Common Sense Approaches to M&V in Performance Contracting

Martin A. Mozzo Jr., PE, CEM, CLEP
President, M and A Associates, Inc.

ABSTRACT

Performance Contracting requires that some measurement & verification (M&V) occur to verify that energy savings are achieved and payments are justified. It has been this author's experience, however, that too often M&V occurs after the fact. Cost to install and maintain the M&V system becomes a significant factor, and typically projects end up stipulated. While stipulation reduces risk to all parties, the "Performance Contract" ends up not really being a true "Performance Contract." This article will discuss some common sense approaches that have been used, and proved, for M&V in performance contracting. The article has true examples that have occurred during his 10+ years of experience in performance contracting.

INTRODUCTION

I have been involved in performance contracting for over a decade and am amazed to find a lack of knowledge in even the most fundamental aspects of performance contracting. This occurs frequently in the measurement & verification (M&V) function of performance contracting.

This article discusses the reasons for performing M&V in a performance contract. More importantly, it discusses common sense approaches to M&V in order to keep costs involved in this function within reason. Remember, M&V systems do not save energy; they only measure and verify savings. Excessive spending on such systems is just not cost effective.

WHAT IS PERFORMANCE CONTRACTING?

Typical projects, whether they are energy savings projects or just everyday normal projects, involve a contractor and an end user. The end user requires that a project be implemented, for example a new HVAC unit. He will hire a contractor to install the new unit. The end user may propose a turnkey project where the contractor would also purchase the HVAC unit.

From a financial view, the contractor is usually paid a sum of money based solely on the cost of labor, materials, overhead, and a profit to construct the project. In such projects, the end user usually assumes the risk for project success, The only risk the contractor assumes is meeting the project timetable and containing his costs.

Performance contracting is different from your normal contract in that, as the name implies, there is a performance factor involved in the project. In our HVAC example, the performance is usually a reduction in energy usage. This will occur if the new HVAC unit is more energy efficient than the old unit, assuming the operation of the HVAC system remains the same.

This example sounds simple enough. In order to verify the performance of the new HVAC system, one only needs to "verify" the savings that have occurred. Measurement & Verification systems are thus required to measure actual energy consumption after the installation to determine energy savings.

Performance contracting shares the risk between the end user and the contractor. The problem usually occurs when M&V systems, including installations, are priced out. The cost of the system can be expensive, especially if complex M&V systems and protocols are designed.

Unfortunately, cost proposals too often are considered to be "too high" and as a result, they are scrapped. We then arrive at a "stipulated savings" for verifying a performance contract.

INTERNATIONAL PERFORMANCE MEASUREMENT & VERIFICATION PROTOCOL (IPMVP)

The IPMVP is an outstanding document that can provide a cost effective methodology for M&V in performance contracting. There are four (4) M&V options stated in the October 2000 protocol. These are Option A, Partially Measured Retrofit Isolation; Option B, Retrofit Isolation; Option C, Whole Building, and Option D, Calibrated Simulation.

Option A requires that savings be determined by partial field measurements. A good example of this is for lighting retrofits. For such a project, the project is classified into groups which are based on operating hours. Then within each group, partial measurements of operating hours are taken to establish the savings level for each group, and then the project in whole. The instrumentation can then removed from the site. It may be reinstalled on a periodic basis to verify that the operating hours have not changed.

Another method for lighting would be to install and maintain in place, monitoring boxes that record operating hours for random fixtures continually over the life of the project. This of course, requires both an initial cost to install the equipment as well as an on-going cost to collect and analyze the data.

Option B is different from Option A in that one is measuring an isolated retrofit. Typically, this would be an HVAC unit, boiler, air compressor, or a process. Option B requires either engineering calculations or continuous measurements. While engineering calculations may be acceptable, there are shortfalls. For example, use of variable frequency drives on fans or pumps. By the affinity laws, power varies as the cube of the speed. However, through experience, I have found that the power varies at something less than the cube of the speed, mainly because of inherent inefficiencies. Thus, I am a firm believer in measurement of savings as a verification tool.

Option C requires the use of a whole building meter or sub-meter data. Obviously, this may be okay if the use of the building remains the same over the years; however, one has to recognize that even constant use buildings can change. For example, schools. Ten years ago, computer use in schools was minimal; however, today that can't be true, and who knows what tomorrow will bring.

Option D is Calibrated Simulation. This approach may be expensive to use as models need to be developed and computer time is required. It also may not be totally accurate if the assumptions used to develop the models are incorrect.

No matter what option is selected, there is a cost involved. Sometimes, this cost becomes too prohibitive and stipulation is used. While this author has used stipulation on several occasions, he does not endorse that methodology as being acceptable in most cases. Stipulated savings typically rely upon engineering calculations of a project that assume how the new piece of equipment will operate. It removes the risk from contractor, and it cannot account for changes in operation or the failure of the equipment to operate as it was planned. Stipulation becomes nothing more than a lease-type project.

There are two reasons that this author disagrees with stipulation. First, it allows the project designer to make assumptions that may be false about operating conditions or to poorly engineer the project. If there is no M&V function to verify that the project has been correctly designed to save energy, how can it ever be proven that it is indeed saving the expected energy? Project risk is then forced onto the end user. The second reason is that as time passes in the life of a project, operating conditions and maintenance changes. Conditions degrade, and with it, savings disappear. Without an M&V system, or at the very least a periodic re-commissioning procedure, it is difficult to prove that savings have been reduced or disappeared.

How then can M&V systems, which appear to be too expensive to support the project, be installed to avoid stipulation? It has been my experience that common sense application of an M&V Protocol can be applied which will be acceptable to all parties and which will reduce M&V costs.

WHAT IS A COMMON SENSE APPROACH TO M&V?

Standardized M&V protocols require that a performance contract be measured and verified, sometimes in accordance with strict rules or an interpretation that strict rules need to be applied. Such an application of these rules however, may result in extremely high costs for M&V.

If allowable for the project, common sense rules should apply. Common sense in this application is basically the use of good engineering judgement in developing a cost effective M&V system and protocol. While the use of the words "good engineering judgement" appears to be an oxymoron as compared to the words "engineering calculations" used in stipulation, I believe that there is a distinct difference that will become apparent when looking at the examples presented.

Three examples are presented here. The first is an HVAC example where actually an M&V protocol does allow for the use of some common sense. The second is a fuel switch project where common sense was not allowed to prevail to its fullest. The third is a process application where common sense was allowed to prevail.

Example #1, HVAC Unit

In this example, an existing inefficient HVAC unit is to be replaced with a more efficient unit. The energy savings is basically the difference between the kWh that would have been consumed by the old unit minus the kWh actually consumed by the new unit. Energy consumption for the new unit is easy to determine; actual power measurements within a time period can be recorded. Actual weather conditions likewise can be measured during the same time periods. The difficulty is determining what the older unit would have consumed during the same weather conditions.

One approach would be to measure the old HVAC unit for an entire heating/cooling season and develop a load curve for energy consumption versus weather conditions. While this is the most accurate M&V protocol, it is not necessarily the most practical. First, an entire season of data needs to be collected, maybe more than one if the weather is not close to “normal.” Second, waiting to obtain this data will result in lost opportunity in energy savings from the installation of the new unit.

Another approach is outlined in the MEASUREMENT PROTOCOL FOR COMMERCIAL, INDUSTRIAL AND RESIDENTIAL FACILITIES. This document was prepared in the context of the implementation of New Jersey’s Demand Side Management Rules. This protocol allows for the use of manufacturer’s load curves **or** default tables. Given the manufacturer and model number of an HVAC unit, a load curve may be available from the manufacturer. This curve would provide both full and part load efficiencies, defined as kW per ton, for a HVAC unit. If these curves are not available, the protocol contains default tables that give full load efficiencies for type of units, such as air-cooled chillers, DX units, etc. Part load curves are also provided.

The M&V protocol would then require measuring the kWh for the new unit during a time period, determine from the new equipment load curves the percent loading on the unit, and then from either manufacturers data or default tables the energy consumption that the old unit would have consumed during the same time period. The difference is obviously the energy savings.

This approach works quite well when replacing HVAC units. It avoids expensive, long-term measurement of existing HVAC units. Measurement of the new HVAC units over the life of the performance contract allows for true verification of energy savings as well as provides a re-commissioning tool for the unit operation.

EXAMPLE # 2, FUEL SWITCH PROJECT

This project involved the replacement of electrically operated HVAC units with a steam absorption chiller. Displaced electrical consumption was measured and calculated based on gallons of chilled water and a delta temperature for the water across each unit. Equivalent tons are calculated and using default tables for full and part load, kWh displaced is calculated for the various time periods.

Off-setting the displaced electrical loads for the HVAC units are several pieces of auxiliary equipment. This equipment consists of chilled water pumps, condenser pumps, and cooling tower fans. The electrical consumption for the auxiliaries should be subtracted from the displaced electrical consumption to determine net electricity saved. This can easily be done.

In the course of reviewing the M&V protocol for this project, one interested party noticed that there were three chemical pumps for the cooling tower, which were not accounted for as an auxiliary load. This party demanded that the kWh used on these pumps be accounted for in the savings calculations. The pumps operate on demand based on the chemical composition of the water in the cooling tower. The pumps were located in a remote building, operated on 115 volts and all three consumed in total less than 0.5 kW. The pumps could not be measured with an existing data logger because of their remoteness; therefore, a new data logger was required, at a significant cost. Common sense somewhat prevailed in this case. The result of some negotiations was that it was assumed that the three pumps ran continuously 24/7, and a stipulated value of over 4,000 kWh/year was considered as an auxiliary load. Of course, this approach reduced the savings as common sense says that these pumps do not run continuously; however, the loss in energy savings clearly offset the cost of a new data logger.

EXAMPLE # 3, PROCESS APPLICATION

This process application project consisted of modifications to air handling systems, including controls. There were 11 air-handling systems involved. Each air-handling house consisted of one supply air fan, 6-9 exhaust fans, controls, and other miscellaneous electrical loads. At that time, the only suitable data logger for analog systems could measure four loads (channels). Each air handling system required the following number of loggers, assuming controls and miscellaneous loads required one channel:

Air Handler # 1 - 2 data loggers (8 channels)
Air Handler # 2 - 2 data loggers (7 channels)
Air Handler # 3 - 2 data loggers (7 channels)
Air Handler # 4 - 2 data loggers (8 channels)
Air Handler # 5 - 2 data loggers (8 channels)
Air Handler # 6 - 2 data loggers (6 channels)
Air Handler # 7 - 3 data loggers (10 channels)
Air Handler # 8 - 2 data loggers (6 channels)
Air Handler # 9 - 3 data loggers (11 channels)
Air handler 10 - 3 data loggers (9 channels)
Air Handler 11 - 3 data loggers (9 channels)

This project would have required 26 data loggers to measure accurately all power consumption in each air house. This, of course, would have been prohibitively expensive and negated the project.

It was noted that each air house had one motor control center (MCC) which provided power to the supply air fan, all exhaust fans, controls, and miscellaneous power. After review, negotiations, and compromises by all parties, it was agreed upon that power consumption could be measured to the MCC for each air house. This power consumption represented the baseline (pre-retrofit) and the after conditions (post-retrofit) fairly. This reduced the number of data loggers required from 26 to 4 for the entire project, a large drop in cost without any adverse impact on verifying energy savings.

The outcome of this project is interesting. If this common sense approach was not accepted and the project stipulated, significant amounts of verifiable savings would have been lost. The project, according to engineering calculations was to save 400 kW. The project today is saving an average of over 800 kW. If the M&V system had not been accepted as proposed, there would have been over 400 kW per hour of savings that would not have been recognized.

CONCLUSIONS

Too often, stipulation is accepted as a means of providing M&V to a performance contract. By accepting stipulation however, the parties to the contract are really accepting a "lease contract" not a "performance contract." Further, the risk of the project success shifts entirely to the end user. Stipulation should only be used as a last resort in place of measurement and verification. Where allowable, common sense approaches can reduce costs for an M&V system yet verifies savings to an acceptable level. The M&V system then also provides a tool for "re-commissioning" the project over its life relatively easily, thus maintaining the energy savings for the project. It truly brings "performance" back to performance contracting.

ABOUT THE AUTHOR

Martin A. Mozzo, Jr., is president of M&A Associates, Inc. M&A Associates provides energy engineering and consulting services to retail, commercial and industrial end users as well as energy service companies. Prior to starting M&A Associates Inc., Mr. Mozzo worked for Energy Performance Services, Inc. and KENETECH Energy Management, Inc., both nationally prominent energy service companies. Prior to that, Mr. Mozzo worked for 17 years at American Standard Inc. in a number of positions including corporate director of energy management.

Mr. Mozzo has been very active in the Association of Energy Engineers. He served as president during 1999. He currently serves as chairman of two of AEE's certification boards, the Certified Lighting Efficiency Professional (CLEP) and the Certified GeoExchange Designer Boards. He is a charter member of AEE, was Region I VP (national) for two years, was executive VP, and was a board of director member for the New Jersey chapter for several years. Mr. Mozzo was elected into the AEE Energy Managers Hall of Fame in 1995.

Mr. Mozzo holds a BS in mechanical engineering from Rutgers University, an MS in logistics management from the Air Force Institute of Technology, Dayton, Ohio, and is a registered PE in the states of New Jersey, New York, Pennsylvania, and Ohio. He has received certification as a CEM and CLEP from AEE.

M&A Associates Inc., PO Box 8693, Trenton, NJ 08650-0693; (p) 609-584-9244; (f) 609-586-0014; (e) mmozzo@aol.com.