

## ***Example Retro-Commissioning Scope of Work***

### **To Include Services As Part of Super ESPC Detailed Energy Survey**

#### **Background**

**Agency** requests that **ESCo** perform retro-commissioning services<sup>1</sup>, as detailed herein, as a part of performing the Detailed Energy Survey (DES) for **site**. The incremental cost for these services will be covered as a part of the project development cost for the Super ESPC project, whether or not viable measures are identified and ultimately implemented.

It is the intent of the Agency to expand the work that will be performed during the DES. Leveraging the DES to complete a thorough scoping of retro-commissioning opportunities will substantially enhance the value of the ESCO services by ensuring that fundamental building systems are calibrated and operating as required to deliver functional and efficient performance. This work will also result in written system operation sequence for the included systems, which help train facility staff. Additional documentation of operating conditions prior to implementing retrofits will be valuable.

The cost effective measures identified in the Final Retro-Commissioning Report shall be included in the Final Proposal for a Super ESPC Delivery Order. The Agency agrees to credit the verified savings identified from these measures to the overall project, even if the measures are implemented by Agency staff prior to award of the Delivery Order (DO).

#### **Objectives**

The primary objectives for conducting these activities are:

- Enhance documentation of the operational and maintenance (O&M) requirements for the equipment and systems included
- Document baseline operating conditions through trending of performance measurements
- Optimize control systems through calibration of critical sensors, review metered data and trend logs, and functional equipment testing
- Identify operational and maintenance enhancements that result in improvements in energy efficiency, occupant comfort, or indoor air quality.
- Identify O&M staff training needs

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<sup>1</sup> Background information on retro-commissioning is available in *A Practical Guide for Commissioning Existing Buildings* through <http://eber.ed.ornl.gov/commercialproducts/retrocx.htm>.

## Systems To Be Included

(If it is not possible to include all major building systems and equipment, select the critical items for inclusion. Generally, the largest energy using equipment as well as systems known for having problematic controls, or operational and comfort problems should be included in the study. Refer to *Continuous Commissioning Guidebook*<sup>2</sup> for example measures and technical guidance.)

For all buildings included in the DES, the following systems should be included:

- Building automation system, including controlled devices, sensors, control loops, and logic
- Cooling systems
  - Central cooling plant
  - Primary air-handling units (AHUs)
  - Terminal units
  - DX systems
- Heating systems
  - Central boiler plant
  - Primary heating systems
- Fire safety / smoke purge aspects of the HVAC system
- Lighting systems
- Domestic hot water equipment
- Humidity control equipment
- Building pressurization controls

## Project Steps

### ***Overview of Project Steps***

The following summarizes the project steps, which are detailed in the following sections.

1. Review existing systems and related documentation
2. Develop Retro-Commissioning Plan
3. Perform calibration and maintenance checks
4. Implement diagnostic monitoring / trending
5. Perform functional tests
6. Analyze the monitoring / trending and test data

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<sup>2</sup> FEMP *Continuous Commissioning Guidebook for Federal Energy Managers* by Texas A&M University, October 2002 is available through <http://ateam.lbl.gov/my>.

7. Asses and document the current operating strategies and sequences of operation for all systems and equipment included
8. Document O&M improvement opportunities
9. Calculate energy impacts and develop implementation cost estimates for O&M opportunities
10. Develop and deliver the Final Retro-Commissioning Report
11. Include cost-effective measures in final proposal with other opportunities identified during the DES.

### ***Detailed Project Steps***

The following sections detail each of the project steps.

#### **Review Existing Systems & Documentation**

- Attending meetings through out the process including a retro-commissioning kick-off meeting in preparation for the site investigation.
- Interview Agency support staff and review the existing building documentation to determine the original specifications, design intent, and their relevance to current owner / user requirements. The following lists the documentation that needs to be gathered and reviewed:
  - Sub-metered utility data and energy bill (electric and gas) information for at least 12 months along with rate schedules
  - Drawings and specifications relevant to the systems scheduled for commissioning, especially control drawings and sequences of operation
  - Existing control points list for each building
  - Operating strategies programmed into the Energy Management and Controls System (EMCS)
  - Equipment list with nameplate information for equipment controlled by the EMCS
  - Existing O&M and system manuals for equipment
  - Test and balance (TAB) reports; sensor calibration documentation

#### **Develop Retro-Commissioning Plan**

Develop a Retro-Commissioning Plan for testing and reporting on the pertinent systems, including documentation strategies. The Retro-Commissioning Plan should include the following:

- Equipment , systems, or specific measures to be included, or selection criteria for inclusion
- Plan for reviewing existing systems and related documentation
- Define current operational requirements from original design documents and interviews with Agency staff

- Detailed plan for equipment calibrations, including calibration forms
- Maintenance checks to be performed
- Detailed plan for diagnostic monitoring / trending, including data archival
- Functional tests to be performed
- Methods to be used in analyzing the monitored / trended data
- Plan to assess and document the current operating strategies and sequences of operation for all systems and equipment included
- Strategies to be used in calculating energy impacts and implementation cost estimates for opportunities identified
- Implementation schedule
- Define the content of the Final Retro-Commissioning Report

#### **Perform Calibration and Maintenance Checks**

A list of sensors and actuators for calibration will be developed following a points list review. Using the trending capability of the control system for troubleshooting, testing and data gathering is a cost effective approach but only if the commissioning provider and building staff is confident that the sensors are reading properly. The appropriate amount of calibration work will depend on the level of confidence in the existing equipment and the history of problems with the controls equipment at an individual site. The calibration plan may include a comprehensive list of sensors and actuators, or critical components for select systems can be chosen. Example of critical control sensors include static pressure, outside air temperature, return air temperatures, mixed air temperature, discharge temperature, variable frequency drive (VFD) speed, flow meters, damper actuators, valve actuators, humidity sensors, and space temperature sensors.

Appropriate calibration procedures and required documentation should be included in the Retro-Commissioning Plan, including the following items:

- Test equipment used for calibration should have traceable calibration documentation provided in the final report.
- Document test equipment readings versus the EMCS sensor readings prior to adjustment.
- Document the adjustments made to match the EMCS sensor readings to the test equipment readings.
- A minimum of two points of calibration to check both slope and intercept is required for sensors seeing a wide range of conditions such as the outside air temperature sensors. Adjusting the offset may be sufficient for sensors seeing a narrow range of conditions.
- Document test equipment readings versus the EMCS sensor readings following adjustment (calibration) and note date and time of the adjustments made.

Two options for providing the needed labor and staffing to accomplishing the calibration procedures are outlined below, and summarized in Table 1. Both of the options require participation by Agency operating staff.

**Option A: Commissioning Provider (ESCO) & Agency Staff Conduct Calibrations**

Using forms and procedures developed by the Commissioning Provider (ESCO), the ESCO and Agency operating staff will investigate, document, and remedy any maintenance issues and perform calibrations as specified in the Commissioning Plan.

Successful completion of the calibrations is required prior to starting any monitoring, trending, and functional testing. This option is the least cost, but its viability depends on the level of expertise of Agency staff as well as their availability. This option is recommended. It provides the highest assurance of quality control and will help educate agency staff.

**Option B: Controls Contractor and Agency Staff Conduct Calibrations**

Using forms and procedures developed by the Commissioning Provider, the Controls Contractor and Agency staff would accomplish the calibration tasks specified in the Commissioning Plan.

The Agency would cover the cost of the Controls Contractor. This option may appear the most expensive (by hourly rate), but may actually take less time due to the Controls Contractor experience.

**Table 1: Options to Accomplish Calibration of Critical Sensors**

Option	Responsible Parties	Task Description	Cost Implication
A	Commissioning Provider (ESCO) assisted by Agency staff	Using forms and procedures developed ESCO, in-house support staff would work with Commissioning Provider (ESCO) to accomplish the calibration tasks would be participating with staff	Least cost depending on level of knowledge of staff and ability to make computer adjustments. Provides high level of quality control along with education for Agency staff
B	Controls Contractor assisted by Agency staff	Using forms and procedures developed Commissioning Provider (ESCO), the Controls Contractor, and Agency staff would accomplish the tasks	Most expensive by hourly rate but may be off set by taking less time due to Controls Contractor experience

**Implement Monitoring and Testing**

The commissioning provider provides a detailed request for required trend logs from the EMCS to the Agency staff or to the Controls Vendor, who executes the trends and provides the data to the commissioning provider (ESCO) in the specified electronic format.

If data loggers are required, the commissioning provider (ESCO) will provide and program the data loggers, which will be installed with the assistance of the facility staff. Facility staff may actually install current transformers and watt transducers on wiring inside electrical cabinets. Facility staff may also be responsible for removing the sensors

and data loggers, packaging them and sending them back to the provider for analysis after the end of the monitoring period.

#### **Functional Testing**

The commissioning provider (ESCO) oversees and conducts functional tests on selected equipment as specified in the Commissioning Plan, with the assistance of facility staff and Controls Vendor as required. Functional tests will be comprised of changing parameters, set-points or conditions and observing and documenting the actual system or equipment response through various modes and conditions (both simulated and real). Tests should be developed on a case-by-case basis to ensure functionality across normal operating conditions.

For equipment that is being monitored with sufficient points, manual testing may be accomplished by changing the parameters, etc. during the monitored period. The monitored data is then examined and used to document and verify correct or incorrect operation. Visual verification of equipment functionality may be required in instances that feedback from the control system is not available.

#### **Analyze Monitoring and Testing Data**

Once the data is gathered from monitoring and testing, the commissioning provider analyzes the findings by comparing actual equipment operation to appropriate operation and to the existing control sequences. Issues and potential improvements are identified and documented. Energy calculations are performed for those operational measures that appear to have the most impact to comfort, energy, or indoor air quality. Implementation costs for the measures will be estimated, and results will be presented in the Final Commissioning Report.

#### **Assess and Document Current Operating Strategies**

Commissioning provider will work with the Agency staff to develop a comprehensive building operations plan for the equipment and systems included in this scope of work, based on the original building specifications and current operational needs of the site.

#### **Document and Analyze O&M Improvements**

The Commissioning provider will document improvement opportunities identified. For the most promising measures, energy impacts will be calculated and implementation cost estimates developed.

#### **Develop Final Retro-Commissioning Report**

The Final Retro-Commissioning Report shall be issued once commissioning scoping activities are completed. This will be a separate deliverable from DO proposal, documenting the actions specified herein.

A Final Retro-Commissioning Report shall include the following information:

- Executive summary
- Project background and scope of the commissioning project
- Overview of activities conducted
- Details of all potential improvements identified and other findings, including:
  - Documentation of equipment conditions

- Identify any needed facility staff training
- Missing critical documentation
- The estimated implementation costs and the energy impacts for each improvement
- Current system operation sequences for all equipment and systems included

In Appendix:

- The Retro-Commissioning Plan
- The EMCS / data logger trended data, analysis, and annotated results. Electronic copies of the data should be provided.
- Completed calibration worksheets
- Documentation of government witnessing, as required

### **Include Recommended Measures in Final DES Proposal**

The Final Retro-Commissioning Report will be presented once all activities are completed, and will precede the presentation of the DES or Final Proposal. The cost effective measures identified in the Final Retro-Commissioning Report shall be included in the Final Proposal for a Super ESPC Delivery Order, including a detailed measurement and verification strategy for each one. Functional tests of all operational modifications should be included as part of the final acceptance procedures for each measure in the DO.

The Agency agrees to credit verified savings identified from these measures to the overall project, even if measures are implemented by Agency staff prior to award of the Delivery Order.

## **Roles & Responsibilities**

The following is an overview of the responsibilities for the team members, including Agency Lead Representative, Agency Technical Support Staff, the Commissioning Provider, and the Controls Contractor.

### **Agency Lead Representative**

- 1) Provides overall supervision of this project
- 2) Is the party referred to as the “owner”
- 3) Develops contractual agreements
- 4) Ensures the participation of Agency staff
- 5) Funds the participation of the controls contractor as needed
- 6) Attends meetings as necessary

### **Agency Technical Support Staff - Building Operator / Engineer**

- 1) Attends meetings as necessary
- 2) Reviews and accepts commissioning plan developed by Commissioning Provider

- 3) Ensures the participation of building personnel and controls contractors as needed
- 4) Assists in gathering the building documentation as needed
- 5) Provides input into the investigation process through interviews
- 6) Provides government witnessing of activities
- 7) Assists with implementation of sensor calibration
- 8) Performs or assists with setting up data trends in the EMCS
- 9) Performs or assists with the installation and removal of diagnostic equipment such as data loggers, as needed
- 10) Assists with performing functional tests
- 11) Ensures maintenance items affecting the project are remedied, such as replacing failed sensors

**Controls Contractor**

- 1) Attends project Kick-Off meeting to coordinate work
- 2) Assists with gathering data and setting up trends as needed
- 3) Assists with performing functional tests
- 4) Assists the Commissioning Provider in identifying and understanding the control sequences and programming of the EMCS

***Commissioning Provider (ESCO)***

- 1) Is the technical lead for this project
- 2) Conducts the Kick-Off meeting
- 3) Develops the Retro-Commissioning Plan
- 4) Reviews required documentation such as energy bills, sequences of operation, drawings, specifications, etc.
- 5) Conducts the operations site investigation including interviews, observations and analysis
- 6) Oversees all monitoring diagnostic planning and execution
- 7) Oversees any manual functional testing planning and execution
- 8) Conducts the engineering analysis and energy calculations
- 9) Develops the Final Retro-Commissioning Report