North Carolina
Department of Public Instruction

High Performance Guidelines

For the Design and Construction of K-12 Public Schools

May 1, 2012

Public Schools of North Carolina
State Board of Education
Department of Public Instruction

Division of School Support – School Planning
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Foreword

The North Carolina Department of Public Instruction High Performance Guidelines have been developed to provide school systems and designers with useful and reliable design information to use as a basis for high performance new schools, major additions and renovations. The requirements in these guidelines will enhance the ability of local school systems to plan economical and energy-efficient facilities that maximize value to their communities and provide healthy, comfortable and inviting environments for learning. It is our intent that these guidelines provide strong direction for school design, construction and operation.

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Introduction

These high performance guidelines have been prepared to give the design team, consisting of architects, engineers and owner representatives, assistance as they make decisions relating to site selections, building materials, and energy consumption that result in construction of high performance facilities.

Good design of spaces and there relationship to other spaces enhances the ability to learn. A good design provides physical separation for acoustics and non-compatible uses, reduces travel time, increases supervision, reduces vandalism and conflicts. Adequate space for all activities as well as all heating and cooling, plumbing, electrical and technology systems while maximizing the ration of programmed to overall area is also part of a good design.

High Performance facilities are buildings that operate with less energy, and have reduced maintenance while providing healthy and comfortable interior environments. Efficient facilities may have a higher initial cost, but with high efficiency systems and proper maintenance, will experience lower operating cost throughout the life of the building. Any increase in initial cost related to energy efficiency will be more than recovered in lower operating and maintenance costs.

These guidelines are intended to be used in the design and construction of new and renovated school buildings. Building design should use an integrated approach where all building systems and components are considered from conception to completion. The goal of the design team should be to provide a healthy and functional facility meeting the requirements of the school system, while giving the best overall cost performance over the life of the facility.

The North Carolina Department of Public Instruction will offer a ***High Performance School Certificate.*** To pursue certification the designer must submit a completed checklist; provide requested documentation listed on the checklist, along with the construction drawing submittal. Projects that fully meet the applicable requirements of the checklist, as solely determined by the Department of Public Instruction, School Planning Staff, will be awarded the certificate. As a pre-requisite to the high performance certification, the project must be reviewed by representatives of the North Carolina State Board of Education and a certificate of review issued without deviation from the North Carolina Public School Facility Guidelines.

This certificate will indicate to the local boards of education and facilities departments that the facility has been designed to the high standards discussed in this guide.

A sample certificate has been included on the next page.

NC Department of Public Instruction, School Planning

Presents this Award for

High Performance Design

To

School

Project:

Applicable Board of Education
Superintendent:

Architect:
Mechanical Engineer:
Electrical Engineer:
Other Designer:

Section I High Performance - Overview

The North Carolina Department of Public Instruction
High Performance Guidelines

These guidelines have been established to provide a simple, concise format for considering aspects of high performance building design. Owners must work closely with the architects and engineers to accomplish this goal. The sum of these features yields a building that is healthy and comfortable, uses energy and materials efficiently and wisely and is easy to maintain and operate.

The checklist, included at the end of this document can be used to gauge the design toward high performance issues, along with verification requirements. All strategies shall be implemented to meet the definition of a high performance school building.

High Performance Schools

A high performance school means several things. Primarily, the building operates at optimum efficiency, saving resources and energy cost for its entire lifespan. Other factors improve user comfort and student achievement.

An "Integrative Design" process should be implemented to fully accomplish a high performance facility. This is a design process that considers the building as a whole system with its environment. Key systems and technologies are considered together, from the beginning of the design process, and optimized based on their combined impact on the performance of the facility. At the end of the process, the entire facility is optimized for long term performance.

For school building design, high performance means:

- Healthy
- Comfortable
- Energy Efficient
- Efficient use of Material
- Easy to Maintain and Operate

Integrative Design Process

The Integrative design process is a process that involves bringing the various experts that contribute to the design of the school facility together in the design process. Integrative design facilitates communication between designers, for the purpose of evaluating and optimizing the proposed solutions, rather than each specialist working in isolation.

To achieve the best results, the integrative process must begin at the programming phase. With the help of the design team, the owner should establish performance goals for the building before any discussion about what site the building will occupy, etc. By setting goals early, and making a commitment among the design team to meeting them, a process for communicating and weighing potentially conflicting goals is established. Issues of first cost, lifecycle cost, and other concerns such as selecting products and materials are considered, together, through the integrative design process.

Health and Comfort

A high performance building must provide a healthy and comfortable environment. Critical elements are:

- Indoor Air Quality
- Thermal Comfort
- Visual Comfort
- Acoustic Comfort

Indoor Air Quality

Maintaining indoor air quality is vital to creating a high performance school. Proper air quality insures the health and performance of both students and staff by eliminating and controlling air pollution (contamination). Care must be taken in preventing unwanted moisture accumulation, and operation and maintenance plans must be implemented to maintain good indoor conditions.

Unhealthy indoor air can have a negative impact on attention span, and increase absenteeism. It can contribute to building deterioration, reduce the efficiency of mechanical equipment, and create negative publicity and liability problems.

Thermal Comfort

Thermal Comfort is mostly a function of temperature and humidity levels, but moving air velocity and the temperature of surfaces nearby can have an influence. It is also a subjective matter with preference ranges that vary. Generally, indoor spaces are perceived as comfortable with temperatures around 68-76 degrees and humidity about 40-60%. Outside these ranges, the room environment can distract attention from learning tasks and inhibit productivity.

Visual Comfort

A comfortable visual environment is critical for high performance school environments. Visual comfort extends beyond simply providing a certain amount of light on a desktop. Students will typically need to absorb visual input from video or display boards across the room, from printed or graphic materials on a desk top, or from a visual screen a few inches away. Inadequate lighting or glare can add to the strain and fatigue of any of these activities and hamper the learning process.

A carefully designed lighting environment combines natural daylight and light from artificial sources. Distant views provide the opportunity to refocus student eyes and relieve the strain of close work. Glare is controlled to optimize concentration and minimize fatigue. A properly designed day lit environment brings ample, diffused daylight into a classroom, while omitting heat gain and glare from direct beam sources. Visual boards and artificial lights should be placed to minimize reflected glare and maximize contrast on the boards.

A well designed daylight response can virtually eliminate the need for artificial light during the day, and yield substantial cost savings for electricity. This reduction can yield further savings by reducing the cooling load and equipment capacity and the overall demand for building cooling by the HVAC system.

Acoustic Comfort

Room acoustics can have a profound impact on the learning environment. Distracting noise from inside or outside the classroom and reverberation (echoes, sound reflected within the classroom itself) can prevent students from understanding verbal and auditory information. Improving room acoustics is a matter of controlling four elements: source of noise, sound transmission, vibration, and reverberation.

Section II   High Performance Criteria

Implementing the following recommendations related to site selections, building materials, and energy consumption will result in construction of high performance facilities.

Site Selection

Location may be the single most important decision impacting the lifecycle cost of a building. What appears to be a “bargain site” may have costly impacts for development. These include high costs to construct infrastructure such as road widening, sewer or utility extensions, or hazardous waste mitigation. Higher costs for paving, parking, and driveway stacking due to lack of transportation alternatives, or limits to the “build able site” due to topography, building orientation, or sensitive land areas such as, wetlands or protected habitats.

S-1 Site Selection

- A Phase I environmental assessment shall be conducted in accordance with ASTM E1527-05.

- A Phase II environmental assessment, if required by the Phase I survey, shall be conducted.

- Survey within ¼ mile of the proposed site. Eliminate sites from consideration that have any of the following undesirable features: high radon potential that cannot be feasibly remediated, high voltage transmission lines near buildings, above ground pipelines for hazardous materials (not including a natural gas pipeline serving the site or neighboring areas), active rail corridors, major traffic corridors (defined as 50,000 vehicles per hour in rural areas and 100,000 vehicles per hour in urban settings), above ground storage tanks for fuel or other hazardous chemicals, and facilities that create hazardous airborne emissions.

S-2 Site Infrastructure

- The building site shall be selected in a developed area with existing roads, utility access, and located centrally to the population being served.

Building Design

B-1 Implementation

A process of Integrative Design shall be implemented. As a minimum, this process shall include the following elements:

1) Meet to set project performance goals as early as practical in the design process (before site selection, if possible).

2) Conduct a "kick-off" meeting to convey these goals to the entire team including design consultants, building operation personnel, building users, and stake holders (teacher, student groups, administrators, school board members, etc.)

3) Design using advanced energy modeling techniques. Use the model to study alternatives and optimize energy performance.

4) Commission the building to insure that all features are properly implemented.

B-2 Lifecycle Cost Analysis

- A computer model shall be prepared to analyze and compare building systems. Consider realistic alternative systems for the building envelope, domestic water heating system, lighting and electrical systems, and building HVAC systems.

- Through use of an energy model, provide the owner with a target energy budget in BTU's per SQ. FT for all energy usage. This will be used to track the operational performance of the facility.

B-3 Building Envelope Analysis

- Building orientation and shape: Careful consideration and analysis shall be given to the building's orientation and shape. These are important factors that influence the performance, size and cost of heating and cooling systems, and natural lighting systems. Site selections shall be made with these factors in mind. A building site shall not be used that will not allow the proper orientation, southern exposure (within 15 degrees) and elongated along the east west axis, of the building.

- The building envelope shall be designed through analysis of alternative systems, in concert with all other building systems, to reduce thermal and solar energy heat gain while creating beneficial features for natural lighting. The selected envelope system will be the best performing of alternatives considered, that reduces heating and cooling loads, provides for natural lighting and, overall, results in the least energy consumed by the building for lighting, heating, and cooling systems.

- Wall Construction; wall construction design shall optimize insulation types and performance comparing cost to economic impact of building operation. Consideration shall also be given to wall mass, which when properly designed, will delay impact on building cooling loads until after occupied periods.

- Roof construction; Careful consideration and analysis of the roof design shall be performed. Sloped roofs have certain advantages over low slope roofs such as service life and drainage. The roof insulation should be analyzed to determine the type and beneficial amount (total resistance value), comparing reduced heating and cooling equipment capacities and resulting energy savings with the materials cost. A minimum Solar Reflectance Index (SRI) rating of 78 for roofs of 2:12 slope or less shall be provided. A minimum SRI of 29 for roofs sloped greater than 2:12 shall be provided.

- Roofing products shall comply with EPA energy star requirements.

- Fenestration shall include area and thermal performance analysis in compliance with the 2012 NCSBC (energy).

B-4 Energy Conservation

- Reduce building energy consumption - New buildings shall be designed and constructed so that the energy consumption is at least thirty percent (30%) less than the energy consumption for the same building as calculated using the energy-efficiency standard in ASHRAE 90.1-2004.

- Renovated buildings shall be designed and constructed so that the energy consumption is at least twenty percent (20%) less than the energy consumption for the same renovated building as calculated using the energy-efficiency standard in ASHRAE 90.1-2004.

B-5 Training

- Owner training, including operation and maintenance manuals, and a preventive maintenance checklist for each high performance building system (ie. HVAC, water, energy, etc.), shall be provided.

B-6 Commissioning

The building shall be commissioned to verify that all systems, components and materials comply with and are installed per the construction documents, per owner requirements, and per manufacturer's recommendations and to confirm the proper calibrations, balance and performance of the systems. This process shall be incorporated into the pre-design, design and construction phases of the facility. It is recommended that the owner extend the commissioning process through the warranty period to confirm interactive performance of all building systems. A commissioning agent, selected by the owner, shall be a licensed professional having relevant experience in the process of commissioning and shall be responsible for developing and implementing the commissioning plan. The designer shall be responsible for coordinating with the commissioning agent to include specifications and guidelines in the construction documents indicating the responsibilities of the contractor/s during the construction phase.

- Design phase process; through coordination of commissioning agent and design team, develop basis of design to include owner requirements and goals, develop construction documents representing design requirements and establish process of coordination of efforts during construction phase.

- Construction phase process; through involvement of the commissioning agent, the design team and contractors shall review shop drawings to confirm proper interpretation of the contract documents by the contractor and manufacturers. The design team shall report to the commissioning agent on status and inspection of all construction work, site conditions relative to the contract requirements and, perform calibration, balancing, testing and measuring of all systems.

- Commissioning activities shall be performed on the following systems as a minimum; HVAC equipment and controls, water (domestic, irrigation, etc.) equipment and controls, lighting and controls, and power generating equipment (solar thermal, PV, etc.) and controls.

Water Efficiency

W-1 Water Efficiency Indoor

The water system shall be designed and constructed so that the calculated indoor potable water use is at least twenty percent (20%) less than the indoor potable water use for the same building as calculated using the fixture performance requirements related to plumbing under the 2009 North Carolina State Building Code. Provisions for monitoring water use shall be provided.

Options for accomplishing the water savings are:

- High Efficiency fixtures
- “Water Sense” certified water closets and urinals.
- Generally high performance fixtures are defined as follows: 1.28 gallons per flush for water closets, .5 gallons per flush for urinals. 0.5 gallons per minute flow for lavatories faucets, 0.25 gallons per metering cycle for metered faucets
- Waterless Urinals. These urinals utilize a trap insert filled with a sealant liquid instead of water. The lighter-than-water sealant floats on top of the urine collected in the U-bend, preventing odors from being released into the air. Other designs do not use a cartridge; instead, use an outlet system that traps odors.

  – Options for consideration that must be proven by life cycle cost analysis as economically feasible are:

- Condensate reclaim Air conditioning condensate can be captured and reused for non-potable water applications that can be used for cooling tower make-up, flushing fixtures, and landscape irrigation.
- Grey water systems. Gray water is water that has been discharged as waste from bathtubs, showers, lavatories, and clothes washers. Gray water does not include water that is discharged from toilets or kitchen sinks. A gray water system is a water reuse system that filters gray water and reuses it, instead of potable water, for non-potable purposes such as toilet flushing and irrigation. The grey water systems must be designed and installed in accordance with Appendix C of the 2009 North Carolina State Plumbing Code.

W-2 Water Efficiency Outdoor

The water system shall be designed and constructed so that the calculated sum of the outdoor potable water use is at least fifty percent (50%) less than the sum of the outdoor potable water use for the same building as calculated using the performance requirements related to plumbing under the 2012 North Carolina State Building Code. Measures implemented should be economically feasible.

Options for accomplishing the water savings are:

- Rain water can be harvested from the roof of the building/s and collected in storage tanks (cisterns) for use as a source for irrigation of outdoor vegetation.

- Recycled water from certain building waste and process systems can be captured and stored in storage tanks and treated for use as a source for irrigation of outdoor vegetation.

- Sprinkler (fire protection) system test water reclaim; pipe test outlets to storage tank/cistern

- Strategic selection of landscaping should be implemented to establish landscaping with site appropriate, drought tolerant plants and grasses that can thrive with only normal rainfall.

- No decorative fountains or other type water features that have water supply maintained by potable water.

- Automatically control operating times for irrigation system by the use of moisture sensors and scheduling by the building automation system.

- Conserve water use during construction by making contractor responsible for water costs, and by specifying appropriate times of year when new landscaping efforts should occur.

Indoor Environment –Daylight and Acoustics

E-1 Daylight

A day lighting design with the following characteristics shall be implemented;

- Provide natural daylight sufficient to adequately illuminate the entire classroom space for 90% of the classrooms for not less than half the school day. Avoid direct solar gain through the use of light shelves, roof monitors, high performance glazing, or diffusing devices such as louvers or screens. Daylighting systems shall be designed to prevent direct sunlight from striking anywhere on a work or viewing surface.

- Natural lighting: daylighting elements of a room, such as interior finishes, window size and arrangement (height), light shelves and slope ceilings must be integrated into the lighting system design to provide effective and beneficial lighted spaces that provide energy savings from reduced artificial light and reduced cooling loads due to the lower internal heat gain associated with artificial light. Illuminate spaces evenly, avoiding high contrast between light and shadow. Accommodate different lighting needs with different strategies (classrooms, corridors, gyms, media centers, etc.).

- Provide automatic operation to modulate artificial lighting when adequate daylight is present.

- Proper lighting: uniformity and foot candle levels shall be as recommended in the Illuminating Engineering Society (IES) guidelines.

E-2 Acoustics

Classrooms should have the following acoustic enhancing characteristics;

- Eliminate direct paths for sound transmission by extending walls to structure and avoiding direct openings between classrooms (including doors and windows) unless necessary for reasons of curriculum or control. If doors and/or windows are necessary, follow industry-standard recommendations and Owner's program requirements for Sound Transmission Class of such products. For typical needs of sound isolation, recommended criteria are (doors) STC approx 40, and (windows) STC approx 30. Use higher STC rating for more critical applications.

- Reduce sound transmission through vibration by providing
- adequate or varying masses, in walls, to reduce low frequency
- sound vibration. Interior partitions separating mechanical rooms,

- toilets, gymnasiums, cafeterias, band and choir rooms from offices, conference rooms and classrooms shall have a minimum STC rating of 60.

- Reduce reverberation by providing ample sound diffusing and absorbing surfaces within the space.

- Reduce noise levels within the spaces by designing quiet HVAC systems. No noise generating mechanical equipment shall be installed directly inside any occupied spaces. Maximum noise level within a classroom generated by the HVAC system shall not exceed 45dBA.

- Buildings in flight path within five miles of airport serving
- Commercial or military aircraft shall have a wall and roof STC rating minimum of 50 and fenestration STC rating minimum of 30.

E-3 Air Quality

Construction materials, furniture/casework materials, interior finishes, ventilation air, cleaning processes and chemical uses all contribute to a healthy or unhealthy indoor environment.

- All adhesives and sealants used in the construction of the facility where exposed directly or indirectly to the indoor environment shall be certified as Low VOC. Specify only caulks, sealers, gaskets, glues expansion joints, and similar products bearing the “Greenseal” or Greenguard” certifications.

- All systems including flooring (especially carpets), furniture, casework, and ceilings used in the construction of the facility where exposed directly or indirectly to the indoor environment shall contain no urea-formaldehyde resins. These systems should be free of any agent which will potentially release gas/fumes/vapors considered to reduce the health quality of air in the building. Provide casework, carpet, composition tiles, ceiling tiles and like products that are certified to have no or low volatile organic compounds or formaldehyde in the manufacturing process.

- All paints, coatings and coverings used in the construction of the facility where exposed directly or indirectly to the indoor environment shall be certified as Low VOC. Specify only paints, primers and undercoats that bear the “Greenguard” or “Greenseal” certification indicating that they contain no, or very low volatile organic compounds.

- Ventilation air: provide indoor fresh air quantities equal to NCSBC (mechanical) 2012 with proper mechanical distribution and control (monitor, continuous during occupied). Filtration installed in air handling equipment must be MERV 8 or better. Locate fresh air intakes away from exhaust air discharge, loading docks, bus loading/unloading zones and cooling towers.

- Special consideration must be given to the prevention of contamination of the indoors due to construction/renovation. Follow the recommendations of SMACNA guidelines regarding control of indoor air quality during construction. All materials must be installed clean and void of abnormal moisture levels. Where HVAC equipment is used to condition the building during construction, provide filters in all air moving equipment and at all air intake locations. Dictate procedures and requirements in the project specifications.

- Duct systems shall be smooth on the inside. Although lined duct work is not recommended, where necessary, only fiber free, non-absorbing materials, protected against microbial growth shall be used.

Energy Conservation

EC-1 Energy Conservation Domestic Hot Water

Domestic hot water heating:

- Solar thermal panels for heating kitchen hot water shall be used where life cycle cost analysis proves system to be economically feasible.

- Instantaneous heaters shall be used in place of centralized systems for remote loads where hot water load is small to reduce system losses.

- Improve system efficiency by increasing insulation values on piping, water heaters and storage tanks when economically feasible (as determined by life cycle cost analysis) and add heat traps at water heating equipment.

- Control of any domestic hot water heating components shall be provided by the building automation system. As a minimum, control the schedule of any hot water circulating pumps, solar system pumps, and monitor applicable water temperatures.

EC-2 Energy Conservation HVAC Systems

HVAC systems; Careful analysis to compare legitimate alternatives must be made in the selection of the HVAC system type and size. The selected HVAC system shall be the best performing of all alternatives considered, by having the best overall life cycle cost. Equipment selections shall be based on accurate load estimates that properly size the equipment to meet the desired internal comfort conditions, internal air quality, at recommended design exterior conditions, but shall not be oversized. Load estimates shall also account for all load reducing measures such as automatic daylighting, energy reclaim systems, etc.

- Design conditions for calculating heating loads, cooling loads and performing energy analysis shall be as follows: Outdoor design conditions shall be as recommended in ASHRAE Fundamentals Handbook, Appendix; Design Conditions for Selected Locations. The cooling conditions shall use the 1% column and the heating conditions shall use the 99% column. Indoor conditions shall be 75° F for cooling and 72° F for heating, and 50% relative humidity.

- System types; System type must be energy efficient and cost effective. Select the system to allow spaces used after hours, such as gyms, auditoriums to operate without using the full capacity central plant. Select systems to reduce air and water flow when full capacity is not necessary.

- Dedicated outside air systems, where exh/relief air is used to preheat/cool intake air, reduces total volume of FA for VAV systems, and removes risk of freezing conditions entering coils.

- Thermal storage systems, where off peak electrical rates allow for loads shifting that results in reduced energy costs, should be considered. Many of these type systems do not provide an acceptable payback period unless construction costs are supplemented by grants and/or special energy rates. Use of these type systems must be justified by performing a life cycle cost analysis.

- Energy reclaim: reclaim energy from exhaust and relief air systems, where high levels of ventilation shall be incorporated where shown to be feasible by life cycle cost analysis.

- All individual systems 3 tons and above shall be provided with air side economizer.

- Controls: Use direct digital control systems. Use occupancy sensors to reset temperature set point and reset outside air volume. Monitor air handling equipment filter status. Monitor electrical, water, gas usage to indicate a problem (leak, systems/equipment left on during unoccupied). Setback space temperature set point during unoccupied periods, however, humidity levels shall be maintained at all times.

- Control strategies shall be established to offer the most efficient operation of the building systems while maintaining proper comfort (to include both temperature and humidity) and air quality conditions.

EC-3 Energy Conservation Electrical Systems

Electrical systems: electrical systems shall be designed to provide efficient power distribution by strategic wire sizing, voltage selection, and proper equipment locations (separation) to reduce voltage drop, and the use of efficient transformers and lighting systems.

- Use High Efficiency lighting fixtures, lamps, ballasts and lenses (indoor and outdoor) including LED exit signs. Lamps shall not only be high efficiency but also provide high color rendition. Include replacement cost in analysis of different lamp types to be used.

- Lighting control: indoor lighting shall be scheduled to automatically turn off during unoccupied hours. During normally occupied hours occupancy sensors shall turn lights off when the space is unoccupied. Outdoor lighting shall be turned on in the evenings by photocells and turned off during the night (except for required security lighting) after an appropriate period during the night.

- Specify high efficiency (Energy Star) appliances and equipment.

Section III Maintaining High Performance After Construction

High Performance Operation and Maintenance Guidelines

These guidelines, while not a part of the high performance certificate, are offered as a guide for the school system facility maintenance and operation staff to ensure the facility performs as intended throughout its service life.

Operate the Building Efficiently

- Conduct an evaluation and re-commissioning 12 months after occupancy to verify that operational goals have been achieved.
- Follow a regular HVAC equipment maintenance inspection schedule to detect problems early. This function shall also include testing and calibration of all control sensors.
- Eliminate use of toxic or allergenic cleaning products or “air fresheners”.
- Implement EPA’s “Tools for Schools” program.
- Develop a policy to specify and purchase only Energy Star equipment and appliances.
- Develop guidelines to restrict building plug loads, and to require set-back and sleep modes for building appliances that use electricity. Prevent the use of personal heaters and limit the use of refrigerators, microwave ovens and other none essential appliances.

Thermal Comfort :

- Educate teachers and staff about energy savings.
- Monitor both humidity levels and temperature with an overall energy management system and strategy.

Eliminate Moisture Accumulation

- Maintain roof membranes and promptly deal with leaking roofs, walls and windows
- Verify that maintenance procedures do not introduce excessive moisture levels into the building for prolonged periods
- Set back, but do not shut down building systems for breaks and unoccupied periods. Control of space humidity must be provided 24 hours a day whether the facility is occupied or not

Section IV High Performance Checklist Submittal Form

The North Carolina Department of Public Instruction will offer a ***High Performance School Certificate.*** To qualify for the certificate the designer must submit a completed checklist, providing pertinent information requested on the checklist, along with the construction drawing submittal.

This certificate will be awarded, to owners, whose buildings meet the criteria outlined in this document, indicating that the facility was designed to high performance standards.

S-1 Site Selection

- Phase I environmental assessment

  Submit phase 1 report at construction document review.

- Phase II environmental assessment if required

  Submit phase 1 report at construction document review.

- Survey of surrounding conditions/hazards

  Submit phase 1 report at construction document review.

S-2 Site Infrastructure

- Site road access and utility availability

  Provide statement concerning infrastructure analysis at construction document review.

B-1 Implementation

- Implement a process of Integrative Design
  DPI will determine during construction document review.

B-2 Lifecycle Cost Analysis

- Computer model

  Provide documentation including input, output and assumptions for each evaluation (construction type, HVAC system, lighting, etc.) performed for this project at construction document review.

- Target energy budget in BTU's per SQ. FT

  Provide documentation at construction document review.

B-3 Building Envelope Analysis

- Building orientation and shape

  DPI will determine during construction document review.

- Building envelope design analysis

  Documentation to be provided as a part of the computer modeling submission.

- Wall construction optimization

  Documentation to be provided as a part of the computer modeling submission.

- Roof construction

  Provide statement concerning analysis of roof type and include energy evaluation for insulation, etc. as a part of the computer modeling at construction document review.

- Comply with EPA energy star

  DPI will determine during construction document review.

- Fenestration area and thermal performance

  Documentation to be provided as a part of the computer modeling submission.

B-4 Energy Conservation

- Reduce building energy consumption

  Documentation to be provided as a part of the computer modeling submission.

- Reduce renovated building energy consumption

  Documentation to be provided as a part of the computer modeling submission.

B-5 Training

- Require owner training

  DPI will determine during construction document review.

B-6 Commissioning

- Design phase commissioning

  DPI will determine during construction document review.

- Construction phase commissioning

  DPI will determine during construction document review.

- System requirements for commissioning

  DPI will determine during construction document review.

Water Efficiency

W-1 Water Efficiency Indoor

- Indoor water reduction requirements

  Provide statement concerning system analysis and include calculations at construction document review.

W-2 Water Efficiency Outdoor

- Outdoor water reduction requirements

  Provide statement concerning system analysis and include calculations at construction document review.

E-1 Indoor Environment –Daylight and Acoustics

Daylight

- Implement a day lighting design

  Provide statement concerning system analysis and include calculations at construction document review.

Acoustics

- Implement acoustical design aspects

  Provide statement concerning system analysis at construction document review.

E-2 Air Quality

- Specify low VOC construction material

  DPI will determine during construction document review.

- Specify low VOC finishes

  DPI will determine during construction document review.

- Design for proper ventilation air

  Provide a ventilation air summary on the construction documents. DPI will determine during construction document review.

- Specify contamination control during construction

  DPI will determine during construction document review.

- Duct systems

  DPI will determine during construction document review.

Energy Conservation

EC-1 Energy Conservation Domestic Hot Water

- Domestic hot water heating

  Provide statement concerning system analysis and include calculations at construction document review.

EC-2 Energy Conservation HVAC Systems

- HVAC systems

  Provide statement concerning each system component analysis and include calculations as a part of the computer modeling submission at construction document review.

EC-3 Energy Conservation Electrical Systems

- Electrical systems

  Provide statement concerning each system component analysis and include calculations as a part of the computer modeling submission at construction document review.