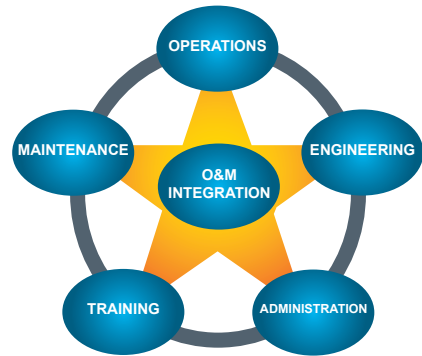

Chapter 3 O&M Management

3.1 Introduction

O&M management is a critical component of the overall program. The management function should bind the distinct parts of the program into a cohesive entity. From our experience, the overall program should contain five very distinct functions making up the organization: **Operations**, **Maintenance**, **Engineering**, **Training**, and **Administration**—OMETA.

Beyond establishing and facilitating the OMETA links, O&M managers have the responsibility of interfacing with other department managers and making their case for ever-shrinking budgets. Their roles also include project implementation functions as well as the need to maintain persistence of the program and its goals.



3.2 Developing the Structure

Five well-defined elements of an effective O&M program include those presented above in the OMETA concept (Meador 1995). While these elements, Operations, Maintenance, Engineering, Training, and Administration, form the basis for a solid O&M organization, the key lies in the well-defined functions each brings and the linkages between organizations. A subset of the roles and responsibilities for each of the elements is presented below; further information is found in Meador (1995).

Operations

- **Administration** – To ensure effective implementation and control of operation activities.
- **Conduct of Operations** – To ensure efficient, safe, and reliable process operations.
- **Equipment Status Control** – To be cognizant of status of all equipment.
- **Operator Knowledge and Performance** – To ensure that operator knowledge and performance will support safe and reliable plant operation.

Maintenance

- **Administration** – To ensure effective implementation and control of maintenance activities.
- **Work Control System** – To control the performance of maintenance in an efficient and safe manner such that economical, safe, and reliable plant operation is optimized.
- **Conduct of Maintenance** – To conduct maintenance in a safe and efficient manner.
- **Preventive Maintenance** – To contribute to optimum performance and reliability of plant systems and equipment.

- **Maintenance Procedures and Documentation** – To provide directions, when appropriate, for the performance of work and to ensure that maintenance is performed safely and efficiently.

Engineering Support

- **Engineering Support Organization and Administration** – To ensure effective implementation and control of technical support.
- **Equipment Modifications** – To ensure proper design, review, control, implementation, and documentation of equipment design changes in a timely manner.
- **Equipment Performance Monitoring** – To perform monitoring activities that optimize equipment reliability and efficiency.
- **Engineering Support Procedures and Documentation** – To ensure that engineer support procedures and documents provide appropriate direction and that they support the efficiency and safe operations of the equipment.

Training

- **Administration** – To ensure effective implementation and control of training activities.
- **General Employee Training** – To ensure that plant personnel have a basic understanding of their responsibilities and safe work practices and have the knowledge and practical abilities necessary to operate the plant safely and reliably.
- **Training Facilities and Equipment** – To ensure the training facilities, equipment, and materials effectively support training activities.
- **Operator Training** – To develop and improve the knowledge and skills necessary to perform assigned job functions.
- **Maintenance Training** – To develop and improve the knowledge and skills necessary to perform assigned job functions.

Administration

- **Organization and Administration** – To establish and ensure effective implementation of policies and the planning and control of equipment activities.
- **Management Objectives** – To formulate and utilize formal management objectives to improve equipment performance.
- **Management Assessment** – To monitor and assess station activities to improve all aspects of equipment performance.
- **Personnel Planning and Qualification** – To ensure that positions are filled with highly qualified individuals.
- **Industrial Safety** – To achieve a high degree of personnel and public safety.

3.3 Obtain Management Support

Federal O&M managers need to obtain full support from their management structure in order to carry out an effective maintenance program. A good way to start is by establishing a written maintenance plan and obtaining upper management approval. Such a management-supported program is very important because it allows necessary activities to be scheduled with the same priority as other management actions. Approaching O&M by equating it with increased productivity, energy efficiency, safety, and customer satisfaction is one way to gain management attention and support.

Management reports should not assign blame for poor maintenance and inefficient systems, but rather to motivate efficiency improvement through improved maintenance.

When designing management reports, the critical metrics used by each system should be compared to a base period. For example, compare monthly energy use against the same month for the prior year, or against the same month in a particular base year (for example, 1985). If efficiency standards for a particular system are available, compare your system's performance against that standard as well. Management reports should not assign blame for poor maintenance and inefficient systems, but rather to motivate efficiency improvement through improved maintenance.

3.3.1 The O&M Mission Statement

Another useful approach in soliciting management buy-in and support is the development an O&M mission statement. The mission statement does not have to be elaborate or detailed. The main objective is to align the program goals with those of site management and to seek approval, recognition, and continued support. Typical mission statements set out to answer critical questions – a sample is provided below:

- *Who are we as an organization* – specifically, the internal relationship?
- *Whom do we serve* – specifically, who are the customers?
- *What do we do* – specifically, what activities make up day-to-day actions?
- *How do we do it* – specifically, what are the beliefs and values by which we operate?
- *Finally, how do we measure success* – what metrics do we use, (e.g., energy/water efficiency, safety, dollar savings, etc.?)

A critical element in mission statement development is involvement of upper management and facility staff alike. Once involved with the development, there will be “ownership” which can lead to compliance (facility staff) and support (management).

3.4 Measuring the Quality of Your O&M Program

Traditional thinking in the O&M field focused on a single metric, reliability, for program evaluation. Every O&M manager wants a reliable facility; however, this metric alone is not enough to evaluate or build a successful O&M program.

Beyond reliability, O&M managers need to be responsible for controlling costs, evaluating and implementing new technologies, tracking and reporting on health and safety issues, and expanding their program. To support these activities, the O&M manager must be aware of the various indicators that can be used to measure the quality or effectiveness of the O&M program. Not only are these metrics useful in assessing effectiveness, but also useful in cost justification of equipment purchases, program modifications, and staff hiring.

Below are a number of metrics that can be used to evaluate an O&M program. Not all of these metrics can be used in all situations; however, a program should use of as many metrics as possible to better define deficiencies and, most importantly, publicize successes.

- **Capacity factor** – Relates actual plant or equipment operation to the full-capacity operation of the plant or equipment. This is a measure of actual operation compared to full-utilization operation.
- **Work orders generated/closed out** – Tracking of work orders generated and completed (closed out) over time allows the manager to better understand workloads and better schedule staff.
- **Backlog of corrective maintenance** – An indicator of workload issues and effectiveness of preventive/predictive maintenance programs.
- **Safety record** – Commonly tracked either by number of loss-of-time incidents or total number of reportable incidents. Useful in getting an overall safety picture.
- **Energy use** – A key indicator of equipment performance, level of efficiency achieved, and possible degradation.
- **Inventory control** – An accurate accounting of spare parts can be an important element in controlling costs. A monthly reconciliation of inventory “on the books” and “on the shelves” can provide a good measure of your cost control practices.
- **Overtime worked** – Weekly or monthly hours of overtime worked has workload, scheduling, and economic implications.
- **Environmental record** – Tracking of discharge levels (air and water) and non-compliance situations.
- **Absentee rate** – A high or varying absentee rate can be a signal of low worker morale and should be tracked. In addition, a high absentee rate can have a significant economic impact.
- **Staff turnover** – High turnover rates are also a sign of low worker morale. Significant costs are incurred in the hiring and training of new staff. Other costs include those associated with errors made by newly hired personnel that normally would not have been made by experienced staff.

While some metrics are easier to quantify than others, Table 3.1.1 below can serve as a guide for tracking and trending metrics against industry benchmarks (NASA 2000).

Table 3.1.1. Industry O&M metrics and benchmarks

Metric	Variables and Equation	Benchmark
Equipment Availability	$\% = \frac{\text{Hours each unit is available to run at capacity}}{\text{Total hours during the reporting time period}}$	> 95%
Schedule Compliance	$\% = \frac{\text{Total hours worked on scheduled jobs}}{\text{Total hours scheduled}}$	> 90%
Emergency Maintenance Percentage	$\% = \frac{\text{Total hours worked on emergency jobs}}{\text{Total hours worked}}$	< 10%
Maintenance Overtime Percentage	$\% = \frac{\text{Total maintenance overtime during period}}{\text{Total regular maintenance hour during period}}$	< 5%
Preventive Maintenance Completion Percentage	$\% = \frac{\text{Preventive maintenance actions completed}}{\text{Preventive maintenance actions scheduled}}$	> 90%
Preventive Maintenance Budget/Cost	$\% = \frac{\text{Preventive maintenance cost}}{\text{Total maintenance cost}}$	15% – 18%
Predictive Maintenance Budget/Cost	$\% = \frac{\text{Preventive maintenance cost}}{\text{Total maintenance cost}}$	10% – 12%

3.5 Selling O&M to Management

To successfully interest management in O&M activities, O&M managers need to be fluent in the language spoken by management. Projects and proposals brought forth to management need to stand on their own merits and be competitive with other funding requests. While evaluation criteria may differ, generally some level of economic criteria will be used. O&M managers need to have a working knowledge of economic metrics such as:

- **Simple payback** – The ratio of total installed cost to first-year savings.
- **Return on investment** – The ratio of the income or savings generated to the overall investment.
- **Net present value** – Represents the present worth of future cash flows minus the initial cost of the project.
- **Life-cycle cost** – The present worth of all costs associated with a project.

Life-Cycle Cost Training

Take advantage of LCC workshops offered by FEMP. Each year, FEMP conducts a 2-hour televised workshop on life-cycle cost methods and the use of BLCC (Building Life-Cycle Cost) software programs. In some years, two-day classroom workshops are offered at various U.S. locations.

More information can be found at: <http://www1.eere.energy.gov/femp/program/lifecycle.html>

FEMP offers life-cycle cost training along with its Building Life-Cycle Cost (BLCC) computer program at various locations during the year – see Appendix B for the FEMP training contacts.

3.6 Program Implementation

Developing or enhancing an O&M program requires patience and persistence. Guidelines for initiating a new O&M project will vary with agency and management situation; however, some steps to consider are presented below:

- **Start small** – Choose a project that is manageable and can be completed in a short period of time, 6 months to 1 year.
- **Select troubled equipment** – Choose a project that has visibility because of a problematic history.
- **Minimize risk** – Choose a project that will provide immediate and positive results. This project needs to be successful, and therefore, the risk of failure should be minimal.
- **Keep accurate records** – This project needs to stand on its own merits. Accurate, if not conservative, records are critical to compare before and after results.
- **Tout the success** – When you are successful, this needs to be shared with those involved and with management. Consider developing a “wall of accomplishment” and locate it in a place where management will take notice.
- **Build off this success** – Generate the success, acknowledge those involved, publicize it, and then request more money/time/resources for the next project.

3.7 Program Persistence

A healthy O&M program is growing, not always in staff but in responsibility, capability, and accomplishment. O&M management must be vigilant in highlighting the capabilities and accomplishments of their O&M staff.

Finally, to be sustainable, an O&M program must be visible beyond the O&M management. Persistence in facilitating the OMETA linkages and relationships enables heightened visibility of the O&M program within other organizations.

3.8 O&M Contracting

Approximately 40% of all non-residential buildings contract maintenance service for heating, ventilation, and air conditioning (HVAC) equipment (PECI 1997). Discussions with Federal building managers and organizations indicate this value is significantly higher in the Federal sector, and the trend is toward increased reliance on contracted services.

In the O&M service industry, there is a wide variety of service contract types ranging from full-coverage contracts to individual equipment contracts to simple inspection contracts. In a relatively new type of O&M contract, called End-Use or End-Result contracting, the O&M contractor not only takes over all operation of the equipment, but also all operational risk. In this case, the contractor agrees to provide a certain level of comfort (space temperature, for instance) and then is compensated based on how well this is achieved.

From discussions with Federal sector O&M personnel, the predominant contract type is the full-coverage contract (also referred to as the whole-building contract). Typical full-coverage contract terms vary between 1 and 5 years and usually include options for out-years.

Upon review of several sample O&M contracts used in the Federal sector, it is clear that some degree of standardization has taken place. For better or worse, some of these contracts contain a high degree of “boiler plate.” While this can make the contract very easy to implement, and somewhat uniform across government agencies, the lack of site specificity can make the contract ambiguous and open to contractor interpretation often to the government’s disadvantage.

When considering the use of an O&M contract, it is important that a plan be developed to select, contract with, and manage this contract. In its guide, titled *Operation and Maintenance Service Contracts* (PECI 1997), Portland Energy Conservation, Inc. did a particularly good job in presenting steps and actions to think about when considering an O&M contract. A summary of these steps are provided below.

Steps to Think About When Considering an O&M Contract

- Develop objectives for an O&M service contract, such as:
 - Provide maximum comfort for building occupants.
 - Improve operating efficiency of mechanical plant (boilers, chillers, cooling towers, etc.).
 - Apply preventive maintenance procedures to reduce chances of premature equipment failures.
 - Provide for periodic inspection of building systems to avoid emergency breakdown situations.
- Develop and apply a screening process. The screening process involves developing a series of questions specific to your site and expectations. The same set of questions should be asked to prospective contractors and their responses should be rated.
- Select two to four potential contractors and obtain initial proposals based on each contractor’s building assessments. During the contractors’ assessment process, communicate the objectives and expectations for the O&M service contract and allow each contractor to study the building documentation.
- Develop the major contract requirements using the contractors’ initial proposals. Make sure to include the requirements for documentation and reporting. Contract requirements may also be developed by competent in-house staff or a third party.
- Obtain final bids from the potential contractors based on the owner-developed requirements.
- Select the contractor and develop the final contract language and service plan.
- Manage and oversee the contracts and documentation.
 - Periodically review the entire contract. Build in a feedback process.

The ability of Federal agencies to adopt the PECI-recommended steps will vary. Still, these steps do provide a number of good ideas that should be considered for incorporation into Federal maintenance contracts procurements.

3.8.1 O&M Contract Types

There are four predominant types of O&M contracts. These are: **full coverage** contracts, **full-labor** contracts, **preventive-maintenance** contracts, and **inspection** contracts. Each type of contract is discussed below (PECI 1997).

Full-Coverage Service Contract. A full-coverage service contract provides 100% coverage of labor, parts, and materials as well as emergency service. Owners may purchase this type of contract for all of their building equipment or for only the most critical equipment, depending on their needs. This type of contract should always include comprehensive preventive maintenance for the covered equipment and systems. If it is not already included in the contract, for an additional fee the owner can purchase repair and replacement coverage (sometimes called a “breakdown” insurance policy) for the covered equipment. This makes the contractor completely responsible for the equipment. When repair and replacement coverage is part of the agreement, it is to the contractor’s advantage to perform rigorous preventive maintenance on schedule, since he or she must replace the equipment if it fails prematurely.

Full-coverage contracts are usually the most comprehensive and the most expensive type of agreement in the short term. In the long term, however, such a contract may prove to be the most cost-effective, depending on the owner’s overall O&M objectives. Major advantages of full-coverage contracts are ease of budgeting and the fact that most if not all of the risk is carried by the contractor. However, if the contractor is not reputable or underestimates the requirements of the equipment to be insured, the contractor may do only enough preventive maintenance to keep the equipment barely running until the end of the contract period. Also, if a company underbids the work in order to win the contract, the company may attempt to break the contract early if it foresees a high probability of one or more catastrophic failures occurring before the end of the contract.

Full-Labor Service Contract. A full-labor service contract covers 100% of the labor to repair, replace, and maintain most mechanical equipment. The owner is required to purchase all equipment and parts. Although preventive maintenance and operation may be part of the agreement, actual installation of major plant equipment such as a centrifugal chillers, boilers, and large air compressors is typically excluded from the contract. Risk and warranty issues usually preclude anyone but the manufacturer installing these types of equipment. Methods of dealing with emergency calls may also vary. The cost of emergency calls may be factored into the original contract, or the contractor may agree to respond to an emergency within a set number of hours with the owner paying for the emergency labor as a separate item. Some preventive maintenance services are often included in the agreement along with minor materials such as belts, grease, and filters.

This is the second most expensive contract regarding short-term impact on the maintenance budget. This type of contract is usually advantageous only for owners of very large buildings or multiple properties who can buy in bulk and therefore obtain equipment, parts, and materials at reduced cost. For owners of small to medium-size buildings, cost control and budgeting becomes more complicated with this type of contract, in which labor is the only constant. Because they are responsible only for providing labor, the contractor’s risk is less with this type of contract than with a full-coverage contract.

Preventive-Maintenance Service Contract. The preventive-maintenance (PM) contract is generally purchased for a fixed fee and includes a number of scheduled and rigorous activities such as changing belts and filters, cleaning indoor and outdoor coils, lubricating motors and bearings, cleaning and maintaining cooling towers, testing control functions and calibration, and painting for corrosion control. Generally the contractor provides the materials as part of the contract. This type contract is popular with owners and is widely sold. The contract may or may not include arrangements regarding repairs or emergency calls.

The main advantage of this type of contract is that it is initially less expensive than either the full-service or full-labor contract and provides the owner with an agreement that focuses on quality preventive maintenance. However, budgeting and cost control regarding emergencies, repairs, and replacements is more difficult because these activities are often done on a time-and-materials basis. With this type of contract the owner takes on most of the risk. Without a clear understanding of PM requirements, an owner could end up with a contract that provides either too much or too little. For example, if the building is in a particularly dirty environment, the outdoor cooling coils may need to be cleaned two or three times during the cooling season instead of just once at the beginning of the season. It is important to understand how much preventive maintenance is enough to realize the full benefit of this type of contract.

Inspection Service Contract. An inspection contract, also known in the industry as a “fly-by” contract, is purchased by the owner for a fixed annual fee and includes a fixed number of periodic inspections. Inspection activities are much less rigorous than preventive maintenance. Simple tasks such as changing a dirty filter or replacing a broken belt are performed routinely, but for the most part inspection means looking to see if anything is broken or is about to break and reporting it to the owner. The contract may or may not require that a limited number of materials (belts, grease, filters, etc.) be provided by the contractor, and it may or may not include an agreement regarding other service or emergency calls.

In the short-term perspective, this is the least expensive type of contract. It may also be the least effective—it’s not always a moneymaker for the contractor but is viewed as a way to maintain a relationship with the customer. A contractor who has this “foot in the door” arrangement is more likely to be called when a breakdown or emergency occurs. The contractor can then bill on a time-and-materials basis. Low cost is the main advantage to this contract, which is most appropriate for smaller buildings with simple mechanical systems.

3.8.2 Contract Incentives

An approach targeting energy savings through mechanical/electrical (energy consuming) O&M contracts is called contract incentives. This approach rewards contractors for energy savings realized for completing actions that are over and above the stated contract requirements.

Many contracts for O&M of Federal building mechanical/electrical (energy consuming) systems are written in a prescriptive format where the contractor is required to complete specifically noted actions in order to satisfy the contract terms. There are two significant shortcomings to this approach:

- The contractor is required to complete only those actions specifically called out, but is not responsible for actions not included in the contract even if these actions can save energy, improve building operations, extend equipment life, and be accomplished with minimal additional effort. Also, this approach assumes that the building equipment and maintenance lists are complete.

- The burden to verifying successful completion of work under the contract rests with the contracting officer. While contracts typically contain contractor reporting requirements and methods to randomly verify work completion, building O&M contracts tend to be very large, complex, and difficult to enforce.

One possible method to address these shortcomings is to apply a provision of the Federal Acquisition Regulations (FAR), Subpart 16.404 – Fixed-Price with Award Fees, which allows for contractors to receive a portion of the savings realized from actions initiated on their part that are seen as additional to the original contract:

Subpart 16.404 — Fixed-Price Contracts With Award Fees.

- (a) Award-fee provisions may be used in fixed-price contracts when the government wishes to motivate a contractor and other incentives cannot be used because contractor performance cannot be measured objectively. Such contracts shall —
 - (1) Establish a fixed price (including normal profit) for the effort. This price will be paid for satisfactory contract performance. Award fee earned (if any) will be paid in addition to that fixed price; and
 - (2) Provide for periodic evaluation of the contractor's performance against an award-fee plan.
- (b) A solicitation contemplating award of a fixed-price contract with award fee shall not be issued unless the following conditions exist:
 - (1) The administrative costs of conducting award-fee evaluations are not expected to exceed the expected benefits;
 - (2) Procedures have been established for conducting the award-fee evaluation;
 - (3) The award-fee board has been established; and
 - (4) An individual above the level of the contracting officer approved the fixed-price-award-fee incentive.

Applying this approach to building mechanical systems O&M contracts, contractor initiated measures would be limited to those that

- require little or no capital investment,
- can recoup implementation costs over the remaining current term, and
- allow results to be verified or agreed upon by the government and the contractor.

Under this approach, the contractor bears the risk associated with recovering any investment and a portion of the savings.

In the past, The General Services Administration (GSA) has inserted into some of its mechanical services contracts a voluntary provision titled Energy Conservation Award Fee (ECAAF), which allows contractors and sites to pursue such an approach for O&M savings incentives. The ECAAF model language provides for the following:

An energy use baseline will be furnished upon request and be provided by the government to the contractor. The baseline will show the 3-year rolling monthly average electric and natural gas use prior to contract award.

- The government will calculate the monthly electric savings as the difference between the monthly energy bill and the corresponding baseline period.
- The ECAF will be calculated by multiplying the energy savings by the monthly average cost per kilowatt-hour of electricity.
- All other contract provisions must be satisfied to qualify for award.
- The government can adjust the ECAF for operational factors affecting energy use such as fluctuations in occupant density, building use changes, and when major equipment is not operational.

Individual sites are able to adapt the model GSA language to best suit their needs (e.g., including natural gas savings incentives). Other agencies are free to adopt this approach as well since the provisions of the FAR apply across the Federal Government.

Energy savings opportunities will vary by building and by the structure of the contract incentives arrangement. Some questions to address when developing a site specific incentives plan are:

- Will metered data be required or can energy savings be stipulated?
- Are buildings metered individually for energy use or do multiple buildings share a master meter?
- Will the baseline be fixed for the duration of the contract or will the baseline reset during the contract period?
- What energy savings are eligible for performance incentives? Are water savings also eligible for performance incentives?
- What administrative process will be used to monitor work and determine savings? Note that overly rigorous submittal, approval, justification, and calculation processes will discourage contractor participation.

Since the contract incentives approach is best suited for low cost, quick-payback measures, O&M contractors should consider recommissioning/value recommissioning actions as discussed in Chapter 7.

An added benefit from the contract incentives process is that resulting operations and energy efficiency improvements can be incorporated into the O&M services contract during the next contract renewal or re-competition since (a) the needed actions are now identified, and (b) the value of the actions is known to the government.

3.9 O&M: The ESPC Perspective

With the prevalence of Energy Savings Performance Contracts (ESPCs) in the Federal sector, some guidance should be offered from the O&M perspective. This guidance takes two forms. First, the need for high-quality and persistent O&M for ESPC projects to assure savings are met. Second, the opportunities O&M provides for enhanced efficiency of new and existing equipment and systems.

3.9.1 O&M Needs for Verified and Persistent Savings (LBNL 2005)

In Federal ESPCs, proper O&M is critical to the maintaining the performance of the installed equipment and to the achievement (and persistence) of the guaranteed energy savings for the term of the ESPC.

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, to ensure long-term energy and cost savings, unambiguous allocation of responsibility for O&M and repair and replacement (R&R) issues, including reciprocal reporting requirements for responsible parties, are vital to the success of an ESPC.

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 ensuring 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.

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 ECM 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.

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. In other instances, limited site access or other issues may 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 contribute toward proper coordination of O&M activities for new and existing equipment. In doing so, the chance of customer dissatisfaction, accusations and potential litigation during the ESPC contract term are minimized.

From the ESPC perspective, Table 3.2.2 below presents an overview of the key O&M issues, the timing or stage in the process which it needs to be addressed and the relevant supporting documents for more information. All listed documents can be found on the FEMP ESPC web site at:

<http://www1.eere.energy.gov/femp/financing/espcs.html>.

Table 3.2.2. Overview of key O&M issues, timing, and supporting documents

Key O&M Topics	ESPC Stage	Reference Documents
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 & 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

3.9.2 Determination and Verification of O&M Savings in ESPCs

O&M and other energy-related cost savings are allowable in Federal ESPCs, and are defined as reduction in expenses (other than energy cost savings) related to energy and water consuming equipment. In fact, an analysis of annual measurement and verification (M&V) reports from 100 ongoing Super ESPC projects showed that 21% of the reported savings were due to reductions in O&M costs (LBNL 2007). These energy-related cost savings, which can also include savings on R&R costs, can constitute a substantial portion of a project's savings, yet O&M and R&R cost savings are often not as diligently verified or reviewed as energy savings.

10 CFR § 436.31. Energy cost savings means a reduction in the cost of energy and related operation and maintenance expenses, from a base cost established through a methodology set forth in an energy savings performance contract, utilized in an existing Federally owned building or buildings or other Federally owned facilities as a result of—(1) The lease or purchase of operating equipment, improvements, altered operation and maintenance, or technical services...

Source: Title 10, Code of Federal regulation part 436 Subpart B – Methods and Procedures for Energy Savings Performance Contracting.

Energy-related cost savings can result from avoided expenditures for operations, maintenance, equipment repair, or equipment replacement due to the ESPC project. This includes capital funds for projects (e.g., equipment replacement) that, because of the ESPC project, will not be necessary. Sources of energy-related savings include:

- Avoided current or planned capital expense,
- Transfer of responsibility for O&M and/or R&R to the ESCO, and
- Avoided renovation, renewal, or repair costs as a result of replacing old and unreliable equipment.

Methods for estimating O&M savings resulting from changes to equipment have not been developed for the FEMP or IPMVP M&V Guidelines. However, the general rule to follow is that any savings claimed from O&M activities must result in a real decrease in expenditures. O&M budget baselines cannot be based on what the agency *should* be spending for proper O&M; baseline expenditures must be based on what the agency is spending. The agency's O&M expenditures after implementation need to decrease for savings to be considered real.

Determining the appropriate level of effort to invest in the M&V of energy-related cost saving is the same as for energy cost savings: The level of M&V rigor will vary according to (a) the value of the project and its expected benefits, and (b) the risk in not achieving the benefits. A graded approach towards measuring and verifying O&M and R&R savings is advised. There is one primary method for calculating O&M savings, which is detailed below.

The most common approach for calculating energy-related cost savings involves the same concepts as those used for determining energy savings: Performance-period labor and equipment costs are subtracted from adjusted baseline values, as shown in the equation below.

$$\text{O\&M Cost Savings} = [\text{Adjusted Baseline O\&M Costs}] - [\text{Actual O\&M Costs}]$$

This method is appropriate for most projects, and is especially simple to apply to those that include elimination of a maintenance contract or reduction in government staff. For other projects, costs for replacement parts can often be determined from purchase records and averaged to arrive at an annual baseline value. Labor costs for particular services may be more difficult to quantify since service records may not be representative or may lack sufficient detail. For example, parts costs for replacement light bulbs, ballasts, or steam traps are relatively easy to quantify from purchase records. Labor costs to replace lamps, ballasts, or steam traps are more difficult to quantify because time spent on these specific tasks may not be well documented. In addition, labor reductions on these specific tasks may not qualify as “real savings” if labor expenditures do not decrease. Although the agency receives value in the sense that labor is freed up to perform other useful tasks, this value may not result in cost savings that can be paid to the ESCO.

Baseline O&M costs should be based on actual budgets and expenditures to the greatest extent practical. This essentially “measures” the baseline consumption of these parts or services. Estimated expenditures should be avoided if at all possible. In cases where such information is not available and must be estimated, parts and labor costs can be derived from resources such as R.S. Means or other methods. Estimated expenditures should be adjusted to reflect any site-specific factors that would affect costs.

A more complete discussion of this topic can be found at the main ESPC web site located at: <http://www1.eere.energy.gov/femp/financing/espcs.html>.

3.10 References

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