



Reviewing Measurement & Verification Plans for Federal ESPC Projects

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Reviewing Measurement and Verification Plans for Federal ESPC Projects

The purpose of this document is to provide a framework for implementing uniform and consistent reviews of measurement and verification (M&V) plans for Federal ESPC projects. These procedures will help provide uniform review approaches for M&V plans, produce standardized reviews, and enable centralized tracking of project metrics.

Evaluating M&V plans is an inexact science that requires technical expertise and experience. Ideally, the reviewer will have been involved in the project development phase and have an intimate understanding of the agency's goals, the agree-upon allocation of project risks and site-specific issues, as well as the objectives and constraints for each energy conservation measure (ECM).

Step 1 – Prepare Custom Report and Checklist from Template

- Create a copy of the M&V Plan Review Template (the template begins on page 7 of this document) and customize by adding project-specific information in the tables provided:

Table 1: Summary of Project Data

Table 2: Distribution List of Review

Table 3: Summary of Savings from Proposed ECMs

Customize the M&V Plan Content Review Checklists (Section 4). The checklists have 2 parts: M&V Plan – Project-Level Checklist; and M&V Plan – ECM-Level Checklist

- Add an ECM-level checklist for each ECM. A placeholder for one ECM has been provided. Make a copy for each ECM.

Step 2 – Review Project Documentation

- Acquire and review project documents. Make note of relevant documentation that is available during the review. Generally the entire Final Proposal, including the Detailed Energy Survey and all technical appendices, is required to thoroughly review an M&V plan and the associated savings calculations.

Step 3 – Determine Level of Savings for Each ECM

- Determine the percentage of overall cost savings contributed by each ECM in the project (from cost schedule DO-4). Determine the percentage of energy and water cost savings [not including operations and maintenance (O&M) cost savings] contributed by each ECM.
- Evaluate savings streams from each ECM, noting the source(s) of cost savings for each measure (O&M, electricity, demand, natural gas, water, etc.) in the appropriate sections of the M&V Plan Review Template. O&M cost savings are generally determined and verified separately from energy and water savings.
- Principal review efforts should be focused on the measures providing the largest portion of the cost savings for the project. This strategy of reviewing the principal

cost saving measures first will help the reviewer spend the smallest amount of time while maximizing the value of the review, and is especially helpful when review time is limited. Provide a detailed review of the M&V strategy for each measure if possible.

Step 4 – Complete Content Checklist

- Read through the M&V Plan while checking off topics and making notes in the customized M&V Plan Checklists. Note the location of key items in the first column of the checklists (labeled “Reference page”). The inability to comment on an item suggests that relevant information may be missing or not in complete form.
- Some of the items in the checklist are marked “Evaluation.” This indicates that additional qualitative assessment is necessary. These items are posed as questions, whereas the required content items are statements.
- Items in the checklist that require follow-up should be flagged by placing an “X” in the last column of the checklist (labeled “Follow-Up?”).
- Include the completed Checklists as part of the written review.
- The inclusion of all items on the checklist does not indicate the appropriateness of the M&V approach. Each item requires qualitative assessment, and tips for evaluating the M&V approach are discussed in the next step.

Step 5 – Evaluate M&V Approach

- Note source(s) of savings from measure. Ensure M&V activities are adequate for all significant savings streams.
- Review Risk & Responsibility Matrix (R&R). Ensure M&V strategy for each measure conforms to agreed-upon risk allocation.
- Evaluate quality of baseline developed:
 - Were key variables affecting energy use measured for each ECM (e.g., watts/fixture and hours/yr)?
 - Are all assumptions and stipulations reasonable, and include sources of data?
 - Were system performance characteristics recorded (e.g., lighting intensities, temperature set points)?
- Are savings estimates sound and reasonable?
 - Were energy calculations closely reviewed?
 - Were utility or weather-based models validated?
 - Were ECM savings compared to system usage?
 - Were project-level savings compared to overall site usage (optional)?
- Evaluate quality of performance-period activities:
 - What is the likelihood for success for this measure? More rigorous M&V strategies are warranted for ECMs with substantial uncertainty and/or technical complexity.
 - Is meaningful ongoing performance-period data going to be used to calculate savings?

- What is being verified? Is this sufficient to support the guarantee?
- Will key variables affecting energy use be measured for each ECM? How often?
 - Will single post-installation measurements apply to all years in the performance period? If so, how valuable are the data used?
 - How likely is this data to change over the performance period? Based on which party has accepted ongoing responsibility for each item, is this approach appropriate?
- Do the M&V strategies allocated support the concepts included in Risk & Responsibility Matrix?
- Were all objectives and constraints of the project considered?
- Were all objectives and constraints of the ECM considered?
- Review the strategy for conducting O&M for ECMs. Who is going to perform the routine O&M tasks, and how often?
 - Are O&M activities sufficiently detailed to demonstrate level of effort?
 - Are responsibilities allocated as suggested by R&R Matrix?
 - Are reporting requirements adequately defined?
- Evaluate overall project assumptions:
 - Are contracted energy rates based on actual rates, including time-of-use rates and peak demand ratchets? Are marginal (not blended) energy rates used?
 - Are proposed escalation rates based on latest NIST data?
- Are M&V costs reasonable? Do costs align with planned activities?
 - See DO-2 for Initial M&V cost for each measure.
 - See DO-4 for performance period M&V costs.

Step 6 – Finalize Report

- The written review should follow the format of the M&V Plan Review Template and include the completed M&V Plan Content Checklists. The format of the report can be modified as needed to meet the specific project needs.

Section 1: Executive summary

Section 2: Background

Section 3: Summary of Findings

Section 4: M&V Plan Checklists

- After reading the M&V Plan and filling out the project-specific M&V Plan Checklists, summarize the findings from the review in the appropriate sections of the review.
- Instructions, placeholder text to be customized, as well as final review text are included within the Review Template. Placeholder text that needs to be customized is underlined italics, while instructions to the reviewer are in *red italics*.

- Complete all the sections and customize placeholder text included in the M&V Plan Review Template. Delete any instructions after a section has been adequately completed.
- Include the completed Checklists as part of the written review.

Step 7 – Provide Written Review to Agency and DOE

- Once completed, the review of the M&V plan should be provided to the agency staff, as well the DOE representative, who will archive it for project records. Discussion with the agency on the review is usually warranted.

Step 8 – Ensure Action Taken on Key Issues

- After the review is submitted, it is **CRITICAL** to ensure that adequate action is taken to implement or address the recommendations.
- Often, the review process is iterative. After an initial review, subsequent revisions of the M&V plan must be assessed to determine if adequate modifications have been made. Written evaluations of these subsequent M&V plans are needed to document follow-up actions taken.

M&V Plan Review Template starts on the next page.

M&V Plan Review Template

Review of Measurement and Verification (M&V Plan <DATED> for ESPC <AGENCY, SITE NAME, DO#>

Section 1: Executive Summary

- *Provide a short summary of the key findings, including:*
 - *Overall adequacy of the M&V plan reviewed, including technical quality of the baseline and performance-period activities*
 - *Overall risk allocation of project and M&V plan's adherence to description in Risk & Responsibility Matrix for project*
 - *Bullet chief action items that need to be taken on M&V Plan*

Section 2: Background

This review of the M&V plan for this ESPC project was performed to ensure that:

- M&V conforms to agreed-upon risk allocation;
- M&V is adequate for all significant savings streams;
- The baseline is adequately defined;
- The savings estimates are sound and reasonable;
- Performance-period activities are meaningful and adequate to support the guarantee;
- Overall project assumptions are reasonable.

Table 1: Summary of Project Data

Project name:	
Location:	
Delivery Order #:	
Date of proposal:	

Table 2: Distribution List of Review

Reviewer:	
Reviewer Contact Information:	
Date of Review:	
Agency Contact info:	
Date review was provided to Agency contact:	
DOE Contact info:	
Date review was provided to DOE contact:	

Table 3: Summary of Savings from Proposed ECMs

ECM #	ECM Name / Description	Annual Energy & Water Cost Savings (\$)	Annual O&M Cost Savings (\$)	% Total Savings	% Total Energy & Water Savings

Section 3: Summary of Findings

- *Include all recommendations resulting from review. Summarize where appropriate using references to completed checklists.*
- *Note any missing or deficient items from the Project-Level Checklist.*
 - *Discuss reasonableness of overall project assumptions*
- *Discuss the overall risk allocation, and the level of correspondence to the risk and responsibility matrix.*
- *Are initial and ongoing M&V costs for this project reasonable? Do costs align with planned activities?*
- *Make a subsection for each ECM if needed. Summarize any issues for each ECM identified during review. Evaluate all items listed in Step 5 for all ECMs. Note any missing or deficient items from the ECM Checklists.*
 - *For each measure, provide a qualitative assessment of*
 - *Measurement and verification approach*
 - *General risk allocation and if supported by the concepts included in Risk & Responsibility Matrix*
 - *Adequacy of the baseline defined*
 - *If savings calculation methods are sound and reasonable*
 - *Accuracy of energy savings computations*
 - *Meaningfulness of the performance-period activities*
 - *Adequacy of M&V activities for all sources of savings*
 - *Strategy for conducting O&M*
 - *Are initial M&V costs for this ECM reasonable? Do costs align with planned activities?*

Section 4: Content Review Checklists—M&V Plan and Savings Calculation Methods (v. 2.0)

M&V Plan — Project-Level Checklist

Reference Page	Project-Level Item	Included? Note any deficiencies.	Follow-up?
	1. Executive Summary / M&V Overview & Proposed Savings Calculations		
	1.1 PROPOSED ANNUAL SAVINGS OVERVIEW		
	Table showing the projected savings by ECM broken out by O&M savings, energy units, energy cost, and other savings values as applicable. Include all applicable fuels / commodities for project, such as electric energy, electric demand, natural gas, fuel oil, coal, water, etc.		
	First Year Guaranteed Cost Savings		
	Site Use and Savings Overview - Include approximate % total site usage saved (for year 1) by energy source type for site (optional)		
Evaluation	Were project-level savings compared to overall site usage? Are savings levels reasonable?		
	1.2 M&V Plan Summary		
	Table presenting M&V Option (from M&V guideline) used and summary of M&V approach for each ECM		
	2. Whole-Project Data / Global Assumptions		
	2.1 Risk & Responsibility		
	Summarize allocation of responsibility for key items related to M&V.		
	<ul style="list-style-type: none"> ▪ Reference location of Risk & Responsibility Matrix 		
Evaluation	Do all M&V strategies included in Plan support the concepts included in Risk & Responsibility Matrix?		
	2.2 Energy, Water, and Operations & Maintenance (O&M) Rate Data		
	Details of baseline energy and water rates included		
Evaluation	Are contracted energy rates based on actual rates, including time-of-use rates and peak-demand ratchets? Are marginal (not blended) energy rates used?		
	Provide performance-period rate adjustment factors for energy, water, and O&M cost savings, if used.		
Evaluation	Are proposed escalation rates based on latest NIST data?		
	2.3 Schedule & Reporting for Verification Activities		
	Define requirements for witnessing of measurements during:		

Reference Page	Project-Level Item	Included? Note any deficiencies.	Follow-up?
	<ul style="list-style-type: none"> ▪ Baseline development 		
	<ul style="list-style-type: none"> ▪ Post-installation verification activities 		
	<ul style="list-style-type: none"> ▪ Performance period 		
	Define schedule of verification reporting activities, including:		
	<ul style="list-style-type: none"> ▪ Post-Installation Report 		
	<ul style="list-style-type: none"> ▪ Annual Report 		
	Define content and format of reports:		
	<ul style="list-style-type: none"> ▪ Post-installation report (Use Post-Installation Report Outline.) 		
	<ul style="list-style-type: none"> ▪ Annual M&V reports (Use Annual Report Outline) 		
	<ul style="list-style-type: none"> ▪ Interval M&V reports (Develop report outline if needed) 		
Evaluation	Are M&V costs reasonable? Do costs align with planned activities? <ul style="list-style-type: none"> ▪ See DO-2 for Initial M&V cost for each measure ▪ See DO-4 for performance-period M&V costs 		
	2.4 Operations, Preventive Maintenance, Repair, and Replacement Reporting Requirements		
	Define Government and ESCO reporting requirements:		
	Summarize key verification activities and reporting responsibilities of government and ESCO on operations, preventive maintenance, repair, and replacement items from details in ECM-specific M&V plans.		
	Define content of reports and reporting schedule.		
	2.5 Construction-Period Savings		
	Provide overview of how construction-period savings will be calculated, if applicable.		
	2.6 Status of Rebates		
	Provide a summary of the source of any third-party rebates or incentives provided on this project.		
	Provide status of any third-party rebates or incentives		
	2.7 Dispute Resolution		
	Describe plan for resolving disputes regarding issues such as baseline, baseline adjustment, energy savings calculation, and the use of periodic measurements.		

M&V Plan — ECM-Level Checklist #1 (Copy for each ECM)

Reference Page	ECM-Level Item	Included? Note any deficiencies.	Follow-up?
	% Project Total Cost Savings:	<i>ECM # / Name</i> X%	
	% Project Energy & Water Cost Savings:	Y%	
	3. ECM [Name / #] M&V Plan and Savings Calculation Methods		
	3.1 Overview of ECM, M&V Plan, and Savings Calculation for ECM		
	Summarize the scope of work, location, and how cost savings are generated.		
	<ul style="list-style-type: none"> ▪ Describe source of all savings including energy, water, O&M, and other (if applicable). 		
	Specify the M&V guideline and option used.		
Evaluation	Do M&V activities match declared M&V option?		
	Provide an overview of M&V Activities for ECM.		
	<ul style="list-style-type: none"> ▪ Explain intent of M&V plan, including what is being verified. 		
	Provide an overview of savings calculations methods for ECM.		
	<ul style="list-style-type: none"> ▪ Provide a general description of analysis methods used for savings calculations. 		
	3.2 Energy and Water Baseline Development		
	Describe in general terms how the baseline for this ECM is defined.		
	Describe variables affecting baseline energy or water use.		
	<ul style="list-style-type: none"> ▪ Include variables such as weather, operating hours, set point changes, etc. ▪ Describe how each variable will be quantified, i.e., measurements, monitoring, assumptions, manufacturer data, maintenance logs, engineering resources, etc. 		
	Define key system performance factors characterizing the baseline conditions such as comfort conditions, lighting intensities, temperature set points, etc.		
	Define requirements for government witnessing of measurements if different than whole-project data requirements included in Section 2.3.		
	Provide details of baseline data collected, including:		
	<ul style="list-style-type: none"> ▪ Parameters monitored/measured ▪ Details of equipment monitored, i.e., location, type, model, quantity, etc. ▪ Sampling plan, including details of usage groups and sample sizes ▪ Duration, frequency, interval, and seasonal or other requirements of measurements ▪ Personnel, dates, and times of measurements ▪ Proof of government witnessing of measurements (if required) ▪ Monitoring equipment used 		

Reference Page	ECM-Level Item	Included? Note any deficiencies.	Follow-up?
		<i>ECM # / Name</i>	
	% Project Total Cost Savings:	<i>X%</i>	
	% Project Energy & Water Cost Savings:	<i>Y%</i>	
	<ul style="list-style-type: none"> ▪ Installation requirements for monitoring equipments (test plug for temperature sensors, straight pipe for flow measurement, etc.) 		
	<ul style="list-style-type: none"> ▪ Certification of calibration / calibration procedures followed 		
	<ul style="list-style-type: none"> ▪ Expected accuracy of measurements/monitoring equipment 		
	<ul style="list-style-type: none"> ▪ Quality control procedures used 		
	<ul style="list-style-type: none"> ▪ Form of data (.xls, .csv, etc.) 		
	<ul style="list-style-type: none"> ▪ Results of measurements (attach appendix and electronic form as necessary) 		
	<ul style="list-style-type: none"> ▪ Completed data collection forms, if used 		
	Provide details of baseline data analysis performed, including:		
	<ul style="list-style-type: none"> ▪ Analysis using results of measurements 		
	<ul style="list-style-type: none"> ▪ Weather normalized regressions 		
	<ul style="list-style-type: none"> ▪ Weather data used and source of data 		
Evaluation	Evaluate quality of baseline developed:		
	<ul style="list-style-type: none"> ▪ Were key variables affecting energy use measured for each ECM (e.g. watts/fixture and hours/yr)? 		
	<ul style="list-style-type: none"> ▪ Are all assumptions and stipulations reasonable, and include sources of data? 		
	<ul style="list-style-type: none"> ▪ Were system performance characteristics recorded (e.g., lighting intensities, temperature set points)? 		
	3.3 Proposed Energy & Water Savings Calculations and Methodology		
	Provide detailed description of analysis methodology used.		
	<ul style="list-style-type: none"> ▪ Describe any data manipulation or analysis that was conducted prior to applying savings calculations. 		
	Detail all assumptions and sources of data, including all stipulated values used in calculations.		
	Include equations and technical details of all calculations made. (Use appendix and electronic format as necessary.) Include description of data format (headings, units, etc.).		
	Details of any savings or baseline adjustments that may be required.		
	Detail energy and water rates used to calculate cost savings.		
	<ul style="list-style-type: none"> ▪ Provide performance-period energy and water rate adjustment factors, if different from in section 2.2.2. 		
Evaluation	Are savings estimates sound and reasonable?		

Reference Page	ECM-Level Item	Included? Note any deficiencies.	Follow-up?
		<i>ECM # / Name</i>	
	% Project Total Cost Savings:	<i>X%</i>	
	% Project Energy & Water Cost Savings:	<i>Y%</i>	
	<ul style="list-style-type: none"> Were energy calculation methodologies closely reviewed? 		
	<ul style="list-style-type: none"> Did the reviewer check the math in the energy calculations? 		
	<ul style="list-style-type: none"> Were utility or weather-based models validated? 		
	<ul style="list-style-type: none"> Were ECM savings compared to system usage? Are they reasonable? 		
	3.4 Operations and Maintenance and Other Cost Savings		
	Provide justification for O&M cost savings, if applicable.		
	<ul style="list-style-type: none"> Describe how savings are generated. 		
	<ul style="list-style-type: none"> Detail cost savings calculations. 		
	<ul style="list-style-type: none"> Provide performance-period O&M cost savings adjustment factors, if different from in section 2.2.2. 		
	Provide justification for other cost savings, if applicable.		
	<ul style="list-style-type: none"> Describe how savings are generated. 		
	<ul style="list-style-type: none"> Detail cost savings calculations. 		
	<ul style="list-style-type: none"> Provide performance-period adjustment factors, if different from in section 2.2.2. 		
Evaluation	Review the strategy for conducting O&M for this ECM. <ul style="list-style-type: none"> Are O&M activities sufficiently detailed to demonstrate level of effort? Are responsibilities allocated as suggested by R&R Matrix? Are reporting requirements adequately defined? 		
	3.5 Proposed Annual Savings For ECM		
	Table detailing proposed annual savings for this ECM for performance period, including the baseline energy use, post-install energy use, and projected savings for ECM. Detail energy units, energy cost, O&M savings, and other savings values as applicable. Include all applicable fuels / commodities for project, such as electric energy, electric demand, natural gas, fuel oil, coal, water, etc.		
	3.6 Post-Installation M&V Activities		
	Describe the intent of post-installation verification activities, including what will be verified.		
	Describe variables affecting post-installation energy or water use.		
	<ul style="list-style-type: none"> Include variables such as weather, operating hours, set point changes, etc. 		

Reference Page	ECM-Level Item	Included? Note any deficiencies.	Follow-up?
		<i>ECM # / Name</i>	
	% Project Total Cost Savings:	<i>X%</i>	
	% Project Energy & Water Cost Savings:	<i>Y%</i>	
	<ul style="list-style-type: none"> ▪ Describe how each variable will be quantified, i.e., measurements, monitoring, assumptions, manufacturer data, maintenance logs, engineering resources, etc. 		
	Define key system performance factors characterizing the post-installation conditions such as lighting intensities, temperature set points, etc.		
	Define requirements for government witnessing of measurements if different than whole project data requirements included in Section 2.3.		
	Provide details of post-installation data to be collected, including:		
	<ul style="list-style-type: none"> ▪ Parameters to be monitored 		
	<ul style="list-style-type: none"> ▪ Details of equipment to be monitored (location, type, model, quantity, etc.) 		
	<ul style="list-style-type: none"> ▪ Sampling plan, including details of usage groups and sample sizes 		
	<ul style="list-style-type: none"> ▪ Duration, frequency, interval, and seasonal or other requirements of measurements 		
	<ul style="list-style-type: none"> ▪ Monitoring equipment to be used 		
	<ul style="list-style-type: none"> ▪ Installation requirements for monitoring equipment 		
	<ul style="list-style-type: none"> ▪ Calibration requirements / procedures 		
	<ul style="list-style-type: none"> ▪ Expected accuracy of measurements/monitoring equipment 		
	<ul style="list-style-type: none"> ▪ Quality control procedures to be used 		
	<ul style="list-style-type: none"> ▪ Form of data to be collected (.xls, .cvs, etc.) 		
	<ul style="list-style-type: none"> ▪ Sample data collection forms (optional) 		
	<ul style="list-style-type: none"> ▪ Detail data analysis to be performed 		
	3.7 Performance-Period Verification Activities		
	Describe variables affecting performance-period energy or water use.		
	<ul style="list-style-type: none"> ▪ Include variables such as weather, operating hours, set point changes, etc. 		
	<ul style="list-style-type: none"> ▪ Describe how each variable will be quantified, i.e. measurements, monitoring, assumptions, manufacturer data, maintenance logs, engineering resources, etc. 		
	Define key system performance factors characterizing the performance-period conditions such as comfort conditions, lighting intensities, temperature set points, etc		
	Describe the intent of performance-period verification activities – what will be verified.		

Reference Page	ECM-Level Item	Included? Note any deficiencies.	Follow-up?
		<i>ECM # / Name</i>	
	% Project Total Cost Savings:	<i>X%</i>	
	% Project Energy & Water Cost Savings:	<i>Y%</i>	
	Provide detailed schedule of performance-period verification activities and inspections.		
	Define requirements for government witnessing of measurements if different than whole-project data requirements included in Section 2.3.		
	Provide details of performance-period data to be collected, including:		
	▪ Parameters to be monitored		
	▪ Details of equipment to be monitored (location, type, model, quantity, etc.)		
	▪ Sampling plan, including details of usage groups and sample sizes		
	▪ Duration, frequency, interval, and seasonal or other requirements of measurements		
	▪ Monitoring equipment to be used		
	▪ Installation requirements for monitoring equipment		
	▪ Calibration requirements/procedures		
	▪ Expected accuracy of measurements/monitoring equipment		
	▪ Quality control procedures to be used		
	▪ Form of data to be collected (.xls, .csvs, etc.)		
▪ Sample data collection forms (optional)			
	Detail data analysis to be performed		
	▪ Define operations, preventive maintenance, repair, and replacement reporting requirements.		
	▪ Detail verification activities and reporting responsibilities of government and ESCO on operations, preventive maintenance, repair, and replacement items.		
	▪ Define contents of report and reporting schedule, if different than in global section 2.4.		
Evaluation	Evaluate quality of performance-period activities:		
	What is the likelihood for success for this measure? <ul style="list-style-type: none"> ○ Is there substantial uncertainty and/or technical complexity? If so, is M&V robust? 		
	Is meaningful ongoing performance-period data going to be used to calculate savings? <ul style="list-style-type: none"> • What is being verified? Is this sufficient to support the guarantee? • Will key variables affecting energy use be measured for this ECM? How often? 		

Reference Page	ECM-Level Item	Included? Note any deficiencies.	Follow-up?
		<i>ECM # / Name</i>	
	% Project Total Cost Savings:	<i>X%</i>	
	% Project Energy & Water Cost Savings:	<i>Y%</i>	
	<ul style="list-style-type: none"> • Will single post-installation measurements apply to all years in the performance period? If so, how valuable are the data used? • How likely is this data to change over the performance period? • Based on which party has accepted ongoing responsibility for each item, is this approach appropriate? 		
Evaluation	Are M&V costs shown in DO-2 reasonable for this ECM? Do costs align with planned activities?		
Evaluation	Note all source(s) of savings from measure.		
Evaluation	Are M&V activities adequate for all significant savings streams?		
Evaluation	Review Risk & Responsibility Matrix. Does M&V strategy for this measure conform to agreed-upon risk allocation?		