Rider A-1
Monitoring Based Commissioning (MBCx) for CSU Projects

Monitoring Based Commissioning (MBCx) Objectives

1. The purpose of an MBCx effort is to realize improved building performance. This performance can be assessed in terms of improved operating efficiencies, reduced maintenance, lower operating costs, and improved occupant comfort, which itself can be considered in terms of temperature, humidity, acoustical performance, draft reduction, improved lighting, etc.

2. Physical objectives include:
   • Establish/verify building level utility monitoring and document baseline operating conditions
   • Identify operational and maintenance improvement opportunities
   • Optimize existing systems
   • Provide updated documentation for operation and maintenance (O&M) of commissioned equipment and systems
   • Provide staff training to manage commissioned systems and help ensure persistence of savings

3. The MBCx scope is unique to each building. It will vary based on the building specifics and the funds available. The scope of work is intended to be refined and revised based upon the commissioning effort and findings during the course of the work.

4. Each MBCx effort is of necessity a phased and iterative effort. Each phase builds upon the previous phase. It is essential and central to this effort that the Commissioning agent works closely with the university to initially define and then refine needs during the course of the effort.

5. The following summarize the MBCx process. Subsequent sections detail the requirements of:
   5.1 Phase 1 - Initial Assessment
   5.2 Phase 2 - Develop MBCx Plan
   5.3 Phase 3 - Pre-MBCx Maintenance and Corrective Measures
   5.4 Phase 4 - Diagnostic and Functional Testing
   5.5 Phase 5 - Analysis of Monitoring and Testing Results
   5.6 Phase 6 - Documenting MBCx Improvements Options
5.7 Phase 7 - Implementation of MBCx Selected Improvements
5.8 Phase 8 - Post Improvement Verification and Documentation
5.9 Phase 9 - Final MBCx Report

6. MBCx projects are often funded, in part, by utility rebate/efficiency programs that provide utility rebate payments to the university based on documented MBCx performance (utility savings) gains. On projects where the university intends to seek program rebates an important part of the MBCx process will be to consider and pursue improvements to realize these rebates where practical. Practicality is critical. The most energy efficient building is useless to CSU purposes if user comfort/performance is not equally considered and provided.

7. The Monitoring Based Commissioning Agent’s (MBCxA) role differs from the advisory role of a Commissioning Agent in that the MBCxA is acting as the person in responsible charge or Engineer-of-Record, as the case may be, for the MBCxA design and for that design work will be preparing documents for a Contractor-of-Record or facilities staff to implement. The MBCxA will also verify and document the efficacy of the results.

8. The university recognizes and expects the MBCx effort to be an iterative process. Accordingly each phase must be fully documented prior to the start of a subsequent phase.

The MBCx Scope

1.0 Phase 1 - Initial Assessment
This phase serves to introduce team members and gather information. At the end of this phase the MBCx provider shall have sufficient information and understanding to develop a meaningful and responsive MBCx plan. This phase does NOT include the development of the MBCx plan.

1.1 The Service Provider engaged for this work is hereby designated as the Monitoring Based Commissioning Agent (MBCxA) for the project.

1.2 Organize and facilitate a project kick-off meeting to introduce the MBCx project team, outline the MBCx process, and confirm mutual understanding of scope, phased approach to services and goals specific to this project. Outline anticipated results.

1.3 Initiate an MBCx Project Log. Record and track MBCx project issues and events and their resolution during the course of the project in the MBCx Project Log. Update and submit the log at the end of each phase. Include an updated narrative summary of outstanding issues and recommendations for action with each log submittal.

1.4 Review available existing building documentation.
1.5 Interview building facilities operations staff.

1.6 Analyze available building-specific information to ascertain original design intent and compare to current university requirements. At a minimum, review the following:

   a. Utility data and energy billing (electric and gas) for at least a 12 month period
   b. Utility rate schedule applicable to building.
   c. Drawings and specifications relevant to systems to be commissioned. In particular this shall include existing building systems controls and sequence of operations documents.
   d. Equipment list and nameplate information for equipment controlled by EMS.
   e. Listing of existing control points.
   f. Description of operating strategies currently programmed into the building’s Energy management and Controls Systems (EMS).
   g. Review and list existing Operations and Maintenance (O&M) manuals for equipment.
   h. Review and list building system test and balance reports.
   i. Review and list building systems sensor calibration reports and documentation.

In each instance for the above identify where elements are missing or not available. Summarize available and missing documents as a part of MBCx project report.

1.7 Develop a Building Assessment Report. Meet with campus to present findings and discuss implications relative to the MBCx effort. Seek authorization to proceed with the next phase: MBCx Plan Development.

2.0 Phase 2 - Development of MBCx Plan

In this phase the MBCxA will develop and present to the university an MBCx plan. At the conclusion of this phase the MBCxA will have sufficient credible data to analyze and establish a baseline performance model for the project and will have determined the systems to be commissioned and the Pre-MBCx Maintenance and Corrective measures to be implemented.

2.1 MBCx is a targeted improvement effort. Generally it will not be possible or cost effective to review every building system. The MBCxA shall work closely with the university to determine what systems to include in this particular MBCx effort. Generally large energy using equipment, equipment known for having problematic controls, and systems that impact operational and comfort calls should be included.

2.2 Identify corrective maintenance measures that must be accomplished before a meaningful pre-functional and functional performance testing can be conducted. This may include items such as replacing or repairing failed or unreliable sensors and actuators, adding refrigerant charge to equipment, installing previously deferred EMS/BMS software updates, and other items that are known or apparent. The purpose
of these repairs and updates is to bring the facility into a state of good repair so that reliable testing results can be obtained.

A listing of ‘critical’ sensors to review would typically include: Static pressure, outside air, return air, mixed air and discharge temperatures, variable frequency drive speeds, flow meters, damper actuators, valve actuators, humidity sensors, and space temperature sensors.

2.3 Identify the main utilities serving the facility and evaluate any existing facility utility metering to verify that the meters are calibrated and functioning properly. Ascertain the capabilities of the existing monitoring systems to support the development of project baselines. If additional metering is required, or if corrective action is required for existing metering, the recommendations should be documented on the MBCx Project Log.

2.4 Study building plans and walk through the building to ascertain the capabilities of the existing monitoring systems relative to anticipated MBCx testing requirements. Identify system deficiencies that must be corrected before trending can commence. This may include items such as filter changes or calibration of sensors required for an MBCx effort. If additional trending capacities are required, or if corrective action is required for existing trending, the recommendations should be documented on the MBCx Project Log.

The university recognizes the importance of calibration of sensors for a meaningful MBCx effort and that there are several possible calibration approaches. The MBCx agent shall assess and define a calibration plan in the MBCx Plan Document and discuss alternative choices with the university so that an informed decision is made to secure reliable trending data.

2.5 Develop an MBCx Plan Document. This document shall include:

a. Equipment, systems and specific measures recommended being included
b. A narrative describing the selection criteria for inclusion
c. Listing of MBCx participants and their respective responsibilities
d. Plan narrative for update/augment of existing systems and documentation
e. Plan narrative summarizing current operational requirements (based on original documents and staff interviews) and recommended changes
f. Plan narrative for equipment calibration (include calibration forms)
g. Plan narrative for maintenance checks to be performed
h. Pre-Functional tests to be performed
i. Functional tests to be performed (a good reference for functional test protocol can be found on line at: http://www.peci.org/ftguide/)
j. Plan for diagnostic monitoring, trending and data archival
k. Monitoring and verification methods to be used in analyzing monitored and trended data

l. Plan narrative to assess current operations and sequence of operations

m. Methodology to be used to calculate energy impacts and cost estimates for identified MBCx opportunities

n. MBCx implementation schedule

o. Outline template for ‘final’ MBCx report

2.6 Review with the MBCx Plan Document with university. Assess time and effort and estimated implementation costs to complete each proposed improvement. Prioritize scope with university. Reconcile projected costs to complete with available funds. Reserve prudent contingencies to complete tasks and have a useful work product. Secure university approval to proceed with the next two phases.

3.0 Phase 3 - Pre-MBCx Maintenance and Corrective Measures

This phase serves to implement the maintenance and corrective measures accepted for action in Phase 2. At the conclusion of this Phase (3) the agreed to collective measures will be in place and confirmed such that Phase 4, Diagnostic and Functional Testing can be conducted.

3.1 Work with university to help facilitate the implementation of the agreed to maintenance and corrective measures that will permit proper monitoring and trending. Please note that no operation changes to the facility should be made prior to finalizing the facility baseline. If operational changes are made prior to finalizing the baseline, they will not be captured in the evaluation of the project’s savings and may effect project utility rebates.

Verify that each item is addressed and returned to operational status sufficient for the MBCx purposes.

3.2 Update the MBCx Findings Log and MBCx Plan Document to reflect the changes made. Review with campus. Secure approval to proceed to Phase 4 - Diagnostic and Functional Testing.

4.0 Phase 4 - Diagnostic and Functional Testing

This phase will see the installation data trackers, the acquisition of performance data and functional testing of systems. At the conclusion of this phase the MBCxA will have sufficient credible data to analyze and establish a baseline performance model for the project. Analysis will occur in the next phase.

4.1 Set up EMS/BMS systems for testing.
4.1.1 Identify the points that are required to be monitored and the frequency of the sampling and download. The download frequency will depend on the analysis and diagnostics planned. It is up to the MBCxA to determine these parameters.

4.1.2 Identify and specify necessary components to supplement existing monitoring capabilities of the existing EMS/BMS system. *In phase 2, the EMS/BMS software may have been upgraded to be able accommodate additional sensors.*

4.1.3 Identify suitable providers for instrumentation.

4.1.4 Procure instrumentation.

4.1.5 Install instrumentation (either physically or oversee that the installation will provide the needed monitoring).

4.1.6 Who actually physically installs the sensors onto the EMS/BMS system will vary, per project. Under this agreement the MBCxA is not required to install the test equipment, but may do so if allowed by the university. If the university elects not to allow this and instead direct its own forces or other parties to install the sensors the MBCxA shall still confirm that the installation is sufficient for the intended purposes.

4.1.7 Confirm correct function of instruments. Document calibration activities.

4.2 Set up data collection routines

4.2.1 Identify the points that are to be monitored and the sampling and download frequencies.

4.2.2 Set up (or cause to be set up) monitoring trends in the EMS software to begin collecting this data. Set up (or cause to be set up) necessary mechanisms to transfer data to a central platform for later analysis.

4.2.3 Set up (or cause to be set up) individual data loggers to collect desired information. Set up (or cause to be set up) necessary mechanisms to transfer data to a central platform for later analysis.

4.3 Prepare for data analysis

4.3.1 Create template charts and tables to receive calculated data.

4.3.2 Check data sampling to ensure that reliable transmission is present and that data is in useable form.

4.3.3 Do not proceed further until data quality is confirmed as acceptable. Document.

4.4 Data collection for baseline creation

4.4.1 Analyze utility and collected data to establish update building, system and equipment baseline performance.
4.4.2 Coordinate and ensure that data collection procedures and durations are consistent with the specific MBCx Project Requirements for the Utility rebate programs that this MBCx effort will be applying for.

4.5 Conduct Pre-Functional Testing

4.5.1 In phase 2 the MBCx plan determined the objectives and scope for this testing. Conduct this testing per the agreed to plan.

4.5.2 Perform pre-functional testing. Witness and adequately document.

4.6

4.6.1 In phase 2 the MBCx plan determined the objectives and scope for this testing. Conduct this testing per the agreed to plan.


4.7 Develop the M&V Plan. The M&V Plan should document the data required to assess and verify the project performance, detail the approach to creating facility baselines, and assess any risk foreseen in collecting the required data.

4.8 Gather all data collected. Review for completeness and suitability for analysis. If not present resample data and or conduct additional performance functional testing as needed to ensure a useable data set is present for analysis.

4.9 Update the MBCx Findings Log and MBCx Plan Document to reflect progress and actions taken to date. Review progress status and upcoming phase scope with campus. Secure approval to proceed to Phase 5 - Analysis of Monitoring and Testing Results.

5.0 Phase 5 - Analysis of Monitoring and Testing Results

During this phase the MBCxA will analyze collected results against baseline readings. Based on the results preliminary recommendation paths for MBCx improvements will be apparent.

5.1 Analyze utility and collected data to update building, system and equipment baseline performance.

5.2 Analyze date to identify issues and likely improvement opportunities.

5.3 Update the MBCx Findings Log and MBCx Plan Document to reflect progress and actions taken to date.

5.4 Review progress status and upcoming phase scope with campus. Determine, in a general way, approaches that hold the most promise relative to cost to implement, time to implement and needs of project, rebates effectiveness, program disruption, etc. This is a general review of factors. A detailed recommendations listing is the scope of the next phase.

5.5 Secure approval to proceed to Phase 6 - Documenting MBCx Improvements Options.
6.0 Phase 6 - Documenting MBCx Improvements Options

During this phase the MBCxA will thoroughly investigate and draft option proposals based on the general scoping discussions held in the prior phase. At the conclusion of this phase options, estimated costs, impacts and potential returns will be presented for university evaluations and direction.

6.1 Based on the scoping discussions with the university in the previous phase, develop MBCx Improvement Options Report for the project. These options shall outline:

1. Cost to implement
2. Time to implement
3. Estimated campus impact to implement
4. Estimated benefit and comparisons (Benefit on an annual basis, Return on investment, break-even point
5. Estimated effectiveness /limitations. (i.e. life expectancy of proposed improvements.)
6. Operational impacts of the proposes changes
7. Evaluation of ‘other factors’ I.e., potential LEED point awards based on building performance or building innovations considered.
8. Other due diligence considerations

6.2 Consider and list potential soft improvements, i.e., plant operational changes and user operational changes. Describe costs impacts etc. as per above.

6.3 Prepare a listing of other improvements that were considered but not pursued. Provide a brief narrative of reasons. I.e. excessive payback period, exceeds available funds to impellent, etc.

6.4 Meet with campus to present draft report and discuss implications. Reconfirm budget status. Seek direction from university on which recommendations to pursue.

6.5 Update the MBCx Findings Log and MBCx Plan Document to reflect progress and actions taken to date.

6.6 Revise report to address university comments. Issue final report that include campus MBCx selections.

6.7 Document university direction via letter.

6.8 Seek university approval for phase 7 - Implementation of MBCx Selected Improvements.

7.0 Phase 7 - Implementation of MBCx Selected Improvements

During this phase MBCx improvement selected by the campus will be physically installed.

7.1 Coordinate with campus to develop appropriate scope(s) of work to realize installation of selected improvements. Participate in campus pre-bid and kick off meeting with
contractor(s). Act as a campus resource to respond to RFI’s relative to intent of selected improvements.

7.2 Witness and confirm installation of selected improvements.

7.3 Update the MBCx Findings Log and MBCx Plan Document to reflect progress and actions taken to date.

7.4 Review progress status and upcoming phase scope with campus.

7.5 Seek university approval for Phase 8 - Post Improvement Verification and Documentation.

8.0 Phase 8 - Post Improvement Verification and Documentation

During this phase MBCxA will test and document the results of improvements made.

8.1 Perform any necessary functional performance testing of building, and gather subsequent trend data and in order to verify the implementation of intended improvements. University will work with MBCxA to establish a timeline for post-improvement verification.

8.2 Evaluate results and assess if results are at, below or exceed expectations.

8.3 Evaluate if adjustments or other rework is warranted to improve performance. Implement accordingly. Retest.

8.4 Revised performance calculations to reflect tested results.

8.5 Update the MBCx Findings Log and MBCx Plan Document to reflect progress and actions taken to date.

8.6 Meet with campus to present draft final report and discuss implications. Gather information and forms necessary to apply for utility rebates.

8.7 Seek university approval for Phase 8 - Post Improvement Verification and Documentation.

9.0 Phase - Final MBCx Report

During this phase MBCxA will develop the final MBCx report and conduct handover training with university.

9.1 Ensure that updated information and systems’ documentation is present.

9.2 Coordinate with university to conduct training for building operators. This training seeks to ensure persistence of results.

9.3 Update the MBCx Findings Log and MBCx Plan Document to reflect progress and actions taken to date.
9.4 Develop final MBCx report. Incorporate university comments received from draft report presented in prior phase. The purpose of the final report is to provide a narrative and exhibits to fully describe the changes made their implications and how to manage these changes for persistence of the gains. **The final MBCx report should be sufficient to be a complete operating reference.** Provide attachments to the final report that include: revised sequence of operations, building control points list, control set points, system diagrams, etc.

9.5 Meet with campus to recap the process, findings and results realized. Review utility rebate application forms with campus and present to campus for university submittal and action.

9.6 Issue close out letter and final invoicing to campus. Identify on invoice that the MBCx project effort has been completed and that upon final payment the university may close out the project contract.

9.7 **Scope of work concludes. Project is complete.**

10.0 Service Duration

10.1 The term of the service authorization shall begin at the onset of MBCx effort and conclude upon presentation and acceptance by the University of the final MBCx report.

10.2 The final MBCx report may extend through all phases or may terminate as directed by campus at an earlier phase. Unless otherwise specially directed by the campus a summary ‘final report’ shall be developed and provided if university elects to close out the project prior to the completion of a full MBCx effort.

11.0 Fee

11.1 Commissioning fee for this project shall be provided on an hourly rate in accordance with the Billing Rate Table agreed and attached hereto as Exhibit B with a maximum ‘not to exceed’ amount identified. Invoicing for services shall be provided monthly.

11.2 Payment shall be made for in arrears of services provided to the satisfaction of the trustees.

12.0 Deliverables by phase

12.1 Provide electronic copies of reports and phase drafts.

12.2 Deliver to campus via email or FTP, Drop box, etc.

12.3 Provide two print copies of the final report copies to university.

12.4 Provide one electronic final report copy to CPDC, Office of the Chancellor.
13.0 Reimbursables

13.1 **MBCx Equipment:** Reasonable data logging device rentals are reimbursable on a pass through basis without mark up. Review with the university in advance to determine where it makes sense to rent or purchase devices.

13.2 **Reprographics:** Reasonable non-local travel and outsourced reprographic expenses are reimbursable under this agreement. Claims for reimbursable items shall be without mark-up for directly related project charges incurred. Provide supporting documentation as a part of claim submittal. In general, travel reimbursement will be provided for project-related travel within the following limitations:

13.3 **Travel Reimbursement:**

   1. Local travel, less than 30 miles to campus, contractor, or project site is not reimbursable.

   2. Reasonable travel costs for distances greater than (30) thirty miles are reimbursable.

13.4 **Commercial Air Travel:** Reasonable airfare costs will be reimbursed when air travel is required. Reimbursement shall be limited to reasonable air fare charges incurred for refundable economy class travel.

   *Generically reasonable example: Southwest Airlines into San Jose with a rental car into Monterey. Generically unreasonable example: United Airlines into Monterey and needing to incur similar rental car charges where that cost is disproportionate to the San Jose cost.*

13.5 **General Aviation:** General aviation travel is reimbursable. **Total** reimbursement (including fuel and tie down and any other costs) shall be **conservatively** limited to approximate equivalent fare amounts that would otherwise be incurred via reasonable commercial air travel from a serving regional airport.

13.6 **Rental Car:** Reasonable rental car costs will be reimbursed when air travel is required.

13.7 **Private Automobile Mileage:** Travel by personal automobile beyond a 30 mile radius will be reimbursed at current federal mileage rates.

13.8 **Lodging:** Lodging costs will be reimbursed up to the current CSU per diem maximum.

13.9 **Meals:** Meal costs will be reimbursed when overnight travel is required at the CSU per diem maximum.

14.0 Authorization by Phase

14.1 This work is expected to occur in phases. Secure authorization by phase prior to the start of work. Receipt of this executed agreement constitutes authorization to begin
Phase 1 efforts.

14.2 Subsequent phases will be authorized by letter. Each letter will identify a not to exceed maximum as agreed upon between contractor and campus for that phase. The service provider shall monitor their efforts and work on the project and shall coordinate with the university for agree upon on projected time/cost to complete each phase during its progress.

14.3 Campus cost control is very important. The service provider needs to work with the campus to predict and manage service provider expenditures on this MBCx project.

The service provider shall monitor their work and advise the university if the feel this amount is likely to be approached or exceeded. Should this occur the university will evaluate and either issue a letter authorizing a higher NTE figure for this phase or issue other direction. It is important to understand that the NTE value does not ‘roll over’ automatically into the next phase. Each phase will be authorized with its own amount.

15.0 Extra Services

15.1 Extra services are distinct from the above. Extra services examples might include authorizations to explore additional work or revisit in a significant way work previously approved and concluded. In the main, extras services are not anticipated for an MBCx project.

15.2 This agreement may authorize extras services via issue of an Extra Service Work Authorization describing the supplemental related project work and agreed fee. Such work must be countersigned by the Service Provider to take effect.

15.3 Extra service work MUST be authorized in advance.

16.0 Invoicing

16.1 Prepare monthly invoicing using supplied invoicing template. For each invoice provide supporting back-up information identifying staff performing work, hourly rate, and hours being billed.

16.2 Payment for services will be made upon presentation of a written invoice in arrears of work completed to the satisfaction of the trustees.

17.0 Project Manager

The University Project Manager and point of contact for this project is:
[Name]
[Contact address]
[Contact Phone]
[Contact Email]
18.0  **SCOPE SUMMARY**

18.1  Campuses may revise this scope during the contracting process to accommodate schedule, maximize incentives and adhere to the goals and processes of the UC/CSU/IOU Energy Efficiency Partnership. More information on the partnership program can be found at: [http://www.uccsuioe.org/index.html](http://www.uccsuioe.org/index.html). Scope revisions shall be included in this section.

1.  Campus scope revisions, omissions, additions, etc. **[Campus to revise this section as needed to address specific project goals]**

18.2  This work initially includes Phase 1 efforts.

18.3  **Phase 1 is authorized to proceed with a not to exceed (NTE) value of ______________ with an expected project completion date of ___________ (# of days).**

18.4  If it is necessary to extend this amount for this phase this will be authorized by separate letter.

18.5  Secure written authorization for each phase prior to proceeding.

18.6  Coordinate and confirm kick off meeting with the project manager.

    Kick off meeting date  **[Campus to insert agreed upon date]**