

Planning and Reporting for Operations & Maintenance in Federal Energy Saving Performance Contracts

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1. Introduction and Overview

In Federal Energy Savings Performance Contracts (ESPCs), operation and maintenance (O&M) is critical to maintaining the performance of the installed equipment and to achieving the guaranteed energy savings for the term of the ESPC.

The purpose of this document is to provide guidance on ESPC project development on a) allocating O&M and repair and replacement (R&R) responsibilities; and b) putting in place O&M reporting requirements. The goal is to minimize disagreements between federal agencies and ESCOs over O&M and R&R and to help ensure that savings persist during performance period. Verification of cost savings from O&M changes resulting from ESPCs is not within the scope of this document.

The document is being developed to provide guidance on allocating responsibilities and instituting proper O&M procedures in all ESPCs. In cases where specific examples are necessary, this document refers O&M sections of the Federal Energy Management Program's (FEMP's) contractual and reporting documents, although the concepts are applicable in other Federal ESPC programs as well.

1.1 Overview of O&M Issues in ESPCs

Inadequate O&M of energy-using systems is a major cause of energy waste, often affects system reliability, and can shorten equipment life. Proper O&M practices are a key component in maintaining the desired energy savings from an ESPC and minimizing the chance of unexpected repair and replacement issues arising during the ESPC contract term. Further, unambiguous allocation of responsibility for O&M and R&R issues, including reciprocal reporting requirements for responsible parties, is critical to assuring long-term energy and cost savings.

Either the ESCO or the government (or the government's representative) may perform O&M activities on equipment installed as part of an ESPC. However, the ESCO is ultimately responsible for assuring the performance of new equipment installed as part of the ESPC throughout the duration of the ESPC contract term. The government is typically responsible for existing equipment.

In an ideal scenario, the ESCO will both operate and perform all maintenance activities on equipment installed in an ESPC project. In many cases, however, it is not practical for the ESCO to carry out these activities. Often the site is accustomed to performing O&M, and the cost of reallocating these responsibilities may not be feasible within the ESPC contract term, since services must be paid from savings. Limited site access or other issues can also make government O&M preferable.

A critical factor in the success of an ESPC is to ensure that the O&M plan for new equipment relates well to the O&M approach for existing equipment. This is especially true when new and existing equipment are located in the same facility or when existing equipment has a potential effect on the operation or savings achieved by new equipment. Clear definition of roles and responsibilities for O&M contributes to proper coordination of O&M activities for new and existing equipment and minimizes the chances of customer dissatisfaction, accusations, and potential litigation during the ESPC contract term.

One Illustrative Scenario: Why O&M reporting is important for ESPC Projects

At one ESPC site, a disagreement during the performance period was seriously exacerbated due to the allocation of O&M responsibilities and the lack of reporting required on O&M conducted.

The primary cost-saving measure implemented by the ESCO was an upgrade to the central chiller plant. The ESCO installed one new chiller (out of two), and two new distribution pumps (out of four). The ESCO did not upgrade the existing cooling tower and distribution system. Due to project economics, the site elected to operate and maintain the entire chilled water system, including the new equipment. The ESPC contract did not require the site to document or report O&M activities to the ESCO.

After project acceptance, several problems with the chiller plant arose. In one instance, both chillers went out of service due to high head pressure. The ESCO asserted that the event was due to improper operations and lack of adequate maintenance by site personnel, and had voided the warranty for the new chiller. The site contended that the system was not properly commissioned and had design problems.

Since the site had not maintained any O&M records, they had no foundation to win the dispute. The site's contracting officer was obligated to continue full payments to the ESCO even though systems were not operating properly. After much contention, the ESCO eventually got the system working properly.

Lessons Learned:

- ❑ *O&M documentation on ECMs is essential to minimizing disputes.*
- ❑ *If feasible, have ESCO accept O&M responsibilities.*
- ❑ *Proper commissioning is essential prior to project acceptance.*

1.1.1 Key Issues, Timing, and Available Guidance on O&M in Federal ESPCs

Table 1 provides an overview of the O&M process by listing key O&M topics, the ESPC stage during which it needs to be addressed, and the documents that provide additional information on those topics. The table references documents specific to the FEMP's Super ESPCs and can be adapted to meet the unique contract requirements of different ESPC vehicles, as the issues remain the same.

Table 1 Overview of Key O&M Issues for ESPCs Projects, Their Timing, and Super ESPC Reference Documents

Key O&M Topics	ESPC Stage	Reference Documents ^a
1. Describe overall responsibility for the operation, maintenance, repair, and replacement at the project level.	Initial and Final Proposals	Section 3.b, 3.c, 3.d of the Risk/Responsibility Matrix; Sections C.6, C.7, C.8 of IDIQ
2. Describe responsibility for the operation, maintenance, repair, and replacement of each ECM.	Final Proposal	Sections C.6, C.7, C.8 of IDIQ
3. Define different conditions under which Repair and Replacement (R&R) work will be performed, who will be liable, and the source of funds for performing R&R activities.	Final Proposal	Section C.8 of IDIQ
4. Define reporting requirement for O&M activities and its frequency.	Final Proposal	IDIQ; M&V Plan Outline (Sections 2.4.1, 3.8.8)
5. Submission of the ECM-specific O&M checklists by the ESCO.	Final Proposal	Recommended, but not required by IDIQ contract
6. ESCO provides O&M training and submits the Operations and Maintenance Manual for ECMs including: <ul style="list-style-type: none"> □ New written operations procedures; □ Preventive maintenance work procedures and checklists. 	Project Acceptance	IDIQ Attachment 2: Sample Checklist/Schedule of Post-Award Reporting Requirements and Submittals Sections C.6.3 and C.7.4 of IDIQ
7. Government (or ESCO) periodically reports on maintenance work performed on ECMs.	Performance Period	Section C.7.3 of IDIQ
8. Identification of O&M issues that can adversely affect savings persistence; Steps to be taken to address the issue.	Performance Period	Annual Report (Sections 1.5, 2.5.1, 2.5.2, 2.5.3); Project-specific O&M checklists

^aAll documents referenced in table are detailed in Section 2, “Steps of Managing O&M Responsibilities.”

2. Steps of Managing O&M Responsibilities

Addressing O&M issues in ESPC projects starts at project development and goes through the end of the performance contract. These issues can be addressed in six steps, which are detailed in the following sections:

- Step 1: Allocate overall responsibilities — Develop ESPC contract Risk & Responsibility Matrix

- Step 2: Develop detailed O&M responsibilities and reporting requirements in the contract
- Step 3: Develop project-specific O&M checklists
- Step 4: ESCO assembles O&M manuals and provides training to site staff
- Step 5: Government (or ESCO) periodically reports on maintenance procedures performed (if applicable)
- Step 6: ESCO submits Annual Report on project performance

Step 1: Allocate overall responsibilities — Develop ESPC contract Risk & Responsibility Matrix

Risk & Responsibility Matrix¹ details the risks and responsibilities to be considered when developing performance contracts. This matrix was developed to help identify the important project risks, assess their potential impact, and clarify which party is responsible for managing the risk.

For Super ESPC projects, the Responsibility Matrix is first included in the *Initial Proposal* and is then finalized in the *Final Proposal*. The ESCO will propose an approach for each item, and separate columns are used to differentiate between the proposed approach, the agency's assessment, and the final agreement. The final allocation of responsibilities in the matrix should drive the content of the M&V plan and other contract details.

Key items related to O&M in the Risk & Responsibility Matrix occur in Section 3: Performance, which covers four topics:

- Equipment Performance
- Operations
- Maintenance
- Equipment Repair & Replacement

The ESCO is responsible for the guaranteed savings of the contract and thus ultimately responsible for all items of O&M. The responsibility for hands-on performance of O&M, as shown in Table 2, may be accomplished by the ESCO or the government, or shared.

Table 2 Excerpt from Risk & Responsibility Matrix

3. <u>Performance:</u>
<p>a. <u>Equipment performance:</u> Generally the Contractor has control over the selection of equipment and is responsible for its proper installation, commissioning, and performance. Generally the Contractor has responsibility to demonstrate that the new improvements meet expected performance levels including specified equipment capacity, standards of service, and efficiency. Clarify who is responsible for initial and long-term performance, how it will be verified, and what will be done if performance does not meet expectations.</p>

¹ *ESPC Contract Risk / Responsibility Matrix* is available in the Super ESPC IDIQ contract, FEMP M&V Guidelines V 2.2, available at http://www1.eere.energy.gov/femp/financing/superespcs_espcbasicsp2.html .

<p>b. Operations: Responsibility for operations is negotiable, and it can impact performance. Clarify responsibility for operations, the implication of equipment control, how changes in operating procedures will be handled, and how proper operations will be assured.</p>
<p>c. Maintenance: Responsibility for maintenance is negotiable, and it can impact performance. Clarify how long-term preventive maintenance will be assured, especially if the party responsible for long-term performance is not responsible for maintenance (e.g., Contractor provides maintenance checklist and reporting frequency). Clarify who is responsible for long-term preventive maintenance to maintain operational performance throughout the contract term.</p>
<p>d. Equipment Repair and Replacement: Responsibility for repair and replacement of contractor-installed equipment is negotiable; however, it is often tied to project performance. Clarify who is responsible for replacement of failed components or equipment throughout the term of the contract. Specifically address potential impacts on performance due to equipment failure. Specify expected equipment life and warranties for all installed equipment. Discuss replacement responsibility when equipment life is shorter than the term of the contract. Clarify what will be done if inadequate repair or replacement impact performance.</p>

An article, *Super ESPC Best Practices: Fine-Tuning for Best-Value Super ESPCs Using the Risk/Responsibility Matrix*,² provides a good overview on how to use the Risk/Responsibility Matrix to allocate and manage risks for different elements of Super ESPCs including O&M.

Step 2: Develop detailed O&M responsibilities and reporting requirements in the contract

In Step 1, the ESCO and Government agreed upon O&M-related responsibilities in the Risk & Responsibility Matrix. This allocation of responsibilities must be realized throughout the details in the ESPC contract. For Super ESPC projects, the allocation of O&M responsibilities is in the Site Management Plan, and O&M reporting requirements are defined in the M&V Plan. Ensuring that all related items are appropriately defined requires careful contract development and review.

These allocations of responsibility in the matrix should drive the content of the M&V plan and other contract details. The content provided in the *Super ESPC IDIQ* and the *M&V Plan and Savings Calculation Outline* is intended to help facilitate defining the details related to O&M for each project and each ECM. Contractually, the ESCO is responsible for the overall O&M activities related to new equipment. Financial, security, or other factors may cause the government to decide to accept responsibility for conducting the O&M activities.

When the government elects to perform O&M activities on new equipment, the following issues will require careful review because the government may be required to compensate ESCO for taking over the O&M activities if inadequate O&M threatens the realization of savings, equipment reliability, or equipment life:

² Article is available at www.eere.energy.gov/femp/financing/superespcs_mvresources.html.

- Provisions for ESCO to monitor government performance of O&M
- Specific O&M record keeping / reporting requirements by government
- Procedures for ESCO review / verification of O&M records
- Impact of O&M of old equipment on new equipment
- Criteria for ESCO to take over operations
- Criteria for ESCO to take over maintenance (prior to equipment failure)
- How ESCO would get paid for performing government's activities

The Super ESPC M&V Plan Outline calls for the detailed information to be provided on the overall project as well as for each ECM, as shown in Table 3.

Table 3 – Excerpt from M&V Plan & Savings Calculations Outline³

From Whole-Project Data / Global Assumptions	
2.4	Operations, Preventive Maintenance, Repair, and Replacement Reporting Requirements
2.4.1	Define Government and ESCO reporting requirements: <ul style="list-style-type: none"> ▪ 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.
From ECM-Specific M&V Plan (for each ECM)	
3.7.8	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.

Step 3: Develop project-specific O&M checklists

Developing comprehensive O&M checklists that are consistent with the O&M manual is an excellent way to maximize the performance of installed equipment and assure savings persistence over the term of the ESPC contract. Although checklists are not

³ From Attachment 7 of IDIQ document and available from www.eere.energy.gov/femp/financing/superespcs_mvresources.html.

always required in the contract, it is a good idea to develop one for those ECMs that may have extensive preventive maintenance requirements and/or where O&M responsibilities may be distributed. Checklists not only provide a good way for ensuring that routine O&M activities are being performed on time but also provide an effective method of documenting and tracking distributed responsibilities.

Typically, the ESCO will develop an O&M checklist listing specific O&M tasks, their frequency, and the party responsible for carrying them out. For O&M checklists to be effective, both the ESCO and the agency must agree on them and be committed to performing the O&M tasks on time. For this reason it is recommended that the O&M checklists should be submitted as part of the Final Proposal. If including finalized checklists is not reasonable, preliminary checklists indicative of the final scope of work should be included.

Table 4 is an example of an O&M checklist for a chiller (*FEMP O&M Best Practices Guide, 2003*), although it is not as detailed as would be needed for use on a specific project. While the exact content of checklists may vary, the intent and the rationale for developing them will remain the same. Apart from the chiller, the O&M Best Practices Guide has standard O&M checklists for lighting, fans, pumps, electric motors, air compressors, cooling towers, steam traps, and building control systems⁴. These checklists are a practical starting point for creating customized O&M documents.

⁴Excerpted checklists are available at <http://www.dc.lbl.gov/federal-espc/working-groups/OM/Equipment-O&M-Checklists.xls>

Table 4 – Example Chiller Checklist – Adapted from *FEMP O&M Best Practices Guide*

Description	Comments	Organization responsible for the activity	Maintenance performed (Yes/No/NA)	Date performed
Chiller use/sequencing	Turn off/sequence unnecessary chillers			
Check on/off chiller controls	Check that proper setting is maintained			
Overall visual inspection	Complete overall visual inspection to be sure all equipment is operating and safety systems are in place			
Check setpoints	Check all setpoints for proper setting and function			
Weekly Operation & Maintenance Tasks for Chillers				
Evaporator and condenser coil fouling	Assess evaporator and condenser coil fouling as required			
Compressor motor temperature	Check temperature per manufacturer's specifications			
Perform water quality test	Check water quality for proper chemical balance			
Leak testing	Conduct leak testing on all compressor fittings, oil pump joints and fittings, and relief valves			
Check all insulation	Check insulation for condition and appropriateness			
Control operation	Verify proper control function including: <ul style="list-style-type: none"> • Hot gas bypass • Liquid injection 			
Semi-Annual Operation & Maintenance Tasks for Chillers				
Check vane control settings	Check settings per manufacturer's specifications			
Verify motor load limit control	Check settings per manufacturer's specifications			
Verify load balance operation	Check settings per manufacturer's specifications			
Check chilled water reset settings and function	Check settings per manufacturer's specifications			

Annual Operation & Maintenance Tasks for Chillers				
Check chiller lockout setpoint	Check settings per manufacturer's specifications			
Clean condenser tubes	Clean tubes at least annually as part of shutdown procedure			
Eddy current test condenser tubes	As required, conduct eddy current test to assess tube wall thickness			
Clean evaporator tubes	Clean tubes at least annually as part of shutdown procedure			
Eddy current test evaporator tubes	As required, conduct eddy current test to assess tube wall thickness			
Compressor motor and assembly	<ul style="list-style-type: none"> • Check all alignments to specification • Check all seals, provide lubrication where necessary 			
Compressor oil system	<ul style="list-style-type: none"> • Conduct analysis on oil and filter • Change as required • Check oil pump and seals • Check oil heater and thermostat • Check all strainers, valves, etc. 			
Electrical connections	Check all electrical connections/terminals for contact and tightness			
Water flows	Assess proper water flow in evaporator and condenser			
Check refrigerant level and condition	Add refrigerant as required. Record amounts and address leakage issues.			

Step 4: ESCO assembles O&M manuals and provides training to site staff

ESCOs prepare the O&M manuals that are the basis for proper O&M of installed equipment. It is the government's responsibility to check the O&M manuals submitted by the ESCO and ensure that they meet the requirements specified in the contract and are adequate for government records. Further, there should be no ambiguity or inconsistency in how the responsibilities of the two parties are detailed in the O&M manual. The ESCO is responsible for providing training to the facility staff on operating and maintaining the equipment.

Generally, O&M manuals (DOE 2004, ASHRAE 1993, 1996) should include:

- A master list of equipment, including building and location. For each piece of major equipment, include:
 - a. **Names and contact information** for the equipment reps, vendors or manufacturers
 - b. **Model and size and its location** in the campus/building.
 - c. **Operating instructions** in a condensed format, suitable for posting near the equipment. This should include:
 - i. Starting up the equipment/system.
 - ii. Shutting down the equipment/system.
 - iii. Operating the equipment in emergency or unusual conditions.
 - iv. Safety precautions.
 - v. Trouble shooting suggestions.
 - d. **Preventive maintenance instructions** in a condensed format, suitable for posting near the equipment. This should include but not limited to:
 - i. Maintenance and overhaul instructions
 - ii. Lubricating schedule including type, grade, temperature, and frequency range.
 - e. **Checklist** that will be used as the basis for performing the O&M procedures. Preventive maintenance actions shall preferably be categorized by the following recommended frequencies:
 - i. Weekly
 - ii. Monthly
 - iii. Quarterly
 - iv. Semi-annually
 - v. Annual
 - vi. Other
- **List procedures** that must be followed while operating equipment

Step 5: Government (or ESCO) periodically reports on maintenance procedures performed (if applicable)

Since the ESCO is responsible for the performance of new equipment for the term of the contract, it is often appropriate for the government to document the completion of O&M procedures. The O&M checklists developed in Step 3 should be used to record these activities.

Although the ESCO is required to submit annual reports that include a summary of O&M

activities, described below in Step 6, there are instances when additional reporting on O&M may be required. These reporting requirements were identified in Step 2 and should be included in the M&V plan in the contract.

Step 6: ESCO submits Annual Report on project performance

A minimum of annual performance reporting is required for Super ESPC projects. The Annual Report Outline provides sufficient O&M reporting provisions for most ECMs. These requirements should be reviewed during contract development. The portions related to O&M in Annual Report Outline are detailed in Table 5.

This step will only provide value if appropriate actions are taken to address issues that are identified during the performance period. Following up on problems identified in the Annual Report is an important key to savings persistence.

Table 5 Excerpts from Annual Report Outline⁵

1. Executive Summary	
1.5 Performance and O&M Issues	<ul style="list-style-type: none"> ▪ Note impact of operating deficiencies or enhancements on generation of savings ▪ Note impact of maintenance deficiencies on generation of savings ▪ Detail any deficiencies needed to be addressed by ESCO or Government
2. Details for ECM	
2.5 O&M and Other Activities	
2.5.1 Operating requirements:	<ul style="list-style-type: none"> ▪ State organization(s) responsible for equipment operations. If appropriate, detail how responsibilities are shared. ▪ Summarize key operating procedures and any related verification activities. ▪ Detail any deficiencies needed to be addressed by ESCO or Government ▪ Note impact of operating deficiencies or enhancements on generation of savings
2.5.2 Preventive maintenance requirements:	<ul style="list-style-type: none"> ▪ State organization(s) responsible for performing maintenance. If appropriate, detail how responsibilities are shared. ▪ Verification of scheduled maintenance items completed by ESCO or Government ▪ Detail any deficiencies needed to be addressed by ESCO or Government ▪ Note impact of maintenance deficiencies on generation of savings
2.5.3 Repair & replacement requirements:	<ul style="list-style-type: none"> ▪ State organization(s) responsible for repair and replacement. If appropriate, detail how responsibilities are shared. ▪ Summary of activities conducted this period by ESCO or Government ▪ Detail any deficiencies needed to be addressed by ESCO or Government ▪ Note impact of equipment deficiencies on generation of savings

⁵ From Attachment 7 of IDIQ document and available from www.eere.energy.gov/femp/financing/superespcs_mvresources.html.

3. Reference Documents

- US Department of Energy's Federal Energy Management Program *O&M Best Practices Guide*,
http://www.eere.energy.gov/femp/operations_maintenance/om_best_practices_guidebook.cfm.
- *ASHRAE Guideline 4: Preparation of Operating and Maintenance Documentation for Building Systems*. Atlanta, GA: ASHRAE, 1993.
- *ASHRAE Guideline 1: The HVAC Commissioning Process*. Atlanta, GA: ASHRAE, 1996.
- US Department of Energy's Federal Energy Management Program *Super ESPC Contract Risk / Responsibility Matrix* is available at
http://www1.eere.energy.gov/femp/financing/superespcs_espcbasicsp2.html or
http://www1.eere.energy.gov/femp/docs/r_r_matrix.doc.
- US Department of Energy's Federal Energy Management Program *Super ESPC Best Practices: Fine-Tuning for Best-Value Super ESPCs Using the Risk/Responsibility Matrix*.
http://www1.eere.energy.gov/femp/pdfs/espc_quickstudy.pdf.
- *US Department of Energy Super ESPC Regional IDIQ Contract*,
http://www1.eere.energy.gov/femp/financing/superespcs_espcbasics.html.