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EVALUATION OF AMERENUE'S BUILDER OPERATOR CERTIFICATION PROGRAM

Prepared for

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Executive Summary

AmerenUE along with the Midwest Energy Efficiency Alliance (MEEA) and the Missouri Department of Natural Resources' Energy Center (Energy Center) began offering a Building Operator Certification (BOC) program in 2005. BOC is a competency-based training and certification program for operations and maintenance staff working in commercial, institutional, or industrial buildings. BOC achieves energy savings by training individuals directly responsible for the maintenance of energy-using building equipment and day-to-day building operations. (Further details on the program can be found in Section II.)

Based on the findings from this evaluation, program accomplishments between October 2003 and December 2006 include:

- Five training sessions completed (and additional classes starting)
- 65 AmerenUE customers representing 41 unique companies trained[1]
- Numerous projects started and/or completed as a result of the training
- Savings of 2,975 MWh and 12,444 MMBtus
- Program effects that expand beyond the companies represented in the trainings

These program accomplishments are described in Section III.

Overall, this program is valuable and does lead to cost-effective savings (see Section IV). Savings from this program were much higher than the online energy analysis or refrigerator recycling programs, but lower than the commercial rebate and residential lighting programs. Savings from this program could easily be increased by increasing the number of training participants.

For upcoming trainings, we recommend that AmerenUE and the Collaborative consider the following:

- Consistently collect information such as square footage in registration forms
- Track how participants learn about the program to determine what marketing and outreach methods are working, and use key account reps and other AmerenUE interactions to promote the course
- Consistently survey participants to gather feedback and make mid-course corrections
- Aim for approximately 20 participants per class
- Make classes more affordable for students
- Review the materials and ensure that they are cutting edge to the industry, and applicable to Missouri
- Seek ways to help increase recognition and understanding of the BOC course.

Details on each of these recommendations is provided in Section V.

[1] 81 total but 16 in one class were from Columbia Power & Light. These 81 customers represented a total of 53 unique companies.

I. Introduction and Methodology

AmerenUE along with the Midwest Energy Efficiency Alliance (MEEA) and the Missouri Department of Natural Resources' Energy Center (Energy Center) began offering a Building Operator Certification (BOC) program in 2005. BOC is a competency-based training and certification program for operations and maintenance staff working in commercial, institutional, or industrial buildings. BOC achieves energy savings by training individuals directly responsible for the maintenance of energy-using building equipment and day-to-day building operations.

This report provides the findings from a process and impact evaluation of AmerenUE's BOC program, led by Opinion Dynamics in partnership with GDS and Associates. This evaluation is based on (1) our review of the program spreadsheet, (2) our review of program materials (i.e., a short program description, the program application form and Ameren's website), (3) in-depth interview with the AmerenUE program administrator, David Harrison of Department of Natural Resources (DNR) Energy Center, (4) telephone in-depth interviews with 23 program participants and (5) our review of DNR's post-training hard-copy survey results from 31 program participants, administered on the final day of class.

ODC interviewed 23 of 81[2] program participants that completed one of the five BOC Level 1 Trainings offered by AmerenUE. These participants completed one of the first three training sessions offered. The first two started in October, 2005 and ended in April, 2006 while the third started in May, 2006 and ended in November, 2006. We did not interview participants in the fourth and fifth sessions (October, 2006 and finished in April, 2007) because they would not have had time to implement measures or practices learned through the course work.

As described above, our findings also draw on surveys conducted post-training. Thirty-one participants had filled out the hard-copy survey administered on the final day of class. While the ODC interviews were conducted with participants that had completed trainings and had time to use the methods and concepts taught in the training session, the MEEA surveys were used to gather participant feedback on the value of the course materials and to determine if participants had used or applied the methods or concepts taught in the courses. Both surveys represent qualitative results due to the limited number of interviews.

[2] Notably, only 65 of the 81 were in AmerenUE territory.

II. Program Description

The BOC program is designed to help businesses, industry, schools, hospitals, and government facilities operate buildings more safely, efficiently, and effectively. Certification is earned by attending courses and completing assignments. There are two levels of BOC training, BOC Level 1 (100 level courses) and BOC level 2 (200 level courses). BOC Level 1 training sessions consists of seven courses and covers topics related to energy transfer, air movement, heating systems and maintenance, motors, cooling, ventilation and control systems, lighting, electrical safety, environmental health and safety and indoor air quality.

Table 1: BOC Level 1 Courses

Course Name
BOC 101: Building Systems Overview
BOC 102: Energy Conservation Techniques
BOC 103: HVAC Systems and Controls
BOC 104: Efficient Lighting Fundamentals
BOC 105: Environmental Health and Safety Regulations
BOC 106: Indoor Air Quality
BOC 107: Facility Electrical Systems

AmerenUE has only offered Level 1 courses so far. At the time of writing this report, BOC Level 2 courses were scheduled to begin in May 2007.

Participants who pass an exam at the end each course and complete all coursework are eligible for certification. Certification must be renewed each year by completing at least five hours of additional training per year.

DNR Energy Center is the program administrator for the Missouri program. They are responsible for setting up the training series, securing classrooms, times and class structure. They are also responsible for finding instructors to teach the courses. DNR receives a list of qualified instructors from MEEA. They review the list for qualified instructors for each course and then send an email bid to the instructors. There is a variety of instructors from different companies who teach the courses. MEEA provides prepackaged education materials to DNR to distribute to the instructors. The materials for the training were licensed from the Northwest Energy Efficiency Council (NEEC).

Marketing is done by MEEA, the DNR Energy Center and AmerenUE. MEEA maintains www.boccentral.org and develops marketing materials for use in the Midwest such as articles and advertisements for trade journals and case studies. MEEA is also the liaison with NEEC for the national marketing plan. DNR Energy Center identifies stakeholders and prospective partners and prepares and distributes written materials to promote BOC, news releases, placement of articles in professional publications. AmerenUE promotes BOC to its customers though company publications.

The total program budget for AmerenUE's program is $538,324. Total expenses through mid 2007 for the BOC program are $263,000.

Table 2: Program Budget for 2005-2007

	2005	2006	2007	Three Year Budget
BOC License	$ 11,340	$ 5,670	$ 5,670	$ 22,680
Program Administration, MEEA	$ 49,525	$ 49,640	$ 33,590	$132,755
Program Administration, Missouri Energy Center	$ 45,640	$ 34,715	$ 34,755	$115,110
Purchase of Services	$ 31,180	$ 38,720	$ 63,130	$133,030
BOC Training Materials	$ 10,950	$ 14,125	$ 23,775	$ 48,850
BOC Instructional Expense	$ 6,720	$ 27,450	$ 51,729	$ 85,899
Total Program Budget	**$155,355**	**$170,320**	**$212,649**	**$538,324**

Using these funds, program design documents indicate that the program seeks to train approximately 60 building operators per year, or a total of 150 participants over the three year period.

Table 3: Participation Goals for 2005-2007

	2005	2006	2007
Number of BOC training series launched	2	3	3
Number of participants per series	15	20	20
Total number of participants	30	60	60

III. Program Accomplishments

Program accomplishments in 2005 and 2006 include:

- Five training sessions completed (and additional classes starting)
- 65 AmerenUE customers representing 41 unique companies trained[3]
- Numerous projects started and/or completed as a result of the training
- Savings of 2,975 MWh and 12,444 MMBtus
- Program effects that expand beyond the companies represented in the trainings

These accomplishments are described below.

Five Training Sessions Completed

In the first two years of the program, five trainings were started or completed. The locations and start dates of these trainings include are shown in the table below. As such, AmerenUE achieved their goal of conducting five trainings within the first two years of the program. Additional trainings are being started in 2007, including the first Level II BOC course.

65 AmerenUE Customers Trained

In the first two years, the program trained 65 individuals within AmerenUE's territory, and an additional 16 individuals in the Columbia area.

Table 4: Participation 2005-2006

Locations	Session Start Date	Total number of AmerenUE participants
Jefferson City	10/5/05	10
St. Louis	10/26/05	28
St. Louis	05/16/06	10
St. Charles	10/11/06	15
Columbia	11/18/06	2
	TOTAL	**65**

These 65 customers represent 41 unique companies.[4]

Based on our in-depth interviews with participants in the first three sessions, buildings operated by participants average 1,157,000 sq feet, much more than anticipated prior to training. The median is 500,000 sq feet. Both the average and median are significantly higher AmerenUE's current estimate of 200,000 sq ft. The unique facilities factor is 0.63 (41 unique companies/65 individuals) compared to the current estimate of 0.71.

[3] 81 total but 16 in one class were from Columbia Power & Light. These 81 customers represented a total of 53 unique companies.

[4] These numbers include two AmerenUE employees.

Table 5: Building Information

Sq Ft	Number of Buildings	Building Use
3,600,000	33	Education; this is a school district
3,000,000	6	offices, patient areas
3,000,000	8	Patient Care/Medical Research
3,000,000	40	Educational purposes
2,200,000	10	Office complex
2,000,000	26	Offices and research
1,800,000	12	Government Offices
750,000	40	University - residential, classroom, lab, offices
750,000	1	Hotel
567,000	1	Shopping mall
500,000	4-5 all connected into one	Umbrella organization for United Van Lines, Mayflower, etc. Building house all departments involved in operations
450,000	25	Highway patrol headquarters
433,000	4	Financial/Banking
376,000	7	library, 2 major academic buildings, athletics building, reserve building not used for much and a dormitory
275,000	1	Hotel
240,000	1	Dining, Athletic and Hotel Rooms
200,000	1	Apartments and a hotel
162,000	3	Main- Non profit plant research laboratory
66,000	1	Engineering Co. Contracting
50,000	1	Mostly meetings, ballroom activities, several restaurants, pro shop, restrooms, locker rooms, showers
43,000	1	Hospital
40,000	3	Office space
No idea		Would include all state buildings in MO (thus included as over 500,000 when calculating median)

Participants are Starting or Have Completed Numerous Projects

Of the 23 participants interviewed, 18 have completed or plan to complete lighting projects and nine have completed or plan to complete HVAC projects. Overall, projects range from switching to energy efficient lighting and installing motion sensors, to upgrading motors and using new variable speed drive (VSD) motors for air handling units (AHU).

Program has saved 2,975 MWh and 12,444 MMBtus

The BOC program appears to be cost effective, as described in the impacts section below. Applying the average savings per square foot to all program participants along with the average square feet of the facilities and the unique facilities factor savings were determined to be 2,975 MWh and 12,444 MMBtus. (The impact and cost effectiveness analysis is described in detail in Section IV.)

Program Effects that Expand Beyond the Companies Represented in the Trainings

Some participants have left the job they held when they attended training while others with whom we spoke with were leaving shortly. As these participants move to other jobs, they bring their knowledge with them the reach of the BOC program increases.

IV. Impacts and Cost-Effectiveness

We calculated the impacts for this program based on a survey of twenty participants in the BOC program. All participants attended the BOC courses in either October 2005, or May 2006, thus all had at least six months to implement projects after completing the course. Our survey asked participants questions ranging from the total square footage of their facilities to the types of projects that they completed based on knowledge gained from the BOC training. Projects ranged from switching to energy efficient lighting and installing motion sensors, to upgrading motors and using new variable speed drive (VSD) motors for air handling units (AHU). Using the responses given in the survey, we determined savings calculations based on energy efficient lighting, motion sensors, motor upgrades, air handling unit upgrades, and rooftop unit upgrades being installed.

Some participants needed to be called multiple times for more details on their completed projects. For lighting projects, clarification was needed on the type of fixture that was replaced (eg; four lamp, T12 lighting being replaced with five lamp, T5 lighting) as well as how many fixtures were replaced. The number of motion sensors and an average of how many light fixtures each sensor controlled was asked to participants. Replacing AHU motors required the evaluation team to find the size of the supply air (cubic feet per minute), motor size (horsepower), and if it has a variable speed drive. Also, information on the old motor was needed, such as age and horsepower. Any rooftop units that were replaced, the old EER rating and the new EER rating along with the cooling size (tons) and heating size (Btuh) were required.

Energy Efficient Lighting and Occupancy Sensors

For lighting, if the original fixtures were unidentified, a four lamp T12 fixture was assumed to have been replaced. The hours lighting was in use was estimated by the hours of operation provided by participants on the survey. Using the wattage data for each fixture, wattage of the bulbs and electronic ballast, kilowatt-hour savings were calculated using the equation below:

Compact Fluorescent Lamp Savings Calculation

kWh = watts saved * (hrs of operation per day * 365 days)

The motion or occupancy sensor savings were calculated using the assumption that they were installed with the new lighting. This makes sense because only the participants who reported installing efficient lighting reported also installing occupancy sensors. That means all wattages are based on the same energy efficient lighting values from above. An estimation of running time was determined by the hours of operation of each facility. Savings were calculated using a 25% reduction in running time in all but one case where a participant mentioned reducing running time by 35%. From the new running time, kilowatt-hour savings were calculated using the same equation above.

Motor and AHU Upgrades

We calculated the energy savings from upgrading motors based on the horsepower, previous efficiency, new motor efficiency and if the motor has variable speed drive (VSD). The horsepower, efficiency and an assumed loading of 75% are used to calculate the kilowatts used

to run the motor. We assumed a running time of 6,000 hours annually to calculate the annual energy use of the motor in kilowatt-hours. Based on the new efficiency and VSD capability, we then calculated energy savings.

Finally, to calculate savings from updated air handling units, we calculated the motor savings as described above. The energy use of the old motor is input to a spreadsheet that contains AHU and regional weather data. The spreadsheet allows for weather data, internal and external temperatures, and heating and cooling to be used in energy calculations. This determines the current annual use of the AHU. On a second spreadsheet, new motor with VSD energy use is input and the natural gas and electric annual savings are calculated.

Total Savings

Table 6 shows the savings calculated from each measure for the 20 participants who completed the survey. These savings were then divided by the square footage for an average savings of 0.063 kWh/sq ft., and 0.00263 MMBtu/sq ft.

Table 6: Energy Savings from BOC Program Survey Based on 20 Participants

Measure		Savings		
		kWh	MMBtu	$
Motors	1	20,034	0	$ 1,160
	2	151,886	0	$ 8,794
	3	5,876	0	$ 340
AHU's	1	42,448	327	$ 5,957
	2	-6,933	916	$ 9,386
	3	75,056	552	$ 10,250
Lighting	Total Lighting (all respondents combined)	256,604	0	$ 14,857
OCC	Occupancy Sensors (all respondents combined)	150,087	0	$ 8,690
Rooftop	Rooftop Units (all respondents combined)	604,613	3,640	$ 73,919
TOTAL		**1,299,672**	**5,435**	**$ 133,353**

Table 7: Calculated Energy Savings per Square Foot

Square Footage	kWh / sf	MMBtu / sf	$ / sf
20,695,000	0.063	0.000263	$ 0.0064

Total energy savings for the program was then calculated by first summing the kWh and MMBtus saved and dividing by the total square footage of the buildings operated by program participants that completed the survey. This provided an estimate of savings per square foot of the BOC program. Next, using the number of classes and participants in each the 2005 and 2006 years, along with the average square footage and unique facilities factor of participating locations (as calculated by our participant survey), we calculated total kilowatt-hour and MMBtu savings per BOC class year. An electric rate of $0.0579/kWh and a gas rate of $10.69/MMBTU were provided by AmerenUE for their commercial users. Using these rates, we calculated the cost savings for the 2005 and 2006 BOC program years.

Table 8: BOC Program Totals

	Total Students	Unique Facilities Factor	Facility Avg sf	kWh / sf	kWh	$ / kWh	MMBtu / sf	MMBtu	$ / MMBtu	Total $
2005	38	0.63	1,157,000	0.063	1,739,505	$0.058	0.000263	7,275	$10.69	$178,483
2006	27	0.63	1,157,000	0.063	1,235,964	$0.058	0.000263	5,169	$10.69	$126,817
TOTAL	65				2,975,469			12,444		$305,300

NEEP estimated a 0.60 kilowatt-hour per square foot savings and a 0.001950 MMBTU per square foot savings for the BOC program. As explained above, ODC/GDS calculates 0.063 kilowatt-hour per square foot savings and 0.000263 MMBTU per square foot savings. NEEP's values for both electric and natural gas savings per square foot are respectfully 9.52 and 7.42 times higher than ODC/GDS's calculations. It is unclear in the BOCfinalreportdelivered.pdf file where NEEP's savings per square foot values came, so it is difficult to determine why the values are so different between NEEP and ODC/GDS. The total program savings calculated by NEEP will be higher partly because they have a unique facilities factor larger than ODC/GDS (0.71) and because of the high value of savings per square foot.

Cost-Effectiveness

The program costs have totaled $263,000 for a total savings of 2,975,469 kWh and 12,444 MMBtu for years 2005 and 2006. Paybacks for these years range from 0.8 to 0.9 years. Also, the benefit-cost ratio varies between 11.1 and 12.4.

Benefits are calculated using $0.0579/kWh and $10.69/MMBTU rates, which was provided by AmerenUE as standard rates charged to their commercial customers. The discount factor was provided by the *Energy Price Indices and Discount Factors for Life-Cycle Cost Analysis - April 2006* report from the US Department of Commerce to the US Department of Energy (http://www1.eere.energy.gov/femp/pdfs/ashb06.pdf). In the report, table Ba-2 uses a 3% rate of inflation and has discount factors adjusted for the Missouri area. Light bulbs were estimated to last for eight years while motors were estimated at fifteen years. Referencing the commercial, electric column and looking to eight years of life, a discount factor of 6.75 was discovered for lighting savings. Motors received a discount factor of 10.00 for natural gas and 11.51 for electric from the respective commercial columns referencing fifteen years. Using the discounted factors, the discounted savings and the benefit-cost ratios were calculated.

Table 9: Benefit-Cost Ratios

	2005	2006
Cost	$160,500	$ 102,500
Benefit	$ 178,295	$ 126,819
Payback	0.9	0.8
Discounted Savings	$ 1,785,013	$ 1,269,657
Benefit Cost Ratio	11.1	12.4

Detailed spreadsheets on the savings and life cycle costs analyses were provided to AmerenUE along with this report.

V. Process Findings and Recommendations

All but one of the 23 participants we interviewed were satisfied with the training they received. Participants liked talking to other people in their fields and learning what they were doing. They also liked the presentation of information and found the instructors knowledgeable. Participants found the lighting, HVAC and energy conservation courses the most valuable.[5] One participant stated, "It was good information for the purposes of facilities operations for energy savings, bringing awareness of the systems in the building, how different systems from HVAC to electrical operate in the buildings." Another said, "the instructor took time to answer peoples questions, homework was important, projects required were about your facility and that was really beneficial."

Many (19 of 23) of those who were interviewed are very interested in completing the BOC Level II training with 10 already signed up or planning to sign up for the Fall course.

- **Consistently collect information such as square footage in registration forms**

  Square footage of the buildings that participants control is an important input to determine the savings from the BOC program. This information should be collected in a consistent manner and used to update savings estimates on a regular basis. MEEA has indicated that they started to do this as of January 2007, and the program should confirm that this information has been collected for all participants in the first BOC course offered in 2007 (starting in May 2007). In addition, AmerenUE and the Collaborative should also consider using the application process to ask for building type or use, hours of operation and other key data to help the program understand both who it is attracting, and the overall impacts of the course.

- **Track how participants learn about the program to determine what marketing and outreach methods are working, and use key account reps and other AmerenUE interactions to promote the course**

  While the program trained 65 AmerenUE customers in the sessions that began in 2005 and 2006 it fell short of its goal of 90 participants during this timeperiod. AmerenUE key account reps and other AmerenUE interactions could help to increase enrollment in the course.

  Most of the participants found out about the BOC program from their employer, DNR or AmerenUE.[6] Others mentioned they heard of the program through fliers or mailings, Facility Operator & Service Provider Association (FOSOP) and IFMA.

  When asked for suggestions on getting more building operators to attend the courses respondents suggested:
  - Mass mailing
  - IFMA or BOMA
  - Go to trade schools and target graduates through the newsletter

[5] Based on MEEA End of Training Evaluation
[6] Based on MEEA End of Training Evaluations

- Advertising
- Use existing databases such as people that subscribe to different technical facility type magazines.
- Word of mouth
- Advertise in local supply houses

As part of the enrollment form a questions should be asked to find out how the trainee learned about the program. Responses should be used to track which marketing and outreach efforts are working the best.

- **Consistently survey participants to gather feedback and make mid-course corrections**

End of training evaluation surveys are important for providing feedback on the course materials and instructors. An end-of-course and an end-of-training survey were provided with the course packet. We suggest continuing to distribute the end-of-training survey to all students at the end of each training session, and reconsidering the use of the end-of-course survey which was formerly handed out at the end of each of the eight courses that make up the training. The results from these surveys can be used to guide instructors and enhance courses.[7]

- **Aim for approximately 20 participants per class**

One training session has 28 participants while two others had only ten participants. While having ten students per class provides for a lot of interaction. The revenue and impacts from such a small number are less than ideal. However, feedback from the DNR Energy Center administrator indicates that 28 was too many to manage. The DNR Energy Center suggests approximately 20 participants per class because it alleviates some of the financial burden and it is a good class size to manage and teach.

- **Make classes more affordable for students**

AmerenUE's BOC courses currently cost $2,300 and AmerenUE pays half for its customers to attend so the cost for the participant is brought down to $1,150. Notably, however, neighboring utilities such as Columbia Water & Power offers the same BOC course for $1,150 and will reimburse the participant half the cost if they become certified so that the cost to the customer is only about $575. AmerenUE's course is also more expensive that a BOC course offered in Arizona, which is offered at approximately $1,200 with a financial incentive from the utility of $600 to bring the cost to approximately $600 to the customer. Our survey did not explore issues around program costs, but AmerenUE and the Collaborative may want to reexamine the program costs to see if they can bring down the course cost in order to increase the number of students per class. (Or similarly, by increasing the number of students per class through additional marketing efforts, AmerenUE may be able to bring down course costs.)

7 We received some end of training evaluation surveys that MEEA conducted to use as part of our research. We received three surveys for the first three training sessions. The surveys were not consistent in the questions asked and it does not appear that all participants completed the surveys.

- **Review the materials and ensure that they are cutting edge to the industry, and applicable to Missouri**

  Currently the course content is based on materials from NEEC. NEEC provides MEEA a package that contains student manuals, PowerPoint presentations and tests. MEEA gives this to DNR for use in each course. Instructors use the prepackaged educational portion to teach the classes. These materials are based on a different geographic location and the instructors (along with MEEA) have attempted to update and customize these materials for the Missouri climate and building codes and make sure they are up to date. Prior to future trainings, AmerenUE and the Collaborative should consider reviewing the materials and ensuring that they are cutting edge to the industry in order to ensure that they are offering customers a valuable service through the trainings. Notably, some other areas of the country have built their own courses from the ground up, which offers a more local flavor to the course, and allows the instructors to be more invested in keeping the materials up to date.

- **Seek ways to help increase recognition and understanding of the BOC course**

  BOC name recognition in Missouri is low, according to program administrators. Additional marketing, promotion, and education about BOC can help increase the recognized value of the course, and ultimately increase both participation and savings from the course. AmerenUE and the Collaborative should seek ways to help increase recognition and understanding of the BOC course.

In addition, respondents to our survey had a few suggestions for improving the BOC program. Suggestions included: have a web log where people dealing with some of the same problems can interact; visit locations that have implemented some of the things talked about in the courses; more emphasis on the LEED program; more displays in each class; and more hands on.