall be of sufficient length to wrap completely around the pipe with a minimum 24 mm overlap. The label shall be 300 mm long complete with 100 mm colour banding at each end with colours to meet CGSB Standards and Ministry of Environment Standards for colour banding. The labels shall be supplied as a one-piece unit.

23.10.10 Directional arrows are required with each of the above labels.

23.10.11 WHMIS symbols are required with each label on all hazardous lines.

Sizes of Characters

23.10.12 Provide the following sizes of characters for labels:

Outside Pipe Diameter	Letter Size
Pipe less than or equal to 25 mm	12 mm
Pipe greater than 25 mm but less than or equal to 50 mm	25 mm
Pipe greater than 50 mm but less than or equal to 300 mm	38 mm
Pipe Greater than 300 mm	50 mm
Ducts	50 mm

Location of Labels

23.10.13 Application of Labels shall conform to the following:

- Both sides of valves
- All branch fittings and elbows
- Both sides where pipes and ducts pass through walls, floors and ceiling.
- Straight runs at maximum distance, centre to centre, as indicated above.
- Where circumstances make contents or direction of flow doubtful

23.10.14 Apply labels in positions that allow them to be easily read from normal operating positions.

23.10.15 All labels to be installed in a workmanlike manner.

23.10.16 Label shall be manufactured by Direct Labeling Services, Stoney Creek, Ontario; or approved equal.

Pumps and Valves Colour Schedule

Table 23-1 Colour Schedule

Pump Type	Colour Schedule CGSB Code
Sump Pump	Light Grey
Sodium Hypochlorite Metering Pump	Light Grey
Hydrofluosilicic Acid Metering Pump	
Aluminum Sulphate Metering Pump	
Chlorination Metering Pump	Light Grey
Ferric Chloride Metering Pump	
RAS Pump	
Sludge Loading Pump	
Wastewater Pump (Normally in Wastewater PS)	
Washwater Pump	Light Blue
High Lift Pumps	Light Grey
Low Lift Pumps	Light Grey

Table 23-2 Valves Colour Schedule

Valve Type	Purpose	Colour Schedule CGSB Code
Manually operated butterfly valves	Cell isolation	Light blue
Electrically operated butterfly valves	Automatic reservoir level control	Light blue
Check valves with lockable device	Direction of flow control, lockable device to keep valve open for reverse flow application	Light blue
Gate valves	Reservoir drainage	Light grey
Valves	Chemical solution	Light grey
Valves	Plumbing and drainage system	Light grey

Table 23-3 Equipment Colour Schedule

Equipment	Colour
Emergency Standby Diesel Generator	Light Grey
Equipment Guard	Red
Air Blower	Light Grey

Nameplates

23.10.17 All equipment, except electrical, shall be provided with a nameplate with the following information stamped on it:

23.10.18 Pump

a. Type

b. Model

c. Serial Number

d. Rated Capacity (L/S)

e. Rated Dynamic Head (TDH m)

f. Number of Stages (Vertical Turbine Pump)
g. Speed
h. Diameter of Suction/Discharge
i. Impeller Diameter
j. Seals
k. Bearing Details
l. Weight
m. Year of Manufacture

23.10.19 Drive Unit

a. Size
b. Type
c. Serial Number
d. Electrical Requirements
e. Current Draw
f. Frame Number
g. Rated Temperature Rise
h. Continuous Service Factor
i. Bearing Details
j. Weight
k. Year of Manufacture

23.10.20 Submersible Pump

a. Nameplate for submerged portion
b. Nameplate for non-submerged portion

Equipment Name Tags

23.10.21 Special equipment name tags shall be provided to identify equipment. The equipment name tags shall be black embossed or engraved on polished rectangular aluminum tags 50 mm high, 1.5 mm thick and long enough to display adequately all the identification characters. The identification characters will be alpha numeric and 10 mm high and should be attached with at least two stainless steel self-tapping screws or black nylon ties where screws fasteners are not practical.

Workplace Hazardous Material Information System (WHMIS)

23.10.22 Supply and install WHMIS's hazard symbols on all tankage, piping and equipment as required by the Ministry of Labour.

23.10.23 Supply weatherproof boxes for the safe keeping of all WHMIS documents/manuals. Size and type of weatherproof boxes shall be determined at the detailed design stage. Weatherproof box shall be installed at locations designated by the Plant Supervisor.

23.11 Division 10 – Specialties

23.11.1 Consultant may use this Division for any special products that do not fit into the other Divisions and shall be determined on a project by project basis.

23.12 Division 11 – Equipment

Bearings

23.12.1 All equipment bearings shall have a minimum specified rating life of B-10, 100,000 hours, unless specified otherwise.

Pump Shaft Seals

23.12.2 Single, mechanical pump shaft seals, unless specified otherwise.

23.12.3 Non-destructive, cartridge type, self-aligning seals of the stationary design, which requires no wearing sleeve for the shaft.

23.12.4 Pump shaft shall have no reduction in size through the seal area.

23.12.5 For all contaminated water services if not previously provided, drill and tap for installation of seal water supply.

23.12.6 316L stainless steel spring or Hastelloy C spring.

23.12.7 Buna-N or Viton O-rings for clean water applications. Specify Viton O-rings for sludge, sewage, scum or grit applications.

23.12.8 Faces:

a. Sewage, Sludge – Sintered silicon (or tungsten) carbide on carbon

b. Potable water – Tungsten carbide on carbon

Couplings

23.12.9 Provide flexible coupling for all equipment with drives over 0.5 hp and less than 160 hp and where the driver is directly connected to the driven unit.

Equipment Guard

23.12.10 Provide guard on moving parts fabricated of 14-gauge sheet steel and galvanize after fabrication.

23.12.11 Guard to be removable to facilitate maintenance of moving parts. Make provision to extend lube fittings through guard.

Gauge Taps and Test Plugs

23.12.12 Provide gauge taps on the suction and discharge side of pumps, blowers and compressors and install gauges at each location.

Indicating Light

23.12.13 Use oil tight transformer type indicating lights with low voltage lamps and push-to-test features, with coloured lenses.

Disconnect Switches

23.12.14 Provide all equipment with padlockable disconnect switch.

Alignment

23.12.15 All rotating equipment is to be set and aligned in accordance with the more stringent requirements of either the equipment manufacturer or the following:

a. Level base, use machinists level on all machined surfaces.

b. Base is to be true and leveled.

c. Alignment of shafts, soft foot of motor and couplings shall be performed by reversed dial, rim to rim and face to face. Soft foot will be rim to rim vertical and horizontal mode.

i) Soft foot of motor shall be checked to be within a tolerance of 0.03 mm

ii) Shaft shall be aligned within a tolerance of ±0.025 mm to 0.070 mm

iii) Piping strains to pump shall be within a tolerance of ±0.025 mm to 0.070 mm

23.13 Division 12 – Furnishing

23.13.1 The requirements for this Division shall be determined on a project by project basis.

23.14 Division 13 – Instrumentation & Controls

Protection

23.14.1 All instrumentation mounted outdoors must be suitable for the surrounding climate and must be appropriately installed and protected with rain/snow hoods, and/or if necessary, thermostatically controlled, electrically heated enclosures.

23.14.2 All instrument sensing lines liable to freezing should be electrically heat traced.

Fire Alarm System

23.14.3 The guidelines for the fire system for each building are as follows:

a. A fire alarm annunciator panel at the main entrance to the building, with fire alarm reset and signal silence buttons, indicating number of zones as required by the Code.

b. Panel is to be fully battery-backed up, providing single-stage, fully supervised fire alarm and detection circuits. Supervisory and trouble circuits to be powered for 24 hours, general alarm outputs (to alarm devices) for minimum of 5 minutes.

c. Provide as minimum, smoke detectors in each level, stairwell, A/H units and MCC rooms.

d. Provide alarms via 8" bells to cover the entire building area.

e. Provide pull stations at each main exit and stairwell, etc.

f. Provide a red fire-fighters' telephone as part of the panel. This will be connected into plant-wide fire telephone system.

g. Approval of "equal alternatives" will require written authority from the Consultant.

h. All equipment is to be CSA or UL tested and conform to the Ontario Building Code requirements.

i. Identification on fire alarm equipment, including annunciator windows to be in English and French.

j. The building fire alarm system is to be "stand-alone" in that in the event of power failure, fire detection and alarm circuits within the building are powered from the building battery-backed panel.

k. All panels will be monitored via a Central Fire Alarm Control Panel located at a designated building.

l. Each "building" fire alarm system shall be provided with all necessary modules for communication of alarms and status and telephone devices, to the main Control Panels in the two Control Room Buildings.

m. Connection and site-wide testing and commissioning of overall fire system will be under a specified contract.

n. Provide alarm status contacts out of each building fire alarm panel for "alarm", "trouble", "healthy signals", and wire as inputs to the building Local Control Panel, for monitoring by the SCADA System.

o. Tunnel and building fire doors are to be equipped with "hold-open" devices which should release automatically on any of fire alarm, power failure, and manual override.

p. Fire alarm annunciation panel must be visible and readable from outside building.

Products

23.14.4 Control Panels

a. Control Panels are defined as panels having a PLC inside them. Design details and Technical Specifications for these panels are included in Section 3 Control Panel Design in the SCADA Standards Manual.

b. The section of the manual and the SCADA Standards Manual are to be read in conjunction and if contradictions exist the consultant is to contact Halton Region for direction.

23.14.5 Control Cabinets and Wiring

a. All panels and cabinets must confirm to the following guidelines:

i) Must be fabricated of high grade cold rolled steel (14 gauge) unless otherwise indicated.

ii) Must be phosphatized, primed, and painted with ASA 61 Grey baked enamel inside and out except stainless steel. Subpanels to be 12 gauge CRS finished with white baked on enamel.

iii) All NEMA 4 outdoor panels are to be stainless steel, and field junction boxes to be NEMA 4X.

iv) Doors to have continuous piano hinge with removable pin and oil resistant cellular neoprene gasket secured by gasket retainers. Door handles to be recessed type, lockable with key numbers, coordinated by area to reduce the quantity of keys.

v) All panels and cabinets to be supplied with print pocket.

vi) Local Control Panel to be NEMA 12 classification unless otherwise indicated.

vii) Provide lamacoid nameplates for all equipment, both door mounted and panel mounted. Sizes for nameplates to be 25 x 75, 37.5 x 100, or 75 x 125 mm whichever is suitable.

viii) and properly sealed.

ix) All screws, blots, fasteners etc., are to be corrosion resistant stainless steel.

x) Provide 150 mm concrete base for floor mounted panels unless otherwise indicated, and provide spacing of 50 mm minimum between rear of panels and external walls, to avoid effects of possible condensation.

xi) All wall mounted units to have wall stainless steel spacers.

xii) All channel mounted panels are to be installed on aluminium channels complete with non-corrosive fastening bolts, etc.

xiii) All panel wiring is to be neatly dressed and run in plastic duct with AC and DC conductors in separate ducts.

xiv) Panel indicator lamps to be LEDs, type Telemechanique XVLA 324 and panel switches Allen Bradley 800 M series.

xv) Neutral conductors are to be coloured white.

xvi) Two separate grounds are to be supplied, one for instrument grounding and one for control circuit grounding. Install grounding so as to keep two grounds isolated (separate). Ground conductors are to be coloured green, with light green used for control circuit ground and dark green for instrument ground.

xvii) Nylon cable ties are to be used for bundling and securing all wiring not enclosed in duct.

xviii) Provide in each panel two pole double throw main fused disconnect switch for power on/off to panel circuit(s). Provide internal panel light and utility power socket, separately switched.

xix) All wiring to be done in shop.

xx) All equipment including switches, circuit breakers etc. to be identified.

xxi) All wiring to be identified with slip-on markers as manufactured by Electrovert or similar. Slip-on markers must be sized to suit wire size and type.

b. Wire and Cable

i) All wire and cable must be sized and installed in accordance with the H.E.P.C. Safety Code Requirements

ii) No control wire smaller than No. 14 gauge shall be used except where so indicated on the drawings or as specified in other Sections.

iii) Analog and low voltage signal cables shall be No. 16 shielded pairs unless otherwise indicated on the drawings.

iv) All feeders shall be run in continuous length between power supply point and the load with no splices.

v) All wiring for signal system shall be identified as to circuit numbers with approved markers on the cables at all panels and terminal strips. Where hand written markers are necessary, use the manufacturers recommended indelible marker pen. Printing must be neat, capital alpha characters.

c. Terminal Blocks

i) All terminals should be easily accessible with ample room for termination of field and panel wiring. Supply terminal block partitions for separating instrument loop (4-20 mA, etc.) from 120V AC terminals. Arrange terminal strips so that power, control wiring, instrument wiring and ground points are partitioned by terminal block barriers. In panels with large numbers of terminals provide separate rails for 120V AC blocks.

ii) Common connection of wires at terminal blocks to be generally by jumper bar, blocks taking the same terminal number.

iii) Group markers to be used for major group (e.g. all signals from an MCC starter.) except in a PLC Control Panel where group marker should be used for each PLC card.

d. Nameplates

i) Lamacoid nameplates shall be provided for each piece of instrumentation equipment. (For interior or exterior panel mounted equipment). Sizes for nameplates to be 25 x 75, 37.5 x 100, or 75 x 125 mm, whichever is appropriate for the equipment/area as determined by Plant Operations.

ii) Nameplates shall be fastened with corrosion resistant screws.

iii) Nameplates on field equipment and control panels shall be black background with white lettering.

iv) Minimum letter height is 6 millimetres.

v) Field equipment label to identify service/function, and classification code number.

Specifications

23.14.6 Consultants shall prepare and submit a list of the equipment specification to Halton Region for review prior to tender. Equipment specification must be in the following format:

a. Instrument

b. Service

c. Measurement Principle

d. Sensor

e. Sensor Mounting

f. Transmitter

g. Mounting

h. Manufacturer

i. Supplier

23.14.7 Example:

a. Open Channel Flow Instrument

b. Service: Measuring flow in open channels and/or tanks outlets.

c. Measurement Principle: Predetermined relationship between flow and level given fixed dimensions (for Parshall flumes, V-notch weirs etc.)

d. Location: Normally outdoors.

e. Sensor: Ultrasonic Transducer - non-contacting CPVC housing, polyurethane radiating face; fully weatherproof temperature range - 40-90 degrees Celsius - RG-62U Coaxial cable as required with temperature compensating unit for flow applications outdoors or in sewer.

f. Sensor Mounting: Sensor to be rigidly mounted in accordance with primary device requirements.

g. Transmitter: 120V AC, 60HZ - Meter 0-100% - Range switchable to flow or level - 6 digit totalizer - output - 4-20 mA Isolated, complete with two adjustable relays.

h. Transmitter Mounting: Enclosure - NEMA and CSA, Hydro approved.

i. Manufacturers: (Provide the name of the manufacturer)

j. Supplier: (Provide the name of the Supplier, address, Telephone and Fax number.)

Installation & Execution

23.14.8 Do not mount instruments on handrails unless approved by Halton Region.

23.14.9 Do not direct mount instruments on process lines subject to pulsation or vibration, or below lines or vessels carrying corrosive chemicals.

23.14.10 Mount all instruments at a suitable height for access and visibility either above grade or above a safe, permanent working platform. General height above grade is 1.4 metres, via pedestal or wall type mounts.

23.14.11 Do not install bypass valves around flow elements except for rotameter.

23.14.12 Consider installation of block and bypass control stations for modulating duty control valves up to 6" body size where failure of the valve will immediately affect ability to control the process.

23.14.13 If a bypass valve is applied, use same size as control valve.

23.14.14 Protect all instruments with capillaries throughout their length by using painted/galvanized angle iron and clips. Avoid sharp bends in capillary and coil any excess close to the sensor end. Protect the coiled capillary by clipping to a steel plate or other safe method.

23.14.15 Install process sample piping to avoid accumulation of vapour or gas (in liquid service) and of liquid or condensate (on vapour or gas service) as appropriate.

23.14.16 Position instruments so that they do not block or obstruct walkways or access points and provide adequate space around installation for removal of covers, etc.

23.14.17 Standard instrument process connections of 1/2" NPT female are to be provided (Pressure gauges normally 1/2" NPT male).

23.14.18 Sensing and sample lines are to be run in 3/8" stainless steel tubing with compression type fittings.

23.14.19 Instrument support brackets may not be welded to process piping, but should generally be pedestal or wall mounted.

23.14.20 Field cable runs of analog signals shall be run in separate conduit from 120V AC control or power supply cables.

23.14.21 Use field junction boxes suitable for the area classification to "marshal" groups of signals of the same type in an area and cable back to buildings and local control panel with multicore cables.

23.14.22 Junction boxes may be FRP (fiberglass reinforced plastic) or similar material suitable for the area and rust and weather resistant. Terminals inside field junction boxes are to be rail mounted SAK 2.5.

23.15 Division 14 – Conveying Systems

23.15.1 The requirements for this Division shall be determined on a project by project basis.

23.16 Division 15 – Mechanical

23.16.1 Refer to other Sections with respect to mechanical requirements.

23.17 Division 16 – Electrical

Fluorescent lamps

23.17.1 Fluorescent lamps shall be T-8 4100°K, 2900 (initial) lumens 75 CRI and unless otherwise specified, shall be rapid start and life rated at 20,000 hours (average).

23.17.2 Lamps shall be provided with single or multi-lamp ballasts, approved for the type, voltage and rating of lamp, also for the operating and starting temperature of the ballasts. Unless otherwise indicated, ballasts shall be integrally mounted with the fixture housing and thus approved for the enclosure and ventilation. Ballasts separately mounted shall be accessible, spaced and located to enclosure proper temperature conditions. Ballasts capacitors shall not contain PCBs.

23.17.3 Fluorescent ballasts shall be rapid start electronic energy conserving, high power factor, low harmonic distortion and shall be approved for use with T8 fluorescent lamps as manufactured by CGE, Osram/Sylvania and Philips.

23.17.4 HID lamp ballasts shall be of the auto-regulator (constant wattage) protected type, high power factor (90% minimum) voltage range □10% nominal, normal ambient 40°C and low starting temperature to -35°C for outdoor use.

Emergency Lighting

23.17.5 Emergency lighting shall be battery operated units and heads.

23.17.6 Each battery unit shall be a sealed lead acid type, long life cells in plastic cases and ten (10) year design life. They shall be 24 volt with indicated capacity for one (1) hour (to 91% voltage) operation and shall be in a standard shelf mounted cabinet, and have integrally mounted 24 volt sealed beam or quality halogen lamps, as indicated on drawings.

23.17.7 Each battery unit shall have an integral charger which shall be fully automatic, solid state, high/low rate with indicating and pilot light, load transfer, meters, test switch, overload and low voltage protection and AC 120 volt line cord and plug. A DC fused block shall be provided for load circuits together with conduit entry. Units shall be Emergi-Lite.

23.18 Variable Frequency Drive (VFD)

Requirements

23.18.1 Each variable frequency drive system shall be appropriately sized for the load requirements and contained in its own enclosure complete with circuit breaker, digital keypad, necessary control devices, etc. Each VFD shall be suitable for double lugging of power cables.

23.18.2 The VFD Drive manufacturing facility shall be ISO 9001 certified. The VFD Drive shall be listed, Canadian UL listed or CSA listed.

23.18.3 All printed circuit boards shall be completely tested and burned-in before being assembled into the completed VFD Drive. The VFD Drive shall then be subjected to a preliminary functional test, minimum four (4) hour burn-in and computerized final test. The burn-in shall be at 104°F (40°C), at full rated load, or cycled load. Drive input power shall be continuously cycled for maximum stress and thermal variation.

23.18.4 The drive shall be designed to provide 100,000 hours mean time before failure (MTBF) when the specified preventive maintenance is performed.

23.18.5 The drive shall be designed to avoid the following conditions:

a. A premature breakdown of the motor insulation.

b. Unacceptable motor temperature rise over the entire speed range.

c. The drive shall be designed to operate a motor that is connected to the drive with conductors (in conduit or raceway) or TECK cable up to 100 metres long.

23.18.6 The digital keypad shall be used to serve as a control and diagnostic station permitting authorized operators to examine all/or reconfigure vital parameters pertaining to the VFD. The fault retention memory capability shall be provided.

23.18.7 Each drive shall be designed so as not to generate any harmonics that would impair the normal operation of other equipment. The VFD supplier shall be responsible to correct any harmonics generated by the operation of his equipment. The Contractor shall be responsible to correct any problem that is caused by the distortion level resulting in causing interference with other equipment.

23.18.8 Each drive shall be designed to protect itself from any harmonics induced by the operation of other equipment.

23.18.9 The VFD Supplier shall review the single line power diagram, to determine and supply harmonic filtering required not to exceed a maximum of 5% total harmonic voltage distortion in accordance with IEEE 519 and as measured on the secondary side of the distribution transformer supplying the drives.

23.18.10 The variable frequency drive shall not cause line side voltage spikes which exceed the envelope of the line voltage waveform by 10% under continuous steady state conditions.

Drive Unit

23.18.11 The drive shall be an open loop voltage source type, with sinusoidal Pulse Width Modulated (PWM) output inverter control, suitable for use with standard or high efficiency squirrel cage induction motors.

23.18.12 The drive shall be a Direct Torque Control (DTC) AC to AC converter utilizing the latest isolated gate bipolar transistor (IGBT) technology. The DTC Drive shall employ Direct Torque Control (DTC) inner loop torque control strategy that mathematically determines motor torque and flux every microseconds (μs) (40,000 times per second). The drive must also provide an optional operational mode for scalar or V/Hz operation.

23.18.13 The requirements of the DTC Drive Ratings are as follow:

a. The DTC Drive shall be rated to operate from 3 phase power at 380VAC to 690VAC +5/-10% and 48Hz to 63Hz.

b. The DTC Drive shall employ a full wave rectifier to prevent input line notching and operate at a fundamental input power factor of 0.98 at all speeds and loads. The DTC Drive

efficiency shall be 97% or better at full speed and load. An internally mounted line reactor shall be provided to reduce input current harmonic content, provide protection from power line transients such as utility power factor correction capacitor switching transients and reduce RFI emissions.

c. Output voltage and current ratings shall match the adjustable frequency operating requirements of standard 575VAC, 3ph, 60Hz, NEMA design B motors. The overload current capacity shall be 150% of rated current for one (1) minute out of ten (10) minutes and 200% for two (2) seconds out the fifteen (15) seconds with an instantaneous over current trip at 350% or higher. Output frequency shall be adjustable between 0Hz and 300Hz. Operation above motor nameplate shall require programming changes to prevent inadvertent high speed operation. The drive's switching pattern shall be continually adjusted to provide optimum motor flux and avoid the high-pitched audible noise produced by motors energized by conventional PWM drives.

d. Transient suppression devices shall be used to protect the drive from AC line transients.

e. A DC filter shall be sized to satisfy the transient load requirements and to minimize the input current harmonics.

f. The drive shall be designed to facilitate testing while the drive is operating as well as when the drive disconnect switch is de-energized (with auxiliary control power applied). In addition, the drive shall be capable of operation without a motor connected, for set-up and testing purposes.

g. Provide an input non-automatic circuit breaker with a door interlock mechanism capable of being padlocked. In addition, provide input line fuses whose characteristics are co-ordinated with the drive's electronic protection circuits, so as not to blow under normal output faults.

h. The drive shall be provided with an input reactor (inductor) to filter out voltage spikes.

i. Size the drive to satisfy the pump output and speed requirements at the design and run out conditions at a maximum of 90% of the drive rating, and in any event shall not be less than the full load electric current rating of the respective motor controlled.

j. Provide the drive suitable to accept a remote 4-20 mA DC signal for speed control.

k. Provide the variable frequency controller to convert the input three (3) phase fixed voltage (575 volts) and fixed frequency (60 HZ) into an output of adjustable voltage and frequency. Provide the output to the induction motor be 0-575 volt, three (3) phase, 6-66 Hertz (No transformers).

l. Provide an RLC power line filter circuit to protect the inverter from AC line disturbances including 10 kV 200 joule voltage spikes the filter is also to prevent the inverter from causing line voltage disturbances. Total Harmonic Distortion (THD) as measured on line side of variable speed drive shall not be more than 5%. In addition to be RLC filters, provide line transient suppressors sized to suit the load to protect the drives from line disturbances such as over and under voltage. Provide separate lightning protection and surge arrester as part of the drive system.

m. The drive shall be provided with an output capable of operating each motor and pump over the entire speed range of 10-100% at high torque conditions.

Operator Control Panel

23.18.14 The requirements for the Operator Control Panel are as follow:

a. Each DTC Drive shall be equipped with a front mounted operator control panel consisting of a four- (4-) line by twenty (20) character backlit alphanumeric display and a keypad with

keys for Run/Stop, Local/Remote, Increase/Decrease, menu navigation and parameter select/save. All parameter names, fault messages, warnings and other information shall be displayed in complete English words or standard English abbreviations to allow the user to understand what is being displayed without the use of a manual or cross-reference table. A display contrast adjustment shall be provided to optimize viewing at any angle.

b. During normal operation, one (1) line of the control panel shall display the speed reference, and run/stop forward/reverse and local/remote status. The remaining three (3) lines of the display shall be programmable to display the values of any three (3) operating parameters. At least twenty-six (26) selections shall be available including the following:

i) Speed/torque in percent (%), RPM or user-scaled units.

ii) Output frequency, voltage, current and torque.

iii) Input voltage, power and kilowatt hours.

iv) Heatsink temperature and DC bus voltage.

v) Status of discrete inputs and outputs.

vi) Values of analog input and output signals.

vii) Values of PID controller reference, feedback and error signals.

Control Interface Inputs and Outputs

23.18.15 Control interface inputs and outputs shall include the following:

a. Three (3) analog inputs, one (1) 0VAC – 10VAC and two (2) 4-20mA, all independently programmable with at least ten (10) input function selections. A differential input isolation amplifier shall be provided for each input. Analog input signal processing functions shall include scaling adjustments, adjustable filtering and signal inversion. Upon loss of input signal, the drive shall be programmable to stop and display a fault message, run at a preset speed and display a warning message or display a warning message and run according to the last reference received.

b. Six (6) discrete inputs, all independently programmable with at least twenty-five (25) input function selections. Inputs shall be designed for “dry contact” inputs used with either an internal or external 24 VDC source.

c. Two (2) analog outputs providing 4-20mA signals. Outputs shall be independently programmable to provide signals proportional to at least twelve (12) function selections including output speed, frequency, voltage, current and power.

d. Three (3) form C relay contact outputs, all independently programmable with at least thirty (30) output function selections. Relay contacts shall be rated to switch 8 Amps at 24VDC or 250VAC. Function selections shall include indications that the drive is ready, running, reversed and at set speed/torque. General and specific warning and fault indications shall be available. Adjustable supervision limit indications shall be available to indicate programmed values of operating speed, speed reference, current, torque and PID feedback.

Performance

23.18.16 The required performance of the VFD shall be as follows:

a. Input voltage: 4160 or 600 Vac ±10%, 3 phase, 3 wire.

b. Input frequency: 60 Hz ±5%.

c. Input power factor: >0.95 over the operating speed range.

d. Output frequency range: 0-60 Hz ±0.5%, minimum frequency and maximum frequency independently adjustable.

e. Power Factor: 0.95 or better any speed or load.

f. Output Volts/Hertz ratio: constant and suitable for 575Vac/60Hz motors, with adjustable voltage boost.

g. Output harmonics: <5% FLA (RMS).

h. Acceleration rate: adjustable.

i. Deceleration rate: adjustable.

j. Overload capacity: 115% FLA continuous.

k. Current limit: adjustable.

l. Drive Control Efficiency at rated load and frequency: 98% or better.

m. The drive shall not be affected by the frequency shifts encountered when line starting other loads with generator power.

n. The drive operation shall not be affected by 100% line notching of a duration less than or equal to 100 milliseconds.

o. The output frequency regulation shall not be greater than 1.0%.

p. The output V/Hz regulation shall not be greater than ± 10%.

q. The output current waveform shall be close to a sine wave so the at the motor rating, including service factor, is not reduced by more than 5%.

Abnormal Operating Conditions Requirement

23.18.17 The drive shall withstand, without any damage, the following conditions:

a. Phase to phase output short circuit.

b. Phase to ground output short circuit without isolation transformers.

c. The application of a stationary, reverse or forward rotating motor while the drive is starting or while inadvertently running on open circuit.

23.18.18 The drive shall be designed such that it will shut down without damage under the following conditions (unless otherwise specified and documented by the drive manufacturer):

a. Low AV input voltage. Indirect sensing of line voltage via the DC bus is not acceptable.

b. Missing AC bus voltage.

c. Over voltage DC bus voltage.

d. Under voltage DC bus voltage.

e. High peak DC bus and/or output current.

Drive Protection Requirements

23.18.19 Design the drive to shutdown without damage, under the following conditions:

a. Ground fault trip (the fault current level shall be adjustable).

b. Instantaneous output over current.

c. DC over voltage.

d. DC under voltage.
e. Heatsink over temperature.
f. Output overload (electronic).
g. Motor overload (thermal).
h. Input fuse fault.
i. Input over current.
j. Incorrect input phase sequence.
k. Input over voltage.

23.18.20 For each programmed warning and fault protection function, the drive shall display a message in complete English words or standard English abbreviations. The five (5) most recent fault messages and times shall be stored in the drive's fault history.

23.18.21 The drive shall include MOVs for phase to phase to ground line voltage transient protection. Output short circuit and ground fault protection rated for 65,000 amps shall be provided without relying on line fuses.

23.18.22 Motor phase loss protection shall be provided. The drive shall provide electronic motor overload protection qualified per EEMAC Class 10 and Class 20 requirements. Protection shall be provided for AC line or DC bus over voltage at 130% of maximum rated or under voltage at 65% of minimum rated and input phase loss. A power loss ride through feature will allow the drive to remain fully operational after losing power as long as kinetic energy can be recovered from the rotating mass of the motor and load.

23.18.23 Stall protection shall be programmable to provide a warning or stop the drive after the motor has operated above a programmed torque level for a programmed time limit. Under load protection shall be programmable to provide a warning or stop the drive after the motor has operated below a selected under load curve for a programmed time limit.

23.18.24 Over-temperature protection shall provide a warning if the power module temperature is less than 5°C below the over- temperature trip level. Input terminals shall be provided for connecting a motor thermistor (PTC type) to the drive's protective monitoring circuitry. An input shall also be programmable to monitor an external relay or switch contact.

Operating and Control Requirements

23.18.25 Provide automatic reset and restart on the first drive fault, the restart being initiated only if the start command is maintained. Should a second drive fault occur within an adjustable time window after the first, the drive shall be locked out and require a manual or remote reset. This feature can be defeated if first fault auto restart is not required.

23.18.26 Start-up data entries shall include motor nameplate power, speed, voltage, frequency and current. A motor parameter ID function shall automatically define the motor equivalent circuit used by the sensorless vector torque controller.

23.18.27 Control of the drive shall be possible at the drive panel (Local Mode with control via start, stop and reset pushbuttons and a speed potentiometer) or externally via a start/stop and reset contacts, and 4-20 mA speed command The selection of the operating mode shall be done by control switches on the drive's operator control panel.

23.18.28 Provide signal isolation and scaling/offset adjustments for the external 4-20 mA and potentiometer speed commands.

23.18.29 Provide a diagnostic LED panel, which displays system status information (i.e. External Auto Mode, Power On, Ready, Run, Fault, etc.), each individual fault status and indication of first fault reset and current limit operation.

23.18.30 Provide for two (2) external permissive interlock and/or E-Stop normally closed contacts.

23.18.31 Provide for one normally closed external system fault contact input.

23.18.32 Provide metering on the drive operator control panel for motor frequency (or speed), current and voltage.

23.18.33 Provide the following signals for remote monitoring:

a. Form C contacts for indicating the Ready, Run and Fault status. Note these status signals must be mutually exclusive (i.e. only one is active at any time) and the fault status must be failsafe.

b. A status contact to indicate selection of the External Auto Mode.

c. An isolated 4-20mA signal proportional to 1-100% frequency.

23.19 Power Transformer

Insulating Oil

23.19.1 Insulating oil shall conform to CSA Standard C50. The PCB content of the insulating oil is to be certified by test at 2 ppm or less before approval to ship will be granted. For this test, the oil sample shall be taken after the completion of all testing.

Instrumentation

23.19.2 Standard instrumentation shall be provided as CAN3-C88- M, with additional features and accessories to be specified for project's specific.

23.19.3 All visual gauges shall be mounted for viewing at eye level, unobstructed by compartments or mechanism boxes.

23.19.4 Temperature gauges shall be provided for top oil temperature AND winding temperature. These gauges shall also provide an adjustable alarm point that shall be wired out to terminal blocks.

23.19.5 A rapid rise pressure relay for the main tank shall be provided with two (2) N.O. and two (2) N.C. contacts and test facilities. The relay shall be Qualitrol #213-001-03 or as may be specified during the design phase.

23.19.6 A vacuum pressure valve and gauge, Qualitrol #050-022-01 shall be provided, or as may be specified, during the design phase for the main tank.

23.19.7 A single current transformer shall be provided on the XO neutral. This C.T. may be mounted internally or externally to the main tank, but the secondary circuits shall be wired to terminal blocks in the main mechanism box. C.T. accuracy shall be 2.5L200 minimum and the CT ratio shall be provided to suit existing neutral grounding resistor.

SCADA Monitoring

23.19.8 The following monitor points shall be provided independent of all other systems and terminated on a separate strip for field interconnection:

a. Top oil HIGH temperature alarm.

b. Winding temperature HIGH alarm.

c. Oil level LOW alarm.

d. Gas pressure rise alarm.

e. Top oil temperature 4-20 mA dc Analog.

23.19.9 An external aux. 120 VAC source will be available. Each point shall be isolated with two (2) wires not connected to any other point.

SECTION 24 APPROVED EQUIPMENT LIST

24.1 General

24.1.1 Halton Region has approved the use of the equipment listed in Appendix A in its facilities. The intent is to ensure that equipment that is specified in future contracts is similar to the equipment that is already incorporated in these facilities. This reduces the number of spare parts that Halton Region must keep on hand in order to maintain its facilities working efficiently as well as to be able to respond effectively for emergency repairs. At the same time, it reduces the number of different equipment types that the maintenance staff must be familiar with in order to be able to provide effective repair/maintenance services. Consultants shall therefore specify such equipment, where applicable, in the design and technical specifications unless these have been changed at the Pre-Design or Detailed Design phase of the project.

Appendix A- Approved Equipment List for Water & Wastewater Facilities

Appendix B- Standard Drawings

Wastewater Pumping Stations

- **Figure C-1: General Overview of Four Typical Stations**
- **Figure C-2: Typical Station 1 Arrangement**
- **Figure C-3: Piping Bypass Arrangement**
- **Figure C-4: Electrical Box Locations**
- **Figure C-5: Typical Station II Arrangement**
- **Figure C-6: Typical Station III Arrangement**
- **Figure C-7: Typical Station IV Arrangement**
- **Figure C-8: Station Recirculation Piping**