STATE OF VERMONT
DEPARTMENT OF BUILDINGS AND GENERAL SERVICES

DESIGN GUIDELINES

PREAMBLE

The following Design Guidelines are intended to accomplish two purposes: provide a global perspective of project objectives, and collect and transfer the institutional knowledge-based resources available at the Department of Buildings and General Services through the development of specific design guidelines.

SECTION 1
Project Objectives

Our construction/renovation projects are supported by tax dollars from businesses and citizens of the State of Vermont, and it is our charge to expend those resources wisely. Every capital project in excess of $25,000 must be authorized and funded by the Vermont legislature. This funding process usually involves budgetary estimates from the Engineering and Construction Division. Frequently, however, projects are not funded at the originally requested amount which leads to conflicts involving competing interests. In cases where the legislature does not provide specific direction, projects' competing interests, due to funding constraints, have traditionally been and should continue to be resolved through the following:

1. Develop a "safe" facility, organizationally, structurally, and consistent with all project permits;
2. Satisfy program goals – maximize developed spaces;
3. Develop a high quality, maintainable and durable facility;
4. Minimize "Value Engineering" of the HVAC system;
5. Maximize the utilization of energy efficient designs and the incorporation of energy efficient equipment, materials and methods;
6. Maximize the incorporation of alternative renewable energy technologies; and
7. Maximize integration of "sustainability" in design and construction, consistent with the State's new environmental objectives.

Elaboration of the first four principles requires little additional commentary as those principles encompass the manner in which we've built buildings in the past.

Recent events and circumstances have brought new requirements, and the State is consciously moving toward a more proactive environmental and energy efficient posture. The remaining Design Guideline objectives address the new State perspective regarding the use of energy and our impact on the environment. However, it should be noted that achievement of an energy efficient and environmentally responsive building is highly dependent upon funding and the scope of work for each project. It is virtually impossible to achieve the same level of efficiency and environmental responsiveness for all of our buildings or for every project given each project's variation in budget, scope of work and particular challenges. Technological changes are occurring continuously, and we try to take advantage of these changes when it is prudent, justified, and without unnecessary or unusual risk.

The State of Vermont, with direction from Governor James Douglas, adopted ***"The Comprehensive Energy and Resource Management Program"*** (CERMP) on May 1, 2004. This Program establishes a single source within State government for identifying and advancing environmental sustainability of State government operations for the first time. There are four (4) philosophical underpinnings for the CERMP. The first is to reduce the environmental impact of State government's daily operations. The second is to reduce the costs of operating State government through energy and programmatic savings. The third is to create new, and sustain existing, Vermont businesses that develop, produce or market environmentally preferable products. The fourth is to demonstrate to other states and the private sector that fiscal responsibility does not have to be sacrificed for environmental stewardship.

Under the direction of the Department of Buildings and General Services, State government will focus on three areas: Infrastructure Management, State Purchasing, and Transportation Management. Additionally, a revised and comprehensive State Energy Plan will be developed by June 2005, executive orders will be updated, and a revolving fund for energy improvements with demonstrated paybacks will be created.

These Design Guidelines focus on Infrastructure Management.

Infrastructure Management

► Significantly change the State's environmental footprint.
- Reduce Greenhouse Gas emissions from the 1990 baseline level.
  - 25% by 2012.
  - 50% by 2028.
  - 75% by 2050.
- Reduce overall energy consumption to reduce emissions.
- Change fuel energy sources.
- Implement renewable energy strategies.
- Design, construct, maintain, operate, and deconstruct facilities with environmental awareness of the effects of these activities.

► Save significant financial resources through intelligent energy management decisions.
- Base decisions on life cycle cost analyses.
- Create new funding mechanisms to fund energy saving initiatives.
- Establish annual energy consumption reduction goals.
  - On square foot basis.
  - On building uses basis.

► Utilize “best practices” to help create markets for sustainably produced and environmentally responsible products, as well as goods and services provided.

► Measure and publicize results demonstrating environmental accomplishments and fiscal responsibility for export of practices to other sectors of the economy.

Infrastructure Strategies

A. Reduce the State's environmental footprint.

1. **Design, Construction and Maintenance Guidelines:** BGS facility service providers Design, Construction and Maintenance Guidelines are based on the United States Green Building Council (USGBC) "Leadership in Energy and Environmental Design” (LEED) rating system model. These Guidelines are for use by all State agencies incorporating the following criteria into new construction projects, renovation projects, and facility operations and maintenance procedures and practices to the greatest degree possible:

a) **Sustainable Sites:** Considerations include erosion and sedimentation control, site selection factors, emphasis on redevelopment in growth centers, Brownfield redevelopment opportunities, alternative transportation opportunities, reductions in initial site disturbance, responsible stormwater management practices, and landscaping features affecting habitability of site, such as green space concepts, and reduction of light trespass from sites.

b) **Water Efficiency:** Considerations will include reducing water requirements by using gray water or captured water for landscaping purposes, reductions in potable water demand by using flow restrictors and low flow fixtures, and investigating the use of innovative wastewater and sanitary waste treatment strategies.

c) **Energy and Atmosphere:** Strategies will include optimizing energy performance to reduce emissions, using renewable sources energy, instituting commissioning and re-commissioning practices, using environmentally responsible refrigeration and fire protection chemical systems, and expanding electronically based measurement and verification systems.

d) **Materials and Resources:** Continue to develop and expand facility-based storage and collection of recyclables, consider building reuse opportunities, intensify construction waste management practices, take increased advantage of extending the useful life of building materials, consider deconstruction of obsolete buildings when demolition and removal of an existing structure is necessary, employ greater use of materials with higher degrees of recycled material content, extend the practice of purchasing and incorporating locally-produced materials into development and operational practices, use more rapidly renewable products and extend the practice of incorporating certified wood products into our building infrastructure.

e) **Indoor Environmental Quality:** Where feasible and appropriate, use carbon dioxide measuring devices to control ventilation air, investigate measures to improve ventilation effectiveness, investigate improvements to our IAQ management practices, use low VOC emitting materials in facility development and operations, carefully control and manage indoor chemical and pollutant sources, install and maintain controllable systems, develop strategies for controlling within reasonable ranges the thermal comfort zone suitable for the occupants of the space, and be cognizant of and provide appropriate daylight and outside viewing opportunities.

2. **Cost/Benefit:** Fiscal resources and measurement of the ratio between the cost and the benefit of project elements will be an important aspect of decision making.

3. **Applicability:** These Guidelines shall further be used to the degree appropriate for all smaller projects on a case-by-case basis where decisions have a measurable impact on the environment. In no case is any capital project exempted from meeting the intent of these Guidelines with respect to the development and operation of the State's building infrastructure in an environmentally responsible manner.

4. **Usage:** These Guidelines shall be incorporated into the development, and the maintenance and operations practices of all State agencies and departments charged with the responsibility of building Ownership.

B. Create operational savings for the State Energy Cost Reduction Programs.

BGS facility service providers shall implement conservation and efficiency measures to reduce resource consumption of electricity, fuels and water to the greatest degree practicable to save the State operational costs in all activities relating to the design, construction, maintenance and operations of the State's infrastructure.

The energy resource expenditure by BGS is about $4,250,000 or 45% of the total State infrastructure energy cost of $9,350,000. Eventually, the State may be able to save as much as 25% or more of the annual expenditure on energy through conservation and improved efficiency measures made possible through legislative actions, executive orders, administrative bulletins, and policy and practice changes.

In order for this program to survive over the term of the initiative, there must be a reliable source of revenue. The State is limited in its ability to fund this initiative through capital bonding due to the Debt Affordability Committee's limit on the annual bond amount which creates tremendous competition for capital bond appropriations. Long-term funding ability is extremely uncertain, and there is no process by which the savings generated by this type of initiative would support the capital bond appropriation process. Past experience has shown that without a reliable source of revenue, this Program will cease to be effective long before we reach our first milestone in 2012.

By creating a "Resource Management Revolving Fund" (RMRF) from the General Fund cash flow in an amount to support the first several years of anticipated funding requests, the RMRF can be paid back through the operational savings achieved between what was actually built or what was changed, as opposed to what would have been built or left unchanged, but for the lack of funds. The request to set up the RMRF is pending before the legislature.

The following strategies draw a distinction between conservation and efficiency. Where efficiency is using necessary energy as effectively as possible, conservation is the choice to limit energy use to only what is essential.

5. **Conservation:** Demand management conservation strategies, often overlooked, are those based on the concept that not using energy in the first place is a simple and effective way to reduce costs. However, conservation strategies are more dependent upon occupant demands and use practices, rather than infrastructure changes.

   Target demand management challenges shall be developed and incentive structures created to help achieve the goals of this policy component. Strategies may include, but are not limited to: incorporation of energy miser devices on vending machines; CO2 measuring instruments to reduce ventilation air quantities when appropriate based on actual occupancy loads; occupancy sensors to turn off lights when an area is unoccupied and light is not needed for security purposes; and educational programs to teach State employees the importance of minimizing resource consumption combined with the use of "challenges" to provide incentives to achieve desired results.

6. **Efficiency Measures:** (Physical improvements using energy efficient products and systems.) An opportunity exists, using current technology, to create new initiatives and make changes to the infrastructure in order to reduce resource consumption and increase smart building operations. New technological changes may include: installation of Direct Digital Control (DDC) Systems in more buildings; a new generation of replacement lamp programs; improved HVAC design strategies; "re-commissioning" older systems; and revisiting existing building envelop features, including windows, use of vestibules, improved foundation, wall and roof thermal barriers and investigating district heating options, as well as distributed cogeneration feasibility. To implement these changes, the State shall begin a new measurement methodology that will direct financial resources to the areas with the most obvious need. The State shall require the establishment and use of technology to measure resource consumption to assist in determining the measures necessary to modify our infrastructure.

   All new buildings and significant renovations to existing buildings shall be designed to achieve efficiencies 30% greater than those required by the current Energy Code. The "Core Performance (Vermont Edition)" should be used as a design foundation from which to achieve this objective. Contact Efficiency Vermont [888-921-5990] if you need a copy of the "Core Performance (Vermont Edition)" guideline.

   Along with the use of these resources, collaboration between the architect, the Owner and Efficiency Vermont is now required by contract and must occur in order to meet our objectives.

   Rigorous building commissioning is now required. At this time, BGS does not require that an independent commissioning agent be hired by the Owner. The architect on each project shall determine whether the commissioning will be done by a third party under contract to the architect or engineer, or whether the mechanical engineer and architect can perform the rigorous commissioning of their designed building elements as required, unless the Request for Proposal (RFP) states otherwise.

C. Create markets for sustainably produced and environmentally responsible products as well as goods and services provided utilizing "best practices".

When appropriate, BGS facility service providers shall incorporate sustainably produced goods and locally available services in all activities relating to design, construction, maintenance and operations.

Vermont has some of the most valued and unique natural materials that can be incorporated into our building environment, including: granite, marble, slate, a variety of hardwoods and other valuable resources. In addition, Vermont has many product and service providers in the building trade industry unparalleled in their ability to incorporate Vermont's natural resources into our building environment, including: cabinetmakers, wood workers, stonecutters, masons, brick manufacturers, and other trades people, as well as designers, engineers, and architects. These resources should be developed and expanded, rather than squandered

Existing specifications should be strengthened and new specifications should be developed to encourage and provide new market opportunities for this sector of the economy.

D. Measure and publicize results to demonstrate the compatibility of fiscal and environmental responsibility.

This Program is intended to have an impact beyond its immediate sphere of influence. One of the beneficial outcomes of this Program is that by demonstrating the State's commitment to preserving our environment, we can prove that fiscally successful governmental operations are not incompatible with environmentally responsible operations. Further, that this governmental success is transferable to private sector business operations.

To accomplish this objective, BGS facility service providers shall participate in data collection and analysis to the extent appropriate in all activities relating to design, construction, maintenance and operations.

SECTION 2
The Design Guidelines

The following is intended to be a compilation of the institutional knowledge-based resources available at the Department of Buildings and General Services. Its intent is to include all the items that have been learned from collective experience. This document is intended to evolve as needed. Comments and feedback are welcome.

PART 1 - GENERAL

1.1 The following requirements are meant to supplement – not replace – code, design and industry standards. Contact the BGS project manager if there are conflicts between your standards and these requirements.

1.2 Budgets and Estimates: Provide preliminary budgets based on systems as described and required herein. Include contingencies early in the budget process. Provide intermediary and final construction estimates. Notify Owner as soon as possible when it is known, or even suspected, that the budget is inadequate.

1.3 Submit specifications in 3-ring binders for design review.

1.4 Number specification sections with the attached CSI numbering process.

1.5 Arrange drawings in the same order as the specifications, i.e., Civil, Architectural, Structural, Plumbing, Heating, and Electrical.

1.6 Keep drawings simple and uncluttered, what looks good blown up on the CAD screen doesn't necessarily reproduce when mass printed. No text less than 8 pt.

1.7 During construction, the prime consultant and sub-consultants shall be required to: inspect site, attend job meetings, and verify as-builts prior to approval of requisitions, at least once per month, when work has been completed in their field.

1.8 On schedules of values and requisitions for payment, break out subcontract amounts. Mechanical and Electrical should be broken into as much detail as the other items.

1.9 Designs shall be complete when bid. No contractor/vendor designs, i.e., curtain walls, fire sprinklers, radiant heat, etc.

1.10 Mercury Containing Devices: The State of Vermont would like to use products which contain NO MERCURY whenever possible. When a product must contain mercury, such as florescent lights, then the model with the lowest amount of mercury shall be selected. Products containing mercury must be identified to the State's project manager.

1.11 Keep it simple. To the greatest degree possible, keep systems design and sequences simple.

1.12 The State desires to minimize our energy footprint. As such, designs shall consider any and all factors which can reduce energy consumption. This shall include, but not be limited to: color of the exterior and roof of the building - light reflective colors require less cooling; and exterior shading of windows with overhangs, fins, recessed windows, trees, canopies, etc.

1.13 On steam and condensate piping: Valves, fittings and pipe products shall be made in the United States or Canada.

PART 2 - CODES

2.1 Information on all State codes is available on the Department of Public Safety, Division of Fire Safety web page at: http://www,dps.state.vt.us/fire/rules.htm.

2.2 Design:

A. Buildings shall comply with the current Vermont Fire & Building Safety Code, and the Vermont State accessibility requirements.

B. State Statute requires that all State buildings comply with CBES: heat, ventilation, air conditioning (HVAC), refrigeration, and lighting systems shall be designed according to the "Vermont Guidelines for Energy Efficient Commercial Construction" (CBES), available at: http://publicservice.vermont.gov/energy-efficiency/ee_energyefficiency.html and be based on the latest accepted versions of the International Energy Conservation Code (IECC) and ASHRAE 90.1. Design shall also comply with the recommendations of the latest accepted version of ASHRAE Ventilation Standard 62 and the ASHRAE Comfort Standard 55. The goal of building design should be to achieve a high performance building, which goes beyond the minimum energy code referenced above. To do this, designers should use the criteria in the "Energy Benchmark for High Performance Buildings (E-Benchmark)." Implementing E-Benchmark criteria will typically result in a building that uses at least 30% less energy than a building designed to the ASHRAE 90.1. The E-Benchmark may be downloaded for free from http://www.poweryourdesign.com, or you may request a free hard copy from Efficiency Vermont (toll free 888-921-5990). In addition, you may obtain free copies of "High Performance Design Guide to Energy Efficient Commercial Buildings: Vermont & the Northeast Region" by contacting Efficiency Vermont (toll free 888-921-5990).

PART 3 - SITEWORK

3.1 Utilize Vermont Agency of Transportation Standard Specifications for construction whenever possible: Sand, Gravel, Bituminous Concrete, etc., which are available on line at: http://www.aot.state.vt.us/conadmin/2001StandardSpecs.htm, or hard copy from Contract Administration, VT Agency of Transportation, One National Life Drive, Montpelier, VT 05633-5001.

PART 4 - CONCRETE

4.1 Use 3000 psi concrete, or greater, for footings.
4.2 Use 3000 - 4000 psi concrete for interior slabs.
4.3 Use 3000 - 4000 psi for interior walls.
4.4 Use 3000 - 4000 psi for exterior walls with 4-6% air entrainment.
4.5 Use 4000 psi for exterior slabs with 4-6% air entrainment.
4.6 Use 3000 psi concrete, or greater, for interior housekeeping pads.
4.7 Use 4000 psi concrete, with 4-6% air entrainment or greater, for exterior housekeeping pads.
4.8 Utilize wet cure for slabs.

PART 5 - ARCHITECTURAL

5.1 All offices of a tenant, within a building with more than one tenant, shall be grouped.

5.2 There shall be at least one large conference room that is accessible directly from a public area with toilet facilities available. Ideally, this shall be located near the main lobby or some other prominent entry that would allow off-hours meetings whereby the balance of the building can be secured. The goal is to limit the public's access to offices. In buildings where there is more than one tenant, this may be a shared conference room.

5.3 There shall be a minimum of three feet of space between the bottom of the structural steel and the finished ceiling. If the air handlers are grouped, such as in a mechanical room or on the roof, then the floor closest to the air handlers shall have four feet of space to accommodate main trunk lines.

5.4 When designing with steel stud and masonry cavity walls, placing rigid insulation exterior to the stud space is the recommended practice. Additional background information and design details related to this practice can be found on-line at the following: http://www.pacerepresentatives.com.

5.5 High traffic areas should have easy to clean hard surface floors, i.e., Ceramic tile, Quarry tile, linoleum, VCT or Wood. Typical high traffic areas include: Main lobbies, corridors, rest rooms, elevators, etc.

5.6 Areas outside shower stalls are to slope to a floor drain.

5.7 Sustainable Wood Requirements: For all wood, wood products, and materials and products containing wood products used on a project, provide wood from certified, well managed, sustainable sources.

5.8 Numbering:

A. There should be a recognizable system for numbering rooms, i.e., 3-digit numbers where the first digit represents the floor the room is on, odd numbered rooms on one side of the corridor and even numbered on the other. Rooms should be numbered up from the place where people predominately enter the floor.

B. Doors shall be numbered the same as the room, if there is more than one door to enter the room then use suffixes, i.e., 117, 117A, etc.

5.9 In new buildings and major renovations, space shall be set aside for recycling and janitorial storage that is separate from the mechanical room.

5.10 Mechanical Related:

A. There should be mechanical office and work areas separate from the boiler room with a mop sink available.

B. The door to the mechanical room should be sized to allow the largest piece of equipment to be replaced, and a route from the outside to allow equipment to be moved.

C. There should be a half-bath close to the mechanical office.

D. Mechanical equipment should be in mechanical rooms, not "shoe-horned" into ceiling spaces, or thrown on the roof.

E. If equipment ends up on the roof, then one of the stair towers shall extend through the roof with a vertical door to access the roof. No ladders or roof hatches shall be used.

F. Provide a convenience outlet within 50' of each piece of roof mounted equipment, unless one already exists.

G. Provide a hose bibb within 50' of each piece of roof mounted equipment, unless one already exists.

H. Guards shall be provided where appliances, equipment, fans or other components that require service are located within 10 feet of a roof edge or open side of a walking surface, and where such edge or open side is located more than 30 inches above the floor, roof or grade below. The guard shall be constructed so as to prevent the passage of a 21-inch diameter sphere.

PART 6 - DOORS AND HARDWARE

6.1 Locks shall be interchangeable core, compatible with the State's 7-pin Falcon cores.

6.2 Card Access Systems shall be used whenever possible. The Card Access System shall be the Westinghouse "NexWatch" System and shall be fully incorporated into the existing State System.

A. All exterior doors that are used by the public shall be on the NexWatch System. All doors that enter departments should also be on the NexWatch System. The use of push button locks should be discouraged. If it needs a push button lock, then it should probably be on the NexWatch System. Exterior doors used exclusively by employees should also be considered for card access.

PART 7 - SECURITY

7.1 Consider video cameras to monitor parking areas and main entry points.

PART 8 - MECHANICAL, HVAC

8.1 Temperatures: Unless otherwise directed, design spaces to be heated to 70°F, cooled to 76°F, with a summer ΔT of 15°F and a winter ΔT of 90°F.

8.2 Mechanical Equipment and Items:

A. Facilities with large heating needs (e.g., greater than 500,000 Btu) should consider using staged boiler systems utilizing either two boilers @ 67%, or three boilers @ 33% capacity, each. Whenever possible, Energy Star ™ labeled boilers should be specified.

B. HVAC Systems shall be designed such that heat shall NOT be required during the summer, i.e., constant volume re-heat shall not be used.

C. Mechanical designs shall consider either air side economizers or water side economizers (free cooling).

D. Places that require cooling in the winter shall utilize "free cooling" whenever possible. Consider hydronic based designs with dry-coolers, over DX.

E. Try to design buildings which do not need mechanical cooling.

F. Cooling systems which operate into the winter shall incorporate measures to reduce their energy consumption even further, such as air cooled condensers, or plate and frame heat exchangers in parallel with the chiller, or liquid pump amplifiers in the refrigeration circuit.

G. Provide heat recovery on all systems of 500 CFM or greater, of outside air. STRONGLY consider total heat recovery (i.e., enthalpic energy recovery) systems. That is, where appropriate, use enthalpic cores for latent heat exchange, (winter-time humidity retention and summer-time humidity rejection). Provide minimum of 2" pleated filters on BOTH airstreams before entering the heat exchanger.

H. Select air conditioning units that meet "Tier 2" energy efficiency ratings (EERs), as specified by the national organization Consortium for Energy Efficiency (CEE) at http://www.cee1.org/com/hecac/ac_tiers/eff_toc.htm.

I. When glycol is required, Propylene Glycol shall be used. No automatic fill from domestic water on any system shall be treated with glycol. The system shall require either a pressure sensor, storage tank and pump; or manual filling.

J. Re-testing of water by qualified agents, and adjusting of proper chemical levels, shall take place within one month, and at one year, after completion of a project.

K. Electric motors in mechanical equipment shall be the highest efficiency motors practical, and motors shall, at least, meet the requirements of the CBES.

L. Balancing valves shall be Tour-Anderson STA or Griswold automatic balancing valves.

M. Self-contained radiator valves shall be Macon N107X7 with B26000 heads.

N. Install fin tube with bottom @ 6" AFF.

O. Shut off valves: full port ball valves with stainless steel ball and stem.

P. Wye Strainers: Shall be installed vertically in "wet" systems (hydronic or condensate) and horizontally for steam.

Q. Provide a space, nominally 3', around all condensers where there is no planting materials.

R. Secure items to the building structure. Plastic anchors, sheetrock anchors and toggle bolts into gypsum wallboard alone shall not be allowed.

8.3 Maintenance-Related Design and Specification Issues:

A. Maintenance friendly designs are absolutely required: all designs shall be made with careful consideration given to ease regular and special maintenance tasks.

1. Do not design systems with air handling units above ceilings. Make them accessible and easy to maintain.

2. Design hydronic systems with "side arm" combination chemical pot feeder and bag filter.

3. Air handlers shall have a minimum of 2" final filter section; combination 2"/4" is preferred. Pre-filters shall be considered on a case-by-case basis. Minimum filter shall be pleated 40% efficient.

4. Air and water filters shall be easily accessible.

5. Air handling units shall be specified with hinged and latched access doors, and not with screwed on access panels.

6. Air handling units shall be specified with cooling coils upstream of heating coils wherever possible. Cooling cycles shall be designed so that the air doesn't blow warm-cool on the occupants. Design should use chilled water coil with proportional control, or DX with face and by-pass, or some other strategy that allows proportional control.

7. Use separate systems for heating, cooling and ventilation. Where space or costs require it, two of the systems may be combined, but not all three.

8. Heat pumps, fan coil units and the like shall not be "buried" within ducting and piping. Where "crowding" cannot be avoided, provide coordination drawings, including sections showing all mechanical and electrical items. Ensure that filters can be changed, and compressors and motors can be serviced adequately.

9. When mechanical items are being specified in building additions or renovations, match manufacturer and model numbers with existing equipment, i.e., if Taco 1600 series pumps exist, then the new pumps shall be Taco 1600 series.

10. Valves shall be easily accessible.

11. An ample number of access doors shall be provided in duct work for damper maintenance and cleaning.

8.4 Provide specs requiring that filters are new and unused when building is turned over. The construction filter set shall be removed and a new set installed by contractor.

A. Provide post-construction maintenance training requirements.

B. Provide consolidated maintenance schedule in O&M Manual, as well as in frame mounted to wall.

8.5 Labeling: All pieces of equipment are to be labeled, and if this is a renovation, then the labeling shall be consistent and coordinated with existing pieces of equipment. Utilize Seton pipe labels and Plastic laminated labels for equipment and ductwork. Indicate direction of flow. All labels are to be mechanically fastened.

8.6 Noise and Vibration Design Considerations:

A. Minimize air velocities to minimize air noise.

B. Locate equipment where noise and vibration from mechanical items is minimized. Locate rooftop units above corridors or utility spaces. Locate mechanical rooms away

from sensitive areas like courtrooms and conference rooms. Locate above-ceiling heat pumps and fan coil units above corridors or closets where possible.

C. Utilize duct silencers with mylar or foil scrim faced insulation where necessary.

D. Specify that all diffusers and return grills are connected with insulated flex duct that are to be curved with extra slack so there is not a "straight shot" between metal duct and diffuser or grill. Maximum 6' in length.

E. Keep hydronic velocity under 5 fpm in runout piping.

F. Take extraordinary measures to eliminate noise in courtrooms, or rooms where audio recording activities take place.

8.7 Ductwork/Accessories:

A. The minimum radius on ductwork elbows shall be 1.5 x width; the maximum width of ductwork shall be 48"; the duct should be as close to square in profile as possible, however, the ductwork profile should not exceed 2:1; unless approved by the Department of Buildings and General Services.

B. Volume dampers shall be stand-off, quadrant lock. These shall be tagged with brightly colored surveyors tape so the balancers may locate them with ease.

C. Access doors shall be double walled and piano hinged, with a minimum of two cam locks and rubberized seal.

D. NO FIBERGLASS IN THE AIRSTREAM! No interior fiberglass duct lining, sound attenuators, VAV box lining or Air Handler lining containing fiberglass. AHUs are to be double walled; where double wall units are not available, line units with Armaflex SA or a foil scrim faced insulation. Use Armaflex sheets, mechanically fastened, or foil scrim faced insulation for sound attenuation.

PART 9 - CONTROLS

9.1 Pre-Construction Submittals Required:

A. Product literature for all system components.

B. Logic diagrams for all control operations, by system, i.e., all the logic for the operation of an air handler shall be chained together to show how each sub loop interacts within the whole. (This could be generated by the engineer as part of the bid package.)

C. Block diagrams for all control operations and equipment.

D. System engineering for the entire control system (i.e., wiring diagrams with terminal numbers, calculations, reset schedules, etc.).

E. Sample graphic display software.

F. Equipment lists, including location of components within the building, part numbers, part names, and purpose/use.

G. List of all components installed in a DDC System, tabulated to show which will show up on the host/graphics screen, which ones are display only, and which are adjustable from the host/graphics screen.

H. Zoning:

1. The preference is for a stat in every room, if budget allows.

2. Rooms with different exposure or thermal load characteristics shall never be same zone, especially interior and exterior exposures. Corner rooms shall be its own zone. Conference rooms shall be its own zone.

3. Exterior office space (either open office or individual offices): Max. 600 SF per zone or a maximum of three rooms per stat.

4. Interior office space (either open office or individual offices): 1,400 SF per zone maximum. Maximum of three rooms per stat.

5. Rooms that should be on their own zone shall include:

   a. Classrooms.
   b. Conference rooms.
   c. Lobbies.
   d. Telecommunications room(s), (these require 24 hr/day conditioning).
   e. Equipment room(s).
   f. Computer room(s).
   g. Waiting room(s).
   h. Break room(s).

6. In addition, zones shall not cross functional boundaries between different departments/tenants.

I. DDC Controls Package:

1. DDC required in new construction of all buildings over 20,000 sf.

2. Location of local control modules to be preferably in closets or the like and always made to be completely accessible.

3. Host terminal shall have complete active graphics package and is to be modem OR internet connectable.

4. Linkages on actuators shall be kept as simple as possible. Damper actuators shall be direct coupled type similar to Belimo.

9.2 Sequences of Control:

A. To the greatest degree possible, utilize industry standard control sequences, then modify as necessary.
   1. An example: The controls for the AHU-2 shall be ASHRAE Cycle III, except when outside air is below 32ºF, then mixed air shall be controlled at 65ºF.

9.3 Energy Efficiency Considerations:

A. Utilize the latest accepted version of the International Energy Conservation Code (which incorporates ASHREA 90.1) that requires designers to incorporate control strategies for the following:

   1. Night set back where appropriate. (Prisons are always occupied.)
   2. Heat recovery.
   3. Air side economizer.
   4. Water side economizer.
   5. Heating water temperature reset control.
   6. Cooling staging.
   7. C02 level control of ventilating air.

B. Specific other areas to examine for cost vs. benefits.

   1. Enthalpic heat recovery;
   2. Geothermal;
   3. Radiant heat; and
   4. Solar.

PART 10 - MECHANICAL, PLUMBING DESIGN

A. All waste piping, within or passing through walls and floors, shall be cast iron, this is for noise concerns. Piping below the lowest floor may be PVC.

B. Drains down column lines to be coordinated with footings; footings shall be lowered to allow pipe to follow column to below slab.

C. No automatic fill from domestic water on any system treated with glycol. System shall require either a pressure sensor, storage tank and pump; or manual filling.

D. Tank type toilets shall be pressure-assisted type.

E. Avoid the use of wall hung toilets, if their use is necessary, additional structural support shall be provided for the carriers to prevent movement.

F. ADA accessible lavatories shall be nominally 20” x 18” NOT the special extended type.

G. Faucets shall be single lever style, gooseneck faucets are discouraged.

H. Avoid the use of direct fired water heaters.

I. Re-testing of water by qualified agents, and adjusting of proper chemical levels shall take place within one month, and at one year, after completion of a project.

PART 11 - FIRE ALARMS

11.1 Fire Alarm Systems shall be specified around FCI, and Notifier systems.

11.2 Fire alarms shall be addressable.

11.3 Devices shall be self-addressable, such as with rotary switches, and shall not require a special device to program them.

11.4 Systems shall be such that Maintenance can reprogram them when adding or deleting a small number of devices.

11.5 Systems shall be such that Maintenance can perform in-house inspection and testing of the systems.

11.6 Systems shall be such that Maintenance can disable them during renovations, such as soldering, to prevent nuisance tripping.

11.7 Reproducible, or electronic, as-builts showing each device, with its unique identifier shall be submitted prior to project completion.

PART 12 - ELECTRICAL

12.1 No shared neutrals on receptacle or florescent lighting circuits.

12.2 Full-sized neutrals.

12.3 Color code wires Red/Black/Blue for 120/208V circuits and Orange/Yellow/Brown for 277/460V circuits.

12.4 Identify circuits contained in: pull-boxes, junction boxes and connection boxes, by labeling inside of cover with either a phenolic tag or neatly handwritten with indelible marker.

12.5 Secure conduits, raceways, boxes, etc., to the building structure. Plastic anchors, sheetrock anchors and toggle bolts into gypsum wallboard alone shall not be allowed.

12.6 Multiple tube fixtures shall be dual switched, i.e., 3-tube fixtures shall be switched to allow 1, 2 or all 3 tubes to be lit.

12.7 Provide quad outlets @ phone jack locations with data connections.

12.8 Where possible, no outlets on exterior walls.

12.9 Panels shall be the breaker bolt in type, not plug in.

12.10 Panels shall have door-in door access, such that breakers are accessible without needing to unscrew a panel face.

12.11 Automatic transfer switches for emergency generators shall have a means for bypassing them so that maintenance may be performed on the ATS.

12.12 After installation, the generator set shall be subjected to all tests specified below using a resistor bank. Certified reports for both of these tests shall be submitted. The engineer shall be notified one week prior to testing so arrangements to witness the test can be made. Generator set shall be tested under varying loads with guards and exhaust system in place. Tests shall include and certified reports shall be submitted for the following:

1. Single-step load pickup.
2. Transient and steady-state governing.
3. Safety shutdown device testing.
4. Voltage regulation.
5. Rated Power (100% output for 4 hours).
6. Maximum Power (110% output for 20 minutes).

12.13 Lighting levels should comply with foot-candle levels provided by the Illuminating Engineering Society of North America (IESNA). These light levels must be achieved with lighting power densities specified in the latest accepted version of ASHRAE 90.1. Ideally, light levels should require no more than the lighting power densities specified in the E-Benchmark.

12.14 Use highest efficiency products where possible. For lighting, the use of "Super T-8" lighting technology and high-bay T-5 technology is encouraged.

12.15 Use LED exit signs, preferably units of 1 watt or less.

12.16 When lighting quality is important (e.g., offices, classrooms, public spaces, etc.), lighting should specify color rendering indices (CRIs) of 80 or higher. Attention should also be paid to selecting lamps with consistent color temperature (e.g., 4000K), so that there is not a mixture of "pink" and "blue" lamps in a space. Stick to higher color temperature lamps.

PART 13 - INFORMATION TRANSPORT SYSTEM INFRASTRUCTURE STANDARD

13.1 Forward: Project managers now have a choice of how to complete the telecommunications wiring and terminations for projects. You may follow the previous procedure of building the telecommunications rooms and installing the conduits under the GC contract, then contacting DII to install the wiring and terminations; or you may have the design consultant incorporate the Information Transport System Infrastructure Standard issued by the State's Department Of Information & Innovation (DII) dated August 18, 2006 http://dii.vermont.gov/DII_Divisions/Customer/Install_Repair/Voice_and_Data_Cabling_Systems, with the following edits into the bid package:

A. In using this standard, it is critical that all coordination requirements with DII are strictly adhered to.

B. In all places where communication/coordination is to take place with DII, it shall be the BGS project manager's responsibility.

C. In all places where the contractor is required to deliver something, i.e., test results, as-builts, etc., these items shall be delivered to the BGS project manager, who will forward them to DII.

13.2 Responsibilities:

A. The project manager shall contact the local phone company and schedule telephone cable entrance and termination, as well as Internet cable (GovNet) entrance and termination.

B. The project manager shall schedule a meeting between the architect, and appropriate sub-consultants, and DII.

C. The designers are to design, for installation under the construction contract, the communication closets, raceways, cables, and termination drops.

1. Standard termination drops shall consist of a 1" conduit, four square box and a single gang mud ring.

D. DII shall be responsible for the final connections of cables in the communication closets.

PART 14 - GENERAL AND POST-CONSTRUCTION REQUIREMENTS

14.1 During Construction:

A. Work and storage areas shall be maintained and swept clean on a daily basis.

B. All subcontractors shall be completed and out of the building one (1) month before Owner occupancy so mechanical contractor can turn HVAC Systems on without possible

contamination from building construction activities, the control contractor can ring out the controls, and balancing contractor may work unimpeded.

C. Ductwork SHALL be cleaned by a subcontractor specializing in duct cleaning at the completion of each project prior to the balancing.

14.2 Balancing: In addition to standard NEBB Specs, include the following language:

A. Notification: Balancer is to immediately notify Owner and engineer as soon as balancing problems are discovered, i.e., specify not to wait for Owner and/or engineer to discover the problems in the final report.

B. Proportionality: Where it is impossible to obtain design flows within 5% at every room within a zone, balance air flows within zones such that the proportionality of the original design is obtained. For example, if there are three rooms that are designed to have 100 cfm each, but one room can only obtain 92 cfm max., proceed balance to as close as possible at 92cfm in all three rooms; i.e., do not balance at 100, 100 and 92. If air flows are less than 90% of design, notify engineer immediately.

14.3 Controls Commissioning:

A. At the end of the construction phase, commission the building in the presence of a representative of the Owner. At this time, demonstrate that all control components operate properly by illustrating their operation via a contractor technician operating the host terminal to verify the status of each point with a separate technician at the point being verified, with two-way communication between technicians. To verify each point:

1. The technician at the terminal will communicate the status of the point to the technician at the point. The technician at the point will verify, through observation or measurement, whether the status is correct.

2. The technician at the terminal will then cause the status of the point to change, and the technician shall verify the following:
   a. The status of the point did change, through observation or measurement.
   b. The status changed in the correct direction.

3. Correct any deficiencies encountered, and re-verify. Record any changes in the project record documents.

4. Work with balancing contractor to calibrate all DDC flow monitoring components.

B. Approximately 6-8 months, after the date of Substantial Completion, coordinate with the Owner and return to the building and re-commission the building, including:

1. Modification of the control sequences and operations to fine tune the systems per the requirements of the Owner.
2. Verification of the proper operation of all control components and software.

3. Modification of the project record documents to reflect all changes and revisions made to date.

C. Training:

1. Include at least four (4) one-day training/fine tuning sessions:

   a. One off-site to familiarize the Maintenance personnel in the operations of the equipment prior to substantial completion.
   b. One at the conclusion of the commissioning period.
   c. One approximately 60 days later.
   d. One to be determined by Maintenance.

D. Post-Construction Submittals:

1. Revised logic diagrams, block diagrams, and system engineering based on the actual installation.
2. Hard copy of all system programming, block diagrams, etc.
3. Software copy of all system engineering, block diagrams control sequences, etc.
4. BGS burner start-up sheet.
5. Commissioning Report.

14.4 Filter Change Out: Contractor is to replace all construction filters with new ones at the very end of the project.

14.5 Cleaning:

A. All mechanical systems shall be thoroughly cleaned, after the building is cleaned, and before each system is started.

B. Hydronic systems to be flushed and chemically cleaned inside. Proper passivators shall be circulated for a prescribed length of time. Inhibitors shall be installed. Testing by qualified lab shall take place, and water chemical treatment shall be adjusted according to lab recommendations.

C. Construction strainers will be removed and hung on their respective strainer prior to balancing, and fin tubes and terminal units vacuumed before covers are set.

D. Ductwork SHALL be cleaned by a subcontractor specializing in duct cleaning at the completion of each project.

END OF DOCUMENT