Chapter 2 Why O&M?

2.1 Introduction

Effective O&M is one of the most cost-effective methods for ensuring reliability, safety, and energy efficiency. Inadequate maintenance of energy-using systems is a major cause of energy waste in both the Federal Government and the private sector. Energy losses from steam, water and air leaks, uninsulated lines, maladjusted or inoperable controls, and other losses from poor maintenance are often considerable. Good maintenance practices can generate substantial energy savings and should be considered a resource. Moreover, improvements to facility maintenance programs can often be accomplished immediately and at a relatively low cost.

2.2 Definitions

Operations and Maintenance are the decisions and actions regarding the control and upkeep of property and equipment. These are inclusive, but not limited to, the following: 1) actions focused on scheduling, procedures, and work/systems control and optimization; and 2) performance of routine, preventive, predictive, scheduled and unscheduled actions aimed at preventing equipment failure or decline with the goal of increasing efficiency, reliability, and safety.

Operational Efficiency represents the life-cycle, cost-effective mix of preventive, predictive, and reliability-centered maintenance technologies, coupled with equipment calibration, tracking, and computerized maintenance management capabilities all targeting reliability, safety, occupant comfort, and system efficiency.

2.3 Motivation

In October of 2009, EO 13514 was signed into law. This order directs Federal agencies to further address energy, water, and operational efficiency beyond E.O. 13423.

The key energy- and operational-efficiency-related provisions in the Executive Order are as follows:

- Federal agencies must enhance efforts toward sustainable buildings and communities. Specific requirements include the implementation of high-performance sustainable Federal building design, construction, operation and management, maintenance, and deconstruction.
- Pursuing cost-effective, innovative strategies (e.g., highly reflective and vegetated roofs) to minimize consumption of energy, water, and materials.
- Managing existing building systems to reduce the consumption of energy, water, and materials, and identifying alternatives to renovation that reduce existing asset-deferred maintenance costs.
- Reducing potable water consumption intensity 2% annually through FY 2020, or 26% by the end of FY 2020, relative to a FY 2007 baseline.
- Reducing agency industrial, landscaping, and agricultural water consumption 2% annually, or 20% by the end of FY 2020, relative to a FY 2010 baseline.
- Identifying, promoting, and implementing water reuse strategies consistent with state law that reduce potable water consumption.

While applicable only to Department of Energy facilities, DOE Order 430.2B was issued in February 2008 clearly outlining the requirements and responsibilities for managing DOE facilities. The relevance of this Order lies in forward-thinking and highlights DOE's commitment to energy and resource efficiency.

The key energy- and operational-efficiency-related provisions in the DOE Order are as follows:

- By FY 2015, reduce energy intensity by no less than 30% on average across the entire Department, relative to the Department's energy use in FY 2003. Energy intensity means energy consumption per gross square foot of building space, including industrial and laboratory facilities.
- By FY 2015, reduce potable water use by no less than 16%, relative to the Department's potable water use in FY 2007.
- Install advanced electric metering systems at all Department sites in accordance with the DOE metering plan for site monitoring of electric energy. Standard metering systems for steam, natural gas, and water must also be installed and centrally monitored at all Department sites for steam, natural gas, and water consumption. Advanced meters are defined as having the capability to measure and record interval data (at least hourly for electricity) and communicate the data to a remote location in a format that can be easily integrated into an advanced metering system.
- Use standardized operations and maintenance (O&M) and measurement and verification (M&V) protocols coupled with real-time information collection and centralized reporting capabilities.

While effective, some feel that capital upgrades are not always the most cost-effective solution. Indeed, the authors of this guide contend that low-cost/no-cost O&M measures (including activities referred to as retrocommissioning or retuning) should be the first energy savings measure considered. O&M measures should be considered prior to the installation of energy conservation measures for the following reasons:

- Typically, O&M measures are low-cost or no-cost in nature.
- Many O&M measures are easily installed by in-house personnel.
- O&M measures can have immediate payback.
- These measures rarely require the design time, bid preparation, evaluation, and response compared to capital projects that can take up to a year to implement.

Is an Energy Savings Performance Contract Being Considered?
(Haasl and Sharp 1999)

Some level of retrocommissioning (i.e., O&M best practices) is usually appropriate if you are considering any type of energy savings agreement such as an energy savings performance contract. There are two primary reasons for performing retrocommissioning before obtaining an energy-savings agreement. First, the low-cost energy savings gained from retrocommissioning remains with the building (the owner gets all of the savings) and does not become part of the financial agreement; second, retrocommissioning optimizes the existing equipment so the most appropriate capital measures are selected and financed through the agreement.

A good reason for doing retrocommissioning as part of an energy-savings agreement is to ensure that the performance of new equipment is not hindered because it interfaces with older equipment, components, or systems that are malfunctioning. Even when commissioning is specified for the new equipment, it often stops short of looking at the systems with which the new equipment interfaces or examining how it integrates with other systems or equipment that may affect its performance. This is especially true for energy management control systems. Because controls are an area where many difficulties and misunderstandings occur between building owners and performance contractors, it is a good idea to specify commissioning for both the new and existing equipment that may affect the performance of the new equipment.

When retrocommissioning is performed before the energy-savings agreement or energy savings performance contract is finalized, it is important to inform the contractor about the retrocommissioning activities and give him or her a copy of the final report. If the contractor is not informed and energy bills from prior years are used to help determine the energy baseline, the baseline may be inaccurate. This may cause the cost savings upon which the financing is based to be significantly less than expected, leading to disagreements and even legal battles.

Retrocommissioning performed up front to capture the low-cost savings may not be a wise choice if the savings from the retrocommissioning do not remain with the building but, instead, go into a general fund. In this case, the "low-cost/no-cost" improvements should be part of the performance contract. In this way, a portion of the savings stays with the building as part of the financial arrangement. Integrating the retrocommissioning measures into the energy-savings agreement is a way to capture the savings as part of the investment repayment. The amount invested can be increased when the savings estimates are higher. Moreover, the savings gained from bundling these measures with the capital upgrades—especially if some of the upgrades are marginally cost-effective (i.e., good value but with long paybacks)—help to increase the overall viability and attractiveness of the energy savings performance contract funding.

2.4 O&M Potential, Energy Savings, and Beyond

It has been estimated that O&M programs targeting energy efficiency can save 5% to 20% on energy bills without a significant capital investment (PECI 1999). From small to large sites, these savings can represent thousands to hundreds-of-thousands of dollars each year, and many can be achieved with minimal cash outlays.

The need for effective building O&M is illustrated in Figure 2.4.1, which shows how, over time, the performance of a building (and its components) will eventually degrade in two scenarios – one with and one without "normal" maintenance. Of interest in the figure is the prolonged service life achieved through effective O&M. Not shown in this figure is the additional benefit of reduced building (energy) operating costs resulting from effectively maintaining mechanical and electrical equipment (e.g., lighting; heating, ventilation, and air conditioning [HVAC]; controls; and on-site generation).

Beyond the potential for significant cost and energy/resource savings, an O&M program operating at its peak *operational efficiency* has other important implications:

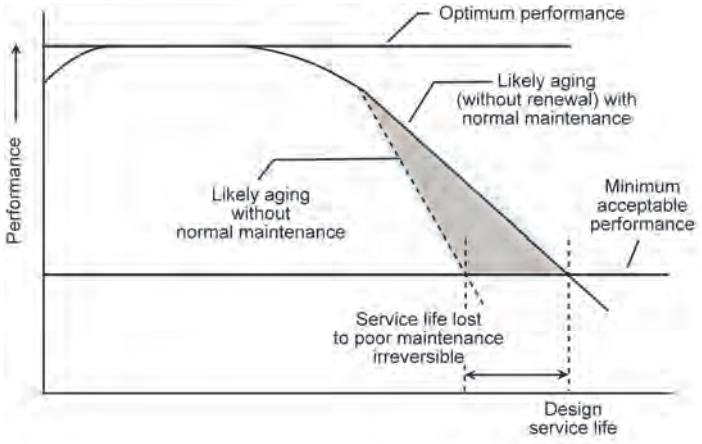

Figure 2.4.1. Effect of adequate and timely maintenance and repairs on the service life of a building (National Research Council 1998).

- A well-functioning O&M program is a safe O&M program. Equipment is maintained properly mitigating any potential hazard arising from deferred maintenance.
- In most Federal buildings, the O&M staff are responsible for not only the comfort, but also the health and safety of the occupants. Of increasing productivity (and legal) concern are indoor air quality (IAQ) issues within these buildings. Proper O&M reduces the risks associated with the development of dangerous and costly IAQ situations.

> When Marion County, Florida, officials realized their new county courthouse was making hundreds of employees sick, they did more than send the workers to the doctor, they sued the builder/ operator of the building for bad air and won a $14.2 million judgment (Ewell 1996).

- Properly performed O&M ensures that the design life expectancy of equipment will be achieved, and in some cases exceeded. Conversely, the costs associated with early equipment failure are usually not budgeted for and often come at the expense of other planned O&M activities.
- An effective O&M program more easily complies with Federal legislation such as the *Clean Air Act* and the *Clean Water Act* as well as expected carbon management legislation.

> O&M measures cost approximately 20 times less and achieve roughly the same energy savings as retrofit measures.

- A well functioning O&M program is not always answering complaints, rather, it is proactive in its response and corrects situations before they become problems. This model minimizes callbacks and keeps occupants satisfied while allowing more time for scheduled maintenance.

Two recent DOE/FEMP-sponsored programs have highlighted both the opportunity and the cost effectiveness of O&M/low-cost energy efficiency measures; these programs were the Energy Savings Expert Teams (ESET) and Energy Efficiency Expert Evaluations (E4). Both programs were designed to respond to the need for immediate, cost-effective energy savings. From the post evaluations, the following findings were highlighted:

A demonstration focused on O&M-based energy efficiency was conducted at the U.S. Department of Energy Forrestal Building in Washington, D.C. (Claridge and Haberl 1994). A significant component to this demonstration was metering and the tracking of steam use in the building. Within several months, $250,000 per year in steam leaks were found and corrected. These included leaks in a steam converter and steam traps. Because the building was not metered for steam and there was not a proactive O&M program, these leaks were not detected earlier, nor would they have been detected without the demonstration. The key lessons learned from this case study were:

- O&M opportunities in large buildings do not have to involve complex engineering analysis.
- Many O&M opportunities exist because building operators may not have proper documentation that hindered day-to-day actions.
- Involvement and commitment by building administrators is a key ingredient for a successful O&M program.

Energy Savings Expert Teams - ESET (Hunt 2007):

- To realize the same benefits (energy savings), equipment retrofits cost approximately 20-times more than low-cost O&M measures
- Dollars saved per dollars invested (calculated values):
  - *O&M projects:* 3.83 (simple payback 0.26 years)
  - *Retrofit projects:* 0.19 (simple payback 5.26 years)
- Overall program cost-effectiveness for measures implemented (as of May 2007) - includes retrofit, O&M measures and program administration/delivery
  - *Annual energy savings:* 202,512 MMBtu
  - *Annual cost savings:* $1,731,780
  - *Total program cost:* $1,795,000
  - *Simple payback:* 1.0 years

Energy Efficiency Expert Evaluations - E4 (Hail 2008):

- Calculated savings range from 3% to over 40%, average savings 15%.
- Dollars saved per dollars invested (calculated values):
  - *O&M projects (defined as <$5,000):* 14.9 (simple payback 0.07 years)
  - *Retrofit projects (defined as >$5,000):* 0.7 (simple payback 1.5 years)
- Overall program cost effectiveness for measures implemented (as of December 2008), includes retrofit, O&M measures and program administration/delivery
  - *Annual cost savings:* $584,000
  - *Total program cost:* $800,000
  - *Simple payback:* 1.4 years

2.5 References

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