



## MODEL GREEN PREVENTATIVE MAINTENANCE PLAN

Customers rely on the expertise of HVACR contractors for all their building system needs. Today's high performance buildings especially require the services of knowledgeable mechanical service contractors who understand what it takes to keep mechanical systems operating as energy efficiently as possible. When developing proposals for preventative maintenance services, there are numerous supplementary items, in addition to routine maintenance tasks, that can, and should, be included to ensure peak operating efficiency and compliance with LEED O & M requirements. The following assumptions and strategies should be taken into consideration when proposing "green" maintenance plans.

### ASSUMPTIONS -

1. Guidelines and practices in [ASHRAE 62.1-2007, Ventilation for Acceptable Indoor Air Quality](#), are routinely followed
2. Guidelines and practices in [ASHRAE 52.2-1999, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size](#), are routinely followed
3. Guidelines and practices in [ASHRAE 55-2004, Thermal Environmental Conditions for Human Occupancy](#), are routinely followed
4. Oil disposal is handled in accordance with relevant environmental regulations
5. Adhesives and sealants that are used have a VOC content less than the current VOC content limits of [South Coast Air Quality Management District Rule #1168](#) or sealants used as fillers meet or exceed the requirements of the [Bay Area Air Quality Management District Regulation 8, Rule 51](#)
6. Paints and coatings that are used have VOC emissions that do not exceed the VOC and chemical component limits of [Green Seal's Standard GS-11](#) requirements
7. Cleaning products (including coil and tube cleaners) meet the [Green Seal GS-37](#) standard
8. Guidelines and practices found in [Industrial Ventilation: A Manual of Recommended Practice for Design, 26<sup>th</sup> edition, and Industrial Ventilation: A Manual of Recommended Practice for Operation and Maintenance](#) published by American Conference of Governmental Industrial Hygienists are routinely followed
9. A phase-out plan for equipment which utilizes CFCs has been developed and leak rates are within acceptable limits
10. All local, state and federal codes/mandates/regulations are understood and complied with.

## STRATEGIES

These additional strategies should be seriously considered when developing a Green Preventative Maintenance Program for customers. These recommendations are in addition to your regularly performed preventative maintenance tasks. These procedures can provide valuable information on system operation and the results may lead to additional measures which could significantly enhance system performance and efficiency.

1. Take appropriate measures to prevent standing water in and around equipment as well as air in-takes
2. Develop baselines of energy consumption for each piece of equipment to include such measurements as:
  - a. Amp draws and volts
  - b. Delta-T – temperature drops
  - c. Combustion analysis
  - d. Program settings/set-backs
3. Perform infra-red thermographic analysis to assess energy efficiency or for use in predictive maintenance programs
4. Perform vibration analysis for use in predictive maintenance programs
5. Perform retro-commissioning per MSCA's *"Enhancing Energy Efficiency for High Performance Buildings: A Retro-Commissioning and Energy Audit Guide"*
6. Perform annual energy audit – verify achieves energy star rating - per MSCA's *"Enhancing Energy Efficiency for High Performance Buildings: A Retro-Commissioning and Energy Audit Guide"*
7. Install power factor correction device for motors (1 hp or less)
8. Incorporate waste heat recovery and heat rejection strategies where applicable
9. Increase frequency of filter changes, condenser coil cleaning
10. Purge-units (where applicable) - check and log run times
11. Do a facility walk-through to look for occupancy changes or occupant habits which compromise system efficiency and IAQ (i.e., blocked registers or vents, extra fans or heaters, open windows, etc)
12. Incorporate trending on DDC systems for earlier detection of system deterioration (add sensors where necessary)
13. Add additional control to other facility operations to help conserve resources: Example: Instead of a simple timer on an irrigation system, add a rain sensor so that irrigation does not run when it is raining out or add a soil moisture sensor to only allow irrigation when necessary. This same approach can be done with snow melt systems. Ensure systems only run when necessary.

## **GREEN PREVENTATIVE MAINTENANCE PLAN**

### **To achieve or maintain LEED EB Operation and Maintenance Certification**

#### **Sustainable Sites**

**SS Credit 6: Stormwater Quantity Control (1 point)**

Intent: Limit disruption of natural water hydrology by reducing impervious cover, increasing on-site infiltration, reducing or eliminating pollution from stormwater runoff, and eliminating contaminants

- Utilize stormwater run-off for landscaping irrigation, toilet and urinal flushes and custodial uses

**SS Credit 8: Light Pollution Reduction (1 point)**

Intent: Eliminate light trespass from the building and site, improve night sky access and reduce development impact on nocturnal environments.

- Ensure lighting control system adequately controlled after-hours
  - o Time Clock
  - o Building Management System

#### **Water Efficiency**

**WE Prereq 1: 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.

- Meet uniform plumbing codes
  - o Establish baseline for water usage

**WE Credit 1.1: Water Performance Measurement (1 point)**

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

- Permanently install water meters
- Monthly reports
- Meter gray or reclaimed water supply

**WE Credit 1.2 (1 or more submeters) (1 point)**

- Install permanent meters
  - o Irrigation
  - o Plumbing fixtures
  - o Cooling towers
  - o Domestic hot water
  - o Process water
- Meter calibration
- Monthly reports

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**WE credit 2: Additional Indoor Plumbing Fixture and Fitting Efficiency (10% reduction (1 point), 15% reduction (2 points), 20% reduction (3 points), 25% reduction (4 points) or 30% reduction (5 points))**

Intent: Maximize indoor plumbing fixture and fitting efficiency within buildings to reduce the use of potable water and consequent burden on municipal water supply and wastewater systems.

- Change batteries on any electronic sensors
  - o Thermostats
  - o Flush valves
  - o Towel dispensers
  - o Faucets
  - o Water closets
- Check and log water meters
  - o Main water meter
  - o Cooling tower water meter
  - o Boiler water meter
  - o Process water meter
- Provide quarterly report on spread sheet based on customer's base line
- Suggest water conservation measures
- Provide quarterly reports on all metered data gathered and, for each metered, a report card of its performance

**WE credit 3: Water Efficient Landscaping (50% reduction (1 point), 62.5% reduction (2 points), 75% reduction (3 points), 87.5% reduction (4 points) or 100% reduction (5 points))**

Intent: Limit or eliminate the use of potable water or other natural surface or subsurface resources available on or near the project site for landscape irrigation

- Irrigation water meter
  - o Calculate baseline for irrigation water use

**WE credit 4.1 and 4.2: Cooling Tower Water Management**

Intent: Reduce potable water consumption for cooling tower equipment through effective water management and/or use of nonpotable makeup water.

**WE Credit 4.1: Chemical Management (1 point)**

- Develop chemical management plan to include:
  - o Install conductivity meter
  - o Automatic controls
  - o Training

**WE credit 4.2 Nonpotable water source use (1 point)**

- Utilize 50% nonpotable water for cooling tower
  - o meter nonpotable and potable water feeds
- Develop water management strategy addressing chemical treatment and bleed-off to ensure proper concentration levels in cooling tower
- Develop biocide treatment program
- Quarterly reports

## Energy and Atmosphere

### **EA Prereq 1 Energy Efficiency Best Management Practices**

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

- Develop a building operation plan (per MSCA's *Enhancing Energy Efficiency Program: Utility Bill Analysis, Energy Audits and Retro-Commissioning*)
- Conduct energy audit (ASHRAE Level 1)
- Implement preventative maintenance plan and schedule

### **EA Prereq 2: Minimum Energy Efficiency Performance**

Intent: Establish the minimum level of operating energy efficiency performance for the building and systems.

- Attain or maintain minimum Energy STAR of 69 or equivalent

### **EA Prereq 3: Refrigerant Management:Ozone Protection**

Intent: Reduce stratospheric ozone depletion

- Develop and/or implement phase-out plan for CFC equipment
- Recycle or properly dispose of used refrigerants

### **EA Credit 1: Optimize Energy Efficiency Performance (1 to 18 points)**

Intent: Achieve an increased level of operating energy efficiency performance relative to typical buildings of similar type to reduce environmental impacts associated with excessive energy use.

- Attain Energy Star of at least 71 (or equivalent)
  - o Enhanced metering
  - o Utilize MSCA's *Enhancing Energy Efficiency Program: Utility Bill Analysis, Energy Audits and Retro-Commissioning* for system commissioning and energy audits
- Install time clocks
  - o Controls
  - o Lights
  - o Exhaust fans
  - o Log and verify times and operation

### **EA Credit 2.1: Existing Building Commissioning: Investigation and Analysis (2 points)**

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

- Develop building commissioning plan per MSCA's *Enhancing Energy Efficiency Program: Utility Bill Analysis, Energy Audits and Retro-Commissioning*

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- Confirm commissioning—Provide quarterly reports including trend logs on:
  - Temperature (x locations) occupied and unoccupied
  - Humidity (x locations)
  - CO<sub>2</sub> (x locations)
  - Building static pressure
  - Air changes per hour
- Provide quarterly reports on all metered data gathered and, for each metered, a report card of its performance
- Perform analysis of Energy Conservation Measures:
  - Make recommendations to building owner
- ASHRAE Level 2 energy audit

**EA Credit 2.2: Existing Building Commissioning: Implementation (2 points)**

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

- Implement building commissioning plan recommendations
- Provide on-going staff training
- Cost/Benefit analysis
- Update building operation plan

**EA Credit 2.3: Existing Building Commissioning: Ongoing Commissioning (2 points)**

Intent: Use commissioning to address 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 service provision

- Complete 50% scope of work as identified in first commissioning cycle

**EA Credit 3.1 Performance Measurement: Building Automation System (1 point)**

Intent: Provide information to support the ongoing accountability and optimization of building energy performance and identify opportunities for additional energy-saving investments

- Install and monitor BAS system that includes heating, cooling, ventilation and lighting
- Maintain BAS system

**EA Credit 3.2: Performance Measurement: System- level metering (40% metering (1 point) or 80% metering (2 points))**

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

- Lighting systems and control
- Electric meters
  - Process

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- Gas meters
    - Process
  - Water meters
    - Process
    - Irrigation
    - Boiler
    - Tower
    - Potable
    - Chilled water systems 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
  - Constant and variable motor loads
  - Variable Frequency Drive (VFD) operation
  - Air distribution, static pressure and ventilation air volumes
  - Provide quarterly reports on all metered data gathered and, for each metered, a report card of its performance
- EA Credit 4: On-site and Off-site renewable energy (1 – 6 points)**  
Intent: Encourage and recognize increasing levels of on-site and off-site renewable energy to reduce environmental impacts associated with fossil fuel energy use.
- Recommend and implement alternative energy sources (solar, geothermal, wind, biomass, biogas, fuel cells)
- EA Credit 5: Refrigerant Management (1 Point)**  
Intent: Reduce ozone depletion and support early compliance with the Montreal Protocol while minimizing direct contributions to global warming.
- Implement refrigerant management program
    - Maintain refrigerant logbook
    - Verify calibration of existing refrigerant monitoring systems
    - Keep log of HCFC and communicate plan of replacement
- EA Credit 6: Emissions Reduction Reporting (1 point)**  
Intent: Document the emissions reduction benefits of building efficiency measures
- Quantify amounts of emission reduction due to enhanced energy efficiencies
    - Track and record
    - Report results

## Materials and Resources

**MR Credit 7: Solid Waste Management: Ongoing Consumables – 50% waste diversion (1 point)**

Intent: Facilitate the reduction of waste and toxins generated from the use of ongoing consumable products by building occupants and building operations that are hauled to and disposed of in landfills or incineration facilities

- Recognize and adhere to established solid waste management policy of customer

**MR Credit 8: Solid Waste Management: Durable Goods (1 point)**

Intent: Facilitate the reduction of waste and toxins generated from the use of durable goods by building occupants and building operations that are hauled to and disposed of in landfills or incineration facilities

- Verify that appliances (includes all mechanical equipment) moved off-site for disposal are recycled

## Indoor Environmental Quality

**EQ Prereq 1: Minimum IAQ Performance**

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.

- Through HVAC maintenance program, ensure compliance with ASHRAE 62.1 or provide 10 cfm of outside air per person
- Conduct airflow monitoring to document outside air cfm
- Quarterly inspections of building outside air and exhaust air systems

**EQ Prereq 2: Environmental Tobacco Smoke (ETS) Control**

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

- If smoking room exists:
  - Verify negative pressure of space to verify LEED compliance
  - Check exhaust fan to verify proper operation
- Maintain and calibrate CO<sub>2</sub> sensors

**EQ Prereq 3: Green Cleaning Policy**

Intent: Reduce the exposure of building occupants and maintenance personnel to potentially hazardous chemical, biological and particulate contaminants, which adversely affect air quality, human health, building finishes, building systems and the environment.

- Recognize and comply with green cleaning policy of the facility (includes safe handling and storage of products)

**EQ Credit 1.1: IAQ Management Program (1 point)**

Intent: Enhance indoor air quality (IAQ) 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.

- Survey and evaluate building systems to identify potential IAQ problems
- Provide quarterly reports

**EQ Credit 1.2: Outdoor Air Delivery Monitoring (1 point)**

Intent: Provide capacity for ventilation system monitoring to help sustain occupants' comfort and well-being

- Install permanent, continuous monitoring systems that provide feedback on ventilation system performance to ensure that ventilation system maintain minimum outdoor air flow rates under all operating conditions
  - o Maintain and calibrate CO<sub>2</sub> sensors
  - o Measure the amount of outdoor air

**EQ Credit 1.3: Increased Ventilation (1 point)**

Intent: Provide additional outdoor air ventilation to improve indoor air quality for occupants' comfort, well-being and productivity

- Exceed requirements in ASHRAE 62.1-2007 by a minimum of 30%
  - o Verify and measure increased ventilation
  - o Determine any adverse building conditions or equipment operation issues due to increased ventilation and correct

**EQ Credit 1.4: Reduce Particulates in Air Distribution (1 point)**

Intent: Reduce exposure of building occupants and maintenance personnel to potentially hazardous particulate contaminants, which adversely affect air quality, human health, building finishes, building systems and the environment.

- Install MERV 13 (or greater) filters where applicable
- Check static pressure
- Establish and follow a regular schedule for maintenance and replacement of these filters

**EQ Credit 2.1: Occupant Comfort: Occupant Survey (1 point)**

Intent: Provide for the assessment of building occupants' comfort as it relates to thermal comfort, acoustics, indoor air quality, lighting levels, building cleanliness and any other comfort issues.

- Conduct occupant survey and address concerns (30% total occupants)
  - o Thermal comfort
  - o Acoustics
  - o IAQ
  - o Lighting
  - o Building cleanliness
  - o Other

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**EQ Credit 2.3: Occupant Comfort: Thermal Comfort Monitoring (1 point)**

Intent: Support the appropriate operations and maintenance of buildings and building systems so that they continue to meet target building performance goals over the long term and provide a comfortable thermal environment that supports the productivity and well-being of building occupants.

- Continuous monitoring of temperature and humidity in occupied spaces
  - Install monitoring system as needed
  - Periodic testing of air speed and radiant temperature in occupied spaces
  - Define and set alarms for conditions outside ASHRAE 55-2004
  - Promptly make repairs and adjustments when alarms occur
  - Periodic calibration of sensors to maintain accuracy

**EQ Credit 3: Green Cleaning: Purchase of Sustainable Cleaning Products and Materials (1 point)**

Intent: Reduce the environmental impacts of cleaning products, disposable janitorial paper products and trash bags

- Comply with sustainable purchasing policy of green cleaning products
  - Attempt to purchase general purpose cleaners that comply with GS-37
  - Environmental Choice CCD -110 for cleaning and degreasing compounds
  - Environmental Choice CCD -113 for drain trap additives
- Verify negative pressure of cleaning chemicals storage space

**IO Credit 1: Innovation in Operations (1 – 4 points)**

Intent: Provide building operations, maintenance and upgrade teams with the opportunity to earn points for additional environmental benefits achieved beyond those already addressed by the LEED for Existing Buildings: Operations & Maintenance Rating System.

- Continually look for ways to enhance building sustainability and system operation and provide specific recommendations

**IO 2: LEED Accredited Professional (1 point)**

Intent: Support and encourage the operations, maintenance, upgrade and project team integration required for LEED for Existing Buildings: O&M implementation and to streamline the application and certification process.

- LEED AP on staff

**IO Credit 3: Documenting Sustainable Building Costs Impacts (1 point)**

Intent: Document sustainable building cost impacts

- Assist with cost saving tracking and documentation for innovative compliance strategies