BGS Design Guidelines

September 2013

Commissioner Michael Obuchowski

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IMPORTANT NOTE FOR USE OF GUIDELINES

The approval and adoption of this document is effective September 1, 2013. All projects commencing design after this date will follow the September 2013 Design Guidelines and not the previous version.

The intention of the following guidelines is the application to all designs and construction projects at the Department of Buildings and General Services (BGS). This guideline is a living document. Confirm the approval date on the front of the document prior to its use to ensure that the entire project team is using the correct version. This guideline serves as a supplement to, not a replacement of, any code, design, and industry standards. Contact the BGS Project Manager if there are any conflicts between current practice and these guidelines. Consultants and contractors shall refer to these guidelines as the legal requirements to fulfill contract commitments. The intention of this document is to evolve as needed; as such, comments and feedback are welcome.

Photo on Front: Fire Safety Training Building in Pittsford, VT. In 2010, this new construction project was first in Vermont State Government recognized with a Leadership in Energy and Environmental Design or LEED® certification. This project achieved a silver certification level under the LEED for New Construction rating system with the U.S. Green Building Council or USGBC. This building design achieved 35 out of a possible 52 points with the majority of the points in the Indoor Environmental Quality category.

Updated by Debra Bordo, LEED Green Assoc, MBA, with support from BGS divisions and other agencies

HISTORY OF PROCESS

The residents and businesses of the State of Vermont publicly fund BGS construction and renovation projects. The expectation is to expend these resources wisely. This funding process usually involves budgetary estimates from the BGS Regions. Projects occasionally fall short on funding due to constraints, leading to conflicts involving competing interests. In cases where the legislature does not provide specific direction, the projects' competing interests are 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 heating, ventilation, and air conditioning (HVAC) system,
5) Maximize the utilization of energy efficient designs and the incorporation of energy efficient equipment, materials and methods,
6) Maximize integration of sustainability in design and construction; consistent with the State's energy and environmental objectives, and
7) Maximize the incorporation of alternative renewable energy technologies.

The first four objectives encompass the manner in which buildings have been designed and constructed in the past. The remaining objectives address the State's perspective regarding the use of energy and its impact on the environment. However, the achievement of an energy efficient and environmentally responsive building is highly dependent upon funding and the scope of work for each project. It is a challenge to achieve the same level of efficiency and environmental responsiveness for all of the projects given each project’s variation in budget and scope of work. Technological changes are occurring continuously, and BGS strives to take advantage of these changes when it is prudent, justified and without unnecessary or unusual risk.

Design all new construction and major renovations to achieve efficiencies 30% greater than those required by the current energy code. There shall be use of *The Core Performance: Vermont Edition* as a design foundation from which to achieve this objective. Required collaboration between the State, contracted architect, and applicable utilities (Burlington Electric Department, Efficiency Vermont or EVT, and Vermont Gas Systems) by an incentive agreement must occur in order to meet the objectives. While there was use of the latest accepted version of the LEED rating systems as resources during the development of these guidelines, there is no requirement to formally document, enroll, or apply for any LEED certifications at this time.

The intent of these guidelines is to have an impact beyond the immediate sphere of influence. One of the beneficial outcomes is that by demonstrating the State's commitment to preserving the environment, BGS can prove that fiscally successful governmental operations are compatible 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.

01 00 00 – GENERAL REQUIREMENTS AND SUMMARY

1) All building designs will incorporate two entries, one for public access, and the other for State access. All building designs will have a vestibule area that will be designated specifically for a reception and security clearance area. This area will be utilized either at the completion of the project or for future use with minimal fit-up.
2) There shall be a minimum of three (3) feet of space between the bottom of the structural steel and the finished ceiling. With grouped air handlers, such as in a mechanical room or on the roof, the floor closest to the air handlers shall have four (4) feet of space to accommodate main trunk lines.
3) Provide preliminary budgets based on systems as described and required herein. Include contingencies early in the budget process. Provide intermediary and final construction estimates. Communicate any anticipated adjustments that adversely affect the budget to the State at the earliest possible time.
4) Submit specifications in three ring binders for design review.
5) Number specification sections with the most current Construction Specifications Institute or CSI numbering process, see website for the latest accepted version, http://www.csinet.org/.
6) Arrange drawings in the same order as the specifications, i.e., Civil, Architectural, Structural, Plumbing, Heating, and Electrical.
7) Keep drawings simple and uncluttered. It may appear acceptable in the computer-aided design software but it may not reproduce acceptable when mass printed. Use text larger than eight (8)-point font in all documents and drawings.
8) On schedules of values and requisitions for payment, break out subcontract amounts. Mechanical and Electrical should be broken into CSI specification items.
9) Designs shall be complete when bid. No contractor/vendor designs, i.e., curtain walls, fire sprinklers, radiant heat, etc.
10) Consider bulk upgrades or renovations as one project to reduce mobilization costs for similar tasks as well as achieving greater energy savings.
11) Use products that do not contain mercury whenever possible. When a product must contain mercury, such as florescent lights then select the model with the lowest amount of mercury. Identify products containing mercury to the State Project Manager for approval.
12) Spaces that house building systems will be required to have at least six (6) feet high with at least three (3) feet of open travel way around and in front of all systems. No crawl spaces or hand holes for major system maintenance. Ensure that preventative maintenance areas are accessible without climbing on ductwork or piping. Filters, valves, meters, and other items that require regular maintenance should be easy to access from the clear travel ways.
13) Priority for mechanical equipment placement should be in mechanical rooms; not "shoe-horned" into ceiling spaces or placed on the roof. The equipment should have at least three (3) feet around it to maintain it properly. Locations of doors, filters, valves, etc should be convenient from the mechanical room entry without stepping over ductwork or crawling under parts of the equipment.
14) If the only available space for equipment is on the roof, then one of the stair towers shall extend through the roof with a vertical door to access the roof. Do not install ladders or roof hatches as the only means of access to the roof.
15) Avoid the use of products containing formaldehyde whenever possible. Identify products containing formaldehyde to the State Project Manager for approval.
16) Steam and condensate valves, fittings, and pipe products will be manufactured in the United States or Canada.
17) Specify staff training and manuals as part of each project. The installation of any new equipment includes all Operations and Maintenance (O&M) Manuals and hands-on training for the staff responsible for the maintenance of the equipment after project completion. Many new technologies rely on computer knowledge and adjustments for maintenance compared to the traditional systems of the past.
18) Cost of hands-on training shall be included in the project costs.
19) Any necessary O&M Manuals will be included in the project costs.
20) To the greatest degree possible, keep system designs and sequences simple.

21) There should be a recognizable system for numbering rooms. Numbering of the rooms should be based on the current accepted Space Management Guidelines.
22) Provide guards 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. Construct the guard to prevent the passage of a 21-inch diameter sphere.
23) All new installations and renovations of roof-mounted equipment will include the installation of Vermont Occupational Safety and Health Administration (VOSHA) compliant roof tie-offs or permanent guardrails on the building and provisions for safe access. Exceptions will be:

    a) Sloped roofs where no equipment exists,
    b) Roofs that will not need general maintenance such as snow shoveling,
    c) Slate roofs that can only be accessed by a lift or will damage the slate,
    d) Existing compliant tie-offs or permanent guardrails, and
    e) Flat roofs that have 39 inches high parapet walls.

01 11 00 Summary of Work

01 11 13 Work Covered by Contract Documents

1) Pre-Construction

    a. Review the feasibility of incorporating any previous recommendations prior to completing the design of any new work within a building.
    b. Required deliverables provided with completed controls to BGS Project Manager:

        i. Product literature for all system components.
        ii. 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. The contracted engineers may generate the diagrams as part of the bid package.
        iii. Block diagrams for all control operations and equipment.
        iv. System engineering for the entire control system, i.e., wiring diagrams with terminal numbers, calculations, reset schedules, etc.
        v. Sample graphic display software.
        vi. Equipment lists, including location of components within the building, part numbers, part names, and purpose/use.
        vii. List of all components installed in a Direct-Digital Control or DDC system, tabulated to show which components will show up on the host/graphics screen, which ones are display only, and which are adjustable from the host/graphics screen.

    c. Conduct field verification of the existing plumbing fixtures. Provide the following findings to the BGS Project Manager:

        i. Compatibility of existing plumbing fixtures with any proposed additions to the building,
        ii. Applicability of existing plumbing fixtures in relation to current acceptable industry practices, and
        iii. Ease of maintenance of proposed plumbing fixtures.

    d. Electric utility savings is an important consideration. In the case of the electric bill, reduction in peak use could result in more savings than just the costs per kilowatt-hour. Achieve cost effective savings by addressing either of these areas.
    e. Use dustless sanding during construction with a High-Efficiency Particulate Air (HEPA) filter vacuum system. Negative air pressure machines must be in operation. Provide this as a one (1)-unit price.

f. Commissioning Planning and Review

i. Develop and distribute a Design Phase Commissioning Plan to describe commissioning activities, roles, and responsibilities during the Design Phase.
ii. Develop a Preliminary Construction Commissioning Plan to describe commissioning activities during the Construction and the Warranty and Operations periods as part of the bid documents. Provide sample checklists and at least one (1) functional performance test with the plan.
iii. Review the Owners Project Requirements and Basis of Design for clarity and completeness. Provide written comments to the State staff.
iv. Review all design and construction documents.

2) Construction

a. Maintain and sweep work and storage areas clean on a daily basis.
b. Seal off all areas of construction from non-construction areas using a pre-approved thickness for plastic.
c. The subcontractor that cleans the ductwork must specialize in duct cleaning. Completion of the cleaning must occur prior to the balancing.
d. Commissioning Planning and Review

i. Organize, coordinate, and direct commissioning activities in a logical, sequential, and efficient manner using consistent protocols. Provide updated timelines and schedules for commissioning activities.
ii. Review submittals of the Testing, Adjusting, and Balancing Plan.
iii. Perform at least two (2) site visits to observe component and system installations, and compliance. Provide field reports for each site visit.

3) Pre-Occupancy

a. All subcontractors shall be completed and out of the building one (1) month before State occupancy so mechanical contractor can turn HVAC Systems on without possible contamination from building construction activities, the control contractor can wring out the controls, and balancing contractor may work unimpeded.
b. Filters - Contractor is to replace all construction filters with new ones at the very end of the project.
c. Provide the specifications requiring that filters are new and unused when building transitions from the contractor to the State for occupancy. The construction filter set shall be removed and a new set installed by contractor.
d. A thorough cleaning of all mechanical systems will occur:

i. After the building is cleaned and
ii. Before the start of each system.

e. Flush and chemically clean the inside of hydronic systems. Proper passivators shall be circulated for a prescribed length of time. Install inhibitors. Testing by qualified lab shall take place, and adjust the water chemical treatment according to lab recommendations.
f. Remove the construction strainers and hang on the respective strainers prior to balancing. All fin-tube and terminal units vacuumed before covers are set, but after all dust generating activities has ceased.
g. The subcontractor that cleans the ductwork must specialize in duct cleaning. Completion of the cleaning must occur prior to the balancing.
h. Balancing will be in accordance to standard the National Environmental Balancing Bureau Specifications, include the following language:

i. The contracted balancer is to notify the State and engineer immediately upon discovering of any balancing problems. Do not wait for State and/or contracted engineer to discover the problems in the final report.
ii. Where it is impossible to obtain design flows within five (5) % at every room within a zone, balance airflows within zones such that the proportionality of the original design. For example, if there are three (3) rooms that are designed to have 100 cubic feet per minute or cfm each, but one (1) room can only obtain 92 cfm maximum, proceed balance to as close as possible at 92 cfm in all three rooms; i.e., do not balance at 100, 100 and 92. If airflows are less than 90 percent (%) of design, notify the contract engineer immediately.

i. At the end of the construction phase, demonstrate that all control components operate properly by illustrating the operation via a contractor technician operating the host terminal to verify the status of each point with a separate technician at the point. Use two-way communication between technicians for all communications. To verify each point:

i. 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.
ii. 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.

iii. Correct any deficiencies encountered, and re-verify. Record any changes in the project record documents.
iv. Work with balancing contractor to calibrate all DDC flow monitoring components.

j. Commissioning Planning and Review

i. Develop detailed construction checklists for distribution and tracking. Verify completed checklists using sampling for terminal equipment and devices, and full verification for major equipment.
ii. Develop a summary report that identifies all items of the project covered by the warranty.
iii. Issue field reports to document checklist process.
iv. Verify systems start-up by reviewing reports and site observations.
v. Review the maintenance plan for the building and verify that all items covered in the warranty are listed within the maintenance plan.
vi. Ensure all scheduled work order item like preventative maintenance tasks are added in the automated work order system, Maintenance Connection such as;

a. Filter changes
b. Duct inspections and cleanings
c. Culvert inspections and cleanings
d. Lubrications

vii. Develop detailed, step-by-step, functional performance testing documents and maintain an action log.

4) Post-Construction

a. Revised logic diagrams, block diagrams, and system engineering based on the actual installation.
b. Hard copy of all system programming, block diagrams, etc.
c. Software copy of all system engineering, block diagrams control sequences, etc.
d. BGS burner start-up sheet.
e. Commissioning Report.

f. Post-construction maintenance training requirements.
g. Consolidated maintenance schedule in the O&M Manual, as well as in frame mounted to wall.
h. 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.
i. Approximately six (6) to eight (8) months, after the date of Substantial Completion, coordinate with the State and return to the building to complete the Warranty and Operations Commissioning, including:

   i. O&M manuals reviewed for completeness, clarity, and adequacy in describing both regular maintenance and troubleshooting.
   ii. Verify that each device and equipment is specifically identified and that all periodically required maintenance is clearly documented. Review and report on one (1) week of DDC-generated trend logs in each quarter.
   iii. Verify warranties and review as-built drawings and control sequences for completeness and accuracy. Modification of the control sequences and operations to fine-tune the systems per the requirements of the State. Verification of the proper operation of all control components and software. Modification of the project record documents to reflect all changes and revisions made to date.
   iv. Review, recommend pre-approval, and verify the training provided by the contractors.
   v. Verify the development and completion of training programs for the building maintenance staff, administrators, instructors, and other staff.
   vi. Schedule and verify deferred and seasonal testing by the contractor.
   vii. Submit a final Commissioning Report. Organize and conduct a lessons-learned workshop to review Commissioning Report.

j. Starting at 10 months and completing prior to the 12-month warranty period date, after the date of Substantial Completion, coordinate with the State and return to the building to conduct a follow-up to the Warranty and Operations Commissioning, including:

   i. Review current building operations and the condition of outstanding issues related to the original and seasonal commissioning with State staff.
   ii. Interview State staff to identify issues or concerns with operating the building as originally designed.
   iii. Compile suggestions for improvements and record changes in the O&M manuals.
   iv. Review, recommend pre-approval, and verify the training provided by the contractors.
   v. Assist State staff in the identification of issues that are related to the warranty or the original construction contract.
   vi. Assist State staff in the development of reports, documents, and requests for services to remedy outstanding issues.

01 31 00 Project Management Coordination

01 31 19 Project Meetings

During construction, the contractors and sub-contractors shall be required to:

1) Inspect the site,
2) Attend project meetings, and
3) At least monthly, upon receipt of the requisitions, verify the as-built drawings of work completed in the consultants and sub-consultants' field prior to approval of requisitions.

01 40 00 Quality Requirements

01 41 13 Codes

1) Buildings shall comply with the latest accepted versions of the current codes:

   a. Vermont Fire and Building Safety Code,
   b. VOSHA,
   c. Occupational Safety and Health Administration (OSHA),
   d. International Plumbing Code,
   e. National Electrical Code,
   f. International Energy Conservation Code (IECC), and
   g. National Fire Protection Association (NFPA).

2) Information on all State codes is available on the Department of Public Safety, Division of Fire Safety web page at: http://firesafety.vermont.gov/Standards.
3) All necessary permits shall be in place prior to construction.

01 41 16 Laws

Buildings shall comply with the latest accepted versions of the current laws and regulations:

Vermont Hazardous Waste Management Regulations,
http://www.anr.state.vt.us/dec/wastediv/rcra/regs.htm

01 42 00 References

01 42 13 Abbreviations and Acronyms

ΔT	delta or difference in temperature
%	percent
ADA	Americans with Disabilities Act
AHU	Air Handling Unit
ANSI	American National Standards Institute
AOT	Agency of Transportation
ASHRAE	American Society of Heating, Refrigeration, and Air-conditioning Engineers
ATS	Automatic Transfer Switch
BGS	Department of Buildings and General Services
BICSI	Building Industry Consulting Services International
BTU	British thermal unit
CBES	Commercial Building Energy Standards
cfm	cubic feet per minute
CO_2	carbon dioxide
CFR	Code of Federal Regluations
CRI	Color Rendering Index
CSI	Construction Specifications Institute
dbh	diameter breast height
DDC	Direct Digital Control
DII	Department of Information and Innovation
DX	Direct Exchanger
EPA	Environmental Protection Agency
EVT	Efficiency Vermont
IP	Internet Protocol
°F	degrees Fahrenheit
FCI	Fire Control Instruments
fps	frames per second
GOVnet	State of Vermont Network or group of State staff that support network
HD	high-definition

HEPA	High-Efficiency Particulate Air
HVAC	Heating, Ventilation, and Air Conditioning
IECC	International Energy Conservation Code
IES	Illuminating Engineering Society
IT	information technology
°K	degrees Kelvin
LED	Light Emitting Diode
LEED®	Leadership in Energy and Environmental Design
NVR	network video recorder
O&M	Operations and Maintenance
OSHA	Occupational Safety and Health Administration
NFPA	National Fire Protection Association
psi	pound per square inch
PTZ	pan-tilt-zoom
PVC	Polyvinyl Chloride
RCDD	Registered Communications Distribution Designers
SF	square foot
TPZ	Tree Protection Zone
USGBC	United States Green Building Council
VAV	Variable Air Volume
VCT	Vinyl Composition Tile
VOSHA	Vermont Occupational Safety and Health Administration
VPN	Virtual Private Network

01 42 19 Reference Standards

The design should strive towards the following latest accepted versions of the BGS guidelines whenever feasible:

1) *BGS Space Management Guidelines* - Consider the existing architecture when making adjustments.
2) *BGS Agency Energy Implementation Plan,* http://bgs.vermont.gov/energy
3) *BGS Commissioning Guidelines*, http://bgs.vermont.gov/sites/bgs/files/pdfs/BGS-Facilities-CommSpec.doc

The design should strive towards the following latest accepted versions of the State-adopted standards whenever feasible:

1) *High Performance Building Guide* - The Energy Efficiency Utility, EVT, http://www.efficiencyvermont.com/for_my_business/ways-to-save-and-rebates/commercial_new_construction/guides.aspx
2) Vermont *Commercial Building Energy Standards* (CBES) –for designing the HVAC, refrigeration, and lighting systems, http://publicservice.vermont.gov/topics/energy_efficiency/cbes
3) Vermont Agency of Transportation (AOT) Standard - for specifications on sand, gravel, and bituminous concrete whenever possible. Information, including how to get a copy, can be found on the AOT website: http://www.aot.state.vt.us/conadmin/construct.htm.
4) Vermont Department of Environmental Conservation Environmental Protection Rules, http://www.anr.state.vt.us/dec/rulessum.htm
5) *Vermont Stormwater Management Manual, http://www.vtwaterquality.org/stormwater/docs/sw_manual-vol1.pdf* and *http://www.vtwaterquality.org/stormwater/docs/sw_manual-vol2.pdf*
6) *State Agency Energy Plan, http://bgs.vermont.gov/energy*
7) *Information Transport System Infrastructure Standard*, http://cobleighlibrary.org/main/wp-content/uploads/2008/01/State-of-Vermont-Information-Transport-System-Infrastructure-Standard.pdf

The design should strive towards the following latest accepted versions of the nationally adopted standards whenever feasible:

1) Illuminating Engineering Society or IES of North America - for lighting levels to comply with foot-candle levels.
2) American Society of Heating, Refrigeration, and Air conditioning Engineers (ASHRAE) *Energy Standard for Buildings except Low-Rise Residential Buildings 90.1*
3) American National Standards Institute (ANSI)/ASHRAE/USGBC/IES *Standard for High-Performance Green Buildings189.1*
4) ASHRAE *Ventilation for Acceptable Indoor Air Quality Standard 62.1*
5) ASHRAE *Thermal Environmental Conditions for Human Occupancy Standard 55*
6) *Americans with Disabilities Act (ADA) Standards and Accessibility Guidelines* - as a minimum standard.
7) ASHRAE 90.1 - to achieve acceptable lighting power densities.
8) USGBC LEED Rating System - using the rating system that best matches the project.
9) Construction Specifications Institute - for formatting.
10) National Environmental Balancing Bureau Specifications
11) ENERGY STAR® Program - for selection of applicable equipment and appliances.
12) International Society of Arboriculture
13) American Society of Sanitary Engineering 1055
14) Consortium for Energy Efficiency - for air conditioning units.
15) *Building Industry Consulting Services International (BICSI) Standards*
16) National Air Duct Cleaners Association Standard *Assessment, Cleaning, and Restoration of HVAC Systems* - for a process on duct cleaning

01 79 00 Demonstration and Training

The contractors responsible for these installations will conduct trainings for the State as outline below:

1) Controls system
2) Wastewater system
3) Stormwater system
4) Tanks
5) Pumps

At least four (4) one-day training/fine tuning sessions:

1) One (1) off-site to familiarize the BGS Maintenance personnel in the operations of the equipment, prior to substantial completion,
2) One (1) at the conclusion of the commissioning period,
3) One (1) approximately 60 days later, and
4) One (1) to be determined by BGS Maintenance.

01 80 00 Performance Requirements

01 81 13 Sustainable Design Requirements

1) When designing changes to a current building that has received an energy or environmental certification such as LEED or ENERGY STAR, ensure that the changes will not remove or alter the features that earned credits towards the certification.

2) Walkable Site Design[1]

   a. One (1) principal functional entry on the front facade facing a public space, excluding a parking lot, such as:

      i. Street - Dedicated, addressable (for mail purposes) right-of-way that can accommodate one or more modes of travel, excluding alleys.
      ii. Park, Square, or Plaza.
      iii. Publicly Accessible Pedestrian Path - At least four (4) feet wide and no more than 12 feet wide, that provides shortcuts between buildings and through the block, connecting street frontages to rear parking areas, mid-block courtyards, alleys, or other streets.

   b. All street frontages have a minimum building height-to-street width ratio of 1:1.5 measured from the centerline of the street. Non-motorized rights-of-way frontages must have a minimum 1:0.5 ratio of building height to street width.
   c. Street trees are provided between the vehicle travel way and walkway at intervals no more than 40 feet.

3) Look at larger, more involved projects to not only save energy, but also increase the reliance on renewable fuels like geothermal, solar, wind, and biomass systems.
4) For all wood, wood products, and materials and products containing wood products used on a project, provide wood from certified, well-managed, sustainable sources whenever feasible and cost effective.
5) The State desires to minimize its energy footprint. As such, designs shall consider any and all factors that can reduce energy consumption. This shall include, but not be limited to, the reflectance and shading of the exterior of the building.

   a. Specify a solar reflectance index of at least 29 when feasible to reduce cooling demand.
   b. Specify exterior shading of windows such as overhangs, fins, recessed windows, trees, and/or canopies.[2]

6) Proper design is essential to ensure the efficiency of the equipment and conserve the energy used to heat state owned infrastructure. This makes the efficiency of the heating systems and its controls critical to achieving energy savings. The load on the HVAC equipment directly affects the efficiency of the equipment. Equipment that is overloaded or under-loaded will operate at a reduced efficiency.[3]

<u>01 81 16 Facility Environmental Requirements</u>

1) Review the use of renewable energy systems for cost effectiveness with consideration for the reduction of the impact of fossil fuels and emissions on the environment. This will also increase the diversity of the state infrastructure portfolio. BGS is currently using biomass; wood chips, wood pellets, wood chunk, biodiesel, geothermal, solar thermal collectors, a wind turbine and a photovoltaic array.

   The screening of the cost effectiveness will depend on:

   a. Type of technology,
   b. Estimated useful life of the equipment, and
   c. Funding used to purchase the technology.

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[1] LEED Pilot Credit Library, USGBC, LT Pilot Credit 14: Walkable Project Site, http://www.usgbc.org/pilotcredits

[2] LEED Reference Guide for Green Building Design and Construction, 2009 Edition, USGBC, SS Credit 7.1: Heat Island Effect - Nonroof, Implementation, page 112 and SS Credit 7.2: Heat Island Effect - Roof, Implementation, page 122

[3] 'Energy Management Handbook', Sixth Edition, Wayne C. Turner and Steve Doty, 10.5.7 HVAC Equipment, Equipment Efficiency, page 267

2) All renewable energy projects must include a method of tracking the generation and saving the data to provide a monitoring method for maintenance and a means of reporting the benefit of the equipment.
3) Utilize the latest accepted version of the IECC which incorporates ASHRAE 90.1 that requires designers to incorporate control strategies for the following:

    a. Night setback, where appropriate,
    b. Correctional facilities are occupied at all times and will not be considered for night setback,
    c. Heat recovery,
    d. Air side economizer,
    e. Water side economizer,
    f. Heating water temperature reset control,
    g. Cooling staging, and
    h. Carbon Dioxide (CO_2) level control of ventilating air.

4) Specific other areas to examine for cost vs. benefits:

    a. Enthalpy heat recovery,
    b. Geothermal,
    c. Radiant heat, and
    d. Solar.

5) The desire is to minimize the stormwater footprint, similar to the standard set for federal buildings[4]

    a. Any project that meets the following criterion shall maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the site with regard to the temperature, rate, volume, and duration of flow. These projects must adhere to the Stormwater Management Option 1 to the maximum extent technically feasible. If not feasible, then projects must meet the Stormwater Management Option 2.

        i. Involves a state facility greater than 1,000 square feet or SF of new impervious area
        ii. Does not trigger a state stormwater permit

    b. To accomplish this, the project engineer shall use site planning, design, construction, and maintenance strategies.

        i. <u>Stormwater Management Option 1:</u> Retain the 90th Percentile Rainfall Event
        Design, construct, and maintain stormwater management practices that manage rainfall onsite, and prevent the off-site discharge of the precipitation from all rainfall events less than or equal to the 90th percentile rainfall event.

        Volumes shall be calculated based 100% of new impervious for new development, 75% of new impervious for expansion projects, and 50% of new impervious for redevelopment projects.

        This objective should be accomplished by the use of green stormwater infrastructure practices that infiltrate evapotranspire and/or harvest and use rainwater.

[4] Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act, EPA 841-B-09-001, December 2009, U.S. Environmental Protection Agency or EPA, Establishing Section 438 Performance Design Objectives, page 14, http://www.epa.gov/oaintrnt/documents/epa_swm_guidance.pdf

In cases where there are discharges to cool water streams or other sensitive receiving waters, additional strategies may be needed to ensure that stormwater discharges do not result in greater thermal impacts than would occur in pre-development conditions.

ii. Stormwater Management Option 2: Meet the Vermont Stormwater Management Manual Treatment Standards

Design, construct, and maintain stormwater management practices that meet Vermont Stormwater Treatment Standards.

c. If meeting these criteria is not feasible due to site constraints, particularly on expansion and redevelopment projects, stormwater mitigation may be done somewhere else on site as a surrogate if:

i. Mitigation adheres to either Option 1 or 2,
ii. Treats the same volume, and
iii. Located within the same watershed.

01 84 00 Interiors Performance Requirements

01 84 13 Interior Construction Performance Requirements

1) Group all offices of a tenant, within a building with more than one tenant.
2) Provide at least one (1) large conference room with toilet facilities accessible directly from a public area. Ideally, the conference room shall be located near the main lobby or some other prominent entry that would allow off-hours meetings while securing the balance of the building. 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.
3) Any plumbing fixtures, existing or proposed, within the construction site will have inline valves to isolate the plumbing fixtures for future maintenance. At a minimum, the isolation valves will isolate two (2) restrooms with an ideal application being the ability to isolate each fixture individually to minimize impact use of area during maintenance.
4) Provide a baby changing table in at least one (1) men's and one (1) women's restroom within a building.
5) Provide at least one (1) lactation room, at a minimum of 70 square feet, will be provided, with a combination lock for entry, for a building to include the following:

a. Sink with hot and cold water
b. At least one (1) bench with a table or shelf adjacent , if more than one (1) station is included, provide a curtain and/or walls for privacy
c. One (1) small refrigerator
d. At least three (3) small, lockable, lockers to hold pumps used for lactation

01 84 16 Stairways Performance Requirements

Access to any building systems will be with stairs or an elevator large enough to transport pieces of equipment to replace or maintain the systems. No use of straight or ship ladders for means to access or maintain buildings. The access areas include those to roofs and catwalks around large mechanical systems. All roof access shall be through a door and not through a hatchway.

01 88 00 Other Facility Construction Performance Requirements

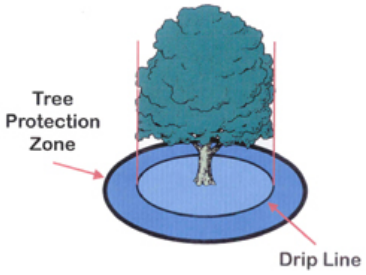
01 88 13 Special Construction Performance Requirements

When calculating the amount of parking spaces based on occupancy, take into account the number of fleet vehicles assigned to the location. Include the total number of fleet vehicles to the occupancy-based totals for an overall parking space total.

01 89 00 Site Construction Performance Requirements

01 89 13 Site Preparation Performance Requirements

1) The purpose of this item is to prevent damage to branches, stems, and root systems of existing individual trees to remain and to ensure the trees' survival. Provisions under this item include steps to minimize soil and root disturbance and to construct protection measures for trees close to construction areas. The contractor shall install barrier fence to the drip line of existing trees or shrubs marked either 'Save' or 'Protect'. The Tree Protection Zone (TPZ) shall be visible on drawings prior to any earth disturbance; barrier fence shall not be removed until the final project inspection. There will be no activity within the TPZ or the drip line of the tree except watering or installation of erosion prevention or sediment control measures where required. The BGS Project Manager or the contracted engineer shall approve tree protection methods and schedule of work.
2) Care shall be taken to avoid breaking tree limbs and branches with construction equipment. Prior to construction, tree limbs of trees identified for protection and any other trees identified by the engineer shall be pruned by a qualified tree service.
3) Roots encountered during excavation work near a TPZ area, shall be cleanly cut with no tearing of roots. Exposed tree roots shall be protected by a double layer of dampened burlap at all times until the roots can be covered with soil, at which time the dampened burlap shall be removed. Following excavation and during construction season, water shall be provided to impacted trees at a minimum of 2.5 gallons per week, per one (1) inch caliper or as directed by the engineer.
4) The contractor shall provide a log to document watering and natural rainfall to the engineer. If a tree is damaged due to the contractor's negligence and determined to be non-repairable by the engineer, the contractor shall replace the tree at no additional cost to the agency. The replacement tree will be of equal value or two (2) or more trees with a total value equal to that of the damaged tree, using the trunk formula method of appraisal established by the International Society of Arboriculture.
5) The TPZ is defined as a circular area surrounding a tree, of which the center is the center of the tree trunk and which has a radius of at least one (1) foot for every inch of trunk diameter or diameter breast height (dbh) taken at 4.5 feet above grade.
   TPZ radius - dbh in inches X 1 foot or the drip line of the tree (whichever is greater)



Courtesy of: Colorado State University

01 89 16 Site Improvements Performance Requirements

1) Landscape planting selection shall include only native or adapted plants to reduce site maintenance needs. Use the Water Sense Water-Efficient Landscape Design Tips from the United States EPA at: http://www.epa.gov/watersense/outdoor/landscaping_tips.html
2) Locate plantings to aid in passive solar design by shading south facing windows and providing a windbreak from prevailing winds.
3) Improve tenant comfort by adding plantings that create pleasant views and muffle off-site noise.
4) Consider the use of edible plantings along walkways and in areas away from public parking areas to support the *Community Garden* portion of the *Let's Move* Initiative.[5]
5) Consider the use of gray water and rainwater capture systems for use as landscape irrigation.
6) Consider the use of vegetated roofs in new construction designs using native or adapted plants only.

[5] Community Garden, February 2010, Let's Move, First Lady Michelle Obama, http://www.letsmove.gov/community-garden-checklist

7) Locate walkways and parking areas at least three (3) feet away from the drip line beneath the roof eaves to reduce the risk of icy spots that will require treatment in the winter season. Design entryways to buildings so that the roofs provide protection from roof rainwater and snow runoff.

01 91 00 Commissioning

01 91 13 General Commissioning Requirements

Rigorous building commissioning is also required with an exception being when the Request for Proposal states otherwise. At this time, BGS does not require contracting with a third party commissioning agent. Early in the design process, the BGS Project Manager and the contracted architect shall determine the source of the commissioning:

1) Third party under contract to the architect or engineer, or
2) Qualified, contracted mechanical engineer and architect as determined by BGS Project Manager.

Refer to the BGS Commissioning Guidelines for further guidance, see website for latest accepted version, http://bgs.vermont.gov/facilities/forms.

Total Building Commissioning, as it has emerged in the public and private sectors, is a cradle-to-grave systematic process of ensuring that facility systems are planned, designed, installed, tested, and capable of being operated and maintained to perform according to the design intent and the owner's needs. The application of the total commissioning process involves all phases of a construction project:

1) Program planning,
2) Design,
3) Construction and installation,
4) Acceptance, and
5) Post-acceptance and occupancy.

The design team provides the Basis of Design or a Statement of Design Intent for the commissioning team to understand the owner's expectations. The commissioning team involvement includes:

1) Involvement in the earliest stages of project planning, where its expertise is applied by defining performance expectations in such areas as sustainability, workplace productivity, security, safety, maintainability, user friendliness, product quality and reliability, ergonomics and projected life cycle costs.
2) Monitor the design and construction decisions to ensure goal attainment for the quality of workmanship, specification adherence, and code compliance.
3) Conduct commissioning tests and inspection procedures for quality assurance and system acceptance.
4) Plan, monitor, and validate the training of the maintenance, operations, and contractor staff for proper operation of the new building systems.
5) Review of the maintenance plan for all items covered under warranty.
6) Development of the process to handle hazardous waste generated on-site.
7) Following acceptance, monitor the installed system to ensure that there are no latent installation defects or degradation of system performance and operational quality.

Exterior Facility and Site Commissioning should occur by inspecting for proper installation and operation as applicable.

1) Air handlers - central station, exhaust fans, and fan coils,
2) Control Systems - lighting,
3) Distribution - ground source heat pumps and domestic water,
4) Flagpoles,
5) Generators and Switchgears,
6) Heat Pump Systems - ground source,

7) Stormwater - culverts and swales,
8) Transformers, and
9) Water Collection Systems.

01 91 19 Facility Shell Commissioning
Inspect for proper installation, air sealing, and operation as applicable.

1) Doors,
2) Insulation Installation,
3) Penetrations in the Envelope, and
4) Windows.

01 91 23 Interiors Commissioning
Inspect for proper installation, air sealing, and operation as applicable.

1) Bathroom and Restroom - accessories, plumbing, and fixtures,
2) Card Readers,
3) Control Systems - HVAC, fire, and lighting,
4) Domestic Hot Water Systems,
5) Doors and Hardware,
6) Drives - variable frequency,
7) Electrical Systems - switchboards, transformers, distribution, power and lighting panel boards, and grounding,
8) Emergency Egress Systems - lighting,
9) Hardware - life safety ancillary
10) Heat Exchangers,
11) Heating Systems - boilers and furnaces,
12) Laboratory-Specific Services,
13) Life Safety Systems - fire alarm, standpipe, and sprinkler,
14) Lighting Fixtures,
15) Motors,
16) Piping - life safety,
17) Plumbing Systems,
18) Pumps - domestic water, HVAC, fire, and sewer,
19) Refrigeration - chillers, heat pumps, and walk-in coolers, and
20) Security System.

01 93 00 Facility Maintenance

01 93 16 Recycling Programs
1) Use designated recycling areas in the main hallways and by the kitchenette area. To do so, specify that the hallway and/or kitchenette have a recessed area within the wall or under an open counter area to house the recycling center with enough height to place the recycling items in the top of the removable recycling center and remove containers for maintenance. Clearly label each bin for recycling and trash.

Montpelier Capitol Complex at State House Cafeteria Area

2) The State encourages the use of recycled building products, and building products that contain recycled content.
3) In new buildings and major renovations, space shall be set aside for recycling and janitorial storage that is separate from the mechanical room.

02 00 00 – EXISTING CONDITIONS

02 24 00 Environmental Assessment

Complete a site survey/assessment to be provided to the BGS Project Manager prior to building design to include[6]:

1) Topography - Contour mapping, unique topographic features, and slope stability risks,
2) Hydrology - Delineated wetlands, 500-year floodways, 100-year floodplains, lakes, streams, shorelines, and watershed modeling,
3) Green Stormwater Infrastructure - For projects with greater than 1,000 SF of new impervious area, site planning, design, construction, and maintenance strategies to maintain or restore predevelopment hydrology of the site with regard to the temperature, rate, volume, and duration of the flow and identify rain and stormwater collection/reuse opportunities,
4) Climate - Solar exposure/potential array locations, heat island effect potential, seasonal sun angles, prevailing winds, monthly precipitation, and temperature ranges,
5) Vegetation - Primary vegetation types, green/brown field areas, significant tree mapping, threatened/endangered species, unique habitats, and invasive plants,
6) Soils - Delineated soils, prime farmland, healthy soils, and previous development disturbed soils,
7) Human Use - views, adjacent transportation infrastructure, adjacent properties, and existing, recycle/reuse of potential construction materials, and
8) Human Health Impacts - proximity of vulnerable populations, adjacent physical activity opportunities, and proximity to large sources of air pollution.

03 00 00 – CONCRETE

03 30 00 Cast-in-Place Concrete

03 30 53 Miscellaneous Cast-in-Place Concrete

Utilize wet cure for slabs.

03 31 00 Structural Concrete

1) Underground Footings - 3000 pounds per square inch (psi) or greater concrete
2) Interior Work

    a. Housekeeping pads - 3000 psi or greater concrete
    b. Slabs - 3000 to 4000 psi concrete
    c. Walls - 3000 to 4000 psi concrete

3) Exterior Work
    a. Housekeeping pads - 4000 psi or greater concrete with four (4) to six (6) % air entrainment
    b. Slabs - 4000 psi with four (4) to six (6) % air entrainment
    c. Walls - 3000 to 4000 psi with four (4) to six (6) % air entrainment

[6] LEED Pilot Credit Library, USGBC, SS Pilot Credit 45: Site Assessment, http://www.usgbc.org/pilotcredits

04 00 00 – MASONRY

04 05 00 Common Work Results for Masonry

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.

05 00 00 – METALS

05 12 00 Structural Metal Framing

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.

There shall be a minimum of three (3) feet of space between the bottom of the structural steel and the finished ceiling. With grouped air handlers, such as in a mechanical room or on the roof, the floor closest to the air handlers shall have four (4) feet of space to accommodate main trunk lines.

07 00 00 – THERMAL AND MOISTURE PROTECTION

07 12 00 Cast-in-Place Concrete

07 12 13 Built-up Asphalt Waterproofing

When applying sealant to a hardened surface, refrain from the use of coal tar-based sealants. Use asphalt-based sealants or a pre-approved equivalent. Consult with the BGS Project Manager or contracted engineer on the appropriate equivalent.

08 00 00 – OPENINGS

08 01 00 Operation and Maintenance of Openings

08 01 71 Operation and Maintenance of Door Hardware

Locks shall be interchangeable core, compatible with the seven pin Falcon cores with a slide pin cover as approved by the BGS Project Manager.

08 41 00 Entrances and Storefronts

Information and Welcome Centers have high volume of traffic and extended hours to serve the visitors. For this reason, special consideration needs to be made for the flow of traffic entering and exiting as well as the circulation within the buildings.

1) All exterior doors will be located away from the prevailing winds and shall be automatic, sensor-controlled, sliding access doors for a touchless entry.
2) All designs will incorporate designs for high volumes of traffic with touchless entrances and maintenance corridors to ensure efficient use of space and proper maintenance.
3) All design will consider the latest accepted version of the ADA Standards and Accessibility Guidelines as a minimum standard due to the high volume of visitors at this building.
4) All public restroom entrances within the building shall be designed for touchless entry through an approved corridor design such that no physical doors will be required for the necessary privacy.

Careful design of wall locations will allow restroom entrances without physical doors
Courtesy of: The Full Wiki

09 00 00 – FINISHES

09 60 00 Flooring

High traffic areas should have easy to clean hard surface floors, i.e., vinyl composition tile (VCT), ceramic tile, quarry tile, linoleum, or wood. Typical high traffic areas include: Main lobbies, corridors, rest rooms, elevators, etc.

09 53 00 Acoustical Ceiling Suspension Assemblies

09 53 23 Metal Acoustical Ceiling Suspension Assemblies
Ceiling grids for dropped ceilings shall not be installed until all above ceiling utilities are substantially complete and above ceiling final inspection is complete. Ceiling utilities include, but are not limited to plumbing, fire sprinkler, HVAC, controls, electrical, fire alarm, data, and communications. Exceptions will be made when the installation of a ceiling tile is necessary for the installation of devices such as occupancy sensors or smoke detectors.

11 00 00 – EQUIPMENT

11 05 00 Common Work Results for Equipment

11 05 13 Common Motor Requirements for Equipment
Electric motors in mechanical equipment shall be the highest efficiency motors practical.

11 11 00 Vehicle Service Equipment

When designing the parking area, locate at least one designated parking space as close as feasible to the electrical room for convenience.

Site preparation should be designed and constructed to support future installation of transportation infrastructure such as conduit and a designated area in the electrical room and near the parking space to accommodate any and all support equipment for electric plug-in vehicles. Each building will be designed with:

1) Conduit properly sized and buried empty for dedicated use with all foundation penetrations completed
2) Conduit sealed from water penetration, locating tape, and surface identification inside and outside, such as signage, for future use.

3) An electrical room designated area on the closest feasible wall to the parking area with signage indicating the designated area for future transportation infrastructure to include all panels, transmitters, and other necessary equipment.
4) Prepare a flat area at the edge of the parking area with properly sloped edges to accommodate a concrete slab and any other support infrastructure for a charging station with signage indicating the space as a future location for a charging station.

Montpelier, corner of State Street and Governor Aiken Avenue:
Example of designated area after installation is complete

11 26 00 Unit Kitchens

At least one (1) kitchenette will be provided for a building. Consider additional kitchenettes when the project has multiple floors, multiple tenants and/or is a large facility. Because kitchenettes are available, these buildings will not accommodate individual appliances within the office spaces. The intent of kitchenettes is to ensure high quality comfort for the tenants of the building by improving air quality, pest control and fire safety while reducing energy use.

22 00 00 – PLUMBING

22 01 00 Operation and Maintenance of Plumbing

1) Valves shall be easily accessible.
2) Balancing valves shall be Tour-Andersson STAD or Griswold automatic balancing valves with preformed rigid polyurethane insulation kits.
3) Shut off valves will be full port ball valves with stainless steel ball and stem.

22 05 00 Common Work Results for Plumbing

22 05 13 Common Motor Requirements for Plumbing Equipment
Electric motors shall be premium efficiency, inverter rated, where possible.

22 05 29 Hangers and Supports for Plumbing Piping and Equipment
Secure system and support equipment to the building structure. Do not use plastic anchors, sheetrock anchors, and toggle bolts alone in gypsum wallboard.

22 13 00 Facility Sanitary Sewerage

22 13 13 Facility Sanitary Sewers
1) All waste piping, within or passing through walls and floors, shall be cast iron, this is for noise concerns. Piping below slabs may be polyvinyl chloride (PVC).

2) Storm drains and roof leaders that come down column lines to be coordinated with footings; lower the footings to allow pipe to follow column to below slab.

22 33 00 Electric Domestic Water Heaters

Use indirect or tankless water heaters based on the most efficient choice for the building. Avoid the use of direct-fired water heaters.

22 34 00 Fuel-Fired Domestic Water Heaters

Use electric storage when possible. Avoid the use of direct-fired water heaters.

22 42 00 Commercial Plumbing Fixtures

22 42 13 Commercial Water Closets, Urinals, and Bidets

1) Tank-type toilets shall be pressure-assisted type. Gravity toilets shall have a three (3) inch flush valve and 2-5/8" trap way.
2) Avoid the use of wall-hung toilets. If it cannot be avoided, provide bariatric fixtures and appropriate hangers.

22 42 16 Commercial Lavatories and Sinks

1) ADA accessible lavatories shall be nominally 20” x 18” not the special extended type.
2) Provide adequate maintenance and custodial staging areas, preferably in a dedicated room. The larger buildings shall have separate maintenance and custodial areas. This area will include a mop sink and storage areas for cleaning supplies and preventative maintenance needs. When custodial closets have mop sinks, at least one custodial closet per building will have a minimum of three (3) feet of clearance on two (2) sides of the mop sink to allow the space to stand with cleaning equipment without standing on/in the mop sink.
3) Mop sinks will have a separate cold-water hose connection with independent valves for custodial chemical mixing stations. All connections for hot water, cold-water, and chemical will have faucet valves to control the use of each. Install backflow prevention to isolate the chemical mixing stations from the water supply per the latest accepted version of the International Plumbing Code and American Society of Sanitary Engineering 1055.

22 42 23 Commercial Showers

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

Showerheads should be listed as 1.5 gallons per minute flow rate or less.

22 42 39 Commercial Faucets, Supplies, and Trim

Faucets shall be single lever style or automatic; gooseneck faucets are discouraged.

23 00 00 – HEATING, VENTILATING, AND AIR CONDITIONING

23 01 00 Operation and Maintenance of HVAC Systems

24) Re-testing of water by qualified agents, and adjusting of proper chemical levels shall take place within one (1) month, and at one (1) year, after completion of a project.
25) No automatic fill from domestic water on any system treated with glycol. System shall require either a pressure sensor, storage tank and pump, or use of manual filling.
26) Steam and condensate valves, fittings, and pipe products will be manufactured in the United States or Canada.
27) Maintenance-friendly designs are required: all designs will carefully consider the ease of regular and special maintenance tasks.

28) Provide a convenience outlet within 25 feet of each piece of roof-mounted equipment, unless one already exists. Verify distance in the latest accepted version of National Electrical Code 210.63.
29) Provide a hose bib within 50 feet of each piece of roof-mounted equipment, unless one already exists.
30) Provide an ample number of access doors in ductwork for damper maintenance and cleaning.
31) Do not design systems with air handling units or AHU above finished ceilings. Make them accessible and easy to maintain.
32) Self-contained radiator valves shall be Macon N107X7 with B26000 heads.

23 05 00 Common Work Results for HVAC

1) Unless otherwise directed, design space temperatures to 70 degrees Fahrenheit (°F) heated and 76°F cooled with a summer temperature difference (ΔT) of 15°F and a winter ΔT of 90°F.
2) There shall be a minimum of three (3) feet of space between the bottom of the structural steel and the finished ceiling. With grouped air handlers, such as in a mechanical room or on the roof, the floor closest to the air handlers shall have four (4) feet of space to accommodate main trunk lines.
3) There should be mechanical office and work areas separate from the boiler room with a slop sink available.
4) Size the door to the mechanical room to allow for the replacement of the largest piece of equipment with an accessible removal route from the outside to the equipment.
5) There should be a restroom close to the mechanical office.
6) Whenever possible, specify ENERGY STAR qualified boilers.
7) Label all pieces of equipment, 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. Mechanically fasten all labels.
8) All condensers will have three feet of open space around them. No planting allowed within the three (3) foot space.
9) Use separate systems for HVAC. Where space or costs require it, two of the systems may be combined, but not all three.
10) Facilities with large heating needs (for example, greater than 500,000 British Thermal Units or BTU should consider using staged boiler systems utilizing either two boilers at 67%, or three boilers at 33% capacity, each.
11) Natural gas- and propane-fired water systems should be sized to allow the return water temperature to drop below 140°F. This will allow the use of condensing low mass boilers.
12) Design HVAC Systems such that heat shall not be required during the summer. Do not use constant volume re-heat.
13) Design buildings for passive cooling unless otherwise specified by the BGS Project Manager.
14) The preference is for a thermostat in every room, if budget allows.
15) 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.
16) Exterior office space with either open office or individual offices: maximum of 600 SF per zone or a maximum of three rooms per thermostat
17) Interior office space with either open office or individual offices: maximum of 1,400 SF per zone or a maximum of three rooms per thermostat.
18) Rooms that should be on an individual zone shall include:

    a. Classrooms,
    b. Conference rooms,
    c. Lobbies,
    d. Telecommunications rooms, these require 24-hour per day conditioning,
    e. Equipment rooms,
    f. Computer rooms,
    g. Waiting rooms, and
    h. Break rooms.

19) In addition, zones shall not cross-functional boundaries between different departments/tenants.

20) Heat recovery and energy recovery ventilation should be considered for high occupancy areas. Demand controlled ventilation should be considered for areas with varied occupancies.
21) When glycol is required, use propylene glycol. Do not install an automatic fill from domestic water on any system with glycol. The system shall require one of the following:

    a. Pressure sensor,
    b. Storage tank and pump, or
    c. Manual filling.

23 05 13 Common Motor Requirements for HVAC Equipment

Electric motors shall be premium efficiency, inverter rated, where possible.

23 09 00 Instrumentation and Control for HVAC

23 09 13 Instrumentation and Control Devices for HVAC

1) DDC required in new construction that contains large multi-zone systems, heating and cooling systems, and complex HVAC systems as determined by the BGS Project Manager.
2) Consider DDC on all new construction and major renovation projects. Factors to be considered and communicated to the BGS Project Manager are:

    a. Size - SF of building
    b. Type of mechanical systems - HVAC
    c. Use of the building - office, technical, storage, and security spaces
    d. Costs - complete a cost benefit analysis

3) DDC will not be required on a single-zone, heat-only system unless otherwise directed by the BGS Project Manager based on a cost benefit analysis.
4) Location of local control modules to be preferably in closets or the like and always made to be completely accessible.
5) Department of Information & Innovation (DII) shall provide a PC for use by the maintenance personnel. The PC shall be provided with internet access and shall have a web browser that will be utilized to access the DDC system.
6) Keep linkages on actuators as simple as possible. Damper actuators shall be direct-coupled type similar to Belimo.
7) To the greatest degree possible, utilize industry standard control sequences, then modify as necessary. For example, the controls for the AHU-2 shall be ASHRAE Cycle III with mixed air controlled at 65ºF. The exception is when the outside air is below 32 ºF,

23 09 23 Direct-Digital Control System for HVAC

The control system shall consist of a high-speed, peer-to-peer network of DDC controllers and a web-based operator interface. Depict each mechanical system and building floor plan by a point-and-click graphic. A web server with a network interface card shall gather data from this system and generate web pages accessible through a conventional web browser. Operators shall be able to perform all normal operator functions through the web browser interface. The server shall be one of the virtual DDC servers the State of Vermont maintains at the National Life location in Montpelier.

New stand-alone servers may be entertained for control systems not currently supported. The DII will create and manage the server to the vendor's specifications, but the vendor bears the cost to create the server, load the controls software and any licensing fees. Connectivity to the server may require publicly accessible interest protocol (IP) for the device.

Remember, these web based tools need access to GOVnet to communicate. Be sure to plan on the required network connectivity and Virtual Private Network or VPN permissions to be in place before expecting the control vendor to configure their devices. When in doubt, submit a DII Footprint support ticket.

Virtual servers' base software are maintained, backed up, and patched regularly by DII. The vendor applications on this server are maintained by:

1) Automated Logic
   Current VPN vendor with access: Temperature Controls of Vermont
   4 Andrew Avenue
   Suite 1
   Essex, VT 05453-5536
   Contact: Matt Williams, (802) 872-8000

2) Barber-Colman/Siebe/Invensys/Schneider
   Current VPN vendor with access: Control Technologies, Inc.
   121 Park Avenue
   Suite 10
   Williston, VT 05495
   Contact: Mike Bessette, (802) 764-2200 extension 1014

3) Johnson Controls
   Current VPN vendor with access: Johnson Controls, Inc.
   116 Railroad Avenue
   Albany, NY 12205
   Contact: Robert Gatchell, (518) 451-2700

23 21 00 Hydronic Piping and Pumps

1) Install wye strainers vertically in wet hydronic systems.
2) Design hydronic systems with side arm combination chemical pot feeder and bag filter.
3) Install fin tube with bottom at six (6) inches above finished floor.

23 22 00 Steam and Condensate Piping and Pumps

Install wye strainers vertically in condensate systems and horizontally for steam.

23 31 00 HVAC Ducts and Casings

1) The ductwork will meet the following criterion unless :

   a. Minimum radius on ductwork elbows shall be one and a half times the width,
   b. Maximum width of ductwork shall be 48 inches,
   c. Duct should be as close to square in profile as possible with the ductwork profile not exceeding a ratio of two to one (2:1) unless approved by the BGS Project Manager.

2) Volume dampers shall be standoff, quadrant lock. Tag the volume dampers with brightly colored surveyors tape so the balancers may locate them with ease.
3) Access doors shall be double-walled and piano hinged, with a minimum of two cam locks and rubberized seal.
4) NO FIBERGLASS IN THE AIRSTREAM! No interior fiberglass duct lining, sound attenuators, variable air volume (VAV) box lining, or air handler lining containing fiberglass. AHUs are to be double walled. If 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.

23 33 00 Air Duct Accessories

23 33 19 Duct Silencers

1) Minimize air velocities to minimize air noise. Design air handlers, fans, and pumps to operate at the lowest possible design pressure, airflow, and speed. Configure ductwork to avoid high pressures arriving at dampers by using longer runs.
2) Locate equipment where mechanical 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. Do not locate rooftop units near building walls. Utilize isolation curbs and hangers where appropriate.
3) Utilize duct silencers with Mylar or foil scrim-faced insulation where necessary. Use sound attenuation devices, Armaflex duct lining, Vibro-Acoustics silencers where appropriate.
4) For all diffusers and return grills, specify curved, insulated flex duct with extra slack so there is not a straight run between metal duct and diffuser or grill. Maximum six (6) feet in length.
5) Keep hydronic velocity under five feet per minute in run out piping.
6) Take extraordinary measures to eliminate noise in courtrooms, or rooms where audio recording activities take place.
7) After installation, verify the proper balancing and commissioning of the system with the completion of any final tuning and adjustments. Provide documented verification to the BGS Project Manager.

23 41 00 Particulate Air Filtration

1) Air handlers shall have a minimum of two (2) inch final filter section; combination two (2) /four (4) inch is preferred. Consider pre-filters on a case-by-case basis. Minimum filter shall be pleated 40% efficient.
2) Air and water filters shall be easily accessible.

23 57 00 Heat Exchangers for HVAC

1) Provide heat recovery on all systems of 500 cfm or greater, of outside air.
2) Use of total heat recovery systems such as enthalpy energy recovery is strongly encouraged. That is, where appropriate, use enthalpy cores for latent heat exchange, (wintertime humidity retention and summer time humidity rejection). Provide minimum of two (2) inch pleated filters on both airstreams before entering the heat exchanger.
3) Mechanical designs shall consider either airside economizers or waterside economizers as a free cooling technology.
4) Places that require cooling in the winter shall utilize free cooling whenever possible. Consider hydronic-based designs with dry-coolers, over direct exchanger (DX).
5) Cooling systems, which operate into the winter, shall incorporate measures to reduce the 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.

23 60 00 Central Cooling Equipment

1) Air conditioning units must meet the requirements set by the latest accepted version of the Consortium for Energy Efficiency website: http://www.cee1.org. Select units based on the higher Tier listed. If the unit is listed with the option of Tier 1 and Tier 2, use Tier 2. If only Tier 1 is listed, than select the unit to meet the Tier 1 requirement.
2) Specify the AHU with hinged and latched access doors, and not with screwed on access panels.
3) Specify all AHU with cooling coils upstream of heating coils wherever possible. Design cooling cycles so that the air does not 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.

23 81 00 Decentralized Unitary HVAC Equipment

23 81 46 Water-Source Unitary Heat Pumps

Do not bury the heat pumps and fan coil units within ducting and piping. Where crowding cannot be avoided, provide coordination drawings, including sections showing all mechanical and electrical items. Ensure that filters, compressors, and motors are accessible for maintenance to include service work and replacement.

When specifying mechanical items in building additions or renovations, match manufacturer and model numbers with existing equipment. For example, if Taco 1600 series pumps exist, then the new pumps shall be Taco 1600 series.

26 00 00 – ELECTRICAL

26 05 00 Common Work Results for Electrical

1) Panels shall have door-in door access, such that breakers are accessible without needing to unscrew a panel face.
2) Maintenance-friendly designs are required: all designs will carefully consider the ease regular and special maintenance tasks.
3) Panels shall be the breaker bolt-in type, not plug in.
4) Spaces that house building systems will be required to have at least six (6) feet high with at least three (3) feet of open travel way around and in front of all systems. No crawl spaces or hand holes for major system maintenance. Ensure that preventative maintenance areas are accessible without climbing on ductwork or piping. Filters, valves, meters, and other items that require regular maintenance should be easy to access from the clear travel ways.

26 05 29 Hangers and Supports for Electrical Systems

Do not use plastic anchors, sheetrock anchors, and toggle bolts alone in gypsum wallboard.

26 05 33 Raceway and Boxes for Electrical Systems

1) Identify circuits contained in: pull-boxes, junction and connection boxes, by labeling outside of cover with a phenolic tag or neatly handwritten with indelible marker.
2) Secure conduits, raceways, boxes, etc., to the building structure.
3) Where possible, no outlets on exterior walls.

26 05 53 Identification for Electrical Systems

Electrical equipment includes switchboards, panelboards, industrial control panels, and motor control centers. Descriptive markings will be located clearly visible to qualified persons before examination, adjustment, servicing, or maintenance. Electrical equipment hazards will be identified with the following descriptive markings and techniques described in the latest accepted version of NFPA 70E as necessary:

1) Electrical current
2) Safety signs, symbols, and tags
3) Safety barricades
4) Use of safety attendants
5) Voltage
6) Wattage
7) Other equipment ratings as necessary

26 05 83 Wiring Connections

1) No shared neutrals on receptacle or florescent lighting circuits.
2) Full-sized neutrals.
3) Color code wires Black/Red/Blue for 120/208V circuits and Brown/Orange/Yellow for 277/480V circuits.

26 55 00 Special Purpose Lighting

26 55 63 Detention Lighting

When specifying fixtures for above ceiling maintenance, design correctional facilities will have access to all light fixtures from a penthouse above the population area ceiling at least six (6) feet high. No crawl spaces or hand holes for major electrical system maintenance. Ensure that preventative maintenance areas are accessible without climbing or crawling on conduit or other mechanical components. Electrical components that require regular maintenance should be easy to access from outside the population area.

26 09 00 Instrumentation and Control for Electrical Systems

26 09 23 Lighting Control Devices

Adjust the time delay on all occupancy sensors prior to occupancy with minor adjustments as necessary after occupancy. Complete the education on the operation of the controls prior to occupancy with key staff.

Use occupancy Sensors in all intermittently used areas. Recommended areas for the installation of occupancy sensors include conference rooms over 150 SF in size, restrooms, storage areas, less active hallways and break areas. Review all new technology with the BGS Project Manager to include:

1) Technologies of sensors include passive infrared, ultrasonic and multi-sensing. Evaluate the space conditions to ensure that the applicable technology is used for the space.
2) Locations of sensors include wall, ceiling, fixture and switch mounted sensors. Evaluate the use of the space to include the items being moved in for occupancy such as furniture, shelving and equipment to ensure proper selection (sensors will not be blocked). In a retrofit application, consider the use of a wireless sensor system with review of the anticipated radio frequency equipment in the space. Consider reflective surfaces when locating the sensor to prevent reflected images from an adjacent space triggering the occupancy sensor.
3) Styles of sensors include automatic on/off, manual on/automatic off and timers. Based on the project manager recommendation, specify the style used in each space with public areas such as hallways using automatic on/off style.

Consider daylight controls in spaces on the south, west, and southwest faces of the building. Evaluate the use of the space when considering the style of dimming or on/off controls. The location of the photocell should be unobstructed by fixtures, ductwork or any other structural features that will impair the line of sight to the outside.

26 51 00 Interior Lighting

26 51 13 Interior Lighting Fixtures, Lamps, and Ballasts

Multiple lamp fixtures shall be dual switched, i.e., three (3) lamp fixtures shall be switched to allow one (1), two (2), or all three (3) lamps to be lit.

Lighting levels should comply with foot-candle levels provided by the IES of North America. Achieve light levels with lighting power densities specified in the latest accepted version of ASHRAE 90.1.

Use highest efficiency products where possible.

1) For interior lighting, do not use T12 linear fluorescent lamps and consider other options in place of incandescent whenever feasible.
2) For exit signs, use white colored light emitting diodes (LED) technology that is one watt or less. Consider self-luminous or electroluminescent exit signs when the exit signs meet the specifications outlined by the latest accepted version of the Vermont accepted OSHA Standards 29 Code of Federal Regulations (CFR) 1910.37(b)(6),

https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9725, and the Vermont Fire and Building Safety Code, http://firesafety.vermont.gov/Standards.

3) Careful consideration should be taken when selecting the manufacturer of new LED fixtures for parking lot and garage applications.
4) Consider use of space when selecting lamp type including the need for instant full light instead of having a warm up period, indirect lighting for high computer use areas, typical temperature of the space, and frequency of use of the space.

For high use areas and detail oriented work areas such as offices, classrooms and public spaces, lighting should specify color-rendering indices (CRIs) of 80 or higher. Attention should also be paid to selecting lamps with consistent color temperature in one space such as 4000 degrees Kelvin (°K), so that there is not a mixture of "pink" and "blue" lamps in a space. Use of color temperatures 4000°K or higher is encouraged.

27 00 00 – COMMUNICATIONS

27 05 00 Common Work Results for Communications

27 05 13 Communications Services

Provide quad outlets at phone jack locations with data connections.

Contact DII to coordinate the voice and network connectivity and pathway requirements for the agency/departments utilizing the space with the design consultant to incorporate the latest accepted version of the Information Transport System Infrastructure Standard issued by the State DII: http://dii.vermont.gov/service-catalog/telecommunications/voice-data, with the following edits into the bid package:

1) The use of this standard requires strict adherence to the coordination requirements with DII.
2) In all places where communication/coordination is to take place with DII, it shall be the BGS Project Manager's responsibility.
3) In all places where the contractor is required to deliver something such as test results, as-built drawings, etc., these items shall be delivered to the BGS Project Manager, who will forward them to DII.

Responsibilities of the project manager are to:

1) Contact the local phone company and schedule telephone cable entrance and termination, as well as Internet cable/GovNet entrance and termination.
2) Schedule a meeting between the architect, and appropriate sub-consultants, and DII.
3) Keep DII apprised of construction progress at regular intervals.

Designers, preferably RCDD (Registered Communications Distribution Designers), shall design for installation under the construction contract, the communication closets, raceways, cables, cable management and termination drops based on BICSI standards. Standard termination drops shall consist of one (1) inch conduit, a four square box, and a single gang mud ring, unless modular furniture is being utilized. Conduit requirements will be dependent on the number of cubicles requested/designed for modular configurations.

DII shall be responsible for coordinating with the Information Technology or IT representatives from the agency/department occupying the space for the final connections of network cables and business representative for the telephone connections in the communication closets.

28 00 00 – ELECTRONIC SAFETY AND SECURITY

28 01 00 Operation and Maintenance of Electronic Safety and Security

28 01 10 Operation and Maintenance of Electronic Access Control and Intrusion Detection

1) Use Card Access Systems whenever possible. The Card Access System shall be the Westinghouse NexWatch System and shall be fully incorporated into the existing State System.
2) All exterior doors used by the public shall be on the NexWatch System. Exterior doors used exclusively by employees should also be considered for card access.
3) All doors that enter departments should also be on the NexWatch System.
4) The use of push button locks should be discouraged. If door requires a push button lock, then the door and lock will be part of the NexWatch System.

28 01 30 Operation and Maintenance of Electronic Detection and Alarm

1) Specify Fire Alarm Systems around Fire Control Instruments (FCI) and Notifier systems.
2) Fire alarms shall be addressable.
3) Devices shall be self-addressable, such as with rotary switches, and shall not require a special device to program them.
4) Submit reproducible or electronic as-built drawings showing each device, with its unique identifier prior to project completion.
5) BGS Maintenance Technicians will be able to:

    a. Re-program them when adding or deleting a small number of devices.
    b. Perform in-house inspection and testing of the systems.
    c. Disable them during renovations, such as soldering, to prevent nuisance tripping.

28 13 19 Access Control Systems Infrastructure

1) Use Card Access Systems whenever possible. The system of choice is the Honeywell Integrated Security ProWatch system. Integrate all buildings equipped with ProWatch controllers and modules with the State's ProWatch server located in Montpelier.
2) Card access system designs are handled through the Office of State Security Programs. Some basic guidelines:

    a. Exterior doors: Exterior doors that will assume moderate to heavy traffic shall be equipped with a card reader. BGS is responsible for the cost of card readers on exterior and/or common space doors (with proper justification). Those that cannot justify a card reader should be equipped with a door position switch so the door's status can be recorded.
    b. Interior doors: Interior doors that will enhance agency/department/division safety and security should be equipped with a card reader. It is the requesting department's responsibility to pay for the card reader if it is located within their space.

3) All card access doors shall be equipped with the following door hardware:

    a. HES electric strike, 24VDC Fail Secure, LBM option (or other where the door hardware will not allow a strike). Magnetic locks are not preferred. Use Fail Safe locks on fire-rated, emergency egress doors.
    b. Storeroom function door hardware (or similar where the door requires something other than a lever-type model)
    c. Door closer
    d. Request to exit device (Kantech #T.Rex-XL)
    e. Door position switch (only if the LBM option is not available)

4) Push Buttons, where used, should be hardwired and not wireless.

    a. Install pushbuttons (momentary, preferred brand is Alarm Controls Corp #RP-26) at the request of the department/division. They will only be installed if the person using the button has BOTH a visual and method to communicate with the person requesting access.
    b. Maintain push buttons are not recommended and therefore should not be installed unless otherwise authorized by the Director of Security or his/her designee.

28 16 00 Intrusion Detection

28 16 16 Intrusion Detection Systems Infrastructure

Use Intrusion alarm systems if requested by the residing agency, department, or division. It is the requesting agencies obligation to pay for the systems required. Intrusion systems shall consist of an alarm controller (preferred DMP #XR100N), motion detectors, door position switches, horns, panic buttons (hard wire or wireless), and/or zone expansions modules.

28 23 00 Video Surveillance

28 23 13 Video Surveillance Control and Management Systems

1) Consider video cameras to monitor parking areas and main entry points.
2) Use video surveillance systems only if approved by the Commissioner of BGS and/or his/her designee.
3) Video surveillance systems are designed by the Office of State Security Programs. Systems that are installed would be for the protection of state assets and/or for reasons to protect state employees. Cameras, when installed, would cover common areas (exterior and interior). Exemptions include Department of Corrections and Department of Public Safety.

    a. Typical cameras are fixed, color, network cameras capable of a minimum 720p High-definition or HD resolution, 30 frames per second or fps, day/night capabilities, heaters and blowers (if necessary). Pan-Tilt-Zoom or PTZ style cameras are used only if the application can justify the cost.
    b. Wire typical cameras using Berk-Tek #10033815 (black riser-rated CAT6). Where plenum is required use Berk-Tek #10035304.
    c. Recommended recording systems are network video recorders or NVR. Brand and model are determined by the Office of State Security Programs and are based on department use and requirements.

28 26 00 Electronic Personal Protection Systems

28 26 16 Electronic Personal Safety Alarm Annunciation and Control Systems

1) Emergency notification systems shall consist of speakers, multi-zone page controllers, page adapters, and/or strobe lights. Emergency notification systems are to be approved by the Director of Security and/or his/her designee. Justification must be determined if a system is being requested.
2) The cost of an emergency notification system shall be assumed equally amongst all tenants in that specific building.
3) The system shall be a Valcom (#V-9940, #V-2003A, and VP-6124) unless otherwise designed and specified by the Office of State Security Programs. Speakers shall be a Valcom #V-1016-W or #V-9022A-2.
4) Emergency notification systems shall have a dedicated phone line.

33 00 00 – UTILITIES

33 01 00 Operation and Maintenance of Utilities

33 01 70 Operation and Maintenance of Electrical Utilities

1) Review of the electric bill could find a demand charge or a power factor penalty that could represent a savings opportunity.
2) The demand charge is the peak hourly use of electricity during the billing period. Use this peak use to set the costs of the electric bill for the next 11 months (in most cases).
3) The utility account includes the power factor penalty when there is equipment in operation that causes a disturbance in the electric distribution. Each utility company allows for some disturbance but if the building it serves exceeds the allowable disturbance, the addition of a power factor penalty. A BGS Mechanical Engineer, BGS Licensed Master Electrician, or hired contractor can review the equipment and adjust the way it operates to correct the power factor. Also, review adding a device in-line that will correct the disturbance.

48 00 00 – ELECTRIC POWER GENERATION

48 11 00 Fossil Fuel Plant Electrical Power Generation Equipment

48 11 26 Fossil Fuel Electrical Power Plant Generators

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

After installation, the generator set shall be subjected to all tests specified below using a resistor bank. Submit certified reports for both of these tests. Notify the BGS Project Manager 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. Submit certified reports and completed tests 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 four (4) hours, and
6) Maximum Power - 110% output for 20 minutes.

48 14 00 Solar Energy Electrical Power Generation Equipment

Given that there are many ways to incorporate solar energy into a project, every project design will consider the use of solar energy in the project. The project will be evaluated and a completed evaluation, with recommendations, will be submitted to the BGS Project Manager during the beginning of the design process.

The evaluation will include:

1) Site Location and Shading - orientation of an unobstructed view of the sky, if any
2) Condition of Roofs - structural design for additional loads and area for additional equipment
3) Utility Usage - demand for electricity and hot water and the hours of operation
4) Condition of Envelope - proper air sealing and efficiency measures in place
5) Technologies - document review of at least photovoltaic, thermal, net metering, and use of generation directly on-site
6) Recommendation - selection of type of technology and justification

48 14 13 Solar Energy Collectors

Look at larger, more involved projects to not only save energy, but also increase the reliance on renewable fuels like solar systems.

Review the use of renewable energy systems for cost effectiveness with consideration for the reduction of the impact of fossil fuels and emissions on the environment. This will also increase the diversity of the state infrastructure portfolio. BGS is currently using solar thermal collectors, a photovoltaic array, and working with a vendor on net metering agreements.

The screening of the cost effectiveness will depend on:

d. Type of technology,
e. Estimated useful life of the equipment, and
f. Funding used to purchase the technology.

All renewable energy projects are required to include a method of tracking the generation and saving the data to provide a monitoring method for maintenance and a means of reporting the benefit of the equipment.

48 15 00 Wind Energy Electrical Power Generation Equipment

Every project design will consider the use of wind energy in the project. The project will be evaluated and a completed evaluation, with recommendations, will be submitted to the BGS Project Manager during the beginning of the design process.

The evaluation will include:

7) Site Location and Shading - orientation of unobstructed wind, if any
8) Utility Usage - demand for electricity and the hours of operation
9) Technologies - document review of at least 10-kilowatt generation, net metering, and use of generation directly on-site
10) Recommendation - selection of type of technology and justification

48 15 13 Wind Turbines

Look at larger, more involved projects to not only save energy, but also increase the reliance on renewable fuels like wind systems.

Review the use of renewable energy systems for cost effectiveness with consideration for the reduction of the impact of fossil fuels and emissions on the environment. This will also increase the diversity of the state infrastructure portfolio. BGS is currently generating with a wind turbine and hosting utility-owned wind turbines.

The screening of the cost effectiveness will depend on:

g. Type of technology,
h. Estimated useful life of the equipment, and
i. Funding used to purchase the technology.

All renewable energy projects are required to include a method of tracking the generation and saving the data to provide a monitoring method for maintenance and a means of reporting the benefit of the equipment.