Initial Applications of the FEMP Measurement & Verification Guidelines in Super ESPC Delivery Orders: Observations & Recommendations

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by

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1 EXECUTIVE SUMMARY

Schiller Associates examined the measurement and verification (M&V) plans and activities for seven western region Super ESPC projects to learn how federal agencies are implementing M&V and what factors influence M&V plan development. This report describes the method used to examine the M&V plans and presents our findings. Our goals were to find common factors that influenced M&V plan development and implementation, assess risks to the agency as a result of particular M&V plans, and develop recommendations for improving M&V plan development and implementation. Participating agencies and sites were:

- National Park Service – Yosemite National Park, CA
- Veterans Affairs – VA Medical Center, San Francisco, CA
- Forest Service – USFS Laboratory, Corvallis, OR
- Federal Aviation Administration – ATRCC, Auburn, WA
- US Department of Defense – Defense Manpower Data Center, Monterey, CA
- US Coast Guard – Coast Guard Station, Alameda, CA
- US Navy – Pt. Mugu, Oxnard, CA

Common themes and influences among the projects were observed. The most notable finding was the predominance of Option A (stipulated savings) in the M&V plans, sometimes implemented without any measurement or annual verification activities. The primary reason for using this method was its low cost. Since agencies pay for M&V services, simplified M&V plans were used to reduce costs so that contract terms would fit within acceptable limits. The primary driver for more rigorous M&V approaches was project motivation—agencies interested in reducing energy use were more likely to demand rigorous M&V methods than agencies whose interest in new equipment was the primary motivation for a Super ESPC project.

While all agencies were aware of the risks inherent in performance contracts, only a few used M&V as a way to mitigate those risks. Some felt that the risks were sufficiently low and that the added expense of M&V activities was not justified. A few desired the reassurance offered by M&V services, but were unable to pay for them. Agencies interested primarily in reducing their energy consumption were willing to pay for more rigorous M&V services. Annual expenses for M&V activities ranged between 2% and 14% of the annual savings, but expenses (as a ratio) did not correlate to capital cost or project savings.

Because of the large use of stipulated savings and occasionally unverified assumptions, the resulting M&V plans leave many agencies at risk in the event of unrealized savings. Although Super ESPC contracts provide for guaranteed savings, the lack of adequate verification activities reduces the value of a guarantee.

Our recommendations for improving M&V planning and implementation are:

1. Clarify the M&V option and method definitions and other terms used in the FEMP M&V Guidelines.

2. Distinguish between equipment performance (e.g., efficiency, capacity ratings) and equipment usage (e.g., operating hours, annual energy consumption) and their relationship to savings.
3. Provide recommendations as to which M&V options and methods should be used with different types of measures, based on project technologies, risks, and value.
4. Clarify use of stipulations for M&V Option A.
5. Develop M&V requirements for operations and maintenance measures.
6. Provide additional training on M&V and develop in-house FEMP M&V expertise.
7. Require that M&V costs be estimated for each individual or group of measures.
8. Integrate the discussion of M&V with the selection of energy conservation measures (ECMs) when finalizing delivery orders (Dos).
9. Develop a standard framework for M&V plan content and evaluation.
10. Provide information on requirements associated with meeting federal ESPC regulations.
11. Develop sample M&V plans and reports.

2 INTRODUCTION

2.1 Report Objectives

This report presents the findings of a review of measurement and verification (M&V) plans for seven western region Super ESPC projects and an examination of how federal agencies are implementing M&V. Although the FEMP M&V guideline describes how M&V might be performed for various types of projects, it leaves considerable room for judgement and interpretation. Because of this, FEMP staff expressed concern that the implementation of M&V may not be consistent or conform with the FEMP M&V Guideline's intent. We thus evaluated the M&V approaches that were common among the involved projects and the factors that were influential to the development of the M&V plans.

Several factors were hypothesized to have significant influence over the quality and rigor of a project's M&V plan: participant attitudes and motivations, economic and logistical factors, and an understanding of energy service performance contracts (ESPCs), and the associated role of M&V. The goals of this assessment were to determine the common influences that shaped M&V activities, compare the planned implementation of M&V with its intended role, and identify shortcomings and innovative approaches in implementing M&V. Additionally, we assessed typical project risks and the role of M&V in allocating those risks. Lastly, based on these findings and risk assessments, we made recommendations to help improve the quality and practice of M&V activities in Super ESPC projects.

In Super ESPC projects, M&V of savings is a way of allocating and mitigating risk to both the federal agency and to the ESCO. Performance contracts are implemented based on estimated savings. Super ESPC legislation requires M&V to document the level of savings actually achieved. Common reasons why savings may not materialize are the following: 1) the savings estimates may not be accurate; 2) the installed equipment may not be working correctly; or 3) equipment usage may be different than originally assumed. A project that fails to produce savings presents a risk to both the agency and to the ESCO. Without performing post-installation measurement and verification activities, there is no way of knowing whether these situations are occurring.

Super ESPC projects are guaranteed savings contracts under which M&V must demonstrate that savings meet or exceed a threshold amount—the actual savings are less relevant. This influences the accuracy requirements for savings estimation. While Super ESPC projects involve guaranteed savings, the guarantees are, in part, only as good as the methods used to verify them. ESCOs must exert some effort through M&V to show that savings are real (and greater than the guaranteed amounts) if the guarantees are to have value. If M&V results show that savings are less than the guaranteed amounts, then the ESCO must be liable for the shortfall.

2.2 Report Organization

This report describes the method used to survey the M&V plans of the participating agencies and it presents our findings. Section 3 describes the methodology used for the project and Section 4 summarizes our findings. In Section 5, typical project risks are assessed and discussed as background to providing specific recommendations. Based on our findings and the risk assessment discussion, specific recommendations for improving and simplifying the M&V development process are made in Section 6. The Appendix contains interview questions and individual site reports from seven western region agencies as supporting material.

3 METHODOLOGY

Schiller Associates reviewed the seven Super ESPC projects in order to become familiar with them and to review the documented development of the M&V plans. Cheri Sayer, a western region contact for the Super ESPC program, invited Schiller Associates staff members to review proposal documents at the Seattle Department of Energy (DOE) office to learn more about the projects and M&V plan development. She and Tim Kehrli, who also participated in many of the projects as a submittal reviewer and facilitator, discussed their experiences and opinions. From this information and discussions with Doug Dahle of the National Renewable Energy Laboratory, and Mike Holda and Steve Kromer of Lawrence Berkeley National Laboratory, we developed a list of common questions for use as the basis for interviews with agency staff members responsible for implementing the projects (this list is included in Appendix A). We forwarded this list to each site prior to visiting so that staff would understand what we were seeking and would have time to research the answers. We then held interviews with agency personnel in an effort to learn more about how M&V plans were developed, what their attitudes were toward M&V, and whether planned M&V efforts were commensurate with the project.

Seven federal agencies agreed to participate in this survey, which included a cross-section of facility types, project types, and ESCOs. Each of the surveyed agencies had recently finalized the delivery orders and were in the process of installing the energy conservation measures (ECMs). Two Schiller Associates staff members reviewed M&V plans and visited five of the sites to meet with the contracting officers and other involved personnel. Staff associated with two other sites were interviewed by a telephone conference call. Table 1 lists the participating agencies and the associated sites and ESCOs.

Table 1: Participating western region agencies

Agency	Location	ESCO
National Park Service	Yosemite National Park, Yosemite, CA	BMP
Veteran's Affairs	VAMC, San Francisco, CA	Johnson Controls
Forest Service	USFS Laboratory, Corvallis, OR	Honeywell
Federal Aviation Administration	ATRCC, Auburn, WA	Johnson Controls
Defense Department	Defense Manpower Data Center, Monterey, CA	Sempra
Coast Guard	Coast Guard Station, Alameda, CA	Honeywell
Navy	Pt. Mugu, Oxnard, CA	ERI

Many of these sites had comprehensive retrofits performed. Technologies included boilers, chillers, variable-frequency drive additions, efficient motors, controls upgrades, lighting, air compressors, HVAC modifications, and steam and hot water system improvements. Sites were chosen with delivery orders that included a broad array of technology categories and that were of different contract funding amounts to see what variations existed in the final M&V plans. This approach would also help us determine how project cost, measure risk, or other factors influenced M&V plan development. The visiting teams then wrote reports that summarized their findings. From these reports, we sought common themes and results.

4 Summary of Findings

The survey of M&V plans and interviews with agency staff at the seven sites revealed a great deal of relevant information. The findings could be summarized into four general categories: project motivations, M&V implementation, M&V implementation costs, and M&V development influences. The following four subsections present these findings.

4.1 Project Motivations

Common Motives among Agencies

The most common motives for using Super ESPC were the following:

1) to obtain new equipment,
2) to reduce energy costs,
3) and to comply with EPACT and Executive Orders[1].

Most projects involved a combination of motives; few agencies used the Super ESPC program for a single reason. In some cases, existing mechanical equipment was near the end of its useful life and a cash-strapped agency needed to find a way to purchase new equipment. That the new equipment would work better and provide energy savings was an added bonus. Other agencies primarily sought financial savings, either from reduced energy consumption or through reduced operations and maintenance expenses, which accompany new equipment.

Reasons for Selecting Super ESPC over Other Available Contract Means

Some agencies considered other available contracting mechanisms for acquiring new equipment (e.g., DMDC, Pt. Mugu, Coast Guard): however the Super ESPC Program was a more attractive option for several reasons: the contractors were pre-qualified, a support team was available to help negotiate and finalize delivery orders, and, generally, more measures and equipment than the agencies originally planned could be included. Lt. Dennis Evans of the Coast Guard said that, initially, the Super ESPC was attractive because the ESCO would be responsible for verifying the savings, thus allowing Coast Guard to consider more risky projects because the risk would be shared. Our reason for probing the agencies about contracting options was to see if the existence of M&V in Super ESPC was an attractive aspect of or a deciding factor in choosing the Super ESPC. None of the agencies reported M&V as their primary motivation for choosing Super ESPC.

Project Marketing

Project marketing was evenly divided between ESCOs, contacting agencies, and agencies directed to ESCOs by the DOE. Many of the projects examined occurred early in the Super ESPC program when it was common for the DOE to approach an agency about trying the program. Some of the ESCOs (Honeywell, Johnson Controls) used the Super ESPC program as a mechanism for continuing work with their existing clients.

[1] Energy Policy Act of 1992 and Executive Orders 12902 and 13123.

Competition Effects

At three agencies—Pt. Mugu, FAA, and DMDC—the contractors were competitively selected. At the other four, each agency used the ESCO that originally approached them to implement their project. It was common among all projects for the agency and the ESCO to jointly identify measures that would go into a project. Most agencies had a small "wish-list'" of items that they wanted, while the ESCOs sought measures that would make the project economically viable. In this sense, most projects were collaboratively developed. None of the three agencies who competitively solicited their projects reported selecting one ESCO over another based on the quality of the proposed M&V plan. Other factors, such as the number of measures, price, and the agency's confidence in the ESCO's ability to perform, were more important.

Project Bundling

All projects were comprehensive and had at least two measures. Savings from lighting measures often subsidized other desired measures. At the San Francisco VAMC, operations and maintenance savings from displaced labor[2] were used to subsidize upgrades in the boiler, energy management and control system (EMCS), and air compressor. At Yosemite, an electrical distribution upgrade was the major contributor to savings. It made them eligible for a lower utility rate and made the boiler and VFD installations possible.

Very few projects involved technology conversions, such as replacing centrifugal chillers with absorption chillers. Some sites installed new equipment, such as variable speed drives and EMCS, that did not replace existing equipment. The EMCS projects at two sites were upgrades of existing systems; however, most measures replaced existing equipment with new, more efficient equipment of a similar type and size.

M&V Option Motivations

Clear motivations for choosing certain M&V options over others were identified, as several agencies did discuss their preferences. A naval engineer for the Pt. Mugu project explained that he preferred to use the simplest M&V option justified for the measure. His contractor had proposed extensive monitoring for a lighting project, which he believed could be handled with appropriate application of stipulations. He indicated that this particular project did not merit the rigor and associated cost of the proposed Option B methodology. He was not at all opposed to using more rigorous M&V, but stated that it should be justified by the measure.

A Coast Guard engineer involved in the Alameda CG Station project preferred Option B methods because he believed it provided firm data to support the savings calculations. One of the measures was an EMCS, which would be used to monitor the other measures in the project. He hoped that the EMCS could be used to reduce costs of Option B measurements. Ultimately, the relatively small savings of the Alameda project did not justify Option B methods even with the EMCS, and an Option A approach was adopted instead.

At Yosemite, NPS staff wanted Option B for two of the highest energy savings projects: VFD installations on the wastewater treatment plant pumps and on AHU fans in the visitor center HVAC system. The savings did not justify the costs of the proposed Option B measurements. The solution was for NPS to do the monitoring outside the ESPC delivery

[2] 5.2 full-time equivalent employees.

order; and the ESCO, Bentley, agreed to use their results when calculating savings. Funding for the meters and installation was provided through DOE.

4.2 M&V Implementation

A summary of ECMs, M&V options, and delivery order contract data are provided in Table 4. The table shows the ECMs installed (or to be installed) at each site, and the corresponding selected M&V option. All seven agencies implemented lighting measures and six of them implemented EMCS. Four sites implemented boiler plant measures; other measures were common to three or fewer agencies.

The dominant M&V option named in the projects was Option A. This is true for all of the lighting ECMs, and for most other ECMs as well. There were several interpretations of the M&V options, which will be discussed below. In a few cases, as shown in table 4, combinations of options were used. For example, Option B or C methods were used in the first post-installation years to determine savings, with results used as stipulations (Option A) for succeeding years, subject to equipment performance checks (in Table 4, these cases are shown with an arrow). Such combinations are innovative uses of the options (they are not specifically described in the FEMP M&V Guideline).

The most common finding was the heavy reliance on Option A with stipulated values as an M&V approach. In some cases, it appeared that 'stipulation' was interpreted to mean that the two parties would agree to savings estimates prior to measure installation and that no baseline measurements or verification would be used and no post-retrofit verification, measurement, or analysis work would be performed. This interpretation was contrary to the intent of the FEMP M&V Guideline and may not adequately verify savings as required by Super ESPC legislation. This interpretation and implementation of Option A was not limited to lighting projects, but was used for a broad range of measures, including complex measures with variable loads or operating schedules. While Option A is allowed by the FEMP M&V Guideline, the proper use of Option A requires baseline, post installation, and annual verification inspections and the use of at least some actual on-site measurements and/or analysis to support stipulated values.

This finding is related to another important finding, which is that the agency's motivation for implementing a project was the single largest factor in determining the level of rigor used in M&V development and implementation. Agencies that used the Super ESPC program to reduce energy costs were interested in quantifying their savings; agencies that were motivated by obtaining new equipment were less interested in quantifying their savings.

As an example of how stipulations were used, Option A for lighting (LE-A-01) calls for using totally stipulated values (no measurements) while the more rigorous method (LE-A-02) calls for taking a sample of measurements of fixture power before and after a retrofit. Both variations call for performing some verification work on an annual basis after the project is installed. "Stipulation" is intended to mean that the two parties agree upon factors used in the savings estimates based on measurements or on sound use of historical data for the project in question. The most common approach was to measure a sample of fixtures to determine power consumption (pre- and post-retrofit) while agreeing to an operating hour schedule. Even with this arrangement, uncertainty still exists. At the USFS laboratory, Honeywell measured fixture powers *after* installation, but had not adequately measured the existing fixtures prior to removal. Because the baseline power level had a high degree of uncertainty, so did the savings estimates. At some sites, no measurements were taken and no annual verification activities will be performed. Without measurements or annual inspections, the stipulated values used to estimate savings introduce uncertainty into the savings estimates.

To illustrate how Option A was interpreted and implemented, Table 2 shows the lighting M&V approach for all seven sites. The use of Option A without measurements had no correlation with the size of the project—totally stipulated values were used on the smallest and largest projects. Only three of the smaller projects specifically called for annual verification activities.

Table 2. M&V approach for lighting at all seven sites

Agency	Lighting Savings	M&V Method	Measured Values	Stipulated Values	Annual Verification
National Park Service	$8,500	A	None	Hours, Power	None
Veteran's Affairs	$121,000	A	Power	Hours	None
Forest Service	$27,000	A	Power	Hours	None
Federal Aviation Administration	$18,000	A	Power	Hours	Power
Defense Military Data Center	$16,000	A	Hours	Power	Hours
Coast Guard	$103,000	A	None	Hours, Power	None
Navy	$12,000	A	Power	Hours	Hours

The reason for using stipulated values was usually cost—the agency pays for the ESCO's M&V services and both the agencies and the ESCOs often felt that there was little value in spending money on lighting M&V services. The use of stipulated values (sometimes with no supporting measurements) was employed to reduce overall project cost, even if it meant that the agency would be assuming more risk. This was an important consideration since, even though the risk of not realizing savings from lighting retrofits was low, the savings projected from lighting retrofits often subsidized the balance of the project. This experience with lighting measures was representative of other measures.

Another example of stipulated values unsupported by measurements was the stipulation of motor load factors at the Alameda Coast Guard Station. Load factors were assumed to be 70% uniformly for all motors connected to the EMCS. The motor kW used in calculations was determined from nameplate motor efficiency, horsepower and this assumed load factor.

Project motivation determined how much the agency was willing to pay for M&V services. Risk was usually not an issue with agencies seeking to obtain new equipment—they perceived a greater risk from failing to replace their equipment than from any uncertainty in the savings estimates. Agencies interested in reducing operating expenses were more interested in M&V services to ensure that savings would materialize and to quantify the amount of savings. These agencies were more concerned with project risk and were willing to spend a little more on M&V services.

To illustrate how project motivation affects M&V rigor, a comparison of M&V methods at the six sites where EMCS systems were installed is presented in Table 30. Savings from EMCS measures are often difficult to estimate and stipulating savings is not always appropriate for such measures. Option B methods (continuous monitoring) can often be implemented by using the EMCS to monitor itself, reducing M&V equipment expense. How savings from this measure are evaluated indicates the agency's commitment to quantifying savings.

Table 3. Project motivation and M&V rigor

Agency	EMCS Savings (% of total)	Total Annual Energy Savings	M&V Option	Dominant Motivation
NPS Yosemite	11	$34,206	A	Cost Reduction, Energy Savings
US Coast Guard	16	$120,141	A	New Equipment
VAMC San Francisco	20	$209,000	A	New Equipment, O&M Savings
Navy - Pt. Mugu	28	$192,822	A with measurement	Energy Savings, New Equipment
US Forest Service	35	$63,100	B&C	Energy Savings, Cost Reduction
DMDC – Monterey	52	$316,671	B → A	Energy Savings, Cost Reduction

Agencies have a strong influence over the rigor of their M&V plans since they pay for M&V services. Those with less interest in M&V are more willing to accept simpler M&V approaches with greater uncertainties. Table 3 shows the tendency that agencies interested in saving energy had more desire to track their actual savings (USFS and DMDC). Agencies seeking new equipment or cost savings (independent of energy savings) were less interested in tracking the savings and were more likely to accept an Option A approach (VAMC).

4.3 M&V Implementation Costs

Because the agency pays for M&V activities as a Service Phase expense, M&V cost has a strong influence on the final M&V option selected. Using information from the delivery order schedules (primarily H-3 and H-6), we estimated average annual M&V costs and compared them to the estimated annual energy cost savings. Included in the M&V cost was the Service Phase margin, which ranged from 18% to almost 30%. Table 4 illustrates all of the expenses associated for each project as well as comparisons of M&V expenses to energy savings and project expenses.

We noted that there was no uniformity in developing costs for M&V activities among the surveyed projects. For example, some ESCOs included annual inspection activities in their maintenance budgets, other M&V budgets were developed with no descriptive detail of tasks at all. M&V activity costs were estimated on a time and materials basis and included all, not individual, measures. Thus, a large variation in the definition of M&V activities existed, and was reflected in their estimated annual budgets.

Generally, project capital costs increased with the number of measures; however, total M&V costs did not scale with the project capital cost or annual savings. Although evidence from discussions with agency staff indicated that M&V costs were reduced in order to reduce contract terms, the data showed no strong influence by the contract term on the M&V cost percentage of annual energy savings. The sample size was small, however, and there were many influencing variables on M&V costs. In order to isolate trends, a much larger sample would be required.

One way to assess whether M&V costs are appropriate is to compare M&V costs with the cost uncertainty of the project. This requires uncertainty and risk analysis in the planning phase. In general, projects with large uncertainties merit larger M&V budgets, enabling more rigorous and accurate M&V activity (this is discussed in more detail in the risk assessment section of this report).

From a cost perspective, Table 4 shows that annual M&V budgets ranged between 2% and 14% of the annual energy savings. A metric often cited in training courses[3] is that annual M&V costs, as a rule of thumb, should not exceed 10% of the annual energy cost savings. Table 4 shows that most of the project's ratios exceeded this value, but not by a large margin. It should be noted, though, that the M&V costs included the service phase margin. Still, these costs seemed relatively high given the prominence of Option A methods. Projects with smaller annual savings had a larger fraction of the savings dedicated to M&V services, presumably because there are some fixed costs associated with M&V services.

[3] ASHRAE M&V Full-Day Course, California SPC Training Workshops

Table 4. Measure and contract information for each agency

	Coast Guard Alameda, CA	**FAA, Auburn, WA**	**Forest Service, Corvallis, OR**	**Pt. Mugu, Oxnard, CA**	**NPS, Yosemite, CA**	**Veterans Affairs, SF, CA**	**DMDC Monterey, CA**
	Honeywell	JCI	Honeywell	ERI	Bentley	JCI	Sempra
Lighting	A	A	A	A	A	A	A
EMCS	A		B&C	A	A	A	B → A
Boiler / Plant Upgrade				A (plant only)	A	B	Gas: C → A kWh: B → A
HVAC •VAV conversion •Repl. Cooling Coil •Economizer				A	B → A A	A	B → A
Steam / Hot Water System Upgrades			A	A			A
Chiller / Plant Upgrade		B		A			
Motor Efficiency						B	A
Install VFDs					B → A		
Air Compressors						B	
Project Capital Cost	$ 998,717	$ 332,310	$ 394,000	$ 1,619,003	$ 584,535	$ 4,428,666	$ 2,142,880
Energy Savings	$ 120,141	$ 50,271	$ 63,000	$ 264,922	$ 34,206	$ 208,774	$ 369,911
O&M (& Other) Savings	$ 5,600	$ 0	$ 14,000	$ 72,100	$ 48,157[4]	$ 319,950	$ 53,240
Contract Term, years.	10	15	10	13	14	19	9
Annual M&V Cost[5]	$ 3,797[6]	$ 6,900	$ 6,700	$ 5,529	$ 4,577	$ 25,286	$ 20,051
Total M&V Cost	$ 37,970	$ 103,500	$ 67,000	$ 71,877	$ 64,078	$ 480,434	$ 180,459
Service Phase Margin	29.5%	27.9%	29.5%	17.3%	25.0%	27.9%	18.0%
Annual M&V Cost / Energy Savings	3%	14%	11%	2%	13%	12%	5%
Total M&V Cost / Project Cap. Cost	4%	31%	17%	4%	11%	11%	8%

Of the seven surveyed sites, two (National Park Service and Veteran's Affairs) had large cost savings that did not result from improved energy utilization, but rather from reduced operations and maintenance or electric rates. The savings were comparable to or greater than the cost savings from energy conservation. The M&V plans were not required to include verification activities for operations and maintenance or electric rate changes.

4.4 M&V Development Influences

It is difficult to generalize as to what point in the project development process the M&V discussions were initiated. Some projects were developed with a clear idea of how the M&V would be done from the beginning. In other projects, M&V was added on to the project late

[4] Savings from an electric rate change

[5] Average values based on data reported in H-3 schedules and include service phase margin

[6] Average M&V cost over 10 years. Contract specified only 5 years of M&V

in the development process. The M&V plans for the seven projects varied from rigorous analysis and long-term metering to assumed values based on audit results. The level of rigor that we found in the M&V plans was not related to project capital cost or annual savings. The agency's commitment to measuring and verifying the savings seemed to be the common factor for having a good M&V plan.

Measurement and verification issues were never the most important issues during the negotiation phase. Negotiations between the agency and the ESCO primarily centered on what projects the agency wanted and what the ESCO could offer and still be economically viable. The criteria that most agencies established was a limited contract term (typically 10 to 15 years). Measures were selected or rejected based on whether the resulting combination of measures could be obtained within the specified contract term. Once a package of measures had been agreed upon (or nearly so), the costs of providing M&V services were then scrutinized. In some cases, M&V expenses were reduced so that a specific contract term could be achieved. No measures were dropped because of M&V technical issues.

The FEMP support team evaluated the technical merit of the M&V plans for most of these projects. Some agencies did not actively participate in the development of their own M&V plans because they lacked either the expertise or the resources to do so, and instead relied heavily on the FEMP team. FEMP is now requiring agencies to pay for such support services, so in the future, agencies may be more self-reliant than those involved in this study. All the agencies had staff members who were aware of the FEMP M&V guidelines due to the training programs.

Technical merit was rarely the reason for substantially changing an M&V plan. Although there was a good deal of negotiation during the development phase, most discussions sought to clarify or refine existing M&V plans. M&V methods usually were changed to reduce project cost and not because of technical concerns. In fact, many agencies were disappointed if an M&V plan had to use a less rigorous approach for cost reasons.

As previously mentioned, the agency's project motivation was the strongest factor in determining M&V rigor. Additionally, comfort with perceived risk was also an important consideration. Agencies that were confident that savings would materialize were less interested in pursuing rigorous M&V plans, especially if energy saving was not their primary motivator. Agencies motivated by energy savings were more willing to commit to more rigorous M&V plans as a way of tracking their savings, especially for non-lighting (and more risky) measures.

It was always the ESCO's role to develop the M&V plan for each site. All the ESCOs were familiar with the FEMP M&V Guideline, but they had various interpretations of the options. Combinations of options were sometimes used when a proposed method was not conveniently described as Option A or Option B. For example, variable frequency drives at Yosemite falls under Option B in the M&V Guideline, but the agency changed over to Option A after one year. The plan called for continuous monitoring of the drives (an Option B long-term measurement approach); then, after one year, the savings were stipulated based on the first year's results (Option A). Similar combinations and descriptions were found at other sites.

The emphasis that ESCOs placed on some of the measurements may have been misdirected. For example, in lighting projects, most ESCOs measured fixture power instead of operating hours; however, it is usually the operating hours that are most uncertain. Fixture power may be obtained from manufacturer specifications or from standard lighting tables with a high degree of reliability, whereas operating hours are a function of building use and occupant behavior. This caused operating hours to be the greatest contributor to savings uncertainty. One possible reason is that emphasis on measuring fixture power comes directly from the FEMP M&V Guidelines, which emphasizes the use of Option A for lighting projects, both with and without measurements. The Guideline itself is somewhat vague as to how to balance risk and rigor and offers little direction in deciding whether an Option A approach with or without measurement or an Option B approach is appropriate for a particular project.

A more probable reason for the emphasis on measured fixture powers is risk allocation. An ESCO has more control over fixture performance than operating hours. Few ESCOs are willing to guarantee savings that are dependent on the agencies usage, which may vary over time and is more difficult to quantify. By measuring fixture powers and stipulating hours, the ESCO is guaranteeing the savings from parameters that they can control while shifting the usage risk to agency for parameters beyond the ESCOs control. In this sense, the risks are allocated appropriately to both parties.

5 M&V PLAN RISK ASSESSMENT

5.1 General Discussion of Risk and its Control by M&V

All performance contracts entail some element of risk. In the realm of performance contracting, risk takes the form of uncertainty in the savings estimates and the possibility that savings may not materialize. For example, when an ESCO proposes a project estimated to save $100,000 in energy costs, the actual project may save between $80,000 and $120,000—the exact value will never be known. In extreme cases, there may be no savings at all. Agencies and facilitators must realize that they are *not* purchasing commodities that can be accurately characterized in terms of cost per unit (e.g., $/gallon), but are purchasing *the promise* that energy costs will decrease due to reduced consumption. The risk is that actual savings will fall short of this mark. M&V helps manage this risk and apportions it between the agency or the ESCO.

Common reasons why savings may not materialize are:

- *Design risk*—The original savings estimates were too optimistic.
- *Performance risk*—The new equipment may not be working properly.
- *Usage risk*—Equipment usage may be different than originally assumed.
- *Energy cost risk*—Dropping energy costs may reduce the value of energy savings.

Design Risk

Overly optimistic savings estimates can be due to incorrect assumptions made during the engineering phase. For example, unrealistic efficiencies or load factors may have been used to estimate savings, or the actual operating strategy of a piece of equipment may be different than the assumed strategy. Verifying assumptions prior to project installation (i.e., during the Detailed Energy Survey) can reduce occurrences of this situation.

Baseline M&V activities, such as taking equipment measurements or performing short-term monitoring of existing equipment or human behavior reduce design risk by defining existing conditions. When an agency accepts an unverified value in the baseline estimates, the agency is taking on a certain amount of risk—and the baseline will not be available for verification after installation. Similarly, design phase M&V activities may reduce risk for the ESCO by preventing over-estimates of savings and by catching design mistakes. Distribution of design risk between the ESCO and the agency depends on the situation and the M&V approach. Use of measured values in the design phase varied across the projects surveyed.

Performance Risk

Assuming improper equipment specifications, improper equipment installation or operation, or poor commissioning can also result in reduced savings. Identifying problems early can reduce performance risk. Equipment monitoring after installation can help identify performance problems, but inspections alone may not. For example, a variable speed drive on a fan has the capacity to save energy, but will not save energy if the duct pressure transducer has failed. Monitoring fan operation through the EMCS will reveal that the fan speed is not changing, but a walk-through inspection may not uncover this problem.

Using stipulated performance characteristics apportions risk to the agency. In general, savings based on nameplate data or engineering estimates will have more risk associated with them than those based on spot or short-term measurements. Even though these are "performance" contracts, stipulated performance characteristics were common in the projects surveyed.

Usage Risk

Equipment usage can also affect savings. Operating hours may be different than originally estimated, or they may change after a project has been installed. For example, efficient lighting fixtures assumed to operate 2,000 hours per year would not generate the intended savings if they only operate 200 hours per year. Monitoring operating hours in a sample of spaces will verify that operating hours are similar to the assumed values, or alert the ESCO to changes if they are not. Changes in building use may affect operating hours, resulting in different savings values. If stipulated hours are not altered to reflect these changes, then the savings values will not reflect what is actually happening at a site.

Apportioning usage risk between the agency and the ESCO can be tricky. On one hand, usage directly affects savings, and improperly stipulated usage estimates by the ESCO could significantly overestimate an agency's actual energy savings. On the other hand, changes such as those in building occupancy are completely out of the ESCO's control, yet some M&V strategies may leave them responsible for disappearing savings.

Energy Price Risk

Another project risk is uncertainty in future energy prices. Contract terms ranged from 10 to 20 years, making certain prediction of energy prices impossible. The FEMP M&V Guideline offers little advice on this subject, so the ESCOs proposed what they felt was appropriate. Original energy price valuations included using the present energy cost for the length of the contract, escalating the energy prices to account for inflation, or using the real energy price each year during the contract term.

If energy valuations are based on future energy prices, then rising energy prices allow the ESCO to claim more financial savings for the same energy savings. Since savings are supposed to be tied to energy savings, not cost savings, this valuation method introduces energy fluctuations into the guaranteed savings amounts. If energy prices were high but energy savings goals were not met, it would allow the ESCO to meet the guaranteed savings amounts when in fact they had not. Conversely, declining energy prices are a risk to the ESCO, who would not be able to claim that savings goals had been met even if they had. Using uncertain dollar values to represent energy savings presents a risk to both the agency and the ESCO.

Using fixed energy prices during the contract term protects both the agency and the ESCO from price uncertainties. If energy prices rise, the agency would still pay an increased utility bill, but not as much as they would have in the absence of a Super ESPC project. If energy prices fall, the ESCO is protected from not meeting savings guarantees while the agency pays less regardless. Using constant energy-cost values provides a fixed relationship between energy savings and financial savings and minimizes risk to all parties.

An alternative is to escalate energy prices to account for inflation. Although no one can predict what energy prices will do in the long term, inflation rates of 2-3% are commonly used to estimate savings. (These values are justified by Energy Information Administration predictions.) One effect that inflating energy prices has is that the guaranteed savings will increase during the contract term. This allows the ESCO to charge more for the project in later years without violating the directive that the agency can never pay more than the guaranteed savings amount. This does present a small risk to the agency, which must ensure that their energy and operations and maintenance budget increase by the estimated inflation rate regardless of actual inflation rates.

Value of Guarantees

While Super ESPC projects have guaranteed savings, these guarantees are only as good as the methods used to verify the savings. In principle, guaranteed savings transfer all project risk to the ESCO. In practice, failure to verify that savings are as claimed transfers project risk back onto the agency even if they are 'guaranteed.' Performing *at least some* post-installation measurement and verification is the only reliable way of knowing whether actual savings are meeting the guaranteed amounts. This is why the Super ESPC requires ESCOs to exert some M&V effort to show that savings are real and greater than the guaranteed amounts if the guarantees are to have any value.

5.2 Perceived Risks and M&V

Most agencies are aware of project risks and realize that savings values are estimates, and that actual savings will be different and may fluctuate due to external factors. They are also aware that in rare cases no savings will materialize. Most are confident that the claimed savings estimates are reliable and conservative, but still want some assurance that the savings are being realized. In some cases, agency staff accepted somewhat less M&V assurance than they would have liked to see in the interest of making the project work.

5.3 Risks in M&V Options

The purpose of M&V is to reduce the total risk and to apportion the balance of the risk among the two parties. By verifying that savings are materializing as intended, the agency's risk of overpayment is reduced. Verification assigns the project risk to the ESCO, who is responsible for ensuring that installed measures are working properly and that savings are being generated.

Total project risk is related to both total savings and uncertainty. Both components should be considered when determining project risk so that appropriate M&V efforts can be made. For example, a small lighting project with well-defined operating hours will have a much smaller financial risk than a large HVAC project where savings are not as well defined (see Table 5).

Table 5: Financial risks due to savings uncertainty

Sample Project	Guaranteed Savings	Savings Uncertainty	Savings Risk
Small lighting	$50,000	10%	$5,000
Large HVAC	$500,000	20%	$100,000

In this example, an agency is at far greater financial risk from the HVAC project than the lighting project, both in absolute and relative terms. The HVAC project may save between $400,000 and $600,000 dollars, but if the savings are *below* the guaranteed amount, then the agency is at risk of paying greater than anticipated energy costs. The purpose of M&V is to reduce financial risk to acceptable levels by reducing uncertainty. In the above scenario, most of the M&V effort should be concentrated on the HVAC project to reduce the agency's total risk.

Reducing uncertainty and risk with M&V activities, however, increases project cost. Good M&V activities reduce uncertainty without significantly increasing project costs. In the example above, reducing the HVAC uncertainty from 20% to 10% will reduce the project uncertainty by $50,000, which reduces the maximum possible overpayment from $100,000 to $50,000.

The different options described in the FEMP M&V Guideline have different implementation costs and levels of rigor. Option A (stipulated savings) has the lowest M&V cost but the greatest uncertainty. Option B (end-use monitoring) is considerably more accurate but has a higher implementation cost. Option C (whole building analysis) can be implemented with varying degrees of certainty and cost. Computer simulation (FEMP Option C, IPMVP Option D) is labor and cost-intensive but can provide a high degree of certainty. It is most often used for new construction projects where real baseline data does not exist.

Option A is used when estimating the savings of a particular measure. It calls for stipulating the savings at agreed-upon values for the contract duration. These values are to be determined based on spot and short-term measurements of old and new equipment. Costs are minimized by not repeating these measurements every year. Risk is reduced by conducting annual inspections to see that the installed equipment is still present and functioning as intended. Because the use of measurements is limited with this option, it is most applicable to constant-load measures that are unlikely to significantly change performance over the contract term.

Option B is also used when estimating the savings of individual measures. It is more rigorous and more expensive than Option A because continuous equipment monitoring is performed for the contract duration. Continuous monitoring reduces the uncertainty in the savings estimate and reduces long-term risk. This option is more applicable to variable-load measures because of their greater complexity, or to measures that may change performance due to weather or occupancy patterns, or both.

Option C, both regression analysis and computer simulation, consider only the total building energy consumption and do not provide savings estimates for individual measures. It should be used only in cases where the retrofits will cause a substantial decrease in energy consumption. When implemented rigorously, this method can estimate the savings due to a large number of inter-related measures if total savings are large enough. Uncertainty and risk are reduced because weather and occupancy factors can be considered when estimating savings. In some cases, M&V cost may be less than those associated with performing a large number of Option B measurements and calculations. Risk is reduced because actual building energy consumption is used to estimate savings, which provides on-going reassurance that the savings will persist.

5.4 Discussion of Risks in Surveyed Projects

5.4.1 Stipulation Risk

By far, the greatest risk the surveyed agencies are exposed to is that associated with stipulated savings. Most Option A methods for stipulating savings base the savings estimates on pre-and post-retrofit equipment measurements. These measured values then determine the savings for the contract duration. While this method has the lowest cost, it also has the highest risk because actual performance is not verified throughout the contract duration. Persistence is usually addressed by conducting annual inspections to verify that equipment is installed and has the *potential* to save energy, but whether the equipment is *actually* saving energy is rarely verified directly.

Steps taken to minimize uncertainty may not be as effective as desired. While taking equipment performance measurements is intended to reduce uncertainty, some parameters have a greater affect on the resulting uncertainty than others. For example, lighting savings are a function of the power difference between the old fixtures and the new *and* the number of operating hours per year. Fixture powers are often known with relative certainty even without measurement (a 100 Watt lamp usually draws about 100 Watts). Operating hours, however, are known with significantly less certainty. While surveys of a facility and interviews with staff can identify occupied hours, occupancy does not always translate into operating hours. Experience with utility DSM programs shows that operating hours may be significantly different (2x or more) than originally assumed due to the presence of cleaning crews, sporadic occupancy, or sufficient daylighting.

Measuring fixture power reduces the already small uncertainty in that parameter but does nothing to address the large uncertainty in operating hours. Stipulating the operating hours without measuring a sample of operating hours places the agency at risk of unrealized savings if the actual operating hours are significantly less than the assumed and stipulated values. (There is little risk to either party if hours exceed the assumed values). ESCOs attempt to minimize risk to the agency by developing conservative estimates, but only two of the surveyed ESCOs performed any operating hour measurements.

5.4.2 Performance Risk

Equipment that fails to perform as intended can also result in unrealized savings and place either the agency or the ESCO at risk. An example might be a variable speed drive installed on a fan motor. While this retrofit has the potential to save energy, it may not perform as intended because the air handler is undersized and the fan needs to continuously operate at full speed or because a defective pressure sensor fails to correctly modulate the fan speed. In the first case, sufficient pre-installation measurements would have revealed that the air handler was undersized and that a VSD was not the appropriate retrofit. Because the ESCO has guaranteed the savings from this project, the agency is protected from risk, but the ESCO must either make additional changes at its expense or alter the payment schedule to make good on the guarantee. In the second case, the pressure sensor can be fixed and the system restored to intended operation so that savings are again realized.

In both cases, sufficient M&V must be performed before and after installation to verify that savings are being realized. In the event that savings are not materializing, the ESCO has sufficient information to identify the cause and take corrective action. If savings are stipulated, this information would not be available to the ESCO or the agency and the situation would not be discovered. This makes the guaranteed savings less valuable, because without adequate M&V, there is no way to enforce them.

5.4.3 Usage Risk

Usage risk occurs if an agency decides to change operating schedules or usage of a building. Referring back to the lighting example, changes in building schedules or use may affect lighting operating hours without the ESCO noticing. Decreased operating hours will erode savings (or savings will be falsely attributed to lighting) if stipulated hours are not changed to reflect actual usage. Annual inspections will show that the installed lighting fixtures have the *potential* to save energy, but this potential is not being realized if the lights are not operating as assumed.

Stipulated savings estimates that are not based on actual measurements or that are not updated to reflect changes place the risk back on the agency despite the guaranteed savings. Without adequate feedback, the ESCO cannot amend the savings estimates.

6 RECOMMENDATIONS

Several recommendations for improving the planning and implementation of M&V were identified by agencies, DOE, and our staff. The recommendations are in three broad categories: M&V resource improvements, M&V plan and budget standardization, and establishing a framework for review and assessment of M&V plans in the development phase.

6.1 Improve M&V Resources

There exist M&V resources that are intended to provide guidance in how to develop and implement M&V plans. Chief among these are the FEMP M&V Guideline and other FEMP produced materials. Review of the existing plans illustrates weaknesses and ambiguities in existing resource materials. There was much variation in the content of each M&V plan evaluated as part of our assessment, even for similar ECMs. It was clear that the current guideline provided insufficient direction on how to develop an M&V plan or what the characteristics are of a good M&V plan[7]. After review of seven M&V plans, several recommendations for improvement to the Guideline are made:

1. <u>Clarify option definitions and other terms.</u> There is much apparent confusion about how and when the options are to be implemented, particularly Option A. One agency staff member reported that she had to read the Guideline a number of times before understanding the distinctions between the Options. It is recommended that the Guideline further emphasize the definitions of the options and their intended use, and more clearly indicate each option's expected activities.

2. <u>Distinguish between equipment performance (e.g., efficiency, capacity ratings) and equipment usage (e.g., operating hours, annual energy consumption) and their relationship to savings</u>. These are distinctly different, but are parameters required to quantify savings. Clearly define these parameters in the Guideline, so that ESCOs and agencies know these factors must be measured or otherwise quantified for each ECM in their projects. Provide guidance on which parameter is more relevant to determining savings. Reviewed M&V plans placed too much emphasis on performance (lighting power, motor efficiency) and not enough on usage (operating hours).

3. <u>Provide recommendation as to which M&V Options and methods should be used with different types of measures, based on project technologies, risks, and value.</u> The FEMP Guideline provides little advice on how to balance costs and risks when selecting an M&V plan.

4. <u>Reduce the volume of the FEMP M&V Guideline's text and perhaps prepare different versions for federal management versus federal and ESCO technical staff</u>. Reducing volume can be achieved by eliminating redundant text in individual M&V methods. Some agency staff reported that the Guideline is too long, repetitive, and unclear in many areas. A shorter version might also be appropriate for agency managers that need to simply understand the basics of M&V requirements and options.

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[7] These comments are based on the current FEMP M&V Guideline, published in 1996. A newer version, developed at the end of 1998, and now available for public comment, incorporates some, but not all, of these recommendations.

5. Clarify use of stipulations for Option A. Specify when equipment performance parameters or equipment usage parameters may be stipulated under Option A. Only in rare (and well-supported) cases may energy savings values also be stipulated. Define acceptable sources of data, and the context for their use, upon which stipulations may be based. Data sources may include spot or short-term measurements, previous studies, maintenance logs, and control schedules. State examples of unacceptable sources of data, such as handshake agreements, unchecked assumptions, past experience, etc. State that periodic (i.e., at least annual) verification activities (which may include actual measurements) are required with Option A methods.
6. Develop M&V requirements for operations and maintenance (O&M) measures. One of the surveyed projects had annual O&M savings that exceeded the annual energy savings of all energy conservation measures. Other projects' O&M savings were the second or third largest cost savings of the project. Payments on O&M savings were not subject to any formal measurement and verification scrutiny, which can be a source of considerable risk to an agency. Part of the reason for this is the simplicity of certain O&M savings, but another part of the reason is that there are no established O&M M&V guidelines.
7. Provide additional training on M&V and develop in-house FEMP M&V expertise. Training can be useful for agency staff, ESCO staff, and/or the purpose of developing additional FEMP in-house expertise. Additional FEMP in-house expertise can be used to provide M&V specific support to agency staff and project facilitators.

6.2 M&V Plan and Budget Standardization

The FEMP M&V Guideline provides a great deal of flexibility, which can be both a strength and a weakness. The strength is that M&V plans can be tailored to meet specific applications and requirements. The weakness is that there is no standardization, and some of the plans reviewed were missing key elements. There is also little agreement on how to determine the cost of M&V services. Some specific recommendations include:

1. Require that M&V costs be estimated for each individual measure or group of measures. This provides the agency with an idea of what is obtained for the money spent on M&V. The costs should be developed at the beginning of the negotiations, so that all relevant costs are available during negotiations. Analysis should consider the cost of M&V relative to the level of uncertainty the M&V provides and thus the value of M&V versus the certainty in cost savings it provides.
2. Integrate the discussion of M&V with the selection of ECMs when finalizing delivery orders. Rather than discussing M&V last in the process, as was the usual case in the projects surveyed, start the discussion earlier. Preferably, M&V should be part of the measure design process and M&V budgets should be included in all preliminary estimates. Certainly the M&V should be established prior to the time contract budgets and terms are finalized.
3. Develop a standard framework for M&V plan content and evaluation. No formal evaluation guidelines or required M&V plan elements exist to assist ESCOs prepare and agencies review M&V plans. One option that has been discussed is a checklist for what should be in an M&V plan. Section 6.3 describes some possible evaluation framework contents.

4. Provide information on requirements associated with meeting federal ESPC regulations. In addition to M&V plan content and evaluation criteria, a description of what is required to comply with federal M&V regulations would be useful.

5. Develop sample M&V plans and reports. Sample M&V plans and reports will provide both agencies and ESCOs examples to follow when preparing to submit documents. Providing a description of legal requirements will also assist in plan development and evaluation.

6.3 M&V Plan Evaluation Framework

Specific items in an M&V plan might include the following elements:

Project overview

I. Project and measure-specific approach (including FEMP option type)
   A. Measure description and how it will generate savings
   B. Description of what savings will be quantified and claimed
   C. Description of any interactive effects
   D. Brief description of measure risks and/or areas of uncertainty

II. Baseline equipment definition
   A. Documentation of existing equipment and space conditions (lumens, temp...)
   B. Supporting measurements (from Detailed Energy Survey)
   C. Assumptions, stipulations, and source of supporting information
   D. Description of how baseline adjustments will be implemented

III. Post-installation equipment definition
   A. Documentation of new equipment and space conditions (lumens, temp...)
   B. Supporting measurements (to be made)
   C. Assumptions, stipulations, and source of supporting information

IV. Energy Savings Calculation
   A. Intended precision and confidence levels
   B. Defining equations
   C. Required variables
   D. Source of data (measurements, assumptions)
   E. How data is measured or modeled (including computer programs used)

V. Measurement equipment specifications
   A. Equipment descriptions
   B. Sampling plans and sampling criteria
   C. Measurement schedule and duration
   D. Accuracy specifications
   E. Calibration interval
   F. Raw data reporting format (especially computer files)
   G. Identification of responsible individual or organization

VI. Annual activities
   A. Inspection/verification activities
   B. Measurement and analysis activities
   C. Reporting requirements
   D. Identification of responsible individuals or organization
   E. Quality assurance plan

VII. Report sample format

   A. Data presentation format
   B. Reporting frequency
   C. Savings true-up reporting
   D. Baseline adjustments

VIII. Estimated M&V costs by measure and activity

As part of the framework there should be guidance for evaluating M&V plans in terms of cost and risk. A simple table that lists and ranks the ECMs by their estimated energy cost savings, associated M&V costs, and risk of realizing savings could be constructed. The risks may be qualitative, and based on the uncertainty of the energy savings estimation. The table could be used to determine whether M&V resources are appropriately applied.

7 GLOSSARY

DDC: Direct digital control, a system that controls HVAC equipment.
HVAC: Heating, Ventilating, & Air Conditioning
MUA: Make-Up Air unit. Provide fresh air to the conditioned space.
OPTION A: M&V method that relies heavily on stipulated values.
OPTION B: M&V method that uses long-term metering of affected equipment.
OPTION C: M&V methods where utility bills are analyzed, or building computer simulations are employed (FEMP Guidelines 2.1).

8 Appendix A: Questions for agency and ESCO staff members

1. Why did your agency pursue a delivery order (DO) for these ECMs?
    - ❑ energy savings
    - ❑ equipment upgrades
    - ❑ performance improvement
    - ❑ EPACT compliance
    - ❑ Other

Which of the above were most important? Why?

2. Were there other contract means available? (Such as area-wide agreements, direct funding...)
3. Was the DO process using Super ESPC the most appealing option? Why or why not?
    - If so, was the idea of getting verified energy savings important or unimportant? Why?
    - Were there other appealing aspects of the delivery order process?
    - If not, what aspects were unappealing or difficult?
4. Did you have competing ESCOs bid to do the work on your facilities?
5. Who identified the ECMs – the agency or the ESCO?
6. Were you familiar with the FEMP M&V Guidelines before starting the delivery order process?
7. Did the Guidelines provide a clear description of what M&V is, and what the necessary steps are in developing, implementing and reporting M&V activities?
8. Did you find them helpful in understanding and reviewing the ESCO's submitted M&V plans?
9. Did you rely on 'experts' to advise you whether a particular version of the M&V plan was appropriate or not?
10. Was the FEMP support team helpful in evaluating plans, providing advice, or assisting in negotiations?
11. What M&V Options did you select for each measure? Why?
12. How well did Agency staff understand the M&V plans? (assumptions & implications)
13. During the negotiation process for the delivery order, when did you first start discussing M&V?
14. Who developed the M&V plans for the implemented measures?
15. Was discussion and negotiation of the M&V plans a difficult or an easy process? Why?
    - Little understanding or poor communication of M&V on ESCOs part?
    - Allocating risk between the agency and ESCO?

- Cost or difficulty of M&V?
- Other-

16. How was project risk allocated between the ESCO and the Agency?
17. Did you get what you wanted in terms of M&V for each ECM from the negotiation process?
18. How effectively has the implemented M&V been to date?
19. What other issues during DO negotiations were important? How did M&V compare to them?
20. Were operations and maintenance issues included in M&V plans, or were they separate?
21. How confident are you in the O&M provisions?
22. What provisions have been made for baseline adjustment or future changes to the facility?