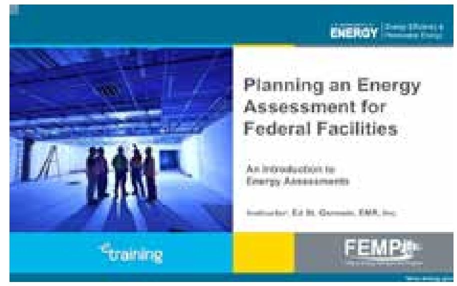
# FEMP eTraining
## Core Course
# Course Supplement

Course: FEMP02
Duration: 4 hours
Learning Units: 4 LU
Prerequisites: None
HSW: Yes
FEMP CEUs: .50 CEU

### FEMP02
### Planning An Energy Assessment for Federal Facilities




Focused on managing the Energy Assessment process in federal facilities, this course assists the Federal Energy and Facility Manager to comply with executive orders and legislative mandates and meet the requirements of Section 432 of the Energy Independence and Security Act of 2007. A properly planned and executed energy assessment provides a road map for making cost-effective improvements that drive energy and operational efficiencies. This course provides a framework for determining the type of energy assessment to conduct and an overview of how the energy assessment process systemically reviews key facility components including building envelope; mechanical systems such as HVAC; and electrical systems such as lighting. This course focuses on key applications of energy assessments in specific Federal applications such as data centers and laboratories, incorporating best practices and practical advice from experts in Federal energy assessments.

**Ed St. Germain**
Enviro-Management & Research, Inc.

The instructor for this course is **Ed St. Germain**, Director of Energy and Environment Support at Enviro-Management & Research, Inc. Mr. St. Germain has more than 37 years public and private sector facility, maintenance management, and energy technical assistance experience, specifically in reliability centered maintenance (RCM), retro-commissioning, and energy saving alternatives. During the last twelve years, he has managed long term O&M support contracts, first for NASA Headquarters, and currently for DOE FEMP. He co-authored two EERE O&M handbooks – *Commissioning for Federal Facilities* (which has an accompanying e-Learning course) and the *Energy Savings Assessment Training Manual.*

### Learning Objectives

By completing this course you will learn to manage the process for conducting an energy assessment in Federal facilities including:

- selecting the proper energy assessment type and prioritizing the facilities most in need of an energy assessments;
- understanding how key building components such as building envelope and electrical and mechanical systems are assessed;
- assembling an energy assessment team with the proper expertise;
- conducting the energy assessment walk-through and interviewing key personnel;
- developing the master list of findings from the energy assessment and prioritizing an operational list of improvements;
- measurement and verification activities.

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WBDG
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*a program of the*
National Institute of Building Sciences

FEMP
Federal Energy Management Program

# Module 1

## 1.1 An Introduction to Energy Assessments

Planning an Energy Assessment for Federal Facilities; Module 1; An Introduction to Energy Assessments Congratulations on your decision to achieve greater energy efficiency in your facilities. The Federal Energy Management Program is pleased to offer you this online training course to help you make the best decisions when conducting an energy assessment at your facility. This course will help you comply with Executive Orders and legislative mandates and meet the requirements of Section 432 of the Energy Independence and Security Act of 2007.

These mandates direct agencies to better manage their energy intensity, reduce greenhouse gas emissions, and use cost-effective renewable energy resources. An effective energy assessment provides one of the best vehicles to achieve these goals. Your instructor for this course is Ed St. Germain, Director of Energy and Environment Support, for Enviro-Management & Research, Inc.

## 1.2 Navigation Instructions

## 1.3 What Is an Energy Assessment?

Hello. I'm Ed St. Germain and I'll be your instructor for this FEMP eTraining course on conducting an energy assessment. I've worked as a contractor in support of the Federal Energy Management Program for several years and have conducted a wide range of energy assessments for all types and sizes of Federal facilities.  Welcome to this course.  Let's get started. What is an Energy Assessment?  An Energy Assessment provides a proven method to identify, gather, review, and analyze, current energy use data in order to recommend conservation measures and improvements to reduce energy use and costs in Federal facilities. A properly planned and conducted energy assessment will provide you with the tools and resources to assemble and empower a team; identify energy conservation measures and incorporate best practices; communicate energy savings to top management; implement cost-effective improvements, and continue to educate and motivate building occupants and O&M personnel.

## 1.4 Energy Assessment Goals

There are several inter-related goals of an Energy Assessment. A properly conducted energy assessment - first and foremost - reduces energy use and operating costs. It also provides a "guaranteed" return on investment when payback analysis is accurately calculated. At the local level, energy assessments optimize facility equipment and operations. They reduce overall energy use; and upgrade systems and procedures to improve occupant comfort and productivity; enhance indoor environmental quality; and boost overall building performance. At a national level, energy assessments help achieve over-arching goals to decrease greenhouse gas emissions; comply with sustainability performance goals, and reduce reliance on foreign sources of energy.

## 1.5 Energy Assessment Benefits

In a time of volatile energy costs and increasing Federal budget constraints, the benefits of conducting an Energy Assessment are many. Benefits include identifying systemic problems, so efficiencies can be gained. These efficiencies will reduce operating costs and conserve agency resources for mission-critical activities. By raising the bar and moving beyond minimum requirements, you also lead by example. Leadership at your site can help you meet and exceed Federal mandates, and serve as a model for others to follow and replicate.

**Notes and Observations**

### 1.6 Other Tools To Meet Goals

It is important to determine which energy-saving tool is best for each situation. Keep in mind there are proven methods to any particular energy saving goal. Preventative maintenance keeps equipment at peak performance. It considers more than equipment condition – it looks at the maintenance culture, technician training and qualifications, scheduling, available documentation, procedures, whether specific checklists are followed, the quality of equipment, and computerized management system applications that might be used. Energy reduction is a great outcome from the primary focus: optimized maintenance effectiveness to support the most efficient operations. With building commissioning, the focus is more concentrated on a specific system, its operation, and its output parameters. Energy efficiency is a positive outcome resulting from optimal system functionality. The easier and smoother a system needs to work, the less energy it requires. Energy Assessments look at the big picture – the need to optimize efficiency wherever possible to reduce the building's energy use intensity and related operating costs.

### 1.7 Legislative Drivers

Six important legislative and executive branch drivers underscore the need for energy assessments. In depth review of relevant sections is not possible here; however, conducting energy assessments are a powerful way to help comply with each mandate. Click on the timeline below for a quick summary.

### 1.8 EISA 2007

The Energy Independence and Security Act of 2007 requires Federal facilities to decrease their energy intensity by 3 percent per fiscal year relative to a 2003 baseline. Section 432 of the Act requires each Federal installation to complete comprehensive energy audits in 25 percent of its covered facilities each year. This roughly translates to conducting an energy assessment of a facility every four years.

### 1.9 Selecting and Prioritizing Facilities

The first step in selecting and prioritizing facilities for an assessment is to determine if an assessment is needed at all. Performing an unnecessary assessment would be a waste of time and money and would divert resources from being applied to other facilities where an assessment is really needed. Ask these six basic questions to prioritize which buildings would best benefit from an energy assessment: How old is the building? Has the building been commissioned in the last 4 years? Has the building been renovated in the last 4 years – including HVAC and Lighting Systems? Are the energy bills high or trending upward? Has the equipment reached its useful life? And finally, using your best judgement, is the building in generally good working condition?

### 1.10 How old is the facility?

A building that is less than 5 years old should have been properly commissioned and should be running efficiently. For this building, the time and expense to conduct an assessment will most likely not provide a good return on investment. Potential benefits would be small and, in comparison to older facilities, would yield long payback periods. Opportunities to improve the performance of this building would be better focused on changing occupant behaviors and O&M procedures. The exceptions would be if utility bills are high, if major deficiencies are known to exist, or if there are unexplained rising energy trend lines.

### 1.11 Has the facility been commissioned in the last 4 years?

According to EISA Section 432, an energy assessment is required once every four years. If a building has been commissioned in the last four years, it is correct to assume that deficiencies have been identified and corrected and the resulting operations and maintenance improvements have been put in place. Usually, new

**Notes and Observations**

technologies have advanced and internal changes have emerged sufficiently to warrant a subsequent energy assessment in another four years.

### 1.12 Has the facility been renovated in the last 4 years?

Professionally designed and constructed building renovations should have also been commissioned. Updated energy strategies and the latest construction methods should have been put in place, including testing, adjusting, and balancing; building efficiency certifications; and the highest standard of building code compliance. In this case, performing an assessment soon after a renovation would not be cost-effective.

### 1.13 Are energy bills high and trending upward?

When energy bills are high or trending upward, conducting an energy assessment has the best potential for an excellent return on investment. Utility bills should be analyzed over a 2 – 3 year period. This will help validate findings, identify specific areas for energy conservation opportunities, or uncover billing errors. Check to ensure that utility schedules match demand charges and that the utility is charging the correct rates under the schedule.

### 1.14 Has the facility equipment reached its useful lifespan?

Aging and obsolete equipment lack the technology advancements and operational improvements to gain mandated efficiencies. Repair parts may no longer be available; and when they are, they are expensive and hard to find. If equipment has reached the end of its useful life, upgrades are most likely cost-prohibitive. The effectiveness of an assessment will be severely diminished and will not have the impact needed to improve existing systems or achieve energy conservation goals.

### 1.15 Is the building in good condition?

This question is subjective, but important. Statistical or empirical evidence does not always tell the whole story. Talk with building occupants; examine the condition of materials and equipment; check for trouble calls and occupant complaints; examine maintenance backlogs. These indicators result from personal observations and are just as valid as data being logged on energy-reading devices.

### 1.16 Energy Assessment Decision Tree

This decision tree outlines the six determining questions on whether to conduct an energy assessment. Follow the decision tree to determine the need for an energy assessment at your site.

### 1.17 What Would You Do?

You are the new Energy Manager at a large Federal campus in the Northeast. The energy manager who previously held your position retired and left a notebook with summaries of four buildings that are being considered for an energy assessment. Your budget allows only one of the four to be assessed. Ask yourself the six questions and use the Energy Assessment decision tree to determine which of the four buildings is most in need an energy assessment.

### 1.18 Learning Check

Each of the four buildings is described on the left-hand page. Click the tabs to move from building to building. After reading the description, answer the six questions on the right-hand page by placing a check in the appropriate box. After you have completed all questions, place a check in the bottom row for the one building that needs the assessment most. Click next to reveal the results.

### 1.19 Learning Check Results

First, let me say, you are right ! - because all four buildings are good candidates for an assessment. Second, let me say the greatest potential for return on investment

**Notes and Observations**

- including low-cost/no-cost ECMs is Building #4. Because of its age, the many stand-alone air conditioners, the many refrigerators, and the poor lighting levels, this building is a prime candidate for an assessment. We don't know when the air conditioners were installed, but as described, they are energy wasters and need to be replaced with a central system. The resulting cost savings will be high and the payback will be quick.

### 1.20 Why Perform an Energy Assessment?

An Energy Assessment can help you reduce costs, find solutions for recurring energy problems, provide documentation to justify funding requests, and, just as important, help your agency meet aggressive Federal energy mandates. In the next module, we will look at the types of energy assessments, and why each one has special advantages and disadvantages for a particular site.

**End of Module 1**

## Module 2

### 2.1 Types of Energy Assessments

Planning an Energy Assessment for Federal Facilities; Module 2. In this module we will review the types of energy assessments, discuss advantages and disadvantages of each, and discuss ways to weigh these options in your decision-making.

### 2.2 Navigation Instructions

### 2.3 Let's Get Started

Know your goals: Conducting an energy assessment does have compliance requirements. However, there are several other important goals to meet. So, as you plan your energy assessment, start with this question first: "What do we want to accomplish from the assessment?" In other words, begin with the end in mind. Create a detailed scope: In response to that first question, the next step is to develop a detailed scope of work, including a budget and schedule. The breadth, depth, and specificity of the scope will depend on your purpose. Take the time necessary to prepare a thorough scope that satisfies the requirements of your agency, your management, and your own objectives. Choose your Assessment Type: After you have developed your scope, choose what type of assessment to conduct: a preliminary or walk-through assessment; a general assessment; or a comprehensive assessment.

### 2.4 Types of Energy Assessments

ASHRAE recognizes three basic types of energy assessments. All three enable you to develop a prioritized list of Energy Conservation Measures; determine if a more detailed type of energy assessment is advisable or necessary; bring a new perspective to unresolved or persistent energy problems; and identify and apply no-cost/low-cost solutions to easy fixes. Apart from these commonalities, there are important differences. Each type of assessment has its own process, advantages and disadvantages, and best practices. Each type moves from the general and less detailed to the more specific and comprehensive. Each becomes more expensive, resource demanding, and time consuming accordingly.

### 2.5 Type I Assessment

Click the tabs to learn more about the process, advantages, and disadvantages of each type of assessment. The Type I energy assessment, also known as a preliminary or walk through assessment, is the simplest and quickest. It's usually consists of a basic utility invoice review; interviews with site operations personnel, and a review of available facility operations data. A walk-through of the facility is conducted to identify areas of energy waste or inefficiencies.

**Notes and Observations**

Observations and basic data analyses are documented; and energy conservation measures are identified with respective costs, estimated savings, and simple payback. This prioritized list of ECMs and ECOs form the basis of an implementation plan. Type I assessments introduce "fresh eyes," to find "low-hanging fruit" and easily observable opportunities with the least effort, time, and expense.

### 2.6 Type I Assessment: Advantages and Disadvantages

The advantages and disadvantages of the Type I assessment are straightforward as you can see. FEMP places a high value on Type I assessments, particularly for budget-constrained agencies and sites. The site can begin to benefit from the improved procedures and simple fixes immediately. Moreover, a simple plan can provide a snapshot of the existing situation and a corresponding voice to top management.

### 2.7 Type I Assessment - Best Practices

Assign one or more new or inexperienced employees to team up with an experienced team member or leader. Create a "mentor" situation where the assessment becomes the start of an ongoing "train-the-trainer" program. Inexperienced members quickly find out "what to look for" and can carry that forward in subsequent assessments. Create a team consisting of a Facility Manager and one or two employees who have both the responsibility and authority to perform a walk-through every six months. Allow them to document any energy wasters and immediately implement low-cost/no-cost energy improvements.

### 2.8 Type II Assessment

The Type II assessment moves beyond simple observations and preliminary assessments and makes deeper energy use analysis the critical element. Each building should be independently examined in depth. Facility energy data will be collected, correlated to its historic data, and analyzed to develop indicies of energy use and cost.

### 2.9 Type II Assessment: Advantages and Disadvantages

Here are some advantages and disadvantages of Type II. For cost analyses, the Type II assessment is much more dependent on industry accepted standards, rather than rules-of-thumb.

### 2.10 Type II Assessment - Best Practices

Most individuals will be more than happy to talk to you if they feel confident you're there to support them and that you're part of their team. Practice "active listening" to learn more about what they have to say, and if it makes sense, pull the string to find out more about potential solutions to provide support for their ideas.

### 2.11 Type III Assessment

The Type III comprehensive assessment expands on the general assessment and may be used on a building that is already efficient and seeking certification. Extensive attention is given, not only to the operating characteristics of energy-consuming systems, but also to situations that cause load profile variations through computer modeling. It evaluates all building systems on a daily, weekly, monthly, and annual basis; and utility data is supplemented by equipment operating characteristics. In a Type III assessment, all energy is investigated and accounted for. All electricity is traced, for example, from the incoming service meter through the switchgear, through the circuit panels, and throughout the building. As a result, it applies specific energy conservation measures to the correct assets, systems, and equipment.

### 2.12 Type III Assessment: Advantages and Disadvantages

The average Federal agency will not often select a Type III assessment due to the

**Notes and Observations**

expense. Here are some advantages and disadvantages to consider.

### 2.13 Type III Assessment - Best Practices

When conducting a Type III Assessment, make sure that you either have the high degree of expertise on staff to conduct it, or choose a contractor with a track record of success. Check with sister facilities in your agency that may have recently conducted a similar type of assessment. Avoid downstream problems. Every data point of a Type III assessment is important, so make sure you "triple check" all assumptions, input data, and output results.

### 2.14 Question: Which Type?

Check all answers that apply.

### 2.15 Type I / II Assessment

To make the most of what you have, consider a Type I/II hybrid assessment. We know the scope of the assessment is dependent on budget, time, and available personnel. Further, it is dependent on the site's objectives and reason for conducting the assessment. Obviously, the site wants to benefit as much as possible with the limited resources at hand. The Type I assessment is low-budget, not very comprehensive, but adequate for identifying many no-cost/low-cost fixes. The Type II assessment is comprehensive, will find deficiencies that may not be readily apparent to simple observation, but will cost more. These reasons make the Type I/II hybrid assessment very attractive. It can be conducted within the available budget and, at the same time, is comprehensive enough to address the site's concerns. Weigh the pros and cons, and the concessions you have to make. Then go for the biggest bang for the buck.

### 2.16 Type I / II Assessment - Benefits

Try to take advantages of the best of both worlds. The benefits of the Type I/II hybrid center on the fact that it is highly cost-effective. It can be completed in a two or three day period using your own agency personnel in key roles. It balances the opportunity to make low-cost/no-cost improvements with the ability to analyze comprehensive data and provide customized reports for targeted ECMs and recommendations to top management.

### 2.17 Best Practices for Energy Assessments

Conduct a "train the trainer" workshop one or two days prior to an assessment. This session provides team members with a combination of classroom and hands-on energy assessment training that will be directly applicable to their work. Partner with a sister facility from within your own agency. Each site can conduct an assessment for the other and share results. Evaluations often are more objective, and there are fresh eyes on the problems. Lessons learned and best practices are shared, and the costs remain in-house. When additional objectivity is required, outsource the assessment. This is more expensive but has the benefit of bringing fresh eyes and new technologies to the site.

### 2.18 Available Resources for Energy Assessments

The resources and personnel to conduct an assessment can be obtained on-site; shared with an agency's sister facility; or outsourced to a third party. At least one on-site O&M technician, however, must always be part of the team to make immediate corrections to systems and equipment. Some states and utilities offer financial incentives that can help to defray the cost of assessments. Further, some assessments can be included with project funding options such as an Energy Services Contract or Utility Energy Service Contract. In particular, the Federal Energy Management Program has a wide array of on-line tools and resources and experts to assist your effort, regardless of agency type or project size.

**Notes and Observations**

### 2.19 Assessment Objectives

Your supervisor has approved your recommendation to conduct an energy assessment on Building #4 at your site. She has outlined compliance requirements, set a deadline, and provided a budget. Click next, and use the scroll bars to determine which type of assessment you recommend.

### 2.20 Assessment Objectives (Learning Check)

Use the red sliders to help determine what type of energy assessment will achieve your facility's goals.

### 2.21 Meeting Assessment Objectives

Experience indicates that the Type I/II hybrid is clearly the best option here. This is typical of many Federal sites with limited budgets and significant mandates to meet. The assessment must also provide value to the site, and be more than just a check-off for completion. DOE FEMP supports a Type I/II hybrid that maximizes the depth of the assessment within the limited resources of the receiving organization. Once again, there is no single "right" answer to this situation. It depends on the resources available and the depth of the assessment required to get the maximum benefit within the limits of those resources.

### 2.22 Summary - Energy Assessment Types

To provide the best return on your investment, balance mandated compliance requirements with the specific needs of your site and the resources available. Remember to keep the end result in mind before you choose your assessment type. In the next module, we will review some of the common building components and systems that will be included in any assessment, regardless of which type you choose.

**End of Module 2**

## Module 3

### 3.1 Components of Energy Assessments

Conducting an Energy Assessment; Module 3. Components of an Energy Assessment

### 3.2 Navigation Instructions

### 3.3 Components of an Energy Assessment

An energy assessment identifies cost effective ways to improve the comfort, indoor air quality, and energy and resource efficiency of buildings. There are many challenges and barriers to overcome in existing Federal buildings in order to make them as efficient as possible. The starting point and key to success is a solid plan for your energy assessment. The most common building components that make up the largest areas examined as part of an Energy Assessment include the Building Envelope; the Mechanical, including HVAC; the Electrical, including Lighting; and Water. We will also cover "People Movers" like escalators and elevators; and we will discuss cultural and behavioral issues.

### 3.4 Energy Assessment Components

Throughout this learning module, we will be taking a closer look at some of the most common areas that are part of an assessment, what to look for, and why.

### 3.5 Building Envelope Components

The first thing to assess is the building envelope. It is comprised of all exterior facing surfaces. Walls; Ceilings; Floors; Doors; Windows; Sky Lights; Foundation; Roof; Attics; For each of these components, the area and resistance to heat flow (R-value) are measured or estimated. Of concern is the leakage rate or infiltration of air through the building envelope, which is strongly affected by

Notes and Observations

insulation, window construction, and the quality of seals around doors, windows, and ventilation openings. The primary objective here is to quantify the building's overall thermal performance. An Energy Assessment examines the integrity of the building shell. How well does it withstand sun, wind, rain, and other weather conditions? Are there deficiencies in the structure of the building? If so, are they affecting other building systems?

### 3.6 Best Practices for Examining the Building Envelope

When evaluating the building, first observe and understand its orientation. Make special note of the sun load on building exterior surfaces. In the northern hemisphere, the southwest-facing barrier is highly susceptible to higher heat gains. Surfaces facing the sun will require a sufficient thermal barrier to mitigate heat gain. Conversely, the northeast facing surfaces are susceptible to higher heat loss. Give special attention to these factors. After evaluating the building orientation, next inspect the integrity of the building shell. Visually examine the structure from the outside to make sure there are no obvious deficiencies or damage. Pay specific attention to gaps that create air leaks. Reducing drafts will reduce operating costs and also make the building more comfortable for occupants. A thermal imaging scan can help detect drafts that are not readily detectable by the senses. Its use will also point out areas of poor or damaged insulation. It will indicate areas with high heat conductivity, such as windows, doors, and other un-insulated architectural features. Indoor air leaks are common along the baseboard or edge of flooring; at junctures of the walls and ceiling, and around pipes, wires, and foundation seals. Check for air seepage in electrical outlets, switch plates; examine window frames and weather-stripping; check for seals around wall or window-mounted air conditioners.

### 3.7 The Building Envelope

Roll over the hotspots to learn about assessing components of the building envelope.

### 3.8 Mechanical Components

Next assess the efficiency, physical condition, and programming of mechanical systems such as HVAC equipment. Include hot water heating and heat pumps as well as HVAC Controls. Thoroughly evaluate the refrigeration, compressed air and vacuum system equipment. Ensuring that these systems are properly functioning will go a long way in increasing the efficiency of your facility.

### 3.9 Best Practices for Examining Mechanical Components

Once the integrity of the building envelope has been verified, address the building's air distribution system. Delivering the right amount of air to the right place at the right time and temperature is critical. Efficiency isn't everything. An efficient building that is well insulated can be stuffy and poorly ventilated, and vice versa. Proper air ventilation and distribution can be a difficult balance to achieve, especially in larger or more complex facilities. Measure and monitor humidity as well as temperature. Sensing the return air is a more accurate method than using outdoor sensors. Always locate the temperature sensors and humidity sensors directly in the path of the return air stream. In addition to checking the condition of the air, examine the condition of the ductwork that transfers and distributes it. Check for obvious holes, splits, and disconnections. Also look for dirt streaks, especially near seams - these are "tell-tale" signs of air leaks. It's very important to inspect heating and cooling equipment regularly, or as recommended by the manufacturer. At certain times of the year, especially during "shoulder seasons," it can be more thermally efficient to bypass the building heating and cooling system altogether. By taking advantage of the natural outdoor ventilation and seasonal temperatures, free cooling can come with an added benefit of improved air quality.

**Notes and Observations**

### 3.10 Mechanical Components
Roll over the hotspots below to learn about assessing mechanical system components.

### 3.11 Electrical Components
The transmission of energy to Federal facilities should be a part of the assessment. In particular, ensure that transformers are efficient and delivering the right load according to facility and utility agreements and specifications. Replace old electrical panels with smart meters. Advanced metering best practices are increasingly important, and the payback is becoming increasingly short. Make a case to senior management that new metering technologies accurately chart usage in real time to pinpoint and address inefficiencies, reduce operating costs, and help meet strategic sustainability goals. Upgrade older, inefficient lighting and identify daylight harvesting opportunities. Look for ways to use task lighting in larger areas. Address cultural and behavioral issues - such as leaving lights on in unoccupied spaces. A good energy assessment will examine lighting configurations, controls systems, and occupant behaviors to match technologies and applications with user needs and routines.

### 3.12 Best Practices for Examining Electrical Components
Transformer rooms must be properly ventilated to control temperature. If the room gets too hot, the equipment works inefficiently and harder. Make sure room is properly ventilated and exhausted to prevent problems. An energy management system that reads smart meters allows management to develop effective energy demand strategies and shut off equipment during peak load times. Take accurate lighting measurements to determine specific lighting needs for each area. Do not replace old inefficient lighting with new technologies one-for-one, without considering required light levels for the task.

Maximize daylighting where possible and use daylight sensors to control the operation of the fixtures. Use occupancy sensors to turn on lights only when needed. Implement zone control strategies to turn on certain banks of lights only when required. In outdoor lighting, use solar lighting where possible, and use daylight sensors or timers.

### 3.13 Electrical Components
Roll over the hotspots below to learn about assessing electrical components.

### 3.14 Water Components
Water itself is a precious resource to conserve and use efficiently.  In addition, water requires significant energy to treat, pump, heat, and process. In a typical building, as much as 48 percent of water is used for heating and cooling; 31 percent is used for domestic use and restrooms; 18 percent for landscaping, and 3 percent for other purposes. The water assessment should include a detailed inventory of all restroom, kitchen, and domestic water users, such as toilets, lavatories, dishwashers, clothes washers, and showers, including their locations and flow rates.

### 3.15 Best Practices for Examining Water Components
In mechanical systems, check the rate of bleeding and the blow-down of cooling tower and boiler water. This periodic “flushing” is required to dispose of chemicals and suspended solids in the equipment water systems at the expense of requiring replacement water to make up the loss. Identify any refrigeration equipment that has a single pass-through of water. This can be compared to having an open faucet running continuously into the drain. These units are top candidates for replacement by more sustainable equipment and processes. In hot and humid climates, air-handling units will dispose of a large amount of condensate. It may be cost effective to divert this water to a nearby

Notes and Observations

cooling tower to use as makeup water. This clean water is already about 50°F and will replace city makeup water with water that would otherwise go "down the drain." In irrigation systems, review programmed and automatic on/off schedules, especially during growing seasons. Consider installing ground moisture sensors to prevent sprinkler activation during or soon after a rainfall.

### 3.16 Water Components

Roll over the hotspots below to learn about assessing water system components.

### 3.17 People-Moving Components

The electricity-consuming components of people movers can be large. In elevators, they are the drive/machine, car illumination, and the controller. In most scenarios, the drive is the dominant energy user. Elevators in high-rise buildings use significant amounts of energy, typically between 4-10 percent of the facility's overall energy use, so even marginal improvements in efficiency can translate into real savings. Escalators should receive regular maintenance for proper efficiency and smooth operation and to increase useful life. A history of proper maintenance goes a long way in predicting the current efficiency of people-moving equipment.

### 3.18 Best Practices for Examining People-Moving Components

The most significant improvement opportunities with elevators can be found in the control systems. Specifically shutting down and activating only as needed, elevators based on demand, considering time of day, frequency of trips, destinations, and occupancy. Also, look to install soft-start regulators that might be compared to variable speed drives on motors, but are not. Additionally, assessments should focus on installing more efficient lighting technologies, and shutting it off when unoccupied cabs are in stand-by mode, and the doors are closed, and working with management and users to determine cost-saving operating strategies.

### 3.19 People-Moving Components

Roll over the hotspots below to learn about assessing people-moving components.

### 3.20 Cultural Components

The energy assessment walk-through of the facility will provide first-hand information about occupant energy use habits. Look for "tell-tale" signs of energy wasters, like space heaters, personal appliances, and blocked vents. Take notes for follow-up. Observe staff attitudes about energy use in the work they perform. Note their behavior in using typical office equipment, energy-intensive laboratory or industrial equipment, data centers, outdoor security needs, and special-use vehicles and related operations. Document the hours of operation of "informal" facility use, including the gymnasium, cafeteria, or other meeting and conference spaces.

### 3.21 Best Practices for Examining Cultural Components

During the assessment, ask the right questions and practice "active listening" - but don't police. Cultural components of an energy assessment need to include the attitudes and behaviors of management, O&M staff, and building occupants. You won't obtain good information if site personnel don't believe you are there to support their interests. Gather observations over time. Sometimes "energy wasters" are readily apparent. Other times, attitudes and behaviors difficult to uncover or pinpoint. Use a progressive approach to discovery. Include building users in the assessment process and keep them updated so future implementation has a greater chance for ongoing success.

### 3.22 Building Culture Components

Roll over the hotspots to learn about building culture components.

**Notes and Observations**

### 3.23 Summary of Energy Assessment Components
This module provided a review of the most common areas of any building assessment, what to look for, and why. While the building components reviewed in this learning module are not exhaustive, they do represent the most important ones for any assessment and the particular features in Federal facilities.

**End of Module 3**

## Module 4

### 4.1 Performing an Energy Assessment - Planning Phase
Planning an Energy Assessment for Federal facilities, Module 4. In this module, we will examine the planning phase of the assessment process.

### 4.2 Navigation Instructions

### 4.3 The Energy Assessment Process
In the Planning Phase, a detailed assessment plan lays the foundation for success. In the Discovery Phase, the investigative process is completed and a "Master Listing of Findings" is compiled. In the Corrective Phase, prioritized ECMs are implemented. And, in the Handoff Phase, the team establishes ways to maintain and continue the improvements over time. In this module, we will focus on the Planning Phase.

### 4.4 The Energy Assessment Process - Planning
In any type of energy assessment, planning outlines the critical steps for success. The more time the team spends planning targeted actions and timed activities, the more successful it will be. First we will discuss ways to gain management support. Assessments can be met with resistance from occupants and staff; and cost-effective ECMs are not always an easy sell, no matter how well documented. So support from upper management is critical. Next we will review steps to determine the assessment scope; namely, what are the objectives for the assessment and how will they be met? What specific equipment, building areas, and potential problem areas will be reviewed? Where are the greatest potential savings opportunities? How will project funding for major improvements be acquired? Then we will discuss how to assemble the Assessment Team – who should be included, what processes will be used, how will site logistics be handled? We will examine the collection and review of critical documents and reports needed to conduct an assessment. Which ones are most important, and why? We look at how to develop a site-specific assessment plan - what are the walk-through and inspection schedules, how will the activities build on one another? We then discuss the Pre-Assessment Survey – what is it, how will it benefit a particular facility, campus, or agency when it is distributed? And finally we will discuss the selection of the right tools to conduct a thorough and well-documented assessment with accurate calculations and valid data.

### 4.5 Gain Upper Management Support
Assessments certainly have costs associated with them. However, arming yourself with the right tools can not only justify those costs, but also go beyond them to provide a positive return. Start with the numbers: Federal mandates require Facilities to decrease energy intensity by 3% each year through 2015 relative to a 2003 baseline. What plans are in place to meet these aggressive goals? If there are gaps, how can the assessment help fill them? Show the trends in utility bills for the last 24 – 36 months. Communicating the details of upward trends - cost and demand - underscore the pace of increasing costs and the potential to reduce them. To combat rising costs, identify ways to reduce consumption, improve efficiency, and prevent energy loss through

**Notes and Observations**

avoided costs and improved operations. Show immediate payback through low-cost/no-cost improvements. Calculate direct cost savings through improved O&M procedures and ECMs to sell the Return on Investment. Show indirect benefits such as the extended life of materials and equipment, improved worker health and productivity, and site environmental quality, indoors and out. Finally, use documentation as a tool to obtain project funding from ESCOs and utilities through ESPCs, UESCs, and other project funding. These organizations can use your findings and reports to support their own funding proposals.

### 4.6 Address Common Objections

Management, staff, and occupants may object to the assessment's timing or scope. Responding to objections you anticipate should be a part of your planning. "Energy assessments are time consuming." A Type I assessment of a building can be completed in a day. A Type I-II Hybrid can be completed in three days or less. Clearly, these assessments are well worth taking time from even the busiest O&M schedules. "Energy assessments are costly." Immediate paybacks benefit the bottom line. Many times, assessments can be conducted using existing facility resources and budget line items.

And assessment documentation can be leveraged for additional project funding. "Maintenance doesn't need an inspection." Assessments document consumption, energy efficiency opportunities, and energy losses to improve existing conditions and the bottom line. It is an effective tool for O&M staff to communicate immediate and potential improvements to senior management. Good reporting allows the team to have a voice that will be clearly heard. "There is no urgency." Federal mandates require urgency. First, under EISA Sec. 432, three years is the longest period a building can go without an assessment or before another one is needed. Second, mandates require Federal facilities to reduce energy intensity by 3 percent annually.

Finally, national energy security and increasing pressures on the Federal budget require all Federal employees to act with urgency. "Energy assessments are disruptive." Whether you are using an in-house team or outside agent, effectively planned assessments can be conducted in a short time with minimal disruption. Teams are small, do not impede research, work schedules, or daily operations, and no building occupant or staff is requested to do anything beyond the norm. Depending upon the type of assessment conducted, specific areas can be targeted to even further reduce any potential for disruption.

### 4.7 Identify Project Scope and Objectives

The Federal facility manager, with input from facilities staff and others, specifically lists the objectives for the assessment. These include major building systems and equipment; specific buildings, and building areas by function or type; potentially problematic areas that need special attention; and applicable utility or power systems. This list serves as general guidance and helps maintain focus on the best candidates for energy conservation opportunities and measures.

### 4.8 Guiding Questions Determine Objectives

The assessment team must consider the unique conditions, personnel, and culture of each Federal site. There are a series of common guiding questions, however, that can help determine the objectives and scope of any assessment. These include: Where have problems consistently occurred in the past? Why have they not been addressed? Can they be expected to continue? Are there unusual characteristics or disturbing trends that should be examined? What is the energy use index of the facility or building? How does it compare to similar buildings located on the site, within the agency or region, or in the commercial

**Notes and Observations**

sector? Based on experience and available utility invoices, where is the greatest potential to save energy and reduce greenhouse gas emissions? Have prior energy assessments been conducted or retro-commissioning reports issued for these facilities? If so, what ECMs have been implemented? Not implemented? Why? Is there a reasonable potential to generate renewable energy on site to meet agency-specific and overarching Federal goals? Are there synergies based on the resources available, and on what scale? Are steps being taken to use water wisely? Is the availability or cost of water a concern?

### 4.9 Assemble an Assessment Team

Selecting the right members of the Assessment team is very important. Each team member must have the right knowledge, skills and experience, and interpersonal skills to be effective as an individual and as a contributing member. Each needs to be committed to the effort; have the ability or authority to help put recommendations into action; and have time to dedicate to the effort. An Assessment team should include: A representative of management should buy-in to the effort and should be a good communicator. This individual, if willing, may be a good choice to lead the assessment. O&M personnel know the facility and equipment operations inside and out.

A historical knowledge of operations and an intimacy with the maintenance culture is important. Facilities personnel have access to all building areas as well as a thorough working knowledge of systems, operating histories, and special energy conservation opportunities the facility presents. Other departmental representatives should be site specific. For example, if your campus contains laboratories, include someone who can provide a research perspective on why common practices occur. If a base feeds thousands in a mess hall, include food service staff who understand how to operate all food service and kitchen equipment. These individuals should be able to constructively voice the concerns of others as well as possess knowledge helpful for the assessment. Consultants may include experts in controls, electrical systems, HVAC operations, or other specialized areas. They provide subject matter expertise, have thorough knowledge of systems interaction, and an ability to think “outside the box,” see the big picture, and remain objective.

### 4.10 Gather the Right Documentation

Gathering the right documentation means having the best general and system-specific information at your fingertips. This enables the team to be efficient and effective during the actual site assessment process. The documentation should provide evidence of: uncorrected deterioration of building materials, equipment, and systems, sub-optimal performance or failure of critical building components, root causes of problems that indicate larger flaws in system design or engineering. Gathering the right documentation means having the best general and system-specific information at your fingertips. This enables the team to be efficient and effective during the actual site assessment process. The documentation should provide evidence of: uncorrected deterioration of building materials, equipment, and systems, sub-optimal performance or failure of critical building components, root causes of problems that indicate larger flaws in system design or engineering,

### 4.11 Documents Answer Key Questions

Many original documents may no longer exist or may be grossly out-of-date. Don’t worry; make the best use of the documents the site makes available. Click on the boxes to learn about previous reports, what types of information they contain, and how that can inform your recommendations. • Equipment Inventory Documents. The equipment inventory should detail the age and condition of all equipment in the facility, sizes, types, and histories. Are there over- or under-sizing problems? Do the equipment inventories indicate holistic,

**Notes and Observations**

integrated operations? • Prior Energy Assessments and/or Retro-Commissioning Reports. These reports will underscore previously observed problems as well as recommendations for cost-effective ECMs. Determine which ECM's were implemented as well as those that were not. If they were not, find out why. • Building Design Documents. A&E drawings and specifications help the team determine the integrity of the building, its operations, and original design intent. Determine if building uses, space configurations, or other systems have been modified, and how those modifications affect efficiency and performance. It is a good idea to reference prior energy assessments and retro-commissioning reports after the on-site energy assessment activities have been completed. This allows the team to stay objective during the assessment inspections. Do not rely on prior documents to help guide your assessment activities. Use them as an additional reference tool after the assessment.

### 4.12 Analyze Utility Bills

The utility bill is a valuable tool. But utility invoice verification is more than checking for accuracy. Use the utility bill analysis as a way to identify where the various parts of the organization spend the most money on energy sources; help set priorities and realistic targets for additional conservation strategies; identify the best strategies for synergies to increase site-wide efficiency; and establish a baseline to compare against and chart future progress.

### 4.13 Identify Critical Utility Bill Data

Locate and identify all meters on the site to validate that the site is being properly charged for those meters only. Ensure the site is not paying for properties it no longer owns or controls. Review the rate schedule to make sure it is appropriate to the operations and consistent with existing agreements. Check to see how much of your usage is billed at peak demand charges, and verify that the demand charges are correct. Explore what opportunities exist to incorporate demand management practices into operations and schedules. Check for usage spikes, determine their causes, and take corrective or remedial actions to prevent them in the future. Compare usage and demand between the current-year and same-time previous years. Correlate usage and demand with personnel loadings, critical mission functions, and tempo of operations. If the site includes several similar facilities, make comparisons of like facilities. Look for efficiencies in one facility that can be applied to another. Finally, compare the utility invoices from pre-ECM periods against post-ECM periods to see the difference. Factoring out weather or any external or other influencing factors. Then document and present the savings to Management for continued buy-in and program support.

### 4.14 Distribute a Pre-Assessment Survey

A Pre-Assessment Survey is provided to, and completed by, the individual requesting the assessment at least six to eight weeks in advance of the team's work. The survey form should be returned with sufficient information to give the team a good idea of what to expect, and what to prepare for, prior to initiating the on-site assessment activities. Information on current equipment size, age, and type should be provided. The Survey also requests information about utilities, and identifies major HVAC and controls systems. This input provides useful information to match team member expertise with the needs of the site. The survey provides a snapshot about the general site conditions and establishes a rough scope and schedule. It allows the team to begin its research, especially if there are unique systems or conditions. It gives the team an early indication of maintenance programs, controls strategies, renewable energy applications, and other conditions. Finally, the survey responses serve as an outline for talking points during the group and individual interviews.

**Notes and Observations**

### 4.15 Develop an Assessment Plan

The Energy Assessment Plan is like a roadmap the team will follow. It includes site assessment objectives, targeted facilities, schedules, locations, and specific systems to be examined. It identifies individual team members, their roles and responsibilities, and when and where they are expected to be on site at any given time. The plan identifies specific strategies for utility bill analysis and document reviews; staff and occupant interviews; schedules for walk-throughs and inspections of buildings and systems targeted by management; and methodologies to document, measure, and verify ECMs. Finally, the plan serves as a living document to update and revise as necessary throughout the on-site assessment process. This “living document” will end up as the basis of the Assessment Final Report.

### 4.16 Assessment Tools

Using the right tools will make energy assessment findings accurate and will focus ECMs. Roll over the images below to learn more about the most common tools in an assessment tool box.

### 4.17 The Energy Assessment Process - Planning

The planning phase helps gain support, assemble a team, develop documentation, and select the best resources. Planning the assessment requires time and attention to detail. The more you can match the talents and skills of the team with the particular needs of the site, the smoother and more effective your on-site activity will be.

### 4.18 The Energy Assessment Process - Summary

In the next module, we will cover the Discovery Phase, where the investigative process described in the assessment plan is completed and a “Master Listing of Findings” is compiled.

**End of Module 4**

## Module 5

### 5.1 Performing an Energy Assessment - Discovery Phase

Performing an Energy Assessment for Federal Facilities, Module 5. In this module, we will examine the discovery phase of the assessment process.

### 5.2 Navigation Instructions

### 5.3 Elements of the Discovery Phase

During the Discovery Phase, the team holds a kick-off meeting that sets the stage for the Energy Assessment. As part of the fact-gathering process, the team conducts interviews in individual and group settings. There are no better eyes and ears than the people who maintain, operate, use, and occupy the facilities every day. The team uses this feedback to gain insight when they observe the facility, its equipment, systems, and building operations. In this module, we will also look at a few areas that have special requirements, including data centers, cafeterias and kitchens, auditoriums, workshop and maintenance areas, and laboratories. The Discovery Phase results in a set of Energy Conservation Measures and Energy Conservation Opportunities that are documented and compiled into a Master List of Findings.

### 5.4 Discovery Phase Investigation

The goal of the Discovery Phase is to uncover the root causes of energy waste using on-site data collected through personal observations, functional testing, staff interviews, and document reviews. This process results in a Master List of Energy Conservation Opportunities, prioritized for implementation. During the Discovery Phase, the focus of activity moves from identification of problems to

**Notes and Observations**

their solutions. This phase includes the in-depth investigation of systems and equipment using diagnostic monitoring techniques and functional testing as well as observations on the culture of organization and the behaviors of staff.

### 5.5 The Kick-Off Meeting

A Kick-off Meeting sets the stage for the on-site energy assessment work and provides a setting to explain the process in detail to site staff and other officials. During this time, introductions are made and site visit parameters are established. These may include photography restrictions, security/escort restrictions and requirements, safety procedures, and a review of working hours. Reaffirm the reasons for the assessment, agree upon site visit objectives, and review the whole process – from kick-off to close-out to the Final Report. Discussions of problematic areas and potential savings opportunities then lead the team into the group interview process.

### 5.6 Team Building and Windshield Tour

The kick-off meeting provides an opportunity to put everyone at ease. Let staff know the team is there to help the site become more efficient. As a result of their upcoming efforts, they will acquire new tools to communicate efficiency measures and cost saving opportunities to management. Establish a "no-fault" policy. Make clear that an energy assessment is not an inspection to find fault, but rather, an opportunity to improve. Use this time to get into specifics: Examine schedules – what are the start and stop times? If there are key staff assisting the team, what are their work schedules and how do they coincide with the team's walk-through? What are the routines of O&M Staff. Site staff can use this opportunity to conduct a "windshield tour" of the facility that the team will be examining later in greater depth. The "windshield tour" provides the team with a "big picture" view of the facility.

### 5.7 Personnel Interviews

In conjunction with the Assessment Survey, interviews may be the most valuable tool of an assessment. Interviews allow site personnel to explain what's really happening in a facility or in many cases, not happening. A group interview allows staff to build off the opinions and comments of others. In many cases, someone's thoughts or comments trigger additional sharing of information. This dialogue allows the facilitator to explore areas of interest and go into greater depth on key issues. Conversely, individual interviews allow a person to feel comfortable and provide an opportunity to share information they would not be willing to share in a group setting. When an individual is comfortable, there is time to ask a series of questions that get to the root of the issue. Often personnel have years of experience at a particular site, so they can elaborate on previously identified problems that have never been resolved or continue to reoccur.

### 5.8 Facility Walk-Through Assessment

The team's on-site walk-through and building inspection includes the following components: Building Envelope, including roof, walls, windows, doors, loading docks, Mechanical Equipment, such as HVAC equipment and related controls, Electrical Components, such as lighting systems and controls, People Mover Systems, such as escalators and elevators, Building Occupancy, including behavior and space utilization patterns, Building Operations, including organizational culture and behavior

### 5.9 Facility Walk-Through Assessment

Using observation and diagnostic testing, the team examines in detail the three components of energy use: Energy Consumption: Is all the site energy being used for intended purposes, or is there waste? Energy Efficiency: Are systems achieving the best output from the energy used? Energy Loss: Is there unwanted

**Notes and Observations**

heat transfer? In addition to collecting data from gauges, meters, and control systems, Functional Performance Testing and Diagnostic Monitoring provide accurate and efficient ways to gather data during the Facility Walk-through. Diagnostic monitoring and testing provides information on operating parameters such as power consumption, demand, power quality, system temperatures, operating hours, critical flows, pressures, and volumes under typical operating conditions. Functional performance testing is the dynamic testing of systems - rather than only their components - during full operation. The tools described in Module 4 should be used to gather the data.

### 5.10 Walk-Through Focus Areas

In addition to collecting data and observations about the operational performance of systems and equipment, look for signs of problems related to: facility design, installation, operations, maintenance, and culture.

### 5.11 Walk-Through Best Practices

Before you walk the building, learn about its history. Take time to briefly discuss each building before your tour. Hear from staff who are most familiar with the site. Understanding a past change in the building's configuration or use can shed new light on why certain things operate the way they do. Talk informally to building occupants. To gain insight, use casual questions like, "How is the temperature in here in the afternoon?" Carry a notepad, camera, and white-board to record observations. Be observant during the walk-through and pay attention to what all your senses tell you. As you examine various spaces, look for unusual conditions. Watch what is happening in the workspaces. Ask yourself: "If I were paying the utility bills, would I be doing the same thing or allowing the current condition to persist?"Carefully read gages and indicators. Do they make sense? Perhaps they don't work, need calibration, or indicate – as they should – that the system parameters can be improved upon. Watch the time and plan accordingly – some spaces are time sensitive. For example, plan on visiting dormitories when they are generally unoccupied; visit kitchens after the meal rush hour; and visit courtrooms when court is not in session.

### 5.12 Areas of Special Interest

Many Federal facilities serve large numbers of occupants and have multiple functions. Some common areas of special interest include Data Centers, Cafeterias and Kitchens, Auditoriums, Workshops and Maintenance Areas, and Laboratories and Research Centers. Click on the building to find out more about these special areas.

### 5.13 Area of Special Interest: Data Centers

Avoid over-cooling data centers beyond ASHRAE standards. Data centers are often over-cooled, not to maintain server operation, but because staff like to be cool and comfortable. Most data center spaces, though, have only a few people occupying a relatively large space. If the space is sparsely occupied, do all the lights need to be on at all times? Recommend occupancy sensors, zoned lighting, and portable task lighting for times when there are occupants in only certain parts of the room. Understand the optimal temperatures and humidity required. Are cooler temperatures actually required for reliable, sustained operation? During cooler seasonal weather and lower night-time temperatures, can free cooling with humidity controls be used to cool the space?

### 5.14 Area of Special Interest: Cafeteria and Kitchen

Check for proper ventilation of dishwashers to avoid excessive condensation and humidity. Ensure that walk-in cooler and refrigeration doors have proper seals and alignment. Check the integrity of hardware to prevent the infiltration and exfiltration of conditioned air and to prevent mold and mildew. Inspect timers and the operation of range hoods so they operate only when needed to

**Notes and Observations**

avoid the exhaust of conditioned air. Specify hoods that have built-in air curtains around them to exhaust only the high cooking heat and not the conditioned air in the rest of the room. Check loading docks for air infiltration and examine the integrity of air curtains. In the kitchen/cafeteria area, use localized natural gas when available for the operation of steam kettles instead of running a boiler 24/7, which is a common practice in many Federal facilities.

### 5.15 Area of Special Interest: Auditorium

Large gathering places generally have HVAC units designed and sized to accommodate a full capacity crowd. However, many times the space is not filled but the HVAC runs to capacity regardless of the number of occupants. Install CO2 sensors to control the HVAC to operate only as required, based on occupancy. Auditoriums and meeting spaces are often reserved by a central system or individual. Because many HVAC systems are controlled by temperature and not occupancy, they operate when spaces are empty and after hours. It is good practice for the HVAC to be in a relatively high temperature default setting, and for central reservations to coordinate HVAC conditioning with the meeting times so that the system runs only when needed. A daily advance schedule of events distributed to the HVAC controls desk may be all that is needed.

### 5.16 Areas of Special Interest: Workshop and Maintenance Areas

Avoid forced air heating and maximize use of infrared heating in buildings that contain hi-bay workshops and maintenance areas with large overhead doors. Infrared heats people and objects, not the surrounding air. So it keeps people and objects warm, including the floor, which then reflects that heat. When bay doors are open, since the air itself is not heated, warmth is not lost to the outdoors. Optimize floor reflectivity by implementing floor treatments that maximize light reflectance and reduce lighting loads by using lower wattage lamps and fixtures. Use industrial size ceiling fans to circulate heat and increase space ventilation. Replace inefficient High Bay lighting with advanced lighting technologies.

### 5.17 Area of Special Interest: Lab and Research Center

Determine the nature of the laboratory work and research being conducted. Are there hazardous materials involved? This impacts the design and operation of the HVAC system. For example, special filters that might have once been required on exhaust fans and restrict airflow may no longer be required if there has been a change in research or mission. Ensure laboratory spaces are set to the appropriate negative pressure. Check and adjust all static controls. Verify that all fume hoods are calibrated correctly and hoods operate properly. Check HVAC systems and adjust to ensure optimum ways to condition 1X fresh air exchange. Ensure the operation of building systems support research conducted and minimize system operation when research is not being conducted, especially refrigeration and steam systems.

### 5.18 Energy Conservation Opportunities

Based on the walk-through findings, the team brainstorms and develops energy conserving strategies and prepares energy conservation measures (ECMs) or energy conservation opportunities (ECOs). These recommendations provide the site with solutions and improvements to generate energy reductions and cost savings. These ECMs and ECOs will range from no-cost/low-cost improvements to larger capital improvements with longer payback periods. Every problem, deficiency, or opportunity found during the Discovery Phase will be summarized on a Master List of Findings, included in the Assessment Final Report.

**Notes and Observations**

### 5.19 Findings and ECMs

Your team was quite successful in identifying both no-cost/low-cost opportunities and some modest cost projects to improve their building's energy efficiency. Here are some that grabbed Management's immediate attention.

### 5.20 The Energy Assessment Process - Summary

The Discovery Phase uncovers the root causes of energy problems through site observations, occupant interviews, and evaluation of equipment and systems operation. In the next module we will cover the Correction and Hand-off Phases of the assessment process.

**End of Module 5**

## Module 6

### 6.1 Performing an Energy Assessment - Correction and Hand-Off Phases

Planning an Energy Assessment for Federal Facilities, Module 6. In this module, we will examine the Correction and Hand-off Phases of the assessment process.

### 6.2 Navigation Instructions

### 6.3 The Energy Assessment Process

In the Correction Phase, a prioritized list of corrections is documented in a Master List of Findings. In the Hand-off Phase, the team produces a Final Report that includes those findings and facilitates ways for the site to use those findings to their best advantage and continue to maintain the improvements over time.

### 6.4 Correction and Hand-Off phases

In this module, we will review what steps take place during the Correction and Hand-off Phases. We will cover specific activities after the on-site walk-through has been conducted and findings have been compiled. We will review: the purpose and organization of the Exit Briefing; the main components of the Final Report; documentation necessary to implement energy conservation measures; distribution and use of the Post-Assessment Survey; best practices in reporting assessment findings; ways for the site continue diagnostic monitoring; and staff training.

### 6.5 Conduct an Exit Briefing

During the exit briefing the team presents a brief summary of the assessment. The team leader should thank management, the escorts, and all of the participants for their help and cooperation. Take this time to recognize key individuals who provided special support. Acknowledge the commendable things observed, note problem areas and some possible solutions – a shopping list of initial findings. Review the assessment findings and let site personnel know that the ECO's currently identified comprise a "shopping list" of findings that are not final. Some will be dropped, some added, and some combined as further analysis is completed by the team. Discuss the close-out schedule and leave the site with a good sense of problems, recommendations, and issues that will be considered for the Final Report. Let site personnel know when they might expect to have a draft report to review.

### 6.6 Produce a Final Report

After the team organizes data and findings, it begins the process of drafting the Final Report. The Final Report summarizes all background information, inventories major systems and equipment, and provides a detailed analysis of data taken from building diagnostic scans and tests and recommended ECMs. In addition to low-cost/no-cost solutions, the Final Report often provides a

Notes and Observations

basis to justify larger projects and capital improvements. A Type I Assessment can be completed quickly, whereas a Type III Assessment will take much longer. It is not unusual for a Final Report to take between six and ten weeks depending on the type of assessment performed, the scope, and the facility size.

### 6.7 Elements of a Final Report

The five basic elements of the Final Report include: An Executive Summary; Background information about the site, the equipment and the personnel; Specific findings and data sets based on the walk-through; Recommendations for ECMs and other recommendations; and Appendicies that include calculations, photos, cut sheets, and other documentation. The Final Report must contain sufficient detail and actionable information to enable sound project decisions and comply with EISA Section 432 guidelines. The report format is based on the report level for an Energy Savings Performance Contract Preliminary Assessment, or, apart from an ESPC, on the agency and site preferences or contract requirements.

### 6.8 Executive Summary - Overview

The Executive Summary provides an high-level narrative of the assessment, including: A brief description of conditions at the building, facility, or campus and the purpose and scope of the assessment; Current energy usage trends and the energy use intensity of facilities or systems; Acknowledgment of best practices and positive actions, good maintenance procedures, and energy saving measures that were observed at the site; A summary of major recommendations. These should include no-cost/low cost improvements with immediate payback, and larger improvements that will require longer-term but larger returns. A summary table of ECMs and ECOs, with energy and cost savings, implementation costs, and simple payback or return on investment. Implementation costs should include design, construction, management, and inspection costs.

### 6.9 Executive Summary - At a Glance

As part of the Executive Summary, include a chart that outlines the energy conservation opportunities so that top management can receive high-level information at a glance.

### 6.10 Background Information

Background information contained in the Final Report begins with general site information and summary information about the facility, energy analyses, building descriptions, and equipment inventories. Background information also covers current and historical energy use data and climate data. References to prior assessments and commissioning reports, and summaries of interviews and current maintenance procedures are included. Calculations and data sets should not be included in this part of the report, because they will be covered in the Appendix.

### 6.11 Data and Findings

The next sections of the Final Report document data and findings from the Discovery Phase of the Energy Assessment. The Energy and Operational Analysis includes data gathered from site utility bills. Depending on the assessment scope, 12 to 36 months of electricity, gas, and water usage and cost data are compared using tables and charts. The team provides a narrative description of use, intensity, and cost trends. Short descriptions of the major building equipment and systems should include the location, purpose, and operating condition. Equipment inventory data should summarize information gathered about each major piece of equipment, including the make and model, location, type, capacity, serial number, and details about the motor or power source. A photograph of each piece should be included for easy reference and identification at later times. A summary of major

**Notes and Observations**

infrared thermography findings is also included. Analysis should include IRT scans of hot and cold spots on mechanical systems, electrical connections, and building envelope. It is useful to include photographs of the equipment for easy comparison to IRT scans.

### 6.12 Recommendations

The recommendations section of the report details the team's individual ECMs. Each ECM includes a brief description, an estimate of cost savings, a simple payback, and a schedule for completion. It also provides information about current conditions and technologies. "Other" recommendations in the report are not necessarily energy savers, but are provided because they can improve the operations of the facility, the comfort and productivity of the staff, or the health and safety of building users. An Action Plan provides added benefit in terms of higher skill sets, the introduction of new technologies, and the acquisition of project funding. Action plans can include goals to maximize renewable energy strategies, leverage assessment reports to obtain funding through ESPCs and UESCs, and expand training for operations and maintenance personnel.

### 6.13 Appendices

The appendices of the Final Report should contain the calculations and documentation to support the ECMs, as well as references and cut sheets for suggested upgrades. All calculations should be clear and easy to understand, so they can be referenced and used for comparison in the future. Be sure to include the Pre-Assessment survey in the Appendix, as well as any reference materials cited in calculations or upgrade recommendations. This supporting documentation keeps information in one location and can help the site make the most informed decisions.

### 6.14 Hand Off the Final Report

When the draft Final Report is complete, it is submitted to the Facility Manager and/or the original Requestor of the Energy Assessment only. They then have an opportunity to provide initial feedback, review assumptions, and question any recommendations, such as equipment replacement. Responses are requested in writing. Management submits a statement saying they agree or disagree with the details, and assumptions that were made, and provide concurrence that the report doesn't contain sensitive information. Corrections and modifications to the draft are made, and the Final is produced. Copies are sent to the sponsor who requested the assessment, others at the site, as directed, and if the work is funded by others, then a courtesy copy is provided to them as well. During the Hand-off, low-cost/no-cost ECMs are scheduled and implemented. Smaller ECMs are reviewed and prioritized. Management also acts on decisions that were waiting for a "go/no-go" decision pending the assessment outcomes.

### 6.15 Prioritize Energy Conservation Measures

Each ECM will include a description of what was observed through the use of tools and data loggers during the site inspection, along with a narrative identifying the situation and conditions related to this observation. They will be prioritized based on factors such as: Simple Payback, Return on Investment, or Life Cycle Cost; Mission Critical Functions; Strategic Objectives or Research at the Facility; Staff availability and capability; and Project funding.

### 6.16 Implement Energy Conservation Measures

Implementing an ECM has both time and budget requirements and critical steps that must occur. First, the site must develop a budget and either allocate funding or arrange for funding to support the improvement through appropriations, grants or special funding, or alternative project financing, such as ESPCs or UESCs. Next the site must establish and manage an implementation plan, with a specific follow-up schedule, to ensure that the

**Notes and Observations**

ECMs are properly implemented, measured, and verified. Finally, for each ECM, the site must be able to compare the actual savings against projected savings. This information is critical for future assessments, commissioning efforts, and other management activity.

### 6.17 Distribute a Post-Assessment Survey

Upon completion and distribution of the Final Assessment Report, a Post-Assessment Survey is sent to the original Requester. The purpose of this survey is to not only thank the Requester for participating in an Energy Assessment, but also to ensure that the site was satisfied with the assessment, the procedures of the team, and ECMs identified. The survey also verifies that the site understands the ECMs and other recommendations delivered. The Post-Assessment Survey should be sent within six weeks after completing the assessment. Schedule a meeting approximately six months after the survey has been sent to follow up on progress, answer questions, and determine the status of ECMs recommended.

### 6.18 Report Assessment Findings

FEMP is responsible for tracking Federal agency progress toward meeting requirements of EISA Section 432. The EISA Section 432 Compliance Tracking System (CTS) reports on agency performance of energy and water assessments, project implementation and follow-up measures, and annual benchmarking requirements.

### 6.19 Continue Diagnostic Monitoring

Continued diagnostic monitoring and functional performance testing should be performed to monitor persistence after the ECMs have been implemented. Pre- and Post-implementation data is compared to confirm that improvements have the desired energy-savings effect. This also establishes parameters to measure the performance of the improvements over the life cycle of the equipment.

### 6.20 Conduct Ongoing Staff Training

O&M staff training is best delivered as a continuous process. Management should support this concept and provide training according to the facility's needs and requests. The energy assessment lead should oversee and provide technical training as ECMs are implemented. All participants should benefit from training. O&M staff should understand each phase of the energy assessment process, the recommendations and corrections that have been made, and the measurement and verification protocols that will be used to set new baselines. This "Train the Trainer" method will encourage continued buy-in and future improvement.

### 6.21 The Energy Assessment Process

Energy assessments have great potential to help meet Federal energy and environmental mandates and reduce energy and operating costs. Recognizing this, EISA Section 432 requires Federal agencies to participate in energy assessments and has specific reporting requirements that agencies must comply with. No matter what type of assessment you conduct at your site, you will be working improve the energy efficiency at your site, improve operations, and cut costs. Congratulations on your commitment to lead by example and make a positive difference.

**End of Module 6**

**End of Course**

Notes and Observations