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8 FACILITIES

8.1 GENERAL

This section contains technical guidelines to follow when designing new buildings or major renovations on the existing buildings for the Oxford County. These guidelines are to be used in conjunction with Ontario Building Code (OBC) and its supplementary standards along with professional judgment to ensure that they are followed only to the extent they are appropriate. Consultants remain ultimately responsible for the design.

More specifically, the intent of this section is to:

- Describe the minimum requirements for various building components, assemblies, and systems that have an impact on serviceability and anticipated life cycle of the facility.
- Alert consultants to design aspects that historically have been problematic.
- Provide solutions or problem avoidance techniques that have been developed through experience and have proven to be practical and effective.
- Provide a vehicle for communicating departmental design standards to consultants in an effective and expedient manner.
- Indirectly, provide a basis for evaluating designs.

No attempt is made to address every conceivable condition. Rather, common sense solutions are provided where experience has indicated that problems commonly arise. This experience can be applied to new designs as a preventative measure, and to existing buildings to address problems that are attributable to design and/or execution that does not conform to these technical design requirements.

Where these guidelines do not address a technical design issue that arises on a project, it is the consultant's responsibility to address it. When a requirement, though normally applicable, may not be appropriate for a specific project, the consultant should propose an alternative for consideration by the project team. This may include the design of facilities for temporary or short-term use.

Innovative designs or products are encouraged after thorough consideration of potential benefits and risks, value analysis, and life cycle cost. Consult project team members and persons with expertise in facility operation and maintenance.

Designs are required to comply with all applicable codes and regulations. Where the technical design requirements contained herein differ from building codes and other applicable codes and standards, apply the more stringent requirements.

Buildings are to be designed in accordance with the County of Oxford's **Official Plan Chapter 6: Rural Settlement Land Use Policies** and all development policies as outlined in **Section 2-Procedures for Development**.

Designer Responsibilities

- The Designer is required to comply with the current version of all applicable acts, codes, bylaws, regulations, guidelines, and standards recognized in the province of Ontario. Review and understand all sections of the guidelines and acknowledge that all sections may not be complete.

- It is the responsibility of the Designer to provide a complete design in accordance with the design guidelines, using industry applicable design principles. If design conditions are not addressed by the guidelines, confirm the design approach with the County prior to the project commencement.

- If the Designer determines a deviation from the guidelines is required during design development, a formal request to the County is required to identify in detail the benefits of the deviation. The deviation from the guidelines must be approved in writing; only after written approval from the County can the deviation occur for the specific project. Additionally, for specific project types, the County may give directions to deviate from portions of this guideline.

8.2 APPLICABLE REFERENCES

It is not the intent of this Guideline to supersede any active legislation standards and regulations governing the design of any projects within the County. It is the responsibility of the Designer to be aware of all applicable regulator requirements, including those not listed below, this shall include the provincial and federal legislation, and municipal standards when designing projects.

The following standards, codes, legislation, and authorities should be reviewed and referenced, at minimum, to complete the capital projects. The adopted versions of these codes and standards, as recognized by the applicable authorities having jurisdiction (AHJs), shall be used. It is the responsibility of the project team to verify and apply the most current and locally adopted editions in effect at the time of design and construction.

a) American National Standards Institute (ANSI)/Hydraulic Institute (HI) Pump Standards.
b) ANSI Standard Z358.1 entitled “Emergency Eyewash and Shower Equipment”.
c) American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Handbooks (Heating, Ventilation, and Air Conditioning (HVAC)).
d) American Society of Plumbing Engineers (ASPE) CEU 205 Compressed Air Systems.
e) ASPE CEU 309 Laboratory Gases.
f) American Society for Testing and Materials (ASTM).
g) ASHRAE 62.1 Standard entitled "Ventilation of Acceptable Indoor Air Quality", 2010.
h) ASHRAE 111- Standard entitled "Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-conditioning and Refrigeration Systems".
i) Canadian Standards Association (CSA) Welding Code.
j) CSA B52 Mechanical Refrigerant Code.
k) CSA B64.10.1 Selection and installation of backflow preventers/Maintenance and field testing of backflow preventers.
l) CSA B139 Series Installation code for oil-burning equipment.
m) CSA B149.1 Natural gas and propane installation code.
n) CSA B149.2 Propane Storage and Handling Code
o) Health Canada Canadian Drinking Water Quality Guidelines, 2014.
p) National Building Code of Canada (NBC)
q) National Energy Code of Canada for Buildings (NECB)

r) National Fire Code of Canada (NFC)
s) National Plumbing Code of Canada (NPC)
t) National Sanitation Foundation (NSF) 61 Drinking Water System Components.
u) National Fire Protection Association (NFPA) 10 Standard for Portable Fire Extinguishers.
v) NFPA 13 Standard for the Installation of Sprinkler Systems.
w) NFPA 14 Standard for the Installation of Standpipe and Hose Systems
x) NFPA 20 Standard for the Installation of Stationary Fire Pumps for Fire Protection
y) NFPA 90 Series- Standard for the Installation of Air Conditioning, Ventilation, Warm Air Heating, and Exhaust Systems
z) NFPA 92 Standard for Smoke Control Systems
aa) NFPA 820 Standard for Fire Protection in Wastewater Treatment and Collection Facilities.
bb) NFPA Standards Series as applicable and adopted by NFC and Ontario Fire Code
cc) NSF/ANSI/CAN 372 and the Safe Drinking Water Act (SDWA) Lead-Free Plumbing Requirements.
dd) Thermal Insulation Association of Canada (TIAC) Best Practices Guide.
ee) Ontario Building Code (OBC)
ff) Ontario Electrical Safety Code (OESC)
gg) Ontario Fire Code (OFC)
hh) SMACNA Standards
ii) SB-10 - MMA Supplementary Standard, Energy Efficiency Supplement
jj) SB-1 Climatic and Seismic Data
kk) Technical Standard and Safety Authority (TSSA) Regulations, Bulletins and Adopted Codes, Standards and Documents

8.3 BUILDING ENVELOPE

8.3.1 Climate Considerations

Designs should follow climate design tables found in the MMAH Supplementary Standard SB-1 Climatic and Seismic Data as well as Table C-1 in NECB. Consideration must also be given to the impact of climate change on the building envelope so that it can effectively manage these changes in the future.

All building envelopes must adhere to the requirements of the SB-10 and NECB to meet the Oxford County climate conditions.

8.3.2 Air Leakage, Vapour Diffusion and Water Management

Effective air barriers and vapour barriers are environmental separators essential to efficient and sustainable building envelope performance. An initial quality installation and subsequent maintenance of air barriers and vapour barriers comes from knowing how they work, knowing which materials can be used, providing effective quality management, and testing during building construction, and knowing how they must be conserved and maintained.

Air leakage and condensation control systems must follow the requirements stated in OBC Section 5 and 9.25.

8.3.3 Thermal Resistance and Assessment

The thermal resistance of the building envelope minimizes heat loss and thereby reduces building energy consumption and increases occupant comfort. Designers are required to perform effective thermal resistance calculations for all exterior building assemblies and must include these within their drawing package to show conformance with OBC and NECB Division B. These calculations can either be done following the requirements of the OBC or following ASHRAE standards as adopted by the Province of Ontario. Nominal insulation values are not acceptable and do not prove compliance. Thermal resistance calculations must also be used to determine the dew point within the assembly for the design temperature of the building location. This calculation must show that the dew point occurs outside of the vapour barrier material to prevent moisture condensation on the interior surfaces of the building envelope.

No thermal resistance values should be lower than the prescriptive values of SB-10 or NECB for the climate zone or local bylaw requirements. Reduced thermal resistance is allowed for all assemblies where the NECB or OBC allows due to seasonal use, or where areas have no heating requirements.

8.3.4 Basements and Crawl Spaces

Provide heating, ventilation, and moisture protection as required by the OBC section 6. Where sites are in areas where the average radon level is higher than Health Canada exposure guidelines, buildings are to include a radon depressurization system and sealed soil gas barrier under floor systems in contact with the ground.

8.3.5 Exterior Doors

Several problems are commonly experienced with exterior doors, including conductive heat loss and air leakage due to loss of material flexibility at cold temperatures, insufficient hardware adjustment, or door panel warpage.

Vestibules are required at all main entrances to separate the inner and outer entrance doors, to prevent heated air loss and drafts, and to increase indoor building comfort. Exceptions may be made for industrial/process related facilities where the interior space is not permanently occupied and accessibility to the area to transfer equipment and tools will be limited via vestibules. Where both sets of doors may be left open at the same time it is recommended to incorporate an air curtain or a revolving door. If an air curtain is installed, consideration should be given to controlling its cycle time.

All exterior doors must follow SB-10 and NECB requirements.

8.3.6 Exterior Windows

The number, size and location in the building of windows should be carefully selected for energy conservation, building envelope, climate and because of the potential for vandalism in some locations. Views and natural light character (glare, sun angles) must be carefully considered when selecting and locating windows.

The total performance of fenestration products will be based on AAMA/WDMA/CSA 101/I.S.2/A440, NAFS – North American Fenestration Standard/Specification for windows doors and skylights and CSA A440S1, the Canadian Supplement to NAFS.

All exterior windows must follow SB-10 and NECB requirements. The standard requirement for County buildings is the installation of gas-filled triple-pane windows, subject to the specific needs of each facility.

8.3.7 Exterior Horizontal Enclosures

8.3.7.1 Roofs

The total annual precipitation increase in some northern regions requires additional attention be given to roof water drainage design and operation. This is to ensure roof drainage water is not retained in ponds on the roof and is able to move away from the building perimeter once drained off the roof.

All roof structural designs are to accommodate future roof-mounted solar panel installations to support renewable energy development without structural deficiencies. Deviations from this standard may be discussed with **County Facilities/ Energy Management** on case by case.

Building roof insulation (R-value) must be designed as minimum in accordance with SB-10 and NECB requirements.

8.3.7.2 Skylights and Clerestory Windows

.1 Skylights

While skylights may be desired or required in certain situations, they should be avoided wherever possible due to maintenance concerns. If a skylight is necessary, it must be discussed and approved by **County Facilities/ Energy Management**.

Successful skylight installation and operation in Ontario conditions requires exceptional care selecting glazing type, frame materials, condensation and heat loss control features, and positioning the skylight above the main drainage plane for positive water drainage. Placement should also avoid snow and ice accumulation and related water-film deterioration of the skylight and its flashed perimeter seals.

Effective skylight performance requires incorporation of several essential technical design and thermal resistance features matching the windows in the same building, including the following:

- A steeply glazed surface slope is required for drainage, i.e., 3:12 to 6:12, or a continuous framed self-draining one-piece molded aluminum unit is used.
- Skylight units should be placed on raised curbs above the roof plane a minimum of 400mm to allow for drainage, expansion and contraction control, and flashing of joints.
- Adequate air circulation must be provided across the interior of the skylight to minimize condensation, and ample interior condensation gutters must be provided.
- Thermally broken or thermally resistive framing members should be detailed with a secondary drainage plane leading to the exterior to meet the environmental separation requirement of provincial or federal codes.
- Skylights should be equipped with blinds or have a tinted shading factor for reducing overly strong sunlight.

- Skylights are not allowed in a building where the cooling load created by heat gain through the skylight outweighs the benefits of reduced lighting requirements.

.2 Celestial Windows

Clerestory windows are preferable alternatives to skylights, provided careful design allows them to remain clear of snow accumulation and resist driven rain intrusion.

Driven rain at clerestory window heads, and drifted snow at the sill, need to be accommodated in the flashing and roofing details to resist the concentrated wind effects around the stepped portions of roofs, or on the vaulted penthouse enclosures above the general roof plane, where clerestory glazing is installed. c) A minimum height to sill of 200mm is required. Eaves extensions at the head are also required to divert driven rain away from the window head frame joint to the wall.

Clerestory windows need to be placed on the interior side of the wall plane to minimize heat loss and avoid water condensation on the interior frame and glass surfaces. Condensate capture trays in the frame and air system diffusers positioned to direct ventilation air to the glass surfaces are recommended where there is a risk of condensation on the window.

Operable clerestory sashes are not acceptable. Rather fixed glazing units are required. Building ventilation from clerestory vaults to be achieved using operable ventilation louvres and controlled by the building controls system if applicable.

8.3.8 Fall Safety

Fall safety must be considered at both the design and construction stages in accordance with the Ontario Occupational Health and Safety Act (OHSA) and Construction Projects Regulation (O. Reg. 213/91).

Designers should incorporate permanent features that minimize reliance on temporary systems, such as safe roof access, guardrails, and engineered tie-off anchor points, to facilitate safe construction, maintenance, and future operations.

Contractors are responsible for implementing and maintaining appropriate fall protection measures during construction, ensuring workers are trained and equipped with suitable systems, and preparing site-specific fall protection plans where hazards exist (e.g., where work at heights of 3 metres or more is required). Regular inspection and coordination of fall safety systems across all trades is expected.

8.4 BUILDING HVAC / BUILDING AUTOMATION SYSTEM (BAS)

8.4.1 General

Design mechanical systems according to OBC (current edition), ASHRAE standards and SB-10 as applicable. Include the following considerations:

- Design conditions shall be January 1% and July 2.5% as per the SB-10.

- A minimum safety factor of 10% shall be applied to heating and cooling load calculations.
- Do not allow a 10% safety factor for cooling loads when sizing central cooling plant equipment. Safety factors for central cooling plants to be determined based on energy code requirements and best engineering judgments.

Heating considerations shall include:

- Enclosed Parking Structures shall be designed with the ability to heat spaces to 18°C.
- Provide heat to interior envelope surfaces as required to prevent condensation on those surfaces where the indoor conditions or the building function favors condensate formation.
- Provide heat to any interior surfaces that are adjacent to spaces with different temperature and relative humidity conditions to prevent condensation.
- In enclosed ceiling spaces with roof heat loss, provide radiation elements and temperature sensors to maintain minimum 18°C within ceiling space.
- Mechanical room space temperature to be maintained between 18°C and 28°C.

Cooling and ventilation requirements for spaces housing Uninterruptible Power Supply (UPS) equipment and components, including batteries, should be coordinated with Electrical Consultant.

Minimum and maximum indoor temperature sensors for occupied spaces to follow OBC Part 6 requirements. Additionally, unoccupiable spaces to be designed for minimum temperature setpoint of 10°C.

Follow Occupational Health and Safety Act (OHSA) for temperature requirements in industrial workplace.

8.4.2 Facility Fuel Systems

The fuel source for the facility shall be selected based on the local availability of fuel, local service staff, and suitability of associated heating system. Selection of facility fuel source must be coordinated with the **County Facilities/Energy Management** team, specifically the Coordinator of Energy Management to select the proper option and also be able to plan for new utility costs and consumption. Selection of facility fuel source shall be incorporated into the Integrated Design Process and shall be included in energy modeling, life cycle costing and total cost of ownership.

Systems shall be sized to provide a minimum of two (2) weeks capacity while operating at peak building demand if fuel storage will be required. Provide additional capacity where required by local conditions.

Mechanical vehicle protection consisting of concrete filled bollards designed and spaced as per the applicable installation standard shall be provided around any tank system located in areas subject to vehicle traffic. Wooden or other removable means of protection will not be accepted. See **Section 8.6.2.4** for bollard design requirements.

8.4.3 Hydronic Systems

Preference should be given to the two-pipe reverse return system for hydronic systems. Direct return systems may be used if the design safeguards against flow imbalance to terminal units.

Pumps shall only be installed at floor level. No pumps shall be installed at elevation. Where suitable, wet-rotor type inline pumps are preferred.

All exterior piping insulation to be cladded with aluminum jacketing. Indoor insulation shall be cladded with PVC jacketing. Flame and Smoke Spread Rating for all jacketing to be less than 25 and 50 respectively where applicable. Sections of indoor piping or ductwork systems that are exposed to physical damages to be cladded with aluminum jacketing.

Provide isolation valves on supply and return mains, risers, and major branches. Provide isolation valves on suction and discharge of pumps. Provide isolation valves for terminal units at the supply and return connections. Circuit balancing valves must be provided at each terminal unit. Pressure independent control valves are encouraged to ensure proper balancing and increase energy performance.

Preferred hydronic system treatment chemicals include:

- Dispersants, phosphonates, corrosion inhibitors, and alkaline controller product.

Piping shall not be supported by floor supports unless specifically noted as required by equipment manufacturer installation instructions. Pipe supports from floor are to be a channel strut support system (Unistrut or approved equal) with pipe clamp. Threaded rod with a half riser clamp as a floor pipe support is not acceptable.

Mechanical grooved couplings shall be permitted on hydronic heating and cooling systems; but only in mechanical rooms. Mechanical grooved couplings are not to be installed in concealed locations such as shafts, above ceilings, etc.

- In addition, for mechanical grooved couplings to be allowed:
  - The grooved supplier must furnish a warranty for the entire grooved system. This warranty is to be for a minimum of 25 years and will be for full labour and materials related to any leaks or failures in the system. The warranty will not just be for the product itself but for any ancillary building elements damaged by the product failure.
  - The grooved supplier to provide inspection services to ensure that every grooved coupling is installed as per the manufacturer's specifications
  - The grooved supplier to provide training for the installing contractor at the startup on any project where these couplings are to be used. Grooved supplier to also provide ongoing support throughout the project.

Lug style isolation valves are preferred; wafer style isolation valves will not be accepted.

- Valves sized DN150 (6NPS) and larger shall be equipment with gear operators.

For variable primary pumping systems for heating or cooling a flow meter is to be provided for each chiller and / or boiler to confirm adequate flow.

Installation of balancing valves are encouraged for better balancing the hydronic systems.

Unit Heaters and terminal units to be provided with a bypass loop upstream of the unit's isolation valve to allow for prestart cleaning and testing of the hydronic loops while the equipment is isolated from the loop.

Installation of drain and vent valves are necessary at lowest and highest points of the hydronic system respectively.

8.4.4 Heating Systems

8.4.4.1 General

Heating systems shall be selected, designed and installed with a priority on efficiency, comfort, serviceability, availability of local services and simplicity.

Projects are required to exceed minimum code requirements and achieve higher efficiency standards where possible.

Consider electric heating for new installations and major retrofits. Refer to **Section 8.14** for energy management measures.

In large mechanical rooms containing natural gas or propane burning equipment, provide ventilation, heating, and or cooling to control the room temperature within the temperature ratings of equipment (i.e. electrical panels) and to maintain the space setpoints.

For buildings with high exhaust/ventilation requirements such as parking and repair garages, specify that combustion air is ducted directly to the unit from outside for all gas fired equipment where possible.

Pipe insulation jacketing is preferred to be canvas within mechanical rooms, when not exposed to moisture.

Size heating elements for:

- exterior wall envelope heat loss;
- infiltration, ventilation, and where applicable:
  - slab heat loss,
  - roof heat loss, and
  - reheat of minimum supply air quantity.
  - Thermal mass of equipment entering the building.

Utilize n+1 redundancy for major heating equipment.

Hydronic heating systems that include condensing boilers shall be designed to optimize return water temperatures.

- Possible optimization options include, but are not limited to,
  - lowering the supply water temperature,
  - sizing heating elements for large temperature drops, or
  - providing a cascading system.

Variable water flow rates through the boilers will only be accepted for boilers specifically designed for variable flow.

On primary-secondary pumping systems, provide a minimum of two (2) secondary circulation pumps, each sized for duty/standby operation at 100% of maximum design capacity.

Provide a temperature-controlled piping loop for air handling system coils, separate from the loop supplying radiation, radiant panels, and terminal reheat coils.

Provide 50% propylene glycol solution for heating coils in air handling units which may be subject to freezing. Specify pre-mixed inhibited propylene glycol only.

Include specification for chemical injection system for boiler treatment and maintenance. Preferred system would include injection points, diaphragm metering pumps, and totes/tanks for chemicals as required to ensure the performance and reliability of boilers.

Secondary containment is required for propylene glycol fill tanks within mechanical rooms.

Feasibility study will be required if geothermal heat exchange systems are to be utilized.

Heat domestic hot water with heaters or boilers independent of the building heating system when facility heating loads are intermittent or the complexity of the combined system is impractical. Proposed combined systems should be considered only where appropriate.

Where solar hot water is incorporated in the hydronic heating system, the system shall include 100% redundant pumps supplying flow to the solar collectors. An alarm is to be issued to the building controls or BAS upon failure of either pump.

Application of heat pumps are encouraged for offsetting the heating loads where applicable. Application of electric resistant heating systems to be limited to the conditions where heat pumps can't be operated for the entire heating season (e.g. peak demand conditions or cold outdoor temperatures) and alternative fuel sources aren't desired by the County (e.g. peak demand conditions or cold outdoor temperatures).

Follow SB-10 for application of heat recovery systems into the HVAC design and where possible.

8.4.5 Cooling Systems

8.4.5.1 General Requirements

Consider project specific factors affecting indoor temperature such as local climate, building envelope, orientation, shading, glazing, and internal heat gains to determine cooling requirements for the project. Provide free-cooling where practical.

Where indoor design temperature cannot be achieved, mechanical cooling may be required. Consider use of passive strategies to reduce or eliminate requirement for mechanical cooling.

Select equipment and systems on the basis of efficiency, controllability, maintainability and life cycle costing.

Provide cooling in LAN room and data centers where required to maintain temperature below design temperature. Consider heat recovery where possible.

Cooling equipment subject to condensate shall be equipped with a suitable drain pan piped to drain. Ensure suitable means of protecting against backflow and odor recirculation is provided.

Equipment shall be located to facilitate maintenance as outlined by manufacturer.

Cooling zones shall be consistent with heating zones where practical. Areas within a single zone shall have similar aspect, sizing and occupant load.

Provide insulation on any cooling distribution system in accordance with NECB.

Equipment shall be mounted with vibration isolation to reduce noise transfer to the structures.

Each piece of air conditioning equipment shall have the refrigerant type and total refrigerant charge (including pre-charge and any refrigerant added on site) permanently mounted adjacent to or on the equipment nameplate. Lamicoid's to be used on indoor equipment, metal placards to be used for outdoor.

Each condensing unit shall have an independent gravity condensate drain line run to a suitable location. If drain runs through a space subject to freezing temperatures, means of preventing freezing shall be provided.

Outdoor units shall be equipped with a lockout feature to prevent operation when ambient temperature is below the equipment rating. Reset function shall incorporate a time delay to allow equipment to warm up above low ambient shut down limit prior to resuming operation.

Each terminal unit shall be provided with an electrical lockable disconnect.

Heat pump or cooling only variable refrigerant flow systems shall be equipped with low ambient kits when they are used for cooling data centers, electrical/ VFD rooms.

8.4.5.2 Cooling Equipment

Locate equipment with consideration to maintenance access, service clearance and acoustics. Cooling equipment with output rating of 5 tonne and above shall be provided with multiple stages of cooling. Where refrigerant based systems are installed, requirements of CAN/CSA-B52 (sections adopted by the TSSA) shall be followed. All refrigerant cooling systems must be installed by TSSA registered contractors. Applicable TSSA regulations to be followed for registration of all refrigerant based equipment/ plants/ systems.

.1 Outdoor units

Shall be elevated above the anticipated snow level on a suitable stand rated to support the equipment and resist seismic loads.

Allowances for condensate drainage shall be provided.

Locate units to minimize transmission of noise into occupied space and onto adjacent properties.

8.4.6 Ventilation

8.4.6.1 General Requirements

Locate outdoor air intakes to maintain minimum required clearances to potential contaminates in accordance with the requirements of ASHRAE 62.1. Consider the effect of the predominate wind direction, local sources of contamination such as dirt roads or parking areas and increase the

distances as appropriate. Where other codes or standards require larger separation distances, adhere to the more stringent requirement.

Provide ventilation systems with required filtration levels as required by ASHRAE 52.2 to maintain adequate indoor air quality for the intended application. Facilities requiring higher filtration, such as health care facilities, shall meet the requirements of the applicable standards. Ventilation equipment shall be provided with summer and winter filter section where subject to frost. Filter sections and rack shall be provided with sufficient clearance to facilitate filter removal and installation without bending filters.

Locate access doors around any in-duct equipment such as coils, damper, filter, and fire dampers.

Consider the use of demand-controlled ventilation.

Occupancy sensors shall be used in intermittently occupied facilities. In systems where ventilation equipment is used to provide space heating or cooling, unit shall be capable to operate in recirculation mode and/ or freeze protection mode during un-occupied periods.

8.4.6.2 Ventilation Equipment

.1 Heat Recovery Equipment

Heat recovery shall be incorporated into all exhaust systems unless life cycle costing confirms it is not practical. Select heat recovery systems for hazardous locations based on the site condition and ensure no cross contamination will cause from heat recovery systems.

Heat recovery system shall be selected based on exhaust and intake air design conditions. Consider use of heat recovery ventilators, energy recovery ventilators, heat pipes or glycol run-around loops to suit application. Utilize latent heat recovery on systems where high relative humidity is expected.

Systems where continuous ventilation is required to maintain adequate indoor air quality and low ambient operation will result in intermittent defrosting, or where low incoming air temperature may damage equipment, provide a means of pre-heating incoming air. Preheat coils shall be sized to allow maximum heat recovery.

System where cross contamination is a concern shall utilize equipment with separated air streams and leakage rates within acceptable range for the application.

In systems utilizing free cooling with outdoor air, system shall be provided with a means of bypassing air around heat recovery system.

A means of balancing shall be provided on all equipment. Use of Electrically Commutated Motors or Variable Frequency Drives (VFDs) are preferred.

.2 Distribution Equipment and Ducting

Insulate all distribution equipment and ducting in accordance with ASHRAE 90.1 (adopted version) and NECB standards.

Provide remote grease nipples on exterior of all ventilation equipment.

Zoning of ventilation system shall be consistent with space function, occupied hours and air quality requirements. Coordinate with heating and cooling zones as much as possible.

Where displacement ventilation is determined to be suitable, it shall be identified at the schematic design phase and shall include the services of a consultant for the production of temperature variation analysis or fluid dynamics simulations as required to evaluate locations of supply air outlets, return air outlets and ventilation effectiveness.

Ductwork

Design and install ductwork in accordance with ASHRAE Handbooks, OBC requirements and Sheet Metal and Air Conditioning Contractors National Association (SMACNA) standards/ manuals with consideration for reducing noise and static pressure.

Provide vapour-retardant jacketing on all cold air ducts, including but not limited to ducts serving air handling units (AHUs) with cooling coils, upstream of duct heaters, louvers, and sections of exhaust systems located within conditioned spaces and downstream of exterior wall dampers.

All ductworks and building mechanical equipment shall be designed with anti-sway supporting systems (bracing restraint cables at the very least) so that they won't sway during earthquakes and cause damage to other/ adjacent systems. Follow SMACNA for bracing requirements of systems installed in post disaster buildings.

At locations where ductwork is connected to louver for either intake or exhaust purposes, ductwork shall be sloped, and connected to louver so water entering ductwork system positively drains back to and out of louver.

Locate ductwork runs vertically and horizontally, avoid diagonal runs wherever possible. Run ductwork in shortest route that does not obstruct usable space or block access for servicing building and equipment. For ductwork run above the ceiling, maximize clearance between bottom of ductwork and top of ceiling construction.

Coordinate ducting and diffuser location with lighting and other building systems. Locate to prevent short-cycling and drafts. Diffuser locations should not be located directly overtop of fixed workstations.

Duct shall be sealed in accordance with SMACNA requirements. Tape shall not be used for sealing duct joints.

Select and size diffusers/ registers to suit air-flow requirements of the space and minimize noise. Conventional ceiling level, adjustable cone, mixed flow diffusers with vertical and horizontal flow are preferred. Consider air flow, velocity and throw distance when selecting diffusers/ registers to minimize drafts and excessive noise while ensuring adequate coverage.

Intakes and exhaust ports outside of the building or on exterior walls shall be located and designed to prevent snow or rain entrance. Locate above highest expected snow level. Minimum of 450 mm of snow clearance to be provided for all inlet/ outlet ports if snow accumulation data is not available.

Provide access doors where required to ensure ductwork is accessible for air duct cleaning and if applicable for damper inspections. Refer for National Air Duct Cleaners Association (NADCA) for cleaning guidelines. Follow fire damper installation instructions for access door requirements.

Fans

Provide sufficient developed length around all fans and fittings. Configure fans to control room pressurization.

Flexible connections constructed of an approved fire-resistant material, are required at the suction and discharge connections of fans and air handling units to isolate the vibration resulted from operation of the fans to the ductwork where applicable.
Fan equipment is to be installed so that the connecting ductwork is aligned with the fan inlet or outlet, and the flexible connection does not obstruct the air flow.

Provide silencers on equipment where required to meet space noise requirements.

Consider the use of de-stratification ceiling fans in high ceiling areas (e.g., in garages, theatres, etc.). Size the fans for total area coverage. Provide protective guards over fans where they may be subject to damage. In occupied areas where noise may be a concern, provide speed controls in an accessible location.

Dampers

Provide a means of balancing distribution ducting and terminal units. Locate balancing dampers away from duct openings. Balancing dampers shall be lockable quadrant type and shall be set and locked with a setting indicator marked by the balancer.

Motorized dampers installed in ductwork that are directly exposed to the outdoors shall be located as per the ASHRAE 90.1 (adopted version) and NECB and shall be of insulated, thermally broken, low-leakage dampers suitable for cold weather operation.

Fire dampers shall be “gate out of airstream” wherever possible. If a “gate in air stream” damper is to be installed, it shall be on ductwork 300mm diameter and larger and shall be accounted for in static pressure loss calculations. Dampers shall be selected and installed in accordance with the OBC, NFPA 80 and its listing. Damper shall have access on both sides of the fire separation. Consider upsizing dampers when damper size would limit access for testing. Dynamic type fire dampers to be specified.

8.4.6.3 Exhaust Systems

Provide exhaust systems where required by OBC Division B part 6, ASHRAE 62.1 or where required to exhaust local containments, smoke, odours, fumes or in heat relief applications. Consider heat recovery on all major exhaust systems if practical. Provide tempered make-up air for all exhaust systems in accordance with Ontario Building Code (OBC) part 6.

Exhaust systems shall be ducted and sealed to prevent recirculation or leakage. Discharge exhaust to minimize risk of re-entrainment. Consider intake locations and prevailing wind.

In systems sharing a common exhaust between multiple occupancies or areas and where the system operates intermittently, provide protection against back-flow or cross contamination on branch ducting.

CO_2 control should be used in facilities where variable occupancy is expected. CO_2 sensors shall be interlocked with exhaust system in areas where vehicles/ equipment may idle or run indoors such as workshops, ambulance bays, etc.

Provide refrigerant vapor detectors, interlocked with an exhaust system as required by CSA B52 in areas where leaked refrigerant is most likely to accumulate. The detector must activate at a level not exceeding the corresponding Occupational Exposure Limit (OEL) as per CSA B52 code. Upon activation, the system shall initiate ventilation and sound an audible alarm. Follow CSA B52 requirements for details.

8.4.6.4 Environmental Separation

Consider requirements of the space and maintain environmental separations. Design all ventilation system to prevent cross-contamination or recirculation of contaminants.

Design systems to maintain pressurization in occupied areas as required to maintain environmental separations. Pressurization shall not exceed ASHRAE levels or affect other areas. Positive pressurization shall be used over negative pressurization where practical to limit air flow from one area to another.

8.4.6.5 Provisions For Balancing and Monitoring

Provide means of monitoring the outdoor air temperature, return air temperature, mixed air temperature, supply air temperature, and status of all fans and dampers.

All systems must be balanced by certified balancers as per accredited program (i.e. AABC/NEB).

Consider the use of variable speed motors/ drives to allow for fan speed adjustment where demand-controlled ventilation is utilized.

Where possible, direct drive fans are preferred. Where belt-driven fans are used, they shall be provided with adjustable sheaves to allow for speed adjustment.

8.4.6.6 Ductwork pressure leak test

Ducts over 2 m in length, forming part of a supply, return, intake or exhaust ductwork system directly or indirectly connected to air handling, make up air units, VAV or fan equipment to be pressure tested for leaks for duct pressure class B (750 Pa) and higher following SMACNA HVAC Air Duct Leakage Test Manual.

Exhaust ducts serving hazardous areas must be tested completely regardless of duct pressure class.

Follow ASHRAE 90.1 standard criteria for testing outdoor duct systems.

8.4.6.7 Acoustics

HVAC systems shall be designed and selected to ensure acoustic levels attributed to HVAC equipment are in accordance with ASHRAE guidelines chapter 49: Sound and Vibration Control and the acoustic requirements of the space.

Fan speeds shall be selected and installed to limit fan noise. Additionally, air velocity shall be within the limits outlined by SMACNA.

Coordinate with architectural and noise consultants to provide sufficient attenuation around equipment to limit sound transfer. Coordinate with architectural to maintain acoustic separations between spaces and limit sound transfer between sensitive areas.

Acoustic insulation is to be provided on all ducting in a fan room, on minimum first three (3) metres of any duct run to or from a fan, on all transfer ductwork and wherever fan and duct noise may be a problem. Insulation shall be secured with pin spot fasteners.

Commissioning of HVAC system to include sound testing in all occupied spaces to ensure compliance with ASHRAE guidelines and the functional requirements of the space. Design to mitigate excessive noise in compliance with OH&S, NBC, as well as with local noise bylaws.

Discuss with the County if sound attenuation of equipment or rooms housing equipment is required in accordance with ANSI S1.13 and CSA Z107.2.

If maximum allowable decibels are confirmed, specify limitations for equipment supplier. Require third party noise testing during Factory Acceptance Testing (FAT) to confirm levels.

Require noise testing once equipment is installed on site for the equipment/ locations that maximum decibels must be met.

Confirm with a third-party acoustic consultant the modelled predicted noise levels in the facility so that appropriate acoustic panel coverage can be included in the design package. Complete a second noise study at the completion of construction to confirm if additional noise mitigation is required.

Ensure compliance with specific regulations and standards. Noise control measures should be tailored to the unique characteristics and requirements of the space to achieve an appropriate balance between operational efficiency and minimizing noise impacts.

8.4.7 Hazardous Area Classification

Hazardous area classifications can vary from plant to plant and the requirements by code can change over time. An Engineer licenced in the province of Ontario to review existing conditions, confirm code compliance, and complete thorough assessment based on the following, including but not limited to:

a) Identifying and assessing potential hazardous substances, processes, and equipment present in the treatment plant area of interest. For new construction consider chemicals, gases, flammable materials, explosion limits, toxicity, and other substances that may pose a risk as part of final operating requirements.
b) Follow applicable codes, regulations and standards governing hazardous area classification (i.e.: Ontario Electrical Safety Code, Canadian Electrical Code, NFPA series or other relevant local regulations). Ensure the design complies with requirements.

c) Where applicable, divide the facility into specific hazardous area classification zones based on the frequency and duration of hazardous material presence. Common classification zones include:
   a. Zone 0: Areas where a hazardous substance is continuously present or present for long periods under normal operating conditions.
   b. Zone 1: Areas where a hazardous substance is likely to be present during normal operation, but only for short periods.
   c. Zone 2: Areas where a hazardous substance is not expected to be present during normal operation, or if present, only for brief periods.
   d. Non-Hazardous Area: Areas where hazardous substances are not expected to be present under normal operating conditions.

d) As part of the risk assessment process, identify potential ignition sources within the hazardous areas, such as electrical equipment, hot surfaces, open flames, or sparks. Ensure that appropriate safeguards, such as explosion-proof or intrinsically safe equipment, are used in these areas to prevent ignition.

e) Design appropriate ventilation systems to the classification requirements per design code/ standard and following determined by a licenced professional engineer. Confirm if gas scrubbing equipment or containment strategies are required to prevent the spread of hazardous substances in the event of a leak or release.

f) All equipment and materials designed as part of the scope of work must be suitable for the hazardous area classification. Use explosion-proof or intrinsically safe electrical equipment, switches, and control devices that comply with the specified hazardous area requirements registered by the CSA.

g) Ensure that electrical wiring and conduits meet the hazardous area classification standards. Use appropriate conduit materials and sealing techniques to prevent the ingress of hazardous substances.

h) The Designer is to include safety signage to identify and mark hazardous areas to alert personnel to the potential risks. Complete an OH&S review of signage for the area that complies with requirements and follow standard colour-coding for different hazard levels.

i) The area classification for each distinct space within the facility to be described, along with any requirements, as part of the code review drawings. The design must ensure equipment is rated to operate for the area classification.

j) Electrical area classifications to be determined by a qualified professional process, electrical, instrumentation and controls or mechanical engineer. Coordinate with architectural/ structural team to ensure the requirements for electrical area classifications are followed in the architectural layouts.

8.4.8 BAS Systems

8.4.8.1 General

All buildings are to be designed and installed with a Distributed Digital Control (DDC) or Building Automation System (BAS) where required by the County. Consult the County in determination of the proper control system for building mechanical systems.

Consult the County for a list of approved BAS vendors.

Any renovations to a building where equipment is replaced or added, that equipment is to utilize DDC controllers. Any new DDC controllers will either connect to the existing building automation system or will be specified such that they can be added to a DDC system in the future.

Only a single BAS manufacturer is allowed in any given building. If there are multiple buildings directly connected to each other, even if they have different site IDs, there shall only be a single BAS manufacturer for those buildings. If a building is being renovated and new DDC systems are being added they must be of the same manufacturer as what is in the building already or the entire system must be removed and replaced to ensure there is only a single BAS manufacturer in the building.

All critical building mechanical equipment shall be hard wired to BAS panels. Strategically placed and located distributed BAS panels are encouraged to minimize control wiring between field equipment to each BAS panel. BAS panels shall communicate with each other using either of the following acceptable ethernet IP based communication protocols:

- BACnet/IP,
- Modbus TCP/IP

Serial based communications are considered outdated and will only be accepted on a case by case situation and only where ethernet IP based solutions are deemed not feasible. In general, proprietary protocols will not be permitted.

The base building BAS should be accomplishing the control functions for all equipment. The exceptions are boiler sequencing controllers and chiller plant controllers where we allow the manufacturer's equipment controller to control those pieces of equipment. The boiler and chiller control systems, including multistage systems, must be provided with an enable and setpoint control supplied by the base building BAS system utilizing hard points as referenced above.

Air handling unit components including fans, dampers, heating, and cooling systems for large central station air handling units shall be controlled directly by the base building BAS. There shall not be a separate integrated controller on the air handling unit unless that controller is manufactured by standardized control suppliers that is compatible with the BAS system. All control points for the components listed above are to be writable through the base building control system.

Ductless split/heat pump units to be specified so that the cooling enable and heating enable are controlled directly from the base building BAS. An adapter card may be required for these systems.

All gas and water meters connect to the BAS via a pulse output from the meter.

All BAS site name, point name, panel name, and graphics filename labeling shall follow Oxford County's **Asset Management Tagging Standards**.

8.4.8.2 Control Documents

Provide a complete schedule of physical control points. For each point provide a short description, the point type, its mnemonic (system name) as well as any alarm limits and fail-safe position.

Provide a detailed control sequence for each mechanical system and any global optimization strategies. Include set points, interlocks, and alarms.

Laminated, permanently installed I/O lists shall be secured to all BAS panels.

8.4.8.3 Hardware

Each control system to be designed in such a way to facilitate a single connection from that control system to the Oxford County network.

Specify that for each BAS panel to allow for 10% spare physical point input/output. An additional eight (8) outputs shall be specified to be allocated at the panel closest to the C-Cure security system panel for future alarm use.

The firmware on the BAS panels must be compatible with the existing building automation network infrastructure. In instances where backwards compatibility to the County server becomes an issue, the Contractor will include the cost to supply and install upgraded software on the County server.

All panels, systems, controllers, equipment etc. must be completely accessible by the County's Controls staff, including the ability to make graphical changes and access to programming. Proprietary or control systems with restricted access will not be permitted. Any specialty software needed to make changes to the system or equipment must be provided to the County. The cost of speciality software licenses shall be included in the tender price. Designer to confirm the specific specialty software required with the County directly.

Terminal control units (TCUs) shall specify standalone microprocessor-based controllers that will continue to control if communication with the sub-network fails. Use TCUs to control terminal heating/cooling devices only.

Specify electrically powered actuators to drive all valves, dampers, and other control devices. The sole exception is large three-way valves where an electric actuator cannot be sourced. All damper, valve, etc. actuators to be accessible.

Select control valves with flow characteristics to match the application. Do not oversize valves. Specify the flow coefficient (Cv) for all control valves.

Specify electronic room thermostats that allow access to TCU set points and configuration information, by either:

- a communication port for the PCs, or
- a display window and program keys incorporated into the room sensor. Program keys and display window only required for areas where user input is desired.

All controls wiring to be in EMT or rigid metal conduit unless within a protected space. Plenum rated control wiring shall be specified where appropriate. It's not allowed to use EMT for industrial applications (e.g. Water/wastewater treatment plants). Rigid Galvanized Steel or Rigid PVC conduit to be used for corrosive or outdoor use applications.

BAS communication wiring shall be CAT6A for ethernet based communications. Fiber optic cabling shall be used should the run exceed 90m.

For all analog hardwired signals, twisted shielded cable shall be used. No splices are permitted, and installation shall be from BAS panel direct to equipment.

Current switches shall not be used. Where status is required, a current transducer outputting an analog signal shall be used.

Variable frequency drives (VFDs) speed command shall be via 4-20mA (preferred) or 0-10V (only if 4-20mA is not available) signal. VFDs shall have hard wired connections for status and control signals. Preferred points for VFD control through BAS include:

- Start Command
- Stop Command
- Speed Reference
- Speed Feedback
- VFD Alarm Point
- Amperage Draw

8.4.8.4 Software

Colour graphics user interface and application software will reside on the Oxford County controls servers. Contractor to supply original graphics files to the County.

Specify dynamic colour graphic screens as follows:

- For any building where graphics are being modified or added as part of a renovation, the existing building graphics are to be modified to match the style vintage of the new graphics.
- A main screen showing the basic floor plan of the facility indicating locations of mechanical rooms and major pieces of mechanical equipment.
- A screen for each mechanical system (AHUs, VAV boxes, RTUs, fan coils, etc.).
- A screen for each floor or zone to show space temperatures.
- A screen showing the network architecture of all BAS panels. The health and status of each processor shall as well as notification of a loss of communication to any panel shall be displayed.

All BAS sites will include single point trend data, available in BACnet/IP or Modbus TCP protocol, for each hard point and event in the entire database. These trends will be polling trends, recording at 15minute intervals and the BAS panel(s) shall have sufficient memory to store all of these trends for a duration of 72 hours. The trends will be rolling trends.

- Change of Value (COV) trends will be preferred and used instead of a polling trend when fewer samples will generate a longer trend history. I.e.: A room temperature will be set up as a COV, single point trend with 1 degree granularity when the room temperature is expected to vary little.

8.5 BUILDING IT INFRASTRUCTURE / AV SYSTEMS

8.5.1 Reference

It is the responsibility of the Designer to be aware of all applicable regulator requirements, including those not listed below, this shall include the provincial and federal legislation, and municipal standards when designing projects.

The following standards, codes, legislation, and authorities should be reviewed and referenced, at minimum, to complete the capital projects:

a) ANSI/INFOCOMM 4-2012
b) DS/EN 50157-2-3
c) CAN/CSA-ISO/IEC TR 14543-4
d) T568.1-1-05

e) Ansi/TIA-568-B.1
f) Ontario Building Code
g) Ontario Electrical safety Code

8.5.2 General

- Coordinate A/V requirements with the County.
- Please provide Network bandwidth calculations prior to tender.
- Provide broadcast frequencies of devices for approval by County - devices must be tunable- all wireless / RF gear / ALD.
- Please provide POE (Power over Ethernet) budget calculations prior to tender.
- Please provide Serial # & MAC Address for each item in tabulated form.
- Page zones are to be made available to all users in smaller zones:
- Be sure to specify a wall mountable weatherproof CB style microphone to the pool deck for emergency pool page only.
- All rack mount UPS shall have data ports connected back to the Oxford County network for remote monitoring.
- Basis of design is the 70V speaker line.
- Network cabling to be installed as per **Oxford County's Network Wiring Standards**.
- Basis of Design for Arena - Wireless microphone to be a dual channel wireless receiver with both audio outputs routed to the corresponding arenas.
  - Only one (1) handheld microphone will be required at time of install. Second wireless channel is for future events or if future wireless expansion is needed.
  - Wireless system to have remote antennas mounted in each corresponding arena, antenna cable to be factory-built cable and any RF inline amplifiers to be installed according to factory specifications to have proper RF gain structure.
  - Handmade cables will not be accepted.
- Network switching manufacturer to be fully defined.

8.5.3 Assistive Listening Device Systems (ALD)

Generally, to code for assembly occupancies. Induction Loop currently preferred. Make allowances in millwork, floor, or ceiling for Induction loop at public service desk locations.

8.6 BUILDING SECURITY

8.6.1 General

Security considerations should be determined in the Functional/Spatial Program development stage and fully incorporated during the Schematic and Design Development stages. This allows security measures to be incorporated into all building systems and subsystems early in the design process.

Security measures specified for a building should consider the costs in relation to capital and operating estimates, and any potential limitation on service program delivery or capacity. The

combination of security measures and flexibility to determine suitable levels of security, in keeping with program requirements, can be considered the most cost-effective protection.

Security measures may include access control systems, surveillance systems and security alarms, and are to be based on a threat and risk assessment, in accordance with Crime Prevention Through Environmental Design (CPTED) principles (Refer to Sub-Section 9.2.2). Additional costs must be identified during each project phase.

Security camera placement must be designed in accordance with **Oxford County Policy 8.11** Video Surveillance Policy.

8.6.2 Crime Prevention Through Environmental Design

Building design, site planning, and landscape design should consider the principles of Crime Prevention through Environmental Design (CPTED) to ensure the safety of users and staff, visitors and the public by deterring criminal activity through design. Designers should consider the following three principles.

- Natural Surveillance: Designing to allow for people to easily observe the space around them, and to eliminate hiding places.
- Territoriality: Allowing for a clear designation between public, private, and semi-private areas to make it easier for people to understand and participate in an area's intended use, to create a sense of ownership, and to discourage criminal activity.
- Access Control: Reduce criminal accessibility by limiting the number of entry points to the property and building and by implementing physical and electronic access control hardware. These principles should be applied to all projects through the use of the following design and performance requirements.

8.6.2.1 Access Control

Discourage entry into non-public areas by restricting public access through the implementation of access control systems. Use locks, non-removable pin hinges, astragals, and other measures to discourage access. Avoid providing pathways that allow for unobserved access.

Clearly identify buildings with a street number to assist emergency services.

8.6.2.2 Common Spaces

Locate active interior occupancies adjacent main exterior spaces and main entries to provide natural surveillance. Design exterior garbage and recycling facilities to screen containers and minimize opportunities to hide. Exterior sidewalks should be wide enough and landscaped to avoid creating narrow corridors, which could be perceived as threatening.

8.6.2.3 Entrances

Clearly identify entrances to make them visible to users through design features and signage. Where possible, minimize the number of entry points.

Clearly guide the public to and from entrances through the use of sidewalks, paving, fencing, lighting, signage and landscaping.

8.6.2.4 Fencing, Bollards, and Landscaping

Where required, fencing, walls, or landscaping along the front of buildings should be kept low, support surveillance from the street and minimize hiding places. Avoid landscaping that obstructs views of the building entry from the street.

Use low groundcover, shrubs, or high canopied trees at parking areas and sidewalks.

Avoid placing large landscape features, accessory buildings, or utility structures next to buildings where they could provide a means of access.

Use gates, fences, walls, landscaping and lighting to prevent or discourage unauthorized access to dark or unmonitored areas. Where appropriate and suited to specific project functional and program requirements use pavement textures, signage, landscape, screening, and fences to define and outline ownership of space.

- To protect building assets, equipment, utilities, or other infrastructure from potential damage caused by vehicle or equipment traffic, bollards shall be installed where required. Bollards should be designed to: Provide sufficient height, diameter, and embedment depth to resist anticipated impact forces.
- Be constructed of durable materials (e.g., steel, concrete-filled steel) with corrosion protection.
- Be spaced to prevent vehicle access while still allowing safe pedestrian movement where applicable.
- Be clearly visible through paint, reflective striping, or other markings to minimize accidental impact.

Comply with applicable municipal standards, accessibility requirements, and Ontario Building Code provisions.
Shop drawing to be submitted by Contractor to ensure compliance with bollard design before installation.

8.6.2.5 Lighting for Building Security

Provide exterior lighting that enhances natural surveillance. Ensure adequate visibility in all outdoor areas to allow their use in the dark. In areas used by pedestrians, provide lighting to avoid possible entrapment areas, and focus lighting on safe routes. Dark sky and cut off lighting shall be used where possible.

Avoid general lighting of areas not intended for use in the dark, and provide motion activated lights in these areas. Lighting should be uniform to avoid creating contrast between over and under lit areas, which will enable hiding. All exterior lights should be controlled using photoelectric sensors in addition to any other lighting controls. Coordinate the placement of lighting and surveillance cameras appropriately.

Consider landscaping in the development of the lighting design.

8.6.2.6 Natural Surveillance

Public and semi-private spaces should be located so that they maintain an unobstructed view from high use areas. Barriers adjacent exterior sidewalks should not obstruct views.

8.6.2.7 Security

Reduce unauthorized access by incorporating security hardware at entry points. Hardware types, functions, operating conditions and other requirements are to be determined during Conceptual and Schematic Design phases. All security systems shall be hardwired to the facility.

8.6.2.8 Building Design

The building design shall include the following crime prevention measures:

- Orient main building entrances towards the main public street.
- Minimize the number of entry points.
- Staff entrances, if separate from the main entrance, should be visible from the street or other high-traffic and "generally occupied" areas.
- Avoid hidden recesses.
- Locate parking areas so they can be observed by nearby occupancies.
- Avoid large areas of parking.
- Open spaces must be clearly designated and located so they are easily observable.
- Avoid creating the potential to climb up buildings to upper levels, roofs, canopies, or ledges. Avoid fencing or other features up against walls, downspouts, or other surface articulation without some means to deter people from using them.

8.7 KEYS

Develop a keying schedule for review and approval by the County, that adheres to existing master and grand master keying systems as required. All facility keys must follow OBC Division B, part 3 guidelines.

All cores must be selected so that keying can be completed locally. If specialty or high security cores are being considered, it is recommended that the consultant confirm with local companies that the key core can be ordered and keyed.

For renovations and additions, all key cores must match the existing building for a consistent keying system.

Allow for five (5) keys per lock.

8.8 ELECTRONIC ACCESS

Provide hardwired electric or keypad access control device at all main and staff entrances and all service areas.

If not stated in the functional program, confirm the requirements for after-hours access to spaces. Design the building to allow for access to these spaces while maintaining the security of the rest of the building.

8.8.1 Access Control and Intrusion Detection

8.8.1.1 Access Control

Provide access control for all buildings accessed by the public, and for buildings containing 20 or more full-time occupants. Access control to consist of electronic access passes (cards), card readers, door hardware and door access control system.

System to be fully integrated and connected to Oxford County servers.

Access control to be designed to record events (enter/exit requests), as well as forced entry through REX detection. Connect to building management system to determine areas of occupancy or unoccupied areas. Armed and locked indicates no occupancy.

Designers to consult with **Oxford County Facilities** if electronic access is required.

8.8.1.2 Intrusion Detection

For buildings with 24-hour access (hospitals, residences, etc.) intrusion detection is limited to service spaces, LAN rooms and medication storage rooms. Provide passive infrared sensor (PIR) detection within the space, and perimeter detection of exterior and secure doors and windows using position switches and glass break devices.

Provide separate partitions based on the functional requirements, so that one (1) area can remain locked, while others are open (this is particularly important for after-hours access, such as in schools). Zone areas accordingly for after-hours access. Make allowance for the physical separation of spaces in the architectural design.

Provide a mechanical partition within the security panel, to allow for critical alarms to be passed to the alarm monitoring company.

8.9 VIDEO SURVEILLANCE

Where required by the functional program or where indicated by **Oxford County Facilities**, provide networked video surveillance of the building to allow for video surveillance on the premises and within the building. Cameras required to store footage on Oxford County's central server, and have a minimum quality of 720p (30 frames per second).

If required, camera locations to be selected in consultation with County staff to ensure compliance with **Oxford County Policy 8.11**.

All cameras to be IP based, and capable of being ported through building LAN equipment. Select camera type based upon location and application.

- Provide IR sensing, low light cameras for exterior locations.
- In large open parking lots, outside schools, or high value installations, provide IR source lights, for improved visibility of IR cameras.

Providing documentation as required to review the orientation of cameras, and to identify any areas of the camera coverage that require masking to protect sensitive information or personal privacy.

8.10 ALARM SYSTEMS

All alarm systems must follow OBC Division B requirements and designer to consult with Oxford County Facilities if building alarm systems are required (outside of process alarms through SCADA system).

Control system shall be capable of receiving building alarms and taking the necessary action to alert operator of failure. All critical building alarms shall be processed through building security system. Non-critical alarms shall alarm locally at panel or graphic display. In buildings where a Building Management Systems are installed, provision for secondary email callout shall be provided.

Buildings without access to security call-out, phone, or internet shall be provided with visual alarms, pro-talk or satellite call out. At minimum, critical alarm shall illuminate exterior strobe located in a visible location, non-critical alarms to indicate at local panel.

In seasonally occupied buildings, alarm function shall be capable of being disabled during unoccupied periods.

At a minimum the following critical alarms shall be provided as applicable.

- Building low temperature alarm, based on any one (1) room thermostat.
- Sprinkler room low temperature alarm.
- Domestic water tank low level alarm.
- Septic holding tank high level alarm with domestic water shut-off interlock.
- Sewage lift station high level alarm, and lead pump failure.
- Low fuel alarm.
- Fuel spill sensor.
- Fuel transfer pump failure.
- Boiler failure.
- DCW frost protection failure.
- Generator failure.
- Propane tank heater failure.
- Transfer switch position notification or alarm.
- Flood monitoring water level sensor alarms.

At a minimum the following non-critical alarms shall be provided as applicable.

- Domestic water tank high level alarm to notify fill operator.
- Lead domestic water pump failure.
- Lift station lag pump start.
- Ventilation system freeze protection.
- Lead boiler failure/lockout.
- Lead pump failure.

8.11 BUILDING ELECTRICAL

The intent of this section is to outline building service electrical design requirements.

8.11.1 References

Meet or exceed guidelines and standards of the following BAS organizations:

a) Canadian Standards Association
b) Illuminating Engineering Society (IES) of North America
c) Institute of Electrical and Electronics Engineers (IEEE)
d) Insulated Cable Engineers Association
e) Canadian Electrical Code (CEC)
f) Ontario Electrical Safety Code (OESC)
g) Ontario Building Code (OBC)

8.11.2 Existing Building Electrical Systems

For projects where an existing building is being renovated or being added to; the Basis of Design for the new electrical system is to match or exceed the existing base building system.

Design Consultant shall identify existing equipment to remain in place for systems being modified. Design Consultant shall coordinate with the County to determine shutdown, maintenance, and long-term preservation requirements for dormant equipment for long term construction projects as appropriate.

Design Consultant shall identify existing equipment being removed or abandoned under the project and define decommissioning procedures and requirements in the project specifications. Design Consultant shall identify if any regulatory requirements exist for equipment to be decommissioned and who will be filing the necessary documentation.

8.11.3 Service and Power Distribution

8.11.3.1 Utility Service

Coordinate new and modified services with the Electrical Utility and Facilities at energy@oxfordcounty.ca. Refer to latest Electrical Utility connection guide.

8.11.3.2 Sizing

Building loads shall be calculated in accordance with OESC and CEC Part 1.

For multi-building sites, or sites with service voltages over 750V, coordinate electrical services with the County.

- Single building services with service voltage under 750V shall be sized as follows:
  - Size main services and service transformers according to connected load with the appropriate load factor applied. Disclose service sizing criteria in design documentation.

- Calculate connected load using load factors as dictated by the type of load, plus an allowance for future load growth. Discuss future load allowances with the County.

For additions to existing service/feeder, provide calculation as per OESC Section 8. County to provide maximum demand load for most recent 12-month period where available. Final Load Calculation(s) to be included in drawing set and to be based on a detailed analysis of the building existing and additional load with an allowance for future growth.

8.11.3.3 Single Line Drawing

Provide electrical single line diagram as part of the Contract Documents, indicating the following:

- Configuration, type, voltage, and amperage ratings of switchgear, transformers, panelboards, and motor control centres (MCCs).
- Type, size, and amperage ratings of services and feeders.
- Type, frame size, and trip rating of overcurrent protective devices.
- kAIC rating of switchgear, panelboards, transformer secondaries, and overcurrent devices.
- Service and distribution grounding/bonding:
- Existing Building: Provide complete facility wide single line diagram; partial single line diagrams will not be accepted. County to provide existing master single line diagrams where available.

Provide copies of single line diagrams from Record Drawings, recording actual construction, to:

- Incorporate into Operating and Maintenance Manuals.
- Display in frame with clear plexiglass and hang in each major electrical equipment room, with equipment in the respective room highlighted. This requirement is to be included in the electrical construction specifications.

8.11.3.4 Protection and Control

Perform arc flash, short circuit, and coordination study in accordance with CSA Z462 complete with arc flash labels for all equipment to inform and validate requirements below.

Ensure priority tripping and coordination of overcurrent and ground fault devices. Provide final consolidated trip curves.

Ensure adequate fault interrupt ratings of all switchgear, panels, MCCs, and overcurrent devices. Provide calculation results when requested by the County.

Use fully rated overcurrent protective devices throughout distribution system. Series-rated combinations may only be used with permission by Oxford County.

Where ground fault protection is provided on services and feeders, ensure protection is also provided for downstream feeders and loads that are susceptible to nuisance ground faults. Ensure ground fault equipment is coordinated to prevent upstream devices tripping before downstream devices.

Evaluate the feasibility of peak demand control through the use of load shedding or emergency generation equipment. Review all options with the County.

8.11.3.5 Harmonics

Building shall meet IEEE 519 requirements at PCC. 519 compliance. Design should account for harmonic mitigation to provide compliance and a study of harmonics should be provided during the design stage. As part of a full load commissioning test and/or monitoring of ITHD & VTHD throughout the first year of operation. If harmonic level is deemed to not meet the IEEE 519 requirement, then harmonic mitigation shall be provided through active harmonic filters or VFD active front ends.

8.11.3.6 Service Spaces

For services under 200A: Main Electrical Service Room may be a shared Mechanical/Electrical space.

For services over 200A: Main Electrical Service Room to be dedicated room containing no mechanical/plumbing fixtures.

.1 Electrical Room

Locate at grade or above if in flood zone when room contains critical pieces of electrical equipment (i.e. Main Switchgear, Generator System, etc.). Electrical rooms not to be close to mechanical equipment, ducts, pipes, shafts, or water contain mains unless the equipment is serving the room.

Provide a minimum of one (1) electrical room sized 1800mm by 3000mm (6’ by 10’) for every 930 sq. m (10,000 sq. ft.) of floor area served or portion thereof.

Doors to be large enough (width and height) to allow for the removal and replacement of the largest piece of equipment.

Provide raceway system between all Electrical Rooms, Closets, and Network Access Rooms.

Where a room contains heat generating equipment, adequate cooling and/or ventilation shall be provided by mechanical.

.2 Electrical Closet

Electrical closets are not permitted to contain transformers, motors, or other heat generating equipment.

Locate electrical closets in core areas of the facility and stack vertically where possible.

8.11.3.7 Grounding & Bonding

Ensure that grounding and bonding is compliant with OESC Section 10 and with Section 36 for systems greater then 750V.

Ensure that all connections to be labelled with their destination.

Design for underground or concrete embedded connections are to be exothermically welded and/or by using a compression system that meets IEEE 837-2014 standard.

8.11.3.8 Switchgear, Panelboards, and MCCs

.1 Switching and Overcurrent Devices

Use bolt on molded case circuit breakers with thermal, magnetic trip for all circuit protective devices except as follows:

- For services over 750V, provide relaying using relay accuracy class CTs with test block and solid-state relays with trip indication for each function. Provide a DC battery source for control and tripping.
- Use industrial duty, draw out type air circuit breakers for all services and feeders 800A and over.
- Use circuit breakers with maintainable contacts, complete with electronic trip units and trip indication for all main service or feeders for all services over 400 Amps and under 800 Amps.
- Use metal enclosed switchgear with air vacuum circuit breakers for all greater then 750V.
- Obtain the approval of Oxford County for the use of fused equipment. Consideration will only be given where fault duties of equipment require a limitation of the available fault current.

.2 Bussing

Use solid copper for switchgear sized 200A and over. Provide min. 25% spare capacity for future growth and ensure bussing extends to all spaces for future growth.

.3 Metering & Power Monitoring

Metering within a facility: Include for power monitoring (recommend Owner hard spec a particular brand, i.e. Eaton PQM II Power monitors) on all main power distribution feeders and equipment. Power monitors shall communicate via Modbus TCP and shall communicate to the facility BAS.

Service entrance/Utility metering: Provide integral, multichannel, owner metering for incoming utility service and distribution feeders unless otherwise directed by the County. Contact Engineering Services for currently recommended models. On larger, more complex distributions consider sub-metering on secondary distributions & Panels. Consult with Engineering Services.

Where feasible, consider submetering to support monitoring-based commissioning services. Feasibility should be evaluated based on whether the load is sufficiently large to justify both the capital investment in metering equipment and the ongoing operational costs associated with data monitoring.

Typical power monitoring signals shall include true RMS, values for phase voltage (line to line and line to neutral), phase currents, kVA, kVAR, kW, PF, Hz, MWh, kWd, kVAd, ITHD, and VTHD.

Consultant shall ensure that any required meter setup, control, or monitoring software is to be supplied to the County.

.4 Control

Control through MCCs generally via Building Management System (BMS)/BAS connection.

.5 Panelboards

The design of panelboards shall consider the following:

- Copper bussing.
- Bolt on style breakers.

- Maximum number of breaker positions in a single tub to be 60. Double wide is acceptable. Provide minimum 225A bussing for panelboards with 42 or more positions.
- Do not use feed through.
- Provide panel schedules indicating breaker size and wattage of all connected loads. Panels to be a maximum of 75% filled at the completion of Construction.
- Hinged, door-in-door construction.
- Lockable.
- Distribution panelboards to be located in dedicated rooms and closets. Provide additional space on wall for at least one (1) future panel.
- Single pole breakers with handle ties are not permitted in place of multi pole breakers.
- Provide minimum of two (2) spare 27mm conduits c/w pullcord to ceiling space for all recessed panelboards.
- Combination (single cabinet) transformer and panel board are not acceptable.
- Wire splices required for panel replacements are to be completed with terminal blocks, housed in a separate enclosure.

.6 Accessories

Provide lifting equipment for all industrial type air circuit breakers, high voltage switches and stacked high voltage starters.

.7 Working Clearances

Provide all switchgear and MCCs with minimum 1m front clearance as required by OESC, in addition to space required for drawout equipment in full disconnect position, and all free-standing switchgear with minimum 1.0m back and side clearance.

.8 Housekeeping Pads

Provide all floor mounted equipment with a 100mm (4”) housekeeping pad except for roll-out style switchgear.

.9 Outdoor Pedestals

Provide precast concrete base and local heater to provide minimum temper heating to 5°C to facilitate proper operation of equipment and prevent condensation.

Provide protection for outdoor electrical equipment against physical damage, moisture, and corrosion as necessary.

8.11.3.9 Transformers

.1 Location

All Transformers shall be installed such that replacement is possible without unforeseen building modifications nor surface or structural damage. Provisions may include double doors, expanded hallways, reinforced and or widened routes to loading docks and grade, removable wall panels, top access pits, etc.

Main Building Transformers: Locate main power transformers outside with pads or vaults as per Electrical Utility guide. Provide bollards or screens where required by project. Location to be serviceable as required by Electrical Utility standards and as close as possible to building service

entrance to reduce capital and operating costs (line losses). All primary, MV services to be in fully isolated, interior vault segregated from 600V or lower distribution.

All Indoor Transformers over 45kVA: allow for removal by wheel mounted equipment.
Indoor transformers are to be preferentially floor mounted on housekeeping pads. Suspended installation only permitted for transformers within service rooms where there is lift accessibility. Transformers 45kVA and less may be cantilevered/wall mounted where access is not impeded by other equipment. Coordinate transformer heat removal with Mechanical.

.2 Type

Use minimum K-4 rated distribution transformer. Increase K rating or opt for HMT, Zig-zag, and/or alternating phase layout where advisable due to amount of non-linear/harmonic load.

Autotransformers only permitted for dedicated equipment step-up/down applications.

Copper wound transformers are preferred and shall be specified where practical.

Combination (single cabinet) transformer and panel board are not acceptable.

.3 Secondary Voltage (isolation/distribution)

- 347/600V, three-phase, four wire, solidly grounded wye.
- 120/208V, three-phase, four wire, solidly grounded wye.
- 120/240V, single-phase, three wire, solidly grounded, center tap.
- Obtain approval from the County for other voltages, connections, or any impedance grounding schemes.

.4 Acoustical Considerations

Ensure adequate acoustic ratings, treatment location and mounting of transformers.

8.11.3.10 Power Factor Correction

For sites with considerable motor loads preliminary calculations indicating power factor to be provided.

Power factor correction shall adhere to the following:

- Correct power factor to at least 95% where normal loading yields a power factor of less than 90%.
- Locate PFC close to the motor or group of motors, preferably downstream of starters.
- Review use of automatic correction equipment with the County.

8.11.3.11 Feeders

Feeder conductors must be copper. Provide a full capacity neutral for main service and for four wire systems as well as a bonding conductor with all feeders.

Other than main service feeder cables and/or raceway, feeders are not permitted to be located in slab or below slab-on-grade.

8.11.4 Motor Protection and Control

8.11.4.1 General

Where possible, provide motors ½HP (0.37kW) and larger as three-phase units and provide motors larger than 1 hp (0.75kW) as three-phase 600V units. Provide motors smaller than ½HP (0.37kW) as single-phase, 120V units. Usually with integrated thermal overload.

8.11.4.2 Motor Protection and Control

Do not use fuses for individual motor overcurrent protection. Instead, provide single-phase protection for all three-phase motors using relays, differential overloads, or BAS shutdown. Ensure there is space on the back panel for BAS current sensors.

Consider harmonic contribution when designing VFDs and provide filtering as required.

8.11.4.3 Control Wiring

Coordinate control requirements with mechanical designers. Indicate control branch circuits on electrical schematics and panel schedules. Low voltage control wiring to be run in conduit, Teck cable or otherwise mechanically protected.

8.11.4.4 Variable Frequency Drives

.1 General:

VFDs, while effective for many control and energy saving system designs, should only be used if there is a positive payback and control effect not otherwise achievable by moderately sized, across the line motor starters. VFDs should not be used as a substitute for soft starts. For very small HVAC applications, ECM motors should also be considered.

Pump mounted or other equipment integrated drives with custom mountings and form factors are not acceptable.

.2 Location:

Drives location shall be co-ordinated with the County. Location shall be in an electrical room or located as proximate to motor loads as practicable and feasible. Drives shall not be located in any environmentally harsh or excessively dusty or dirty environment without extraordinarily rated enclosures and other mitigating methods.

Consider maintenance implications in terms of accessibility and replacement items such as filters.

.3 Bypasses, Branch Circuit Wire Size & Over Current Protection (OCP):

Bypasses are generally not supported or advisable as many variable speed applications cannot be run safely or effectively without speed control. High availability, when required, is best achieved by fully redundant n+1 drive trains including VFDs, motors, and rotating equipment (pump, fan, etc.) to best address all failure modes. In these scenarios be sure to consider adequate, if not necessarily full, system capacity in failure scenarios and also employ duty cycling, swapped lead, or other methods to keep all units operationally tested and worked. If a bypass is required (i.e. parkade ventilation) then all wiring, OCP, overloads, etc. shall be sized as in a standard, across the line application.

When bypasses are not specified, VFD branch OCP and conductors should match and be sized as per manufacturer's recommendations or otherwise 125-175% of drive rated FLA.

.4 Enclosures:

VFDs shall have adequate local LCD/LED control panel and display for configuration and control. Also, where the is a BAS system, full Modbus/ BACnet connectivity is required for monitoring and control.

VFD component should generally be specified with integral fusing and disconnects and in a NEMA 12 enclosure.
Drives and above input & output filter elements and bypasses may be neatly mounted separately or located in an integrator enclosure. All such integrator enclosures must be heat run tested at full load for 24 hours and not exceed manufacturer's published environmental limit for any interior components (i.e. drive, filters, etc.). All enclosures shall have active, redundant fan ventilation with over-temperature and fan failure alarms. Only filter inlet ports. When an integrator supplies an enclosure with multiple components they have full design, commissioning, and warranty responsibility for the entire package.

Input voltage rating +/- 10% or better of nominal.

.5 Motor Protection & Wiring:

Output from drive/filter to all motors (or to motor starter, overload & disconnect distribution and on to motors) shall be correctly wired. Co-ordinate with VFD vendor to determine if drive/VFD "Teck" style cable similar to Beldan Symmetrical YC4936x series or Nexans DriveRX.is required.

All motors shall be inverter grade and explicitly rated as meeting the NEMA MG1 Part 31 standard with respect to insulation withstand of 3.1 times or greater of the rated voltage with rise time of 0.1 microseconds.

Output to motors larger than 10HP shall be via a dV/dT Full Sine filter might be considered if motor accessibility is very poor or in a retrofit application to non Part31 motor.

Motors over 20HP should be specified with shaft grounding bushing if they are not otherwise shaft grounded by equipment connection or conductive fluid coupling.

Where VFDs are mounted remotely, provide local safety disconnect at motor local safety disconnect must be labeled in visible location with "Safety Lockout ONLY. Shutdown and disconnect VFD before switching."

8.11.5 Surge Protective Devices

Provide surge protective device (SPD) on Utility incoming mains. For areas containing a large group of electrically sensitive load, provide surge protection on panelboards serving the area. Coordinate surge suppression devices within the same power distribution system.

8.11.6 Branch Wiring

8.11.6.1 General

Use copper conductors minimum #12 AWG conductor size, unless otherwise specified. Provide a separate bonding conductor in all branch circuit raceways. Conduit shall not serve as bond.

Branch circuit cable and/or raceway are not permitted to be located in slab or below slab-on-grade. Minimum raceway size to be 21mm.

Obtain approval from Oxford County for the use of non-metallic sheathed cables. Consideration will only be given for buildings of combustible construction.

Use AC-90 cable only in short lengths, less than 3m, for final connections to luminaires and similar equipment or vibration isolation.

All receptacles to be specification grade.

All branch circuits to be labelled with panel name and circuit designation.

- For circuits less than or equal to 20A and 240 volt, panel name and circuit designation to be indicated with a wrap-around style label on the faceplate and permanent marker inside the box.
- Otherwise, all higher voltage and ampacity circuits to have lamacoid style labels with panel name, circuit, and voltage/phase.

For high humidity applications, ensure surface raceways are galvanized steel or PVC and painted (coordinate with Architectural).

8.11.6.2 Provisions for Computer and A/V Based Equipment

Identify electronic equipment and systems likely to be affected by electrical service disturbances including voltage sags, surges, short and long-term transients and outages. For this equipment, determine the extent of protection necessary for normal operation.

Protection and Power Conditioning:

- Isolation Transformers: electrostatically shielded transformers for equipment affected by transients and noise.
- Regulated Power Supplies: for equipment and systems affected by transients, noise, voltage sags, and surges.
- Electronic Filters: for equipment affected by power line noise.
- Uninterruptible Power Supplies: for equipment requiring continuity of service.

Computer Circuits:

- Generally, supply only two (2) computer workstations per circuit.
- Provide a separate, dedicated bond and neutral back to panel for each circuit.
- In situations where multiple circuits will supply potentially interconnected equipment in an area, ensure the circuits feed from a common panel.

Include provisions for electrical requirements to support IT network switches.

8.11.6.3 Block Heater Outlets

Design to shut off all power to outlets when outside temperature is above -10°C. Assuming supply sized to supply all outlets simultaneously, inhibit cycling below -30°C.

Use the building's BAS system to control parking lot loads where possible. Coordinate with the Mechanical Section.

Provide override switch (i.e., H-O-A) for parking lot controller testing/maintenance.

8.11.6.4 Electric Vehicle Supply Equipment

All EV charger installations are to be coordinated with County Fleet and Energy Management. Ensure that EV chargers are monitoring-enabled and payment-enabled including network connection. If more than one EV charger is planned to be installed, consider utilizing dual-port chargers in place of two (2) single port chargers. Charger to be SAE J1772 compatible.

Charging stations to be located as close as possible to the electrical supply service while also assuring that they are conveniently located for drivers. Provide self retracting cord where possible.

Provide curbs, bollards, wheel stops and/or equipment setbacks to prevent vehicle damage to equipment. See **Section 8.6.2.4** for bollard design requirements. Provide adequate lighting in area of charger to facilitate nighttime use.

Consideration to be given to using higher charge rate equipment (40A, 240V).

8.11.6.5 Provisions for Equipment

Custodial:

- Storage/Janitorial rooms to have adequate (number and current capacity/type) receptacles for any equipment charging. Ensure mechanical is aware of any exhaust requirements due to battery charging.
- Ensure adequate (number and current capacity/type) receptacles throughout facility for equipment such as floor polishers, etc.

8.11.6.6 Provisions for Mechanical

Indicate location and circuiting of all mechanical control panels on drawings.

Coordinate electrical equipment required for mechanical equipment with the mechanical designer. Items may include UPS for head end of BAS systems, power filters, regulators, electrically powered valves and dampers, lighting in air handling units, heat tracing of piping or equipment, etc.

Rooftop receptacles to be on dedicated branch circuit.

Local disconnects to be provided for all mechanical equipment.

8.11.7 Life Safety, Emergency, and Security Systems

8.11.7.1 General

Provide emergency power for all life safety, security, and Mechanical Systems. Pay particular attention to fire rating of emergency lighting feeds or feeds to smoke evacuation fans, elevators, fire pumps, or similar emergency life safety classed equipment. Provide battery backup for all systems with volatile electronic memory.

Where a Backup Power source is installed, ensure the following equipment are connected;

- All components of any heating system within the building,

- Building Automation System
- Additional freeze protection systems
- Critical systems on a case-by-case basis.
- Additional non-critical systems may be placed on standby power.

8.11.7.2 Life Safety

Automated external defibrillators (AED's) to be supplied and installed for all public facing facilities.

8.11.7.3 Fire Detection Systems

Fire detection and alarm systems to be in accordance with the Ontario Building Code (OBC) and the Ontario Fire Code (OFC).

Where a fire alarm system is not required by the OBC provide smoke and fire detection devices as discussed with the County.

Show F/A devices on plan drawing(s). Include a fire alarm system riser diagram in contract documents.

Use horn/speaker-strobe combination devices for audio-visual signals unless site conditions dictate otherwise.

Coordinate duct detectors with mechanical to ensure air velocities are compatible with detectors in accordance with OBC and OFC.

Coordinate sprinkler flow alarms and valve tamper locations with mechanical and indicate on fire alarm plan.

Indicate all auxiliary connections to the F/A panel, including elevators, BAS, emergency diallers, fire door hold-open devices, fan shut-down relays, cistern tank levels, etc.

Note that any and all consultant expenses for fire alarm verification are considered included in design and construction management fees.

All F/A wiring to be red FAS cable or fiber in conduit. BX/AC90 only acceptable for movement or vibration isolation, final device stub, or in a retrofit situation where running conduit not practical. Length to be 3m or less without explicit County approval and product must be factory supplied as red armoured FAS.

Fire Alarm Communications (dialer) to be provided for all Fire Alarm systems regardless of if required by the OBC or not.

Fire alarm panel monitoring to be completed by Fire Monitoring of Canada in alignment with the County's current service provider.

Ensure that the fire alarm system modifications are sufficiently coordinated with other systems:

- Elevator homing,
- Security system door locks,
- BAS system,
- Fire Suppression (if separate).

Update the facility fire plan as required based on modifications being made.

8.11.7.4 Generators

Environmental and Regulatory Compliance Review must be completed as part of the generator design.

Locate generator and associated electrical equipment at grade or above if in area subject to flooding. Provide sufficient clearances for maintenance and repair personnel to access all sides of the generator. Provide provisions for removal/replacement of generator at end of life that does not require substantial building modifications.

Provide protection for outdoor equipment against physical damage, moisture, and corrosion. Bollards shall be included in the design to protect generators and utility systems located outside. See **Section 8.6.2.4.** for bollard design requirements.

Transfer switches are to be capable of remote monitoring of generator status and state. When fire pump transfer switch is on generator power and pump is running, generator battle short mode shall be engaged.

Provide vibration isolators for field installation.

Paralleled generator configurations shall only be considered for extremely high availability applications and/or large loads. They shall be of integrated, PLC controlled switchgear style and fully configured to operate and load shed feeder breakers under failed generator and overload conditions. BAS only load shed not acceptable.

Service and parts shall be available within 24 hours.

Manufacturer shall provide a certified summary of prototype-unit test report. Manufacturer shall be experienced in installation and operation of generator set of comparable size.

Generator shall include at a minimum:

- Remote annunciator panel
- External Battery Charger.
- Braided fuel lines c/w union connections for fuel inspections (carburetor to tank)

Final Site Design Load Calculation(s) to be included in drawing set. Site Design load to be posted on each transfer switch with red lamacoid (white writing). Minimum size 50mm x 100mm.

.1 <u>Enclosure</u>

Generator to be installed within facility. Where not feasible and with County approval, a sound attenuated enclosure and Winter Package may be acceptable. Refer to section Generator Power Supply for Life Safety Loads for additional requirements for Life Safety loads.

.2 <u>Exhaust</u>

Exhaust shall discharge vertically for maximum dispersion modeling. Rain cap shall fully open without impeding the vertical discharge while the generator is operating. Position the exhaust point above roof level and away from air intakes.

.3 Ventilation

Outside air and recirculating motorized dampers to be provided. Ensure generator room layout allows for optimal generator cooling, intake and exhaust louvres to be configured as per manufacturer recommendations.

.4 Fuel Fill Port and Control Panel

Fill level indicator panel adjacent to exterior fuel fill port. Panel to contain six (6) indicator lights and lockable cover with clear plexiglass window:

- "Fuel Leak" (Red) (Local Audible Alarm at fill panel)
- "25%" (Yellow)
- "50%" (Green)
- "75%" (Green)
- "Tank Full - STOP FILL" (Red) (90%)
- "Overfill Alarm" (Red) (Local Audible Alarm at fill panel)

One (1) button:

- "Indicator Test" (momentarily activates all Indicator Lights (1 thru 6 and Local Audible Alarms)

Fill levels to be manufacturer set to allow for full -40C tank expanding to +40C. Automatic overfill prevention device to be used to comply with code. Fuel Port to have lockable cover. Plan for fueling accessibility and spill control during fueling.

"Fuel Leak" indicators (where applicable) to be tied to high level sensor within curbed generator room (or generator containment perimeter). CSA 282 compliant as required.

CSA Certification or approved equal.

.5 Annunciator

Panel to be located at Service Desk or Operator's station or as directed by the County.

Panel to contain four (4) indicator lights:

- "Generator Run" (Green) (Audible Alarm)
- "Generator Trouble" (Red) (Audible Alarm)
- "Generator Fail" (Red) (Audible Alarm)
- "Low Fuel" (Red) (Audible Alarm)

Two (2) buttons:

- "Silence Horn" (acknowledges and silences any alarm)
- "Indicator Test" (momentary button activating all indicators and audible alarms)

CSA Certification or approved equal.

.6 Sub-base fuel tank

Provide curb as well as built-in fuel gauge on the sub-base tank. Ensure two (2) fill ports are sufficient to facilitate fuel conditioning.

Exterior generator installation to have NEMA 4 spill containment device fitted to the inlet of the storage tank. Spill containment device to be at least five (5) gallons and must be lockable.

.7 Stand-alone fuel tank

Provide integral secondary containment with leak detector tied to indicators and alarms.

Provide levelometer.

Fuel tank shall rest on supports or piling made of concrete, masonry, or steel. Tank supports shall be installed on firm foundations designed to minimize uneven settling of the tank and to minimize corrosion of the part of the tank resting on the foundation.

Barriers such as bollards shall be used to protect exterior fuel tanks from mechanical damage by vehicle or other sources. See **Section 8.6.2.4.** for bollard design requirements.

.8 Load bank

Cam-lok connectors for load bank test to be E1016 Series, female and to be mounted in load bank quick connect (c/w non-conductive mounting plate) located inside generator room where clear path to outside is available. Otherwise, to be located adjacent Fuel Port and Control Panel (exterior).

LSI local breaker (generator) with hunt trip and aux. contacts for load bank connection.

Minimum load on generator to be 30% (or as dictated by monthly testing for installations to CSA C282). A permanent load bank is to be installed unless it can be shown that the site demand will not drop below the minimum load requirement.

.9 Portable Generator Connection

Cam-lok connectors for a portable generator to be E1016 Series, male and to be mounted in quick connect (c/w non-conducive mounting plate) located in close proximity to the Load bank connection.

Manual transfer switches are only permitted for installation to accommodate portable generator.

Combination Manual Transfer switch - portable generator cabinets are preferred.

.10 Acoustics

Refer to the section Acoustic Considerations: Electrical.

.11 Overfill/Leak Protection/Diesel Piping Leak

Overfill and leak protection is required on all installations as stated in **9.11.7.3.4**.

Double wall tubing is required where fuel fill tanks are stored indoors and fuel fill port is located outside.

In room spill control to be considered for elevated generator rooms or as directed by the County. Ensure room is capable of containing the capacity of the largest tank in the room.

8.11.7.5 Generator Power Supply for Standby Loads

Provide a minimum of one (1) receptacle in electrical and mechanical rooms connected to emergency power where a generator is installed.

Power to electrically actuated washroom fixtures shall be on standby power circuits if available.

8.11.7.6 Generator Power Supply for Life Safety Loads

CSA 282 shall be met for all generator installations powering Life Safety (L/S) systems as per code.

- EXCEPTION: All police, fire, and ambulance facilities shall have C282 compliant generator installations even if not required by code for L/S system service.

Generator to be installed within the facility. Where not feasible and with County approval, a climate controlled, sound attenuated, walk-in enclosure equipped with motorized louvres may be acceptable.

Where systems are required by code to run past 30 minutes, concrete encasement of conductors/conduit may be permitted in place of MI cable. County to provide direction on a case-by-case basis.

8.11.7.7 Uninterruptible Power Supply

Uninterruptible Power Supply (UPS) system are required to maintain the County Fiber network for facilities' VOIP and communications function during generator tests. Provide UPS power for all Emergency Services facilities or facilities that provide County Fiber connectivity to said facilities. OCT Network Analyst to provide a list of associated County Fiber switch sites.

Provide centralized UPS system for groups of loads unless otherwise directed. Provide all centralized UPS assemblies with a 100mm (4") housekeeping pad.

Locate the UPS within the designated area for network and server equipment, or near critical systems that require the reliable power source to prevent outages.

UPS system to include the following features.

- Static Bypass.
- External Maintenance Bypass Switches for centralized UPS systems.
- True Sine Wave output.
- Size battery for minimum 20-minute runtime at full load or as dictated by site specific requirements.
- Ensure the UPS is provided with a relay output card capable of general alarm and low-battery alarm dry contacts.
- For larger (>20 kVA) UPS consider vendor provided monitoring solutions, as directed by the County.

Consider the following for UPS design.

- Increased redundancy for complex or critical facilities.
- System scalability.
- System components to be hot swappable.

Provide ventilation and cooling requirements as required by manufacturer. Coordinate requirements with Mechanical Consultant.

UPS system to be provided the following alarm outputs to the BAS.

- AC power failure.
- Battery failure.
- Output failure.

UPS to supply power to the following systems.

- IT systems.
- BAS Head end.
- Client specific systems (Fire Rescue, Police, Public Library, Waste, etc.).

8.11.7.8 Egress/Emergency Lighting

Design emergency lighting in such a way as to ensure local emergency lighting is activated when normal lighting in the area it serves is disrupted at the branch circuit level, not just when main building power or major feeders are disrupted.

All battery powered emergency lighting unit equipment shall have auto-self test with audible battery failure alarm.

In all electrical and generator rooms provide battery powered emergency lighting unit equipment with a minimum 2-hour capacity or greater as required by any codes.

Integral batteries within standard area lighting fixtures not permitted without explicit approval from **Oxford County Facilities**.

8.11.7.9 Exit Signs

All emergency exit signs shall be designed in accordance with the Ontario Building code.

Any particular renovation/addition must be judged on its unique merit in terms of the implementation of new standard 'Green Running Man' signage vs. older 'Red Exit' signage. The factors will include, but not necessarily be limited to:

- Percentage size of new area (however *no* absolute number such as 51%)
- Impact on egress routes and need for clear wayfinding to building exits, i.e. Only one (1) signage style permitted on any egress route.

Acceptable solutions may include:

- Usage of older "Red Exit" signage in new areas to preserve the integrity of egress route wayfinding "system" and prevent confusion when exiting (particularly in lower area percentage renovations/additions).
- Mixed use of older "Red Exit" and new "Green Running Man" signage (i.e. situation where there is basically no crossing of exit routes and little to no connection between old and new areas; or situation where there would only be one (1) change of signage on the way out, such as a full floor renovation or additional building wing).
- Retrofit of entire building to new standard "Green Running Man" signage for a consistent egress route wayfinding "system" (preferred solution when renovation and addition would

be a substantial percentage, 50%+ of resultant new space, and said retrofit of old area would not result in undue cost).

Any project that is remotely questionable should be submitted to the Sustainable Development Building Inspection office for AHJ review at the conceptual stage to avoid unnecessary costs due to design changes or construction change orders.

8.11.8 Lighting

8.11.8.1 General

Design to maximize the energy efficiency of lighting systems and to lighting density level regulations from OBC.

All lighting must be LED.

Lighting controls (occupancy sensors, daylight sensors, etc.) should be considered where appropriate (i.e. not in mechanical rooms, or other areas where sudden reduced lighting levels could be considered a safety concern).

Only use the task-ambient approach where work surface and task orientations are predetermined and as agreed to by Oxford County.

Consider incorporating photoelectric layouts into the design package, discuss requirement with the County.

It is not necessary to design for worst case work surface and task orientations in general office space. Design to minimize direct and reflected glare and maximize contrast.

8.12 BUILDING FIRE SUPPRESSION SYSTEM

Automatic sprinkler systems, standpipe systems and fire extinguishers shall be provided where required by the OBC and installed to the relevant NFPA standards. Special cases, such as heritage buildings, may require automatic sprinkler systems regardless of the requirements of the code requirements and should be prescribed by the architects. Where automatic sprinkler systems are provided, they shall be designed and installed to the requirements of NFPA.

Architect to develop an Ontario Building Code (OBC) Matrix with each permit application, identifying key details as required in the OBC and herein.

8.12.1 OBC Matrix for Part 3 Buildings (Type 3)

For buildings governed by OBC Part 3, the OBC Matrix shall include the following information: project address and description, applicable OBC edition, designer name and BCIN (if applicable), major occupancy classification(s), building area (per floor and total), building height (in storeys and metres), number of streets facing the building, construction type (combustible or non-combustible), fire-resistance ratings of key elements, spatial separation and unprotected openings, occupant load, exit capacity, exit travel distances, number and types of fire protection systems (e.g., sprinklers, fire alarm, standpipe), emergency lighting and exit signage, barrier-free

design provisions, and applicable energy efficiency compliance path. The Matrix must also identify any alternative solutions proposed, zoning designation, and site-related constraints affecting code compliance.

8.12.2 OBC Matrix for Part 9 Buildings (Type 9)

For buildings governed by OBC Part 9, the OBC Matrix shall include: project address and description, applicable OBC edition, major occupancy classification(s), building area and height, number of storeys, construction type, fire-resistance ratings of floors, walls, and supporting elements, spatial separation data (including limiting distances and unprotected openings), required fire protection systems (if any), emergency lighting and smoke alarms, occupant load (if applicable), number and size of exits, door swing and egress routes, basic barrier-free design requirements, and energy efficiency compliance path under SB-12. Zoning designation and any relevant site-specific considerations should also be noted.

All OBC Matrix must be sealed by a Professional Engineer or a Licenced Architects registered in the province of Ontario.

In applications where specialty systems should be considered, such as heritage facilities, data center, and archives areas, the relevant design guidelines combined with good engineering practice and the requirements set out in this document shall be used to determine the most suitable system.

8.12.3 Water-Based Fire Suppression

8.12.3.1 Water Storage Tanks

Install all fire water tanks in accordance with NFPA 22.

In facilities requiring water storage tanks for the provision of fire water, dedicated fire water tank shall be provided inside the building. Underground tanks subject to freezing and with restricted access are not acceptable.

Tanks shall be located to allow for inspection, cleaning and draining. Where the storage tank is located below the facility drainage system and a pump is required to fully drain the tank, provide a permanently mounted lift pump piped to a suitable drain location. Note that drainage systems that drain to a septic field are not considers suitable.

8.12.3.2 Fire Pumps

Fire pumps to be installed to the requirements of NFPA 20 and NFPA 13.

Electric fire pumps are preferred due to the decreased testing and maintenance requirements compared to diesel fired pumps. However, the Consultant shall perform life cycle costing analysis to compare increased cost of emergency generator supplying stand-by back-up power to an electric fire pump to the cost and maintenance requirements of a diesel pump with consideration to facility location and availability of maintenance personnel.

8.12.3.3 Dry-Pipe Systems

.1 <u>General Requirements</u>

Dry-pipe systems shall be used only in areas where piping is subject to freezing and adequate coverage cannot be provided using dry heads fed from an interior wet system.

Dry systems shall be installed to provide proper drainage to common auxiliary low point drains located to facilitate annual maintenance. Low point drains shall be clearly identified and a legend indicating the drain valve locations shall be clearly displayed at the sprinkler tree.

Drains shall be located inside the warm space wherever possible and be piped to a suitable drain capable of handling the expected flow.

Dry valves shall be equipped with galvanized trim package and be selected with pressure rating consistent with the air compressor.

Nitrogen based dry systems may be used where life cycle costing and total cost of ownership analysis shows it is favourable over a conventional compressed air system and where approved by the County.

.2 Air Compressors

Dry system air maintenance devices shall be selected and designed in accordance with NFPA 13.

Compressor sizing shall be designed and selected based on the dry valve requirements, systems size, and the requirements of NFPA 13. Tank mounted oil-less compressors are preferred.

For small systems requiring less than 28.3L/min (1cfm), a small riser mounted unit may be considered.

Compressors shall be equipped with integral regenerative desiccant air dryers and filtration capable of providing compressed air with a -40°C dew point. Compressor units shall be factory assembled and complete with all necessary controls for automatic operation. Shall include run time meter.

.3 Piping and Fittings

Piping shall be selected to minimize corrosion. Hot-dipped galvanized piping, or equal shall be used throughout dry systems.

Piping above 50mm shall be assembled with grooved fitting complete gaskets rated to a minimum ambient temperature of -40°C.

Gaskets shall not protrude into the pipe such that it would impede water drainage or cause water to collect at joints.

8.12.3.4 Wet-Pipe Systems

Wet-pipe systems shall be installed where required to the requirements of the Authority Having Jurisdiction, OBC, and NFPA 13.

Sprinkler heads shall be selected based on the intended hazard and area of coverage. Upright heads are preferred in areas with exposed piping. Provide concealed type heads where installed under 2.4m above floor in facilities that may be subject to vandalism such as institutional facilities.

Wet piping shall not be run in exterior walls or areas subject to temperature below 5°C.

8.12.3.5 Standpipe Systems

Install standpipe system in accordance with the OBC Section 3.2.9 and NFPA 14. Coordinate with requirements of **Area Municipality Fire Department, Oxford County Facilities** and Authorities Having Jurisdiction.

Standpipe valve shall be located in valve cabinets in areas accessible to the public or where they may be subject to vandalism.

Assess cabinet door closure and requirements for locks to be considered with respect to location and hazard. Doors without locking closures are preferred where practical.

All cabinets to have breakable glass front if locked.

8.12.3.6 Installation Requirements for Water Based Fire Suppression Systems

Piping 50mm and under to be Sch. 40 and shall be assembled using threaded, FM approved, fittings.

Quick response heads should be used wherever permitted by NFPA 13.

Systems shall be equipped with all required allowances for maintenance as required by NFPA. Arrange system to facilitate servicing and draining.

All drain valves, inspector tests and testing appurtenances shall be clearly labeled and identified on record drawings submitted at the completion of the project.

Provided all signage and identification in accordance with NFPA.

Zoning shall be in accordance with NFPA and the Authority Having Jurisdiction. Coordinate with fire alarm system. At minimum, provide individual zone at each floor and in attic.

Protect water service against back flow in accordance with National Plumbing Code.

Sway bracing shall be accordance with NFPA 13. Size bracing to resist thrust loads during operation. Connection to structure to be coordinated with structural engineer and seismic requirements.

Provide electrical supervision on all control valves. Locked handles are not permitted.

Coordinate fire department connection with local fire department.

Seismic restraint of all piping and equipment must be completed in accordance with NFPA 13 and Chapter 1, Section 8 – Seismic Restraint. A Letter of Assurance from the seismic engineer will be required as confirmation that the installation meets relevant requirements for local seismic conditions.

Conduct all required testing and include NFPA Contractors Material and Test Certificate in Operations and Maintenance Manual.

8.12.4 Fire Extinguishing

8.12.4.1 Specialty/Supplemental Systems

Where supplemental protection requiring specialty system, such as kitchen hoods or protection of sensitive equipment, is identified in the functional requirements of the facility, provide specialty system to the requirements of NFPA.

Specialty system shall not be used to replace the automatic sprinkler system as required by NFPA 13 but rather as supplement protection.

System (e.g., dry/wet chemical, FM-200 clean agent, etc.) shall be installed to the relevant standards and the requirements of the manufacturer.

8.12.5 Fire Protection Specialties

8.12.5.1 Fire Extinguishers

Follow Ontario Fire Code under Fire Protection and Prevention Act (O. Reg. 213/07) requirements for determining the type, capacity, location and rating of fire extinguishers. Fire extinguishers shall be installed in accordance with the OBC Division B, Part 3, the NFC, and NFPA 10.

Fire extinguishers in public areas shall be located in recessed or semi recessed cabinets. Coordinate cabinet type, finish, and location with the architect. Fire extinguishers located in service areas may be wall mounted. Fire extinguishers shall be located along the path of egress with the required signage.

Commercial kitchens shall be fitted with Type K extinguisher, size and quantity determined by the Consultant. This does not apply to kitchens inside residential dwelling units.

8.13 BUILDING PLUMBING SERVICES

8.13.1 General

Building Plumbing Systems must be designed in accordance with OBC Division B, Part 7.

Heat domestic hot water with heaters or boilers independent of the building heating system when facility heating loads are intermittent or the complexity of the combined system is impractical. Proposed combined systems should be considered only where appropriate.

Domestic water heating shall be achieved by a dedicated domestic water heater or boiler and storage tank. Instantaneous domestic water heaters shall only be used where the application requires it. Specify a water softener for all instantaneous domestic hot water installations.

Domestic hot water recirculation piping shall connect as close as practical to washroom lavatories. Hot water recirculation pumps to be provide following NECB/ SB-10 criteria.

Hot water heaters to be ASHRAE 90.1 Certified. Install thermal expansion tank on hot water heating systems follow OBC Chapter 7 requirement. Size thermal expansion tanks as per ASHRAE handbooks.

All commercial hot water heaters must be ASME Section VIII Stamped.

Consideration shall be given to the volume of water dispensed by a lavatory per cycle. Where applicable, low water consumption fixtures to be specified.

Domestic water recirculation systems shall be designed to maintain a water velocity below 0.9m/s. PEX piping may be considered for domestic hot water recirculation applications only.

Insulate hot water piping systems in accordance with OBC and ASHRAE 90.1 requirements to minimize heat loss and for personnel safety where surfaces exceed 60°C. Insulate cold water piping where there is potential for condensation formation, in accordance with ASHRAE 90.1 or applicable industry standards. Indoor plumbing pipe insulation jacketing shall be PVC.

Cleanouts shall be specified as 50mm or larger. Clean-outs for urinals shall be located above the rim flood level.

Backflow preventors to be designed and installed as per the most recent version of OBC and CSA B64 series, to provides protection against cross contamination as results of backflow and/ or back pressure.

For any facility with more than four (4) shower heads, a feedforward digital mixing valve shall be specified. This applies to large recreation centres. The valve is to be installed in a gender neutral, accessible area.

Domestic hot water recirculation pumps to be installed so they are readily accessible from ground level. Service valves must be installed on either side of the pump with couplings for ease of maintenance.

Follow OBC Chapter 7 for sump pump design requirements. Submersible sump pumps shall be equipped with chain, rails, or removal methods to facilitate maintenance activities. Submersed impellers with motor outside the sump are preferred.

Obtain approval for water treatment consulting services from the County when special water systems are required.

No under sink water filtration devices are to be installed unless permitted by the building operation team.

8.14 BUILDING ENERGY USE AND GREENHOUSE GAS EMISSIONS

Designer to ensure that facilities design follows OBC, SB-10 and NECB (most recent versions as adopted by OBC).

Any Project that involves new/replacement of equipment and/or building systems, shall minimize negative impacts on the targets outlined in the current version of the **County's 100% Renewable Energy (RE) Plan**, **Energy Management Plan (EMP)** and the **Renewable Energy Action Plan (REAP).**

Consider sub-metering

Reducing GHG emissions is a goal of Oxford County. The Project shall identify ways to reach the targets for consideration by the County to mitigate growth, and upgrade existing facilities. Options for consideration shall include ways to attain GHG reductions, and shall include lifecycle costs based on incremental capital, energy and maintenance costs.

8.14.1 Energy Assessments & Modelling

In order to verify energy and GHG performance of the Project, completing an energy assessment or model is essential. The project team shall discuss with **County Facilities/ Energy Management** to determine energy assessment needs for each specific project. The level of assessment required shall be determined based on the project's energy impact and compliance with OBC/ SB-10. Typically, monthly analysis models on RETScreen will be sufficient. However, if the NECB performance path is pursued, an hourly simulation software such as IES-VE/Design Builder/etc. is required to demonstrate code compliance.

Assessments and/or modelling should be completed in the early stages of design through to implementation and Commissioning (Cx) Process, as well for verification and monitoring during the post occupancy Cx phase.

Provide complete energy model for all new buildings or processes or, major renovations to existing buildings and process as well as new heating or cooling energy supply and RE harvesting Projects.

Energy Model to be develop early on, during the schematic design to assist in the decision-making process, and updated throughout design, and implementation process as required to reflect changes to design, and implementation.

Energy Model to compare reference (base case) with proposed in order to quantify energy and GHG avoidances achieved in the Project and to obtain incentives and/or grant funding.

Base Case (or Reference) for new construction or change in facilities requirements (including change in use, occupancy or process), shall follow minimum NECB (most recent version adopted by OBC) requirements for the facility or process, and for retrofits shall be existing conditions.

The energy model shall be developed using software which will be provided to the County upon completion of Project, in order for the County to measure and verify energy performance using the International Performance Measurement and Verification Protocol (IPMVP) Option D (calibrated simulation). This energy model shall be calibrated using energy data from the first full year of utility data after Project completion in order to verify actual energy savings.

The energy modeling shall reference local climate data and include as a minimum the following information for both the reference (base case) and proposed:

- Average normalized annual (by month) energy consumption and cost (by source - electrical, natural gas, solar, etc.), for total Project as well as broken down by major systems and equipment.
- Average normalized annual (by month) energy loss/gain (heating/cooling) via building envelop, broken out by Type (glazing, wall, roof, etc.).
- Average normalized annual (by month) energy loss/gain (heating/cooling) for ventilation air.
- Average normalized annual (by month) energy usage by internal heat gain.
- Peak Electrical & Natural Gas demand.
- Process Loads

8.14.2 Metering

Metering to verify and validate energy performance of the Project shall be considered for all sources of energy (electrical, gas, solar PV, solar Thermal, BTU, etc.). The project team shall discuss with **County Facilities/ Energy Management** to determine if metering is applicable to the subject project, and if so, how best to implement.

The metering data will be utilized during the post occupancy and monitoring based Cx phase of the Project to calibrate the energy model, and for identifying issues of performance of design and implementation and to identify adjustments required to mitigate as required.

Metering points shall be identified early in the design stage for consideration for inclusion in the Project. The projected value (monetary) of energy being captured by a potential meter (as determined by the energy model) will determine whether it has sufficient value to be included in Project, and at what level of accuracy and performance. If metering cost (install, verification, etc.) is less than 25% of annual energy costs being measured, the metering point should be included. Metering points shall be connected back to the County's Energy Management Information System (EMIS), where possible (i.e. via MeterConnex, or through the SCADA or BAS system) and verified for accuracy.

8.15 BRANDED SIGNAGE

Coordinate with Oxford County Facilities for specific requirements.

8.16 FACILITY ACCESSIBILITY DESIGN STANDARDS (FADS)

Oxford County strives to meet Facility Accessibility Design (FADS) where possible which exceeds OBC accessibility requirements. Contractor/ Consultant to work with **Oxford County Facilities** to determine how FADS can best be implemented on each specific project.

Building accessibility must follow the OBC Division B, Part 3 as well as Accessibility for Ontarians with Disabilities Act (AODA).