Energy & Atmosphere

Required

EA Prerequisite 1

Fundamental Commissioning of the Building Energy Systems

Intent

Verify that the building's energy related systems are installed, calibrated, and perform according to the owner's project requirements, basis of design, and construction documents.

Health Issues

Commissioning verifies the efficient and effective operations of a building's mechanical and electrical systems. It ensures compliance with energy performance goals and indoor air quality and thermal comfort design criteria. The benefits of commissioning lessen dependence on natural resources, resulting in improved outdoor air quality and reduced greenhouse gas emissions.

Credit Goals

- The following commissioning process activities shall be completed by the commissioning team:

1. Designate an individual as the Commissioning Authority (CxA) to lead, review and oversee the completion of the commissioning process activities.

    a. The CxA shall have documented commissioning authority experience in at least two building projects.

    b. The individual serving as the CxA shall be independent of the project's design and construction management, though they may be employees of the firms providing those services. The CxA may be a qualified employee or consultant of the Owner.

    c. The CxA shall report results, findings and recommendations directly to the Owner.

    d. For projects smaller than 50,000 gross square feet, the CxA may include qualified persons on the design or construction teams who have the required experience.

2. The Owner shall document the Owner's Project Requirements (OPR). The design team shall develop the Basis of Design (BOD). The CxA shall review these documents for clarity and completeness. The Owner and design team shall be responsible for updates to their respective documents.

3. Develop and incorporate commissioning requirements into the construction documents.

4. Develop and implement a commissioning plan.

5. Verify the installation and performance of the systems to be commissioned. Verify that training and operation and maintenance documentation have been provided to the owner's operations staff.

6. Complete a commissioning report.

EA Prerequisite 1 continued

Fundamental Commissioning of the Building Energy Systems

- Commissioning process activities shall be completed for the following energy-related systems, at a minimum:
  - Heating, ventilating, air conditioning, and refrigeration (HVAC&R) systems (mechanical and passive) and associated controls.
  - Lighting and daylighting controls
  - Domestic hot water systems
  - Renewable energy systems (wind, solar etc.)
  - Building envelope systems
- For renovations and additions, all energy-related systems that meet the following criteria shall be commissioned or recommissioned. All other systems in the facility are exempt from this Prerequisite.
  1. All existing energy-related systems located within the boundaries of the project that serve the addition or alteration.
  2. Existing energy-related equipment or systems that do not have sufficient capacity to serve the addition or alteration and are supplemented to provide the required capacity.
  3. Energy-related equipment that is replaced or relocated.
  4. New energy-related equipment serving the addition or alteration.
  5. Existing energy-related systems where the project uses more than 25% of the capacity of such systems.
  6. Any modified portions of the existing envelope, or the entire envelope where more than 50% of the existing building is renovated.

Suggested Documentation

❑ Document that the commissioning requirements outlined in the credit goals have been successfully executed or will be provided under existing contract(s).

Reference Standard

Green Building Reference Guide for New Construction and Major Renovations (LEED for New Construction) Version 2.2, Washington, DC: U.S. Green Building Council, http://www.usgbc.org/DisplayPage.aspx?CMSPageID=220#v2.2

EA Prerequisite 1 continued

Fundamental Commissioning of the Building Energy Systems

Potential Technologies and Strategies

- Engage a commissioning authority and adopt a commissioning plan.
- Include commissioning requirements in bid documents and task the commissioning authority to produce a commissioning report once commissioning activities are completed. Hospitals and health care systems with in-house expertise in design and commissioning may perform this work. However, this is extremely specialized expertise and the Owner may benefit from engaging a credentialed Commissioning Authority.
- Owners are encouraged to seek out qualified individuals to lead the commissioning process. Qualified individuals are identified as those who possess a high level of experience in the following areas:
  - Energy systems design, installation and operation
  - Commissioning planning and process management
  - Hands-on field experience with energy systems performance, interaction, start-up, balancing, testing, troubleshooting, operation, and maintenance procedures
  - Energy systems automation control knowledge
- Owners are encouraged to consider including water-using systems and other similar systems in the scope of the commissioning plan as appropriate.
- The LEED for New Construction Version 2.2 Reference Guide provides guidance on the rigor expected for this prerequisite for the following:
  1. Owner's Project Requirements
  2. Basis of Design
  3. Commissioning plan
  4. Commissioning specification
  5. Performance verification documentation
  6. Commissioning report

Resources

National Institute of Building Sciences (NIBS) Guideline 3-2005: Exterior Enclosure Technical Requirements for the Commissioning Process.

"Retro-Commissioning & Commissioning Building Envelope Systems to Reduce Health Risks & Improve IAQ: What we have Learned to Date," William Turner, Steven Caulfield, et. al., Turner Building Science, LLC, 2005.

EA Prerequisite 1 continued

Fundamental Commissioning of the Building Energy Systems

GGHC Construction Credit Synergies

- SS Credit 4: Alternative Transportation
- SS Credit 8: Light Pollution Reduction
- WE Credit 1: Water Efficient Landscaping
- WE Credit 2: Potable Water Use Reduction
- EA Prerequisite 2: Minimum Energy Performance
- EA Credit 1: Optimize Energy Performance
- EA Credit 2: On-Site Renewable Energy
- EA Credit 3: Enhanced Commissioning
- EA Credit 5: Measurement & Verification
- EQ Prerequisite 1: Minimum IAQ Performance
- EQ Prerequisite 3: Hazardous Material Removal or Encapsulation
- EQ Credit 1: Outdoor Air Delivery Monitoring
- EQ Credit 5: Chemical & Pollutant Source Control
- EQ Credit 6: Controllability of Systems
- EQ Credit 7: Thermal Comfort
- EQ Credit 8: Daylight & Views

GGHC Operations Credit Synergies

- IO Prerequisite 1: Integrated Operations & Maintenance Process
- IO Prerequisite 4: Outside Air Introduction & Exhaust Systems
- IO Credit 1: Building Operations & Maintenance
- IO Credit 2: IAQ Management
- WC Credit 1: Water Efficient Landscaping
- WC Credit 2: Building Water Use Reduction
- WC Credit 3: Performance Measurement: Enhanced Metering
- EE Prerequisite 1: Existing Building Commissioning
- EE Credit 1: Optimize Energy Performance
- EE Credit 2: On-Site & Off-Site Renewable Energy
- EE Credit 5: Performance Measurement

Required

EA Prerequisite 2

Minimum Energy Performance

Intent

Establish the minimum level of energy efficiency for the proposed building and systems.

Health Issues

Lower building energy use results in reduced combustion of fossil fuels for source energy generation. Energy efficiency benefits health by reducing emissions from the products of combustion, including fewer particulates and pollutants, which in turn help to improve outdoor air quality. Greenhouse gas emissions, which contribute to global climate change, are also reduced.

Credit Goals

- Many codes applicable to health care facilities have requirements that preclude the building from meeting ASHRAE 90.1-2004 requirements. This section has been designed to allow a building baseline computation that recognizes regulatory context. This prerequisite distinguishes between (a) buildings regulated by health code requirements, which exempt them from all or portions of local energy code requirements, and (b) buildings that are required to meet local energy codes.
    - For acute care hospitals, long term care facilities or freestanding surgery centers with regulatory requirements that exempt the facility from all or portions of the local energy code, design to meet or exceed the energy requirements as defined below under Documentation.
    - For buildings not exempted from any portion of the local energy codes, design to meet building energy efficiency requirements of the local energy code or ASHRAE/IESNA 90.1-2004, whichever is more stringent.
- Establish an ENERGY STAR® Rating goal of 75 or higher for the facility design using U.S. EPA's Target Finder rating tool.

Suggested Documentation

❑ For acute care hospitals, long term care facilities or freestanding surgery centers with regulatory requirements that exempt the facility from all or portions of the local energy code, select one of the two compliance paths described below:

OPTION 1:

- Model anticipated building energy performance in accordance with ASHRAE 90.1-2004 Appendix G as modified by the Design Assumptions in GGHC Appendix 1, using DOE2.1E or Energy Plus.
- Demonstrate that the proposed building performance meets the ASHRAE 90.1-2004 Energy Cost Budget.
- Obtain an EPA energy performance rating of 75 or higher for estimated energy use of the design project from Target Finder. Print the Statement of Energy Design Intent generated from Target Finder. Apply for the "Designed to Earn the ENERGY STAR" graphic from EPA. Place the graphic in the title block on drawings and on the cover of project Contract Documents.

EA Prerequisite 2 continued

Minimum Energy Performance

OR

OPTION 2:

- Design the building project to comply with both—
  - The mandatory provisions (Sections 5.4, 6.4, 7.4, 8.4, 9.4 and 10.4) of ASHRAE/IESNA Standard 90.1-2004 (without amendments); and
  - The prescriptive requirements (Sections 5.5, 6.5, 7.5 and 9.5) or performance requirements (Section 11) of ASHRAE/IESNA Standard 90.1-2004 (without amendments).

❑ For acute care hospitals, long term care facilities or freestanding surgery centers, medical office buildings, clinics or health care buildings not exempted from any portion of the local energy codes:

OPTION 1

- Prepare calculations verifying that the building complies with ASHRAE/IESNA 90.1-2004 using the Energy Cost Budget Method or local energy codes. If local energy codes were applied, demonstrate that the local code is equivalent to, or more stringent than, ASHRAE/IESNA 90.1-2004.

OR

OPTION 2

- Design the building project to comply with both—
  - The mandatory provisions (Sections 5.4, 6.4, 7.4, 8.4, 9.4 and 10.4) of ASHRAE/IESNA Standard 90.1-2004 (without amendments); AND
  - The prescriptive requirements (Sections 5.5, 6.5, 7.5 and 9.5) or performance requirements (Section 11) of ASHRAE/IESNA Standard 90.1-2004 (without amendments).

❑ For all buildings where the energy cost budget has been calculated, estimate anticipated whole building energy performance using DOE2.1E or Energy Plus modeling results. Use the Process Loads Procedures and Assumptions listed in GGHC Appendix 1 to create a whole building energy consumption estimate from the results of the modeling. Incorporate energy efficiency measures into the design energy model to ensure a minimum energy performance rating of 75 or higher using EPA's Target Finder rating tool. The GGHC is exploring new methods and tools for increasing energy performance in the design stage. We strongly request that projects submit the Statement of Energy Design Intent generated by Target Finder and a detailed description of the proposed building to:

GGHC Research Project; Center for Maximum Potential Building Systems; 8604 FM 969, Austin, TX 78724.

(*Note: while the GGHC process, including this prerequisite, is both voluntary and self-certifying, your submission of this data will greatly inform the process of improving future versions of this document*.)

EA Prerequisite 2 continued

Minimum Energy Performance

Reference Standards

2003 Savings By Design Health Care Modeling Procedures, Pacific Gas and Electric Company, http://www.gghc.org/Documents/PGEModProc.pdf

AIA Guidelines for Design and Construction of Health Care Facilities, 2006 Edition, http://www.aia.org

ASHRAE Handbook, HVAC Applications, Chapter 7 Health Care Facilities, Specific Design Criteria, http://www.ashrae.org

ASHRAE/IESNA 90.1–2004 Energy Standard for Buildings, Except Low Rise Residential, http://www.ashrae.org

U.S. EPA National Energy Performance Rating System, http://www.energystar.gov/benchmark

U.S. EPA Target Finder new design rating tool, http://www.energystar.gov/newbuildingdesign

Potential Technologies & Strategies

- Design building systems to maximize energy performance while maintaining or improving health and safety requirements. Consider the following strategies as regionally appropriate:
  - Use energy (latent and sensible) recovery.
  - Ground source heat pumps.
  - Use evaporative cooling when ambient conditions allow.
  - Reduce outside airflow during unoccupied periods.
  - Expand unoccupied temperature dead band by automatically resetting zone temperature set points based on occupancy.
  - Separate HVAC zones with constant airflow, temperature and humidity control requirements from those with single or double shift occupancy that would allow reductions in air changes or setbacks in temperature and humidity.
  - Provide a cooling system with at least two cooling loops operated at different temperatures. This can be accomplished with separate chillers (or direct tower cooling).
  - Design for high part-load heating and cooling efficiency.
- Daylighting decreases energy costs for buildings by providing natural solar lighting. A well-designed daylit building is estimated to reduce lighting energy use by 50 to 80% and reduce the associated HVAC energy used to remove the heat of electric lighting from 10 to 20%. Overall power density can be reduced as much as 30%, resulting in lower capital costs for power and HVAC systems. Daylighting should be implemented in health care facilities with the special needs of the building occupants in mind (See GGHC EQ Credit 8: Daylight & Views).
- Design high efficiency chiller plants that use various technologies and strategies to reduce overall plant energy consumption at full and part loads (such as chillers with variable speed drives on the compressors, primary-only variable flow pumping, series-counterflow chiller arrangements, etc.).

EA Prerequisite 2 continued

Minimum Energy Performance

- Use low leakage air handling units to reduce overall fan horsepower while ensuring that air is properly filtered.
- Use a computer simulation model to assess the energy performance and identify the most cost effective energy efficiency measures. Quantify whole building energy performance as compared to a baseline building and to an annual energy performance target, if available.
- Obtain local, state, and federal incentives to help fund energy conservation measures.
- Use heat recovery from laundry and kitchen operations.
- Use a heat recovery loop on steam condensate for pre-heating water.
- Connect to a combined heat and power (cogeneration) plant.
- Provide occupancy sensors to control all lighting in administration areas, equipment rooms, storage rooms, med prep rooms, offices, lounges, break rooms, public toilets, and other similar spaces.
- Provide dimming or other multi-level switching capable of reasonably uniform illuminance reduction for conference rooms, dining areas, lounges, and all other spaces larger than 100 square feet in which the connected lighting load exceeds 0.8 watts per square foot.
- For daylit areas that are deeper than 15 feet from the source of natural illumination and do not require controls for patient treatment, provide separate controls for lighting fixtures located within 15 feet of the source of daylight.
- Specify and install fluorescent lamps rated for high efficiency and long life to reduce energy use. See GGHC MR Prerequisite 2: Mercury Elimination and GGHC MR Credit 4.2: PBT Elimination: Mercury.

GGHC Construction Credit Synergies

- ID Prerequisite 1: Integrated Design Process
- SS Credit 8: Light Pollution Reduction
- EA Prerequisite 1: Fundamental Commissioning of the Building Energy Systems
- EA Prerequisite 3: Fundamental Refrigerant Management
- EA Credit 1: Optimize Energy Performance
- EA Credit 2: On-Site Renewable Energy
- EA Credit 3: Enhanced Commissioning
- EA Credit 5: Measurement & Verification
- EA Credit 7: Equipment Efficiency
- EQ Prerequisite 1: Minimum IAQ Performance
- EQ Credit 1: Outdoor Air Delivery Monitoring
- EQ Credit 2: Natural Ventilation
- EQ Credit 6: Controllability of Systems
- EQ Credit 7: Thermal Comfort
- EQ Credit 8: Daylight & Views

EA Prerequisite 2 continued

Minimum Energy Performance

GGHC Operations Credit Synergies

- IO Prerequisite 1: Integrated Operations & Maintenance Process
- IO Prerequisite 4: Outside Air Introduction & Exhaust Systems
- IO Credit 1: Building Operations & Maintenance
- EE Prerequisite 1: Existing Building Commissioning
- EE Prerequisite 2: Minimum Energy Performance
- EE Prerequisite 3: Ozone Protection
- EE Credit 1: Optimize Energy Performance
- EE Credit 2: On-Site & Off-Site Renewable Energy
- EE Credit 3: Energy Efficient Equipment
- EE Credit 4: Refrigerant Selection
- EE Credit 5: Performance Measurement

Required

EA Prerequisite 3

Fundamental Refrigerant Management

Intent

Reduce ozone depletion.

Health Issues

Stratospheric ozone layer depletion leads to increased exposure to ultraviolet radiation, increasing risk factors for skin cancer and immune system depression. The United States is one of the world's largest emitters of ozone depleting substances. As part of the US commitment to implementing the Montreal Protocol, the EPA has implemented regulations relative to the responsible management of CFCs, including programs to end the production of ozone depleting substances.

Credit Goals

- Zero use of CFC-based refrigerants in new base building HVAC&R systems. When reusing existing base building HVAC equipment, complete a comprehensive CFC phase-out conversion prior to project completion. Small HVAC units (defined as containing less than 0.5 lbs of refrigerant), and other equipment such as standard refrigerators, small water coolers, and any other cooling equipment that contains less than 0.5 lbs of refrigerant, are not considered part of the "base building" system and are not subject to the requirements of this prerequisite.

Suggested Documentation

- ❑ Document that the building's HVAC&R systems do not use CFC based refrigerants.
- ❑ For existing buildings, compile a listing of all existing HVAC&R components and state whether each component uses CFCs. For those components that use CFCs, prepare a phase out plan describing how these components will be converted or removed and replaced with CFC-free components before construction is complete.

Reference Standards

There is no reference standard for this credit.

Potential Technologies & Strategies

- When reusing existing HVAC systems, conduct an inventory to identify equipment that uses CFC refrigerants and provide a replacement schedule for these refrigerants. For new buildings, specify new HVAC equipment in the base building that uses no CFC refrigerants.

Resources

U.S. EPA, Stratospheric Ozone Protection: Moving to Alternative Refrigerants, http://es.epa.gov/program/epaorgs/oar/.

EA Prerequisite 3 continued

Fundamental Refrigerant Management

GGHC Construction Credit Synergies

- SS Credit 1: Site Selection
- EA Prerequisite 2: Minimum Energy Performance
- EA Credit 1: Optimize Energy Performance
- EA Credit 4: Enhanced Refrigerant Management
- MR Credit 1: Building Reuse

GGHC Operations Credit Synergies

- EE Prerequisite 2: Minimum Energy Performance
- EE Prerequisite 3: Ozone Protection
- EE Credit 4: Refrigerant Selection
- WM Credit 2: Regulated Medical Waste Reduction
- CM Credit 1: Community Contaminant Prevention

10 points

EA Credit 1

Optimize Energy Performance

Intent

Achieve increasing levels of energy performance above the baseline in the prerequisite standard to reduce environmental and economic impacts associated with excessive energy use.

Health Issues

Lower building energy use results in reduced combustion of fossil fuels for energy generation. Energy efficiency benefits health by reducing emissions from the products of combustion, including less particulates and pollutants, which in turn help to improve outdoor air quality. Greenhouse gas emissions, which contribute to global climate change, are also reduced. Reductions in operational expenses for energy use may allow for future investments in improved facilities or services.

Credit Goals

- Model anticipated building energy performance using DOE2.1E or Energy Plus in accordance with the instructions provided in Prerequisite 2.
- For buildings that are not exempt from local energy codes, compare performance of the proposed building systems with the baseline systems in accordance with ASHRAE 90.1-2004 Appendix G.
- For buildings that are exempt from all or portions of the local energy code, compare performance of the proposed building systems with the baseline building systems as described in Prerequisite 2.

(Note: An alternate prescriptive pathway for achievement of a portion of the total available points will be added to this credit in 2007 via an administrative update.)

Point total	Exempt Health Care Buildings and All Building Renovations	All Other Buildings
	Compared with baseline described in GGHC EA Prerequisite 2	Compared to ASHRAE 90.1-2004
Credit 1.1 (1 point)	Reduce design energy consumption by 3.5%	Reduce design energy cost by 10.5%
Credit 1.2 (2 points)	Reduce design energy consumption by 7%	Reduce design energy cost by 14%
Credit 1.3 (3 points)	Reduce design energy consumption by 10.5%	Reduce design energy cost by 17.5%
Credit 1.4 (4 points)	Reduce design energy consumption by 14%	Reduce design energy cost by 21%
Credit 1.5 (5 points)	Reduce design energy consumption by 17.5%	Reduce design energy cost by 24.5%

EA Credit 1 continued

Optimize Energy Performance

Point total (cont.)	Exempt Health Care Buildings and All Building Renovations	All Other Buildings
	Compared with baseline described in GGHC EA Prerequisite 2	Compared to ASHRAE 90.1-2004
Credit 1.6 (6 points)	Reduce design energy consumption by 21%	Reduce design energy cost by 28%
Credit 1.7 (7 points)	Reduce design energy consumption by 24.5%	Reduce design energy cost by 31.5%
Credit 1.8 (8 points)	Reduce design energy consumption by 28%	Reduce design energy cost by 35%
Credit 1.9 (9 points)	Reduce design energy consumption by 31.5%	Reduce design energy cost by 38.5%
Credit 1.10 (10 points)	Reduce design energy consumption by 35%	Reduce design energy cost by 42%

Suggested Documentation

- ❑ Prepare a narrative documenting energy saving measures incorporated in the building design, including a table listing baseline and proposed comparisons of all model variables that are different.
- ❑ Prepare calculations verifying the building energy consumption performance achieved by the proposed energy conservation measures.
- ❑ Document anticipated whole building energy performance using the EPA's Target Finder design tool as described in GGHC EA Prerequisite 2.

Reference Standards

2003 Savings By Design Health Care Modeling Procedures, Pacific Gas and Electric Company, http://www.gghc.org/Documents/PGEModProc.pdf

AIA Guidelines for Design and Construction of Health Care Facilities, 2006 Edition, http://www.aia.org

ASHRAE Handbook, HVAC Applications, Chapter 7 Health Care Facilities, Specific Design Criteria, http://www.ashrae.org

ASHRAE/IESNA 90.1–2004 Energy Standard for Buildings, Except Low Rise Residential, http://www.ashrae.org

U.S. EPA National Energy Performance Rating System, http://www.energystar.gov/benchmark

U.S. EPA Target Finder new design rating tool, http://www.energystar.gov/newbuildingdesign

Potential Technologies & Strategies

See GGHC EA Prerequisite 2 Potential Technologies & Strategies and Credit Synergies.

3 points

EA Credit 2

On-Site Renewable Energy

Intent

Encourage and recognize increasing levels of on-site renewable energy self-supply in order to reduce environmental and economic impacts associated with fossil fuel energy use.

Health Issues

Providing renewably-based on-site electricity to fulfill a portion of a building's energy needs offsets the greenhouse gas, toxic chemical, and particulate emissions associated with fossil-fuel electrical generation.

Credit Goals

Supply a net fraction of the building's total energy use (as expressed as a fraction of watts per square foot) with on-site renewable energy systems.

Point total	Renewable energy provided as fraction of annual energy use
Credit 2.1 (1 point)	0.05 watts of renewable generating capacity / sf of building area
Credit 2.2 (2 points)	0.10 watts of renewable generating capacity / sf of building area
Credit 2.3 (3 points)	0.15 watts of renewable generating capacity / sf of building area

Notes: The renewable energy fraction in the above table is based on the following calculation:

(21.5 kWh/sf)(0.25%)*(1,000 Wh/1 kW) = 53.75 Wh/sf*

This calculation makes two assumptions:

- *A typical hospital uses 21.5 kwh/sf of electricity per year.*
- *A typical PV array operates 1,000 hours per year.*

Note: Typical hospital electricity consumption data taken from "Default Energy Consumption Intensity for Different Building Types," EIA 1999 Commercial Building Energy Consumption Survey.

Note: Natural gas and oil consumption are not addressed in this credit.

Suggested Documentation

❑ Obtain calculations demonstrating that the required generating capacity is supplied by renewable energy system(s) in accordance with the credit goals.

Reference Standards

U.S. Department of Energy, Energy Information Administration, http://www.eia.doe.gov.

EA Credit 2 continued

On-Site Renewable Energy

Potential Technologies & Strategies

- Assess the project for non-polluting and renewable energy potential including:
  - Solar: Photovoltaic and active thermal systems
  - Wind
  - Bio-fuel- and biogas- based electrical systems (including biodiesel)
  - Geothermal heating systems
  - Geothermal electric systems
  - Low-impact hydro electric power systems
  - Wave and tidal power systems
- When applying these strategies, take advantage of "net metering" with the local utility if possible.
- Ineligible On-Site Renewable Energy Systems:
  - Architectural features
  - Passive solar strategies (included under EA Credit 1 calculation)
  - Daylighting strategies
  - Geo-exchange systems (ground source heat pumps)
  - Renewable or Green-power from off-site sources

GGHC Construction Credit Synergies
- ID Prerequisite 1: Integrated Design Process
- SS Credit 1: Site Selection
- SS Credit 5: Site Development
- EA Prerequisite 1: Fundamental Commissioning of the Building Energy Systems
- EA Prerequisite 2: Minimum Energy Performance
- EA Credit 1: Optimize Energy Performance
- EA Credit 3: Enhanced Commissioning
- EA Credit 5: Measurement & Verification
- EQ Credit 8: Daylight & Views

GGHC Operations Credit Synergies
- IO Prerequisite 1: Integrated Operations & Maintenance Process
- IO Prerequisite 4: Outside Air Introduction & Exhaust Systems
- IO Credit 1: Building Operations & Maintenance
- EE Prerequisite 1: Existing Building Commissioning
- EE Credit 1: Optimize Energy Performance
- EE Credit 2: On-Site & Off-Site Renewable Energy

1 point

EA Credit 3

Enhanced Commissioning

Intent

Begin the commissioning process early during the design process and execute additional activities after systems performance verification is completed.

Health Issues

Commissioning verifies the efficient and effective operations of a building's mechanical and electrical systems. It ensures compliance with energy performance goals and indoor air quality and thermal comfort design criteria. The benefits of commissioning lessen dependence on natural resources, resulting in improved outdoor air quality and reduced greenhouse gas emissions.

Credit Goals

In addition to the Fundamental Commissioning of the Building Energy Systems prerequisite (GGHC EA Prerequisite 1), implement or have a contract in place to implement, the following additional commissioning process activities:

1. Prior to the start of the construction documents phase, designate an independent Commissioning Authority (CxA) to lead, review, and oversee the completion of all commissioning process activities. The CxA shall, at a minimum, perform Tasks 2, 3 and 6. Other team members may perform Tasks 4 and 5.

    a. The CxA shall have documented commissioning authority experience in at least two building projects.

    b. The individual serving as the CxA shall be—

        i. independent of the work of design and construction;

        ii. not an employee of the design firm, though they may be contracted through them;

        iii. not an employee of, or contracted through, a contractor or construction manager holding construction contracts; and,

        iv. (can be) a qualified employee or consultant of the Owner.

    c. The CxA shall report results, findings and recommendations directly to the Owner.

    d. This requirement has no deviation for project size.

2. The CxA shall conduct, at a minimum, one commissioning design review of the Owner's Project Requirements (OPR), Basis of Design (BOD), and design documents prior to mid-construction documents phase and back-check the review comments in the subsequent design submission.

3. The CxA shall review contractor submittals applicable to systems being commissioned for compliance with the OPR and BOD. This review shall be concurrent with A/E reviews and submitted to the design team and the Owner.

4. Develop a systems manual that provides future operating staff the information needed to understand and optimally operate the commissioned systems.

EA Credit 3 continued

Enhanced Commissioning

5. Verify that the requirements for training operating personnel and building occupants are completed.

6. Assure the involvement by the CxA in reviewing building operation within 10 months after substantial completion with O&M staff and occupants. Include a plan for resolution of outstanding commissioning-related issues.

Suggested Documentation

- ❑ Document that the required additional commissioning tasks have been successfully executed or will be provided under existing contracts.

Reference Standards

- Green Building Reference Guide for New Construction and Major Renovations (LEED for New Construction) Version 2.2, Washington, DC: U.S. Green Building Council, http://www.usgbc.org/DisplayPage.aspx?CMSPageID=220#v2.2
  Potential Technologies & Strategies

- GGHC EA Prerequisite 1 establishes the framework of an effective commissioning program. The Enhanced Commissioning credit ensures peer review through independent, third party verification.

- Engage the commissioning authority early in the design phase.

- It is recommended that the same independent Commissioning Authority deliver the two re-commissioning tasks, although it is not required. Hospitals and health care systems with in-house expertise in design and commissioning may perform this work. However, this is extremely specialized expertise and the owner may benefit from engaging a credentialed Commissioning Authority.

- Although it is preferable that the Owner directly contract the CxA, for the enhanced commissioning credit the CxA may also be contracted through the design firms or construction management firms not holding construction contracts.

- The LEED for New Construction Version 2.2 Reference Guide provides detailed guidance on the rigor expected for following process activities:
  - Commissioning design review
  - Commissioning submittal review
  - Systems manual

EA Credit 3 continued

Enhanced Commissioning

GGHC Construction Credit Synergies

- SS Credit 4: Alternative Transportation
- SS Credit 8: Light Pollution Reduction
- WE Credit 1: Water Efficient Landscaping
- WE Credit 2: Potable Water Use Reduction
- EA Prerequisite 1: Fundamental Commissioning of the Building Energy Systems
- EA Prerequisite 2: Minimum Energy Performance
- EA Credit 1: Optimize Energy Performance
- EA Credit 2: On-Site Renewable Energy
- EA Credit 3: Enhanced Commissioning
- EA Credit 5: Measurement & Verification
- EQ Prerequisite 1: Minimum IAQ Performance
- EQ Prerequisite 3: Hazardous Material Removal or Encapsulation
- EQ Credit 1: Outdoor Air Delivery Monitoring
- EQ Credit 5: Chemical & Pollutant Source Control
- EQ Credit 6: Controllability of Systems
- EQ Credit 7: Thermal Comfort
- EQ Credit 8: Daylight & Views

GGHC Operations Credit Synergies

- IO Prerequisite 1: Integrated Operations & Maintenance Process
- IO Prerequisite 4: Outside Air Introduction & Exhaust Systems
- IO Credit 1: Building Operations & Maintenance
- IO Credit 2: IAQ Management
- WC Credit 1: Water Efficient Landscaping
- WC Credit 2: Building Water Use Reduction
- WC Credit 3: Performance Measurement: Enhanced Metering
- EE Prerequisite 1: Existing Building Commissioning
- EE Credit 1: Optimize Energy Performance
- EE Credit 2: On-Site & Off-Site Renewable Energy
- EE Credit 5: Performance Measurement

1 points

EA Credit 4

Enhanced Refrigerant Management

Intent

Reduce ozone depletion and support early compliance with the Montreal Protocol while minimizing direct contributions to global warming.

Health Issues

HVAC refrigerant emissions of halogenated hydrocarbons such as chlorofluorocarbons (CFCs) deplete the stratospheric ozone layer, which shields life on Earth from harmful levels of ultraviolet radiation. Higher levels of exposure can lead to increases in the incidence of skin cancers and eye cataracts. In addition, CFCs are thousands of times more powerful than carbon dioxide in trapping heat and therefore significantly contribute to the greenhouse warming effect.

Credit Goals

OPTION 1

- Do not use refrigerants.

OR

OPTION 2

- Select refrigerants and HVAC&R equipment that minimize or eliminate the emission of compounds that contribute to ozone depletion and global warming. The base building HVAC&R equipment shall comply with the following formula, which sets a maximum threshold for the combined contributions to ozone depletion and global warming potential:

$$LCGWP + LCODP \times 10^5 \leq 100$$

Where:

$LCODP = [ODP_r \times (Lr \times Life + Mr) \times Rc]/Life$
$LCGWP = [GWPr \times (Lr \times Life + Mr) \times Rc]/Life$
LCODP: Lifecycle Ozone Depletion Potential (lbCFC11/Ton-Year)
LCGWP: Lifecycle Direct Global Warming Potential ($lbCO_2$/Ton-Year)
GWPr: Global Warming Potential of Refrigerant (0 to 12,000 $lbCO_2$/lbr)
ODPr: Ozone Depletion Potential of Refrigerant (0 to 0.2 lbCFC11/lbr)
Lr: Refrigerant Leakage Rate (0.5% to 2.0%; default of 2% unless otherwise demonstrated)
Mr: End-of-life Refrigerant Loss (2% to 10%; default of 10% unless otherwise demonstrated
Rc: Refrigerant Charge (0.5 to 5.0 lbs of refrigerant per ton of cooling capacity)
Life: Equipment Life (10 years; default based on equipment type, unless otherwise demonstrated)

- For multiple types of equipment, a weighted average of all base building level HVAC&R equipment shall be applied using the following formula:

$$[\ \Sigma\ (LCGWP + LCODP \times 10^5) \times Qunit\ ] / Qtotal \leq 100$$

EA Credit 4 continued

Enhanced Refrigerant Management

Where:

Qunit = Cooling capacity of an individual HVAC or refrigeration unit (Tons)
Qtotal = Total cooling capacity of all HVAC or refrigeration

- Small HVAC units (defined as containing less than 0.5 lbs of refrigerant), and other equipment such as standard refrigerators, small water coolers, and any other cooling equipment that contains less than 0.5 lbs of refrigerant, are not considered part of the "base building" system and are not subject to the requirements of this credit.

AND

- Do not install fire suppression systems that contain ozone-depleting substances (CFCs, HCFCs or Halons).

Suggested Documentation

- ❑ Document that HVAC&R systems either do not use refrigerants or use refrigerants that meet the credit goals for leakage, ozone depletion and global warming potential as described in this credit.
- ❑ Document that fire suppression systems do not contain ozone-depleting substances in accordance with credit goals.

Reference Standards

There is no reference standard for this credit.

Potential Technologies & Strategies

- Design and operate the facility without mechanical cooling and refrigeration equipment.
- Where mechanical cooling is used, utilize base building HVAC and refrigeration systems for the refrigeration cycle that minimize direct impact on ozone depletion and global warming.
- Select HVAC&R equipment with reduced refrigerant charge and increased equipment life.
- Maintain equipment to prevent leakage of refrigerant to the atmosphere.
- Utilize fire suppression systems that do not contain HCFCs or Halons.

EA Credit 4 continued

Enhanced Refrigerant Management

Ozone-Depletion (ODP) and Global-Warming Potential (GWP) of Refrigerants			
Refrigerant	**ODP**	**GWP**	**Common Building Applications**
Chlorofluorocarbons			
CFC-11	1.0	4,680	Centrifugal chillers
CFC-12	1.0	10,720	Refrigerators, chillers
CFC-114	0.94	9,800	Centrifugal chillers
CFC-500	0.605	7,900	Centrifugal chillers, humidifiers
CFC-502	0.221	4,600	Low-temperature refrigeration
Hydrochlorofluorocarbons			
HCFC-22	0.04	1,780	Air-conditioning, chillers
HCFC-123	0.02	76	CFC-11 replacement
Hydrofluorocarbons			
HFC-23	≈0	12,240	Ultra-low-temperature refrigeration
HFC-134a	≈0	1,320	CFC-12 or HCFC-22 replacement
HFC-245fa	≈0	1,020	Insulation agent, centrifugal chillers
HFC-404A	≈0	3,900	Low-temperature refrigeration
HFC-407C	≈0	1,700	HCFC-22 replacement
HFC-410A	≈0	1,890	Air conditioning
HFC-507A	≈0	3,900	Low-temperature refrigeration
Natural Refrigerants			
Carbon Dioxide (CO2)	0	1.0	
Ammonia	0	0	
Propane	0	3	

Resources

Calm, J., "Comparative global warming impacts of electric vapor-compression and direct-fired absorption equipment," Electric Power Research Institute, Pleasant Hill, CA, EPRI 19TR-103297, 1993.

Carbon Dioxide Emissions from the Generation of Electric Power in the United States, 21 pp., Washington, DC: Department of Energy and Environmental Protection Agency, 2000, http://www.eia.doe.gov/cneaf/electricity/page/co2_report/co2emiss.pdf.

"Class I ozone-depleting substances," http://www.epa.gov/ozone/ods.html, 2002.

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Domanski, P., D. Didion, and J. Chi, "CYCLE D: NIST vapor compression cycle design program," National Institute of Standards and Technology, Gaithersburg, MD, NIST Standard Reference Database 49, version 2.0, 1999.

Environmental Protection Agency, Global Programs Division, Washington, DC 2003, "Data maintained in the tracking system for compliance with the Montreal Protocol."

"Global warming potentials of ODS substitutes," http://www.epa.gov/ozone/geninfo/gwps.html, 2002.

Green Building Reference Guide for New Construction and Major Renovations (LEED for New Construction) Version 2.2, Washington, DC: U.S. Green Building Council, http://www.usgbc.org/DisplayPage.aspx?CMSPageID=220#v2.2

EA Credit 4 continued

Enhanced Refrigerant Management

Inventory of U.S. Greenhouse Gas Emissions and Sinks, 291 pp., Washington, DC: EPA 430-R-04-003, 2004, http://yosemite.epa.gov/oar/globalwarming.nsf/content/ResourceCenterPublicationsGHGEmissions.html.

McLinden, M., and S. Klein, "NIST thermodynamic and transport properties of refrigerants," National Institute of Standards and Technology, Gaithersburg, MD, NIST Standard Reference Database 23, 1998.

United Nations Environmental Program, "UNEP Report of the Montreal Protocol Refrigeration, Air Conditioning and Heat Pumps Technical Option Committee," 2002.

United Nations Environmental Program, "Report of the TEAP Chiller Task Force (on CFC chillers and incentives/impediments to their replacement)," 2004.

GGHC Construction Credit Synergies
- EA Prerequisite 2: Minimum Energy Performance
- EA Prerequisite 3: Fundamental Refrigerant Management
- EA Credit 1: Optimize Energy Performance
- MR Credit 1: Building Reuse

GGHC Operations Credit Synergies
- EE Prerequisite 3: Ozone Protection
- EE Credit 3: Energy Efficient Equipment
- EE Credit 4: Refrigerant Selection

1 point

EA Credit 5

Measurement & Verification

Intent

Provide for the ongoing accountability of building energy consumption over time.

Health Issues

Optimizing energy consumption reduces dependence on natural resources, contributing to healthy ecosystems and reducing the particulate, toxic chemical, and greenhouse gas emissions associated with fossil-fuel generated electricity.

Credit Goals

- Develop and implement a Measurement & Verification (M&V) Plan consistent with Option D: Calibrated Simulation (Savings Estimation Method 2), or Option B: Energy Conservation Measure Isolation, as specified in the *International Performance Measurement & Verification Protocol (IPMVP) Volume III: Concepts and Options for Determining Energy Savings in New Construction, April, 2003.*

- Provide for long-term (minimum 3 years) continuous measurement of substantive energy uses within the facility (i.e. electrical loads greater than 100 KVA).

- At a minimum, provide metering for the following electrical and mechanical systems (as applicable to the scope of the project):
  - Lighting system power and controls
  - Motor loads (including air compressors, vacuum pumps and boiler systems)
  - Chillers
  - Data Centers
  - Critical Equipment Electrical Distribution Systems
  - Air distribution systems

Suggested Documentation

- ❑ Prepare a Measurement & Verification Plan.
- ❑ Include a summary schedule of the instrumentation and controls for the required monitoring categories, highlighting the I/O data points to be collected.
- ❑ Document the monitoring system, including cut sheets of sensors and the data collection system.

Reference Standards

International Performance Measurement and Verification Protocol Volume III: Concepts and Options for Determining Energy Savings in New Construction, April, 2003, http://www.evo-world.org.

EA Credit 5 continued

Measurement & Verification

Potential Technologies & Strategies

- Model the energy systems to predict savings.

- Develop and implement a Measurement and Verification Plan evaluating building and/or energy system performance. Characterize the building and/or energy systems through energy simulation or engineering analysis. Install the necessary metering equipment to measure energy use. Track performance by comparing predicted performance to actual performance, broken down by component or system as appropriate. Evaluate energy efficiency by comparing actual performance to baseline performance.

- Sub-meter electric systems.

- Use measured system data to analyze the performance of electrically driven equipment and systems (such as chiller performance at part loads, and operational profiles of variable flow fan and pump systems).

- While the IPMVP describes specific actions for verifying savings associated with energy conservation measures (ECMs) and strategies, this credit expands upon typical IPMVP M&V objectives. The IPMVP provides guidance on M&V strategies and their appropriate applications for various situations. These strategies should be used in conjunction with monitoring and trend logging of significant energy systems to provide for the ongoing accountability of building energy performance.

- Research possible peak load reduction incentive programs offered by some states or utility providers.

GGHC Construction Credit Synergies

- SS Credit 4: Alternative Transportation
- SS Credit 8: Light Pollution Reduction
- WE Credit 1: Water Efficient Landscaping
- WE Credit 2: Potable Water Use Reduction
- EA Prerequisite 1: Fundamental Commissioning of the Building Energy Systems
- EA Prerequisite 2: Minimum Energy Performance
- EA Credit 1: Optimize Energy Performance
- EA Credit 2: On-Site Renewable Energy
- EA Credit 3: Enhanced Commissioning
- EQ Prerequisite 1: Minimum IAQ Performance
- EQ Prerequisite 3: Hazardous Material Removal or Encapsulation
- EQ Credit 1: Outdoor Air Delivery Monitoring
- EQ Credit 2: Natural Ventilation
- EQ Credit 5: Chemical & Pollutant Source Control
- EQ Credit 6: Controllability of Systems
- EQ Credit 7: Thermal Comfort
- EQ Credit 8: Daylight & Views

EA Credit 5 continued

Measurement & Verification

GGHC Operations Credit Synergies

- IO Prerequisite 1: Integrated Operations & Maintenance Process
- IO Credit 1: Building Operations & Maintenance
- IO Credit 2: IAQ Management
- TO Credit 1: Alternative Transportation
- WC Credit 1: Water Efficient Landscaping
- WC Credit 2: Building Water Use Reduction
- WC Credit 3: Performance Measurement: Enhanced Metering
- EE Prerequisite 1: Existing Building Commissioning
- EE Prerequisite 2: Minimum Energy Performance
- EE Credit 1: Optimize Energy Performance
- EE Credit 2: On-Site & Off-Site Renewable Energy
- EE Credit 3: Energy Efficient Equipment
- EE Credit 5: Performance Measurement

4 points

EA Credit 6

Green Power

Intent

Encourage the development and use of grid-source, renewable energy technologies on a net zero pollution basis.

Health Issues

Purchasing renewably-based electricity to fulfill a portion of a building's energy needs offsets the greenhouse gas and particulate emissions associated with fossil-fuel electrical generation.

Credit Goals

- Provide a portion of the building's electricity from renewable sources by engaging in at least a two-year renewable energy contract. The annual electricity usage of the facility should be modeled to determine the expected energy demand. Renewable sources are defined by the Center for Resource Solutions (CRS) Green-e products certification requirements.

Point total	Green power provided as fraction of total annual electrical energy use
Credit 6.1 (1 point)	20%
Credit 6.2 (2 points)	50%
Credit 6.3 (3 points)	80%
Credit 6.4 (4 points)	100%

To determine baseline electricity use:

- Use the annual electricity consumption from the results of GGHC EA Credit 1 calculations.

OR

- Use the Department of Energy (DOE) Commercial Buildings Energy Consumption Survey (CBECS) database to determine the estimated electricity use.

Suggested Documentation

❑ Compile calculations of the building's baseline energy use and contracts that demonstrate the percentage of annual energy use in accordance with the credit goals.

Reference Standards

Center for Resource Solutions (CRS) Green-e program, http://www.green-e.org/.

EA Credit 6 continued

Green Power

Potential Technologies & Strategies

- Determine the energy needs of the building and investigate opportunities to engage in a green power contract. Green power is derived from solar, wind, geothermal, biomass or low-impact hydro sources. Visit http://www.green-e.org for details about the Green-e program. The power product purchased to comply with credit requirements need not be Green-e certified. Other sources of green power are eligible if they satisfy the Green-e program's technical requirements. Renewable energy certificates (RECs), tradable renewable certificates (TRCs), green tags and other forms of green power that comply with Green-e's technical requirements can be used to document compliance with GGHC EA Credit 6 credit goals.

GGHC Construction Credit Synergies
- ID Prerequisite 1: Integrated Design Process
- SS Credit 1: Site Selection
- SS Credit 5: Site Development
- EA Prerequisite 1: Fundamental Commissioning of the Building Energy Systems
- EA Prerequisite 2: Minimum Energy Performance
- EA Credit 1: Optimize Energy Performance
- EA Credit 3: Enhanced Commissioning
- EA Credit 5: Measurement & Verification
- EQ Credit 8: Daylight & Views

GGHC Operations Credit Synergies
- IO Prerequisite 1: Integrated Operations & Maintenance Process
- IO Prerequisite 4: Outside Air Introduction & Exhaust Systems
- IO Credit 1: Building Operations & Maintenance
- EE Prerequisite 1: Existing Building Commissioning
- EE Credit 1: Optimize Energy Performance
- EE Credit 2: On-Site & Off-Site Renewable Energy

1 point

EA Credit 7

Equipment Efficiency

Intent

Reduce energy consumption by using efficient medical and other equipment.

Health Issues

Energy efficiency benefits health by reducing particulate, toxic chemical, and greenhouse gas emissions associated with fossil-fuel based electrical generation, thereby improving outdoor air quality and curbing global climate change potential.

Credit Goals

- Calculate 75% of the equipment purchased for the project (based on number of units, not cost) according to one of the following criteria:
  - Where Energy Star® rating is available for a class of equipment, use only Energy Star qualified equipment.

  OR

  - Where Energy Star rating is not available for a class of equipment, use models that are among the 25th percentile of lowest energy consumers for that class of equipment. Equipment shall be compared based on their continuous (or "standby") mode electrical energy consumption.

Suggested Documentation

- ❑ Where Energy Star rating is available for a class of equipment, compile a listing of all medical and non-medical equipment purchased and demonstrate that Energy Star-qualified products have been purchased.
- ❑ Where Energy Star-qualified equipment is not yet available for an application, evaluate multiple pieces of equipment in accordance with credit goals.

Reference Standards

U.S. EPA's Energy Star® Program, http://www.energystar.gov.

Potential Technologies & Strategies

- Purchase computers, related electronics, and office equipment that carry the Energy Star® label. Examples of these include:
  - Computers, Monitors Printers & Scanners
  - Copiers
  - DVD Products
  - Exit Signs
  - Refrigerators and Freezers
  - TVs & VCRs
  - Water Coolers

EA Credit 7 continued

Equipment Efficiency

This is just a sampling of a steadily increasing list. Refer to EPA's Energy Star® Program for an up to date list of product categories and models (http://www.energystar.gov).

- Investigate the availability of Energy Star® qualified products for medical equipment purchases, particularly those items that are purchased or leased in quantity or represent particularly high electric consumption. Compile a market survey for classes of equipment where Energy Star® labeling is not yet available, identifying the top 25th percentile of lowest energy consumers. Examples of the most important high load medical equipment to focus upon include:
  - Diagnostic imaging equipment (x-rays, MRIs, etc)
  - Sterilization
  - Physiological monitoring
  - Laundry
  - Dietary
- Example calculation:
  - A facility is trying to decide whether purchasing the following equipment package for the new addition will win them this credit:
    - **20** computers (**Energy Star** rated)
    - **10** printers (**Energy Star**)
    - 2 copiers (not Energy Star)
    - 5 refrigerators (**2 Energy Star**, 3 not)
    - 1 MRI (Siemens' best, has higher heat rejection than the Philips, but lower than the GE)
    - 2 Cath lab set-ups (Siemens again, but this time, lower heat rejection than both the Philips and the GE). The set-up from Acme Cath Labs has higher heat rejection, but it isn't really the equivalent to the Siemens, Philips and GE set-ups. Acme does real-time 3-D imaging while the other three don't.
    - 4 scope washers (much worse heat rejection than any of the competitors)
    - 2 commercial hot food holding cabinets (not Energy Star rated)
    - **2** commercial steam cookers (**Energy Star rated**)
  - EVALUATION:
    - 48 pieces of equipment total.
    - To achieve the 75% threshold, 36 pieces of equipment must meet the credit goals.
    - 34 are Energy Star.
    - The two Cath Lab set-ups are the best in the industry, but there are only two other equivalent competitors, so they only represent the top 33rd percentile (not top 25th).
  - As originally scoped, the project misses the credit by two pieces of equipment. In order to receive the credit, the facility will need to switch two additional refrigerators to an Energy Star qualified model or two additional commercial hot food holding cabinets to an Energy Star qualified model, or one from each to an Energy Star qualified model or purchase medical equipment that is in the top 25%.

GGHC Operations Credit Synergies

- EE Prerequisite 1: Existing Building Commissioning
- EE Prerequisite 2: Minimum Energy Performance
- EE Credit 1: Optimize Energy Performance
- EE Credit 2: On-Site & Off-Site Renewable Energy
- EE Credit 3: Energy Efficient Equipment

GGHC Appendix 1

Design Assumptions & Procedures for Modeling for the GGHC Energy Credits

The following design assumptions that differ from the requirements of ASHRAE 90.1-2004 Appendix G shall be used:

- Lighting levels – area category lighting power density values shall be as described in Table L-1 below. Use area categories from Table L-1 in combination with any valid area category from ASHRAE-90.1

- Indoor Design Conditions: in accordance with 1999 ASHRAE Handbook, HVAC Applications, Chapter 7 Health Care Facilities, Specific Design Criteria, or the requirements of the local jurisdiction, whichever is more stringent.

- Ventilation, air changes and air pressure relationships: Use specific ventilation rates, air changes, and pressure relationships, as required by authorities having jurisdiction. If the authorities having jurisdiction have no specific requirements, use the requirements from 2006 AIA Guidelines for Design and Construction of Hospital and Health Care Facilities, or most recent version.

- Baseline Building HVAC Systems: The requirements of ASHRAE 90.1-2004, Appendix G, Section G4.2 shall be modified as follows: If the proposed building systems are Constant Air Volume or Variable Air Volume with devices to maintain pressure relationships at all times, the HVAC systems in the baseline building design shall be Constant Volume Systems with hot water (not electric) reheat. If the proposed building systems are Variable Air Volume without pressure tracking devices, then the HVAC systems in the baseline building design shall be Variable Air Volume with hot water (not electric) reheat.

- Plug Loads: See Occupancy Assumptions below.

- Process Ventilation loads: Special ventilation requirements in a health care facility are not unusual. While Table OCC-1 quantifies the typical ventilation in a health care facility, some spaces may require higher ventilation rates. The higher ventilation rates shall be simulated in both the Baseline and Proposed building simulation runs, making this an energy neutral feature.

- Process Fan Loads: Any energy consumed by fans that are solely related to process uses (such as EtO exhaust and kitchen hood exhaust), where the fan does not run 24 hours per day, may be excluded from the analysis.

- Occupancy Assumptions: Table OCC-1 lists the default values that shall be used in both the Baseline and Proposed building simulations. Should the user choose to use a different value for any of these assumptions (except for the lighting baseline), based upon professional judgment, the same value will be used in both the Baseline and Proposed building simulations.

- Lighting Controls and Daylighting: Table D-1 below shows factors that may be used to reduce lighting power densities calculated by the area category method to account for the various lighting control strategies listed. Factors shall be used to reduce the calculated LPD by multiplying the LPD for the area affected by the relevant strategy by the sum of 1 minus the factor listed. This corrected area LPD can then be used in the area/category calculations.

- Occupancy Schedules: In accordance with ASHRAE 90.1-2004 guidelines.

Table D-1 Lighting Power Savings Adjustment

TYPE OF CONTROL	TYPE OF SPACE	FACTOR
Occupant sensor With separate sensor for each space	Any space <250 square feet enclosed by opaque floor-to-ceiling partitions; any size classroom, corridor, conference or waiting room	0.20
	Rooms of any size that are used exclusively for storage	0.60
	Greater than <250 square feet	0.10
Dimming system		
Manual	Hotels/motels, restaurants, auditoriums, theaters	0.10
Multiscene programmable	Hotels/motels, restaurants, auditoriums, theaters	0.20
Tuning	Any space	0.10
Automatic time switch control device	<250 square feet and with a timed manual override at each switch location required by §131 (a), and controlling only the lights in the area enclosed by ceiling-height partitions.	0.05
Combined controls		
Occupant sensor with programmable multiscene dimming system	Hotels/motels, restaurants, auditoriums, theaters	0.35
Occupant sensor with a separate sensor for each space used in conjunction with daylighting controls and separate sensor for each space	Any space <250 square feet within a daylit area and enclosed by opaque floor-to-ceiling partitions	0.10 (may be added to daylighting control credit)

Automatic Daylighting Controls (Stepped/Dimming)			
	WINDOWS Window Wall Ratio		
Glazing Type	20%	20% to 40%	40%
VLT> 60%	0.20 0.30	0.30 / .040	0.40/0.40
VLT> 35 and < 60%	0/0	0.20/0.30	0.30/0.40
VLT< 35%	0/0	0/0	0.20/0.40
	SKYLIGHTS Percentage of Gross Exterior Roof Area		
Glazing Type	< 1%	1% to 3%	>3%
VLT > 60%	0/0.30	0.15/0.40	0.30/0.40
VLT>35 and < 60%	0/0.20	0/0.30	0.15/0.40
VLT < 35%	0/0.10	0/0.20	0/0.30

Notes for Table D-1:
1. From 2001 California Energy Efficiency Standards Non-residential Manual, August 2001, Table 5-10.

Table OCC-1 Area Occupancy Assumptions

Space Function	Occupant Density[1] (people/	Sensible (Btu/h / person)	Latent (Btu/h / person)	Receptacle Power[1] (W/ft²)	Service Water Heating[1] (Btu/h-person)	Lighting Power Density[2] (W/ft²)	Minimum O.A.[3] (CFM/ft²)	Operating Schedule[1] (Table 7.1.C)
Anesthesia Storage	5	250	213	1.00	0	3.0	1.20	H
Angiographic-All Other Types	5	250	213	1.00	600	3.0	0.30	H
Angiographic-Heart Only	5	250	213	1.00	600	3.0	0.75	H
Autopsy	5	250	213	1.00	600	1.2	0.30	H
Bathroom/ Public	3.3	250	250	0.10	0	0.6	0.15	H
Bedpan Room	5	250	213	0.10	600	0.5	0.15	H
Cast Room	5	250	213	1.00	600	3.0	0.30	H
Clean Linen Storage	1	250	250	0.10	0	0.5	0.30	H
Clean Utility / Workroom	5	250	213	2.00	215	1.2	0.30	H
Conference Rooms	20	245	155	0.10	150	1.2	0.50	H
Corridors	10	250	250	0.10	0	0.6	0.30	H
Cystoscopy	5	250	213	1.00	600	3.0	0.75	H
Darkroom	5	250	213	1.00	600	0.3	0.30	H
Decontamination	5	250	213	1.00	600	1.2	0.30	H
Delivery Room	5	250	213	1.00	1000	4.5	0.75	H
Dietary Day Storage	2	250	250	0.10	0	0.5	0.30	H
Dining Room	10	275	275	0.10	300	1.1	1.50	B
Dishwashing	5	275	475	1.00	215	1.7	0.30	H
Endoscopy	5	250	213	1.00	600	3.0	0.30	H
Histology	5	150	213	1.00	600	4.5	0.30	H
Isolation	5	250	213	1.00	300	0.5	0.30	H
Janitors Closet / Utility	1	250	250	0.10	0	0.5	1.50	H
Kitchen, Food Preparation	5	275	475	1.00	400	1.7	0.30	B
Labor/ Delivery/Recovery	5	250	213	1.00	1000	4.5	0.30	H
L / D / R / Post Partum	5	250	213	1.00	1000	0.7	0.30	H
Laboratory	5	250	213	1.00	600	3.0	0.30	H
Linen Storage, Clean	2	250	250	0.10	0	0.5	0.30	H
Lobby	10	250	250	0.10	100	1.1	0.15	H
Lockers	10	250	250	0.25	0	0.7	0.15	H
Mammography	5	250	213	1.00	600	3.0	0.30	H
Mechanical Equipment Room	0.5	250	250	0.10	0	0.7	0.15	H
Medical Records	2	250	250	0.10	0	3.0	0.15	H
Nuclear Medicine, Hot Lab	5	250	213	1.00	600	1.2	0.30	H
Nursery, General	5	250	213	1.00	300	3.0	0.45	H
Nursery, Exam	5	250	213	1.00	300	0.7	0.45	H
Nursing Stations- General	5	250	213	0.25	150	1.2	0.15	H
Operating Room	5	250	213	1.00	1000	4.5	0.75	H
Pathology	5	250	213	1.00	600	3.0	0.30	H
Patient Room	5	245	155	1.00	300	0.5	0.30	H
Pharmacy / Medicine Room	5	250	213	1.00	150	3.0	0.30	H
Physical Therapy and Hydrotherapy	5	250	213	1.00	150	1.2	0.30	C
Recovery	5	250	213	1.00	300	3.0	0.30	H
Scrub Up Area, Surgical Corridor	5	250	213	1.00	1000	4.5	0.30	H
Soiled Linen, Sorting	5	250	213	1.00	600	1.2	1.50	H
Special Procedure Room, Diagnostic	5	250	213	1.00	600	3.0	0.30	H

Space Function	Occupant Density[1] (people / 1000 ft²)	Sensible (Btu/h / person)	Latent (Btu/h / person)	Receptacle Power[1] (W/ft²)	Service Water Heating[1] (Btu/h-person)	Lighting Power Density[2] (W/ft²)	Minimum O.A.[3] (CFM/ft²)	Operating Schedule[1] (Table 7.1.C)
Special Procedure Room, Invasive	5	250	213	1.00	600	3.0	0.75	H
Stairways	1	250	213	0.10	0	0.6	0.15	H
Sterilizer Room	5	250	213	1.00	600	1.2	1.50	H
Sub-Sterile	5	250	213	1.00	600	0.7	0.30	H
Surgical Supply	5	250	213	1.00	0	1.2	0.30	H
Trash Chute Room	0.5	250	250	0.10	0	0.5	1.50	H
Trauma	5	250	213	1.00	600	3.0	0.75	H
Treatment / Examination	5	250	213	1.00	300	1.2	0.30	C
Unsterile Supply	2	250	250	1.00	0	0.5	0.30	H
Waiting Areas/Lounges	10	250	250	0.10	0	1.1	0.15	H
X-ray, Diagnostic and Treatment	5	250	213	1.00	600	3.0	0.30	H

Notes for Table OCC-1
(1) From ASHRAE/IESNA 90.1-2001 ECB Supplement Tables 7.1A & 7.1B
(2) See Table L-1
From 1998 California Mechanical Code when listed, otherwise from California ACM Manual Table 2-2.

Table L-1 Area Category Method

Baseline Lighting Power Density Values(watts/sf) by Primary Function For Hospital / Healthcare				
Anesthesia Storage	3.0		Lockers	0.7
Angiographic-All Other Types	3.0		Mammography	3.0
Angiographic-Heart Only	3.0		Mechanical Equipment Room	0.7
Autopsy	1.2		Medical Records	3.0
Bathroom	0.6		Nuclear Medicine, Hot Lab	1.2
Bedpan Room	0.5		Nursery, Exam	3.0
Cast Room	3.0		Nursery, General	0.7
Clean Linen Storage	0.5		Nursing Stations	0.7
Clean Utility / Workroom	1.2		Operating Room	4.5
Conference Rooms	1.2		Pathology	3.0
Corridors	0.6		Patient Room	0.5
Cystoscopy	3.0		Pharmacy / Medicine Room	3.0
Darkroom	0.3		Physical Therapy and Hydrotherapy	1.2
Decontamination	1.2		Recovery	3.0
Delivery Room	4.5		Scrub Up Area, Surgical Corridor	4.5
Dietary Day Storage	0.5		Soiled Linen, Sorting	1.2
Dining Room	1.1		Special Procedure Room, Diagnostic	3.0
Dishwashing	1.7		Special Procedure Room, Invasive	3.0
Endoscopy	3.0		Stairways	0.6
Histology	4.5		Sterilizer Room	1.2
Isolation	0.5		Sub-Sterile	0.7
Janitors Closet / Utility	0.5		Surgical Supply	1.2
Kitchen, Food Preparation	1.7		Trash Chute Room	0.5
Labor/Delivery/Recovery	4.5		Trauma	3.0
L / D / R / Post Partum	0.7		Treatment / Examination	1.2
Laboratory	3.0		Unsterile Supply	0.5
Linen Storage, Clean	0.5		Waiting Areas/Lounges	1.1
Lobby	1.1		X-ray. Diagnostic and Treatment	3.0
From Pacific Gas & Electric's 2003 Savings By Design Healthcare Modeling Procedures				

Process Loads Procedures:

- Remove the process load energy consumption calculated in the model used to demonstrate that the proposed building performance meets the ASHRAE 90.1-2004 Energy Cost Budget.

- Add in the process loads. Create an estimate of whole building process load usage or use the area category method, selecting load densities from Table P-1 below. Multiply the load density for an area by the operating hours per year for that area, and sum up all the areas to obtain the annual process energy consumption to be added to the modeling results for the HVAC, lighting, and service water heating energy consumption.

- Process Fan Loads: Add in an estimate of process fan loads.

Table P-1 Process Load Densities

Space Function	Process Equipment Average Watts/sf	Process Steam Average W/sf
Imaging Department or area	8	0
Emergency Department	3	0
Full-Service Kitchen	2	5
Surgical Suite	3	0
Radiation Therapy (linear accelerator and simulator room)	15	0
ICU/CCU	1	0
Nursing Units	½	0
Central Sterile	5	7
Cath Labs	5	0
Laundry	½	10
Labs	3	0