Facilities Management

Required

FM Prerequisite 1

Energy Efficiency Best Management Practices:
Planning, Documentation & Opportunity Assessment

Intent

Promote continuity of information to ensure that energy-efficient operating strategies are maintained and provide a foundation for training and system analysis.

Health Issues

Coal-fired power plants, the largest source of energy production in the U.S., are major contributors to particulate pollution, which can increase the risk of asthma, respiratory diseases, and heart attacks. Power plant emissions amplify their contribution to global climate change by releasing greenhouse gases such as carbon dioxide and nitrogen oxide (NOx) into the atmosphere through smoke stacks. Sulfur dioxide emissions contribute to acid rain. Furthermore, according to the U.S. EPA, coal-fired power plants are the largest source of human-caused mercury emissions.[1] Mercury released to the environment enters the aquatic food chain and contaminates fish consumed by people and wildlife. Mercury is a potent neurotoxin. The most sensitive health effect of mercury is an adverse impact on brain development of fetuses, infants and children. Low-level prenatal exposure can result in language, memory and attention deficits in children who were exposed in utero. Energy efficiency can enhance human health by reducing particulate, chemical and greenhouse gas emissions associated with fossil-fuel based combustion and electrical generation, thereby improving outdoor air quality and curbing global climate change and acid rain.

Credit Goals

- Develop and annually revise a Building Operating Plan that provides details on how the building is to be operated and maintained. The Building Operating Plan, at a minimum, shall include an occupancy schedule, equipment run time schedule, design set points for all HVAC equipment, and design lighting levels throughout the building. Identify any changes in schedules or set points for different seasons, different days of the week, and different times of day. Validate that the Building Operating Plan has been met for a minimum twelve-month period.
- Develop and annually revise a Systems Narrative that provides a brief description of the mechanical and electrical systems, equipment, and envelope systems in the building with a corresponding preventive maintenance plan for all equipment covered by the Narrative. The Systems Narrative shall include all the systems used to meet the operating conditions stated in the Building Operating Plan including, but not limited to, heating, cooling, ventilation, lighting and any building controls systems.
- Document and annually review the current Sequence of Operations for the building.
- Create and annually review a narrative of the preventative maintenance plan for equipment described in the Systems Narrative and document the preventative maintenance schedule over a minimum twelve-month period.
- Annually conduct an energy audit that meets the requirements of ASHRAE Level I – Walk-Through Assessment.

[1] U.S. Environmental Protection Agency (EPA), http://www.epa.gov/camr/basic.htm

FM Prerequisite 1 continued

Energy Efficiency Best Management Practices:
Planning, Documentation & Opportunity Assessment

Suggested Documentation

- ❑ Compile and annually review documentation of the Building Operating Plan, Systems Narrative, Sequence of Operations, preventative maintenance plan and energy audit in accordance with Credit Goals.

Reference Standards

American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE), http://www.ashrae.org

ASHRAE Level I – Walk-Through Assessment, supporting documents available at http://eweb.ashrae.org:

- Evaluation of Proposed ASHRAE Energy Audit form and procedures
- A guide to analyzing and reporting building characteristics and energy use in commercial buildings.
- An expert system for commercial Building HVAC and energy audits
- Procedures for commercial building energy audits
- Energy audit Input Procedures and Forms
- Evaluation of Proposed ASHRAE Energy Audit Form and Procedures

Potential Technologies & Strategies

- ***Credit Synergies:*** *Coordinate implementation of this prerequisite in coordination with GGHC IO Credit 1.1: Education: Building Operations & Maintenance Staff; GGHC FM Prerequisite 2: Minimum Building Energy Efficiency Performance; GGHC FM Credit 1: Optimize Energy Efficiency Performance; GGHC FM Credit 3: Existing Building Commissioning; GGHC FM Credit 5: Performance Measurement; and, GGHC FM Credit 6: IAQ Management: Maintaining Indoor Air Quality.*
- For facilities that have been operational less than one year constructed in accordance with the GGHC *Construction* section or LEED for Healthcare, consider demonstrating continuity of construction commissioning into operations and maintenance through a building operations review with O&M staff and occupants within ten months after substantial completion, in accordance with GGHC v2.2/LEED for Healthcare EA Credit 3: Enhanced Commissioning.
- The commissioning process activities begin by identifying the current building operating intents (Owner's Operational Requirements) and then proactively making sure that the buildings' systems are operating as necessary to meet these operating intents.
- Ensure that the commissioning program addresses, at a minimum, the following systems: heating system, cooling system, humidity control system, lighting system, safety systems, building envelope, and the building automation controls.
- Prepare a building operating plan that specifies the current operational needs of the building and identify building systems and other practices necessary to meet those needs. Outline the current sequence of operations to identify and eliminate any inefficiency.

FM Prerequisite 1 continued

Energy Efficiency Best Management Practices:
Planning, Documentation & Opportunity Assessment

- Develop and implement a preventative maintenance program to regularly monitor and optimize the performance of mechanical equipment regulating indoor comfort and the conditions delivered in occupied spaces.

Resources

"Continuous Commissioning Guidebook for Federal Energy Managers," Federal Energy Management Program, U.S. Department of Energy (DOE), October 2002.

U.S. Environmental Protection Agency (EPA), Energy Star "Building Manual", Stage 1 "Recommissioning" chapter http://www.energystar.gov/index.cfm?c=business.bus_upgrade_manual.

U.S. Environmental Protection Agency (EPA), Energy Star, "2003 CBECS National Average Source Energy Use and Performance Comparisons," located at http://www.energystar.gov/targetfinder. This site allows comparison of energy use intensities of non-ratable spaces to industry averages. Industry averages are derived from the 2003 Commercial Buildings Energy Consumption Survey.

Required

FM Prerequisite 2

Minimum Building Energy Efficiency Performance

Intent

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

Health Issues

Coal-fired power plants, the largest source of energy production in the U.S., are major contributors to particulate pollution, which can increase the risk of asthma, respiratory diseases, and heart attacks. Power plant emissions amplify their contribution to global climate change by releasing greenhouse gases such as carbon dioxide and nitrogen oxide (NOx) into the atmosphere through smoke stacks. Sulfur dioxide emissions contribute to acid rain. Furthermore, according to the U.S. EPA, coal-fired power plants are the largest source of human-caused mercury emissions.[2] Mercury released to the environment enters the aquatic food chain and contaminates fish consumed by people and wildlife. Mercury is a potent neurotoxin. The most sensitive health effect of mercury is an adverse impact on brain development of fetuses, infants and children. Low-level prenatal exposure can result in language, memory and attention deficits in children who were exposed in utero. Energy efficiency can enhance human health by reducing particulate, chemical and greenhouse gas emissions associated with fossil-fuel based combustion and electrical generation, thereby improving outdoor air quality and curbing global climate change and acid rain.

Credit Goals

OPTION 1

- For building types rated by Energy Star®, annually demonstrate that the facility has achieved a score of at least 69 utilizing the EPA Energy Star® Portfolio Manager Benchmarking Tool. Ratable spaces, including acute care hospitals and medical office buildings, are those that receive a 1-100 score in Portfolio Manager which enables weather normalized comparisons to the national building stock.

  OR

- For building types not rated by Energy Star, annually demonstrate that the facility has achieved an EUI of 19% above industry average in KBtu/ft2/year. Non-ratable spaces, including clinics and assisted living facilities, receive an EUI designation that is not normalized for climate nor adjusted for activities which may affect energy use.

  Note: Option 1 automatically awards projects 2 points in GGHC Facilities Management Credit 1: Optimize Energy Performance.

OR

[2] U.S. Environmental Protection Agency (EPA), http://www.epa.gov/camr/basic.htm

FM Prerequisite 2 continued

Minimum Building Energy Efficiency Performance

OPTION 2

- Facilities with Energy Star scores below 69 (or, if a non-rated facility, with an EUI that does NOT achieve 19% above industry average) shall improve energy performance by at least 7% per year on average over the improvement period until they reach the threshold listed under Option 1.

  AND

- Verify energy performance ratings through certification by a licensed professional engineer or facility manager, either on staff or third party.

Note: This prerequisite has been defined to require a building baseline computation that recognizes regulatory context and that is based upon actual ongoing building performance as a basis for defining performance improvement.

FM Prerequisite 2 continued

Minimum Building Energy Efficiency Performance

Suggested Documentation

- ❑ Quarterly compile the Statement of Energy Performance over a minimum one-year period from the Portfolio Manager benchmarking tool in accordance with Option 1 Credit Goals OR document the facility's plan to achieve an Energy Star score of 69 or EUI of 19% and quarterly and annual reviews of progress towards 7% improvement in energy performance in accordance with Option 2 Credit Goals.
- ❑ Compile and quarterly update a summary of the energy bills over the previous twelve months, including cost and usage amounts (kilowatt-hours, therms, gallons, etc.), for each type of energy used by the building annually. *Note: Energy use summaries are compiled automatically for those using EPA's Portfolio Manager benchmarking tool.*

Reference Standards

U.S. Environmental Protection Agency (EPA), Energy Star® National Energy Performance Rating System, http://www.energystar.gov/benchmark. Users create their own private accounts with Energy Star at no cost.

U.S. Environmental Protection Agency (EPA), Energy Star, "2003 CBECS National Average Source Energy Use and Performance Comparisons," http://www.energystar.gov/targetfinder. This site allows comparison of energy use intensities of non-ratable spaces to industry averages. Industry averages are derived from the 2003 Commercial Buildings Energy Consumption Survey (CBECS).

Potential Technologies & Strategies

- ***Credit Synergies:*** *Coordinate implementation of this prerequisite in coordination with GGHC IO Prerequisite 1: Integrated Operations & Maintenance Process; GGHC IO Credit 1.1: Education: Building Operations & Maintenance Staff; GGHC FM Prerequisite 1: Energy Efficiency Best Management Practices: Planning, Documentation & Opportunity Assessment; GGHC FM Prerequisite 3: Refrigerant Management: Ozone Protection; GGHC FM Credit 1: Optimize Energy Efficiency Performance; GGHC FM Credit 3: Existing Building Commissioning; GGHC FM Credit 5: Performance Measurement; GGHC FM Credit 7: On-Site & Off-Site Renewable Energy; GGHC FM Credit 8: Refrigerant Management; GGHC EP Prerequisite 2: Electronic Assets Environmental Management Plan; and, GGHC EP Credit 5: Electronics Purchasing & End of Life Management.*
- Retrofit building systems to improve energy performance while maintaining or improving health and safety requirements. Consider the following strategies as are regionally and climatically appropriate:
  - Building envelope improvements to reduce energy requirements, including, for example, insulation, window and door replacements.
  - Energy (latent and sensible) recovery.
  - Ground source heat pumps.
  - Evaporative cooling when ambient conditions allow.
  - Reduce outside airflow during unoccupied periods while maintaining appropriate pressure relationships (e.g., operating rooms) required by the 2006 Guidelines for Design and Construction of Hospitals and Healthcare Facilities. Ensure close monitoring to protect patient safety.
  - Expand unoccupied temperature dead band by automatically resetting zone temperature set points based on occupancy.

FM Prerequisite 2 continued

Minimum Building Energy Efficiency Performance

- 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 partial-load heating and cooling efficiency.
- Integrate daylighting strategies to decrease building energy demand.
- Design high efficiency chiller plants that use various technologies and strategies to reduce overall plant energy consumption at full and partial loads (such as chillers with variable speed drives on the compressors, primary-only variable flow pumping, series-counterflow chiller arrangements, etc.).
- Use low leakage air handling units to reduce overall fan horsepower while ensuring that air is properly filtered.
- Retrofit using variable speed motors, and Energy Star-rated equipment to reduce electrical consumption.
- Install energy efficiency lighting devices, such as: LED exit signs, fluorescents, Energy Star qualified lighting fixtures, and occupancy sensor controls. Ensure that all occupancy sensors are installed with capacity for manual override.
- Document the health and financial benefits of energy efficiency measures using tools such as the Healthcare Clean Energy Exchange's Energy Impact Calculator (EIC). Based on U.S. EPA and other peer-reviewed data, the EIC calculates carbon emissions and energy use health impacts such as premature deaths, chronic bronchitis, asthma attacks work loss days and hospital ER visits on a per kWh/year basis, as well as health care facilities' and external societal dollar costs per incident. Use the documented energy efficiency savings and the EIC to educate stakeholders (senior management, trustees, funders, staff, suppliers, service providers, host community, etc.) on efficiency benefits related to human and environmental health, financial, climate change risk reduction and fiduciary responsibilities. Monetize the documented energy efficiency for sale as energy efficiency credits (a.k.a. White Tags).

Resources

BetterBricks Hospitals & Healthcare website, http://www.betterbricks.com/subHomePage.aspx?ID=1

2006 Guidelines for Design and Construction of Hospitals and Healthcare Facilities, http://www.fgiguidelines.org/guidelines.html

Healthcare Clean Energy Exchange Energy Impact Calculator: http://www.hccleanenergy.org/

U.S. Environmental Protection Agency (EPA), Energy Star health care case studies, http://www.energystar.gov/labeledbuildings. Under “Selected Resources”, click “Find Labeled Buildings” and display those with Profiles. Commercial buildings that have earned the ENERGY STAR are the most energy efficient in the U.S. and cost 35% less to operate than average buildings.

Required

FM Prerequisite 3

Refrigerant Management: **Ozone Protection**

Intent

Reduce stratospheric ozone depletion.

Health Issues

Stratospheric ozone layer depletion increases exposure to ultraviolet radiation, increasing risks of 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 U.S. commitment to implementing the Montreal Protocol, the EPA has implemented regulations relative to the responsible management of Chlorofluorocarbons (CFCs), including programs to end the consumption and production of ozone depleting substances (ODS) and Hydrochlorofluorocarbons (HCFCs). HCFCs are a class of ozone depleting substance that have been used to replace CFC refrigerants. While HCFCs have a lower ODS rating than CFCs, the Montreal Protocol lists them in the second class of ODS to be phased out over time. In 2005, the World Meteorological Organization (WMO) reported an 8-9% decrease of ODS in the atmosphere from the peak in 1992-1994, while the level of HCFCs continues an upward trend. The U.S. has joined other countries party to the Montreal Protocol proposing an accelerated mandatory phase-out of HCFCs to bolster protection of the ozone layer. According to the United Nations Environment Programme, ozone depletion is also linked to climate change. Both trends are largely induced by human activities. Additionally, many ozone-depleting substances, such as CFC-11 and CFC-12, and some substitutes for ozone-depleting refrigerants, such as HFCs, are potent greenhouse gases.[3]

Credit Goals

- Zero use of Chlorofluorocarbon (CFC)-based refrigerants in new and replacement Heating, Ventilation, Air Conditioning, and Refrigerant (HVAC&R) base building equipment.
- If CFC-based refrigerant containing HVAC&R equipment is maintained in the building, implement a phase-out plan that reduces annual leakage to 5% or less using EPA Clean Air Act, Title VI, Rule 608 procedures governing refrigerant management and reporting, and reduces the total leakage over the remaining life of the unit to less than 30% of its refrigerant charge.
- Small HVAC&R units (defined as containing less than 0.5 lbs of refrigerant), and other equipment, such as standard refrigerators, small water coolers, medical equipment, 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.

[3] UNEP/GRID-Arendal, Ozone depletion and climate change, UNEP/GRID-Arendal Maps and Graphics Library, http://maps.grida.no/go/graphic/ozone-depletion-and-climate-change (Accessed 16 October 2008)

FM Prerequisite 3 continued

Refrigerant Management: **Ozone Protection**

Suggested Documentation

- ❑ Maintain documentation and evidence of an annual review demonstrating that base building HVAC&R equipment does not use CFCs. For CFC-based refrigerant containing equipment, document progress of the phase out plan in accordance with Credit Goals.

Reference Standards

U.S. Environmental Protection Agency (EPA) Clean Air Act, Title VI, Rule 608 governing refrigerant management and reporting, http://www.epa.gov/oar/caa/contents.html

Potential Technologies & Strategies

- ***Credit Synergies:*** *Coordinate implementation of this prerequisite in coordination with GGHC FM Prerequisite 1: Energy Efficiency Best Management Practices: Planning, Documentation & Opportunity Assessment; GGHC FM Prerequisite 2: Minimum Energy Efficiency Performance; GGHC FM Credit 1: Optimize Energy Efficiency Performance; GGHC FM Credit 3: Existing Building Commissioning; GGHC FM Credit 5: Performance Measurement; and, GGHC FM Credit 8: Refrigerant Management.*
- Non-CFC-based HVAC&R equipment is often more efficient than CFC-based equipment and can improve overall facility energy performance.
- Set up leakage minimization procedures and systems to meet annual leakage minimization standards and reporting requirements. For more information, see U.S. EPA's "Complying with the Section 608 Refrigerant Recycling Rule."
- 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&R equipment in the base building that uses no CFC refrigerants.
- Specify only non-CFC-based refrigerants in all new building HVAC&R systems. Identify all existing CFC-based refrigerant uses and upgrade the equipment if economically feasible.

FM Prerequisite 3 continued

Refrigerant Management: **Ozone Protection**

Resources

ANSI/ASHRAE 15-2004, *Safety Standard for Refrigeration Systems* (Also defines HFCs, CFCs and HCFC by formulation, compound and common name), http://www.ashrae.org.

ANSI/ASHRAE Standard 34-2004, Designation and Safety Classification of Refrigerants and Addenda a thru u., http://www.ashrae.org.

Building Owners and Managers Association (BOMA), The Refrigerant Manual: Managing the Phase Out of CFCs, 1993, http://www.boma.org

Chartered Institution of Building Services Engineers (CIBSE), CFCs, HCFCs and Halons - Professional and Practical Guidance on Substances that Deplete the Ozone Layer, 2000, http://www.cibse.org

Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), Building Systems Analysis & Retrofit Manual, 1995, http://www.smacna.org

U.S. Environmental Protection Agency (EPA), CFC Phase-Out Schedule, http://www.epa.gov/ozone/title6/phaseout

U.S. Environmental Protection Agency (EPA), Ozone Depletion, http://www.epa.gov/ozone

U.S. Environmental Protection Agency (EPA), Significant New Alternatives Policy (SNAP), http://www.epa.gov/ozone/snap/index.html

U.S. Environmental Protection Agency (EPA), Stratospheric Ozone Protection: Moving to Alternative Refrigerants, http://www.es.epa.gov/program/epaorgs/oar/altrefrg.html

U.S. Green Building Council, The Treatment by LEED of the Environmental Impact of HVAC Refrigerants, http://www.usgbc.org/DisplayPage.aspx?CMSPageID=154

Refrigerant Definitions

CFC: Chlorine Based

HCFC: Reduced ozone depleting potential, but still containing chlorine

HFC: Hydroflourocarbon that does not contain chlorine, but that still may contribute to global warming

Natural Refrigerants: water, carbon dioxide (CO_2), Ammonia (NH3), propane, etc.

Required

FM Prerequisite 4

Minimum Indoor Plumbing Fixture and Fitting Efficiency

Intent

Reduce indoor fixture and fitting water use within buildings to reduce the burdens on potable water supply and wastewater systems.

Health Issues

Maintaining adequate potable water supplies is a basic necessity for the health of individuals and communities. Only about 1% of the water on Earth is fresh water. Over-consumption, drought and poor water management have led thirty-six states in the U.S. to anticipate local, regional, or statewide water shortages by 2013.[4] Processing potable water is energy intensive and thus contributes to air emissions associated with fossil fuel energy generation (for the treatment, pumping and maintenance of the potable water systems). Only about 20% of current urban water is used for drinking and sanitary purposes, with the other 80% not requiring treatment to potable standards. Using reclaimed water for selected applications can reduce costs and preserve precious potable water supplies. To protect the public health, a dual or dedicated distribution system must be installed to segregate potable and reclaimed water.

Credit Goals

- Reduce potable water usage of indoor plumbing fixtures and fittings to a level equal to or below the facility baseline, calculated assuming 100% of the building's indoor plumbing fixture and fitting count were outfitted with fixtures and fittings meeting the Uniform Plumbing Code 2006 (UPC) or the International Plumbing Code (IPC) 2006 fixture and fitting performance requirements. Fixtures and fittings included in the calculations for this credit are water closets, urinals, showerheads, faucets, faucet replacement aerators and metering faucets.
- The baseline water usage is set depending on the year of substantial completion of the building's indoor plumbing system. Substantial completion is defined as either initial building construction or the last plumbing renovation of all or part of the building that included 100% retrofit of all plumbing fixtures and fittings as part of the renovation.
- Set the baseline as follows:
  - Plumbing system substantially completed in 1993 or later throughout the building – 120% of the water usage that would result if all fixtures meet the codes cited above; OR
  - Plumbing system substantially completed before 1993 throughout the building – 160% of the water usage that would result if all fixtures meet the codes cited above.
- If indoor plumbing systems were substantially completed at different times for different parts of the building, because the plumbing renovations occurred at different times, set a whole-building average baseline by prorating between the above limits. Prorate based on the proportion of plumbing fixtures installed during the plumbing renovations in each date period. Pre-1993 buildings that have had only minor fixture retrofits (aerators, showerheads, flushing valves) but no plumbing renovations may use the 160% baseline for the whole building.

[4] U.S. EPA, http://www.epa.gov/WaterSense/water/why.htm

FM Prerequisite 4 continued

Minimum Indoor Plumbing Fixture and Fitting Efficiency

- Demonstrate fixture and fitting performance through calculations to compare the water use of the as-installed fixtures and fittings to the use of the UPC/IPC compliant fixtures and fittings.
- Develop and implement a policy requiring economic assessment of conversion to high-performance plumbing fixtures and fittings as part of any future indoor plumbing renovation. The assessment must account for potential water supply and disposal cost savings and maintenance cost savings.

Suggested Documentation

- ❑ Compile documentation and annually update to verify that the existing building fixture potable water use is equal to or less than the baseline calculated according to Credit Goals.
- ❑ Maintain quarterly and annual water meter data for potable water use inside the building showing that the annual fixture potable water use is equal to or less than the calculated baseline.
- ❑ Compile a policy and annual assessment of progress phasing in high-performance plumbing fixtures and fittings in accordance with Credit Goals.

Reference Standards

International Plumbing Code (IPC) 2006, http://iccsafe.org

Uniform Plumbing Code (UPC) 2006, http://www.nfpa.org

Potential Technologies & Strategies

- ***Credit Synergies:*** *Coordinate implementation of this prerequisite in coordination with GGHC SSM Credit 1.2: Site Management: Integrated Pest Management, Erosion Control & Landscape Management Plan; GGHC SSM Credit 3: Stormwater Management; GGHC SSM Credit 5: Connection to the Natural World; GGHC FM Prerequisite 1: Energy Efficiency Best Management Practices: Planning, Documentation & Opportunity Assessment; GGHC FM Prerequisite 2: Minimum Energy Efficiency Performance; GGHC FM Credit 1: Optimize Energy Efficiency Performance; GGHC FM Credit 3: Existing Building Commissioning; GGHC FM Credit 2: Potable Water Use Reduction; and, GGHC FM Credit 5: Performance Measurement.*
- Reduce fixture potable water usage through automatic water control systems.
- Install, where possible, water conserving plumbing fixtures and fittings that meet or exceed the Uniform Plumbing Codes 2006 (UPC) or the International Plumbing Codes 2006 fixture and fitting requirements in combination with high efficiency or dry fixture and control technologies.
- Reclaim potable “grey” water drains, cooling coil condensate, and/or captured rainwater for filtration and treatment to use in non-potable process water needs such as process cooling (sterilizers) or cooling tower water make-up.

FM Prerequisite 4 continued

Minimum Indoor Plumbing Fixture and Fitting Efficiency

- Track the facility's water consumption using the water tracking feature of U.S. EPA's Energy Star® National Energy Performance Rating System, found within Portfolio Manager at http://www.energystar.gov/benchmark. Energy Star users create their own private accounts at no cost.
- Record meter and document reclaimed potable water use for further non-potable process use (i.e. cooling tower water make-up).
- Calculate annual fixture potable water use per occupant and per square foot.

Resources

American Society of Plumbing Engineers (ASPE), Plumbing Engineering Design Handbook, http://www.aspe.org

Healthcare Environmental Resource Center, Facilities Management – Water Conservation, http://www.hercenter.org/facilitiesandgrounds/waterconserve.cfm

New Hampshire Department of Environmental Services, Water Efficiency Practices for Health Care Facilities, http://www.des.state.nh.us/factsheets/ws/ws-26-14.htm

U.S. Department of the Interior, Water Measurement Manual, http://www.usbr.gov/pmts/hydraulics_lab/pubs/wmm/

U.S. Environmental Protection Agency (EPA) Region 2, Pollution Prevention (P2) for the Healthcare Industry, http://www.epa.gov/region2/p2/health.htm

Required

FM Prerequisite 5

Outdoor Air Introduction & Exhaust Systems

Intent

Establish minimum indoor air quality (IAQ) performance to enhance indoor air quality in buildings, thus contributing to the health and well-being of the occupants.

Health Issues

The EPA estimates that indoor air pollution is one of the top five environmental risks to public health. Indoor air can be as much as 10 times more polluted than outside air and contain many unique contaminants. Indoor air pollutants can cause problems ranging from immediate acute effects such as eye, nose, and throat irritation; sinusitis, asthma attacks, headaches; loss of coordination; and nausea; to long range chronic damage to the lungs, central nervous system, and other organ systems, depending on the specific contaminants. Poor IAQ is a leading cause of absenteeism from work and job dissatisfaction.

Credit Goals

- Modify or maintain each outdoor-air (OA) intake, supply air fan, and/or ventilation distribution system to supply at a minimum, the outdoor air ventilation rate required by ANSI/ASHRAE 62.1-2007 under the Ventilation Rate Procedure under all normal operating conditions or the minimum requirements of the relevant local licensing requirement for ventilation, whichever is more stringent, AND the air quality criteria required by ANSI/ASHRAE 62.1-2007 under all normal operating conditions. Show compliance through measurements taken at the system level (i.e. at the air handler unit). For variable air volume systems the dampers, fan speeds, etc. must be set during the test to the worst-case system conditions expected during normal ventilation operations. Each air-handler must be measured; sampling of air-handlers is prohibited.
- Implement and maintain an HVAC System Maintenance Program that incorporates a reliability centered maintenance approach to ensure the proper operations and maintenance of HVAC components as they relate to outdoor air introduction and exhaust.
- Meet the EPA Indoor Air Quality (IAQ) guidelines OR Sheet Metal & Air Conditioning Contractor's National Association (SMACNA) Indoor Air Quality Guidelines for Occupied Buildings Under Construction to ensure the proper operations and maintenance of HVAC components as they relate to IAQ.
- Test and maintain the operation of all building general and local exhaust systems, including but not limited to, bathroom, shower, utility areas, paint shops, print shops, laboratories, kitchen, parking, copy rooms, and large volume shredding exhaust systems.

FM Prerequisite 5 continued

Outside Air Introduction & Exhaust Systems

Suggested Documentation

- ❑ Annually compile a letter and backup tabular information from a mechanical engineer HVAC system specialist, or other qualified NSF testing and certification contractor demonstrating the general dilution ventilation and specialty local exhaust systems serving the building are operating as designed AND that the existing building outdoor-air (OA) ventilation distribution system supplies at least the outdoor air ventilation rate and air quality criteria required by ANSI/ASHRAE 62.1-2007 or the minimum requirements of the relevant local licensing requirement for ventilation, in accordance with the Credit Goals.
- ❑ Compile annual documentation verifying that HVAC components meet the EPA Indoor Air Quality (IAQ) guidelines OR Sheet Metal & Air Conditioning Contractor's National Association (SMACNA) Indoor Air Quality Guidelines for Occupied Buildings Under Construction in accordance with Credit Goals.
- ❑ Document and annually review the activity and successes associated with the HVAC System Maintenance Program, in accordance with Credit Goals.
- ❑ Annually compile a letter and backup tabular information of the most recent four quarterly inspections of the building OA/exhaust air system in accordance with Credit Goals and signed by a mechanical engineer or HVAC system specialist demonstrating that the exhaust air HVAC systems serving the building are operating as designed.

Reference Standards

ANSI/ASHRAE 62.1-2007, http://www.ashrae.org

NSF International, http://www.nsf.org

Sheet Metal & Air Conditioning Contractor's National Association (SMACNA) Indoor Air Quality Guidelines for Occupied Buildings Under Construction, http://www.smacna.org

U.S. Environmental Protection Agency (EPA) "Building Air Quality: A Guide for Building Owners and Facility Managers", Document No. 402-F-91-102, December 1991, http://www.epa.gov/iaq/largebldgs/graphics/iaq.pdf

Potential Technologies & Strategies

- ***Credit Synergies:*** *Coordinate implementation of this prerequisite with GGHC FM Prerequisite 1: Energy Efficiency Best Management Practices: Planning, Documentation & Opportunity Assessment and GGHC FM Credit 3: Existing Building Commissioning.*
- Maintaining indoor air quality begins with careful monitoring of outside air at intakes into the indoor air distribution systems, as well as the systems' exhaust components. Coupling properly designed, operated and maintained mechanical equipment with low-emitting materials can ensure healthy indoor air.
- Conduct a visual inspection of OA air vent/dampers and remove any OA air vent/louver obstructions that restrict full OA capacity from entering the distribution system.

FM Prerequisite 5 continued

Outside Air Introduction & Exhaust Systems

- Conduct airflow monitoring to document OA in terms of CFM. Compare measured flow to designed flow for each unit.
- Test the operation of each exhaust fan and verify that exhaust airflow meets design requirements/intentions, including demonstrating adequate capture velocity at the source interface. The U.S. EPA Guidelines for HVAC System Maintenance provide guidance on developing, implementing and maintaining an HVAC System Maintenance Program to ensure the proper operations and maintenance of HVAC components as they relate to IAQ.
- Place all components noted above in the institution's preventative maintenance system.

Resources

American Conference of Governmental Industrial Hygienists (ACGIH®), *Industrial Ventilation; A Manual of Recommended Practice,25th Edition (2004),* ACGIH®, 1330 Kemper Meadow Drive, Cincinnati, OH 45240-1634. http://www.acgih.org/store/

Harvard University, http://www.greencampus.harvard.edu/theresource/tech-prod/hvac-exhaust/

Industrial Ventilation; A Manual of Recommended Practice,25th Edition (2004), ACGIH®, 1330 Kemper Meadow Drive, Cincinnati, OH 45240-1634.

U.S. Environmental Protection Agency (EPA), Indoor Air Quality in Large Buildings, http://www.epa.gov/iaq/largebldgs/

Required

FM Prerequisite 6

Environmental Tobacco Smoke (ETS) Control

Intent

Prevent exposure of building occupants, indoor surfaces, and systems to Environmental Tobacco Smoke (ETS).

Health Issues

There are well-known health risks associated with Environmental Tobacco Smoke (or "secondhand smoke"). A 1993 report published by the U.S. EPA, *Respiratory Health Effects of Passive Smoking: Lung Cancer and Other Disorders,* concluded that secondhand smoke causes lung cancer in adult nonsmokers and impairs the respiratory health of children, corroborating earlier studies undertaken by the National Academy of Sciences and the U.S. Surgeon General. The EPA report classified secondhand smoke as a known human carcinogen, indicating sufficient evidence of the substance causing cancer in humans. The California EPA finds that ETS is a cause of breast cancer. ETS also increases the risk of premature birth, low birth weight, sudden infant death syndrome, and middle ear infections in children. Research has found that smoke-free workplaces are healthier for occupants. Smoke-free policies reduce the number of employees who start smoking, reduce the number of cigarettes smoked by employees by an average of 3.1 per day and reduce the number of employees who smoke by 3.8 percent. Reduced employee smoking prevalence reduces absenteeism, increases productivity, and reduces direct health care costs.

Credit Goals

- Prohibit smoking from the campus, including all buildings and public outdoor spaces.

  Note: For the purposes of this credit, a campus is defined as all facilities within the registered project's scope that are owned, leased and operated by the organization.

Exceptions:

Only in licensed residential health care facilities, psychiatric units and substance abuse clinics where the functional program requires accommodation for smokers may there be an exception to establish smoking areas according to the following criteria:

- Prohibit smoking in the building except in designated smoking areas.
- Locate any exterior designated smoking areas at least 50 feet (15.24 meters) away from building entries, operable windows, outdoor air intakes, bus stops, disabled parking, and other locations where occupants could inadvertently come in contact with ETS when occupying, entering or leaving the building.

FM Prerequisite 6 continued

Environmental Tobacco Smoke (ETS) Control

- Provide one or more designated smoking room designed to effectively contain, capture and remove ETS from the building. At a minimum, the smoking room(s) must be directly exhausted to the outdoors, away from air intakes and building entry paths, with no re-circulation of ETS-containing air to the non-smoking area of the building, enclosed with impermeable deck-to-deck partitions, operated at a negative pressure compared with the surrounding spaces of at least an average of 5 Pa (0.02 inches of water gauge) and with a minimum of 1 Pa (0.004 inches of water) when the door(s) to the smoking room are closed.
- Initially verify performance of the smoking room differential air pressures by conducting 15 minutes of measurement, with a minimum of one measurement every 10 seconds, of the differential pressure in the smoking room with respect to each adjacent area and in each adjacent vertical chase with the doors to the smoking room closed. Annually verify continued performance. The testing will be conducted with each space configured for worst-case conditions for transport of air from the smoking rooms to adjacent spaces.

Suggested Documentation

- ❑ Document and annually review the effectiveness of a written no-smoking policy. Maintain publicly displayed signage on the property .
- ❑ Residential facilities that accommodate smoking: Prepare and annually update a copy of the building site plan indicating designated smoking areas and their distances from entries, operable windows, air intakes, and other locations where occupants could inadvertently come in contact with ETS. Demonstrate achievement of the Credit Goals for designated smoking rooms through annual testing and monitoring records or equivalent documentation over a minimum one-year period.

Reference Standards

There is no reference standard for this credit.

FM Prerequisite 6 continued

Environmental Tobacco Smoke (ETS) Control

Potential Technologies & Strategies

- ***Credit Synergies:*** *Coordinate implementation of this prerequisite with GGHC FM Prerequisite 1: Energy Efficiency Best Management Practices: Planning, Documentation & Opportunity Assessment and GGHC FM Credit 3: Existing Building Commissioning.*
- Develop and implement a smoking-free/smoke-free policy including, at a minimum: defined smoke free facilities; publicly available information on the dangers of smoking and second hand smoke and the benefits of smoking cessation programs; a prohibition on the sale of tobacco products on the hospital campus; and, enforcement mechanisms for facility occupants in violation of the policy.
- Develop and implement smoking/ smoke-free policies.[1] Include within the policies an overview of the smoke free facilities, information on the dangers of smoking and second hand smoke, prohibiting the sale of tobacco products on the hospital campus, and the enforcement of policies.
- According to the U.S. EPA, "A smoke-free workplace is safer and healthier with reduced hazards, risks and costs for all employees and encourages a reduction in employee smoking. Smoke-free policies reduce the number of employees who start smoking, reduce the number of cigarettes smoked by employees by an average of 3.1 per day and reduce the number of employees who smoke by 3.8 percent. Reduced employee smoking prevalence reduces absenteeism, increases productivity, reduces direct health care costs, and may make it possible to negotiate lower health, life and disability coverage. ."[2&3]
- Promote Smoking Cessation and Employee Wellness programs such as the Quit for Life Program, preventive health care and wellness programs, and poster campaigns to post information about the dangers of smoking and second hand smoke in designated smoking areas and in other public areas.
- Offer other health and wellness programs and benefits, such as health care deductions, for participating in a Health Screening program and meeting established standards for tobacco usage, body-mass index, blood pressure and cholesterol.
- Display the smoke-free policy both in the facility and on the facility's website.
- Consider performing additional testing of the designated smoking room with the door open, operating exhaust sufficient to create a negative pressure with respect to the adjacent spaces of at least 1 Pa (0.004 inches water gauge).

Resources

Centers for Disease Control and Prevention, http://www.cdc.gov/tobacco/pubsl.html.

Quit for Life Program, http://www.freeclear.com

Tobacco Free Partners, http://www.tobaccofreepartners.org

University of Arkansas Medical Center; Smoke Free Hospital Tool Kit: A Guide for Implementing Smoke Free Policies, http://www.uams.edu/coph/reports/SmokeFree_Toolkit/Hospital%20Toolkit%20Text.pdf

U.S. Environmental Protection Agency (EPA), Respiratory Health Effects of Passive Smoking: Lung Cancer and Other Disorders, http://cfpub1.epa.gov/ncea/cfm/recordisplay.cfm?deid=2835.

1-15 points (2 Mandatory)

FM Credit 1

Optimize Energy Efficiency Performance

Intent

Achieve an increased level of energy efficiency performance relative to typical buildings of similar type to reduce environmental and health burdens associated with excessive energy use.

Health Issues

Coal-fired power plants, the largest source of energy production in the U.S., are major contributors to particulate pollution, which can increase the risk of asthma, respiratory diseases, and heart attacks. Power plant emissions amplify their contribution to global climate change by releasing greenhouse gases such as carbon dioxide and nitrogen oxide (NOx) into the atmosphere through smoke stacks. Sulfur dioxide emissions contribute to acid rain. Furthermore, according to the U.S. EPA, coal-fired power plants are the largest source of human-caused mercury emissions.[5] Mercury released to the environment enters the aquatic food chain and contaminates fish consumed by people and wildlife. Mercury is a potent neurotoxin. The most sensitive health effect of mercury is an adverse impact on brain development of fetuses, infants and children. Low-level prenatal exposure can result in language, memory and attention deficits in children who were exposed in utero. Energy efficiency can enhance human health by reducing particulate, chemical and greenhouse gas emissions associated with fossil-fuel based combustion and electrical generation, thereby improving outdoor air quality and curbing global climate change and acid rain.

Credit Goals

- Demonstrate either the EPA Energy Star® score or the Energy Use Intensity (EUI) that the facility has achieved according to the table below over a minimum twelve-months. Utilize the EPA benchmarking system within the Portfolio Manager Benchmarking Tool for building types addressed by Energy Star.
- Verify energy performance ratings through certification by a licensed professional engineer or facility manager, either on staff or third party.
- An energy meter(s) that measures all energy use for a minimum twelve-month period of each building in the project is required. Each building's energy performance must be based on actual metered energy consumption for both the GGHC project building(s) and all comparable buildings used for the benchmark. A full 12 months of continuous measured energy data is required.
- Meters must be calibrated within the manufacturer's recommended interval if the building owner, management organization, or a tenant owns the meter. Meters owned by third parties (e.g., utilities or governments) are exempt.

  Note: GGHC FM Prerequisite 2 automatically awards projects 2 points under this credit.

[5] U.S. Environmental Protection Agency (EPA), http://www.epa.gov/camr/basic.htm

FM Credit 1 continued

Optimize Energy Performance

	Ratable Spaces*	Non-ratable Spaces**
Credit 1.1 (1 point - Required)	Energy Star score of 67	EUI is 17% better than average
Credit 1.2 (2 points – Required)	Energy Star score of 69	EUI is 19% better than average
Credit 1.3 (3 points)	Energy Star score of 71	EUI is 21% better than average
Credit 1.4 (4 points)	Energy Star score of 73	EUI is 23% better than average
Credit 1.5 (5 points)	Energy Star score of 75	EUI is 25% better than average
Credit 1.6 (6 points)	Energy Star score of 77	EUI is 27% better than average
Credit 1.7 (7points)	Energy Star score of 79	EUI is 29% better than average
Credit 1.8 (8 points)	Energy Star score of 81	EUI is 31% better than average
Credit 1.9 (9 points)	Energy Star score of 83	EUI is 33% better than average
Credit 1.10 (10 points)	Energy Star score of 85	EUI is 35% better than average
Credit 1.11 (11 points)	Energy Star score of 87	EUI is 37% better than average
Credit 1.12 (12 points)	Energy Star score of 89	EUI is 39% better than average
Credit 1.13 (13 points)	Energy Star score of 91	EUI is 41% better than average
Credit 1.14 (14 points)	Energy Star score of 93	EUI is 43% better than average
Credit 1.15 (15 points)	Energy Star score of 95+	EUI is 45% better than average

*Ratable spaces, including acute care hospitals and medical office buildings, are those that receive a 1-100 score in Portfolio Manager, which enables weather normalized comparisons to the national building stock.

**Non-ratable spaces, including clinics and assisted living facilities, receive an EUI only, which is not normalized for climate nor adjusted for activities which may affect energy use.

FM Credit 1 continued

Optimize Energy Performance

Suggested Documentation

- ❑ Compile the Statement of Energy Performance over a minimum one-year period from the Portfolio Manager benchmarking tool in accordance with Credit Goals.
- ❑ Compile and quarterly update a summary of the energy bills over the previous twelve months, including cost and usage amounts (kilowatt-hours, therms, gallons, etc.), for each type of energy used by the building annually. *Note: Energy use summaries are compiled automatically for those using EPA's Portfolio Manager benchmarking tool.*

Reference Standards

U.S. Environmental Protection Agency (EPA), Energy Star® National Energy Performance Rating System, within Portfolio Manager at http://www.energystar.gov/benchmark. Energy Star users create their own private accounts at no cost.

U.S. Environmental Protection Agency (EPA), "2003 CBECS National Average Source Energy Use and Performance Comparisons," http://www.energystar.gov/targetfinder. This site allows comparison of energy use intensities of non-ratable spaces to industry averages. Industry averages are derived from the 2003 Commercial Buildings Energy Consumption Survey (CBECS).

Potential Technologies & Strategies

- ***Credit Synergies:*** *Coordinate implementation of this credit in coordination with GGHC IO Prerequisite 1: Integrated Operations & Maintenance Process; GGHC IO Credit 1.1: Education: Building Operations & Maintenance Staff; GGHC FM Prerequisite 1: Energy Efficiency Best Management Practices: Planning, Documentation & Opportunity Assessment; GGHC FM Prerequisite 2: Minimum Building Energy Efficiency Performance; GGHC FM Prerequisite 3: Refrigerant Management: Ozone Protection; GGHC FM Credit 3: Existing Building Commissioning; GGHC FM Credit 5: Performance Measurement; GGHC FM Credit 7: On-Site & Off-Site Renewable Energy; GGHC FM Credit 8: Refrigerant Management; GGHC EP Prerequisite 2: Electronic Assets Environmental Management Plan; and, GGHC EP Credit 5: Electronics Purchasing & End of Life Management.*
- Implement energy-efficiency retrofits and energy-saving techniques to reduce energy use to the level required to earn this credit.
- Retrofit building systems to improve energy performance while maintaining or improving health and safety requirements. Consider the following strategies as are regionally and climatically appropriate:
  - Building envelope improvements to reduce energy requirements, including insulation, window and door replacements.
  - Energy (latent and sensible) recovery.
  - Ground source heat pumps.
  - 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.

FM Credit 1 continued

Optimize Energy Performance

- 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.
- Integrate daylighting to decrease building energy costs.
- 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.).
- Use low leakage air handling units to reduce overall fan horsepower while ensuring that air is properly filtered.
- Retrofit using variable speed motors, and Energy Star® rated equipment to reduce electrical consumption.
- Install energy efficiency lighting devices, such as: LED exit signs, fluorescents, Energy Star qualified lighting fixtures, and Occupancy sensor controls.

- Annually apply for the ENERGY STAR award from the U.S. EPA for Energy Star scores that are 75 or higher. The ENERGY STAR is awarded for a specific year to indicate superior energy performance. A facility that has earned the ENERGY STAR can re-apply one year after the previous year's application, provided the facility still maintains at least a 75.

- Document the health and financial benefits of energy efficiency measures using tools such as the Healthcare Clean Energy Exchange's Energy Impact Calculator (EIC). Based on EPA and other peer-reviewed data, the EIC calculates carbon emissions and energy use health impacts such as premature deaths, chronic bronchitis, asthma attacks work loss days and hospital ER visits on a per kWh/year basis, as well as healthcare facilities' and external societal dollar costs per incident. Use the documented energy efficiency savings and the EIC to educate stakeholders (senior management, trustees, funders, staff, suppliers, service providers, host community, etc.) on efficiency benefits related to human and environmental health, financial, climate change risk reduction and fiduciary responsibilities. Monetize the documented energy efficiency for sale as energy efficiency credits (a.k.a. White Tags).

Resources

BetterBricks Hospitals & Healthcare website, http://www.betterbricks.com/subHomePage.aspx?ID=1

Healthcare Clean Energy Exchange Energy Impact Calculator: http://www.hccleanenergy.org/

U.S. Environmental Protection Agency (EPA), Energy Star health care case studies, http://www.energystar.gov/labeledbuildings. Under “Selected Resources”, click “Find Labeled Buildings” and display those with Profiles. Commercial buildings that have earned the ENERGY STAR are the most energy efficient in the U.S. and cost 35% less to operate than average buildings.

1-5 points

FM Credit 2.1-2.5

Potable Water Use Reduction: **Total Building Reduction**

Intent

Maximize indoor potable water use efficiency within buildings to reduce the burden on municipal water supply and wastewater systems.

Health Issues

Maintaining adequate potable water supplies is a basic necessity for the health of individuals and communities. Only about 1% of the water on Earth is fresh water. Over-consumption, drought and poor water management have led thirty-six states in the U.S. to anticipate local, regional, or statewide water shortages by 2013.[6] Processing potable water is energy intensive and thus contributes to air emissions associated with fossil fuel energy generation (for the treatment, pumping and maintenance of the potable water systems). Only about 20% of current urban water is used for drinking and sanitary purposes, with the other 80% not requiring treatment to potable standards. Using reclaimed water for selected applications can reduce costs and preserve precious potable water supplies. To protect the public health, a dual or dedicated distribution system must be installed to segregate potable and reclaimed water.

Credit Goals

- Ensure no once-through potable water use for interior water features. If potable water is used in interior or exterior water features, it shall be separately metered and the water features' consumption shall be excluded from the numerator of the water reduction calculations outlined in the table below.
- Develop and implement strategies and systems that in aggregate produce a percentage reduction of total building potable water use from a facility baseline measured over a minimum one-year period. At least one meter for the overall building water use is required.
- Develop potable water use reduction strategies in collaboration with the facility infection control committee to minimize potential infection control risks.

  Note: See FM Credit 5.3: Performance Measurement: Enhanced Water Metering for more information about sub-metering potable water use.

Credit 2.1 (1 point)	Reduce total building potable water use by 10% when compared with the facility's measured baseline.
Credit 2.2 (2 points)	Reduce total building potable water use by 20% when compared with the facility's measured baseline.
Credit 2.3 (3 points)	Reduce total building potable water use by 30% when compared with the facility's measured baseline.
Credit 2.4 (4 points)	Reduce total building potable water use by 40% when compared with the facility's measured baseline.
Credit 2.5 (5 points)	Reduce total building potable water use by 50% when compared with the facility's measured baseline.

[6] U.S. EPA, http://www.epa.gov/WaterSense/water/why.htm

FM Credit 2.1-2.5 continued

Potable Water Use Reduction: **Total Building Reduction**

Suggested Documentation

- ❑ Compile and annually review documentation verifying that no once-through potable water is used for interior water features.
- ❑ Demonstrate that the existing building total potable water use is less than the facility's measured baseline using calculations, fixture cut sheets, results of direct measurement, photographs and other equivalent documentation over a minimum one year period. Exclude interior and exterior water features from the baseline in accordance with Credit Goals.
- ❑ Compile quarterly and annual water meter data for water use in the building supporting the documentation of the annual total building potable water use.

Reference Standards

There is no referenced standard for this credit.

Potential Technologies & Strategies

- ***Credit Synergies:*** *Coordinate implementation of this credit in coordination with GGHC SSM Credit 1.2: Site Management: Integrated Pest Management, Erosion Control & Landscape Management Plan; GGHC SSM Credit 3: Stormwater Management; GGHC SSM Credit 5: Connection to the Natural World; GGHC FM Prerequisite 1: Energy Efficiency Best Management Practices: Planning, Documentation & Opportunity Assessment; GGHC FM Prerequisite 2: Minimum Energy Efficiency Performance; GGHC FM Prerequisite 4: Minimum Indoor Plumbing Fixture and Fitting Effciency; GGHC FM Credit 1: Optimize Energy Efficiency Performance; GGHC FM Credit 2: Potable Water Use Reduction; GGHC FM Credit 3: Existing Building Commissioning; and, GGHC FM Credit 5: Performance Measurement.*
- Reduce fixture water usage through automatic controls and other actions.
- Specify water conserving plumbing fixtures and fittings that exceed the Uniform Plumbing Code 2006 (UPC) or the International Plumbing Code (IPC) 2006 fixture and fitting performance requirements in combination with high efficiency or dry fixture and control technologies.
- Reclaim potable water drains for filtration and treatment to use in process non-potable water needs, reducing the facility's overall consumption (i.e. cooling tower make-up, sterilizer steam quench, or other process cooling needs).
- Track the facility's water consumption using the water tracking feature of EPA's Energy Star® National Energy Performance Rating System, found within Portfolio Manager at http://www.energystar.gov/benchmark. Energy Star users create their own private accounts at no cost.

FM Credit 2.1-2.5 continued

Potable Water Use Reduction: **Total Building Reduction**

Resources

American Society of Plumbing Engineers (ASPE), Plumbing Engineering Design Handbook, http://www.aspe.org

Healthcare Environmental Resource Center, Facilities Management – Water Conservation, http://www.hercenter.org/facilitiesandgrounds/waterconserve.cfm

Maryland Department of the Environment, Water Saving Tips for Health Care Facilities, http://www.mde.state.md.us/Programs/WaterPrograms/Water_Conservation/Business_Tips/health.asp

New Hampshire Department of Environmental Services, Water Efficiency Practices for Health Care Facilities, http://www.des.state.nh.us/factsheets/ws/ws-26-14.htm

Practice Greenhealth, Water Conservation Tools, http://www.practicegreenhealth.org

U.S. Department of the Interior, Water Measurement Manual, http://www.usbr.gov/pmts/hydraulics_lab/pubs/wmm/

U.S. Environmental Protection Agency (EPA) Region 2, Pollution Prevention (P2) for the Healthcare Industry, http://www.epa.gov/region2/p2/health.htm

1 point

FM Credit 2.6

Potable Water Use Reduction: **Water Efficient Landscaping**

Intent

Eliminate the use of potable water or other natural surface/subsurface resources available on or near the facility site for landscape irrigation.

Health Issues

Maintaining adequate potable water supplies is a basic necessity for the health of individuals and communities. Only about 1% of the water on Earth is fresh water. Over-consumption, drought and poor water management have led thirty-six states in the U.S. to anticipate local, regional, or statewide water shortages by 2013.[7] Processing potable water is energy intensive and thus contributes to air emissions associated with fossil fuel energy generation (for the treatment, pumping and maintenance of the potable water systems). Only about 20% of current urban water is used for drinking and sanitary purposes, with the other 80% not requiring treatment to potable standards. Using reclaimed water for selected applications can reduce costs and preserve precious potable water supplies. To protect the public health, a dual or dedicated distribution system must be installed to segregate potable and reclaimed water.

Credit Goals

- Use only captured rainwater, recycled wastewater, recycled greywater, or water treated and conveyed by a public agency specifically for non-potable uses for irrigation.
  OR
- Install landscaping that does not require permanent irrigation systems. Temporary irrigation systems used for plant establishment are allowed only if removed within one year of installation and plants are weaned in accordance with design and installation instructions.

AND

- In urban settings, where there is no lawn or landscaping, this credit can be earned by eliminating the use of potable water for watering any roof and/or courtyard garden space or outdoor planters, provided that the planters and/or garden space cover at least 5% of the building site area (including, building footprint, hardscape area, parking footprint, etc.). If the planters and/or garden space cover less than 5% of the building site area, the project is ineligible for this credit.

Note: For the purposes of this credit, potable water shall be defined in accordance with health regulations having jurisdiction.

Note: If authorities having jurisdiction (e.g., Infection Control) do not permit irrigation using non-potable water sources, vegetated areas in accordance with SSM Credit 4.2: Heat Island Effect: Roof; SSM Credit 5.1: Connection to the Natural World: Outdoor Places of Respite; and/or SSM Credit 5.2: Connection to the Natural World: Exterior Access for Patients comply with this credit if they install a high-efficiency irrigation system. For the purposes of this credit, "high-efficiency irrigation systems" are defined as irrigation systems that use minimum 30% less water than conventional sprinkler irrigation. High-efficiency irrigation systems include micro or drip irrigation systems, moisture sensors, clock timers and water-data based controllers.

[7] U.S. EPA, http://www.epa.gov/WaterSense/water/why.htm

FM Credit 2.6 continued

Potable Water Use Reduction: **Water Efficient Landscaping**

Suggested Documentation

- ❑ Compile and annually update documentation such as a brief narrative description, system schematics, and photographs demonstrating non-potable water use in irrigation in accordance with the Credit Goals. Include a description about how the irrigation system is connected to the non-potable water source and how that non-potable water is treated/filtered and managed.
- ❑ Compile records of sign off from the head of facility management for the facility on the annual meter readings documenting the amount of non-potable water used for irrigation.
- ❑ Compile and annually review quarterly water meter readings supporting the documentation of the reduction in potable water use for irrigation as well as quarterly reports that document the maintenance activities implemented to ensure proper operation of the irrigation system.
- ❑ In urban settings with no lawn or landscaping, compile documentation verifying that the planters and/or garden space cover at least 5% of the building site area in accordance with Credit Goals.

Reference Standards

There is no reference standard for this credit.

Potential Technologies & Strategies

- ***Credit Synergies:*** *Coordinate implementation of this credit in coordination with GGHC SSM Credit 1.2: Site Management: Integrated Pest Management, Erosion Control & Landscape Management Plan; GGHC SSM Credit 3: Stormwater Management; GGHC SSM Credit 5: Connection to the Natural World; GGHC FM Prerequisite 1: Energy Efficiency Best Management Practices: Planning, Documentation & Opportunity Assessment; GGHC FM Prerequisite 2: Minimum Energy Efficiency Performance; GGHC FM Prerequisite 4: Minimum Indoor Plumbing Fixture and Fitting Effciency; GGHC FM Credit 1: Optimize Energy Efficiency Performance; GGHC FM Credit 2: Potable Water Use Reduction; GGHC FM Credit 3: Existing Building Commissioning; and, GGHC FM Credit 5: Performance Measurement.*
- Implement and maintain high efficiency irrigation technologies that include micro irrigation, moisture sensors, or weather data based controllers.
- Feed irrigation systems with captured rainwater, gray water (site or municipal), or on-site treated wastewater. Using reclaimed water for selected applications can reduce costs and preserve precious potable water supplies.
- Consider eliminating use of an irrigation system. Consider use of xeriscaping principles. Select water-efficient, native or adapted, non-invasive climate tolerant plantings.
- Track the facility's water consumption using the water tracking feature of U.S. EPA's Energy Star® National Energy Performance Rating System, found within Portfolio Manager at http://www.energystar.gov/benchmark.

FM Credit 2.6 continued

Potable Water Use Reduction: **Water Efficient Landscaping**

Resources

American Rainwater Catchment Systems Association (ARCSA), http://www.arcsa-usa.org

Teresa Durkin and Marita Roos, *Green Guide for Health Care* Sustainable Site Design: Stormwater Mitigation Technical Brief, http://www.gghc.org.

The Irrigation Association, http://www.irrigation.org; Certification program, http://www.irrigation.org/certification/default.aspx?pg=default.htm&id=18

The Sustainable Sites Initiative, http://www.sustainablesites.org/

Texas Evapotranspiration Website, http://texaset.tamu.edu

U.S. Department of Energy (DOE) Federal Energy Management Program, Water Efficiency Best Management Practice #14 – Alternate Water Sources, http://www1.eere.energy.gov/femp/water/water_bmp14.html

U.S. Environmental Protection Agency (EPA), Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices, December 2007, http://www.epa.gov/owow/nps/lid/costs07/

1-2 points

FM Credit 2.7 & 2.8

Potable Water Use Reduction: **Cooling Tower**

Intent

Reduce potable water consumption for cooling tower equipment through effective water management and/or use of non-potable make-up water.

Health Issues

Maintaining adequate potable water supplies is a basic necessity for the health of individuals and communities. Only about 1% of the water on Earth is fresh water. Over-consumption, drought and poor water management have led thirty-six states in the U.S. to anticipate local, regional, or statewide water shortages by 2013.[8] Processing potable water is energy intensive and thus contributes to air emissions associated with fossil fuel energy generation (for the treatment, pumping and maintenance of the potable water systems). Only about 20% of current urban water is used for drinking and sanitary purposes, with the other 80% not requiring treatment to potable standards. Using reclaimed water for selected applications can reduce costs and preserve precious potable water supplies. To protect the public health, a dual or dedicated distribution system must be installed to segregate potable and reclaimed water.

Credit Goals

FM Credit 2.7: Cooling Tower Chemical Management (1 point)

- Develop and implement a water management plan for the cooling tower that addresses chemical treatment, bleed-off, biological control and staff training as it relates to cooling tower maintenance.
- Improve water efficiency by installing and/or maintaining a conductivity meter and automatic controls to adjust the bleed rate and maintain proper concentration at all times.
- Employ non-toxic treatment chemicals or chemical-free cooling tower systems that meet NACE International Standard 7K189, "Control Factors in Performance Testing of Nonchemical Water Treatment Devices," 1997, and that demonstrate effectiveness in controlling at minimum, *Legionella spp.* per the 2003 CDC/HICPAC Guidelines for Environmental Infection Control in Health-Care Facilities.

Note: For the purposes of this credit, "non-toxic treatment chemicals" are defined as chemicals free of components listed by the U.S. DOT (Department of Transportation), OSHA (Occupational Safety and Health Administration), or EPA (Environmental Protection Agency) as toxic or hazardous.

[8] U.S. Environmental Protection Agency (EPA), http://www.epa.gov/WaterSense/water/why.htm

FM Credit 2.7 & 2.8 continued

Potable Water Use Reduction: **Cooling Tower**

FM Credit 2.8: Cooling Tower Non-Potable Water Source Use (1 point)

- Use make-up water that consists of at least 50% non-potable water over a minimum one-year period, such as:
    - Harvested rainwater
    - Air conditioner condensate
    - Swimming pool filter backwash water
    - Cooling tower blowdown
    - Pass-through (once-through) cooling and reverse osmosis water
    - Foundation drain water
    - Municipally reclaimed water
    - Steam condensate
    - Processed cooling water
    - Any other appropriate on-site water source that is not from a well (aquifer), river, or lake
- Develop and implement a measurement program that verifies make-up water quantities used from non-potable sources.

Note: An innovation point is available to facilities reducing potable water use as cooling tower makeup by 100% over a minimum 12-month period.

Note: For the purposes of this credit, potable water shall be defined in accordance with health regulations having jurisdiction.

Note: Meters must be calibrated within the manufacturer's recommended interval if the building owner, management organization, or a tenant owns the meter. Meters owned by third parties (e.g., utilities or governments) are exempt.

Suggested Documentation

FM Credit 2.7:

- ❑ Document and annually review the facility's water management plan addressing chemical treatment, bleed-off, biological control and staff training as it relates to cooling tower maintenance in accordance with Credit Goals.
- ❑ Document and annually review records of installation and periodic maintenance for cooling tower conductivity meter(s) and automatic controls.
- ❑ Compile annual documentation of the cooling tower's treatment chemicals (if any) in accordance with Credit Goals.

FM Credit 2.8:

- ❑ Document and annually review the percent of cooling tower makeup water from non-potable sources and its provenance over a minimum one-year period.

FM Credit 2.7 & 2.8 continued

Potable Water Use Reduction: **Cooling Tower**

Reference Standards

NACE International (formerly National Association of Corrosion Engineers) Standard 7K189, "Control Factors in Performance Testing of Nonchemical Water Treatment Devices," 1997, http://www.nace.org

U.S. Centers for Disease Control and Prevention, 2003 CDC/HICPAC Guidelines for Environmental Infection Control in Health-Care Facilities, http://www.cdc.gov/ncidod/dhqp/gl_environinfection.html

U.S. Department of Transportation Federal Hazardous Materials Transportation Law (Title 49 CFR), http://www.phmsa.dot.gov

U.S. Environmental Protection Agency (EPA) Toxic Substances Control Act, Toxic Substances Control Act, http://www.epa.gov/lawsregs/laws/tsca.html

U.S. Occupational Safety and Healthy Administration (OSHA), Hazardous and Toxic Substances, http://www.osha.gov/SLTC/hazardoustoxicsubstances/index.html

Potential Technologies & Strategies

- ***Credit Synergies:*** *Coordinate implementation of this credit in coordination with GGHC SSM Credit 1.2: Site Management: Integrated Pest Management, Erosion Control & Landscape Management Plan; GGHC SSM Credit 3: Stormwater Management; GGHC SSM Credit 5: Connection to the Natural World; GGHC FM Prerequisite 1: Energy Efficiency Best Management Practices: Planning, Documentation & Opportunity Assessment; GGHC FM Prerequisite 2: Minimum Energy Efficiency Performance; GGHC FM Prerequisite 4: Minimum Indoor Plumbing Fixture and Fitting Effciency; GGHC FM Credit 1: Optimize Energy Efficiency Performance; GGHC FM Credit 3: Existing Building Commissioning; GGHC FM Credit 2: Potable Water Use Reduction; and, GGHC FM Credit 5: Performance Measurement.*
- Work with a water treatment specialist to develop a water management strategy addressing the appropriate chemical treatment and bleed-off to ensure proper concentration levels in the cooling tower. Also, develop a biocide treatment program to avoid biological contamination and the risk of Legionella in the building.
- Identify non-potable water sources that may be suitable for use in the cooling tower make-up water. Ensure that the water meets the cooling tower manufacturer's guidelines in terms of water purity and adjust the chemical treatment program accordingly.
- Explore technologies and strategies to eliminate chemical waste to drain in cooling tower and boiler blowdown. Treat blowdown so that chemical treatment can be reclaimed for re-use.

Resources

Cooling Technology Institute, http://www.cti.org/

Federal Energy Management Program Best Management Practice (BMP) #8 – Cooling Tower Management, http://www.p2pays.org/ref/21/20923.htm

1 point

FM Credit 3.1

Existing Building Commissioning: **Investigation & Analysis**

Intent

Through a systematic process, develop an understanding of the operation of the facility's major energy using systems, options for optimizing the building's energy performance and a plan to achieve energy savings.

Health Issues

Coal-fired power plants, the largest source of energy production in the U.S., are major contributors to particulate pollution, which can increase the risk of asthma, respiratory diseases, and heart attacks. Power plant emissions amplify their contribution to global climate change by releasing greenhouse gases such as carbon dioxide and nitrogen oxide (NOx) into the atmosphere through smoke stacks. Sulfur dioxide emissions contribute to acid rain. Furthermore, according to the U.S. EPA, coal-fired power plants are the largest source of human-caused mercury emissions.[9] Mercury released to the environment enters the aquatic food chain and contaminates fish consumed by people and wildlife. Mercury is a potent neurotoxin. The most sensitive health effect of mercury is an adverse impact on brain development of fetuses, infants and children. Low-level prenatal exposure can result in language, memory and attention deficits in children who were exposed in utero. Energy efficiency can enhance human health by reducing particulate, chemical and greenhouse gas emissions associated with fossil-fuel based combustion and electrical generation, thereby improving outdoor air quality and curbing global climate change and acid rain.

Credit Goals

- Document the breakdown of energy use in the building.
- Annually list identified capital improvements that will provide cost-effective energy savings and document the cost benefit analysis associated with each.

AND

- Conduct one of the following:
  - Commissioning Process
    - Develop and bi-annually review a retrocommissioning, recommissioning or ongoing commissioning plan for the facility's major energy using systems and envelope systems.
    - Bi-annually conduct the Investigation and Analysis Phases
    - Bi-annually list operating problems impacting occupant comfort and energy use, and develop potential operational changes that will solve them.

  OR

  - ASHRAE Level II Energy Audit
    - Bi-Annually conduct an energy audit that meets the requirements of ASHRAE, Level II – Energy Survey and Analysis.
    - Bi-Annually perform a savings and cost analysis of all practical measures that meet the owner's constraints and economic criteria, along with a discussion of any effect on operation and maintenance procedures.

[9] U.S. Environmental Protection Agency (EPA), http://www.epa.gov/camr/basic.htm

FM Credit 3.1 continued

Existing Building Commissioning: **Investigation & Analysis**

Suggested Documentation

- ❑ Compile and maintain documentation of the breakdown of energy use in the building and capital improvements that will provide cost-effective energy savings in accordance with Credit Goals.
- ❑ Compile and maintain documentation of an annual commissioning plan OR energy audit in accordance with Credit Goals.

Reference Standards

American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE), http://www.ashrae.org

The following ASHRAE Documents available at http://eweb.ashrae.org

- Evaluation of Proposed ASHRAE Energy Audit form and procedures
- A guide to analyzing and reporting building characteristics and energy use in commercial buildings.
- An expert system for commercial building HVAC and energy audits
- Procedures for commercial building energy audits
- Energy audit Input Procedures and Forms
- Evaluation of Proposed ASHRAE Energy Audit Form and Procedures

Potential Technologies & Strategies

- ***Credit Synergies:*** *Coordinate implementation of this credit in coordination with GGHC IO Credit 1.1: Education: Building Operations & Maintenance Staff; GGHC FM Prerequisite 1: Energy Efficiency Best Management Practices: Planning, Documentation & Opportunity Assessment; GGHC FM Prerequisite 2: Minimum Building Energy Efficiency Performance; GGHC FM Credit 1: Optimize Energy Efficiency Performance; GGHC FM Credit 5: Performance Measurement; and, GGHC FM Credit 6: IAQ Management: Maintaining Indoor Air Quality.*
- The commissioning process activities begin by identifying the current building operating intents (Owner's Operational Requirements) and then proactively making sure that the buildings' systems are operating as necessary to meet these operating intents.
- Ensure that the commissioning program addresses, at a minimum, the following: heating system, cooling system, humidity control system, lighting system, safety systems, building envelope, and the building automation controls.
- Investigate evidence of simultaneous heating and cooling as a basis for recommendations of adjustments to building systems management.
- Include test and balances investigation activities as part of the commissioning process to determine the actual amounts of outside air and exhaust air.

FM Credit 3.1 continued

Existing Building Commissioning: **Investigation & Analysis**

Resources

"Continuous Commissioning Guidebook for Federal Energy Managers," Federal Energy Management Program, US Department of Energy (DOE), October 2002.

U.S. Environmental Protection Agency (EPA) Energy Star, "Building Manual", Stage 1 "Recommissioning" chapter, http://www.energystar.gov/index.cfm?c=business.bus_upgrade_manual.

U.S. Environmental Protection Agency (EPA) Energy Star, "2003 CBECS National Average Source Energy Use and Performance Comparisons," http://www.energystar.gov/targetfinder. This site allows comparison of energy use intensities of non-ratable spaces to industry averages. Industry averages are derived from the 2003 Commercial Buildings Energy Consumption Survey (CBECS).

1 point

FM Credit 3.2

Existing Building Commissioning: **Implementation**

Intent

Implement minor improvements and identify planned capital projects to ensure that the facility's major energy using systems are repaired, operated, and maintained effectively to optimize the buildings' energy performance.

Health Issues

Coal-fired power plants, the largest source of energy production in the U.S., are major contributors to particulate pollution, which can increase the risk of asthma, respiratory diseases, and heart attacks. Power plant emissions amplify their contribution to global climate change by releasing greenhouse gases such as carbon dioxide and nitrogen oxide (NOx) into the atmosphere through smoke stacks. Sulfur dioxide emissions contribute to acid rain. Furthermore, according to the U.S. EPA, coal-fired power plants are the largest source of human-caused mercury emissions.[10] Mercury released to the environment enters the aquatic food chain and contaminates fish consumed by people and wildlife. Mercury is a potent neurotoxin. The most sensitive health effect of mercury is an adverse impact on brain development of fetuses, infants and children. Low-level prenatal exposure can result in language, memory and attention deficits in children who were exposed in utero. Energy efficiency can enhance human health by reducing particulate, chemical and greenhouse gas emissions associated with fossil-fuel based combustion and electrical generation, thereby improving outdoor air quality and curbing global climate change and acid rain.

Credit Goals

- Annually develop and evaluate a five-year capital plan for major retrofits or upgrades including implementation of no- or low-cost operational improvements.
- Provide training in accordance with GGHC IO Credit 1.1: Education: Building Operations & Maintenance Staff for facility management staff at the point of hire and annually that builds awareness and skills in a broad range of sustainable building operations subject matter, including energy efficiency and building, savings and benchmarking, and equipment and systems operation and maintenance.
- Annually demonstrate the observed and/or anticipated financial costs and benefits of measures that were implemented.
- Update the building's Building Operating Plan as necessary to reflect any changes in the occupancy schedule, equipment run time schedule, design set points, and lighting levels.

[10] U.S. Environmental Protection Agency (EPA), http://www.epa.gov/camr/basic.htm

FM Credit 3.2 continued

Existing Building Commissioning: **Implementation**

Suggested Documentation

- ❑ Compile and maintain documentation of the five-year capital plan for major retrofits or upgrades in accordance with Credit Goals.
- ❑ Compile and maintain documentation of individual staff annual training in accordance with Credit Goals.
- ❑ Compile and maintain documentation of the observed and/or anticipated financial costs and benefits of implemented energy efficiency measures in accordance with Credit Goals.
- ❑ Maintain documentation of the building's Building Operating Plan in accordance with Credit Goals.

Reference Standards

There are no reference standards for the credit.

Potential Technologies & Strategies

- ***Credit Synergies:*** *Coordinate implementation of this credit in coordination with GGHC IO Credit 1.1: Education: Building Operations & Maintenance Staff; GGHC FM Prerequisite 1: Energy Efficiency Best Management Practices: Planning, Documentation & Opportunity Assessment; GGHC FM Prerequisite 2: Minimum Building Energy Efficiency Performance; GGHC FM Credit 1: Optimize Energy Efficiency Performance; GGHC FM Credit 5: Performance Measurement; and, GGHC FM Credit 6: IAQ Management: Maintaining Indoor Air Quality.*
- The commissioning process activities begin by identifying the current building operating intents (Owner's Operational Requirements) and then proactively making sure that the buildings' systems are operating as necessary to meet these operating intents.
- Engage building operators in the commissioning process through the following steps:
  - Help develop objectives and compile a list of possible improvements and known problems
  - Gather up-to-date building documentation
  - Perform appropriate preventive maintenance tasks prior to commissioning
  - Perform simple repairs and improvements as the project progresses
  - Assist with diagnostic monitoring and functional testing
  - Implement or assist with implementing the selected improvements
  - Operational narratives
- Ensure that the commissioning program addresses, at a minimum, the following: heating system, cooling system, humidity control system, lighting system, safety systems, building envelope, and the building automation controls.
- If an outside person is hired for commissioning services, verify that the contractor's technical personnel are specially qualified and competent to complete the work.

FM Credit 3.2 continued

Existing Building Commissioning: **Implementation**

Resources

American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) Learning Institute Courses, http://www.ASHRAE-eLearning.org
Example Courses: Fundamentals of Standard 62.1 (Indoor Air Quality), Fundamentals of Standard 90.1 (HVAC Equipment Efficiency Standards), Fundamentals of HVAC Systems, Fundamentals of HVAC control Systems

Building Operator Certification (BOC®), http://www.theBOC.info
Example classes: BOC 214 – Building Commissioning; BOC 105 – Operation & Maintenance Strategies for Sustainable Buildings.

Building Owners & Managers International (BOMI), http://www.bomi.org
Example Courses: Buildings Systems Maintenance Certificate (SMC), Facilities Management Certificate (FMC)

"Continuous Commissioning Guidebook for Federal Energy Managers," Federal Energy Management Program, U.S. Department of Energy (DOE), October 2002.

U.S. Environmental Protection Agency (EPA) Energy Star, "Building Manual", Stage 1 "Recommissioning" chapter, http://www.energystar.gov/index.cfm?c=business.bus_upgrade_manual.

1 point

FM Credit 3.3

Existing Building Commissioning: **Ongoing Commissioning**

Intent

Use commissioning to address constant changes in facility occupancy, usage, maintenance and repair. Make periodic adjustments and reviews of building operating systems and procedures essential for optimal energy efficiency and provided service.

Health Issues

Coal-fired power plants, the largest source of energy production in the U.S., are major contributors to particulate pollution, which can increase the risk of asthma, respiratory diseases, and heart attacks. Power plant emissions amplify their contribution to global climate change by releasing greenhouse gases such as carbon dioxide and nitrogen oxide (NOx) into the atmosphere through smoke stacks. Sulfur dioxide emissions contribute to acid rain. Furthermore, according to the U.S. EPA, coal-fired power plants are the largest source of human-caused mercury emissions.[11] Mercury released to the environment enters the aquatic food chain and contaminates fish consumed by people and wildlife. Mercury is a potent neurotoxin. The most sensitive health effect of mercury is an adverse impact on brain development of fetuses, infants and children. Low-level prenatal exposure can result in language, memory and attention deficits in children who were exposed in utero. Energy efficiency can enhance human health by reducing particulate, chemical and greenhouse gas emissions associated with fossil-fuel based combustion and electrical generation, thereby improving outdoor air quality and curbing global climate change and acid rain.

Credit Goals

- Implement an ongoing commissioning program that includes elements of planning, system testing, performance verification, corrective action response, ongoing measurement and documentation to proactively address operating problems.
- Create and annually revise a written plan that summarizes the overall commissioning cycle for the building by equipment or building system group. The ongoing commissioning cycle shall not exceed 24 months. This plan must include a building equipment list, performance measurement frequency for each equipment item and steps to respond to deviation from expected performance parameters.
- Track progress of the ongoing commissioning program against a baseline of two years previous to the current year.
- Update the Building Operating Plan and/or Systems Narrative as necessary to reflect any changes in the occupancy schedule, equipment run time schedule, design set points, lighting levels, or system specifications.

[11] U.S. Environmental Protection Agency (EPA), http://www.epa.gov/camr/basic.htm

FM Credit 3.3 continued

Existing Building Commissioning: **Ongoing Commissioning**

Suggested Documentation

- ❑ Compile and maintain documentation of the ongoing commissioning program, updating the baseline to reference two years previous to the current year.
- ❑ Compile and maintain documentation of a written plan that summarizes the overall commissioning cycle in accordance with Credit Goals.
- ❑ Maintain documentation of the building's Building Operating Plan in accordance with Credit Goals.

Reference Standards

There are no reference standards for the credit.

Potential Technologies & Strategies

- ***Credit Synergies:*** *Coordinate implementation of this credit in coordination with GGHC IO Credit 1.1: Education: Building Operations & Maintenance Staff; GGHC FM Prerequisite 1: Energy Efficiency Best Management Practices: Planning, Documentation & Opportunity Assessment; GGHC FM Prerequisite 2: Minimum Building Energy Efficiency Performance; GGHC FM Credit 1: Optimize Energy Efficiency Performance; GGHC FM Credit 5: Performance Measurement; and, GGHC FM Credit 6: IAQ Management: Maintaining Indoor Air Quality.*
- The commissioning process activities begin by identifying the current building operating intents (Owner's Operational Requirements) and then proactively making sure that the buildings' systems are operating as necessary to meet these operating intents.
- Ensure that the commissioning program addresses, at a minimum, the following: heating system, cooling system, humidity control system, lighting system, safety systems, building envelope, and the building automation controls.
- Incorporate into the commissioning program regular inspections of the mechanical ventilation system to identify if the filters are clean, not overloaded and without leaks or tears and insure that drip pans are free of standing water or other contaminants.

Resources

"Continuous Commissioning Guidebook for Federal Energy Managers," Federal Energy Management Program, U.S. Department of Energy (DOE), October 2002.

U.S. Environmental Protection Agency (EPA) Energy Star, "Building Manual", Stage 1 "Recommissioning" chapter, http://www.energystar.gov/index.cfm?c=business.bus_upgrade_manual.

U.S. Environmental Protection Agency (EPA) Energy Star, "2003 CBECS National Average Source Energy Use and Performance Comparisons," located at http://www.energystar.gov/targetfinder. This site allows comparison of energy use intensities of non-ratable spaces to industry averages. Industry averages are derived from the 2003 Commercial Buildings Energy Consumption Survey (CBECS).

1 point

FM Credit 4.1

Building Operations & Maintenance: **Staff Education**

Intent

Support appropriate training for facilities maintenance and engineering staff in monitoring, operations and maintenance of building systems to ensure the facility delivers target building performance goals over the life of the building.

Health Issues

Ongoing facilities operations and maintenance procedures for building systems are inextricably linked to occupant health and safety. Monitoring operations and maintenance practices for consistency with original design intent of mechanical and other building systems with facility environmental and health policies helps to ensure that indoor air quality and mechanical performance standards are sustained over the life of the building.

Credit Goals

- Develop and implement a continuing education program for facilities management operations and maintenance staff that provides each staff person with primary building maintenance responsibilities with minimum 8 hours per year of continuing education courses above and beyond licensure requirements on topics covered in the GGHC Facilities Management section such as building systems operations, continuous commissioning, maintenance, energy and water efficient building operations and maintenance practices, and/or achieving sustainable building performance. Qualifying courses shall meet the quality standards for continuing education required by the staff member's licensing board.

Note: Coordinate implementation of this credit with pursuit of Prerequisites and Credits in the GGHC Facilities Management section.

FM Credit 4.1 continued

Building Operations & Maintenance: **Staff Education**

Suggested Documentation

- ❑ Document and annually review records of the training received by building operations and maintenance staff in accordance with Credit Goals. Compile training certificates listing the staff member's name, course titles, relevant course reference citations, course certification body, hours of training, and annual total training hours.
- ❑ Document and annually review records of the calculated annual average training hours for all building operations and maintenance staff in accordance with the Credit Goals.

Reference Standards

There are no reference standards for this credit.

Potential Technologies & Strategies

- ***Credit Synergies:*** *Coordinate implementation of this credit with all prerequisites and credits in the GGHC Facilities Management section.*
- Ensure that all maintenance staff is trained in optimal operations and maintenance practices within their scope of work at hire and annually.
- Arrange on-site or off-site training for building operations and maintenance staff that addresses:
  - Building and building systems operation
  - Maintenance
  - Achieving sustainable building performance

Resources

American Institute of Architects (AIA), http://www.aia.org

(ASHE), http://www.ashe.org

American Society of Healthcare Engineering Educational Offerings, http://www.ashe.org/ashe/education/

American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), Learning Institute Courses, http://www.ASHRAE-eLearning.org

American Trainco, http://www.AmericanTrainco.com

Building Owners & Managers Institute International (BOMI) International, Courses & Seminars, http://www.bomi.org/CourseOfferingList.aspx?id=154

International Facility Management Association (IFMA), http://www.ifma.org

Practice Greenhealth, http://www.practicegreenhealth.org

U.S. Environmental Protection Agency (EPA), http://www.epa.gov

U.S. Green Building Council (USGBC), http://www.usgbc.org

1 point

FM Credit 4.2

Building Operations & Maintenance: **Building Systems Maintenance**

Intent

Support appropriate training, monitoring, operations and maintenance for buildings and building systems to ensure they deliver target building performance goals over the life of the building.

Health Issues

Ongoing operations and maintenance procedures are inextricably linked to the protection of occupant health and safety. Preventive maintenance practices including adequate training for operations and maintenance staff ensures consistency with original design intent. In combination with facility environmental/health policies, preventive maintenance improves the wellbeing of patients, staff and visitors by safeguarding indoor air quality, infection prevention and control and mechanical performance.

Credit Goals

- Establish and maintain a comprehensive best practices equipment preventive maintenance program that provides in-house resources and/or contractual services to deliver maintenance.
- If operating a new building, require that the operating and maintenance documentation provided to the building owner contain meaningful, appropriate, and system/equipment-specific training materials from the design/construction team explaining the sustainable building goals and anticipated performance.
- Use a formal Computerized Maintenance Management System (CMMS) to track equipment and trigger preventive maintenance, document history, and manage the maintenance program.

Suggested Documentation

- ❑ Demonstrate ongoing building systems maintenance in accordance with the Credit Goals through minimum one-year documentation of in-house resources and/or contractual services to deliver post warranty equipment maintenance.
- ❑ If operating a new building, compile and store in an easily accessible place the operating and maintenance documentation provided by the design/construction team.
- ❑ Compile and annually review documentation associated with the Computerized Maintenance Management System, including actions (such as repairs) triggered by the CMMS.

Reference Standards

There is no reference standard for this credit.

Potential Technologies & Strategies

- ***Credit Synergies:*** *Coordinate implementation of this credit in coordination with GGHC IO Credit 1.1: Education: Building Operations & Maintenance Staff; GGHC FM Prerequisite 1: Energy Efficiency Best Management Practices: Planning, Documentation & Opportunity Assessment; GGHC FM Prerequisite 2: Minimum Building Energy Efficiency Performance; GGHC FM Credit 1: Optimize Energy Efficiency Performance; and, GGHC FM Credit 5: Performance Measurement.*

FM Credit 4.2 continued

Building Operations & Maintenance: **Building Systems Maintenance**

- Establish a maintenance program that includes regular weekly inspections with inspection logs and meeting minutes narrative observations, findings, and actions taken. Document rationale for inspections frequency.
- Use existing documentation protocols and methodologies to demonstrate ongoing credit achievement.
- Have in place a computer-based Building Automation System (BAS) that monitors and controls key building systems including, but not limited to, heating, cooling, ventilation, and lighting. Have a preventive maintenance program in place that ensures BAS components are tested and repaired or replaced according to the manufacturer's recommended interval. Demonstrate that the facility's BAS is being used to inform decisions regarding changes in building operations and energy saving investments.
- Consider implementing Reliability Centered Maintenance (RCM) protocols.- RCM is a statistical method of optimizing the preventive and predictive maintenance programs for assets, with the goal of maximizing the assets' availability and performance at the lowest total cost of ownership and life-cycle cost. It is a systematic approach to developing a focused, effective and cost-efficient preventive and predictive maintenance program. The program objectives also include increasing asset reliability, availability, and maintainability, while focusing on reducing life-cycle cost and total cost of ownership.

Resources

2006 Guidelines for Design and Construction of Hospitals and Healthcare Facilities, http://www.aia.org/aah_gd_hospcons

The Association for Facilities Engineering, http://www.afe.org

BetterBricks, http://www.betterbricks.org

"Certified Plant Maintenance Manager Review Book," The Association for Facilities Engineering, Cincinnati, OH. Release Version 2.02, August 2004.

Sehulster LM, et al. Guidelines for environmental infection control in health-care facilities. Recommendations from CDC and the Healthcare Infection Control Practices Advisory Committee (HICPAC). Chicago IL; American Society for Healthcare Engineering/American Hospital Association; 2004, http://www.cdc.gov/ncidod/hip/enviro/guide.htm

Trout, Tim, "Reliability Centered Maintenance Can Often Increase Efficiency And Reduce Risk And Expense To An Organization," "Facilities Engineering Journal," November/December 2004. http://www.fmlink.com/ProfResources/Magazines/article.cgi?AFE:afe1104c.htm

Whole Building Design Guide, "Facilities Operations & Maintenance," http://www.wbdg.org/om/om.php

1 point

FM Credit 4.3

Building Operations & Maintenance: **Building Systems Monitoring**

Intent

Provide capacity for ventilation system monitoring to help sustain long-term occupant comfort and well-being.

Health Issues

Ongoing operations and maintenance procedures are inextricably linked to the protection of occupant health and safety. Preventive maintenance practices including adequate training for operations and maintenance staff ensures consistency with original design intent. In combination with facility environmental/health policies, preventive maintenance improves the wellbeing of patients, staff and visitors by safeguarding indoor air quality, infection prevention and control and mechanical performance.

Credit Goals

Install permanent, continuous monitoring systems that provide feedback on ventilation system performance to ensure that ventilation systems maintain minimum outdoor airflow rates under all operating conditions.

For all mechanical ventilation systems:

- An outdoor airflow measurement device must be provided that is capable of measuring (and, if necessary, controlling) the minimum outdoor airflow rate at all expected system operating conditions within 15% of the design minimum outdoor air rate. Monitoring must be performed for at least 80% of the building total outdoor air intake flow serving occupied spaces.
- The outdoor airflow measurement device(s) must take measurements at the system level (i.e. at the air handling unit).
- The outdoor airflow measurement device shall be monitored by a control system capable of and is configured to trend outdoor airflow in intervals no longer than 15 minutes apart for a period of no less than six months.
- The control system shall be capable of and configured to generate an alarm visible to the system operator if the minimum outdoor air rate falls more than 15% below the design minimum rate.
- All measurement devices must be calibrated within the manufacturer's recommended interval.

For mechanical ventilation systems that predominantly serve densely occupied spaces with a design occupant density greater than or equal to 25 people per 1,000 square feet (40 square feet per person):

- Have a CO_2 sensor or sampling location for each densely occupied space and compare with outdoor ambient CO_2 concentrations. Each sampling location shall be between 3 feet and 6 feet above the floor.
- Test and calibrate CO_2 sensors to have an accuracy of no less than 75ppm or 5% of the reading, whichever is greater. Sensors must be tested and calibrated at least once every year or per the manufacturers' recommendation or other required regulations, whichever time period is shorter.
- Monitor CO_2 sensors with a system configured to trend CO_2 concentrations in intervals no longer than 30 minutes apart.

FM Credit 4.3 continued

Building Operations & Maintenance: **Building Systems Monitoring**

- Configure system capability to generate an alarm visible to a system operator and, if desired, to building occupants if the CO_2 concentration in any zone rises more than 15% above that corresponding to the minimum outdoor air rate required by ASHRAE Standard 62 (see GGHC FM Prerequisite 5: Outside Air Introduction & Exhaust Systems).
- CO_2 sensors may be used for demand-controlled ventilation, provided the control strategy complies with ASHRAE Standard 62 (see GGHC FM Prerequisite 5: Outside Air Introduction & Exhaust Systems), including maintaining the area-based component of the design ventilation rate.

  Note: If the total square footage of all dense space is less than 5% of total occupied square footage, the project is exempt from this section. Rooms less than 150 square feet are also exempt.

For natural ventilation systems (as permitted by code and infection control policy):

- CO_2 sensors located in the breathing zone of every densely populated room.
- CO_2 sensors located in the breathing zone of every natural ventilation zone,
- CO_2 sensors shall provide an audible or visual alarm to the occupants in the space and building management if CO_2 conditions are greater than 530 parts per million above outdoor CO_2 levels or 1,000 parts per million absolute. The alarm signal shall indicate that ventilation adjustments (i.e. opening windows) are required in the affected space.
- Permanently open areas must meet the requirements of ASHRAE 62.1-2007, section 5.1.
- All monitoring devices must be calibrated within the manufacturer's recommended interval.

  Note: If the total square footage of all space served by natural ventilation systems is less than 5% of total occupied square footage, the project is exempt from this section. Rooms less than 150 square feet are also exempt.

FM Credit 4.3 continued

Building Operations & Maintenance: **Building Systems Monitoring**

Suggested Documentation

- ❑ Compile and annually review documentation of the continuous monitoring systems in accordance with Credit Goals.
- ❑ Annually document alarms that occurred, responses, and corrective actions taken. Include analysis of the root cause and short term and long-term actions.
- ❑ Annually document the percent of time desired conditions are delivered in the building on a floor area weighted basis.

Reference Standards

ANSI/ASHRAE 62.1-2007, http://www.ashrae.org

Potential Technologies & Strategies

- ***Credit Synergies:*** *Coordinate implementation of this credit in coordination with GGHC IO Credit 1.1: Education: Building Operations & Maintenance Staff; GGHC FM Prerequisite 1: Energy Efficiency Best Management Practices: Planning, Documentation & Opportunity Assessment; GGHC FM Prerequisite 2: Minimum Building Energy Efficiency Performance; GGHC FM Credit 1: Optimize Energy Efficiency Performance; GGHC FM Credit 3: Existing Building Commissioning; and, GGHC FM Credit 5: Performance Measurement.*
- Use automated systems that monitor equipment function and indoor space conditions, identify system problems automatically and issue an alarm that initiates procedures to fix the problems identified.
- Install carbon dioxide and airflow measurement equipment and feed the information to the HVAC system and/or Building Automation System (BAS) to trigger corrective action, if applicable. If such automatic controls are not feasible with the building systems, use the measurement equipment to trigger alarms that inform building operators or occupants of a possible deficiency in outdoor air delivery.

Resources

2006 Guidelines for Design and Construction of Hospitals and Healthcare Facilities, http://www.aia.org/aah_gd_hospcons

U.S. Department of Energy (DOE) Federal Technology Alert, "Demand-Controlled Ventilation Using CO_2 Sensors," http://www1.eere.energy.gov/femp/pdfs/fta_co2.pdf

1-2 points

FM Credit 5.1-5.2

Performance Measurement: **System-Level Energy Metering**

Intent

Provide accurate energy use information to support energy management and identify opportunities for additional energy-saving improvements.

Health Issues

Coal-fired power plants, the largest source of energy production in the U.S., are major contributors to particulate pollution, which can increase the risk of asthma, respiratory diseases, and heart attacks. Power plant emissions amplify their contribution to global climate change by releasing greenhouse gases such as carbon dioxide and nitrogen oxide (NOx) into the atmosphere through smoke stacks. Sulfur dioxide emissions contribute to acid rain. Furthermore, according to the U.S. EPA, coal-fired power plants are the largest source of human-caused mercury emissions.[12] Mercury released to the environment enters the aquatic food chain and contaminates fish consumed by people and wildlife. Mercury is a potent neurotoxin. The most sensitive health effect of mercury is an adverse impact on brain development of fetuses, infants and children. Low-level prenatal exposure can result in language, memory and attention deficits in children who were exposed in utero. Energy efficiency can enhance human health by reducing particulate, chemical and greenhouse gas emissions associated with fossil-fuel based combustion and electrical generation, thereby improving outdoor air quality and curbing global climate change and acid rain.

Credit Goals

- Develop a breakdown of energy use in the building, either through GGHC FM Credit 3.1 & 3.2 or by using energy bills, spot metering or other metering to determine the energy consumption of major mechanical systems and other end use applications. This analysis of major energy use categories must have been conducted within the past two years.

AND

- Based on the energy use breakdown, employ system-level metering covering the total expected annual energy consumption of the building. Permanent metering and recording is required. All types of submetering are permitted.
  - **FM Credit 5.1** (1 point): Demonstrate that system-level metering is in place covering at least 40% of the total expected annual energy consumption of the building. Further, at least one of the largest two energy use categories from the breakdown report must be covered to at least an 80% extent (i.e., if energy use in the largest two categories is each 100 BTU/yr, at least 80 BTU/yr in one of them must be metered).
  - **FM Credit 5.2** (1 point in addition to FM Credit 5.1): Demonstrate that system-level metering is in place covering at least 80% of the total expected annual energy consumption of the building. Further, at least two of the three largest energy use categories from the breakdown report must be covered to at least an 80% extent.

Note: Meters must be calibrated within the manufacturer's recommended interval if the building owner, management organization, or a tenant owns the meter. Meters owned by third parties (e.g., utilities or governments) are exempt.

[12] U.S. Environmental Protection Agency (EPA), http://www.epa.gov/camr/basic.htm

FM Credit 5.1-5.2 continued

Performance Measurement: **System-Level Energy Metering**

Suggested Documentation

- ❑ Compile and annually review documentation of the breakdown of energy use and percentage of system-level metering in accordance with Credit Goals.
- ❑ For each item metered prepare a description of the performance improvement program implemented using the data gathered to improve system/building performance over a minimum one-year period.
- ❑ Prepare quarterly reports on the metered data gathered and for each item metered a report card of its performance. Include one day of actual output for all data recorded in the report.

Reference Standards

There is no reference standard for this credit.

Potential Technologies & Strategies

- ***Credit Synergies:*** *Coordinate implementation of this credit in coordination with GGHC IO Credit 1.1: Education: Building Operations & Maintenance Staff; GGHC FM Prerequisite 1: Energy Efficiency Best Management Practices: Planning, Documentation & Opportunity Assessment; GGHC FM Prerequisite 2: Minimum Building Energy Efficiency Performance; GGHC FM Credit 1: Optimize Energy Efficiency Performance; GGHC FM Credit 3: Existing Building Commissioning; and, GGHC FM Credit 5: Performance Measurement.*
- Use International Performance Measurement and Verification Protocol (IPMVP) Volume I: Concepts and Options for Determining Energy Savings to track energy savings of specific energy efficiency measures implemented in the facility.
- Establish and maintain continuous metering for the following major energy users in health care facilities:
  - Lighting systems and controls.
  - Separate building electric consumption that allows aggregation of all process electric loads.
  - Separate building natural gas consumption that allows aggregation of all process natural gas loads.
  - Chilled water system efficiency at variable loads (kW/ton) or cooling loads (for non-chilled water systems).
  - Cooling load.
  - Air and water economizer and heat recovery cycle operation.
  - Boiler efficiencies.
  - Building specific process energy systems and equipment efficiency.
  - Constant and variable motor loads.
  - Variable frequency drive (VFD) operation.
  - Air distribution, static pressure and ventilation air volumes.

FM Credit 5.1-5.2 continued

Performance Measurement: **System-Level Energy Metering**

- Identify, through an energy audit, building commissioning or some other means, how the buildings systems are consuming energy. Based on the energy use profile, develop a metering plan to capture the most significant building loads.
- Use output from the meters to identify any changes in consumption and opportunities for energy-saving improvements.
- Develop and implement a plan for periodically inspecting the meter data.

Resources

International Performance Measurement and Verification Protocol, Volume 1, 2001 Version, http://www.nrel.gov/docs/fy02osti/31505.pdf

1 point

FM Credit 5.3

Performance Measurement: **Enhanced Water Metering**

Intent

Measure building and subsystem water performance over time to understand consumption patterns and identify opportunities for additional water savings.

Health Issues

Maintaining adequate potable water supplies is a basic necessity for the health of individuals and communities. Only about 1% of the water on Earth is fresh water. Over-consumption, drought and poor water management have led thirty-six states in the U.S. to anticipate local, regional, or statewide water shortages by 2013.[13] Processing potable water is energy intensive and thus contributes to air emissions associated with fossil fuel energy generation (for the treatment, pumping and maintenance of the potable water systems). Only about 20% of current urban water is used for drinking and sanitary purposes, with the other 80% not requiring treatment to potable standards. Using reclaimed water for selected applications can reduce costs and preserve precious potable water supplies. To protect the public health, a dual or dedicated distribution system must be installed to segregate potable and reclaimed water.

Credit Goals

- Have in place permanently installed metering devices to measure potable water use, as applicable to the facility. One point is earned for sub-metering that captures 85% of water consumption from among the following list:
  - Water use in laboratory
  - Water use in dietary department
  - Water use in central sterile and processing department
  - Water use in laundry
  - Water use in radiology and imaging department
  - Water use in surgical suite
  - Purified water system (reverse osmosis and/or de-ionized) and filter backwash water
  - Outdoor irrigation systems
  - Cooling tower make-up and filter backwash water
  - Steam boiler system make-up water
  - Closed loop hydronic system make-up water
  - Water use in mechanical equipment, including pumps.
  - Water-cooled equipment and cooling towers

Note: Meters must measure potable water use at a minimum, but applicants may also meter gray or reclaimed water as applicable to meet the requirements of this credit. Metering must be continuous and data-logged to allow for an analysis of time trends. The project must compile monthly and annual summaries of results for each subsystem metered.

Note: Meters must be calibrated within the manufacturer's recommended interval if the building owner, management organization, or a tenant owns the meter. Meters owned by third parties (e.g., utilities or governments) are exempt.

[13] U.S. Environmental Protection Agency (EPA), http://www.epa.gov/WaterSense/water/why.htm

FM Credit 5.3 continued

Performance Measurement: **Enhanced Water Metering**

Suggested Documentation

- ❑ Establish and annually review a Water Measurement & Verification Plan.
- ❑ Compile annual documentation verifying that the sub-metering locates a minimum of 85% of the total non conditioned water usage.
- ❑ Compile documentation and annually review the monitoring system, including cut sheets of sensors and the data collection system.

Reference Standards

There are no reference standards for this credit.

Potential Technologies & Strategies

- ***Credit Synergies:*** *Coordinate implementation of this credit in coordination with GGHC SSM Credit 1.2: Site Management: Integrated Pest Management, Erosion Control & Landscape Management Plan; GGHC SSM Credit 3: Stormwater Management; GGHC SSM Credit 5: Connection to the Natural World; GGHC FM Prerequisite 1: Energy Efficiency Best Management Practices: Planning, Documentation & Opportunity Assessment; GGHC FM Prerequisite 2: Minimum Energy Efficiency Performance; GGHC FM Prerequisite 4: Minimum Indoor Plumbing Fixture and Fitting Effciency; GGHC FM Credit 1: Optimize Energy Efficiency Performance; GGHC FM Credit 3: Existing Building Commissioning; GGHC FM Credit 2: Potable Water Use Reduction; and, GGHC FM Credit 5: Performance Measurement.*
- Install subsystem-level water metering to measure and track potable water consumption by specific building systems; prioritize metering for those systems that use the most potable water.
- Use measured system data to identify opportunities to reduce potable water use.

Resources

American Society of Plumbing Engineers (ASPE), Plumbing Engineering Design Handbook, http://www.aspe.org

Healthcare Environmental Resource Center, Facilities Management – Water Conservation, http://www.hercenter.org/facilitiesandgrounds/waterconserve.cfm

Practice Greenhealth water conservation tools, http://www.practicegreenhealth.org.

International Performance Measurement and Verification Protocol, Volume 1, 2002, http://www.nrel.gov/docs/fy02osti/31505.pdf

Maryland Department of the Environment, Water Saving Tips for Health Care Facilities, http://www.mde.state.md.us/Programs/WaterPrograms/Water_Conservation/Business_Tips/health.asp

New Hampshire Department of Environmental Services, Water Efficiency Practices for Health Care Facilities, http://www.des.state.nh.us/factsheets/ws/ws-26-14.htm

U.S. Department of the Interior, Water Measurement Manual, http://www.usbr.gov/pmts/hydraulics_lab/pubs/wmm/

U.S. Environmental Protection Agency (EPA) Region 2, Pollution Prevention (P2) for the Healthcare Industry, http://www.epa.gov/region2/p2/health.htm

1 point

FM Credit 5.4

Performance Measurement: **Emissions Reduction Reporting**

Intent

Document emission reduction benefits of building efficiency measures.

Health Issues

Coal-fired power plants, the largest source of energy production in the U.S., are major contributors to particulate pollution, which can increase the risk of asthma, respiratory diseases, and heart attacks. Power plant emissions amplify their contribution to global climate change by releasing greenhouse gases such as carbon dioxide and nitrogen oxide (NOx) into the atmosphere through smoke stacks. Sulfur dioxide emissions contribute to acid rain. Furthermore, according to the U.S. EPA, coal-fired power plants are the largest source of human-caused mercury emissions.[14] Mercury released to the environment enters the aquatic food chain and contaminates fish consumed by people and wildlife. Mercury is a potent neurotoxin. The most sensitive health effect of mercury is an adverse impact on brain development of fetuses, infants and children. Low-level prenatal exposure can result in language, memory and attention deficits in children who were exposed in utero. Energy efficiency can enhance human health by reducing particulate, chemical and greenhouse gas emissions associated with fossil-fuel based combustion and electrical generation, thereby improving outdoor air quality and curbing global climate change and acid rain.

Credit Goals

- Identify building performance parameters that reduce conventional energy use and emissions, quantify those reductions, and report them to a formal tracking program.
- Meet all standards of California South Coast Air Quality Management District or local regulations or permit, whichever is more stringent, for all products of combustion.
- Track and record the significant emission reductions including those delivered by energy efficiency, renewable energy and other building emission reduction actions. Emissions to be tracked may include, but are not limited to: carbon dioxide (CO_2), sulfur dioxide (SO_2), nitrogen oxides (NOx), mercury (Hg), small particulates (PM2.5), large particulates (PM10), and volatile organic compounds (VOCs).
- Report the reductions in emissions resulting from these energy efficiency and renewable operations using a third party voluntary reporting/certification program including, but not limited to: EPA Climate Leaders, Energy Star® or WRI/WBCSD protocols.
- Retire at least 10% of the emission reductions annually, delivered by the energy efficiency actions through a third party voluntary certification program. (To meet this requirement the third party voluntary emission reduction certification and emission reduction retirement programs must be programs of credible organizations. Third party programs shall notify any applicable local or regional emission reduction registries of the reported emission reductions.)

AND

[14] U.S. Environmental Protection Agency (EPA), http://www.epa.gov/camr/basic.htm

FM Credit 5.4 continued

Performance Measurement: **Emission Reduction Reporting**

- Develop and implement a review process to upgrade existing equipment to the best technological system of continuous emissions reduction available every five years or when retrofitting or upgrading, whichever comes first.
- Utilize biodiesel fuels or other low-emitting fuel (e.g., biodiesel, compressed natural gas or liquid propane) for generators and other diesel equipment, unless replacing fuels will void the equipment warranty.

AND

- Ask the suppliers of goods and services for the building to do the same by implementing the actions listed above annually or at the point of contract renewal.

Suggested Documentation

- ❑ Calculate and compile a an annual report of compliance with California South Coast Air Quality Management District (or similar) standards for products of combustion, emissions reduction efforts, and the resulting reductions for the significant types of environmental emissions resulting from the energy efficiency operations and other emission reduction actions in accordance with Credit Goals using the emission reduction calculation protocol of a third party voluntary certification program.
- ❑ Document the retirement of at least 10% of the emission reductions annually, delivered by the energy efficiency measures, Renewable Energy and other emission reduction actions, through a third party voluntary certification program.
- ❑ Ensure that a third party voluntary certification program has notified any applicable local or regional emission reduction registries of the reported annual emission reductions.
- ❑ Compile documentation of the facility review process for upgrading existing equipment to the best technological system of continuous emissions reduction in accordance with Credit Goals.
- ❑ Compile documentation of equipment using low-emitting fuel and annually review opportunities to expand the program.
- ❑ Compile documentation of conversations with suppliers of goods and services for the building in accordance with Credit Goals.

Reference Standards

There is no reference standard for this credit.

Potential Technologies & Strategies

- ***Credit Synergies:*** *Coordinate implementation of this credit in coordination with GGHC IO Credit 1.1: Education: Building Operations & Maintenance Staff; GGHC FM Prerequisite 1: Energy Efficiency Best Management Practices: Planning, Documentation & Opportunity Assessment; GGHC FM Prerequisite 2: Minimum Building Energy Efficiency Performance; GGHC FM Credit 1: Optimize Energy Efficiency Performance; GGHC FM Credit 3: Existing Building Commissioning; GGHC FM Credit 5: Performance Measurement; GGHC CM Prerequisite 2: Chemical Management Policy and Audit; and, GGHC CM Credit 1: Indoor Chemical Contaminant Prevention.*

FM Credit 5.4 continued

Performance Measurement: **Emission Reduction Reporting**

- Annually store an electronic copy of the Statement of Energy Performance from EPA's Portfolio Manager benchmarking tool, documenting the carbon inventory of the facility, found at http://www.energystar.gov/benchmark. Energy Star users create their own private accounts at no cost.
- ENERGY STAR qualified buildings emit less carbon than typical buildings. Annually apply for the ENERGY STAR award from the U.S. EPA for building scores that are 75 or higher. The ENERGY STAR is awarded for a specific year to indicate low carbon emissions from superior energy performance. Review the energy efficiency strategies listed under ENERGY STAR qualified facility profiles to gather best practices for emission reduction. Profiles of Energy Star qualified facilities list the energy efficiency strategies that helped them achieve Energy Star status.
- Energy efficient strategies can be achieved at a low cost yielding significant emission reductions.
- The prescriptive path for energy efficiency outlined in LEED for Healthcare offers a package of emission reduction measures that models have shown to reduce energy use in a new acute care health care facility by at least 14% in all U.S. bioclimatic regions.
- Document the health and financial benefits of energy efficiency measures using tools such as the Healthcare Clean Energy Exchange's Energy Impact Calculator (EIC). Based on EPA and other peer-reviewed data, the EIC calculates carbon emissions and energy use health impacts such as premature deaths, chronic bronchitis, asthma attacks work loss days and hospital ER visits on a per kWh/year basis, as well as health care facilities' and external societal dollar costs per incident. Use the documented energy efficiency savings and the EIC to educate stakeholders (senior management, trustees, funders, staff, suppliers, service providers, host community, etc.) on efficiency benefits related to human and environmental health, financial, climate change risk reduction and fiduciary responsibilities. Monetize the documented energy efficiency for sale as energy efficiency credits (a.k.a. White Tags).
- Use the EIC or equivalent cost/benefit data to enhance investment in renewable energy systems, renewable energy credits or renewable energy purchases.
- Request that the suppliers of fossil fuels report energy savings, Renewable Energy use and other emission reduction actions. Report all types of resulting emissions reductions annually and retire at least 10% of these reductions through a third party voluntary certification program and ask their suppliers of goods and services to do the same.
- Ensure that equipment warranty will not be affected through the use of bio-diesel or other low-emitting fuels.

Resources

Carbon Disclosure Project, http://www.cdproject.net

Chicago Climate Exchange, http://www.chicagoclimatex.com

Healthcare Clean Energy Exchange Energy Impact Calculator, http://www.hccleanenergy.org/

U.S. Environmental Protection Agency (EPA) Energy Star, http://www.energystar.gov

1 point

FM Credit 6

IAQ Management: **Maintaining Indoor Air Quality**

Intent

Enhance Indoor Air Quality (IAQ) performance by optimizing practices to prevent the development of indoor air quality problems in buildings, correcting indoor air quality problems when they occur and maintaining the well-being of the occupants.

Health Issues

The EPA estimates that indoor air pollution is one of the top five environmental risks to public health. Indoor air can be as much as 10 times more polluted than outside air and contain many unique contaminants. Waste anesthetic gases (WAGs), potent ozone depleting substances that leak into the air in operating rooms during the delivery of anesthesia, can contain harmful chemicals such as nitrous oxide and halogenated compounds. Exposure to WAGs can cause acute reactions such as headaches, fatigue and nausea. Several studies have also linked low-level, long-term exposure of operating room staff to WAGs with higher instances of birth defects and cancer.[15] Indoor air pollutants can cause problems ranging from immediate acute effects such as eye, nose, and throat irritation; sinusitis, asthma attacks, headaches; loss of coordination; and nausea; to long range chronic damage to the lungs, central nervous system, and other organ systems, depending on the specific contaminants, and can contribute to the development of chemical sensitivities. Poor IAQ is a leading cause of absenteeism from work and job dissatisfaction.

Credit Goals

- Develop and implement on an ongoing basis an IAQ management program in accordance with infection control and prevention protocols in the 2003 CDC/HICPAC Guidelines for Environmental Infection Control in Health-Care Facilities AND in accordance with either “A Guide to Managing Indoor Air Quality in Health Care Organizations”, Joint Commission, 1997 OR the U.S. EPA document “Indoor Air Quality Building Education and Assessment Model (I-BEAM),” EPA Reference Number 402-C-01-001, December 2002.
- Verify that the facility’s Indoor Air Quality (IAQ) management plan requires routine review of locations of sterilization equipment, copiers, paint shops, and other indoor pollutant sources requiring air monitoring to ensure that healthy IAQ will be maintained.
- Verify that the facility annually undertakes air testing and complies with regulatory limits for any substance listed in OSHA Table Z-1-Limits for Air Contaminants.
- Annually evaluate the plan’s success responding to IAQ incidents. Analyze and determine the root causes of IAQ incidents and compile documentation on the short term and long-term actions taken.

AND

- Maintain a minimum annual indoor air quality satisfaction rate of 80% reported by an annual survey of facility occupants, in accordance with ASHRAE 62.1-2007. In acute care settings, survey staff in both administrative and clinical settings; in residential health care occupancies, survey both residents and staff.

[15] U.S. Environmental Protection Agency (EPA), http://www.cdc.gov/niosh/docs/2007-151/

FM Credit 6 continued

IAQ Management: **Maintaining Indoor Air Quality**

Suggested Documentation

- ❑ Compile and annually review documentation of an IAQ management program for the facility demonstrating compliance with the referenced standard and requiring routine review of locations of indoor pollutant sources and annual air testing for OSHA Table Z-1-Limits for Air Contaminants over a minimum one-year period in accordance with Credit Goals.
- ❑ Compile and annually review the facility's IAQ satisfaction rate and IAQ incidents, in accordance with Credit Goals.

Reference Standards

Joint Commission, "A Guide to Managing Indoor Air Quality in Health Care Organizations", 1997.

Sehulster LM, et al. Guidelines for Environmental Infection Control in HealthCare Facilities, 2003. Recommendations from CDC and the Healthcare Infection Control Practices Advisory Committee (HICPAC). Chicago IL; American Society for Healthcare Engineering/American Hospital Association; 2004. http://www.cdc.gov/ncidod/hip/enviro/guide.htm

U.S. Environmental Protection Agency (EPA) document "Indoor Air Quality Building Education and Assessment Model (I-BEAM)," EPA Reference Number 402-C-01-001, December 2002, http://www.epa.gov/iaq/largebldgs/i-beam/index.html

Potential Technologies & Strategies

- ***Credit Synergies:*** *Coordinate implementation of this credit with GGHC FM Prerequisite 3: Refrigerant Management – Ozone Protection; GGHC FM Prerequisite 5: Outdoor Air Introduction & Exhaust Systems; GGHC FM Credit 5: Performance Measurement; GGHC FM Credit 8: Refrigerant Management; GGHC CM Prerequisite 2: Chemical Management Policy and Audit; GGHC CM Credit 1: Indoor Chemical Contaminant Prevention, and GGHC ES Credit 1: Environmentally Preferable Cleaning.*
- Establish and implement a program to enhance IAQ performance by optimizing practices to prevent the development of indoor air quality problems on an ongoing basis, thereby enhancing the well being of the building occupants.
  - Evaluate systems to identify potential IAQ problems.
  - Include in the program a plan for preventing moisture accumulation and mold in the building. For additional information, see the U.S. Environmental Protection Agency (EPA) website, http://www.epa.gov/iaq/largebldgs/baqtoc.html
  - Demonstrate compliance using existing infection control/maintenance reports.
  - Monitor building temperature, relative humidity and CO_2 levels, note changes, and investigate trends.
- Reduce occupant exposure to waste anesthetic gases (WAGs) in the post anesthesia care unit (PACU) and intensive care unit (ICU). Utilize climate control and scavenging devices to prevent staff and patient exposure to WAGs.

FM Credit 6 continued

IAQ Management: **Maintaining Indoor Air Quality**

- Establishing guiding principles for indoor air quality associated with operations and maintenance is important to ensure established thresholds are achieved and maintained during the life of the building. Procedures to monitor compliance with design intent should be standard practice. These strategies can be categorized by type and prioritized as follows:
  - *Ventilation* (refer to GGHC FM Prerequisite 5: Outside Air Introduction & Exhaust Systems). Monitor mechanical ventilation air change rates required by health code standards, zoning areas where contaminants are generated.
  - *Building Materials* (refer to GGHC EP Credit 3.1-3.5: Toxic Chemical Reduction: Facility Alterations & Additions and GGHC EP Credit 3.6: Toxic Chemical Reduction: Furniture & Medical Furnishings). Significant sources of indoor air pollution are materials and products used in the building, such as cleaning compounds, adhesives, paints, carpeting, upholstery, manufactured wood products and other components of furniture, including medical furniture & equipment, each of which may emit volatile organic compounds (VOCs), including formaldehyde.
  - *Source Control* (refer to GGHC CM Credit 1: Indoor Chemical Contaminant Prevention, GGHC CM Credit 2: Pharmaceutical Minimization, Management & Disposal, and GGHC EP Credit 1: Solid Waste Prevention in Purchasing). Sources can include outdoor pollutants, indoor chemical use (including glutaraldehyde and other sterilizing agents and methylene chloride, used in adhesive removers, paint stripper, and aerosol spray paints), cleaning products, fragrances and pesticides.
  - *Building Operations and Maintenance* (refer to GGHC IO Credit 1.1: Education: Building Operations & Maintenance Staff; GGHC FM Prerequisite 1: Energy Efficiency Best Management Practices: Planning, Documentation & Opportunity Assessment; GGHC FM Credit 1: Existing Building Commissioning; and, GGHC FM Credit 4: Building Operations & Maintenance). Improperly functioning building equipment can lead to indoor environmental quality, whether through mechanical malfunction or introducing pollutants or airborne microbes to the indoor air. Regular maintenance and commissioning of building systems equipment is required to ensure that the building functions as designed.

Resources

High Performance Building Guidelines, New York City DDC, 1999.
http://www.nyc.gov/html/ddc/html/ddcgreen/reports.html

1-4 points

FM Credit 7.1-7.4

On-Site and Off-Site Renewable Energy

Intent

Encourage and recognize increasing levels of on-site and off-site renewable energy in order to reduce environmental and health burdens associated with fossil fuel energy use.

Health Issues

Coal-fired power plants, the largest source of energy production in the U.S., are major contributors to particulate pollution, which can increase the risk of asthma, respiratory diseases, and heart attacks. Power plant emissions amplify their contribution to global climate change by releasing greenhouse gases such as carbon dioxide and nitrogen oxide (NOx) into the atmosphere through smoke stacks. Sulfur dioxide emissions contribute to acid rain. Furthermore, according to the U.S. EPA, coal-fired power plants are the largest source of human-caused mercury emissions.[16] Mercury released to the environment enters the aquatic food chain and contaminates fish consumed by people and wildlife. Mercury is a potent neurotoxin. The most sensitive health effect of mercury is an adverse impact on brain development of fetuses, infants and children. Low-level prenatal exposure can result in language, memory and attention deficits in children who were exposed in utero. Energy efficiency can enhance human health by reducing particulate, chemical and greenhouse gas emissions associated with fossil-fuel based combustion and electrical generation, thereby improving outdoor air quality and curbing global climate change and acid rain.

Credit Goals

- Fulfill some or all of the building's total energy use through the use of on-site or off-site renewable energy systems. Points are earned according to the following table. The percentages shown in the table are the percentages of building energy use over a minimum one year period that are met by renewable energy.
- Off-site renewable energy sources shall be defined by the Center for Resource Solutions (CRS) Green-e products certification requirements, or the equivalent. Green power may be procured from a Green-e certified power marketer, a Green-e accredited utility program, or through Green-e certified Tradable Renewable Certificates, or the equivalent. For on-site renewable energy that is claimed for this credit, the associated environmental attributes must be retained or retired and cannot be sold. If the green power is not Green-e certified, equivalence must exist for both major Green-e program components: 1) current green power performance standards, and 2) independent, third party verification that those standards are being met by the green power supplier over time.
- If the on-site renewable energy for this credit is leased through a Purchase Power Agreement, the amount of energy generated on-site shall only count towards the credit if the energy is used by the facility or if the facility purchases Green-e certificates equivalent to the amount of on-site renewable energy generation.
- Up to the four-point limit, any combination of individual actions will be awarded the sum of the points allocated to those individual actions. For example, one point would be awarded for implementing 1% of on-site renewable energy and two additional points would be awarded for meeting 50% of the building's energy load with renewable power or certificates over a minimum twelve-month period.

[16] U.S. Environmental Protection Agency (EPA), http://www.epa.gov/camr/basic.htm

FM Credit 7 continued

On-Site and Off-Site Renewable Energy

- Projects shall compile proof of a contract to purchase RECs for a minimum of two years and shall also make a commitment to purchase RECs on an ongoing basis beyond that contract.
- Only projects meeting an Energy Star® score of 75 or Energy Use Intensity (EUI) of 25% better than average in accordance with GGHC FM Credit 1: Optimize Energy Performance may pursue more than one point under the off-site renewable energy certificates compliance pathway.

Total Points	On-site Renewable Energy		Off-site Renewable Energy/ Certificates
1	1%	OR	25%
2	3%	OR	50%
3	5%	OR	75%
4	10%	OR	100%

FM Credit 7.1-7.4 continued

On-Site and Off-Site Renewable Energy

Suggested Documentation

- ❑ Compile and annually update system schematic diagrams and narrative highlighting on-site renewable energy systems installed in the facility.
- ❑ Meter energy output of on-site Renewable Energy system over minimum twelve-months in accordance with Credit Goals.
- ❑ Compile calculations documenting the percentage of the building's total energy requirements that was supplied by on-site Renewable Energy systems for the most recent twelve-month period.

AND/OR

- ❑ Calculate the percentage of the building's total energy requirements that was met with renewable power or certificates over a minimum twelve-month period in accordance with Credit Goals. If the off-site renewable power or certificates exceed 25% of the total facility energy usage, annually update documentation verifying that the facility has attained an Energy Star score of 75 or above or an Energy Use Intensity of 25% better than average for non-rated facilities.
- ❑ Compile and annually review documentation demonstrating that the supplied renewable power or certificates over the minimum twelve-month period met the referenced Green-e requirements or the equivalent.
- ❑ Demonstrate a commitment to ongoing purchases of renewable power or certificates at the same or higher level over the next 12 month period through contracts, certificates of purchase or equivalent documentation.

Reference Standards

Center for Resource Solutions Green-e Products Certification Requirements, http://www.green-e.org

Potential Technologies & Strategies

- ***Credit Synergies:*** *Coordinate implementation of this credit in coordination with GGHC IO Prerequisite 1: Integrated Operations & Maintenance Process; GGHC IO Credit 1.1: Education: Building Operations & Maintenance Staff; GGHC FM Prerequisite 1: Energy Efficiency Best Management Practices: Planning, Documentation & Opportunity Assessment;* GGHC FM Prerequisite 2: Minimum Building Energy Efficiency Performance; *GGHC FM Prerequisite 3: Refrigerant Management: Ozone Protection; GGHC FM Credit 1: Optimize Energy Efficiency Performance; GGHC FM Credit 3: Existing Building Commissioning; GGHC FM Credit 5: Performance Measurement; and, GGHC FM Credit 8: Refrigerant Management.*
- To establish on-site renewable energy sources without capital expenditures, enter into a Purchase Power Agreement with a renewable energy services provider.
- Design and specify the use of on-site nonpolluting renewable technologies to contribute to the total energy requirements of the facility. Consider and employ solar, geothermal, wind, biomass (other than unsustainably harvested wood) and biogas technologies. Purchase renewable energy or renewable energy tradable certificates to meet some or all of the building's energy requirements.
- Utilize best practice web-based reverse auction procurement technology, such as Practice Greenhealth's Healthcare Clean Energy Exchange http://www.hccleanenergy.org, for purchases of green power, renewable energy certificates, and/or natural gas bundled with carbon offsets.

FM Credit 7.1-7.4 continued

On-Site and Off-Site Renewable Energy

- Review historic building electrical consumption trends.
- Research power providers in the area and select a provider that guarantees that a fraction of its delivered electric power is derived from net nonpolluting renewable technologies.
- If the project is in an open market state, investigate green power and power marketers licensed to provide power in that state.
- Grid power that qualifies for this credit originates from solar, wind, geothermal, biomass or low-impact hydro sources.
- Establish a renewable power policy that mandates continued on-site production or purchasing Green-e certificates.
- Annually apply for the Energy Star award from the U.S. EPA for building scores that are 75 or higher. The Energy Star is awarded for a specific year to indicate low carbon emissions from superior energy performance.
- Use the Healthcare Clean Energy Exchange's Energy Impact Calculator (EIC) or equivalent cost/benefit data to enhance investment in renewable energy systems, renewable energy credits or renewable energy purchases. Based on U.S. EPA and other peer-reviewed data, the EIC calculates carbon emissions and energy use health impacts such as premature deaths, chronic bronchitis, asthma attacks work loss days and hospital ER visits on a per kWh/year basis, as well as health care facilities' and external societal dollar costs per incident.
- Use renewable energy commitments and the EIC to educate stakeholders (senior management, trustees, funders, staff, suppliers, service providers, host community, etc.) on clean power benefits related to human and environmental health, financial, climate change risk reduction and fiduciary responsibilities.
- Use the Healthcare Clean Energy Exchange to auction off to the highest bidder the renewable energy credits (RECS) generated by on-site renewable energy systems. The Healthcare Clean Energy Exchange is a reverse auction program (as of 2008, in a pilot stage) to assist health care providers in lowering energy bills while increasing the percentage of clean energy in their energy procurement portfolio.

Resources

American Bioenergy Association, http://www.biomass.org

American Wind Energy Association (AWEA), http://www.awea.org

Database of State Incentives for Renewable Energy (DSIRE), http://www.dsireusa.org

Green Power Network, http://www.eere.energy.gov/greenpower

Healthcare Clean Energy Exchange, http://www.hccleanenergy.org

National Center for Photovoltaics (NCPV), http://www.nrel.gov/ncpv

U.S. Department of Energy (DOE), Office of Energy Efficiency and Renewable Energy (EERE), http://www.eere.energy.gov

U.S. Environmental Protection Agency (EPA) Green Power Partnership, http://www.epa.gov/greenpower/index.htm

1 point

FM Credit 8

Refrigerant Management

Intent

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

Health Issues

Stratospheric ozone layer depletion increases exposure to ultraviolet radiation, increasing risks of 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 U.S. commitment to implementing the Montreal Protocol, the EPA has implemented regulations relative to the responsible management of Chlorofluorocarbons (CFCs), including programs to end the consumption and production of ozone depleting substances (ODS) and Hydrochlorofluorocarbons (HCFCs). HCFCs are a class of ozone depleting substance that have been used to replace CFC refrigerants. While HCFCs have a lower ODS rating than CFCs, the Montreal Protocol lists them in the second class of ODS to be phased out over time. In 2005, the World Meteorological Organization (WMO) reported an 8-9% decrease of ODS in the atmosphere from the peak in 1992-1994, while the level of HCFCs continues an upward trend. The U.S. has joined other countries party to the Montreal Protocol proposing an accelerated mandatory phase-out of HCFCs to bolster protection of the ozone layer.

Credit Goals

OPTION A

- Do not use refrigerants in base building HVAC&R systems.
- Small HVAC&R units (defined as containing less than 0.5 lbs of refrigerant), and other equipment such as standard refrigerators, small water coolers, medical equipment, 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.

OR

FM Credit 8 continued

Refrigerant Management

OPTION B

- Select refrigerants and HVAC&R 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:

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

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

- Small HVAC&R units (defined as containing less than 0.5 lbs of refrigerant), and other equipment such as standard refrigerators, small water coolers, medical equipment, 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).

FM Credit 8 continued

Refrigerant Management

Suggested Documentation

❑ Document the alternative technologies applied to base building HVAC&R systems in accordance with Credit Goals.

OR

❑ Establish and annually update documentation verifying that emissions of refrigerants from base building HVAC&R equipment comply with the formula outlined in the Credit Goals.

Reference Standards

There are no reference standards for this credit. Potential Technologies & Strategies

- ***Credit Synergies:*** *Coordinate implementation of this prerequisite in coordination with GGHC FM Prerequisite 1: Energy Efficiency Best Management Practices: Planning, Documentation & Opportunity Assessment; GGHC FM Prerequisite 2: Minimum Energy Efficiency Performance; GGHC FM Prerequisite 3: Refrigerant Management: Ozone Protection; GGHC FM Credit 1: Optimize Energy Efficiency Performance; GGHC FM Credit 3: Existing Building Commissioning; and, GGHC FM Credit 5: Performance Measurement.*
- Set up loss minimization procedures and systems to meet annual loss minimization standards and reporting requirements.
- Based on useful life and refrigerant type, develop a strategy to replace equipment starting with equipment containing Halons, CFCs and HCFCs in largest quantities and in worse condition. Select HVAC&R replacement equipment with reduced refrigerant charge and increased equipment life.
- Maintain HVAC&R equipment to prevent leakage of refrigerant to the atmosphere.
- Consider reducing or eliminating CFC or HCFCs in plumbing systems, refrigerators, freezers, water coolers, lab equipment and other non-building systems.

FM Credit 8 continued

Refrigerant Management

Resources

ANSI/ASHRAE 15-2004, *Safety Standard for Refrigeration Systems* (Also defines HFCs, CFCs and HCFC by formulation, compound and common name).

Chartered Institution of Building Services Engineers (CIBSE), CFCs, HCFCs and Halons - Professional and Practical Guidance on Substances that Deplete the Ozone Layer, 2000, http://www.cibse.org

Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), Building Systems Analysis & Retrofit Manual, 1995, http://www.smacna.org

U.S. Environmental Protection Agency (EPA), Clean Air Act, Title VI, Rule 608 governing refrigerant management and reporting,
http://www.epa.gov/oar/caa/contents.html.

U.S. Environmental Protection Agency (EPA), Ozone Depletion, http://www.epa.gov/ozone

U.S. Environmental Protection Agency (EPA), Phase-Out of Ozone Depleting Substances,
http://www.epa.gov/ozone/title6/phaseout/

U.S. Environmental Protection Agency (EPA), Significant New Alternatives Policy (SNAP),
http://www.epa.gov/ozone/snap/index.html

U.S. Environmental Protection Agency (EPA), Stratospheric Ozone Protection: Moving to Alternative Refrigerants, http://www.es.epa.gov/program/epaorgs/oar/altrefrg.html

U.S. Green Building Council, The Treatment by LEED of the Environmental Impact of HVAC Refrigerants,
http://www.usgbc.org/DisplayPage.aspx?CMSPageID=154

1 point

FM Credit 9
Light Pollution Reduction

Intent

Minimize light trespass from the building and site, reduce sky-glow to increase night sky access, improve nighttime visibility through glare reduction, and reduce development impact on nocturnal environments.

Health Issues

Light pollution is caused by excessive or poorly focused outdoor lighting reflecting off the sky dome, thereby brightening the nocturnal ambient environment. Studies have found a potential link between light pollution and hormone production, specifically related to melatonin and estrogen levels in women. Light at night reduces melatonin levels, which can be causally related to elevated estrogen levels in women and increased responsiveness of estrogen-dependent tissues to cellular proliferation. Collectively, these changes are linked to increased breast cancer risk. Light-related decreases in melatonin may also increase the risk of other kinds of cancer. Studies showing links to other cancers such as lung and prostate cancer have led the International Agency for Research on Cancer, a branch of the World Health Organization, to label overnight shift work as a probable carcinogen. Light pollution has also been found to disrupt nocturnal ecosystems, for example, confusing animal navigation and/or suppressing signals for seasonal behavior such as mating and pollination. Light pollution can also contribute to the collapse of local and regional ecosystems. For example, excessive artificial light and sky glow has been linked to exacerbating algal blooms by preventing zooplankton from consuming surface algae. Health care facilities can help protect their local and regional ecosystem by eliminating on-site light pollution by installing properly designed exterior lighting.

Credit Goals

FOR INTERIOR LIGHTING

- The angle of maximum candela from each interior luminaire as located in the building shall intersect opaque building interior surfaces and not exit out through the windows.
- In spaces with fenestration that do not function 24/7, all non-emergency interior lighting shall be automatically controlled to turn off during non-business hours. Provide up to 2-hour manual override capability for after hours use.

AND

FOR EXTERIOR LIGHTING

- Zone and control lights so as to restrict full night lighting to the following areas: Emergency Department, a small employee parking area, a small visitor parking area, pedestrian walkways, and circulation routes. Reduce sight lighting by 50% in all other non-essential areas after 11pm.
- Only light areas as required for safety and comfort. Do not exceed 80% of the lighting power densities for exterior areas and 50% for building facades and landscape features as defined in ASHRAE/IESNA Standard 90.1-2004, Exterior Lighting Section, without amendments.

FM Credit 9 continued

Light Pollution Reduction

- All projects shall be classified under one of the following zones, as defined in IESNA RP-33, and shall follow all of the requirements for that specific zone.
  - For Lighting Zones 2, 3, and 4 - For site boundaries that abut public right-of-way, light trespass requirements may be met relative to the curb line shared by the public right-of-way and the site instead of the site boundary.
  - For ALL Zones - Illuminance generated from a single luminaire placed at the intersection of a private vehicular driveway and public roadway accessing the site, is allowed to use the centerline of the public roadway as the site boundary for 2 times the driveway width.

LZ1 — Dark (Park and Rural Settings)
Design exterior lighting so that all site and building mounted luminaires produce a maximum initial illuminance value no greater than 0.01 horizontal and vertical footcandles at the site boundary and beyond. Document that 0% of the total initial designed fixture lumens are emitted at an angle of 90 degrees or higher from nadir (straight down).

LZ2 — Low (Residential areas)
Design exterior lighting so that all site and building mounted luminaires produce a maximum initial illuminance value no greater than 0.10 horizontal and vertical footcandles at the site boundary and no greater than 0.01 horizontal footcandles 10 feet beyond the site boundary. Document that no more than 2% of the total initial designed fixture lumens are emitted at an angle of 90 degrees or higher from nadir (straight down). For site boundaries that abut public rights-of-way, light trespass requirements may be met relative to the curb line instead of the site boundary.

LZ3 — Medium (Commercial/Industrial, High-Density Residential)
Design exterior lighting so that all site and building mounted luminaires produce a maximum initial illuminance value no greater than 0.20 horizontal and vertical footcandles at the site boundary and no greater than 0.01 horizontal footcandles 15 feet beyond the site. Document that no more than 5% of the total initial designed fixture lumens are emitted at an angle of 90 degrees or higher from nadir (straight down). For site boundaries that abut public rights-of-way, light trespass requirements may be met relative to the curb line instead of the site boundary.

LZ4 — High (Major City Centers, Entertainment Districts)
Design exterior lighting so that all site and building mounted luminaires produce a maximum initial illuminance value no greater than 0.60 horizontal and vertical footcandles at the site boundary and no greater than 0.01 horizontal footcandles 15 feet beyond the site. Document that no more than 10% of the total initial designed site lumens are emitted at an angle of 90 degrees or higher from nadir (straight down). For site boundaries that abut public rights-of-way, light trespass requirements may be met relative to the curb line instead of the site boundary.

FM Credit 9 continued

Light Pollution Reduction

Suggested Documentation

- ❑ Compile and annually review documentation verifying that interior lighting complies with Credit Goals.
- ❑ Compile and annually review an electrical site plan showing the zoning of the light fixtures and the control system for the fixtures and a brief exterior lighting system narrative describing the lighting objectives and the measures taken to meet the ambient light and direct beam illumination requirements.

Reference Standards

Illuminating Engineering Society of North America (IESNA) Recommended Practice Manual: Lighting for Exterior Environments (RP-33-99), http://www.iesna.org.

Potential Technologies & Strategies

- ***Credit Synergies:*** *Coordinate implementation of the credit with GGHC SSM Credit 1.1: Site Management: Building Exterior & Hardscape Management Plan; GGHC SSM Credit 1.2: Site Management: Integrated Pest Management, Erosion Control & Landscape Management Plan, GGHC SSM Credit 2.2: Reduced Site Disturbance: Protect or Restore Open Space or Habitat, GGHC SSM Credit 4: Heat Island Reduction, GGHC SSM Credit 5: Connection to the Natural World.*
- Implement site lighting criteria to maintain safe light levels while avoiding off-site lighting and night sky pollution.
- Minimize site lighting where possible and model the site lighting using a computer model.
- Technologies to reduce light pollution include:
  - Full cutoff luminaries
  - Low-reflectance surfaces
  - Low-angle spotlights
- Maintain even site lighting to avoid “hot spots” that could cause glare.

Resources

Illuminating Engineering Society of North America, http://www.iesna.org

International Dark-Sky Association, http://www.darksky.org/