BOC 1001 Instructor Notes & Metrics

Overview
One major program goal of the BOC is to increase participants' ability to identify areas for reductions in energy consumption and demand and to design projects to accomplish this. The competency basis of the Building Operator Certification adds responsibilities to the instructors to ensure appropriate material coverage and effective delivery so that participants are successful on the test and any related project assignments (see below). To the degree possible, instructors should encourage and maintain an interactive classroom environment to enable participants to learn from each other's experiences and apply the information to their facilities. Metrics are defined for Class Exercises, Project Debrief, and Proctorship of Tests to ensure quality of program delivery. You should familiarize yourself with these metrics and seek assistance from the BOC program administrator, if questions arise.

Preparation
BOC 1001 has two parts, A & B, which equates to a 2-day class when offered on site, and 4 half-day classes when offered virtually. Guidance for start and end points for each of the 4 half-days is provided in the Suggested Activities matrix further below. Instructors are at liberty to modify start/end points to suit the delivery that works best for them provided that the test material is covered sufficiently for participants to be successful on the Part A and Part B tests.

Review the suggested activities and checklist below, and reference the project workbook and review the project rubric from the previous class. Both provide criteria for effectively engaging participants, promoting discussion on key topics, and helping participants review and check for understanding. Since class activities are a required component of BOC training, determine if you will be implementing activities suggested or equivalent (objective, method and time) activities of your choice. In making your decision, remember that the ultimate goal is to facilitate the learning by adults who prefer experienced-centered and problem-centered instruction.

HVAC System Tour– If possible, a short tour of the HVAC system at the training facility in Part B of the training is recommended. In advance of class day, consult with the class coordinator and the facility to make the required arrangements.

Speak with your BOC program manager to determine who is sponsoring the BOC course. The BOC program helps connect participants to local resources including utility programs that can assist then with their energy efficiency projects. Check the www.dsireusa.org website. DSIRE is a comprehensive source of information on state, local, utility and federal incentives and policies that promote renewable energy and energy efficiency. Research and become familiar with utility rebate and incentive programs, state energy office initiatives, and local energy efficiency trends and

initiatives relevant to the class subject matter. Use the research to supplement discussion and tailor/adapt BOC curriculum to support sponsor interests. For example:

1. Describe how the BOC sponsor's EE initiative and/or DSM program benefits building owners.
2. Provide one or more examples of how their initiative/program relates to the topic you are teaching. What would a building operator need to know about this relationship? How would you tailor the instruction to share this information with the participants?

NOTE: Check with your BOC program manager to determine the class schedule for the course. Each course has six core classes and one supplemental class. If the supplemental class for your course is BOC 1014, "Electrification and Building Operations", keep in mind that the heat pumps section is largely repeated in that class. In this case, providing a very high-level overview of the types of heat pumps is sufficient for BOC 1001. The instructor for 1014 will deliver a more in-depth discussion of the various types of heat pumps in that class. If the supplemental class for your course is not 1014, feel free to deliver a more in-depth discussion of the different types of heat pumps in 1001, as time allows.

Presentation Materials

The BOC Program provides Microsoft PowerPoint slides that complement the participant handbook to help you prepare participants for the tests and exercises. We encourage you to enhance the slides with your own teaching aides provided these do not confuse coverage of the basic materials nor create any ambiguity in the minds of the participants. These aides might include additional slides, case studies, demonstration props and specialty equipment, videos, and in-class exercises. Instructors are also encouraged to note current changes and developments in the topic they are presenting. See the suggested props/specialty equipment in the checklist below.

Participant Materials

Participants receive a handbook that complements the presentation slides. The handbook may contain pages, illustrations, tables, charts, and other documents, supporting activities. Instructors should reference the handbook during class and refer participants to specific pages when giving instructional cues.

Class Exercises

Metric: integrate a minimum of 1 hour of non-lecture, participant-centered activity into the training day.

Class exercises are activities led by the instructor in class to enable participants to practice skills and concepts taught. The average retention rate for lecture mode of instruction is 5% compared to 50% for discussion group and 75% for practice by doing. Additionally, activities break up a long day of presentations and offer participants an opportunity to network with and learn from each others' experiences. Most classes in BOC Level I and II have several suggested in-class exercises for the instructor to administer. Review the suggested exercises below.

Project Assignment
Metric: allot a minimum of 10 minutes of class time facilitating a debrief on the project assignment from the class taught before yours.

Successful completion of all project assignments is required for Level I certification. It is therefore important to ensure participants understand the assignment and are comfortable completing it. Participants return the completed projects to the following class where it is reviewed and graded by the training coordinator.

Review the Project Workbook to familiarize yourself with the project assignments. Review the project specific to the class taught before yours (if applicable; see course schedule). Develop three questions you would use to facilitate the discussion keeping in mind the goal of providing participants with the opportunity to share their experiences and create action steps for implementing energy efficiency improvements.

The instructor is responsible for providing an overview of the project assignment at the end of the class before administering the test. Refer participants to their Project Workbook and grading rubric when reviewing the assignment.

BOC Test Proctor Procedure
Metric: follow the BOC test procedure.

The BOC test is designed as an assessment of a participant's grasp of the material and it is essential that the integrity of the test be maintained. The following test procedure maintains the integrity of the test by preparing participants to be successful in the absence of coaching to the test.

TEST PROCEDURE: If the test format is on paper, the instructor is responsible for administering the test. If conducted via an LMS, the instructor should direct students there to take the test. Either way, the instructor will be present throughout the test to answer questions. The instructor is permitted to clarify the questions, if needed, but may not provide the answers to any questions under any conditions.

At the beginning of the class session, the instructor will review the day's agenda, including the timing of the test and general points concerning its administration. The instructor will review the test procedures and restrictions with participants prior to taking the test.

The exams are open-book and any notes or handout materials may be used as a reference. A period of one hour is available for the test, but it will not be strictly timed.

Note: **Coaching of participants about material that appears on the test is not permitted during instruction of BOC classes. Directing participants to highlight or put post-it notes at specific points in the Participant Handbook is also not permitted.**

The instructor is responsible for ensuring a quiet test environment, which includes no use of cell phones and no unnecessary conversation of any kind while the test is underway.

In the case of a paper test, when finished, the TEST BOOKLET and the COMPLETED ANSWER SHEET should be turned in to the instructor or the site coordinator, as appropriate.
Test takers finish at much different times. A test review after the test isn't generally practical. We recommend instructors review the test with learners at the start of the next class day in the course.

Evaluation
At the end of class, all participants will complete a *Class Evaluation* form after taking the test. The evaluation is designed to collect information about the class content, instruction, and future interest in topics. The information is used by NEEC to make improvements to the curriculum, to share with instructors, and to plan future classes offered in the BOC program.

Suggested Class Activities

BOC 1001 has several activities. For Part A, please plan the lesson to allot 75 minutes of class time to activities. For Part B, please plan the lesson to allot 80 minutes to class activities.

These activities are **extremely** important to each participant in successfully passing the test and meeting learning objectives. Instructors should familiarize themselves with these exercises and are encouraged to improve upon them or add to them, as time will permit. These are described in more detail below. In addition to class exercises, BOC 1001 has suggested discussion topics and case studies. Small group break out discussion and other participant-centered techniques are encouraged. Instructors are encouraged to bring additional or more familiar case studies to the class that emphasizes the importance of O&M best practices.

At the end of BOC 1001, reference the project workbook and setup the first assignment that participants must complete at their facility. Review the instructions for sketching a floor plan and answer any questions. Participants will draw or reproduce the facility footprint and identify on the plan the major heating, cooling, or ventilation equipment, including the distribution system and control points of the system. See additional details in the suggested activities section below.

* NOTE: Slide titles are noted below in the Materials column. Activities are described for each title.

Materials	Suggested Activities	Time
PARTS A&B: Onsite **HALF-DAYS 1 - 4: Virtual class** **Props:** HVAC tools and equipment **Handbook:** Agenda Objectives Poll Glossary **Slide Title:** ***Before we begin...***	**PART A On-Site: Slide title "Before we begin…" is start point. Slide title "BOC 1001 Test" is end point.** **PART B On Site: Slide title "Part B Agenda" is the start point. Slide titled "BOC 1001 Part B Test" is the end point.** **PART A DAY 1 - Virtual Class: Slide title "Before we begin…" is start point. Slide title "Exercise 1A" is end point.** **PART A DAY 2 - Virtual Class: Slide title "Boiler Fundamentals" is start point. Slide title "BOC 1001 Part A Test" is end point.** **PART B DAY 3 - Virtual Class: Slide title "Part B Agenda" is start point. Slide title "Air Systems Fans" is end point.** **PART B DAY 4 - Virtual Class: Slide title "Air System Pressure Readings" is start point. Slide title "BOC 1001 Part B Test" is end point.** **Class Poll/Introductions – Individual Activity and Instructor Led Discussion** A. **Polling Questions Activity** 1. Refer participants to the "polling questions" in the Appendix. 2. Set up the activity and explain the purpose is intended to engage the class in a discussion. Ask participants to complete the poll as quickly as possible and clarify that the poll is not a test nor will participants be asked to submit their answers to site coordinators. 3. When the participants complete the questions, walk the class through the questions and answers. Ask for participants to volunteer their answers. Use the opportunity to both gauge the knowledge level of the class and to provide participants with insight as to how BOC will help them learn more about the issues the poll addresses. B. **Class Agenda.** Provide an overview of the day and a brief explanation of the topics the class will cover and why. C. **Learning Objectives.** Provide an explanation of the learning objectives D. **Glossary.** Direct participants to the glossary and review key glossary terms found in the Appendix of the participant handbook.	10 min
Slide Title: ***Roundtable Discussion***	**I. Round-Table Discussion – Small group Activity** A. Cue participants to break into groups. (If class is virtual, use breakout rooms for this activity.) Explain how the activity will	10 min

Materials	Suggested Activities	Time
	allow them to network with other class participants and exchange information about professional experiences. B. Refer participants to the discussion questions provided in the participant handbook: 1. What role does the building operator play in energy efficient building operations? 2. When hiring new staff or promote existing staff, what skills, abilities or knowledge are employers looking for in building operators? 3. What are the major differences in requirements and skills between running smaller commercial and industrial buildings that may have individual components, but not sophisticated building control systems? C. What role does the building operator play in energy efficient building operations? Ask members from at least three groups to volunteer insights from their discussion with the rest of the class. Additional questions for discussion with the whole class (optional): 1. When hiring new staff or promote existing staff, what skills, abilities or knowledge are employers looking for in building operators? What are the major differences in requirements and skills between running smaller commercial and industrial buildings that may have individual components, but not sophisticated building control systems?	
Slide Title: ***Exercise 1A – Occupant Comfort***	**II. Exercise 1A – Small Group Discussion - Occupant Comfort** A. Ask the participants to break into small groups and discuss the questions listed about how occupant comfort complaints are reported, resolved and documented in their organizations. **With the whole class, ask for volunteers from a few of the groups to share highlights of their discussions.**	15 min
Slide Title: ***Combustion Air Supply***	**III. Note for Combustion Fundamentals section**: Please emphasize the importance of following safety practices and local code guidelines for supply of combustion air. This is discussed on the slide titled "Combustion Air Supply."	
Slide Title: ***Class Discussion – Condensing Boilers***	**IV. Class Discussion – Condensing Boilers** As a wrap up to the section on condensing boiler systems, lead a class discussion about the benefits of condensing boilers and appropriate conditions for retrofitting a steam or hot water system with a condensing boiler.	10 min
Slide Title: Exercise 1B – ***Hot Water Piping***	**V. Exercises 1B and 1C – Small Group and Instructor Led Discussions** A. Refer participants to exercise 1B in their handbook. Ask participants to break into groups of 4-5 and spend 5 minutes to discuss the following questions. (If class is virtual, use breakout rooms for this activity.) Afterwards, call on groups to report on their exercise results (5 minutes).	15 min

Materials	Suggested Activities	Time
	1. The maintenance requirements of a steam boiler, hot water boiler or gas furnace. 2. Normal operating conditions, including pressures, temperatures and cycling rates. 3. Areas which could be evaluated and/or modified to optimize operations and increase efficiency. B. (Note: Activity 1B, slide 118, is located near the end of PartA, but alternatively it could be used to break up the lecture earlier, near the end of the section on boilers, e.g. after slide 98, "Night Setback Effects".) Refer participants to Exercise 1B, the Hot Water Piping illustration in their handbook (page 131). Ask participants to: 1. Locate zones or areas where heat is purposely dissipated into the conditioned zone. 2. Identify points of heat loss, then provide feedback and answer questions. 3. Find points for routine maintenance. then provide feedback and answer questions. List three or more maintenance tasks for the system. List three operational tasks to improve efficiency (e.g. scheduling, setpoints, etc.). 4. Then provide feedback and answer questions. Discuss typical boiler and system efficiency.	
Slide Title: Exercise 1C – *Steam Distribution System*	C. (Note: Activity 1C, slide 119, is located near the end of PartA, but alternatively it could be used to break up the lecture earlier, near the end of the section on steam distribution, e.g. after slide 72, "Steam Converter Illustration".) Refer participants to exercise 1C, the Steam Distribution System illustration in their handbook (page 132). 1. Ask participants to identify points of heat loss, then provide feedback and answer questions. 2. Ask participants to find points for routine maintenance, then provide feedback and answer questions. 3. Discuss typical boiler and system efficiency.	15 min
PART B: Onsite HALF-DAYS 3 & 4: Virtual		
HVAC System Tour	**HVAC System Tour**: For on-site classes, consider leading a short tour of the HVAC system at the training facility. Your class coordinator can help make arrangements by consulting with you and the building engineer on site.	25 min
Slide Title: Exercise 2 – System Sketch	**VI.Exercise 2. System Sketch - Instructor Demo and Individual Activity** A. Refer participants to Exercise 2 instructions.	15 min

Materials	Suggested Activities	Time
	B. Set up the activity and explain that the purpose of this exercise is to provide an opportunity prepare participants in completing the project assignment back at their facility following the class. C. Using a whiteboard or a flip chart, demonstrate how to sketch piping components for a heat pump system. Include piping, primary components, related controls and expected normal operating conditions. Then, discuss areas which could be inspected, evaluated, and/or modified to optimize operations and increase efficiency. D. Ask participants to sketch draw out the piping components from either a *DX air conditioner or achilled water packaged chiller* and include piping, primary components, related controls and expected normal operating conditions. Optionally, this could be accomplished in small groups. Circulate around the room and answer questions and assist as needed. E. Using a whiteboard or a flip chart, sketch a *DX air conditioner* and a *chilled water packaged chiller.* Then for each system, discuss the areas which could be inspected, evaluated, and/or modified to optimize operations and increase efficiency.	
Slide Title: ***Exercise 3 – Air Properties and Human Comfort*** **AND** **Slide Title:** ***ASHRAE Std. 55 Comfort Chart***	**VII. Exercise 3. Air Properties & Human Comfort – Individual Activity and Exercise Review.** A. Refer participants to the Psychrometric Chart in the Handbook Appendix (last page). B. Setup the activity and provide instructions for completing the exercise, as needed. 1. Ask participants to plot out the following comfort conditions on the psychometric chart: • Winter: 68° F Dry Bulb, 45% RH • Summer: 76° F Dry Bulb, 75% RH 2. Then, cue participants to compare their results to the ASHRAE comfort chart (on page 185) and determine if the occupants in their building will be comfortable and within the boundaries of the comfort zone. Review answers, provide feedback, and respond to questions. 3. Discuss factors and areas which could be inspected, evaluated, and/or modified to optimize operations and increase efficiency while maintaining the comfort level.	10 mins
Slide Title: ***Class Discussion – Climate Zone Challenges***	**VIII. Climate Zone Challenges & Thermal Comfort / Productivity – Instructor Led Discussion.** A. Discuss the issues around occupant comfort, productivity, and energy costs. Currently it is known that during data processing, the least amount of errors are made when the temperature is between 70-73°F with reasonable air movement. Additionally, research indicates test scores improve in rooms with proper daylighting	10 mins

Materials	Suggested Activities	Time
	B. Follow-up question: What challenges does your climate offer during air economizer operation?	
	IX. Exercise – Daily CO2 Profile	
Slide Title: ***Exercise – Daily CO2 Profile***	This activity can be done as a class discussion or as an individual exercise. Show the slide and review the chart with participants. Explain the setting and scenario (e.g., school building). Ask participants to consider the question – What does the CO2 plot tell us? – and to volunteer their answers.	10 mins
	X.In-Facility Project Assignment – Instructor Led Discussion. A. Refer participants to the floor plan check-list located in their Project Workbook and the HVAC floor plan symbols in Project Workbook APPENDIX. Discuss the grading criteria on the scoring check-list. B. Refer participant to the three sample projects and discuss the difference between good and poor quality work. 1. How can example A be improved? 2. How can example B be improved? Ask participants what makes it easier to read than example A? 3. Ask participants what makes example C better than the others?	
Slide Title: ***Project Section – Project Assignment 1 – Floor Plan***		10 mins

Instructor's Checklist (as needed depending on class format)

- ☐ Number of people expected: _____
- ☐ Classroom set-up confirmed?
- ☐ Instructor(s) bio
- ☐ Participant IDs
- ☐ Pens and sign-up sheets
- ☐ Evaluation forms
- ☐ Participant handbooks
- ☐ Test booklets
- ☐ Test answer sheets
- ☐ Blank overheads
- ☐ Overhead pens
- ☐ Duct tape
- ☐ Extension cord
- ☐ Props:
    - ☐ Digital Infrared Temperature Indicator
    - ☐ Boiler Stack Thermometer
    - ☐ Magnahelic Gauge w. Small Pitot
    - ☐ Multimeter -- Digital
        - ☐ amperage clamp
        - ☐ temperature sensors
        - ☐ harmonics analyzer (optional)

- ☐ Assorted HVAC devices
  - ☐ motorized dampers
  - ☐ valves
  - ☐ pneumatic actuators
  - ☐ in-line sensors
    - ☐ temperature
    - ☐ pressure
  - ☐ controller(s)
- ☐ Sling psychrometer
- ☐ Pitot tube
- ☐ Manometer
- ☐ Anemometer
- ☐ Flow hood
- ☐ Miscellaneous equipment parts: (i.e., screw compressor, steam traps, assorted fans)
- ☐ HVAC System Tour – provide a short tour of the HVAC system at the training facility on Day 2 of the training.

Be sure to review with participants all of the material covered on the test. Forward all test booklets and answer sheets to NEEC within two weeks of the class (if test is administered via paper).

Collect these evaluations at the end of the class and return the completed evaluations to the training coordinator (unless evaluations are submitted electronically via LMS).