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Commercial Workforce Credentialing Council

Building Commissioning Professional
Educational/Training Outline

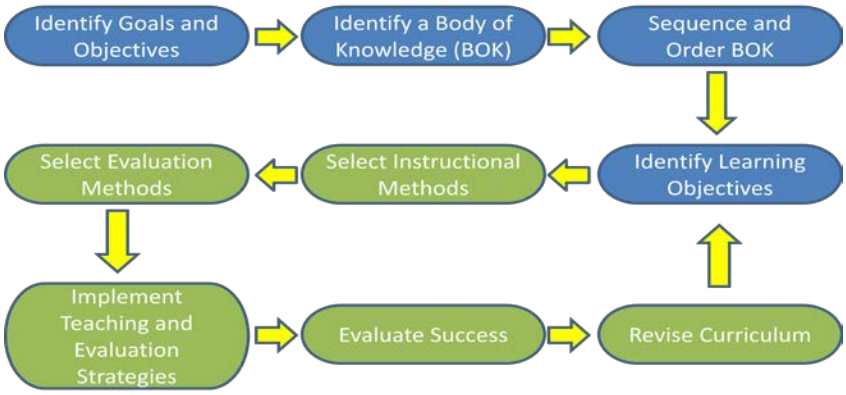
Introduction

A Building Commissioning (Cx) Professional is an individual who leads, plans, coordinates and manages a commissioning team to implement commissioning processes in new and existing buildings. The major tasks of a Building Commissioning Professional are to:

- Manage Commissioning Projects
- Prepare Commissioning Documentation
- Conduct Commissioning Activities
- Manage Training Activities
- Complete Warranty Phase Activities
- Conduct Existing Building Commissioning
- Conduct On-Going Commissioning

Curriculum Design

The process used to define the components to be included in an educational/training program for Building Commissioning Professional includes the stages as depicted in the following graphic:



The goals and objectives of an educational/training program must first be defined. For purposes of this program, the goals and objectives of the educational/training program are as follows:

- To prepare an individual to work as an entry level Building Commissioning Professional

- To provide building commissioning foundational knowledge to allow an individual to function sufficient to obtain the experience required to meet eligibility requirements for obtaining a professional credential as a Building Commissioning Professional.

Then a body of knowledge must be identified. In the case of Building Commissioning Professional the body of knowledge was identified through a job/task analysis. The body of knowledge was then sequenced and ordered to facilitate instruction of the content.

Curriculum

Following is a proposed curriculum. This curriculum is designed to cover all content for which a Building Commissioning Professional should be proficient. However not all content may be taught in a single course. For example some of the content may be part of other building construction programs. To use the course outline, community colleges and vocational institutions are recommended to review existing courses to identify content that may already be incorporated in existing courses. Then a course should be developed only to cover the remaining content not covered in existing courses. Instructional design experts and instructional staff would then select the learning activities to ensure the student learns the content including:

- Selection of textbooks and other appropriate course materials
- Creation of learning activities (lectures, handouts, performance activities, etc.)
- Creation of assessment and evaluation activities to verify learning
- Creation of curriculum evaluation activities

Course Outline

I. Building Systems

a. Air distribution systems
b. Access controls systems
c. Audio-visual systems
d. Automated windows and blinds systems
e. Building automation systems
f. Building control systems
g. Building envelope
h. Chilled water systems
i. Combined heat and power systems
j. Communication systems
k. Condenser water systems
l. Conveying systems
m. Domestic hot water systems
n. Electrical power quality monitoring systems
o. Electrical power system and Emergency power systems

p. Emergency communication systems
q. Energy metering and monitoring systems
r. Energy recovery systems
s. Fire alarm systems
t. Fire protection (sprinkler) systems
u. Fuel oil systems
v. Gray and black water systems
w. HVAC control systems
x. HVAC system or HVACR systems
y. Irrigation systems
z. IT systems
aa. Laboratory gas systems
bb. Life safety systems
cc. Lighting control systems
dd. Lighting systems
ee. Low temperature refrigeration systems
ff. Medical gas systems
gg. Nurse call systems
hh. Plumbing systems
ii. Pneumatic tube systems
jj. Potable cold water systems
kk. Public address systems
ll. Pumps and pumping systems
mm. Renewable energy system (CHP, PV, Wind, Thermal, etc.)
nn. Security systems
oo. Smoke evacuation systems
pp. Space scheduling systems
qq. Steam and hot water systems (heating)
rr. Steam distribution systems
ss. Variable speed (frequency) drive systems
tt. Vertical transportation systems
uu. Water distribution and control systems

II. Commissioning Projects and Planning

a. Scopes of commissioning projects
b. Commissioning project teams
c. Commissioning project budgets
d. Commissioning schedules
e. Sampling procedures
f. System verification procedures
g. System integration testing

h. Commissioning deliverables
i. Value engineering
j. Construction Management
k. Functional performance tests and results
l. Commissioning meetings
m. End of warranty reviews

III. Managing Commissioning Activities
a. Planning commissioning construction activities
b. Monitoring commissioning construction activities
c. Facilitating the completion of commissioning construction
d. Acceptance of construction

IV. Commissioning Project Documentation and Data
a. Owner's project requirements
b. Commissioning plans
c. Commissioning specifications
d. Facility requirements
e. System and equipment lists
f. Basis of design
g. Legal contract documents
h. Design documents
i. Design modifications
j. Project code requirements
k. BIM models
l. Submittals
m. Factory witness tests
n. Schedules
o. Sequence of operations
p. Training materials and plans
q. Installation documents
r. Contractor start-up reports
s. Mechanical acceptance testing forms
t. BAS software
u. TAB reports
v. Operation manuals
w. Record documents (as-builts)
x. Commissioning reports
y. Utility bills
z. Maintenance records
aa. Trend logs

bb. Contracts (with utilities, chilled water, steam, etc.)
cc. O&M contracts
dd. BAS contracts
ee. Issues logs
ff. System manuals
gg. System verification checklists
hh. Commissioning progress reports
ii. Commissioning final reports

V. Training
a. Training plans
b. Conducting training
c. Training follow-up activities

VI. Warranty Activities
a. Off-season testing
b. Troubleshooting facility issues
c. Measuring energy performance
d. End of warranty meetings

VII. Existing Building Commissioning
a. Determining scope of projects
b. Building performance assessments
c. Preparing CFRs
d. Systems assessments
e. Site investigations
f. Identifying corrections and improvements
g. Implementation of corrective measures
h. Performance verifications

VIII. Ongoing Commissioning
a. IEQ performance measurements
b. Building system performance evaluations
c. Analyzing building operating plans
d. Building maintenance activities
e. Space/function changes
f. Corrective actions
g. Measurement and performance results

IX. Commissioning Tools and Equipment
a. Adjustable pliers

b. Adjustable wrench
c. Allen wrenches
d. Anemometer
e. Balometer
f. Blower Door Test Equipment
g. Boroscope
h. Calibration equipment
i. Channel locks
j. Circuit tracer
k. Combination wrenches
l. Combustion analyzing instruments
m. Computer test equipment
n. Digital thermometer (surface and air)
o. Dosimeter
p. Electrical Meters
q. Extension magnet
r. Flashlight
s. Flow meters
t. Gas Analyzers
u. Hydrometer
v. Hygrometer
w. Infrared thermometer
x. Inspection mirror
y. Labeling machine
z. Ladders
aa. Laser levels
bb. Light meters
cc. Locking pliers
dd. Lock-out/Tag-out equipment
ee. Manometer
ff. Markers
gg. Measuring devices
hh. Megohmmeter
ii. Moisture meter
jj. Multimeter
kk. Nut drivers
ll. Pipe wrenches
mm. Pliers
nn. Pocket knife
oo. Pocket level
pp. Power analyzer

qq. Psychrometers
rr. Rain gear
ss. Ratchets
tt. Refractometer
uu. Refrigerant gauges
vv. Refrigeration test equipment
ww. Rubber mallet
xx. Screw drivers
yy. Small power tools (hand electric drill)
zz. Smoke stick
aaa. Socket sets
bbb. Sound meters
ccc. Square
ddd. Stop watch
eee. Stroboscope
fff. Tachometers
ggg. Tape measure
hhh. Temperature measuring device
iii. Thermal imaging camera
jjj. Torque wrench
kkk. Velometer
lll. Vibration analysis instrument
mmm. Wire Brush
nnn. Wire cutters
ooo. Wire nuts

X. Electrical Tools
a. Amp Probe
b. Electrical gloves
c. Electrical multimeter
d. Electrical tape
e. Electrically insulated tools
f. Fake Smoke
g. GFCI Equipped Extension Cords

XI. Plumbing Tools
a. Backflow preventer test equipment
b. Peppermint test equipment
c. Pressure test plugs

XII. Testing and Balancing Tools

a. Air data meter
b. Differential pressure gauges
c. Flow hoods
d. Flow measuring device
e. Flow tree
f. Hydro data meter
g. Magnehelic gauges
h. Pitot tubes
i. Thermometers

XIII. Commissioning Software

a. Computer aided drafting software
b. BIM and related software
c. Building automation systems
d. Building energy modeling software
e. Computer aided facility management (CAFM)
f. Computerized maintenance management system (CMMS)
g. Construction management software
h. Data analysis software
i. Energy management system
j. Energy Star Portfolio manager
k. Integrated work management system (IWMS)
l. Project management software
m. Scheduling management software
n. Spreadsheets/Word Processing/Presentation (Microsoft)

XIV. Technology Tools

a. Computer with:
    1. Spreadsheet applications
    2. Internet access
    3. Word processing applications
    4. Data storage
    5. Graphics software
    6. External data storage/backup
b. Data gathering:
    1. Data loggers with sensors (t/h/kw/on-off)
    2. Thermal imaging
    3. Vibration analysis
    4. Direct digital controls
c. Smart phone with:
    1. Camera

2. Internet access
3. Two-way communications
4. Video recording/transmitting
5. Wi-Fi access

d. Tablet computer

XV. Personal Protective Equipment

a. Arc flash protection (NFPA 70e)
b. Back protection
c. Dust masks
d. Eye protection/safety glasses
e. Face shield
f. Fall protection
g. Gloves
h. Hardhat
i. Hearing protection (plugs and muffs)
j. Respirator
k. Rubber boots
l. Safety harnesses
m. Vests
n. Work shoes (toe and shank protection)

Learning Objectives

The following learning objectives are identified as the desired outcome of instruction. These objectives should be reviewed and sequenced according to like objectives by subject matter experts familiar with the content.

1. Upon completion of the course, the student will be able to manage Cx projects
2. Upon completion of the course, the student will be able to identify scopes of Cs projects
3. Upon completion of the course, the student will be able to develop a list of tasks associated with Cx projects
4. Upon completion of the course, the student will be able to review systems to be commissioned
5. Upon completion of the course, the student will be able to identify the type of building to be commissioned or re-commissioned
6. Upon completion of the course, the student will be able to identify the commissioning deliverables
7. Upon completion of the course, the student will demonstrate knowledge of building systems
8. Upon completion of the course, the student will demonstrate knowledge of construction scheduling
9. Upon completion of the course, the student will demonstrate knowledge of Cx manpower requirements
10. Upon completion of the course, the student will demonstrate knowledge of Cx processes and procedures

11. Upon completion of the course, the student will demonstrate knowledge of Cx schedules
12. Upon completion of the course, the student will demonstrate knowledge of Cx sequence of events
13. Upon completion of the course, the student will be able to develop a Cx team
14. Upon completion of the course, the student will be able to determine in-house team capabilities
15. Upon completion of the course, the student will be able to identify stakeholders for Cx projects
16. Upon completion of the course, the student will be able to identify needs for outside consultants for Cx projects
17. Upon completion of the course, the student will be able to select a Cx team
18. Upon completion of the course, the student will be able to identify service maintenance providers
19. Upon completion of the course, the student will be able to determine IT requirements for Cx projects
20. Upon completion of the course, the student will demonstrate knowledge of construction contracting
21. Upon completion of the course, the student will be able to manage a Cx budget
22. Upon completion of the course, the student will be able to review Cx fees
23. Upon completion of the course, the student will be able to evaluate an overall Cx project budget
24. Upon completion of the course, the student will be able to develop Cx project execution plans and timelines
25. Upon completion of the course, the student will be able to recalibrate a Cx project plan
26. Upon completion of the course, the student will be able to evaluate invoices from consultants
27. Upon completion of the course, the student will be able to analyze costs against the budget
28. Upon completion of the course, the student will be able to account for project costs that might affect the budget
29. Upon completion of the course, the student will be able to assist contractors in developing their Cx budgets
30. Upon completion of the course, the student will be able to identify Cx deliverables
31. Upon completion of the course, the student will be able to identify building systems
32. Upon completion of the course, the student will be able to identify the components and equipment associated with the building systems
33. Upon completion of the course, the student will be able to identify the tasks associated with each component (what tests you will perform, etc.)
34. Upon completion of the course, the student will be able to document deliverables
35. Upon completion of the course, the student will be able to identify Cx deliverable timelines and schedules
36. Upon completion of the course, the student will be able to participate in VE activities
37. Upon completion of the course, the student will be able to conduct an ROI analysis
38. Upon completion of the course, the student will be able to evaluate recommendations and alternatives
39. Upon completion of the course, the student will be able to associate budgets with recommendations and alternatives
40. Upon completion of the course, the student will be able to interpret the value of the impact on the OPR
41. Upon completion of the course, the student will demonstrate knowledge of construction budgeting and costing
42. Upon completion of the course, the student will demonstrate knowledge of OPR

43. Upon completion of the course, the student will demonstrate knowledge of ROI analysis
44. Upon completion of the course, the student will be able to review project documents
45. Upon completion of the course, the student will be able to review the OPR/CFR
46. Upon completion of the course, the student will be able to review the BOD
47. Upon completion of the course, the student will be able to review the division of responsibilities
48. Upon completion of the course, the student will be able to review other team member responsibilities
49. Upon completion of the course, the student will be able to review legal contract documents
50. Upon completion of the course, the student will be able to review the design documents
51. Upon completion of the course, the student will be able to design suggestions for modifications
52. Upon completion of the course, the student will be able to verify the project is to code
53. Upon completion of the course, the student will be able to review BIM models
54. Upon completion of the course, the student will be able to review submittals
55. Upon completion of the course, the student will be able to review factory witness tests
56. Upon completion of the course, the student will be able to review schedules
57. Upon completion of the course, the student will be able to review sequence of operations
58. Upon completion of the course, the student will be able to review training materials
59. Upon completion of the course, the student will be able to review installation documents
60. Upon completion of the course, the student will be able to review contractor start-up reports
61. Upon completion of the course, the student will be able to review mechanical acceptance testing forms
62. Upon completion of the course, the student will be able to validate BAS software
63. Upon completion of the course, the student will be able to review TAB report
64. Upon completion of the course, the student will be able to review operation manuals
65. Upon completion of the course, the student will be able to review record documents (as-builts)
66. Upon completion of the course, the student will be able to review previous Cx reports
67. Upon completion of the course, the student will be able to review utility bills
68. Upon completion of the course, the student will be able to review maintenance records
69. Upon completion of the course, the student will be able to review trend logs
70. Upon completion of the course, the student will be able to review existing contracts (with utilities, chilled water, steam, etc.)
71. Upon completion of the course, the student will be able to review O&M contracts
72. Upon completion of the course, the student will be able to review BAS contracts
73. Upon completion of the course, the student will demonstrate knowledge of BAS or monitoring systems
74. Upon completion of the course, the student will demonstrate knowledge of sampling protocols and procedures
75. Upon completion of the course, the student will be able to monitor the construction/project schedule
76. Upon completion of the course, the student will be able to create project schedules
77. Upon completion of the course, the student will be able to maintain project schedules
78. Upon completion of the course, the student will be able to insert Cx milestones and durations into master construction schedules
79. Upon completion of the course, the student will be able to identify when adjustments to schedules need to be communicate
80. Upon completion of the course, the student will be able to review meeting minutes

81. Upon completion of the course, the student will demonstrate knowledge of general construction processes
82. Upon completion of the course, the student will be able to conduct Cx meetings
83. Upon completion of the course, the student will be able to prepare agendas for meetings
84. Upon completion of the course, the student will be able to facilitate a design Cx kick-off meeting
85. Upon completion of the course, the student will be able to facilitate a construction Cx kick-off meeting
86. Upon completion of the course, the student will be able to facilitate Cx meetings
87. Upon completion of the course, the student will be able to facilitate sequence of operation review meetings
88. Upon completion of the course, the student will be able to write meeting minutes
89. Upon completion of the course, the student will be able to track deficiencies (issues log)
90. Upon completion of the course, the student will be able to identify issues
91. Upon completion of the course, the student will be able to characterize identified issue
92. Upon completion of the course, the student will be able to participate in resolution processes for identified issue
93. Upon completion of the course, the student will be able to verify resolution of issues
94. Upon completion of the course, the student will be able to document issue resolution
95. Upon completion of the course, the student will demonstrate knowledge of engineering principles
96. Upon completion of the course, the student will demonstrate knowledge of OPR
97. Upon completion of the course, the student will be able to facilitate risk assessment as it relates to Cx activities
98. Upon completion of the course, the student will be able to review Cx Plan, testing approaches, and protocols
99. Upon completion of the course, the student will be able to facilitate a safety review
100. Upon completion of the course, the student will be able to conduct integrative testing
101. Upon completion of the course, the student will be able to monitor Cx schedules
102. Upon completion of the course, the student will be able to monitor construction schedules
103. Upon completion of the course, the student will be able to review communication protocols (e.g., two-way radios)
104. Upon completion of the course, the student will be able to participate in the risk mitigation
105. Upon completion of the course, the student will be able to review budgets as related to Cx activities
106. Upon completion of the course, the student will be able to review project management for risk mitigation as related to Cx activities
107. Upon completion of the course, the student will demonstrate knowledge of Cx processes and procedures
108. Upon completion of the course, the student will demonstrate knowledge potential environmental, health and safety (EHS) hazards and risks
109. Upon completion of the course, the student will demonstrate knowledge of risk assessment and management
110. Upon completion of the course, the student will demonstrate knowledge of safety practices
111. Upon completion of the course, the student will demonstrate knowledge of testing equipment and procedures
112. Upon completion of the course, the student will demonstrate knowledge of testing standards

113. Upon completion of the course, the student will be able to assess pass/fail criteria for functional test results
114. Upon completion of the course, the student will be able to document Cx team participant
115. Upon completion of the course, the student will be able to complete functional tests
116. Upon completion of the course, the student will be able to review functional tests results
117. Upon completion of the course, the student will be able to review issues log
118. Upon completion of the course, the student will be able to recommend whether findings are compliant with OPR/CFR
119. Upon completion of the course, the student will demonstrate knowledge of functional testing procedures, equipment and results
120. Upon completion of the course, the student will demonstrate knowledge of systems interactions and integration
121. Upon completion of the course, the student will demonstrate knowledge of trend analysis
122. Upon completion of the course, the student will be able to Identify tasks for completion of Cx process
123. Upon completion the course, the student will be able to verify completion of resolution of issue log
124. Upon completion of the course, the student will be able to complete the commissioning report
125. Upon completion of the course, the student will be able to review owner's turnover criteria for commissioning project
126. Upon completion of the course, the student will be able to schedule off-season mode testing
127. Upon completion of the course, the student will be able to schedule end-of -warranty meeting
128. Upon completion of the course, the student will be able to schedule off-season training
129. Upon completion of the course, the student will be able to prepare Cx documentation
130. Upon completion of the course, the student will be able to assist in developing the OPR/CFR
131. Upon completion of the course, the student will be able to conduct an interview with owner staff and commissioning team
132. Upon completion of the course, the student will be able to develop an OPR/CFR criteria matrix for commissioned systems
133. Upon completion of the course, the student will be able to assist in drafting the OPR/CFR
134. Upon completion of the course, the student will be able to review a draft OPR/CFR
135. Upon completion of the course, the student will be able to update the OPR/CFR draft
136. Upon completion of the course, the student will demonstrate knowledge of climate zone variations
137. Upon completion of the course, the student will demonstrate knowledge of environmental sustainability and efficiency goals
138. Upon completion of the course, the student will demonstrate knowledge of IEQ
139. Upon completion of the course, the student will demonstrate knowledge of life-span cost and quality
140. Upon completion of the course, the student will be able to create system/equipment list
141. Upon completion of the course, the student will be able to review Cx scope of work
142. Upon completion of the course, the student will be able to review schedule of commissioned equipment
143. Upon completion of the course, the student will be able to review existing building record documents
144. Upon completion of the course, the student will be able to compare drawings, specification, and BOD for compliance with OPR/CFR

145. Upon completion of the course, the student will be able to identify systems and equipment
146. Upon completion of the course, the student will be able to document selected systems and equipment
147. Upon completion of the course, the student will be able to create Cx process tracking matrixes
148. Upon completion of the course, the student will be able to identify systems to be commissioned
149. Upon completion of the course, the student will be able to identify tasks to be completed on each system
150. Upon completion of the course, the student will be able to develop a Cx plan
151. Upon completion of the course, the student will be able to determine roles and responsibilities of Cx team members
152. Upon completion of the course, the student will be able to create a contact list for Cx team members
153. Upon completion of the course, the student will be able to establish communication protocols for the Cx team
154. Upon completion of the course, the student will be able to establish document distribution protocols for the Cx team
155. Upon completion of the course, the student will be able to create a detail description of the Cx process activities
156. Upon completion of the course, the student will be able to develop a schedule of the Cx process activities
157. Upon completion of the course, the student will be able to determine appropriate sampling procedures and methodology in collaboration with the Cx team
158. Upon completion of the course, the student will be able to create examples of documentation
159. Upon completion of the course, the student will be able to document design documentation evaluation procedures
160. Upon completion of the course, the student will be able to describe Cx process activities
161. Upon completion of the course, the student will be able to describe system verification procedures
162. Upon completion of the course, the student will be able to describe testing procedures performed by Cx team
163. Upon completion of the course, the student will be able to describe systems integration testing procedures
164. Upon completion of the course, the student will be able to develop training plans for systems being created
165. Upon completion of the course, the student will be able to describe system manual requirements
166. Upon completion of the course, the student will be able to describe site observation procedures and documentation
167. Upon completion of the course, the student will be able to create issue resolution logs
168. Upon completion of the course, the student will be able to create Cx progress reports
169. Upon completion of the course, the student will be able to create a list of systems to be commissioned
170. Upon completion of the course, the student will be able to describe procedures to mitigate issues that are not compliant with OPR/CFR
171. Upon completion of the course, the student will be able to create the draft Cx Plan for review and comments
172. Upon completion of the course, the student will be able to review the Cx Plan

173. Upon completion of the course, the student will be able to update the Cx Plan
174. Upon completion of the course, the student will be able to develop Cx schedules
175. Upon completion of the course, the student will be able to develop Cx duration schedules
176. Upon completion of the course, the student will be able to assign the sequence of activities
177. Upon completion of the course, the student will be able to determine team assignments for activities
178. Upon completion of the course, the student will be able to identify milestones in the Cx project
179. Upon completion of the course, the student will be able to identify deliverables in the Cx project
180. Upon completion of the course, the student will be able to identify the critical path in the Cx project
181. Upon completion of the course, the student will be able to create a Cx project schedule
182. Upon completion of the course, the student will be able to work with contractor to integrate the Cx schedule into the construction/project schedule
183. Upon completion of the course, the student will be able to identify resources that will be required for the Cx project
184. Upon completion of the course, the student will demonstrate knowledge of construction scheduling
185. Upon completion of the course, the student will demonstrate knowledge of construction methods and concepts
186. Upon completion of the course, the student will demonstrate knowledge of manpower utilization
187. Upon completion of the course, the student will demonstrate knowledge of testing durations
188. Upon completion of the course, the student will be able to develop communications plans
189. Upon completion of the course, the student will be able to determine meeting frequencies
190. Upon completion of the course, the student will be able to create a contact list
191. Upon completion of the course, the student will be able to determine the best communication methods (phones, etc.) for the Cx project
192. Upon completion of the course, the student will be able to establish a distribution list
193. Upon completion of the course, the student will be able to create Cx specifications
194. Upon completion of the course, the student will be able to prepare project specific Cx specifications
195. Upon completion of the course, the student will be able to review OPR
196. Upon completion of the course, the student will be able to incorporate Cx specifications into the bid document
197. Upon completion of the course, the student will be able to establish protocols for retesting and associated costs
198. Upon completion of the course, the student will be able to establish sampling protocols
199. Upon completion of the course, the student will be able to create sample Cx documents to include in the specifications
200. Upon completion of the course, the student will demonstrate knowledge of typical construction specification formats and divisions
201. Upon completion of the course, the student will be able to create system verification checklists
202. Upon completion of the course, the student will be able to identify the systems to be commissioned
203. Upon completion of the course, the student will be able to review the drawings, specifications, submittals, RFIs and addenda
204. Upon completion of the course, the student will be able to obtain the IOMs

205. Upon completion of the course, the student will be able to review the IOMs
206. Upon completion of the course, the student will be able to review the details in the drawings (schematics, one-line diagrams, etc.)
207. Upon completion of the course, the student will be able to review sequence of operations
208. Upon completion of the course, the student will be able to prepare draft checklists
209. Upon completion of the course, the student will be able to list the materials, components and installation techniques required by the construction documents
210. Upon completion of the course, the student will be able to conduct control point-to-point and positional checks and calibration
211. Upon completion of the course, the student will demonstrate knowledge of methodologies used to inspect systems
212. Upon completion of the course, the student will demonstrate knowledge of testing, training, design and construction requirements
213. Upon completion of the course, the student will be able to create FPTs
214. Upon completion of the course, the student will be able to review sequence/modes of operations
215. Upon completion of the course, the student will be able to review project documents
216. Upon completion of the course, the student will be able to review BAS documents
217. Upon completion of the course, the student will be able to review the steps involved in performing FPTs
218. Upon completion of the course, the student will be able to develop the FPT steps
219. Upon completion of the course, the student will be able to determine equipment and systems integration
220. Upon completion of the course, the student will be able to develop the acceptance criteria
221. Upon completion of the course, the student will be able to conduct risk assessments
222. Upon completion of the course, the student will be able to determine various scenarios for FPTs
223. Upon completion of the course, the student will be able to determine load simulation equipment needed
224. Upon completion of the course, the student will be able to determine equipment/tool/instrument requirements
225. Upon completion of the course, the student will be able to determine interface and integration requirements
226. Upon completion of the course, the student will be able to determine timing and schedule for execution of FPTs
227. Upon completion of the course, the student will be able to determine precursors for testing (scheduling)
228. Upon completion of the course, the student will be able to verify hardware or software driven per specifications
229. Upon completion of the course, the student will be able to determine trending criteria
230. Upon completion of the course, the student will demonstrate knowledge of BAS or monitoring systems
231. Upon completion of the course, the student will demonstrate knowledge of controls graphics
232. Upon completion of the course, the student will demonstrate knowledge of controls theory and operation
233. Upon completion of the course, the student will be able to determine site visit protocols (logistics)

234. Upon completion of the course, the student will be able to review safety protocols and procedures
235. Upon completion of the course, the student will be able to review site access and security
236. Upon completion of the course, the student will be able to review communication protocols
237. Upon completion of the course, the student will be able to develop site visit schedules, durations and intervals
238. Upon completion of the course, the student will be able to collect evidence (digital photos, etc.)
239. Upon completion of the course, the student will be able to determine documentation protocols
240. Upon completion of the course, the student will be able to describe how to coordinate with contractor/site personnel
241. Upon completion of the course, the student will be able to conduct pre-visit reviews of drawings, trends, etc.
242. Upon completion of the course, the student will be able to create a site visit agenda (formal or informal)
243. Upon completion of the course, the student will be able to identify typical goals of site visits
244. Upon completion of the course, the student will be able to create site visit (field) reports
245. Upon completion of the course, the student will be able to determine distribution protocols for reports
246. Upon completion of the course, the student will be able to determine deficiencies to be placed on issues logs
247. Upon completion of the course, the student will be able to develop issues logs
248. Upon completion of the course, the student will demonstrate knowledge of construction documentation protocols
249. Upon completion of the course, the student will demonstrate knowledge of evidence collection techniques
250. Upon completion of the course, the student will be able to determine if there should be a separate design team log versus a construction log
251. Upon completion of the course, the student will be able to select an issues log format
252. Upon completion of the course, the student will be able to determine if an issues log is in conformity with design team punch lists
253. Upon completion of the course, the student will be able to determine who should be on an issues log distribution list and the protocols for distribution
254. Upon completion of the course, the student will be able to determine issues log feedback procedures
255. Upon completion of the course, the student will be able to identify responsible parties for issues
256. Upon completion of the course, the student will demonstrate knowledge of how to develop a spreadsheet
257. Upon completion of the course, the student will be able to document Cx meetings
258. Upon completion of the course, the student will be able to develop Cx meeting agendas
259. Upon completion of the course, the student will be able to develop list of Cx meeting attendees
260. Upon completion of the course, the student will be able to create Cx meeting sign-in sheets
261. Upon completion of the course, the student will be able to determine Cx meeting locations and logistics
262. Upon completion of the course, the student will be able to prepare Cx meeting minutes
263. Upon completion of the course, the student will be able to establish up conference call numbers for a Cx meeting
264. Upon completion of the course, the student will be able to distribute Cx meeting minutes

265. Upon completion of the course, the student will be able to send out Cx meeting invitations
266. Upon completion of the course, the student will be able to create Cx reports
267. Upon completion of the course, the student will be able to compile all Cx documentation
268. Upon completion of the course, the student will be able to identify Cx deliverables
269. Upon completion of the course, the student will be able to identify Cx report distribution list
270. Upon completion of the course, the student will be able to obtain documents from others (start up reports, TAB reports, special tests, etc.)
271. Upon completion of the course, the student will be able to develop executive summary including details of test results
272. Upon completion of the course, the student will be able to create a table of contents
273. Upon completion of the course, the student will be able to determine Cx report delivery method (pdf, paper, CMMS, etc.)
274. Upon completion of the course, the student will be able to determine format for the Cx report (report body)
275. Upon completion of the course, the student will be able to finalize the Cx report
276. Upon completion of the course, the student will be able to create systems manuals
277. Upon completion of the course, the student will be able to collect O&Ms
278. Upon completion of the course, the student will be able to review sequence of operations
279. Upon completion of the course, the student will be able to create a facility guide/BOP (schedule, set points, etc.)
280. Upon completion of the course, the student will be able to collect training materials
281. Upon completion of the course, the student will be able to obtain owner approval (sign-off)
282. Upon completion of the course, the student will be able to identify spare parts list
283. Upon completion of the course, the student will be able to develop end of warranty review processes
284. Upon completion of the course, the student will be able to identify the Cx team members to participate in end of warranty processes
285. Upon completion of the course, the student will be able to identify the equipment/systems warranties
286. Upon completion of the course, the student will be able to establish acceptance dates
287. Upon completion of the course, the student will be able to identify modifications to facility systems
288. Upon completion of the course, the student will be able to verify punch lists and issues log items are resolved
289. Upon completion of the course, the student will be able to identify extended/voided warranties
290. Upon completion of the course, the student will be able to verify owner and occupant satisfaction with building conditions
291. Upon completion of the course, the student will be able to establish an end-of- warranty review report format
292. Upon completion of the course, the student will be able to document warranty expiration dates
293. Upon completion of the course, the student will be able to plan Cx construction activities
294. Upon completion of the course, the student will be able to assist in updating the OPR
295. Upon completion of the course, the student will be able to review BOD/RFI/SK addenda
296. Upon completion of the course, the student will be able to review commissioning plans and schedules
297. Upon completion of the course, the student will be able to update commissioning plans

298. Upon completion of the course, the student will be able to coordinate Cx activities with construction
299. Upon completion of the course, the student will be able to review the control sequencing
300. Upon completion of the course, the student will be able to plan a controls integration meeting (fire alarm, life safety, etc.)
301. Upon completion of the course, the student will be able to plan BAS and TAB meetings
302. Upon completion of the course, the student will be able to review the TAB plan
303. Upon completion of the course, the student will be able to align the Cx schedule with the occupied schedule
304. Upon completion of the course, the student will be able to schedule a kick-off meeting
305. Upon completion of the course, the student will be able to plan onsite access
306. Upon completion of the course, the student will be able to plan responses to emergencies
307. Upon completion of the course, the student will be able to describe how to monitor Cx construction activities
308. Upon completion of the course, the student will be able to describe how to monitor the TAB
309. Upon completion of the course, the student will be able to describe how to monitor the construction installations
310. Upon completion of the course, the student will be able to conduct a controls integration meeting (fire alarm, life safety, etc.)
311. Upon completion of the course, the student will be able to coordinate BAS and TAB meetings
312. Upon completion of the course, the student will be able to describe how to monitor site housekeeping conditions
313. Upon completion of the course, the student will be able to describe how to monitor equipment storage conditions
314. Upon completion of the course, the student will be able to describe how to monitor compliance with manufacturer's installation requirements
315. Upon completion of the course, the student will be able to check construction for damage/leaks/etc.
316. Upon completion of the course, the student will be able to check maintenance access to building system components
317. Upon completion of the course, the student will be able to check for maintainability of building system components
318. Upon completion of the course, the student will be able to determine owner's requirements regarding coordination with AHJ
319. Upon completion of the course, the student will demonstrate knowledge of proportional balancing
320. Upon completion of the course, the student will demonstrate knowledge of construction site safety
321. Upon completion of the course, the student will be able to facilitate the completion of construction checklists
322. Upon completion of the course, the student will be able to prepare construction checklists
323. Upon completion of the course, the student will be able to train Cx team on construction checklists
324. Upon completion of the course, the student will be able to conduct site observations back-check
325. Upon completion of the course, the student will be able to verify completion of construction checklists
326. Upon completion of the course, the student will be able to identify issues needing resolution

327. Upon completion of the course, the student will be able to facilitate issues resolution
328. Upon completion of the course, the student will be able to track overall progress of construction checklists
329. Upon completion of the course, the student will demonstrate knowledge of issue resolution processes
330. Upon completion of the course, the student will be able to facilitate the acceptance phase
331. Upon completion of the course, the student will be able to execute point-to-point checks
332. Upon completion of the course, the student will be able to perform TAB verification to design tolerance requirements
333. Upon completion of the course, the student will be able to conduct functional performance tests according to the manufacturer's guidelines
334. Upon completion of the course, the student will be able to set up and review trending
335. Upon completion of the course, the student will be able to perform integrated system testing
336. Upon completion of the course, the student will demonstrate knowledge of control systems
337. Upon completion of the course, the student will demonstrate knowledge of failure mode analyses
338. Upon completion of the course, the student will demonstrate knowledge of risk assessments and risk management
339. Upon completion of the course, the student will demonstrate knowledge of TAB
340. Upon completion of the course, the student will be able to develop staff training plans
341. Upon completion of the course, the student will be able to conduct a gap analysis of capabilities of staff to identify needed training
342. Upon completion of the course, the student will be able to identify needed training for specific individuals
343. Upon completion of the course, the student will be able to identify resource and space requirements for training
344. Upon completion of the course, the student will be able to identify other training logistics
345. Upon completion of the course, the student will be able to prepare handouts and other training materials
346. Upon completion of the course, the student will be able to identify training prerequisite materials such as O&M manuals, record drawings, etc.
347. Upon completion of the course, the student will be able to identify training recording requirements (video, etc.) per specifications
348. Upon completion of the course, the student will be able to verify instructor qualifications
349. Upon completion of the course, the student will be able to coordinate training schedule (training and O&M start up are not on the same day, etc.)
350. Upon completion of the course, the student will be able to create a training matrix of required training (logs, etc.)
351. Upon completion of the course, the student will be able to verify safety instruction is included where appropriate
352. Upon completion of the course, the student will be able to identify off season mode training requirements
353. Upon completion of the course, the student will demonstrate knowledge of training methodologies
354. Upon completion of the course, the student will be able to coordinate training
355. Upon completion of the course, the student will be able to verify training is effective

356. Upon completion of the course, the student will be able to coordinate the integration of all parties involved in training
357. Upon completion of the course, the student will be able to obtain copy of all training materials/videos to be placed into the systems manual
358. Upon completion of the course, the student will be able to determine requirements for supplemental materials
359. Upon completion of the course, the student will be able to conduct off-season mode training
360. Upon completion of the course, the student will be able to identify lessons learned related to training
361. Upon completion of the course, the student will be able to conduct training follow-up activities
362. Upon completion of the course, the student will be able to evaluate the effectiveness of the training
363. Upon completion of the course, the student will be able to verify training acceptance criteria was met
364. Upon completion of the course, the student will be able to identify follow-up training requirements
365. Upon completion of the course, the student will be able to facilitate off-season testing
366. Upon completion of the course, the student will be able to facilitate incomplete or deferred tests
367. Upon completion of the course, the student will be able to identify testing logistics (occupant convenience, etc.)
368. Upon completion of the course, the student will be able to review system manufacturer and verification checklists
369. Upon completion of the course, the student will be able to set up trends
370. Upon completion of the course, the student will be able to analyze test data
371. Upon completion of the course, the student will be able to troubleshoot facility issues
372. Upon completion of the course, the student will be able to collect tenant complaint information
373. Upon completion of the course, the student will be able to query CMMS/work orders
374. Upon completion of the course, the student will be able to review trend data and alarms
375. Upon completion of the course, the student will be able to interview maintenance staff
376. Upon completion of the course, the student will be able to interview building owners
377. Upon completion of the course, the student will be able to review equipment for proper operation
378. Upon completion of the course, the student will be able to document issues and resolutions
379. Upon completion of the course, the student will be able to investigate and analyze issues
380. Upon completion of the course, the student will be able to solve issues or make recommendations for solutions
381. Upon completion of the course, the student will be able to verify warranty issue resolution
382. Upon completion of the course, the student will be able to verify completion of punch lists/issue logs
383. Upon completion of the course, the student will be able to measure energy performance
384. Upon completion of the course, the student will be able to assist with calibrating the energy model
385. Upon completion of the course, the student will be able to establish actual building energy performance baseline Upon completion of the course, the student will be able to evaluate submeter trends
386. Upon completion of the course, the student will be able to evaluate M&V

387. Upon completion of the course, the student will be able to review energy performance tracking program
388. Upon completion of the course, the student will be able to analyze power factor performance
389. Upon completion of the course, the student will be able to make system improvement recommendations
390. Upon completion of the course, the student will be able to optimize building performance
391. Upon completion of the course, the student will be able to facilitate end of warranty meeting
392. Upon completion of the course, the student will be able to review CMMS systems
393. Upon completion of the course, the student will be able to review service contracts
394. Upon completion of the course, the student will be able to assess occupant comfort
395. Upon completion of the course, the student will be able to conduct IEQ assessments
396. Upon completion of the course, the student will be able to review BOP (building operations plans) schedules and set points
397. Upon completion of the course, the student will be able to conduct existing building commissioning
398. Upon completion of the course, the student will be able to determine scope of existing building Cx project
399. Upon completion of the course, the student will be able to determine existing building Cx project goals and objectives
400. Upon completion of the course, the student will be able to determine the existing building Cx project scope of work
401. Upon completion of the course, the student will be able to analyze the building, systems and equipment
402. Upon completion of the course, the student will be able to prioritize the goals and objectives
403. Upon completion of the course, the student will be able to determine if incentive funding is available
404. Upon completion of the course, the student will be able to determine M&V requirements
405. Upon completion of the course, the student will be able to determine metering requirements
406. Upon completion of the course, the student will be able to develop the existing building Cx team
407. Upon completion of the course, the student will be able to conduct a building performance assessment
408. Upon completion of the course, the student will be able to identify missing system documentation
409. Upon completion of the course, the student will be able to research systems where documentation does not exist
410. Upon completion of the course, the student will be able to obtain BOP
411. Upon completion of the course, the student will be able to review other specialized facility specific documents and reports (asbestos, containment plans, infection control plans, etc.)
412. Upon completion of the course, the student will be able to conduct Energy Star performance analysis
413. Upon completion of the course, the student will be able to establish existing building performance baselines
414. Upon completion of the course, the student will be able to inspect the equipment
415. Upon completion of the course, the student will be able to determine the building automation capabilities
416. Upon completion of the course, the student will be able to evaluate single point of failure analysis

417. Upon completion of the course, the student will be able to estimate improvement potentials
418. Upon completion of the course, the student will demonstrate knowledge of energy use analysis
419. Upon completion of the course, the student will demonstrate knowledge of utility bill structures
420. Upon completion of the course, the student will be able to prepare a CFR
421. Upon completion of the course, the student will be able to determine operations strategies, parameters, setpoints and schedules
422. Upon completion of the course, the student will be able to determine space allocation and usage
423. Upon completion of the course, the student will be able to determine emergency and safety modes of operation
424. Upon completion of the course, the student will be able to determine performance goals
425. Upon completion of the course, the student will be able to determine occupancy levels and schedules
426. Upon completion of the course, the student will be able to conduct a systems assessment
427. Upon completion of the course, the student will be able to identify deferred maintenance issues
428. Upon completion of the course, the student will be able to identify FIMs/ECMs
429. Upon completion of the course, the student will be able to create master log of deficiencies
430. Upon completion of the course, the student will be able to identify new and recently upgraded equipment/systems
431. Upon completion of the course, the student will be able to conduct a field check of control sensor calibration
432. Upon completion of the course, the student will be able to review alarm logs
433. Upon completion of the course, the student will be able to review reports associated with fire life safety
434. Upon completion of the course, the student will be able to review systems to verify compliance with applicable life safety codes
435. Upon completion of the course, the student will be able to review maintenance contracts
436. Upon completion of the course, the student will be able to review troubleshooting logs
437. Upon completion of the course, the student will be able to review controls contracts
438. Upon completion of the course, the student will be able to deploy data loggers
439. Upon completion of the course, the student will be able to determine locations for data loggers
440. Upon completion of the course, the student will be able to review CMMS
441. Upon completion of the course, the student will be able to create a finalize list of equipment to be tested
442. Upon completion of the course, the student will be able to conduct site investigations
443. Upon completion of the course, the student will be able to conduct functional performance testing
444. Upon completion of the course, the student will be able to download data loggers
445. Upon completion of the course, the student will be able to analyze data logger data
446. Upon completion of the course, the student will be able to identify equipment and system issues
447. Upon completion of the course, the student will be able to develop testing strategies for the building and systems
448. Upon completion of the course, the student will be able to conduct a root cause analysis
449. Upon completion of the course, the student will be able to analyze results from FPTs and determine if additional tests are required
450. Upon completion of the course, the student will be able to implement quick fixes if approved

451. Upon completion of the course, the student will be able to recommend corrections and improvements
452. Upon completion of the course, the student will demonstrate knowledge of troubleshooting methodologies
453. Upon completion of the course, the student will be able to develop FIMs and ECMs
454. Upon completion of the course, the student will be able to calculate the benefits of implementing various measures
455. Upon completion of the course, the student will be able to determine ROI
456. Upon completion of the course, the student will be able to create budgets and identify potential for incentives
457. Upon completion of the course, the student will be able to develop scope for recommendations, FIMs, and ECMs
458. Upon completion of the course, the student will be able to prioritize corrections and improvements
459. Upon completion of the course, the student will be able to select an action plan with owner
460. Upon completion of the course, the student will be able to oversee implementation of corrective measures
461. Upon completion of the course, the student will be able to manage the implementation of FIM or ECM projects
462. Upon completion of the course, the student will be able to commission the corrections
463. Upon completion of the course, the student will be able to implement low-cost/no-cost items
464. Upon completion of the course, the student will be able to update the BOP
465. Upon completion of the course, the student will be able to optimize controls operating parameters or setpoints
466. Upon completion of the course, the student will be able to conduct performance verifications
467. Upon completion of the course, the student will be able to compare current data to original pre-project baseline
468. Upon completion of the course, the student will be able to calculate actual and projected savings
469. Upon completion of the course, the student will be able to prepare final reports
470. Upon completion of the course, the student will be able to assist in obtaining incentives
471. Upon completion of the course, the student will be able to make recommendations for ongoing Cx
472. Upon completion of the course, the student will be able to conduct on-going Cx
473. Upon completion of the course, the student will be able to measure IEQ performance
474. Upon completion of the course, the student will be able to conduct an occupant survey
475. Upon completion of the course, the student will be able to prepare IEQ draft report
476. Upon completion of the course, the student will demonstrate knowledge of IEQ
477. Upon completion of the course, the student will be able to evaluate building systems performance
478. Upon completion of the course, the student will be able to report degradation of savings
479. Upon completion of the course, the student will demonstrate knowledge of data normalization (weather, days of the month, etc.)
480. Upon completion of the course, the student will demonstrate knowledge of energy management fundamentals
481. Upon completion of the course, the student will demonstrate knowledge of regression modeling

482. Upon completion of the course, the student will be able to conduct an analysis of the current BOP to the original BOP
483. Upon completion of the course, the student will be able to conduct field investigation to determine deferred maintenance items
484. Upon completion of the course, the student will be able to accommodate space/function changes
485. Upon completion of the course, the student will be able to identify space/function changes
486. Upon completion of the course, the student will be able to review the as-built drawings
487. Upon completion of the course, the student will be able to recommend system modifications
488. Upon completion of the course, the student will demonstrate knowledge of facilities management
489. Upon completion of the course, the student will be able to implement corrective actions
490. Upon completion of the course, the student will be able to identify corrective actions
491. Upon completion of the course, the student will be able to change BAS parameters
492. Upon completion of the course, the student will be able to repair equipment deficiencies
493. Upon completion of the course, the student will be able to commission major system modifications
494. Upon completion of the course, the student will be able to publish measurement and performance results to stakeholders
495. Upon completion of the course, the student will be able to prepare progress reports
496. Upon completion of the course, the student will be able to present results to stakeholders