


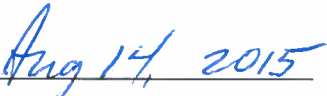
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The City of Winnipeg
Winnipeg Sewage Treatment Program

Building Mechanical Design Guideline

Document Code:
Revision: 00

Approved By:	 Duane Griffin, Branch Head - Wastewater Planning & Project Delivery	 Date
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1 INTRODUCTION

This document identifies the standard building mechanical design requirements that are applicable to any work within the City of Winnipeg wastewater treatment facilities.

1.1 Scope of the Standard

These design requirements shall apply to the following facilities:

- Wastewater treatment plants

1.2 Application

The scope and intent of this document is to convey general design guidance and expectations regarding building mechanical systems. This document does address specifics related to design type, selection, and configuration; however the indicated requirements are presented without knowledge of the specific building mechanical system implementation. It is not within the scope of this document to provide detailed design direction, and it will be the responsibility of the respective building mechanical and HVAC designers to fully develop the system details with general conformance to the concepts presented herein. This standard shall not be construed as comprehensive engineering design requirements or negate the requirement for professional engineering involvement. Any design must be executed under the responsibility and seal of the engineer in each instance, and must be performed in conformance with all applicable codes and standards, as well as good engineering practice.

Existing facilities do not necessarily comply with this standard. The expectations regarding application of this standard to maintenance and minor upgrades at existing facilities must be assessed on a case-by-case basis; however general guidelines for application are presented as follows:

- All new buildings are expected to comply with this standard.
- All major upgrades to a building are expected to comply with this standard; however in some cases, compromise with the configuration of the existing facility design may be required.
- All minor upgrades should utilize this standard as far as practical for new work; however in some cases, compromise with the configuration of the existing facility design may be required.

1.3 Deviations from Standard

It is expected that there will be occasional situations where the design architect / engineer will propose a deviation from this design guideline. The rationale for potential deviations from the design guideline may include:

- Evolution of technology,
- Updates to standards and regulations,
- Practical limitations due to existing conditions on site, or
- Significant cost benefits to the City due to specific project constraints.

For each proposed deviation from this standard, fully complete a *WSTP Standards Deviation Form* and submit to the City project manager for approval. Do not proceed with the proposed deviation unless approval is received from the City project manager.

1.4 Acronyms and Abbreviations

ACH	Air Changes per Hour
AHU	Air Handling Unit
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
CGA	Canadian Gas Association
CSA	Canadian Standards Association
CO	Carbon Monoxide
DX	Direct Expansion
FRP	Fiber Reinforced Plastic
H ₂ S	Hydrogen Sulphide
HVAC	Heating Ventilation and Cooling
MAU	Make-up Air Unit
MCC	Motor Control Center
MERV	Minimum Efficiency Reporting Value
NBC	National Building Code
NFC	National Fire Code
NFPA	National Fire Protection Association
PLC	Programmable Logic Controller
RH	Relative Humidity
PCS	Process Control System
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
UL	Underwriters Laboratory, Inc.
VFD	Variable Frequency Drive
WSTP	Winnipeg Sewage Treatment Program

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2 GENERAL

2.1 Design Codes and Standards

All designs shall comply with municipal, provincial, and national codes and bylaws. This includes but is not limited to:

- National Building Code of Canada with Manitoba Building Code Amendments
- National Energy Code of Canada for Buildings 2011
- National Fire Code of Canada
- Province of Manitoba Workplace Health and Safety Act
- City of Winnipeg WWD Hydrogen Sulphide Monitoring Program
- National Plumbing Code of Canada with Manitoba Plumbing Code Amendments
- CSA B149.1-10 Natural Gas and Propane Installation Code
- ANSI Z358.1-2009, Standard for Emergency Eyewash and Shower Equipment
- CSA B64.4-11 Reduced Pressure Principle (RP) Backflow Preventers
- CSA B64.5-11 Double Check Valve (DCVA) Backflow Preventers

2.2 Referenced Standards

The application of NFPA 820 Standard for Fire Protection in Wastewater Treatment and Collection Facilities shall be as per Section **Error! Reference source not found..**

The following standards are to be referenced during the design; however application of these standards will not necessarily be comprehensive:

- ASHRAE Standard 62.1 Ventilation for Acceptable Indoor Air Quality
- NFPA 90A Standard for the Installation of Air Conditioning and Ventilation Systems
- ASHRAE Standard 90.1 for building energy efficiency

2.3 Other City Standards

1. While not exclusive, ensure that the following City Standards are adhered to:
 - 1.1 Water and Waste Department Identification Standard
 - 1.2 WSTP Piping Color Standard
 - 1.3 WWD Hydrogen Sulfide Monitoring Program

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2.4 Units

All drawings and documentation shall use the International System of Units (SI units). Imperial units may be provided in parenthesis after the metric unit, where requested or appropriate. Specific requirements are as follows:

1. All building dimensions shall be in millimeters.
2. All elevations shall be in meters, in the format EL. ###.### (example EL. 273.520)
3. All pipe sizes to be in mm.
4. All duct sizes to be in mm.
5. All liquid flow rates shall be l/s.
 - 5.1 Alternate units may be considered for flows less than 0.1 l/s or greater than 10,000 l/s.
6. All airflow rates shall be in l/s.
 - 6.1 Design airflow rates shall also be expressed in ACH for process areas.
7. All liquid pressures shall be in kPa (kilopascals).
8. All HVAC air pressures shall in Pa (Pascals).

3 HVAC SYSTEMS

3.1.1 General Requirements

1. General design concept for the entire system shall be well defined.
2. Ensure each system is designed to be complete in every respect for a trouble free operation, including AHU's, fans, pumps, expansion units, ducting, refrigerant and drain piping, thermal and vapor insulation for ducts and pipes, grilles, registers, diffusers, louvers, dampers, sound attenuators, vibration isolators, air coolers, electric air heaters, air filters, etc.
3. Ensure design takes into consideration sufficient redundancy capacities (see Section 3.4.4) and safety margins.

3.2 Design Parameters

3.2.1 Outdoor Design Parameters

1. Ensure outdoor design parameters based on NBC design data for Winnipeg weather conditions are followed:

Table 3-1 : Outdoor Temperature Design Criteria

Winter:	-35°C DB (Dry Bulb)
Summer:	30°C DB (Dry Bulb)
	23°C WB (Wet Bulb)

3.2.2 Indoor Temperature

- The design of building HVAC system shall be carried out based on the criteria below:

Table 3-2: General Indoor Design Criteria

Space	Heating ¹	Cooling ²	
	Design Temp	Design Temp	Type ³
Administration / Office	20°C	22°C	M
Control Room	20°C	22°C	M
Generator Room	18°C	35°C	HR
Blower room	18°C	35°C	HR
Process Area	18°C	35°C	M
Chemical Area	18°C	35°C	HR
Mechanical Room	18°C	35°C	HR
Electrical Room	20°C	27°C	M
Electrical Room – Small & Non-Critical ⁴	20°C	35°C	M / HR
Server Room	20°C	21°C	M
Storage room	18°C	-	-
Washroom and Janitor Room	18°C	30°C	V
Gallery/Tunnel	18°C	-	-
Vestibule, Stairs	18°C	-	-

Notes:

- The heating design temperatures are minimum indoor temperatures under the coldest design day condition.*
 - The cooling design temperatures are maximum minimum temperatures under the hottest design day condition.*
 - HR= Heat Relief (does not imply air conditioning), *M=Mechanical, *V=Ventilation*
 - Electrical Rooms may only be considered small if they distribute power for less than 100 KVA of load. Electrical rooms may only be considered non-critical if the loads powered from the room can be turned off at any time for a complete day with minimal consequence. An example of a small electrical room would be an electrical room for a small storage building.*
- The design shall allow for occupied and unoccupied temperature setpoints.
 - Provide recommended initial setpoints for occupied and unoccupied states in both heating and cooling modes.
- Ensure the minimum and maximum temperature setpoints are specified to protect the assets.
 - Ensure that the minimum temperature setpoint protects against freezing and protects the asset to achieve the expected asset life.
 - Ensure the maximum temperature setpoint is set to provide the expected asset life.

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3.2.3 Humidity Control Criteria

1. Humidity control shall be considered in specific areas if deemed necessary where sensitive electrical equipment is present such as the server room, control room and electrical rooms. Where humidity control is necessary, effort shall be taken to maintain humidity levels at % R.H 50±10.

3.2.4 Noise Criteria

1. Refer and adhere to the noise control criteria as defined in the WSTP Architectural Design Guideline.
 - 1.1 Provide noise attenuation such as acoustical enclosures when the equipment has a high noise level and is located in a regularly accessed area which would impact on operations. It shall be noted that fan selection shall not be based solely on noise generation.
2. Ensure that the air handling units and make-up air units are equipped with internal vibration isolators or pads and insulation on casing.
3. Provide duct silencers for the exhaust/supply fans if required to minimize the HVAC equipment noise level.
4. Provide silencers for generator rooms and blower room air intake and exhaust louvers to meet the design criteria.
5. Specify equipment noise limits based upon acceptable noise levels.
6. Ensure the design takes into account the cumulative noise impact of all equipment operating simultaneously.

3.3 Space Pressurization

1. In general, ensure that negative pressure (approx. -25 Pascal) is maintained for process areas where odour or off-gas occurs in accordance with NFPA 820.
2. Ensure ventilation systems serving the control rooms, electrical rooms and administration office area keep a positive pressure of roughly 25 Pascal under all operating conditions.

3.4 Design Requirements

3.4.1 Protection against Fire and Explosion Hazards

1. Application of NFPA 820 shall be comprehensive, except as approved by the City during the preliminary design phase of a project.
2. Preliminary design stage:
 - 2.1 During the preliminary design stage, review and make recommendations regarding the application of NFPA 820 to the project. Review the lifecycle capital and operating costs for the proposed ventilation rate and associated electrical classification.
 - 2.1.1 Consider heating costs in the application of NFPA 820.
 - 2.1.2 Propose ventilation rates to the City for review, along with corresponding annual heating costs.

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2.1.3 Review the proposed ventilation strategy with the City and implement as per City direction.

3. Electrical classification vs. ventilation:

3.1 For many spaces, NFPA 820 permits a lower ventilation rate provided that a higher level of electrical classification is provided. The higher ventilation rate and lower electrical classification shall be utilized in all cases, except as follows:

3.1.1 The total lifecycle costs of the higher ventilation rate is significantly greater than the lifecycle costs of electrical classification;

3.1.2 The proposed lower ventilation rate will provide adequate ventilation to remove any toxic gases, including H₂S, in any area that is routinely occupied;

3.1.3 The proposed ventilation rate and electrical classification does not impede maintenance activities; and

3.1.4 The proposed lower ventilation rate is accepted by the City.

3.2 In spaces that are routinely occupied or have a significant level of maintenance requirements, an electrical classification of Class I, Zone 1 (Div. 1) presents much greater maintenance challenges than a Class I, Zone 2 (Div. 2) electrical classification. The City will not typically accept a Class I, Zone 1 (Div. 1) electrical classification in any routinely occupied space or a space with significant maintenance requirements.

3.4.2 Protection Against Toxicity Or Biological Hazards

1. Provide appropriate ventilation to address toxic and/or biological hazards to allow personnel to enter all spaces requiring routine access without special entry requirements. This may require ventilation over and above that required in Section 3.4.1.
2. Ventilation at the source of the hazard is preferred to minimize overall ventilation requirements.

3.4.3 General Ventilation Requirements

1. Follow ASHRAE and National Fire Code guidelines as well as good practice for ventilation requirements in chemical areas.
2. For non-process area or auxiliary area and service areas, ventilation shall follow ASHRAE 62.1 for minimum outdoor air and exhaust.
3. For areas with no established standards (NFPA 820, ASHARE and NFC), design the ventilation in terms of air changes to follow good engineering practice in Manitoba. Consider heating costs when determining proposed ventilation rates.
4. Ensure that ventilation air flow rates into air-conditioned areas are included in the cooling load calculations.
5. Ensure spaces are pressurized such that leakage airflow is from the cleanest space to the most odorous space.
 - 5.1 Utilize NFPA 820 as a guide for space pressurization.
 - 5.2 Electrically classified spaces shall always be negatively pressurized.
 - 5.3 Electrical and control rooms shall always be positively pressurized.
 - 5.4 Ensure that harmful gases do not migrate into stairwells or escape routes.
6. Where gas detection systems are provided, ensure that a hardwired interlock is provided to engage the high-rate of ventilation (if provided). In addition to the ventilation interlock, all gas

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detection systems shall provide the current detected gas level to the PCS, except that this requirement is not mandatory for carbon monoxide sensors.

7. Provide low and high speed control ventilation system for chemical areas with dual ventilation rates via VFD control to meet ventilation requirements as per National Fire Code and ASHRAE standards.
8. Provide local exhaust fans for washrooms and janitor rooms as required.

3.4.4 Equipment Redundancy

1. Provide ventilation system redundancy where required. Minimum requirements are as follows:
 - 1.1 For routinely occupied areas (frequency of daily or greater) with a direct source of odorous, toxic or combustible gases (such as open tank areas), ensure that at minimum 50% of the maximum ventilation rate can be provided with any single point of mechanical failure. Provide parallel fans as required.
 - 1.2 For electrically classified spaces, supply and exhaust fans shall be redundant such that at minimum 50% of the maximum design ventilation rate is provided upon fan failure. Higher level of redundancy requirements shall be evaluated on a case-by-case basis.

3.4.5 Heating Systems

1. The use of central hot water boilers to service the heating loads of sewage treatment facilities is preferred. In case of additions or modification to a facility, review hydronic heating systems and central boilers serving the existing facility to determine whether upgrades are warranted to accommodate the new increased heat loads.
 - 1.1 Hot water coils shall not be utilized for applications heating outdoor air. Utilize a heat exchanger loop with glycol running through coil to prevent coil freezing in event of a system failure.
 - 1.2 Boiler water treatment is required for all boiler systems.
 - 1.3 Provide automation for boiler water treatment systems to limit operational involvement.
2. Gas fired air-handlers are preferred in areas of the facility where the use of hydronic heating is not practical.
3. Electric heat may be utilized where hydronic or gas-fired heating is not practical.

3.4.6 Heat Recovery

1. Heat recovery systems shall be investigated for all systems with airflows greater than 1000 l/s. Consider both flushing water heat recovery and glycol runaround loops. Other heat recovery technologies may be considered for clean-air applications.
 - 1.1 Calculate the capital, operating and maintenance costs for the entire lifecycle of the facility. Calculate the economic payback of the heat recovery system. Consider available subsidies from local utilities (i.e. Manitoba Hydro).
 - 1.2 Provide written recommendations to the City.
2. Unless otherwise directed by the City, provide heat recovery systems for all systems where there is an economic payback of less than ten years. Where the economic payback is greater than ten years, proceed based upon direction of the City.

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3.4.7 Air Conditioning System

1. Provide DX split AC unit or air handling unit with built-in DX refrigerant coil and outdoor air-cooled condenser for control rooms, server rooms and main electrical rooms for cooling in summer to meet required indoor design temperature.
2. Size air conditioning system based on the heat gains from the electrical and control equipment in the associated space plus the ventilation loads and base loads from the building structures.
3. Ensure sufficient safety margin is taken into account in all design calculations.

3.5 Equipment and Material Design Requirements

3.5.1 General Layout Requirements

1. Ensure all equipment is accessible and has clearance to allow for maintenance.
2. Provide a minimum of 1000 mm clearance in front of all equipment.
3. For all equipment with a motor power rating of 7.5 kW (10 hp) or greater, provide a minimum clearance of 800mm between the outermost extremities of adjacent pieces of equipment, and between a wall and the equipment.
4. Provide a minimum of 800mm clearance between open doors (including electrical panel doors) and adjacent pieces of equipment, walls or obstacles.
5. Ensure adequate clearance above or below units is provided for the lifting / removal down of equipment for repair or replacement. Ensure clearance is provided for anchored/load rated lifting devices.
6. Provide sufficient clearances for removal and refitting of the serviceable components of all installed equipment without removal or dismantling of other equipment or assets. For clarity this includes planned service requirements throughout the life of the asset and non-routine unplanned failures.
 - 6.1 Provide sufficient clearances to replace air handling unit filters.
7. Provide sufficient clearances to replace air handling unit coils and fans.
8. Coordinate clearances with all engineering disciplines to ensure that the final commissioned installation meets all clearance requirements.
9. Locate equipment outside of corrosive locations. HVAC equipment may only be installed in corrosive locations with the approval of the City.
10. Equipment shall be located such that accumulation of snow on the roof does not hinder their operation, either under normal or extreme snow conditions.
11. Equipment should be located at sufficient distance from the edge to avoid use of barricades. Alternately, provide permanent guardrails to allow for safe working access to all maintainable aspects of the equipment.
12. Dampers
 - 12.1 Ensure dampers and damper actuators are accessible.
 - 12.2 Provide hinged access doors for actuated dampers to allow for maintenance.
 - 12.3 Locate motorized dampers (and pneumatic dampers where applicable) in indoor locations. Outdoor applications of motorized dampers should be avoided if possible.

3.5.2 Outdoor Air Filtration Criteria

1. Provide outdoor air filtration in accordance with Table 3-3.

Table 3-3: Outdoor Air Filtration Criteria

Filtration Type	Description	Typical Application
A	Pre-filter MERV ¹ 8 (30~35 percent efficiency), Chemical Filters Stage 1 & Stage 2, After-filter and Final filter MERV ¹ 13 (80~90 percent efficiency)	Control Rooms, Server Rooms & Electrical Rooms where corrosive gases may be present
B	Pre-filter MERV ¹ 13 (80~90 percent efficiency)	Administrative Areas Control Rooms, Server Rooms & Electrical Rooms where corrosive gases are not typically present
C	Pre-filter MERV ¹ 8 (30~35 percent efficiency)	Process Areas

Note(s):

1. *Minimum Efficiency Reporting Value (MERV) for filters as per ASHRAE Standard 52.2.*
2. Provide bird screens for rooftop air handling unit intake louvers.
3. Provide air filters for air handling units or make-up air units with differential pressure gauges and switches that will automatically alert plant personnel via the PCS when filters require replacement.
4. Where there is a potential for corrosive gases, ensure stage 1 (carbon) and stage 2 (permanganate) filters are provided for control rooms and electrical rooms or MCC rooms air handling units or pressurization units to filter the hydrogen sulphide in the air intake stream.
 - 4.1 Provide additional filter stages as required to address the atmosphere present.
 - 4.2 Coordinate with the City to ensure the filter size is compatible with existing equipment to reduce the number of filter types the City needs to manage.

3.5.3 HVAC Equipment Selection Criteria

1. Provide corrosion resistance for HVAC equipment by using chemical resistant coatings on HVAC equipment, or using FRP or stainless steel exhaust fans in corrosive environments.
2. Provide premium efficiency motors.
3. Ensure provision of removable insect screens for any air intake dampers and supply fans and also on the vent ducts/pipes for process as required.
4. Provide AMCA Type A or Type B spark resistant fans in all fans serving electrically classified spaces.

3.5.4 Ductwork

1. Provide ductwork as per the below criteria:

Location	High Humidity	Corrosive Gases or Chemicals	Material	Notes
Process Areas	No	No	Aluminium	
	Yes	No	Aluminium	
	Yes	Mild H ₂ S	Aluminium	
	Yes	Yes	FRP Stainless Steel	Potential for corrosion. Select appropriate corrosion resistant material.
Non-process areas.	No	No	Aluminum or Galvanized steel	

2. Ductwork specifications shall be written such that Sheet Metal and Air Conditioning Contractors National Association (SMACNA) standards for duct construction are adhered to. This standard stipulates duct thickness based on size and pressure ratings.
3. Utilize round ductwork wherever possible. Where rectangular ductwork is required, limit aspect ratios to a maximum of 4:1.
4. Ensure that the maximum duct pressure drop is 25 Pascal per 30 metres of duct.
5. Provide access doors where required for inspection and maintenance, including but not limited to control dampers and fire dampers.

3.6 HVAC System Monitoring and Controls

3.6.1 HVAC Controls

1. All HVAC control and monitoring shall be by PLC, consistent with the WSTP Automation Design Guide. No exceptions shall be permitted except for the following:
 - 1.1 Natural gas fired air handlers may utilize proprietary packaged controls for the natural gas burner and associated devices. However, the proprietary packaged controls shall not monitor or control any equipment or instrumentation outside of the air handler unit. Any liquid coils in the air handler shall be controlled by the PLC.
 - 1.2 Boilers and chillers may utilize packaged controls that do not fully comply with the WSTP Automation Design Guide. Ensure sufficient integration into the plant PCS to meet operational requirements.
 - 1.3 Small out-buildings with a ventilation rate of 100 l/s or less may utilize non-PLC based controls, provided the control is very basic. For example, a single unit heater may be controlled by a wall-mounted thermostat.
2. All HVAC systems shall be monitored by the plant PCS.
3. Provide room temperature sensors for control and monitoring. Provide low and high temperature alarms to operations personnel via the PCS.

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4. Unit heater control (including all mounted baseboard heaters, convectors, etc.):
 - 4.1 Ensure all heater control is integrated into the overall PLC based control system. Ensure that simultaneous heating and cooling of the space is prevented.
 - 4.2 Where there is a risk of building freezing due to the PLC being out of service, provide backup thermostats to override the PLC control upon low temperature.
5. Provide duct smoke detectors only where required by the National Building Code or local code requirements.
6. Install freeze stats for hydronic heating coils and glycol heat recovery coils of air handling units or make-up air units.
 - 6.1 Ensure provision of a freezing alarm to the plant PCS.
7. Provide normal (low) ventilation and emergency (high) ventilation for air handling units, make-up air units or supply/exhaust fans designed for chemical areas.
 - 7.1 High speed ventilation shall be triggered by a local push button manually outside of the entrance of chemical areas to activate the emergency exhaust fans and supply fans.

3.6.2 Gas Detection

1. General Requirements
 - 1.1 Provide gas detection systems to monitor all potential hazardous gases, considering that the wastewater treatment plants service a combined sewer collection system.
 - 1.2 A sufficient quantity of gas detection systems shall be provided to adequately cover the space. Do not assume that a single gas detection sensor is sufficient to cover an entire room or space.
 - 1.3 Ensure gas detection systems are located appropriately to detect hazardous gases within the coverage area. Review ventilation flow patterns and locate the sensors appropriately. For example, it is not appropriate to locate a gas detection sensor adjacent to a supply air grille.
 - 1.4 Locate gas detection systems at the appropriate elevation, considering the hazardous gas density, ventilation patterns, and location of personnel.
 - 1.5 Where a dual-rate ventilation system is provided, interlock the gas detection with the ventilation system to ensure that a high-rate of ventilation is provided upon detection of a hazardous gas.
 - 1.6 Ensure provision of detected gas levels to plant PCS. The only exception is that carbon monoxide sensors may simply transmit an alarm to the plant PCS.
2. Provide H₂S sensors for process areas with a risk of hydrogen sulphide.
 - 2.1 When the hydrogen sulphide level in the associated space exceeds the pre-set monitoring level, as per the City of Winnipeg's WWD Hydrogen Sulphide Monitoring Program criteria, the ventilation system shall remain at a high-flow rate to provide required air changes for classified areas per NFPA 820.
3. Provide a Combustible Gas Detection system for process areas as required by NFPA 820 and interlock with space ventilation or odour control make-up air system when gas levels exceed 10 percent of the lower explosive limit as per NFPA 820.
4. Provide Carbon Monoxide (CO) sensors for direct gas-fired air handling units or make-up air units to monitor incomplete combustion of the natural gas. When CO levels of the unit discharge air is higher than the pre-set point, ensure that the unit gas burner automatically shuts down.

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5. Provide Oxygen Deficiency sensors in spaces where there is a risk of oxygen displacement.
6. Provide other gas detection systems as appropriate for the gases that may be present.

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4 PLUMBING SYSTEMS

4.1 Plumbing System Concepts

1. Comply with the National Plumbing Code of Canada with Manitoba Code for sanitary drainage, storm drain, potable water, and plant service water system design. Comply with CSA B149.1 for natural gas piping system design.
2. Provide potable water for washroom/janitor room's plumbing fixtures and combination shower/eyewash stations.
3. For interior hose valves in process area, provide 25mm or 40 mm globe valves with hose thread adapters.
4. For potable hot water, selection of hot water heating shall be as follows:
 - 4.1 Utilize electric heating for all low usage requirements.
 - 4.2 Consider the use of gas water heaters for high-usage requirements such as locker rooms. Review and make recommendations based upon the life-cycle cost of the equipment.
5. Design all sanitary drains and wash down gutter/floor drains to be collected in sanitary sumps in the basement.
 - 5.1 Provide sump pump systems to pump the sanitary drainage to the discharge location.
 - 5.2 Ensure provision of high sump level alarms to be sent to plant PCS.
 - 5.3 Ensure the sump pumps are discharged into an appropriate location in the plant. City approval is required for all discharge locations other than the headworks.
6. Provide gutter drains for basement tunnels, pipe galleries, perimeter walls as required to collect floor wash down drain and underground seepage water.
7. Provide floor drains for process areas, mechanical rooms, washrooms, janitor rooms, locker rooms as required.
 - 7.1 Coordinate with the structural discipline to ensure that floors are sloped to the drains.
 - 7.2 For process areas ensure that floor drains have sufficient capacity to cope with flows associated with washing floors with industrial hoses up to 25 mm diameter.
 - 7.3 Provide additional floor drainage in process areas associated with sludge pumping and / or processing, and inlet screening.
 - 7.4 Provide trench drains with industrial quality gratings in areas where routine wash down is expected or heavy spillage in preparation for maintenance activity could occur. Areas subject to infrequent spillage may have point drainage.
 - 7.5 Provide mechanically secured gratings for all drains.
8. Provide hub drains for mechanical equipment including air conditioning units to collect overflow drain and condensate drain as required.
9. All floor/gutter drains and hub drains that are infrequently used shall have primed P-traps.
10. Water source for trap priming shall be either non-potable water (preferred) or flushing water.
11. Provide ganged traps where allowed by codes, otherwise provide individual traps for floor drains/gutter drains and hub drains.
12. Provide conventional roof drains and overflow drains for all new buildings. Design individual rain water leaders to discharge to grade or to be collected and discharged into the plant storm drainage system if available.

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13. Drainage system piping and appurtenance material section shall be appropriate for the location to ensure corrosion resistance.
14. Provide a proximity switch for the safety shower/eyewash.
 - 14.1 An alarm signal shall be sent to the plant PCS to notify staff in the control room that the equipment is being used.
 - 14.2 Insulate and heat trace piping in the outdoor emergency showers to prevent piping freezing.
15. Provide natural gas piping and regulators to each natural gas fired air handling unit as required.
 - 15.1 Install natural gas piping either underground (buried) or, if possible, on building roof. Installation of natural gas piping within the basement galleries will not be accepted without approval of the City.
 - 15.2 The natural gas meter and gas regulator at the plant gas main shall be coordinated with Manitoba Hydro for new gas loads.

4.2 Piping

1. Provide corrosion resistant piping on sump pump suction lines. Standard of acceptance is stainless steel.
2. Ensure piping is primed and painted in accordance with the WSTP Piping Color Standard.

4.3 Insulated Plumbing Piping

1. Provide insulation for the following pipes:
 - Cold potable water
 - Cold non-potable water (including pump seal water)
 - Hot Potable Water and Recirculation
 - Refrigerant and Gas Piping
 - Roof/Overflow Drain Pipes
2. Insulation for plastic cold water piping may be eliminated where piping material characteristics will reasonably eliminate condensation and not cause any personnel safety or asset damage.

4.4 Plumbing Fixtures

1. In buildings designed in accordance with building code requirements for accessibility for persons with disabilities, provide water closets and lavatories in the washroom with barrier-free plumbing fixtures for the physically disabled.
 - 1.1 As per the WSTP Architectural Design Guideline, only buildings having administration functionality will be designed in accordance with building code requirements for accessibility for persons with disabilities.
2. Toilets shall be wall-mounted or floor-mounted, flush-valve-type complete with dual-flow control.
3. Provide mop sinks for janitor room.

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4. Provide wall-hung, flush-valve-type urinals for washroom as required.

4.5 Emergency Safety Equipment

1. Provide emergency eyewash and shower stations with control mixing valves for tempered water for process areas and chemical areas wherever required for safety protection.
2. Ensure that the safety mixing valve is pre-set to 26.7 deg. Celsius (80 deg. Fahrenheit) by the manufacturer for the mixing temperature of cold and hot water supply.

4.6 Water Conservation

1. Specify and install low water consumption plumbing fixtures and trim in accordance with the requirements of the Manitoba Building Code.
2. Provide high-efficiency plumbing fixtures for water use reduction.
3. Provide water meters for main water usage facility as per City Standards

4.7 Cross-Connection Control

1. Provide cross-connection control in accordance with the CSA standards.
2. Install backflow prevention assemblies for the following: potable cold water main entrances into each new building with a double check valve back-flow prevention assembly and non-potable water main entrance into each new building with a reduced pressure backflow prevention assembly.
3. Provide local reduced pressure backflow preventers for the HVAC heating system and glycol heat recovery system make-up water as required.

4.8 Plumbing Equipment

1. Include plumbing equipment for sump pumps and hot water heaters.
2. Building sanitary drains for plumbing system shall be discharged by gravity drain to available plant main sanitary systems.
 - 2.1 Where gravity drain is not possible, duplex sanitary sump pumps shall be provided in the basement of process areas and pipe galleries to collect sanitary drainage from washrooms, floor/gutter drains and seepage drains, and the drainage flow shall be pumped and discharged into the plant head works via basement tunnels.
 - 2.2 Provide sump pits for the basement tunnel as required.
3. Provide gas or electric domestic hot water heaters/tanks for potable hot water to washrooms/janitor rooms and to emergency shower/eyewash station mixing valves.
 - 3.1 Install hot water recirculation pumps to compensate for hot water piping heat loss for remote plumbing fixtures and safety shower/eyewash station as required.

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5 FIRE PROTECTION SYSTEMS

1. Co-ordinate with the architect for the design of sprinkler systems and standpipe system for locations of required fire pump and fire protection water supply.
2. Determine if fire pump is required to boost the fire protection water pressure to meet the required pressure for sprinkler system or standpipe system.
3. Prepare the detailed design and installation of sprinkler system and standpipe system and ensure that it is certified by a Fire Protection Engineer.
4. Provide a comprehensive design for portable fire extinguishers as required and coordinate with the architectural drawings. All fire extinguishers shall be identified as per the City WWD Identification Standard.
 - 4.1 Supply of the portable fire extinguishers will be by the City, based upon the design provided.
5. Ensure provision of fire dampers on the ductwork penetrating any fire-rated walls, and floor slabs as required per codes.
6. Where duct smoke detectors are required, ensure smoke detector alarm contact is connected to the fire alarm panel.

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6 BUILDING MECHANICAL DESIGN TEAM RESPONSIBILITIES

6.1 General

1. Responsibility for deliverables
 - 1.1 All drawings and other deliverables related to a design are the responsibility of the design engineer. Under a Design-Bid-Build project delivery methodology, delegation of design responsibility to the contractor is not acceptable.
2. Ensure all building mechanical deliverables are sealed by a qualified professional engineer.
3. Completeness of drawings:
 - 3.1 All drawings shall be comprehensive in nature to allow for effective use in construction.
4. Update of existing drawings:
 - 4.1 If the project is an addition, expansion, upgrade or modification to an existing site or facility, existing drawings may require up-dating. Coordinate with the City to understand the specific requirements. Typical requirements include.
 - Updating existing building floor plans.
 - Updating P&ID drawings.
 - The update of detail drawings for existing works is not expected or required.
5. Design reviews:
 - 5.1 Issue the design documents to the City for review at appropriate intervals in accordance with the City's expectations.
 - 5.2 Incorporate all WSTP comments into the design. Where a WSTP comment is not accepted by the design team, provide a complete response, including rationale, to the City Project Manager.
6. As-Built Drawings:
 - 6.1 All building mechanical deliverables shall be updated to "as-built" status at the end of the project. The "as-built" documents shall incorporate contractor mark-ups, inspections performed by the design team, change orders, RFIs, and other communication between the Contractor and Design Team.
 - 6.2 Unless otherwise specified by the City and agreed to by the Design Team, as-built drawings are not required to be sealed (Otherwise known as record drawings).
7. External, 3rd Party Consultants:
 - 7.1 Expertise and assistance may be required, from external 3rd party specialized consultants, outside of the primary architectural / design team.
 - 7.2 Areas where an external 3rd party consultant may be utilized, with permission from the City, are:
 - Fire protection systems.
 - Acoustic systems.
 - 7.3 The design team shall be responsible for monitoring the activities and progress of each 3rd party consultant.
 - 7.4 It is the responsibility of the design engineer to ensure that the deliverables follow all City standards and guidelines.

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8. Site Visits:
 - 8.1 The design team is responsible for ensuring that a sufficient number of site visits occur to facilitate the understanding of specific field conditions or status of existing facilities and buildings.
9. Demolition Requirements
 - 9.1 It is generally required that the architect / engineer is responsible for associated demolition works required to implement the scope of work. Clearly indicate all demolition requirements on the drawings and in the specifications.
 - 9.2 Small demolition works (less than ~1/3 of the drawing) shall generally be shown by revision of existing drawings. Where demolition requirements are significant (approximately more than 1/3 of a drawing), create dedicated demolition drawings.

6.2 Drawings

The drawings indicated in this section are minimum requirements for new construction, unless otherwise approved by the City.

6.2.1 General Requirements

1. *Provide scale bar on all scaled drawings to allow for measurement takeoff and avoid any potential confusion regarding scale, regardless of the format or size reproduction of the document.*
2. *Show a north arrow on all plan drawings.*

6.2.2 Legend

1. Requirement
 - 1.1 Provide a legend drawing showing the symbols and abbreviations utilized. Coordinate with the City regarding re-use of any existing legend drawings.
2. Content
 - 2.1 Ensure that the legend is consistent with the City's practices. Symbols shall be the same as process mechanical symbols for common items (i.e. valves).
3. Format:
 - 3.1 Produce drawings in an A1 size format.

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6.2.3 Process and Instrumentation Diagrams (P&IDs)

1. Requirement
 - 1.1 Provide P&ID's for the complete HVAC system, including all hydronic systems, unit heaters and associated controls.
 - 1.2 Provide P&IDs for the complete plumbing system. All components shall be shown on the P&IDs except for floor drainage systems.
2. Content
 - 2.1 P&ID's shall depict all equipment and ductwork, including AHUs, fans, cooling coils, heating coils, filters, dampers, etc.
 - 2.2 All automation and control components including instrumentation such as pressure gauges, temperature sensors, RH sensors and manometers shall also be indicated.
 - 2.3 Indicate the appropriate Pipe / Duct identification codes for all pipework and ductwork, as per the WWD Identification Standard.
3. Format
 - 3.1 Produce drawings in an A1 size format.
 - 3.2 The P&IDs shall be in the same format as the process P&IDs.
 - 3.3 The P&IDs shall be in a format compliant with the City WWD Identification Standard and ISA 5.1.

6.2.4 Schematic Airflow Diagram

1. Requirement:
 - 1.1 Provide a schematic airflow diagram for the complete HVAC system.
2. Content:
 - 2.1 Show all ventilated spaces and flow of air through each space.
 - 2.2 Show all airflow rates.
 - 2.3 Show room pressurization.
 - 2.4 Show all fans and air handling units.
3. Format:
 - 3.1 Produce drawings in an A1 size format.

6.2.5 Building Mechanical Plan Drawings

1. Requirement
 - 1.1 Building mechanical plan drawings are required for every floor elevation, including the roof.
2. Content:
 - 2.1 Show the arrangement of all HVAC equipment, including ductwork and piping.
 - 2.2 Show all AHU's, condensing units, volume control dampers, fire dampers, grilles, registers, unit heaters, ventilation fans and all other accessories.
 - 2.3 Show duct sizes and duct elevations.
 - 2.4 Indicate the appropriate Pipe / Duct identification codes for all pipework and ductwork, as per the WWD Identification Standard.

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- 2.5 Provide a scale bar to allow for scale takeoffs.
- 3. Format:
 - 3.1 Produce drawings in an A1 size format.
 - 3.2 Scale:
 - 3.2.1 Recommended: 1:75
 - 3.2.2 Maximum: 1:100

6.2.6 Building Mechanical Section and Detail Drawings

- 1. Requirement
 - 1.1 Provide building mechanical section and detail drawings to completely make clear the required installation of the mechanical systems.
- 2. Content
 - 2.1 Ensure all materials of construction and dimensions are clearly identified.
 - 2.2 Indicate the appropriate Pipe / Duct identification codes for all pipework and ductwork, as per the WWD Identification Standard.
 - 2.3
- 3. Format:
 - 3.1 Produce drawings in an A1 size format.
 - 3.2 Scale:
 - 3.2.1 Recommended: 1:50
 - 3.2.2 Maximum: 1:100

6.2.7 Schedule Drawings

- 1. Requirements
 - 1.1 Provide schedule drawings for all building mechanical equipment.
- 2. Content
 - 2.1 The content of the schedule drawings shall include but not be limited to:
 - 2.1.1 AHU schedules
 - 2.1.2 Fan schedules
 - 2.1.3 Grille/louvre/diffuser schedules
 - 2.1.4 Unit heater schedules
 - 2.1.5 Heat exchanger schedules
 - 2.1.6 Pump schedules
 - 2.1.7 Expansion tank schedules
 - 2.1.8 Heater schedules
 - 2.1.9 Air conditioning unit schedules
 - 2.1.10 Condensing unit schedules.
 - 2.1.11 Damper schedules.
- 3. Format:
 - 3.1 Produce drawings in an A1 size format.

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6.2.8 Pipe Work Layout Drawings

1. Provide drawings clearly showing piping layouts and associated pipe accessories.
2. Provide isometrics for piping.
3. Include pipe schedules and sizes.

6.2.9 Fire Fighting Layout Drawings

1. Provide drawings showing the firefighting equipment and piping layouts.
2. Provide fire extinguisher, fire hose reel and hydrant schedules.

6.2.10 Installation Detail Drawings

1. Requirements
 - 1.1 Provide piping detail drawings.
 - 1.2 Provide plumbing detail drawings.
 - 1.3 Provide HVAC detail drawings.
 - 1.4 Existing City piping detail drawings may be referenced if available and appropriate for the project.
2. Content
 - 2.1 Content requirements include, but are not limited to:
 - 2.1.1 Typical duct support requirements for all duct configurations.
 - 2.1.2 Duct connection details, including odour control connections to tanks and channels.
 - 2.1.3 Duct insulation details.
 - 2.1.4 Fan installation details (i.e. roof mounted fan)
 - 2.1.5 Typical pipe supports for all piping configurations.
 - 2.1.6 Piping floor/wall/roof penetration installation details.
 - 2.1.7 Duct floor/wall/roof penetration installation details.
 - 2.1.8 Piping flushing connection details.
 - 2.1.9 Instrumentation installation details.
 - 2.1.10 Pipe marking details.
 - 2.1.11 Hose rack and other appurtenances details.
 - 2.1.12 Pipe insulation details.
3. Format:
 - 3.1 Produce drawings in an A1 size format.

6.2.11 3D Model

1. When 3D design is required by the City, or proposed by the Consultant, this section shall be complied with in its entirety. 3D models and associated drawings are not mandatory for all projects
2. The 3D model shall include all pipework, ductwork and equipment to allow for full representation of the entire facility, including all other disciplines.

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3. In addition to the 3D model provide:
 - 3.1 3D elevation and section drawings to convey the complete building mechanical configuration.
 - 3.2 3D detail drawings of all areas with significant interdisciplinary coordination requirements.
4. 3D drawings shall be rendered. Simple 3D line representations are not acceptable.

6.2.12 Coordination with Other Disciplines

1. Structural / Architectural
 - 1.1 Ensure that openings for ductwork, louvres, and other openings are coordinated with, and shown on the structural and architectural drawings.
 - 1.2 Ensure all equipment weights are coordinated with the structural design.
 - 1.3 Where new equipment is installed on an existing floor/roof, the engineer is responsible for coordinating the appropriate structural review to ensure that the weight of the equipment is supported. Upgrade the existing structure as required.
 - 1.4 Where new penetrations are made to an existing structure, ensure that structural elements are not affected. Coordinate the appropriate structural review and upgrade as required.
 - 1.4.1 Where penetrations are made through reinforced concrete, care should be taken during the design planning and construction stages to minimize the cutting of reinforcement.

6.3 Design Calculations

1. As a minimum, provide the following non-exhaustive list of HVAC and building mechanical design data and calculations:
 - Tabulation of interior heat loads (heat dissipation).
 - Calculation of heating load.
 - Calculation of the cooling load.
 - Calculation of air flow rates.
 - Calculation of make-up air flow rates for the building pressurization.
 - Calculation of static duct pressure drops.
 - Sizing of ducts, grilles, registers, diffusers, valves, dampers, louvers, filters, cooling coils, air heaters, fans, compressors, condensers, refrigerant and drain pipes.
 - Plumbing and firefighting piping and equipment design calculations.