Final Technical Report
for
Building Operator Certification (BOC®)
for Building Technicians

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Executive Summary

The work completed under this grant expanded the capacity of the Building Operator Certification (BOC®) program to better serve the skill enhancement needs of the commercial building technician workforce to achieve DOE's goal of net-zero energy commercial buildings. The project created five significant product performance and delivery enhancements which have been fully integrated into the national BOC program and are being actively used in well over 25 states across the country to train and certify building technicians. These enhancements include:

- A skill standard for building operators in energy efficient building operation
- Ten training modules comprised of 40 hours of curriculum in energy efficiency
- One online module for integration in a blended learning format
- Twenty pilot modules delivered to 300 building operators
- Full integration of the new modules into the BOC Level I course scheme
- A commercialization and sustainability plan

In addition to improving building energy performance through operator training and credentialing, the product enhancements developed under this project are advancing the broader ARRA goal of job preservation by providing technicians with a means of distinguishing themselves to employers through improved job skills and a commitment to the profession.

BOC is a national workforce training and credential program which leverages occupational skills standards in a curriculum that covers energy efficient building operation and maintenance practices, energy management, sustainability, water efficiency, general and electrical safety, and building performance measures. To earn the BOC® credential, participants attend training, pass class exams, and complete a series of project assignments at their facility. The program is administered nationally by the Northwest Energy Efficiency Council and a network of licensed training providers.

Actual v. Planned Accomplishments

The project set out to achieve five major objectives which in combination would advance commercial buildings towards net-zero energy by preparing the building technician workforce to optimize the energy efficient operation of the facilities they serve. At the close of the grant period, all major objectives have been satisfactorily achieved as summarized in the table below.

Objectives – Planned v. Actual			
Project Objectives		Planned Date	Actual Completion
1.0	Skill Standard & Gap Analysis	1/31/2011	1/31/2011
2.0	Ten New Modules & One Online Module	2/9/2012	2/9/2012
3.0	Module Integration Plan	4/30/2012	4/30/2012
4.0	Certification/Accreditation Plan	7/30/2012	7/30/2012
5.0	Commercialization Plan	7/31/2012	7/31/2012

Project Activity Summary

Activity 1: The project team developed a skill standard in energy efficient building operation for building technicians. NEEC's Building Operator Certification Skills Standards document embodies the general areas of responsibility, tasks, knowledge, skills, and abilities for building operators that are specific to improving building energy use and performance and maintaining high performance over time. A collection of Knowledge, Skill and Ability (KSA) competencies, which workers must have in order to perform a given occupational task with excellence are also articulated. The skill standard was reviewed by the National BOC Advisory Committee and validated by a survey of BOC graduates and their supervisors. The standard identified five key activity areas which served as the basis for conducting a gap analysis of the existing BOC curriculum to inform the content focus of the new curriculum developed under the grant. The gap analysis emphasized the need for curriculum enhancement in two areas of energy efficient building technologies and practices:

1. Low-Cost Operational Improvements for HVAC, Lighting and Building Controls, and
2. High Performance HVAC Technologies.

Deliverables:

BOC® Skills Standard for Building Operators, Feb 2011.

Energy Conservation Skills Inventory Self-Assessment Tool, March 2011.

Activity 2: The project team developed ten (10) curriculum modules addressing the energy efficiency knowledge gaps identified in the BOC gap analysis. Each module is comprised of instructor notes, detailed lesson plans, slides, in-class activities, and assessments. The module topics are:

- BAS Screen Checks (2hrs)
- The Four Common Opportunity Areas for Low-Cost Operational Improvement (4hrs)
- How to Conduct a Building Energy Scoping for Building Tune-up (6hrs)
- High-Performance Heating and Cooling Equipment (4hrs)
- Energy Savings through Energy Recovery (4hrs)
- Introduction to Spreadsheets for Energy Management (4hrs)
- Using Data Loggers and EMS Systems for Energy Diagnostics (4hrs)
- Using Time Series Trend Data to Set Performance Targets and Measure Improvements (4hrs)
- High-Performance Heating and Cooling Equipment (4hrs)
- Energy Savings through Energy Recovery (4hrs)

The project team developed a BOC Online Learning site www.onlineBOC.info which poises the program to offer BOC classes as distance learning through self-study during the post-grant period. A one-hour online module was developed to support the new module referenced above

titled “How to Conduct a Building Energy Scoping for Building Tune-up.” The online module prepares students to collect data on their building for use in the classroom-delivered portion of the class.

Deliverables:

A comprehensive 50-100 page Instructor Manual for each module.

Activity 3: The project team tested each new module in geographically diverse markets to evaluate the effectiveness of the instructional design and delivery and to determine its market value. Pilot classes were scheduled and conducted in 2012. The project team provided training to the instructors with the help of subject matter experts who developed the content. Survey instruments were administered at the end of each pilot class to solicit instructor and student feedback on the relevance, training need, and usefulness to their job. The majority of students (80%) rated the new modules as “Useful to Very Useful.” Instructors provided feedback on refinements to the final curriculum material before full integration into the BOC® Level I course scheme.

Deliverables:

Twenty (20) pilot classes delivered in geographically diverse locations for 300 building operators.

Activity 4: The project team completed a curriculum integration plan and a new class scheme for BOC Level I based on the results of the module pilots. The new scheme supports the BOC skill standard by addressing the four critical work functions of the Building Operator/Technician. The scheme is sequenced to first provide foundational understanding of energy using equipment and systems in the building – HVAC systems, Envelope, Lighting, Building Controls, and IEQ, culminating in a class that helps the student develop an action plan for O&M improvements to save energy. The scheme also offers administrators flexibility in customization to local interests through the selection of a supplemental class which was not available under the original course scheme. As in the past, the new scheme is non-commercial and designed to be supplemented with regional case studies, tools, and energy efficiency programs. The project team has scheduled three train-the-trainer sessions to prepare BOC’s existing national SME instructor pool to teach the new material. Commensurate with the new Level I course scheme, the project team developed a set of recommendations for revisions to the requirements for BOC® certification and to the BOC® accreditation standards

NEEC’s deployment goal is to have the new class scheme fully integrated into the BOC Level I course delivery in all locations by December 31, 2013. The new class scheme would be delivered in 60 courses or more on an annual basis, serving some 1,400 building operators in 30 states.

BOC States in 2012

Deliverables:

New, fully integrated class scheme for BOC Level I.

Activity 5: The project team completed a commercialization and sustainability plan (CSP) for introducing the new content into the existing market served by BOC and to extend BOC's reach into new market segments. The plan builds off of BOC's established base in the market as a highly valued professional training and recognized credential serving 25-plus states across the country. A keystone of the plan is the application of a blended learning approach to serve new territories and underserved, rural markets through the integration of online and on-site learning activities into the existing curriculum.

The project team is currently implementing the CSP, and will continue to implement after the grant period with a focus on the following strategies:

- Integrating the new curriculum modules into the BOC program's well-established existing markets;
- Researching and applying a blended learning approach to the BOC program to serve new territories and underserved, rural markets through the integration of online and on-site learning activities; and
- Extending the BOC's program reach to serve new and underserved markets in territories in no less than 25 states.

The project team prepared and distributed a survey to assess BOC student and graduate interest in and experience with online learning. The survey was administered using Survey Monkey and

distributed via the national BOC administrator partner network to approximately 2,600 BOC students, graduates, instructors, and other interested parties. The survey had a total of 928 responses, achieving a response rate of 35%. One of the aims of the survey was to determine BOC participants' access to the technology needed for online learning, both at home and at work. An overwhelming majority of respondents have access to the Internet at work (96%) and at home (92%), and about 80% can access audio and video content at work and at home. Only 0.8% of respondents do not have a computer at work and 5.7% do not have a computer at home. Thus, the project team interprets these results to mean that future applications of blended and online learning in the BOC program will not be hindered greatly by BOC participants' lack of access to the necessary technology. The survey asked respondents to share their past experience and satisfaction level with 1) online-only education programs (no classroom based component) and 2) blended learning programs (a mixture of online and classroom-based components).

With regard to online-only programs, 34% have not participated in any programs, whereas 66% have participated in at least 1 or more (47% in 1-5 programs, 10% in 5-10 programs, and 9% in more than 10 programs). 52% of respondents were either satisfied or very satisfied with online learning programs, 17% were neutral, and only 3% were not satisfied.

With regard to blended learning programs, 45% have not participated in any programs, and 55% have participated in 1 or more (46% in 1-5 programs, 6% in 5-10 programs, and 3% in more than 10 programs). 46% of respondents were either satisfied or very satisfied with online learning programs, 12% were neutral, and only 1% was not satisfied.

These results demonstrate that the respondents have had more experience with online-only programs than with blended learning. Thus, it may be advantageous in the future to conduct more targeted polling or focus groups amongst respondents who have had experience with blended learning, as this is the approach preferred for use in the BOC program. Very small percentages of respondents were not satisfied with online and blended learning; thus the BOC program should feel confident about applying blended learning approaches in the future.

Deliverables:

Commercialization & Sustainability Plan for the National BOC Program, July 2012.

Conclusion & Next Steps

The project team developed this Commercialization and Sustainability plan to ensure that the new curriculum modules developed by the BOC for Building Technicians project will be commercially viable and sustainable and will provide skill enhancement and job preservation to program graduates in new and underserved markets. The plan provides a report of progress made thus far and charts the course for future actions.

In summary, the project team has made the following achievements:

- Developed new energy efficiency curriculum modules to enhance the existing BOC curriculum and advance commercial buildings towards net-zero energy;
- Established and began undertaking a plan for achieving successful and sustainable integration of the modules into the national BOC program;
- Developed new online curriculum content for integration into the BOC program;

- Researched BOC participants' experience with and interest in online learning to inform best practices and future program improvements;
- Expanded BOC to four new states – Michigan, New Mexico, South Carolina, and Texas – supporting job enhancement and preservation of new populations of commercial building operators;
- Piloted an innovative model to offer BOC as a workforce development tool, achieving 70% job placement for unemployed workers in the Washington state pilot;
- Integrated BOC with three utility retro-commissioning programs to optimize energy efficient operation of facilities; and
- Established a competency credit partnership with BOMI and engaged other professional associations to build awareness for and promote BOC to professionals in building energy efficiency fields.

The key next steps for the project team after the grant period are to:

- Ensure successful roll out of the new curriculum modules in 2013;
- Pilot the new online curriculum module, fully integrate it into the national BOC program, and identify additional classes in the BOC Level I and II course series for similar adaptation to a blended learning delivery;
- Pilot BOC with untapped audiences such as federal workers and big box retailers;
- Further extend the BOC program's reach by expanding the program to additional states such as Idaho, Indiana, Kentucky, Montana, Nebraska, North Dakota, Pennsylvania, and South Dakota;
- Establish formal partnerships with additional professionals associations such as IUOE, APPA, and others;
- Contribute feedback to GSA as it finalizes core competencies for buildings personnel and identifies training and certification resources as required under the Federal Buildings Personnel Training Act (FBPTA); and
- Assess the cost/benefit to BOC of pursuing the ANSI Standard 17024 for organizations certifying personnel.

Products and Technology Transfer Activities

a. Publications and Conference Presentations

Conference Papers and Presentations:

BOC Skills Standards for Building Operators, 2011 World Energy Engineering Conference, April 2011. Chicago, IL.

BOC Skills Standards for Building Operators, Labs21 2011 Annual Conference, Sept 22, 2011. Providence, RI

Job Placement for the Unemployed through Partnerships with Industry-recognized Credential Programs, 2012 ACEEE Summer Study, August 15, 2012, Monterey, CA.

Leveraging National Guidelines for Building Operator Credentialing, 2012 ACEEE Summer Study, August 13, 2012, Monterey, CA.

Papers published in the Proceedings of the 2012 ACEEE Summer Study:

Job Placement for the Unemployed through Partnerships with Industry-recognized Credential Programs, ACEEE, August 2012.

Leveraging National Guidelines for Building Operator Credentialing, ACEEE, August 2012.

b. Web Sites

Course Descriptions – Level I Gets an Update

<http://theboc.info/h-course-descriptions.html>

Energy Conservation Skills Inventory Self-Assessment Tool

http://www.theboc.info/pdf/ENERGY-CONSERVATION-SKILLS-INVENTORY_FORM_distr.pdf

New Data Loggers Class for BOC

<http://theboc.info/blog/past-events/new-data-loggers-half-day-class/>

2012 Webinar Series features New Modules

<http://theboc.info/m-live-webinars.html>

c. Networks and Collaborations

BOMI and BOC Announce Partnership

BOMI International and the Northwest Energy Efficiency Council (NEEC) announced a new partnership. This new partnership will enable both organizations to further benefit building engineers and maintenance technicians by awarding competency credit between NEEC's Building Operator Certification (BOC®) and BOMI International's Systems Maintenance Technician (SMT®) designation.

<http://theboc.info/n-press-media/pr-041012-neec-bomi-partnership.html>

BOC Earns 2012 ENERGY STAR Award for Excellence

The U.S. Environmental Protection Agency (EPA) named NEEC as a winner of the 2012 ENERGY STAR Award for Excellence for its contributions through the BOC® program.

<http://www.theboc.info/n-press-media/pr-030312-neec-epa-award.html>

d. License Agreements

During the grant period the project team successfully expanded BOC to the following four states through license agreements between NEEC and the entities below.

Michigan

BOC partner MEEA launched the BOC program in Michigan in 2010 with Level I series in Okemos and Detroit. Three series were conducted in 2011, and three more will be completed in 2012. MEEA is currently working with its core program partners – the Michigan State Energy Office, DTE Energy, and Consumers Energy – to solidify the program infrastructure and expand the BOC program to new areas in Michigan by engaging community colleges and additional

project partners.

New Mexico

NEEC executed a license agreement with Santa Fe Community College for the State of New Mexico. The college houses a Center of Excellence in Energy Efficiency which will administer the program in partnership with colleges in the state. Courses are slated to begin in 2013.

South Carolina

NEEC executed a license agreement with South Carolina Community College System for the State of South Carolina. The college established a BOC Consortium comprised of three colleges which will administer the program in the state. Courses are slated to begin in 2013.

Texas

NEEC executed a license agreement with the South-Central Partnership in Energy Efficiency as a Resource (SPEER), a partnership of energy efficiency industry stakeholders committed to the accelerated adoption of advanced building systems and energy efficiency products and services in the South-central United States. SPEER is offering its first BOC course in Austin, TX in summer 2012.

BOC Goes to Texas and New Mexico

Welcome SPEER and Santa Fe Community College

<http://theboc.info/blog/uncategorized/boc-announces-new-partner-speer/>

Idaho and Montana

NEEC executed a license agreement with the International Building Operators Association (IBOA) for the States of Idaho and Montana. IBOA will administer the program in partnership with Idaho Power and Northwestern Energy. Courses are slated to begin in 2013.

f. Instructional Products

Ten comprehensive 50-100 page Instructor Manuals for each of the following modules.

- BAS Screen Checks (2hrs)
- The Four Common Opportunity Areas for Low-Cost Operational Improvement (4hrs)
- How to Conduct a Building Energy Scoping for Building Tune-up (6hrs)
- High-Performance Heating and Cooling Equipment (4hrs)
- Energy Savings through Energy Recovery (4hrs)
- Introduction to Spreadsheets for Energy Management (4hrs)
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Attachments

BOC® Skills Standard, 2011
BOC Level I New Module Integration Scheme, 2012
BOC® Commercialization and Sustainability Plan, 2012

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