12. MECHANICAL - TECHNICAL

12.1 REGULATIONS

12.1.1 CODES AND STANDARDS

1. National Building Code of Canada
2. National Plumbing Code of Canada
3. National Fire Code of Canada
4. Model National Energy Code of Canada for Buildings
5. National Energy Code of Canada for Buildings
6. Applicable CSA Standards
7. ASHRAE Standards and Guidelines
8. SMACNA Manuals
9. Provincial Fire Prevention Regulations
10. National Fire Protection Association Standards
11. ASTM and ASME standards
12. Other applicable international standards

12.1.2 AUTHORITIES HAVING JURISDICTION

1. Office of the Fire Commissioner
2. Service NL
3. Department of Environment & Conservation
4. Mechanical & Building Inspections, Department of Government Services
5. Department of Health & Community Services
6. Workplace Health, Safety and Compensation Commission
7. Municipality

12.2 SUBMISSION REQUIREMENTS

12.2.1 SUBMISSION REQUIREMENTS

1. Submissions are to follow PEGNL publication “Guidelines for Mechanical Engineering Services”, August 1995.

12.3 PLUMBING

12.3.1 DOMESTIC WATER SUPPLY (HOT AND COLD)

1. Water meter is to be installed if required by municipality. If water meter is not required, provision for future installation should be shown on water service entrance detail. Water meter complete with output signal to the building EMCS.
2. Hot water circulation systems shall be in accordance to ASHRAE “HVAC Applications”. Hot water circulation systems shall not be used where the distance of the hot water piping from the heater to the farthest fixture or appliance is less than 30 m. Attempt to locate hot water tanks close to the areas of highest use.
3. Hot water service to fixtures and appliances shall be delivered at a temperature in accordance with ASHRAE 90.1 Energy Standards for Buildings Except Low-Rise Residential Buildings. Booster heaters may be used at locations where fixtures or appliances require a higher water temperature than being generated by the hot water heater. Maintain stored water temperature at 60°C to prevent bacteria growth.
4. All showers are to be protected by scald proof devices. Central thermostatic mixing valves are an acceptable means of controlling water temperature.
5. Avoid locating plumbing in exterior walls.
6. Provide for freeze protected exterior hose bibs as required.
7. Provide for drain valves at all low points.
8. Provide for access to all valves and faucets

12.3.2 DRAINAGE, WASTE AND VENTING

1. Do not locate drain lines in exterior walls.
2. If a drain will only be used occasionally, a trap seal primer is required.

3. In Labrador, insulate vent piping at a distance of 3.0 m down from roof penetration.
4. Do not run horizontal vent pipe in vented attic space.
5. Invert elevations shall be shown for sanitary and storm sewer lines where they are to connect to site services outside building.
6. Pipe penetrating roof shall be next size up from pipe below, minimum diameter of 75 mm preferably 100 mm.
7. Clean-outs are required, for all sanitary lines, at changes of direction of 45 degrees and greater.
8. Slope all waste lines at a minimum of 2%,or to code whichever is greater

12.3.3 Plumbing Fixtures

12.3.3.1 Water Closets

1. Generally, water closets are to be wall hung type, open seat, and complete with flush valve (where sufficient water pressure exists). Provide elongated rim bowl syphon jet flush action water closets.
2. Water closets in public washrooms, schools and recreation facilities to be fitted with extra heavy seat ring only.
3. Use low water consumption toilet fixtures.
4. Electronic flush valve complete with manual override and hardwired with battery backup.
5. Dual flush may be used in limited applications on approval of TW.
6. Vitreous china fixtures are preferred for most installations. Stainless steel fixtures are to be used in security related facilities.

12.3.3.2 Hand Basins

1. Vitreous china fixtures normally are preferred. Stainless steel fixtures may be appropriate for high public use areas, security related facilities, and schools. Enamel covered steel, plastic, and fiberglass fixtures are not permitted.
2. Spring loaded faucets are not acceptable.
3. Use infra-red sensing faucets in public washrooms, with battery back-up.

12.3.3.3 Sinks

1. All sinks shall be stainless steel.
2. Janitors' mop sinks should be as per the master specification. One janitors' sink per 1400 m^2, with at least one per floor, shall be provided.

12.3.3.4 Drinking Fountains

1. Drinking fountains shall be stainless steel.
2. If refrigerated units are required they must be the self-contained type. Remote refrigeration units are not acceptable.
3. Hydration Stations are preferable.

12.4 FIRE PROTECTION

12.4.1 SPRINKLER AND STANDPIPE SYSTEMS

1. Provide sprinkler systems where required designed to NFPA 13-Installation of Sprinkler Systems. Consultant shall provide sprinkler layout. The fire protection Contractor is responsible for the final hydraulic design, calculations and detail layout with pipe sizes indicated, according to applicable codes and standards.
2. Sprinkler systems shall be electrically supervised.
3. Dry pendant heads should be used in areas where there is a possibility of freezing.
4. A glycol loop is necessary where sprinkler piping may be exposed to freezing temperatures.
5. Where standpipe systems are used, they are to be taken off sprinkler systems unless otherwise directed shall be designed in NFPA 14 – Installation of Standpipe and hose systems
6. Standpipe cabinets to be of sufficient size to accommodate a 9 kilogram dry chemical fire extinguisher.
7. Standpipe hose and nozzle fittings to be internal lug quick-connect couplings conforming to ULC S543–Standard for Internal Lug Quick Connect Couplings for Fire Hose.
8. Siamese fire department connection and caps shall have internal lug quick-connect couplings conforming to ULC S543. Siamese connection is to be in vicinity of the fire alarm panel.

12.4.2 Clean Agent Extinguishing System

1. A clean agent extinguishing system should only be considered for highly valued spaces which are not occupied designed to NFPA 2001 Clean Agent Fire Extinguishing Systems.

12.4.3 Wet Chemical Extinguishing Systems

1. Environmentally friendly, wet chemical extinguishing systems shall be installed over fryers and ranges, when required, designed to NFPA 17A Wet Chemical Extinguishing Systems.

12.4.4 Portable Fire Extinguishers

1. Portable fire extinguishers shall be specified ULC approved, rechargeable type extinguishers are acceptable for buildings which are occupied on a daily basis. Extinguishers selection and installation shall meet NFPA 10 Portable Fire Extinguishing Systems. CO^2 shall be used in electrical and data rooms.

12.5 Heating

12.5.1 General

1. Ensure heating system provides uniform distribution of heat. In particular, perimeter heating shall be designed to avoid potential for occupant discomfort by drafts from exterior wall.

12.5.2 Design Temperatures (heating load)

1. Use 1% January outside temperatures for critical spaces, otherwise use 2½% as listed in the Appendix C of the National Building Code, latest edition for the outside design temperature. Indoor design temperatures shall typically be set as per table below. Minimum temperature at floor level shall be 18^{o}C.

	Occupied Hours	Unoccupied Hours
Office Areas	21°C	15°C
Warehouse, storage space, etc. With transient occupancy	15°C	10°C
Industrial areas such as kitchen, laundry, shops, etc.	18°C	12°C
Institutional	22°C	15°C
Laboratory	21°C	15°C
Health Care Facilities	to CSA Z317.2	to CSA Z317.2
Correctional (Administration)	21°C	15°C
Correctional (Inmates)	21°C	15°C
Correctional (Industrial areas)	20°C	12°C

12.5.3 Zoning

1. Spaces with similar thermal load profiles and/or occupancy shall be grouped into thermal control zones such as:
   a. perimeter and interior spaces zoned separately
   b. perimeter spaces, normally zoned by exposure
   c. the maximum size of perimeter zones for heating is the entire exposure
2. Each occupied space shall have its own heater and temperature control unless otherwise approved by TW.

12.5.4 Forced Air Systems

1. Forced air heating systems are only applicable to buildings where multiple zone control is not required.
2. The furnace shall have two fan speeds where the furnace supplies ventilation air. Where a separate ventilation system is installed one fan speed is sufficient.
3. Adequate outside air shall be introduced into the mechanical room for combustion.
4. Generally, ducts for air heating systems shall be run under the floor with distribution grilles located in the floor. In certain circumstances (such as a garage bay), overhead exposed ducting may be acceptable.

12.5.5 Hydronic Heating Systems

12.5.5.1 General

1. Design to CSA B214 Installation Code for Hydronic Heating Systems

12.5.5.2 Boilers

1. The boiler plant shall consist of a minimum of two (2) oil-fired or electric boilers, each sized at a minimum of two thirds of the total load where economically justifiable. Three (3) boilers each sized for 33% of the total load is preferable. In critical applications, three (3) boilers each sized for 50% of the total load is preferable (TW approval required).
2. Establish the type of boilers to be used. Multiple pass forced draft fire-tube boilers are preferred in larger buildings where boiler size required exceeds 250 kW or electric multi-stage boilers.
3. Use retention head burners.

12.5.5.3 Chimneys

1. A separate chimney for each oil burning device is preferred.
2. Pressure rated chimneys are required for all forced draft appliances.
3. Chimney lengths should be minimized and kept within the heated building envelope as much as possible with the exposed exterior length kept to a minimum.
4. Cleanouts are to be provided at each change of direction. Cleanout covers shall be insulated.

12.5.5.4 Heating Fluids

1. Normally, the heating fluid will be 100% water.
2. Glycol mixture for colder climate regions such as Labrador in secondary heating loops to be determined on a project by project basis. Glycol is to be ethylene glycol premixed with inhibitors. A 100 mm air gap must be provided between water supply line and the top of the glycol make-up tank in glycol-water mixtures.

12.5.5.5 Circulation

1. Primary/secondary piping loops to allow constant or variable flow based on life cycle cost analysis on both loops under varying load demands are preferred for systems supplying over 50 kW. A single loop is acceptable for smaller heating loads.
2. Standby pumps are to be installed with each pump and sized to handle 100% of full system load. Use automatic start, with lead/lag automatic switch control and manual-off-auto selector switch.
3. All pump to have mechanical seals.
4. Pressurized EPDM bladder expansion tanks are preferred.

12.5.5.6 Distribution

1. Wall fin radiation is the preferred method of heat exchange.
2. If permanent cabinets or built-in furniture must be located against the same wall as radiation units ensure appropriate inlet and riser vents are installed.
3. Floor and wall mounted forced flow units are usually required for vestibules and entrances. Units should be recessed where structural conditions allow and controlled by low range thermostats.
4. Use radiant floor systems with approval of TW only.
5. A shut-off valve is required for each zoned section of radiation.
6. A balancing valve shall be provided for radiators on return branch piping.

12.5.5.7 Controls and Instrumentation

1. Provide indoor/outdoor controls for boilers with 2 or 3 step settings without reducing water flow to each boiler. Ensure a boiler’s lowest water temperature shall not be below the boiler manufacturer’s recommendations. Where low water temperature scheduling is economically justifiable, apply on secondary heating loops.
2. Normally open, electrically operated heating zone valves shall be used. Do not use thermostatic valves. Isolation valves and unions to be provided on both sides of zone valves and a piggy back drain is to be provided on the discharge side of the zone valve.
3. Thermostats located in public areas must have vandal proof guards. Locking type thermostats shall be used in public facilities where maintenance personnel only should be

able to adjust temperature settings. In areas where it is deemed appropriate for users to adjust thermostat settings, the range shall be restricted to prevent extreme settings. Where group of radiation units are controlled by a room thermostat, provide knob operated dampers in each unit enclosure.

12.5.5.8 Monitoring

1. Devices installed to allow testing of low water fuel cut-offs must allow testing without draining the boiler.
2. Stack thermometers are required at breeching outlet of each boiler.
3. Thermometers are required on wells located on:
    a. return piping of each zone
    b. converging side of three (3) way valves
    c. supply and return side of coils
    d. supply and return headers of heating equipment
    e. digital gauges and thermometers are preferred
4. A needle valve is required on supply and suction side of each pump, complete with pressure gauge and impulse damper. All gauges must be installed with isolating valves and snubbers.

12.5.5.9 Maintenance Requirements

1. Air Vents: with clearly identified access covers. Automatic air vents may only be used in mechanical rooms where system contains glycol. All air vents must have isolation valves.
2. An 18 mm combination hot and cold water connection shall be installed in the boiler room in close proximity to the boilers. The hose bibbs shall be equipped with vacuum breakers.
3. Access doors to all control and isolation valves are required.
4. Radiation cabinets must be secure but easily removable by maintenance personnel.

12.5.6 Fuel Tanks and Piping

12.5.6.1 General

1. Support tanks by a fire resistant cradle.

2. The design and installation of fuel tanks shall be in accordance with the National Fire Code of Canada and provincial regulations.
3. Use aboveground tanks, where possible.

12.5.6.2 Above Ground

1. Fabricate horizontal steel tanks conforming to ULC standards or field fabricated to API Standards.
2. Equip tanks with secondary containment conforming to ULC standards, and a provision for monitoring the secondary containment.
3. Coat tanks and steel containments internally and externally with a corrosion resistant material providing 100% surface coverage.
4. All above ground tanks shall be double walled with interstitial leak detection.
5. Detail guardrails as appropriate to protect tanks from vehicular traffic or other potential hazards.
6. Provide overfill protection device,
7. Air pressure testing according to ULC standards before being put in to service is required.

12.5.6.3 Underground

1. Place a geotextile fabric in the excavation to separate the native soil from the backfilling material.
2. Where underground tanks are proposed, first consideration shall be given to reinforced double wall fiberglass tanks.
3. Double wall tanks shall have interstitial leak detection conforming to ULC standards.
4. Steel tanks shall be catholically protected according to ULC standards. The cathodic protection system shall be commissioned prior to being put into use. Provision for future testing shall also be included.
5. Steel tanks shall be coated with a corrosion resistant material.
6. Tanks shall be anchored by ise or a reinforced concrete slab under the tank and anchor straps. The anchoring system must be designed to resist the buoyant force acting on the tank, when empty, fully submerged in water.

7. Reinforced fiberglass tanks shall have a minimum of 300 mm of bedding material (pea gravel) between the tank and concrete pad.
8. Double wall tanks shall be used when the capacity is greater than 20,000 L.

12.5.6.4 Piping

1. All storage tank piping located at or below the product level shall be equipped with either a manual or automatic shut-off valve as close as practical to the storage tank.
2. Primary piping shall not have buried mechanical joints.
3. Underground piping shall have secondary containment,
4. All storage tank piping shall be pressure tested before being put into service.

12.5.6.5 Additional Requirements for Sensitive Sites

1. Double wall tanks shall have interstitial leak detection conforming to ULC standards.
2. Underground tanks shall be of double wall construction.

12.5.7 Heat Pump Systems - Unitary Water-Loop

1. Minimize the use of console units. Use preferably ceiling mounted units and vertical closet-type units.
2. Select units for quiet operation. Locate units away from noise-sensitive areas and avoid noise transmission through ceiling and return air intakes.
3. Provide an acoustically lined “T” or “L” section at the return air inlet of each unit.
4. Units must be easy to access for routine service.
5. Operate the outside make-up air system at 100% when the outside temperature permits and modulate with return air when required.
6. In the ceiling plenum, duct the outside air supply for each pump to within 1.2 m of the return air of the unit, or discharge the air directly towards the inlet, or supply the outside air directly to the occupied space.
7. Thermal storage is generally required in reducing supplementary heating use and stabilizing loop temperature.
8. Provide freeze protection for the heat rejecter and associated piping.

9. Protect the supplementary heater against conditions of both thermal shock and low water flow.

12.5.8 Ground Source Heat Pumps

TO BE DEVELOPED

12.6 Ventilation And Air Conditioning

12.6.1 Ventilation

1. Minimum ventilation rates shall be as per ASHRAE Standard 62.1 (most current edition.) Outside air make-up shall not be less than all exhaust air flows. Control provision for continuous monitoring is an acceptable method of ensuring system is supplying minimum required ventilation rate.
2. Tailor a HVAC System type selection and its design to the need and hourly occupancy fluctuations where signification energy cost saving potential exists.
3. Provide HVAC system flexibility in buildings which employ an open-office type setting.
4. Equipment shall be BACnet Compatible.
5. Air velocity within an occupied space, defined as any point between 200 mm and 1700 mm from floor and more than 300 mm from a full height partition or an exterior wall, shall meet the following:
    a. Winter - not more than 0.15m/s
    b. Summer - not more than 0.25m/s
6. Locate outside air intakes so they will not entrain air from building exhaust or relief air outlets, vehicle exhausts, or other fume/contaminant sources. Consider relative locations, prevailing winds and air flow patterns around buildings in selecting exhaust/relief outlet and air intake locations.
7. Use flow stations to control and monitor all H/V unit fans.

12.6.2 Variable Air Volume (VAV) Systems

1. Bypass type VAV systems, with constant supply fan air flow, may be considered for small buildings where packaged air handling or roof top equipment is appropriate.

2. Performance characteristics of selected diffusers/grilles and registers shall be adequate over the whole range of air flows.
3. Do not use a VAV system to provide perimeter heating.
4. VAV system at minimum setting, must supply the minimum outdoor air requirements.
5. Supply fan air flow modulation control recommendations:
    a. Systems larger than 10,000 l/s - Static pressure control VSD.
    b. Systems smaller than 1,000 l/s. - No control; select forward curved fan to maintain acceptable duct static pressures as the system curve 'rides' up the fan curve. Ensure that excessive VAV terminal box pressure drops do not occur.
6. Return fan air flow modulation control recommendations:
    a. No return fan - Where the building design makes possible a return air flow pathway open enough so a return fan is unnecessary.
    b. Relief fan - Where the building design makes possible a return air flow pathway open enough so that the supply fan can draw return air effectively on minimum outside air operation, use a relief fan when the system is on free cooling operation. Relief fan and inlet damper should be controlled from building space pressure with high quality, low pressure span, differential pressure.
    c. Return fan - Use on large systems, and where free cooling is justifiable.
7. Where it is necessary to maintain specific pressure relationships between adjacent areas (such as adjacent to laboratories), special control provisions for the VAV shall be provided.

12.6.3 Design Temperatures (Cooling Load)

1. Use July 2.5% values as given in the National Building Code, latest edition for the outside design temperatures for space heat and humidity calculations. Omit envelope heat gains from cooling load calculations where air conditioned areas are unoccupied during summer months.
2. Interior design temperatures for cooling loads as per table below. The Consultant, upon request, shall show calculations indicating the need for mechanical cooling where necessary to maintain indoor design temperatures. If ventilation system is the primary source of heat, follow the design temperatures given previously.
3. Maximum temperature fluctuation is 2°C per hour.

Type of Space	Occupied Hours	Unoccupied Hours
Office Areas	24°C	None
Warehouse, storage space, etc. with transient occupancy	None	None
Industrial areas such as kitchen, laundry, shops, etc.	project specific	project specific
Institutional	24°C	None
Laboratory	24°C	None
Health Care Facilities to CSA Z317.2	to CSA Z317.2	to CSA Z317.2
Correctional (Administration)	24°C	None
Correctional (Inmates)	27°C	None
Correctional (Industrial areas)	None	None

12.6.3.1 Temperature Gradients

1. Horizontal - Maximum 2°C between 300 mm and 3000 mm from exterior wall at desk height.
2. Vertical - Maximum 2°C between 200 mm and 1700 mm from floor at any point more than 300 mm from an exterior wall.

12.6.4 Zoning

1. Group spaces with similar thermal load profiles and/or occupancy shall be grouped into thermal control zones. Given this principle, consider the following in making final zoning decisions:
   a. perimeter and interior spaces zoned separately
   b. perimeter spaces, normally zoned by exposure
   c. Perimeter zones:
   d. maximum size for cooling, 100 m^2
   e. Interior Zones:
   f. maximum size – 250 m^2 for open space
   g. 100 m^2 for enclosed spaces
2. Zone conference/meeting rooms larger than 20 m^2 separate with a local control to provide extra cooling and air changes as necessary.
3. Areas with special functional, occupancy or environmental requirements are to have separate zones or systems.

4. Each occupied space shall have its own cooling terminal unit and temperature controller unless otherwise approved by TW.

12.6.5 Humidity

1. Humidification during the winter shall be required if it is determined that the humidity level will drop below 25% at the design room temperature. Provide 30% R.H. minimum humidification for normal occupancy.
2. Dehumidification during the summer months shall be accomplished by latent cooling. Cooling coils shall be capable of keeping humidity level below 60% at design room temperature.
3. Maximum humidity fluctuation is 20% per hour.

12.6.6 Acoustics

1. Design HVAC systems to control equipment vibration and noise propagation such that background noises from these systems are below the maximums indicated in the most current version of the ASHRAE design manuals.
2. Ensure the HVAC systems serving private offices, interview rooms, counseling rooms, conference rooms, etc., provide a degree of acoustic privacy consistent with the rest of the construction.

12.6.7 Equipment and Components

12.6.7.1 General

Select systems, equipment and components to suit local service and maintenance capabilities. Use less complex equipment in remote areas.

12.6.7.2 Air Handling Equipment

1. Factors to be considered for operating efficiency and cost optimization when selecting air handling equipment:
2. Fan selection and efficiency:
    a. optimum air inlet/discharge configuration (follow AMCA recommendations)

   b. noise levels
   c. highest operating efficiency
   d. part load operation for VAV systems

3. Coil face area:
   a. larger face area gives lower friction loss (both air-side and heating/cooling fluid)
   b. larger heat exchange surface area will permit smaller temperature difference (e.g. on cooling will permit higher refrigerant evaporating temperature and system efficiency)
   c. on cooling, fewer rows may be possible
4. Filter face area:
   a. Larger face area decreases static pressure drop, and increases dust-holding capacity.
5. Duct system design:
   a. Lower duct velocities and streamlined duct fittings both decrease system friction loss.
6. Roof top units are generally not recommended. However, in certain circumstances it may be hard to justify not using roof top units when analyzing capital cost. The use of roof top units generally depends on:
   a. the climate
   b. whether or not primary space heating depends on the unit, and
7. Controls complexity required.
8. Place over areas where noise is not a concern
9. Avoid contaminated air through heat recovery wheels. Avoid recirculation type heat recovery equipment defrost

12.6.7.3 Refrigeration Equipment Selection

1. Do not select refrigeration equipment using refrigerants which are restricted under the 1987 Montreal Protocol on substances which deplete the ozone layer.
2. All refrigeration equipment of 7.0 kW (2.0 tons) or greater capacity must be complete with a liquid-line filter-drier, complete with shut-off valves to permit service or replacement.

3. Select packaged refrigeration equipment which has service valves or ports to permit withdrawal, and isolation, of the refrigerant charge into a receiver or container, thus preventing its release to the atmosphere during service work. For refrigeration equipment with a cooling capacity greater than 35 kW (10 tons), select equipment with isolation valves to permit containment of the refrigeration charge in one portion of the system, thus reducing the amount of refrigerant which has to be recovered and replaced during service work.
4. In order to maximize refrigeration system operating efficiency, consider life-cycle cost optimization in the selection of refrigeration equipment, both packaged units and individually selected components. Some factors to consider are:
    a. larger coil surface areas will reduce condensing, and increase evaporating temperatures thus improving efficiency
    b. basic compressor efficiency and performance
    c. humidity requirements for product cooling/freezing may limit selection flexibility
5. Consider condenser heat recovery from product cooling/freezing units for domestic hot water preheating.
6. Where operation of refrigeration systems will be required in cold weather, ensure equipment with the necessary low-ambient temperature features is selected. Where refrigeration system components are located outdoors, or where freezing temperatures could occur, ensure the design provides for protection from freeze-up or damage due to the cold conditions.
7. Avoid use of municipal water supply for once-through water-cooled condensing unless there is no realistic alternative. If it is proposed, provide justification and obtain the approval of the Design Manager prior to commencement of final design. Discharge only to storm water drainage system.

12.6.8 Equipment Access

1. Provide access via stairway for equipment located in a penthouse.
2. Provide access for roof mounted equipment from the interior.
3. Equipment access doors must be hinged and latched.

4. Provide access around equipment so that it is easily accessible for servicing and maintenance.

12.6.9 Air Distribution Systems

1. Design ducts to conform to good engineering practice such as described in the ASHRAE and SMACNA Handbooks.
2. Distribution system design must permit easy relocation of any ceiling diffuser within a radius of 1.5 m.
3. Limit flexible duct use to buildings where frequent repartitioning is expected. Flexible ducts are not allowed to align duct branches. Maximum flexible duct length is 1.5 m.
4. Design systems for good air distribution throughout the occupied space under all load conditions. In particular, the design must avoid the following unsatisfactory conditions:
    a. exterior wall drafts during cold weather when heating is from a ventilation system with ceiling supply
    b. short-circuiting, when both supply and return are at the ceiling, particularly in perimeter areas during cold weather when the ventilation system provides space heating
    c. lack of adequate return air flow from private offices and meeting rooms
    d. incorporate ASHRAE HVAC applications volume included hourly circulation air changes in design
5. Provide low leakage type motorized dampers for inlet, relief or exhaust air at the building envelope.

12.6.10 Air Filtration

1. All filtration should meet the most current MERV standards.
2. For special applications such as hospitals or laboratories, select filters based on specific space requirements or standards.

12.6.11 Humidifiers

1. Humidifiers should be electrode steam design, with a self-contained cleanable steam cylinder, or provided by a boiler when economically justified.

2. Distribution shall normally be through a supply air duct mounted rapid steam absorption bank/panel.

12.7 CONTROL SYSTEMS FOR HVAC

12.7.1 GENERAL

1. Most medium and large size buildings will utilize an Energy Management and Control System (EMCS). Most control functions will be carried out by computerized direct digital controls (DDC). Local hard-wired controls will only be used for simple functions such as unit heaters, small exhaust fans and for all safety shut-downs such as freezstats. All fans starters will be equipped with hand-off-auto switches.
2. Submit control sequence descriptions and schematic diagrams for all systems for review.

12.7.2 HARDWARE

1. Control panels to be stand-alone intelligent controllers with non-volatile program memory. The panel is comprised of a micro-processor capable of supporting all necessary software.
2. Application Specific Controllers
3. Control panels shall have the capability of being networked for single point programming and for the sharing of point information and control instructions between panels
4. It should be possible for each control panel to have a dedicated local display or for a collection of control panels to share in single operator terminal
5. Control loops shall be user programmable, automatic self-tuning digital control loops with individual proportional gain and integral adjustments, capable of sharing controller inputs and integration through controller software
6. The system shall be capable of generating job specific control strategies that can be activated in any of the following ways:
    a. continuously
    b. at a particular time of day
    c. on a predefined date
    d. when a specific measured or controlled variable reads a selected value or state

   e. when a piece of equipment has run for a certain period of time (trend)

7. Provide a personal computer interfaced with the Digital Control System (DCS) located in the mechanical room.
8. Specify web browser control where available for remote monitoring.
9. Provide a printer located in the mechanical room for printing alarms and summaries etc.
10. Required points are to be summarized in the specification or on the drawing.

12.7.3 Software

1. Energy management system software shall be a graphics-based display in a Windows environment and contains features in the NL Master Specification Guide for Public Funded Buildings.
2. Include communications software package for remote monitoring of controls system.

12.8 Energy Life Cycle Costs

1. Identify those criteria which have the major or greatest effect on life cycle costs and whether only one specific escalation rate is required and can be justified for each major criteria identified.
2. Use energy costs obtained from utilities for oil, gas, and electrical energy sources when making comparative studies. Rates shall relate to energy peaks and consumption based on building concepts under consideration.
3. TW will provide the following to the Consultant for the life cycle study:
   a. present value discount interest rate to be used
   b. escalation rate for annual maintenance services
   c. annual escalation rate to be applied for each energy source
   d. the asset life, generally 20-25 years
   e. industry average costs for operating and maintaining mechanical systems if specific cost experience is unavailable for the proposed facility
4. Define a base building systems concept for use as a basis for comparison and selection of the final design concept solution. The base concept should represent the latest acceptable conventional system.
5. Analyze alternative systems' energy and cost deviations from the base concept.

6. Provide a life cycle cost summary comparing alternatives with the base building system concept.