

# 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<sup>1</sup>. [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

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<sup>1</sup> 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<sup>2</sup>.

### 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.

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<sup>2</sup> 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.
Ongoing training	Agreed-upon frequency	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.
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.
Ongoing training	Agreed-upon frequency	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.
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.
Ongoing training	Agreed-upon frequency	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.
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.
Ongoing training	Agreed-upon frequency	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.
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.
Ongoing training	Agreed-upon frequency	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.
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	<p>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</p> <p>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).</p>
Performance verification at the end of warranty period	Before warranty expires	<p>Provide physical inspection to verify that the installed equipment and its components have been properly maintained and operated (per O&amp;M manual).</p> <p>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.</p>
O&M training	Upon completion of installation	<p>Provide comprehensive training that includes ECM Cx protocol, O&amp;M as recommended by the manufacturer and any additional activities described in the ECM design, and ECM rCx protocol.</p> <p>Provide original equipment manufacturer manuals and cut sheets.</p> <p>Provide ECM Cx plan and rCx plan.</p> <p>Provide O&amp;M personnel with classroom training that includes hands-on activities, demonstrations, and video recording of training.</p> <p>Provide refresher training throughout contract period as described in the task order.</p>
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, <i>Grid Connected Photovoltaic Systems—Minimum Requirements for System Documentation, Commissioning Tests, and Inspections</i> (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	<p>Provide comprehensive training that includes ECM Cx protocol, O&amp;M as recommended by the manufacturer and any additional activities described in the ECM design, and ECM rCx protocol.</p> <p>Provide original equipment manufacturer manuals and cut sheets.</p> <p>Provide ECM Cx plan and rCx plan.</p> <p>Provide O&amp;M personnel with classroom training that includes hands-on activities, demonstrations, and video recording of training.</p> <p>Provide refresher training throughout contract period as described in the task order.</p> <p>Agency O&amp;M personnel to complete the FEMP training course on <i>O&amp;M for Optimal PV System Performance</i>.</p>
Ongoing training	Agreed-upon frequency	

<p>Periodic inspections and verification</p>	<p>Agreed-upon frequency</p>	<p>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 <i>Photovoltaic System Performance Monitoring—Guidelines for Measurement, Data Exchange and Analysis</i> has classifications of monitoring system (A, B, C) and the O&amp;M related to monitoring depends on the system class. Communications protocols with facility energy information system as per IEC 61850-90-7—<i>Object Models for Photovoltaic, Storage, and other DER inverters</i>.</p>
<p>Performance discrepancy resolution</p>	<p>Every time performance assurance service is completed</p>	<p>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.</p>