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Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

Performance Assurance Planning:

Continuous Design-Level Performance of Each Energy Conservation Measure in a Utility Energy Service Contract is Fundamental to Achieving Projected Results

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FEMP
Federal Energy Management Program

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Performance Assurance Planning

Design-level performance of each energy conservation measure (ECM) in an awarded utility energy service contract (UESC) is fundamental to achieving the projected results through the term of the contract and over the life of the measure.

Because the authority for a UESC[1] does not require contractual guarantees of energy, water, or cost savings, FEMP developed a protocol for emphasizing sustained performance to help ensure projected savings are realized. The information and templates offered within this paper reflect responsible project management and oversight, align with UESC best practices, and satisfy the conditions for annual scoring provided by the Office of Management and Budget (OMB). OMB memorandum M-12-21[2] requires, "energy savings performance assurances," "measurement and verification (M&V) of savings through commissioning and retrocommissioing," and "competition or an alternatives analysis as part of the selection process."[3]

Planning for persistent optimal performance will be both agency- and project-specific and can be built into crucial elements of each developing project through task order language:

1. **Acquisition planning**: Indicate that a comprehensive performance assurance plan will be a required deliverable which must include subplans for operations and maintenance (O&M), commissioning (Cx), recommissioning (rCx), and training.

2. **Performance assurance plan**: Develop a comprehensive plan that provides agency training, ECM functional testing and Cx, effective long-term O&M, periodic monitoring, and rCx.

3. **Analysis**: Ensure ECM recommendations are technically aligned with the facility mission and project objectives and are cost-effective over each ECM's life cycle.

4. **Design**: Optimize efficiencies, consider long-term performance strategies, and provide for cost-effective monitoring and automated controls during design.

5. **Installation**: Establish a process for ensuring design performance is achieved through the installation including equipment quality, materials, workmanship, functionality, Cx and fine tuning as required.

6. **Commissioning**: The Cx subplan should include ECM specific protocol, schedules, and templates complete with specific design performance metrics and key performance indicators (KPI); the Cx deliverables will include the efforts of functional testing, Cx, fine-tuning and verification that the design and performance metrics are met; and documented in a Cx report.

7. **Operations and maintenance**: The O&M subplan should address requirements for operating equipment and systems for the designed performance and include protocol, templates, and manuals for periodic maintenance, measuring and interpreting performance, and returning to optimal performance.

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[1] Authority for UESC comes from 42 USC 8256; https://www.law.cornell.edu/uscode/text/42/8256

[2] OMB M-12-21, September 28, 2012. UESCs that meet the criteria prescribed in this memorandum, and following the guidance prescribed in M-98-13, can receive the same budget scoring treatment as ESPCs. Through this authority, a UESC may be scored on an annual basis if the UESC requires: (1) energy savings performance assurances or guarantees of the savings to be generated by improvements, which must cover the full cost of the federal investment for the improvements; (2) measurement and verification of savings through commissioning and retrocommissioning; and (3) competition or an alternative analysis as part of the selection process prior to entering into a UESC.

[3] Addendum to OMB Memorandum M-98-I3 on Federal Use of Energy Savings Performance Contracts (ESPCs) and Utility Energy Service Contracts (UESCs) https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/memoranda/2012/m-12-21.pdf

8. **Recommissioning**: The rCx suplan should be similar to the Cx subplan including the protocol, schedules, instructions for measuring actual performance and returning ECMs to optimal performance. For each ECM, include a narrative for sustaining performance and recommend rCx frequency.

9. **Comprehensive Training**: The training curricula should address the design with performance objectives; the Cx subplan including observing the actual functional testing, Cx process, and reviewing the Cx report; the O&M subplan including hands-on activities, periodic maintenance schedule, and maintenance manuals; the rCx subplan with a template for writing a rCx report. Consider also the benefit of refresher training at intervals during the post-acceptance performance period.

Initially, optimal performance is predominantly dependent on the quality of the design, equipment, installation, and Cx of the ECMs. Continual performance over the life of the ECM, will be accomplished through implementation of ECM-specific and detailed rCx protocol and effective O&M.

Key Performance Indicators (KPIs)

The plan must include performance metrics for each ECM and instructions for establishing, investigating, and reestablishing optimal performance over time, including clearly identified KPIs and acceptable targets sufficiently defined to correlate with the contract savings values for each ECM. These KPIs are important for maintaining optimal performance, and can alert staff to ECM tune-up needs before those needs become expensive repair or replacement problems.

Training Plan

It is critical that the training be designed to prepare the agency to operate, maintain, and recommission each ECM in the project. The training should address the agency's priorities and objectives, design specifications for the performance of each ECM, equipment manufacturers' recommended O&M and other O&M-related activities required to meet or exceed performance targets, and the Cx and rCx activities and schedules.

The Performance Assurance Plan

A performance assurance plan is, in effect, a set of deliverables with performance obligations and an absolute requirement of delivering a fully functional project that meets or exceeds design performance for the term of the contract. Furthermore, the plan must prepare the agency (or a designated source) to operate, maintain, verify performance, and recommission each ECM implemented as well as to offer continued utility engagement as outlined in the contract.

The deliverables will be project-specific and may include something similar to the following:

1. **Baseline**: An accurate baseline documenting existing conditions, systems, equipment, and performance that will be modified by the project

2. **Design**: A design that is cost-effective over the life cycle of the ECM, buildable, maintainable, and capable of delivering the proposed performance

3. **Training plan**: A training plan including the training schedule, video recording of the training, and a project notebook that contains:

    A. A project overview and systems and equipment changes and warranties

    B. ECM details

        i. Description

        ii. Location

iii. Controls, sequence of operations

iv. Performance projected, KPIs, and guidance for maintaining performance. Specifically, how will agency staff determine the performance is optimal and sufficient to meet or exceed the proposed energy and dollar savings?

v. O&M requirements

vi. Functional testing

vii. Annual tune-ups

viii. Troubleshooting.

C. Commissioning plan and report

i. Equipment that was submitted, delivered, and installed meets design specifications

ii. Cx protocol including activities checklist with KPIs and performance targets

i. Start-up performance verification based on measured data

ii. Functional testing

iii. Performance verification.

iii. Report findings, conclusions, and recommendations.

D. Annual reporting.

4. **Installation**: The installed ECMs must meet the quality, characteristics, and functionality of the design and the manufacturers' recommended procdedures as well as applicable code and agency requirements as described or referenced in the contract.

5. **Energy conservation measure training**: As agreed to in the contract, training may include:

A. Classroom sessions

B. Reviews of installed equipment

C. Observation of functional testing for each ECM

D. Observation of Cx for each ECM

E. Review of the Cx report.

6. **Functional testing**: Once installed, each ECM will be tested according to the manufacturers' recommendations.

7. **Commissioning, performance verification, and commissioning report**: The Cx protocol must be applied to all ECMs.

8. **Post-acceptance**:

A. Utility engagement, as described in the task order

i. Miminimum performance assurance plan[4] recommended by the Federal Energy Mangement Program (FEMP) and commonly described as a "wraparound warranty" with a negotiated duration

ii. Performance guarantees specifically described in the task order may be for one or more ECM with a specified duration

iii. O&M services for one or more ECM as described in the task order with a specified duration

iv. Performance verification through rCx provided at time intervals e.g. every 3rd year or as negotiated and included in the task order; at a minimum, include refresher training and rCx of specified ECMs, a written summary report listing measured results, a comparison of the design performance of KPIs, and mechanisms to remedy poor performance and either take immediate corrective action or include recommendations for corrective actions.

B. Agency

i. O&M as described for optimal performance, including maintenance prescribed by the equipment manufacturer and/or the ECM design

ii. Annual rCx, performance verification, and reporting.

Initially, the majority of the plan development and implementation responsibilities are on the shoulders of the utility led by a Cx expert or agent and closely engaging the agency O&M experts and engineers.

[4] The FEMP Fact Sheet, Performance Assurance for Multi-Year Contracts Under the Utility Incentive Program, can be accessed at https://www.energy.gov/sites/prod/files/2013/11/f5/41898.pdf.

Considerations for Task Order Language

Performance Assurance

With the objective of delivering a fully functional project that meets or exceeds design performance, the utility shall provide a comprehensive performance assurance plan adapted to the agency, the facility, and the project objectives, and implement the activities determined to be the responsibility of the utility. At a minimum and in accordance with the contract, the utility will provide, as part of the performance assurance plan deliverable for each ECM identified, analysis-based design and operational instructions; installation as good as or better than that defined in the project design; a training plan and training; a Cx plan with specific protocol to measure and prove that performance meets contract requirements; and an rCx plan with detailed instruction for measuring, comparing, and interpreting the actual performance of each KPI. Include a resource for interpreting performance and identifying the correctional action required. In using the Cx plan, the utility will verify the installed equipment is operating to specified performance and efficiency in accordance with the final proposal.

Recommended Task Order Best Practices

1. Require a performance assurance plan lead, who develops the plan, verifies design effectiveness, leads commissioning during construction, writes the Cx report, and leads utility engagement for performance period services as negotiated in the contract.

2. Require a plan for every UESC project, reference the plan template in the UESC guide, and establish a responsible party for all activities.

    A. **Baseline:** Determine requirements for setting the baseline and ensure that the agency concurs with the requirements. After each ECM is installed, commission and compare to the baseline. For any discrepancies, an explanation and recommended solutions should be included in the Cx report. Performance verification and reCx will be compared to this as-built baseline.

    B. **Design:** Include competition between qualified contractors to ensure that the selected design contractor will deliver an effective, complete, and buildable design that ensures ECM performance and competitive pricing.

    C. **Training plan:** Develop a training plan and materials to support the agency's abiliity to operate, maintain, and recommission ECMs.

    D. **Installation:** Provide project management, quality assurance, and competitive bids; demonstrate performance at installation, upon seasonal changes, at completion of one year of service, and prior to the end of warranty period.

    E. **Commissioning:** Develop ECM-specific performance metrics, protocols, and training materials, and include in the Cx report.

    F. **Operations and Maintenance:** Ensure that ECMs meet equipment manufacturers' requirements and performance metrics and verification procedures.

    G. **Recommissioning:** Provide a performance period rCx plan that supports the O&M of ECMs, identifies KPIs out of set point or range, and includes scheduled, written protocols that will return the ECMs to optimal performance.

3. Insist on O&M training that will support agency's ability to operate and maintain design-level performance; understand, measure, and interpret performance metrics; and self-perform rCx. Include a training plan, a project notebook addressing design, O&M, Cx, etc., for each ECM.

4. Insist on a minimum 1-year wraparound warranty beginning at project acceptance. During the first 12 months of the performance period, verify performance and functionality.

5. Include identification and resolution of performance discrepancies.

6. Define utility engagement as negotiated in the contract. For example:

    A. Beginning with the end of year 1, the utility will provide annually or at 3-year intervals, an rCx consultation and refresher training.

    B. Develop an rCx and written report at the end of post-acceptance services.

7. Perform continuous Cx for complex and energy-significant ECMs.

8. Review O&M practices and effectiveness and recommend adjustments to meet or exceed performance targets.

The contractor should provide a narrative describing their vision of the performance assurance plan (Plan) with the preliminary assessment, a fully developed draft of the Plan with the feasibility study, and submit a final Plan for review and approval prior to the preconstruction meeting. The Plan will detail how the contractor will verify that the operation and efficiency of installed equipment meets its design performance specifications and outline the expected level of O&M necessary to assure the annual estimated savings are achieved throughout the task order period. The plan will also detail how the contractor shall collect data specific to the performance of the ECMs, review these data for validity, and integrate the data and systems operation into a report.

Deliverable—Commissioning Plan

1. The contractor shall submit a Cx plan, as part of the Performance Assurance Plan (Plan), detailing how the Cx process shall be completed, for review and approval prior to the preconstruction meeting and updated prior to Cx start should updates be required.

2. Start-up performance verification (measured) shall be achieved through Cx.

3. Performance shall be verified at the end of the 1-year construction warranty period through rCx (measured).

4. The contractor shall submit a rCx plan as part of the Performance Assurance Plan. An updated rCx shall be submitted along with an updated Cx plan should updates be required.

5. The contractor shall submit a written rCx report after completing rCx at the end of year 1 and as required in the task order.

Deliverable—Performance Assurance Training Plan

The training must prepare the agency O&M team to operate and maintain the ECMs as well as to understand the process for Cx each ECM and provide the rCx process for verifying the performance of each ECM. The training should include:

1. **Project Overview**: Describe the full scope and intent of the project, emphasizing the relationship between sustained performance and project payback.

2. **Key Performance Indicators for Energy Conservation Measures:** the design of each ECM shall include performance metrics and be designated as key performance indicators (KPI) within the Plan. The Cx and rCx protocol must include templates with the specific KPI element and acceptable setpoint or range for each ECM.

3. **Energy Conservation Measure Operations and Maintenance:** Explain how to operate, maintain, and keep ECM performance optimized. For each ECM, provide the energy, water, and demand savings associated with the measure; cover the manufacturer's recommended O&M; and highlight any changes or additions to current procedures necessary for maintaining and verifying performance.

4. **Energy Conservation Measure Commissioning:** For each ECM and the project as a whole, address Cx protocol and review protocol checklist and performance metrics. The training schedule should include opportunities for the agency O&M team to observe actual functional testing and Cx to prepare them for implementing the rCx in the future as part of their O&M activities.

5. **Energy Conservation Measures Recommissioning and Retuning**: For each ECM and for the project, address the rCx protocol, review protocol checklist and performance metrics, and include a video module for rCx. Integrate rCx into periodic maintenance.

6. **Periodic inspections and verification of appropriate operations and maintenance performance**: This can be achieved through performance assurance reports, as described below.

7. **Performance discrepancy resolution:** Include a description of how discrepancies in performance will be investigated and recommendations provided in the yearly reports.

Deliverable—Performance Assurance Reports

The contractor shall submit performance assurance reports based on the approved plan for the contracting officer's review and approval. These reports should include:

1. At the completion of installation, the utility shall implement the Cx plan, perform necessary actions required to ensure each ECM and the project as a whole is performing to the parameters of the final design. Document the Cx activities and results in the Cx report, which is required prior to acceptance.

2. Recommission the ECMs at the end of the first year following acceptance and document the findings, including O&M; review and interpret the results; provide recommendations for improving O&M and retuning or repairing as needed, and submit a complete report.

3. Recommission each ECM annually, every other year, or at an interval determined to be responsive to the criticality, complexity, or stability of that ECM. Given the flexibility of the UESC method, Agencies might consider the most cost-effective interval that supports the complexity of an ECM, for example every year for a chiller and every 3rd year for lighting. During the walk through, consider also identifying new efficiency opportunities.

4. The annual, or frequency set in the task order, written report of findings will summarize results, conclusions, and recommendations and shall be furnished by the responsible party on the following schedule:

    A. **Report 1:** Final baseline report that records preconstruction energy and water usage prior to start of construction; Utility is responsible for this report.

    B. **Report 2:** Commissioning report at initial activation and prior to government acceptance; Utility is responsible for this report.

    C. **Report 3:** Recommissioning report 1 year after government acceptance—any discrepancy noted between the anticipated annual savings and the actual savings shall be noted and the cause of the discrepancy shall be investigated and noted in the report, with recommendations for government and/or Utility actions where appropriate; Utility is responsible for this report.

D. **Report 4, and later reports**: Recommissioning report at the end of each year or at interval years following the 1st year report that notes any discrepancy between the measured KPI, anticipated annual savings and the actual savings, and investigates the cause of the discrepancy with recommendations for government and/or Utility actions where appropriate. The Agency or the Utility will be responsible for these reports as indicated in the task order.

Deliverable—Commissioning

The utility shall implement the Cx plan following the protocol developed for each of the installed ECMs:

1. The performance of all installed ECMs shall be proven to be equal to or greater than the design performance metrics specified in the task order. The contractor shall provide performance verification and documentation through implementation of the Cx plan and by providing a written Cx report to the contracting officer.

2. All heating, ventilating, and air-conditioning (HVAC) and electrical systems and equipment including controls, plumbing, and photovoltaic systems, shall be commissioned in accordance with ASHRAE Guideline 0-2013. The Cx plan is required to contractually implement the installation phases of the process, and it must be project-specific. Cx of systems and equipment shall take place only after functional testing is complete. Cx will be witnessed by an agency representative.

3. The final Cx report shall be submitted to the contracting officer for approval prior to final acceptance of the project. The report shall consist of completed pre-functional performance test checklists and completed functional performance tests organized by system and subsystem and submitted as one package. The Cx report shall also include all ECM systems' test reports; inspection reports (preparatory, initial, and follow-up inspections); start-up reports; testing, adjusting, and balance (TAB) report; TAB verification report; controls start-up test reports; and controls performance verification test report. The results of failed tests shall be included along with a description of the corrective actions taken.

4. Final acceptance of the project will not be given until corrective measures identified in the Cx report have been completed.

Deliverable—Prior to Acceptance

The report shall detail the requirements and results of the Cx Plan, including the following:

1. Copy of the Cx plan
2. Copy of training materials
3. Verification of training completed
4. Verified TAB report
5. Copies of corrective modification documentation
6. Copies of accepted performance variance documentation
7. Copies of pre-start/start-up checklists
8. Copies of all completed functional performance tests checklists
9. Final deficiency report
10. Completed punch list with resolution of all items

11. Maintenance plan with maintenance manuals.

Deliverable—Post-Acceptance

As negotiated in the contract, rCx reports shall detail the findings and recommendations for performance, O&M, and, if requested, future project suggestions.

Performance Assurance Plan Protocol

The protocol provided within the delivered performance assurance plan will be prepared by the utility team Cx lead. It will be prepared for the specific project ECMs and adjusted for the agency's site O&M staff. The protocol must clearly identify performance metrics or KPIs, Cx methodologies, and other performance assurance actions.

Due to the flexibility allowed by UESC, the contract may place performance period responsibilities for implementing the protocol completely or partially on the utility or be kept by the agency. On the spectrum of contracted performance period service, the highest cost and highest level of utility engagement may include annual utility-provided O&M, rCx, follow-up retune or repair actions necessary to correct any discrepancies to return ECM to optimal performance, and an annual written report. The least expensive performance period utility responsibilities will always include providing refresher training, rCx consultation, a 1-year wraparound warranty beginning at acceptance, and a written rCx report. Between the highest- and lowest-cost scenarios, the agency may limit the responsibility to specific ECMs and require performance period services such as refresher training, rCx consultation, and recommendations for government actions to correct any discrepancies and return the ECMs to optimal performance set points at multiyear intervals—every 3rd or 4th year beginning after the 1-year wraparound services are completed, for example.

The extent and cost of performance assurance plan implementation should be appropriate to the size and complexity of the project. The plan protocol activities must demonstrate that the ECM performance as installed meets the performance as implied and stated in the contract.

Common Energy Conservation Measure Templates

1. Energy management control system upgrade
2. Condensing boilers
3. Lighting retrofit
4. Water efficiency (domestic)
5. HVAC and air handling unit replacement
6. Chiller replacement
7. Photovoltaic system.

Appendix I: Performance Assurance Plan—Format

Performance Assurance Plan—Format

Executive Summary

1. Project overview
2. Performance projected with key performance indicators (KPIs)
3. Maintaining performance

Training Plan

A training plan as agreed to in the contract including training schedule, video recording, and project notebook:

1. Classroom and installed equipment
2. Observe functional testing of each ECM
3. Observe Cx of each ECM
4. Baseline—an accurate baseline documenting existing conditions, systems, equipment and performance that will be modified by the project.
5. Design—a design that is life cycle cost effective, buildable, maintainable, and will deliver the proposed performance
    A. Description
    B. Performance projected with KPIs
    C. Controls, sequence of operations.
6. Commissioning
    A. Functional testing – once installed, each ECM will be tested according to the manufacturers' recommendations and compared to KPIs
    B. Commissioning plan
    C. Performance verification
    D. Cx Report—the Cx protocol must be applied to all ECMs
    E. Review Cx report.
7. O&M requirements
    A. Annual tune-ups
    B. Troubleshooting.
8. Performance period
    A. Utility engagement annually or at intervals and responsibility levels described in contract
        iii. Wraparound 1-year warranty

iv. Recommissioning, performance verification, training, report

v. O&M if included in contract.

B. Agency responsibility

vi. O&M

vii. Annual rCx, performance verification, and reporting

viii. Repair and replacement as needed.

Baseline

An accurate and baseline documenting existing conditions, systems, equipment, and performance that will be modified by the project.

Design

1. Design that is life cycle cost-effective, buildable, maintainable, and will deliver the proposed performance
2. Performance projected with KPIs
3. Controls, sequence of operations, and other information essential to optimizing performance.

Installation

1. ECMs must meet the quality, characteristics, and functionality of the design and the manufacturers' recommended procedures as well as applicable code and agency requirements as described or referenced in the contract.
2. Equipment submittals, deliverables, and installations meets design specifications.
3. Commissioning plan and report
    A. Cx protocol including activities checklist with performance target
    B. Start-up performance verification based on measured data
    C. Functional testing
    D. Performance verification
    E. Report findings, conclusions, and recommendations.
4. Acceptance.

Commissioning

1. Functional testing—once installed, each ECM will be tested according to the manufacturers' recommendations
2. Cx for all ECMs
    A. Cx protocol
    B. Performance verification

C. Cx Report.

Operations and Maintenance

1. Periodic maintenance
2. Recommissioning/annual tune-ups
3. Troubleshooting.

Performance Period

1. Year one
    A. Wraparound 1-year warranty
    B. Recommissioning, performance verification, training, report
    C. O&M if included in contract.
2. Beyond year 1; utility engagement annually or at intervals and responsibility levels described in contract
    A. Continued warranty, if included in contract
    B. Recommissioning, performance verification, training, report
    C. O&M if included in contract.
3. Agency responsibility
    A. O&M
    B. Annual rCx, performance verification, and reporting
    C. Repair and replacement as needed or recommended.

Appendix II: Performance Assurance Plan—Training Format

Performance Assurance Plan—Training Format

1. Section 1
    A. Purpose and objectives
    B. Baseline—an accurate baseline documenting existing conditions, systems, equipment, and performance that will be modified by the project
    C. Design—a design that is life cycle cost-effective, buildable, maintainable, and will deliver the proposed performance
2. Section 2
    A. UESC project training plan—a training plan including training schedule, video recording, and project notebook
3. Section 3
    A. Project overview, systems, and equipment changes and warranties
    B. ECM details
        a. Description
        b. Location
        c. Controls, sequence of operations
        d. Performance projected and maintaining performance
        e. O&M requirements
        f. Functional testing.
            i. Annual tune-ups
            ii. Troubleshooting
4. Section 4
    A. Cx plan and report
    B. Equipment submittals, delivered, and installed meets design specifications
    C. Cx protocol including activities checklist with performance target
    D. Start-up performance verification based on measured data
    E. Functional testing
5. Section 5

A. Performance verification

B. Report findings, conclusions, and recommendations

C. Invoicing and payment process

D. Annual reporting

6. Section 6

   A. Installation—the ECMs must be installed so that they meet the quality, characteristics, and functionality of the design and the manufacturers' recommended procedures as well as applicable code and agency requirements as described or referenced in the contract

   B. ECM Training—as agreed to in the contract

      a. Classroom

      b. Installed equipment

      c. Observe functional testing of each ECM

      d. Observe Cx of each ECM

      e. Review Cx report

      f. Functional testing—once installed, each ECM will be tested according to the manufacturers' recommendations

      g. Cx, performance verification, and Cx Report—the Cx protocol must be applied to all ECMs

7. Section 7

   A. Post-acceptance

   B. Utility engagement, as described in contract

   C. Wraparound 1-year warranty

   D. O&M if included in contract

   E. RCx, performance verification, training, report at 3–4-year intervals

   F. Agency

   G. O&M

   H. RCx, performance verification, reporting.

Appendix III: Performance Assurance Protocol—Template

Template—Performance Assurance Protocol

This protocol provided within the delivered performance assurance plan is prepared by *(Utility or Cx contractor name)* for the *(Agency, site name, and site location)* to document performance metrics with specific key performance indicators (KPI), to provide commissioning (Cx) activities, schedules, checklists, and other performance assurance actions that are technically appropriate and sufficient to measure the actual performance of each ECM and necessary to sustain energy conservation measure (ECM) performance[5]. [In developing this protocol, consider that all ECM must be addressed with consideration given to the ECM-set, the impact each ECM carries, and the complexity of particular ECM regardless of the implementing party.] The plan protocol activities must demonstrate that the ECM performance as installed meets the performance as implied and stated in the contract.

Agency Responsibilities

In order for the utility to conduct its performance assurance services, the agency is responsible for each of the following:

1. Maintain and perform preventative maintenance on all installed equipment and systems in accordance with manufacturers' standards and specifications (include in training curriculum).
2. Integrate new requirements within existing periodic maintenance work plan to preserve strategies and set points programmed in the control system (document as KPI and include in training curriculum).
3. Keep usage and maintenance records and share with *(Utility or Cx contractor name)* as needed.
4. Record any change in facility or equipment use or any other matter that may impact the ECM performance. Promptly notify *(Utility or Cx contractor name)* of these changes.
5. Provide *(Utility or Cx contractor name)* and its subcontractors access to all facilities that are subject to the performance assurance services.
6. Provide *(Utility or Cx contractor name)* and its subcontractors access to the customer's equipment, systems, and energy usage data or energy usage data files as necessary to measure KPI, determine consumption, and deduce actual performance and/or to validate savings (spreadsheet or database software format).
7. Perform periodic recommissioning (rCx) following the provided metrics and protocol checklist.
8. Perform visual inspection of equipment and systems to ensure replacement parts match original specifications.
9. Provide scheduling and shut down of affected locations during rCx activities, as needed.
10. Refer to the performance assurance plan as delivered according to the negotiated contract for responsible parties concerning post-acceptance corrective actions identified in connection with the performance assurance services.

The Agency acknowledges that (Utility or Cx contractor name) is responsible for delivering a project with each ECM performing according to design intent and beyond the date of acceptance or as stated in the task

[5] The responsibility for implementation of these activities will be as written in each specific project task order. For the sake of this template, we have used "Agency responsibility" and "Utility responsibility", however, it is reasonable and potentially more cost effective to consider a standalone contract for implementation of the Cx and recommissioning services by a professional Cx company.

order; does not guarantee any level of savings from the ECMs and agrees that unrealized savings or cost reductions are not a basis for failing to make payments under the task order[6].

Utility Responsibilities

(Utility Name) will provide the performance assurance services set forth below for each ECM as specified below:

1. Per the task order, the utility will access the energy system data to confirm that appropriate strategies are in place and functioning. The energy system data may be used to validate energy savings through logs, trends, and compilation of data for all the mechanical equipment installed.
2. Conduct pre- and post-installation measurements, as described in each ECM table below
3. Provide O&M training, as described in each ECM table below
4. During equipment and system inspections, review the agency's maintenance records to validate proper O&M has been performed
5. Record any performance deficiencies and recommended corrections as well as optimization opportunities and include in report.

The utility is responsible for identifying and reporting corrective actions in accordance with the performance assurance plan.

Common Energy Conservation Measure Templates

1. Energy management control system (EMCS) upgrade
2. Condensing boilers
3. Lighting retrofit
4. Water efficiency (domestic)
5. Heating, ventilating, and air conditioning (HVAC) and air handling unit (AHU) replacement
6. Chiller replacement
7. Photovoltaic system.

[6] Energy or cost savings guarantees may be available upon request however they are not a standard offering and may be in conflict with a Utility's policy or regulations.

1. Energy Management Control System Upgrades

Buildings included: _____

Proposed Performance Assurance Services

What	When	How
Start-up performance verification	Upon completion of installation	Commission control system to determine whether it performs as designed. Validate that controls strategies are programmed in control system. Set trends to track temperature set points, hours of HVAC operation, and other variables applicable to the equipment it controls. Review trend logs after two weeks of operation to verify control settings and proper operation of control strategies, or Create calibrated simulations for this facility using detailed survey data and HVAC equipment short-term metering to determine baseline and potential post-installation energy usage. Controls operating parameters recorded during the system Cx will be used for the calibrated energy model to determine actual post-installation energy use and savings (model shall account for interactions from other ECMs to arrive at an adjusted baseline).
Performance verification at the end of warranty period	Before warranty expires	Provide physical inspection to verify that the installed equipment and components have been properly maintained (per O&M manual). Conduct an annual review of controls trends, status, and alarm reports to ensure controls set points, algorithms, and sequences are as originally specified and performing as intended. Analyze system response during seasonal changes and adjust program as needed. Verify system continues to meet operating parameters.
O&M training	Upon completion of installation	Provide comprehensive training that includes ECM Cx protocol, O&M as recommended by the manufacturer and any additional activities described in the ECM design, and ECM rCx protocol. Provide original equipment manufacturer manuals and cut sheets. Provide ECM Cx plan and rCx plan. Provide O&M personnel with classroom training that includes hands-on activities, demonstrations, and video recording of training. Provide refresher training throughout contract period as described in the task order.
Ongoing training	Agreed-upon frequency	
Periodic inspections and verification	Agreed-upon frequency	Repeat actions as listed in the first two rows annually or as designated in the task order.
Performance discrepancy resolution	Every time performance assurance service is completed	If the activities described above indicate that equipment is not performing as designed or is not being properly operated and maintained, detail the required corrective actions in the written report. The corrective actions and related costs will be completed by the responsible party as designated in the task order.

2. Condensing Boilers

Buildings included: _____

Proposed Performance Assurance Services

What	When	How
Start-up performance verification	Upon completion of installation	Have an independent Cx agent commission condensing boilers to confirm proper system operation. Validate controls strategies have been programmed and establish trends to track efficiency variables and hours of operation. Review trend logs after two weeks of operation to verify control settings and proper operation of control strategies, or Calculate post-installation equipment energy consumption using an energy model including short-term measurements of boiler efficiency/combustion and agreed-upon operating hours using existing EMCS data (model shall account for interactions with other ECMs to arrive at an adjusted baseline).
Performance verification at the end of warranty period	Before warranty expires	Provide physical inspection to verify that the installed equipment and its components have been properly maintained and operated (per O&M manual). Using information from control system, review trends and recorded operating conditions to demonstrate that the system performs as designed. Report any deviations from the expected conditions to the customer.
O&M training	Upon completion of installation	Provide comprehensive training that includes ECM Cx protocol, O&M as recommended by the manufacturer and any additional activities described in the ECM design, and ECM rCx protocol. Provide original equipment manufacturer manuals and cut sheets. Provide ECM Cx plan and rCx plan. Provide O&M personnel with classroom training that includes hands-on activities, demonstrations, and video recording of training. Provide refresher training throughout contract period as described in the task order.
Ongoing training	Agreed-upon frequency	
Periodic inspections and verification	Agreed-upon frequency	Repeat actions as listed in the first two rows annually or as designated in the task order.
Performance discrepancy resolution	Every time performance assurance service is completed	If the activities described above indicate that equipment is not performing as designed or is not being properly operated and maintained, detail the required corrective actions in the written report. The corrective actions and related costs will be completed by the responsible party as designated in the task order.

3. Lighting Retrofit

Buildings included: _____

Proposed Performance Assurance Services

What	When	How
Start-up performance verification	Upon completion of installation	Use manufacturer's lamp and ballast power consumption for baseline and post-installation energy demand (kW) calculation. Determine operating hours using short-term measurements of sample areas before the retrofit and assume that these measurements remain the same in the post-retrofit scenario, or Use pre- and post-power measurements of lighting fixtures representing each electrically significant fixture configuration for baseline and post-installation energy demand (kW) calculation. Determine operating hours through short-term measurements of sample areas before the retrofit and assume that these measurements remain the same in the post-retrofit scenario.
Performance verification at the end of warranty period	Before warranty expires	Provide physical inspection to verify that the installed equipment and its components have been properly maintained and operated. Identify changes in fixture/equipment counts and types based on sample surveys. Report any deviations from the expected conditions to customer.
O&M training	Upon completion of installation	Provide comprehensive training that includes ECM Cx protocol, O&M as recommended by the manufacturer and any additional activities described in the ECM design, and ECM rCx protocol. Provide original equipment manufacturer manuals and cut sheets. Provide ECM Cx plan and rCx plan. Provide O&M personnel with classroom training that includes hands-on activities, demonstrations, and video recording of training. Provide refresher training throughout contract period as described in the task order.
Ongoing training	Agreed-upon frequency	
Periodic inspections and verification	Agreed-upon frequency	Repeat actions as listed in the first two rows annually or as designated in the task order.
Performance discrepancy resolution	Every time performance assurance service is completed	If the activities described above indicate that equipment is not performing as designed or is not being properly operated and maintained, detail the required corrective actions in the written report. The corrective actions and related costs will be completed by the responsible party as designated in the task order.

4. Water Efficiency (Domestic)

Buildings included: _____

Proposed Performance Assurance Services

What	When	How
Start-up performance verification	Upon completion of installation	Apply manufacturer's fixture water usage to pre- and post-installation water calculations. Determine agreed-upon frequency of use through water balance calculations and customer interviews, or Apply pre- and post-installation water measurements protocol to a representative sample of fixtures for each fixture type to determine actual water usage and flow rates and calculate savings. Determine agreed-upon frequency of use through water balance calculations and customer interviews.
Performance verification at the end of warranty period	Before warranty expires	Provide physical inspection to verify that the installed equipment and its components have been properly maintained and operated. Identify changes in fixture/equipment counts and types based on sample surveys. Report any deviations from the expected conditions to customer.
O&M training	Upon completion of installation	Provide comprehensive training that includes ECM Cx protocol, O&M as recommended by the manufacturer and any additional activities described in the ECM design, and ECM rCx protocol. Provide original equipment manufacturer manuals and cut sheets. Provide ECM Cx plan and rCx plan. Provide O&M personnel with classroom training that includes hands-on activities, demonstrations, and video recording of training. Provide refresher training throughout contract period as described in the task order.
Ongoing training	Agreed-upon frequency	
Periodic inspections and verification	Agreed-upon frequency	Repeat actions as listed in the first two rows annually or as designated in the task order.
Performance discrepancy resolution	Every time performance assurance service is completed	If the activities described above indicate that equipment is not performing as designed or is not being properly operated and maintained, detail the required corrective actions in the written report. The corrective actions and related costs will be completed by the responsible party as designated in the task order.

5. Heating, Ventilating, and Air-Conditioning Equipment and Air Handling Unit Replacement

Buildings included: _____

Proposed Performance Assurance Services

What	When	How
Start-up performance verification	Upon completion of installation	Have an independent Cx agent commission AHUs to confirm proper system operation. Validate that controls strategies have been programmed and establish trends to track operation of variable speed drives and monitor operating hours and set points. Review trend logs after two weeks of operation to verify control settings and proper operation of control strategies or Collect pre- and post-installation fan motor power and air flow measurements for a sample of AHUs. Monitor operating hours for select motors using existing EMCS data or data loggers sensing space temperature to confirm whether equipment runs continuously. Monitor duct and space temperatures using existing EMCS data or data loggers sensing space temperature. Calculate pre- and post-installation energy use and demand using energy model including monitored/trended values (model to account for interactions of other ECMs for an adjusted baseline).
Performance verification at the end of warranty period	Before warranty expires	Provide physical inspection to verify that the installed equipment and its components have been properly maintained and operated (per O&M manual). Using information from control system, review trends and recorded operating conditions to demonstrate the system performs as designed. Report any deviations from the expected conditions to customer.
O&M training	Upon completion of installation	Provide comprehensive training that includes ECM Cx protocol, O&M as recommended by the manufacturer and any additional activities described in the ECM design, and ECM rCx protocol. Provide original equipment manufacturer manuals and cut sheets. Provide ECM Cx plan and rCx plan. Provide O&M personnel with classroom training that includes hands-on activities, demonstrations, and video recording of training. Provide refresher training throughout contract period as described in the task order.
Ongoing training	Agreed-upon frequency	
Periodic inspections and verification	Agreed-upon frequency	Repeat actions as listed in the first two rows annually or as designated in the task order.
Performance discrepancy resolution	Every time performance assurance service is completed	If the activities described above indicate that equipment is not performing as designed or is not being properly operated and maintained, detail the required corrective actions in the written report. The corrective actions and related costs will be completed by the responsible party as designated in the task order.

6. Chiller Replacement

Buildings included: _____

Proposed Performance Assurance Services

What	When	How
Start-up performance verification	Upon completion of installation	Have an independent Cx agent commission chiller system to confirm proper operation. Validate controls strategies have been programmed and establish trends to track Btu consumption, operation of variable speed drives, operating hours, and set points. Review trend logs after two weeks of operation to verify control settings and proper operation of control strategies, or Determine pre- and post-installation chiller efficiency from mutually-agreed manufacturer's data and chiller amperage, operating hours, and cooling load using recorded logs and EMCS data to the extent available. Calculate baseline energy use and demand using a bin model (model shall account for interactions from other ECMs to arrive at an adjusted baseline).
Performance verification at the end of warranty period	Before warranty expires	Provide physical inspection to verify that the installed equipment and its components have been properly maintained and operated (per O&M manual). Use information from the control system, a review of trends, and recorded operating conditions to demonstrate the system performs as designed. Report any deviations from the expected conditions to customer.
O&M training	Upon completion of installation	Provide comprehensive training that includes ECM Cx protocol, O&M as recommended by the manufacturer and any additional activities described in the ECM design, and ECM rCx protocol. Provide original equipment manufacturer manuals and cut sheets. Provide ECM Cx plan and rCx plan. Provide O&M personnel with classroom training that includes hands-on activities, demonstrations, and video recording of training. Provide refresher training throughout contract period as described in the task order.
Ongoing training	Agreed-upon frequency	

Periodic inspections and verification	Agreed-upon frequency	Repeat actions as listed in the first two rows annually or as designated in the task order.
Performance discrepancy resolution	Every time performance assurance service is completed	If the activities described above indicate that equipment is not performing as designed or is not being properly operated and maintained, detail the required corrective actions in the written report. The corrective actions and related costs will be completed by the responsible party as designated in the task order.

7. Photovoltaic System

Buildings included: _____

Proposed Performance Assurance Services

What	When	How
Start-up performance verification	Upon completion of installation	Physical inspection, array testing, and complete system testing as per IEC 62446, *Grid Connected Photovoltaic Systems—Minimum Requirements for System Documentation, Commissioning Tests, and Inspections* (2009 or most recent), which requires documentation of the system, array testing, and whole-system performance test (applicable to commercial, industrial, and utility-scale systems). For PV module strings that do not provide the precise open circuit voltage and short circuit current expected for the conditions, I-V curve testing shall also be conducted to identify the problem.
Performance verification at the end of warranty period	Before warranty expires	Physical inspection of PV modules and array. Infrared camera inspection of array, combiner boxes, inverter fuse holders, and switchgear; torque any loose connections. Electrical inspection of all fuses and the position of all switches and disconnects. System performance test that reports on performance ratio, temperature-corrected performance ratio, and performance ratios based on either standard test condition data or performance test condition data as per IEC 61724.
O&M training	Upon completion of installation	Provide comprehensive training that includes ECM Cx protocol, O&M as recommended by the manufacturer and any additional activities described in the ECM design, and ECM rCx protocol. Provide original equipment manufacturer manuals and cut sheets. Provide ECM Cx plan and rCx plan. Provide O&M personnel with classroom training that includes hands-on activities, demonstrations, and video recording of training. Provide refresher training throughout contract period as described in the task order. Agency O&M personnel to complete the FEMP training course on *O&M for Optimal PV System Performance.*
Ongoing training	Agreed-upon frequency	

Periodic inspections and verification	Agreed-upon frequency	Provide system monitoring and data presentation according to transparent measurement protocols and procedures. The approach depends on the size of the system and associated savings/revenue. IEC 61724 *Photovoltaic System Performance Monitoring—Guidelines for Measurement, Data Exchange and Analysis* has classifications of monitoring system (A, B, C) and the O&M related to monitoring depends on the system class. Communications protocols with facility energy information system as per IEC 61850-90-7—*Object Models for Photovoltaic, Storage, and other DER inverters*.
Performance discrepancy resolution	Every time performance assurance service is completed	If the activities described above indicate that equipment is not performing as designed or is not being properly operated and maintained, detail the required corrective actions in the written report. The corrective actions and related costs will be completed by the responsible party as designated in the task order.

Appendix IV: Performance Assurance Report

Following the anniversary of the performance assurance services, and within 60–90 days after receipt of applicable customer data, (Utility Name) will provide the customer with reports at the end of performance year 1, 4, and 7 or as negotiated in the contract. The reports will include:

Report Content

1. Performance and savings achieved to date
2. Determination of whether control strategies are in place and functioning
3. Determination of whether proper O&M has been performed
4. Description of performance deficiencies
5. Description of opportunities to enhance equipment performance.

Utility Reporting Responsibilities

1. Notify the agency that the report is forthcoming
2. Set up a site meeting to discuss the report
3. Work with the agency's qualified witnesses
4. Review the performance assurance report for operational findings for follow-up.

Appendix V: Energy Conservation Measure Performance Verification Checklist

The checklist should be developed specifically for the set of ECMs in the project and reflect the activities in the performance assurance plan. It is intended to support the process of verifying sustained performance during installation, performance testing, and acceptance, as well as throughout the term of the contract and life of the ECMs.

For Each ECM

1. Document intention for the measure (design intent or basis of design)
2. Confirm correct number, type, and location of measures (if multiple lights, motors, etc., are installed)
3. Confirm correct interconnection with building systems and controls
4. Confirm operational sequence (start-up, shutdown) or multiple modes of operation
5. Document tests to confirm improvement in efficiency (the performance assurance plan should provide sufficient detail describing performance measurement procedures and metrics)
6. Confirm complete training of staff
7. Confirm on-site user's manual.

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