Measurement and Verification Protocols – Facts and Fiction, News from the Field

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ABSTRACT

This paper provides descriptions of the 1997 International Performance Measurement and Verification Protocol (IPMVP), the 1996 Federal Energy Management Program's (FEMP) Measurement Verification Guidelines, and the draft ASHRAE 14-P Measurement of Energy and Demand Savings Guideline. These protocols and guidelines are establishing a framework for measurement and verification (M&V) activities throughout the world. The M&V protocols are also being used by the energy performance contracting industry as an educational tool and as the starting point for program specific M&V guidelines. Beyond descriptions of the documents the paper covers how the documents are being used and the perspective of various user groups - such as government entities, utilities, private companies, and energy services companies.

The protocols were designed around four main M&V options to allow flexiblity in their application to different types of projects. However, this intentional flexibility has caused confusion among some users who are now required to select the appropriate option, method, level or rigor, and accuracy for their projects. Eventually though, as the protocols are more widely used and more documentation is available on M&V costs and accuracy, the industry will become more comfortable selecting the best option and applying the M&V protocols in a more consistent manner for different types of projects and programs.

Introduction

Energy efficiency projects are considered performance-based when the "Seller's" compensation, and perhaps the project's financing, are meaningfully tied to the amount of energy, or the energy costs, actually saved by the "Buyer". While most people think of shared savings deals, performance contracting can involve any of a variety of contracting and financing mechanisms. These include guaranteed savings, shared savings, pay from savings, chauffage and, in some cases, leasing mechanisms.

Performance contracting in the U.S. can be broken down into three broad markets, or groups of buyers: contracts with private companies, contracts with public entities, and utility-sponsored performance contracting programs. Utility-sponsored programs include standard offer and demand-side management (DSM) bidding programs.

The providers of performance contracting services are predominantly (a) energy services companies (ESCOs) and (b) companies that provide construction services and/or products, but want to expand their market by also providing financing. The term ESCO is commonly defined as a company that is engaged in developing, installing and financing comprehensive, performance based projects (typically with contracts of 7 to 10 year duration) which are focused on improving energy efficiency and reducing maintenance costs for facilities owned or operated by customers.

The "performance" aspect of energy efficiency performance contracting requires that the amount of savings resulting from the project be determined in order for the contractor to receive his or her compensation. Therefore, the *measurement and verification (M&V)* process, in which savings from energy efficiency projects are determined, is one of the most important activities associated with implementing performance contracts. Its importance becomes obvious at the time of negotiations, where, after price considerations, M&V is the most crucial negotiation issue. M&V can become contentious because performance contracts, like all contracts, are about sharing financial risks within a legal structure. M&V is an important part of the language of the these legal agreements. Essentially, M&V is about controlling risks for the energy service suppliers, energy users, and project financiers.

Typical M&V activities can be divided into the following tasks:

1. Both parties to a performance contract agree on a general M&V approach or option.
2. A site-specific M&V plan is defined for the particular project being installed. The plan includes details on items such as metering, analyses tools, accuracy requirements, reporting, etc. This is usually done after the performance contract has been signed.
3. The pre-installation, baseline conditions are defined.
4. After the project is installed the post-installation conditions are defined.
5. Energy savings for the first year are calculated.
6. First year payments are calculated.
7. Annual M&V activities are conducted to verify operation of the installed equipment/systems and/or calculation of current year energy savings.
8. Annual payments are calculated for each year of the performance contract.

Protocol Benefits and Constraints

Defining standards for common business and technical practices is part of the process of maturation of any industry. The performance contracting (energy efficiency) industry has begun the process of standardizing the language and procedures that constitute the core of the industry's business practices. Much like agreeing on a standard gauge for railroads or formats for videotapes, the recent M&V protocols represent the best efforts of the industry to define common approaches to industry-specific technical challenges. Furthermore, the process by which the standard options were chosen was open to all concerned parties and assured that the resulting protocols would be the basis for agreement, not dissension.

There are many options for conducting M&V. The protocols discussed in this paper give form and consistency to the historically-random practice of M&V in the field. M&V protocols offer several potential benefits, some of which are quite significant, and all of which could lead to more energy efficiency projects. Some potential benefits are:

- *Reduced transaction costs for performance contracts.* This is the most significant potential M&V protocol benefit. Currently, transaction costs for many types of energy-related performance contracts (including costs for financing, M&V, marketing, and contract negotiations) are high due, in part, to the lack of standard methods for measuring and verifying savings. ESCOs are using the M&V protocols and thus are reducing the amount of time they spend researching, developing, and negotiating M&V requirements for specific projects.

- *New resources for the energy efficiency community.* M&V protocols are valuable resources that provide current and accepted M&V definitions, methods, and techniques.
- *Improved "comfort" for energy users.* Many energy users are unfamiliar with the M&V process. M&V protocols increase users' level of acceptance with performance contracting since they indicate that "typical" methods of determining energy savings exist, and users need not fear the M&V process. However, users should not be lulled into assuming that M&V is a simple process.
- *Improvements in the field of M&V.* By developing M&V protocols, the authors are improving the M&V methods and addressing issues such as sampling, analysis methods, metering, and uncertainty calculations.

What M&V protocols cannot do is make agreeing on M&V specifications for a particular contract as simple as following a simple cooking recipe. Buyers and sellers probably will always have to resolve the details of M&V for each contract—since every project has unique aspects and a unique risk profile that demand a customized definition relating to M&V rigor, cost, and accuracy. Details on how to conduct project specific M&V data collection, savings analyses, and quality control/accuracy analyses are not contained in any M&V protocol—and they probably never will.

Compliance is also an issue to consider. The advantage of the protocols, providing a wide range of industry standard options and methods, can also be a drawback. This is because a contractor can claim compliance with the protocols by conducting M&V using any of the numerous methods described in them—but with an unspecified level of accuracy, and with no assurance that the M&V results will be repeatable. Thus, owners should request that their energy service providers state clearly which options and methods they are using for their specific project, and why.

Users should be cautious about one more aspect of using M&V protocols. Some M&V options available under the protocols, such as "Option A" (see below) addresses risk allocation by stipulating values of operational parameters (such as cooling load) based on historical usage. Thus, "savings:" may be different from the expected amounts if operation differs from historical patterns. Where such M&V options are specified, users may be assuming more risk, than if they used a more expensive continuous metering option, and paid for "savings" may fail to materialize on their utility bills. Conversely, if operational parameters (again, such as cooling load) increase, the ESCO will not receive larger payments for the savings generated. In either case, it is important for both parties to understand the implications of the M&V option they select.

M&V Protocols

Several M&V guidelines and protocols have been (or are being) developed. Each provides an M&V framework (that is, a set of M&V options, methods, techniques and procedures) as well as definitions and guidance on how to conduct M&V. The range of M&V options allows users to specify M&V activities at a level commiserate with the value and risk profile of their projects. The most widely cited documents are:

- *The International Performance Measurement and Verification Protocol (IPMVP).* This is currently the top contender for becoming the industry-standard M&V protocol. Until recently, this document had been known as the North American Measurement and Verification Protocol (NEMVP). It was first published in 1996 and second version was

published in December of 1997. It will probably be revised annually. It can be found on the web at <http://www.ipmvp.org>

- *FEMP (Federal Energy Management Program) M&V Guideline.* This document was written to fulfill the requirement of the regulations governing federal energy service performance contracts and thus without it there would be not be any such contracts. As this report went to press, the FEMP M&V Guideline (which was first published in 1996) is being revised for distribution in 1998. The FEMP M&V Guideline is designed as an M&V application manual for federal projects that is consistent with the purpose and definitions of the IPMVP. The new version will cover more topics and it will be consistent with the 1997 version of IPMVP. The FEMP M&V Guideline can also be found on the web at links to <http://www.ipmvp.org>>.
- *ASHRAE 14-P Guideline on Measuring Energy and Demand Savings.* This document is scheduled for public comment in 1998. However, at this time it is not publicly available, in accordance with ASHRAE's policy of not allowing draft versions to be circulated widely - though some information on the draft is available at *<http://www.ashrae.org>>*.

Both of the existing documents (the IPMVP and the FEMP M&V Guideline) should be considered only as *starting points* for developing M&V specifications. Neither currently is sufficiently detailed to serve as a stand alone M&V specification, even though both contain some "how-to" descriptions of various M&V options and methods that can be applied to many common types of energy efficiency measures. Also, while both documents suggest where different options may be appropriate, neither specifies which options or methods are required for specific types of projects or contracts. When published, ASHRAE's 14-P Guideline will be more detailed than the other existing protocols (with respect to analysis methods and metering techniques), and may provide additional materials for defining project-specific M&V plans.

Prior to the development of the current guidelines and protocols, there were many fragmented efforts to achieve a similar goal. Utilities, state agencies, and trade organizations developed these early protocols—and each one was different. The National Association of Energy Service Companies (NAESCO) made the first attempt to create an industry-wide M&V protocol in 1988. This document had been, until recently, the energy service industry's primary M&V protocol. However, NAESCO has endorsed the IPMVP as the new "industry protocol." Therefore, it is safe to assume that ESCOs actively involved in the performance contracting business are aware of the IPMVP and many of them refer to the IPMVP in one way or another for their M&V work.

The IPMVP

Barriers to implementing energy efficiency are often more political and institutional than technical. In early 1994 U.S. Department of Energy (DOE) officials Gregory Kats and Art Rosenfeld sought to better understand some of these barriers and thus convened a series of meetings with the financial communtity. They determined that a lack of of standard M&V protocols was resulting in higher-than-necessary transaction costs and blocking potential investment. By the autumn of 1994 Kats and Rosenfeld began working to develop a single, universally accepted M&V protocol. Working with representatives of the financing and ESCO industries, the result was the NEMVP, which was released in 1996 and renamed the IPMVP in 1997 to reflect its intended international applicability.

The IPMVP is being translated into half a dozen languages, and currently involves individuals and institutions from approximately 20 countries. What began as a domestic energy efficiency effort has flourished internationally, largely due to the quality of volunteer work from many professionals in the energy services field.

The IPMVP covers energy and water conservation for both retrofit and new construction projects, and also projects involving emission-reduction credits. It includes chapters on performance contracting basics, M&V concepts and procedures, and descriptions of various M&V methods associated with each option. It also has references and definitions of M&V terms, and it discusses many M&V issues including metering and uncertainty. Future versions of the protocol are expected to cover performance measurement for indoor air quality, cogeneration, operations and maintenance, and renewable energy projects.

There are four main ways to apply the IPMVP. These are referred to as "Options A, B, C, and D" in the protocol. None of these options is "the best" in all circumstances—for each option, there are specific types of projects where it would be most appropriate. For all of these options, verifying a project's potential to produce savings involves collecting nameplate data, taking spot measurements, and performing commissioning.

- Option A: Installations verified with inspections, spot measurements, commissioning, etc. Performance is measured and key operational factors used for calculating savings are stipulated based on analysis of historical data or spot/short-term measurements. Performance is measured or checked in the first year and at regular intervals (e.g., annually.)
- Option B: Savings are determined after project completion by short-term or measurements taken throughout the term of the contract at the device or system level, e.g. end-use metering of chiller systems
- Option C: After project completion, savings are determined at the whole-building or facility level using utility meter, billing data analyses.
- Option D: Savings are determined through simulation of building components and/or the whole building.

The FEMP M&V Guideline

FEMP's M&V Guideline is a manual for conducting M&V for energy service performance contracts involving federal facilities. The regulations implementing the 1992 Energy Policy Act require an annual assessment of energy savings from such projects using a methodology to be defined in the contract. The Guideline covers general procedures for defining those methodologies in each federal energy services contract, and it sets forth 24 basic, effective M&V methods that minimize contract administration activities.

This Guideline allows significant latitude to federal contracting officers. It does not dictate which M&V methods or strategies an agency should choose for specific types of projects. Rather, federal contracting officers are free to choose one or more of the M&V methods listed in the document. Then, the energy service provider writes a site-specific M&V plan based on the selected method(s).

FEMP is a DOE program, so for some it may have been confusing that DOE has sponsored two M&V documents at about the same time. However, there is no conflict between these documents since they are written for different audiences and purposes. IPMVP (or NEMVP) came first and the FEMP

Guideline is a sequential, application of the IPMVP. The FEMP Guideline is intended to be used by the Federal Energy Management Program, so it contains specific language that pertains to FEMP. In contrast, the IPMVP covers topics more broadly and it also addresses generic performance contracting and M&V issues that FEMP does not cover. The 1997 IPMVP contains portions of the 1996 FEMP document as an example of an application for a specific energy program.

ASHRAE 14-P Guideline for Measurement of Energy and Demand Savings

ASHRAE 14-P has not yet been published. As of this writing, the 14-P committee has prepared an extensive draft, and it is expected that a version will be available for public comment in the second half of 1998. When published, ASHRAE 14-P will include details on analysis methods, calculation methods, instrumentation, and uncertainty analysis—making it more specific than both the IPMVP and FEMP's Guideline. However, the ASHRAE document probably will address only projects that would fall under IPMVP Options B, C, and D, based on ASHRAE's objective of including methods that include measurements of performance and operational factors. Guideline 14-P may be an "official" ASHRAE Guideline in that compliance with it could be specified in a performance contract.

Application of the M&V Protocols

Many, if not most, energy service providers now use one of the main M&V protocols in developing project- or contract-specific M&V specifications for performance contracts. The following sub-sections describe uses and impression of the protocols by various groups.

Utilities

A number of utilities use M&V protocols in their performance contracting programs. There are two general formats for such programs: demand-side management (DSM) bidding programs, and standard performance contracts:

- *DSM bidding programs* involve requests for proposals (RFPs). Energy service providers and utility customers respond to these RFPs with proposed energy projects. The M&V protocol to be used should be defined in the utility's RFP
- In *standard performance contracting programs*, the utility sets the price it will pay for energy savings and the requirements for participation. The M&V protocol is defined as an appendix to the standard contract.

Most existing DSM bidding programs (such as those run by Texas Utilities and PacifiCorp) were started before the IPMVP and FEMP Guideline were published. Therefore, they use earlier M&V protocols, such as NAESCO's. Two utilities in California (Pacific Gas and Electric and Southern California Edison) use an M&V protocol similar to the FEMP Guideline in their DSM bidding programs, because their M&V protocols and the FEMP Guideline all were developed around the same time by the same consultant. Other utilities, including Houston Light & Power and Texas Utilities, have updated the M&V protocols in their contracts with IPMVP, via the FEMP Guideline. In addition, Public Service Company of Colorado recently used the IPMVP's "Option A" principals for developing a simple M&V approach for its new DSM bidding program, "Bid 2000".

Programs that use standard performance contracts are being promoted in several states by the ESCO community as a mechanism for distributing ratepayer energy efficiency funds in a deregulated market. Standard performance contracts also are being heavily promoted in California as a market-transformation tool for 1998 and beyond. The 1998 California Non-Residential Standard Performance Contracting programs all use a M&V Guideline document which is based on the IPMVP and the FEMP Guideline. The oldest programs of this type in the U.S. are run by several New Jersey utilities, including Public Service Electric & Gas Co. The New Jersey programs use a variant of the NAESCO protocols for their programs.

The FEMP Guideline in particular has been very helpful for the utilities since (a) the documents can be fairly easily adopted for their particular programs and (b) by using a nationally accepted protocol the utilities are less open to criticism from ESCOs and regulatory bodies.

Financiers

Most financiers in this field agree that standardization of performance contracts – particularly regarding M&V planning, approval, and implementation – is important to reducing transaction costs. In general, they are especially concerned with avoiding disputes about the savings over the term of the contract, so references to M&V protocols in a performance contract may make them more comfortable in that respect - although it will not affect financing costs.

Most financiers involved with energy efficiency projects are generally familiar with the major M&V protocols, but so far they are not requiring them for their projects. They evaluate each project individually, with a much greater level of interest in the balance sheets of the project's participants than in the M&V plan. Some, however, do pay close attention to M&V protocols specified in their contracts. One such financier who is very familiar with IPMVP notes that when he sees Option A being specified, he knows that the project's payments will depend more on projected savings than actual savings—which could reduce his financing risk because there would be less likelihood of a dispute between the service provider and the user.

ESCOs

It appears that because of its endorsement by DOE and NAESCO, its recent publication (the NAESCO protocols were published in 1994), the broad range of options it presents, and its use in the U.S. federal programs it appears that the IPMVP is the document now being referenced by ESCOs. In conversations with ESCO representatives, several consistent themes are clear with respect to how ESCOs use the IPMVP and its application the FEMP Guideline:

- *Making an impression.* ESCOs report that their clients like seeing the IPMVP document—it looks "official" and helps inspire confidence in the project. Consequently, many ESCOs use it in marketing presentations. However, most clients aren't familiar with the protocol, so there is the potential for confusion if clients believe—or if ESCOs lead them to believe that merely specifying compliance with the IPMVP is sufficient to prevent misunderstanding on savings calculations.
- *Education.* If properly used, the IPMVP can be educational for clients who do not understand M&V. For clients who already understand the basics of M&V, the IPMVP illustrates the complexity of this process and defines a framework for dealing with that

complexity. The IPMVP also demonstrates that is acceptable, and prudent, to base M&V specifications on how risks are allocated.

- *Used as a framework but not "word for word" on the details.* ESCOs typically use the IPMVP as a starting point and framework when writing M&V plans, particularly for federal projects where the FEMP Guideline is referenced. In finalizing M&V for specific projects, they prefer to leave considerable room for personal engineering judgment, rather than use the examples in the IPMVP for substantial pieces of their M&V plans. This happens for a variety of reasons, including: ESCOs often have their own established methods, lack of detail in the IPMVP and FEMP Guideline, concern about what compliance really means, and the fact that customers and financiers are not requesting that specific pieces of the protocol be used.
- *Working with federal clients.* In these cases, ESCOs use the IPMVP (through the FEMP Guideline) extensively. When a detailed plan is required for a project, they simply "cut and paste" sections of the FEMP Guideline into there own plan.
- *Claiming compliance is problematic.* Despite ESCOs' inherent marketing-driven desire to claim compliance with IPMVP in order to make their clients feel better, most practitioners admit that the 1996 version did not specify any criteria for determining compliance, and that too often *even their own documents* demur on the details. With the 1997 IPMVP, ESCOs can claim compliance if they define certain details of their approach and use the IPMVP as a starting point and framework. However, ESCOs and users will have to pay close attention to the M&V and not just look for cookie cutter answers to their M&V needs.
- *Client demand for the protocol may grow.* Currently, ESCOs' clients and financiers rarely request that M&V protocols be used in a contract. However, ESCOs expect these protocols will be referenced more in the future, particularly as the federal sector does more well-publicized performance contracting using the IPMVP and the FEMP Guideline.

Public Sector

Federal energy saving performance contracts (ESPCs) and utility Federal Areawide contracts are where the IPMVP has been applied the most, particularly through the FEMP Guideline. In the last year ESCOs have encountered the FEMP Guideline primarily in federal "Super ESPC"[1] regional RFPs and utility sole-source contracts. Firms selected to participate in a Super ESPC must demonstrate a general understanding of the FEMP Guideline and they must be able to apply those M&V concepts to specific sites included in the solicitation. Few ESPC projects have been completed thus far, but most of the ones currently underway use the FEMP Guideline as a starting point for M&V.

What's Next For M&V Protocols

Over time, there is a good chance the IPMVP will become an important tool for reducing energy performance contracting transaction costs and increasing performance contracting activity. The degree to which this happens will depend on whether the protocols continue to be updated with current

[1] SuperESPC is the name given to the six regional Indefinite-Delivery Indefinte-Quantity contracts signed by the Department of Energy.

"state-of-the-art" methods, documentation on case studies, information on how to calculate M&V costs and accuracy, and information on how to select appropriate M&V options and methods for different contractual situations.

For now, the IPMVP is most likely to be used by ESCOs for institutional, utility and government projects – projects for which regulatory or government oversight is involved. The IPMVP's Department of Energy sponsors also expect the IPMVP to be used for non-energy performance projects (e.g., water conservation, indoor air quality, and emissions reductions) and for a wide variety of international projects funded through organizations such as the World Bank. Irrespective of any success the IPMVP has in these new areas, it is clearly being used as educational tool to explain the M&V process to all of the parties involved in performance contracting.

The IPMVP and FEMP Guidelines are living documents and thus will be revised and possibly expanded to cover new topics. Important for this process will be how resource documents, such as ASHRAE's 14-P, and application documents, such as the FEMP Guideline and M&V handbooks for utility standard performance contracts, feed back into the design of the IPMVP. One concept is that once 14-P is published the IPMVP becomes more of a framework with details on subjects such as water conservation and indoor air quality M&V, while simply referencing 14-P for details on energy efficiency M&V.

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