

Technical Note

Measuring and Verifying Savings From Operation and Maintenance Improvements

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April 27, 1998

Introduction

Losses associated with poor operation and maintenance cost industry and government billions of dollars each year¹. Improved O&M offers an opportunity to lower costs and increase profits by using existing systems and equipment more effectively. For example, a recent California Energy Commission report indicates that improved preventative maintenance techniques can result in energy savings ranging from six to nineteen percent of a typical community college's energy bill.² In addition to energy savings there can be reductions in costs for O&M, equipment and labor as well as improvements in a building's environment – such as improved lighting or indoor air quality – that can lead to productivity benefits.

However, the decision to make needed improvements may hinge on the ability to quantify or place a value on the savings. At this time there are no specific M&V protocols for assessing O&M measures. If M&V protocols did exist there could be more O&M cost saving measures, both performance based and conventional self-financed projects. This is because there would be more confidence in O&M savings as projects are evaluated under common standards and agreed to methods for determining savings.

The “pay for performance” aspect of performance contracting requires that the benefits be quantified. Therefore, the measurement and verification (M&V) process, in which savings from projects are documented, is one of the most important activities associated with implementing performance contracts. It also is the second most crucial negotiation issue after pricing—and it is usually the basis for disputes when they do occur between contractors and users. Concerns about documenting savings is a barrier to implementing O&M measures as many owners are unsure about how savings will be achieved and quantified.

¹ “Enhancing Productivity through Improved O&M”, Pacific Northwest National Laboratory, <http://www.pnl.gov/energy/om/om.htm>, 10/13/97

² Study: HVAC Maintenance and Training Does Pay”, Barry Abramson and Michael MaGee, Energy User News, April, 1998, page 16.

Measurement and Verification (M&V) Issues

At first glance, the basics of M&V for O&M are no different than they are for other measures – savings are the difference between what happens and what “would have been” had the measures not been implemented. However, several important issues arise when we seek to measure and value these O&M benefits. Some O&M M&V issues include:

- **Persistence.** A simple O&M measure such as cleaning filters may achieve substantial energy savings, but only so long as the practice is continued. Concerns about persistence apply to a wide variety of maintenance and operational items. Experience tells us that, after certain procedural improvements are made, a tendency to slip back into earlier practices can occur in which clogged filters are continued in use, controls are no longer optimized, drive belts are slipping, and repairs are not made. It is easy to conclude that many O&M measures have short lives. A related issue, for performance contracts, is how long the problem e.g., poor O&M procedures, would have persisted before they would have been corrected without the use of a performance contract.
- **Short-term and long-term effects.** O&M budget cuts “today” do not result in long term savings if they lead to still higher O&M costs “tomorrow”. Few tools exist to place a meaningful value on the impacts of “deferred maintenance”.
- **Consequential losses and savings.** Additional attention to preventative maintenance may add to the operating staff budget, but if the effect is to avoid emergency repairs and/or cause interruptions in service, then the consequential savings could far outweigh the savings.
- **Documenting non-energy benefits.** If, for example, O&M changes are projected to provide labor savings, those savings will be realized only if the staff is reduced. If a facilities department is already understaffed, any labor savings are likely to be redirected to other pressing needs. Indeed it might be argued that the labor should be redirected, perhaps with benefits that need to be evaluated on their own merits.
- **Setting baseline M&V procedures.** Determining the baseline from which savings are calculated for O&M measures often requires evaluating what the existing standards of performance are for O&M activities. These existing standards are often not well documented and the baseline definition can thus involve identifying the incremental value of “more robust” O&M measures versus “well done, conventional” measures – both of which need to be defined for the calculation of savings. In addition, while the standard for acceptable practice may be defined for the facility, actual practice may be sub-standard. Thus, should the savings be based on the O&M standard or the actual O&M practices?
- **M&V as an O&M Measure.** Measurement and verification activities have an overlap with several activities that can be considered O&M activities. These include metering, commissioning and re-commissioning. Logic and the arguments of some practitioners indicate that just the M&V activity of tracking O&M activities and their results result in improvements. Tracking costs and comparing them to “norms” indicates where more effort is needed.

Energy savings program developers and facility owners have tended to concentrate on improvements to specific systems and equipment that have easy to quantify benefits and to shy away from programs that achieve savings through more hard to define and quantify O&M improvements. Overcoming barriers to more O&M savings measures requires (a) improvements in information management and management of perceptions about what savings can be achieved

through O&M measures and (b) improvements in the methods for measuring and verifying O&M project savings.

Measurement and Verification Framework

Methods for measuring and verifying the savings from O&M measures are not nearly as developed or tested as methods for M&V of energy or water retrofit projects. In our companion paper³ to this technical note we discuss an initial M&V framework for O&M measures. The M&V Options for O&M measures follow the International Performance Measurement and Verification Protocol (IPMVP).⁴ In general, we find that Options A, B and C can be applied to O&M measures. The IPMVP's Option D, which involves calibrated simulation models, does not appear applicable to O&M measures.

At this time, measurement and verification plans for O&M measures will need to be custom developed by the contractor and the customer since there are no guideline M&V methods (as there are for water and energy measures). It is highly recommended that not only the definition of the measures and their projected savings be established early in the planning process, but also the M&V approach. Prior to the customer's approval of a project's scope and design, the contractor should submit a final M&V plan that addresses the following elements:

- Describe the facility and the project; include information on how the project saves energy and/or provides non-energy benefits and what key variables effect the realization of savings.
- Indicate how the customer's budget will directly be reduced, or services enhanced, by the implementation of the measure(s).
- Define the baseline O&M performance standard. If this standard is better and more expensive than the existing standard then document how the baseline O&M budget will be established and calculated.
- Define the minimum performance standards (indoor air, temperature ranges, lighting levels, safety requirements, etc.) that are currently in place and those required once the measure is in place. Determine if, and if so, how benefits (or losses) associated with improvements (or reductions) in performance standards will be allocated between parties. Indicate how compliance with performance standards will be verified during the term of the agreement and what will happen if they are not met.
- Indicate who will conduct the M&V activities and prepare the M&V analyses and documentation.
- Define the details of how calculations will be made and the assumptions that will be made about significant variables or unknowns.

³ Measuring and Verifying Savings From Improvements in Operation and Maintenance of Energy-Consuming Systems in Commercial and Institutional Buildings, Steven R. Schiller and Gale Corsen, Schiller Associates, Oakland, CA, prepared for Lawrence Berkeley National Laboratory and ReBuild America.

⁴ International Performance Measurement and Verification Protocol (IPMVP), U.S. DOE, DOE/EE-0157, 1997 and U.S. DOE Federal Energy Management Program M&V Guideline, 1996. www.ipmvp.org

- Specify what metering and data logging equipment will be used, who will provide the equipment, its accuracy and calibration procedures, and how data from the metering will be validated and reported, including formats.
- Specify what additional management oversight logs will be maintained, the nature and frequency of entries, and interpretation that is to be assigned to the results. Examples include logging of equipment failures and frequencies, equipment down time, and complaints.
- Describe any sampling that will be used, why it is required, sample sizes, documentation on how sample sizes were selected, and information on how random sample points will be selected, if appropriate.
- Define the level of accuracy which should be achieved—if not for the entire analysis, at least for key components.
- Indicate how quality assurance will be maintained and repeatability confirmed. For instance: “The data being collected will be checked every month and provided to the customer”.
- Indicate which reports will be prepared, what they will contain, and when they will be provided.

Recommendations for Future Research

The issues identified and the framework for O&M M&V options provide a starting point for further development of M&V protocols for operations and maintenance measures. To continue the effort the following applied research efforts are suggested:

- Development of analysis and documentation tools for quantifying O&M benefits for each of the O&M cost categories (energy, labor, and equipment), pre-mature equipment failure, and indirect benefits such as improved indoor air quality and comfort. This would include developing statistically valid procedures for generalizing such benefits.
- Development and publication of case studies in which the costs and benefits of O&M measures are documented using different M&V options.
- Development and testing of techniques and tools for estimating (prior to implementation) the value of improved O&M