Maintenance

OBJECTIVE

Insure effective lifetime performance in energy efficiency and occupant comfort by keeping building systems operating to design specifications.

- As the building ages and occupants change, follow scheduled maintenance procedures to sustain building value and performance.

KEY IDEAS

General

- **Make maintenance a priority.** Budget constraints and operations and maintenance (O&M) understaffing are a major cause for the poor operations of many buildings, leading to high, long term energy cost and equipment penalties. Allocate a budget for timely repair and preventive maintenance. Train personnel.
- **Keep documentation on file and update regularly.** Develop a set of easy-to-use recommended procedures and maintenance schedules and keep readily accessible in the building, along with manufacturer literature and warranties. Keep as-built drawings in the mechanical room and in the operating engineer's office. Update as required. Log all maintenance or replacement activities, modifications to original systems, space usage changes and other notable operations events. Keep track of the cost and effectiveness of upgrades and support this assessment, if possible, with any utility bill reductions due to the upgrade.
- **Proper commissioning gets O&M off on the right track.** When commissioning is successful, the building begins its occupancy phase with all systems functioning as close to design intent as possible. An accurate baseline for performance is established to guide O&M activities through the life of the building. O&M staff should be involved in commissioning, to assist in their training and to ease the hand-off of the building from commissioning personnel to O&M staff.
- **Involve building occupants.** Keep occupants informed of O&M activities when their comfort is a factor. Inform new occupants about design intent and use of control features (e.g., lighting controls). Locate occupants receptive to daylight utilization near the windows if possible. Suggestions or complaints can be used for trouble shooting. Occupants can be good team players for increased energy efficiency, if they are made aware of energy penalties in individual behavior patterns and encouraged to participate in reducing overall building energy use.
- **Keep an eye out for further energy efficiency opportunities.** When equipment needs replacing, review energy efficient technologies that may not have been available or affordable when the building was constructed. Also, check with the local utility for any possible incentives for replacement equipment. Evaluate energy impact of any proposed architectural changes such as additions, retrofits or major changes in space usage. Periodically review O&M procedures for possible improvement.

Envelope and Lighting

- **Keep all light-reflecting surfaces clean.** Elements in the building intended to assist daylight penetration or distribution should be regularly cleaned of dirt: windows, skylights, light shelves, exterior reflectors, sills, blinds, and ceiling.
- **Clean light fixtures once a year.** It is good building practice to clean the fixtures approximately once a year in relatively clean office environments, more often otherwise. Since lamps are typically replaced once every three years, fixtures are cleaned three times for each new set of lamps. Clean the photo sensor.
- **Re-lamp in groups.** When using standard-color lamps (cool white, white, etc.) it is generally cost effective to do a group re-lamping at 50-60% into the rated lamp life. If T8s are used and labor costs are low, it may be more cost-effective to spot re-lamp. When group re-lamping, functioning lamps should be appropriately marked and stored for spot-re-lamping needs. Group re-lamping is especially important to ensure effectiveness of lumen maintenance. At a minimum, wipe the fixture reflector and lens clean during re-lamping.
- **Replacement lamps should follow the original specification.** If lamp type or manufacturer is changed, check ballast-lamp compatibility.
- **Check that all controls are functioning as intended.** Make sure timeclocks, occupancy sensors, photocells, and nighttime setbacks are working properly and haven't been disabled or thrown off by building changes. Check at intervals recommended by manufacturer or as changes are made to the building.
- **Recalibrate controls when interior is modified.** Recalibrate light control system with each space change (furniture location or color, paint, carpet, etc.). See section on commissioning and calibration.
- **Rebalance the air if occupancy or window/lighting system is changed.** For example, if the equipment load has been reduced considerably, the supply air can be cut back based on new calculations.
- **Changes to space usage should follow design intent.** Ceilings should be kept uncluttered, furniture placement should not block daylight, interior colors to be predominately light, and so on.
- **Make sure occupants are not disabling photocells.** If so, find out why and explore a solution together with the occupant(s) in question. Educate occupants as to the benefits of daylighting.

INTEGRATION ISSUES

ARCHITECTURE

Design building with maintenance in mind. Location and accessibility of equipment, complexity of systems, and longevity of materials and products are important factors.

COST EFFECTIVENESS

Poor O&M practices are cheap in the short term but can be costly in the long run. Poor O&M can waste energy, reduce equipment life, and reduce occupant comfort. Building owners or managers must use experience and educated guesswork to estimate the cost/benefit of proper O&M. Empirical evidence supports the claim that proper O&M is highly cost effective.

OCCUPANT COMFORT

Comfort is dependent on systems operating as designed. Poor maintenance or lack of adjustment when space usage is changed often leads to occupant discomfort and complaints.

PROVISOS

- Occupant comfort and productivity are more important than energy savings. O&M activities to preserve or increase energy efficiency should never impinge on comfort.
- Indoor air quality is a common occupant complaint. Treatment of this concern may conflict with original energy efficiency intentions of the mechanical system. Give indoor air quality priority.

TOOLS & RESOURCES

- **ASHRAE** The American Society of Heating, Refrigerating and Air Conditioning Engineers offers a wide range of technical support materials, including the monthly *ASHRAE Journal.* Up-to-date maintenance information is often found in this literature. Call 800-527-4723 for a publications list. For *ASHRAE Journal* subscription information, call above number or 404-636-8400.
- **AEE** The Association of Energy Engineers publishes a number of periodicals on subjects ranging from energy management to lighting efficiency and environmental compliance. Call (770) 447-5083 for a publications list, or visit the AEE world wide web site at http://www.aeecenter.org.
- **BOMA** The Building Owners and Managers Association offers publications on a variety of topics, including a large selection of economic materials. Request a publications list from BOMA, PO Box 79330, Baltimore, MD, 21279-0330, (800) 426-6292.
- **Books** ASHRAE has many book titles available addressing maintenance (see above), including the useful *ASHRAE 1995 HVAC Applications Handbook.*

  Energy Management Handbook by W. Turner (Fairmont Press 1993) is somewhat dry but very thoroughly covers maintenance issues for all building systems.
- **Utility Company** Many utilities offer incentives for energy efficient equipment replacements. Inquire at your local utility about retrofit programs for lamp, ballast, and control system upgrades.
- **Diagnostic Tools** Troubleshooting, searching for energy improvements, and simple routine maintenance are greatly assisted by appropriate measurement tools. Devices ranging from data loggers to hand-held survey instruments can measure everything from dry bulb temperature to building power consumption. Many tools are inexpensive and easy to use. A good source for information is the monthly *Sensors Magazine.* Subscription information: PO Box 1285, Northbrook, IL 60065-1285. Publisher: Helmers Publishing, Inc., 174 Concord St., PO Box 874, Peterborough, NH 03458-0874, (603)924-9631.
- **Consultants** Outside specialists in optimum O&M and energy management are an option. For lighting control specialists, check with the manufacturer's support services or a local lighting engineer.

☑ CHECKLIST

1. Verify that O&M documents are on file. If not, create this file. What should be there:
   - An index or directory of all documents on hand.
   - Operating manuals and manufacturer warranties.
   - Performance standards for all building systems.
   - Maintenance procedures.
   - Responsibilities of the O&M staff.
   - Test, calibration and balance reports.
   - All construction documents, including as-builts.
   - Emergency procedures.
   - O&M staff training procedures.
2. Promptly update documents with each equipment modification or replacement.
3. Regularly follow all maintenance procedures as prescribed in the O&M documents.
4. Log all maintenance activities and changes in space usage.
5. Modify the recommended maintenance procedures or schedule if appropriate. Note this change in the O&M documents.
6. Keep photometer on hand and in good working order. Recalibrate before a required sensor recalibration.
7. Acquire diagnostic tools if regular maintenance alone isn't leading to specified system performance.
8. Choose energy efficient equipment when replacements are due. Contact utility company for possible replacement incentives.
9. Watch for further energy efficiency opportunities.
10. Monitor building energy data for any sign of savings erosion or any unusual energy use patterns. Find the problem and take corrective measures.
11. Engage building occupants as energy efficiency team players.

If you have...

no time

1. Follow recommended O&M procedures according to recommended schedule, to the best of building operator's ability.
2. Promptly repair any equipment failures.
3. When replacements are due, choose the most energy efficient equipment available within allowed budget.

a little time

In addition to above:

1. Perform a comprehensive window and lighting systems evaluation once a year.
2. Periodically evaluate individual spaces for adequate performance of local controls.

more time

In addition to above:

1. Maintain a dedicated, full time O&M staff; size of the staff should correspond with building size and complexity.
2. Perform continuous local evaluations, sweeping through the building space by space. Complete the loop within a maximum of one year.
3. Enable O&M staff to work directly with occupants in reviewing individual energy efficiency opportunities.
4. Keep O&M staff informed of utility incentive programs and current equipment and control technologies.