Building Operator Certification – Level I

A Partnership of the NYC Department of Education Division of School Facilities, International Union of Operating Engineers, and the City University of New York

Department of Education
Dennis M. Walcott, Chancellor

The City University of New York

Class 26

Class Announcements

Welcome to Class 26

Countdown to Complete:

4 Weeks

Today's Objectives and Topics

- Exam Review
- Energy Improvement Measures
  - What are they and how can we work with them
- Project Work Session
  - Identify your project and describe it
  - Practical Project 2C – Energy Improvement Project
- Energy Audits
  - The Energy Audit Process
  - Role of the Building Operator
  - Reading & Using the Report

Exam Review

Review of Exam 5 – Class 25

Energy Improvement Measures Overview

What are Energy Improvement Measures ?

Actions that

- Reduce energy use
- Improve IEQ or do no harm to IEQ

These can be

- Equipment - *Capital Improvements*
- Behavioral – *Getting people to change*
- Operational – *How the equipment is operated*

Energy Improvement Measures Overview

What are **Operational** Energy Improvement Measures?

Actions that

- Reduce energy use
- Improve or do no harm to IEQ
- **We, the building operators, can implement with little or no external support**

History of Operational Energy Measures

- Part of Energy Audit practice – items listed with general note
  - about 5 – 10% savings
- Texas A&M Energy Systems Lab in the 1990's
  - More structured, formal approach to O&M measures
  - Applied to retrofitted systems, new buildings
  - Saved 25% - 35% of system-level energy use….
    - ***by fixing systems that were not working as intended***
- Retro-commissioning (RCx)
  - Required under new NYC Local Law 87 - Over 50,000 SF
  - PECI document library http://peci.org/resources/commissioning.html#rcxresources
  - Related terms – On-going Cx, Monitoring-based Cx

Not just for older equipment!

- Newer equipment that was never properly set-up, adjusted for energy performance
- Newer buildings offer many opportunities
  - RTU, AHU – outside air control, economizers
  - System balance
    - Do areas heat/cool evenly, receive proper ventilation?
    - Throttled valves or dampers?
  - Pump, Fan speed control

Figure A-2. Input versus output data for fans and pumps with variable-speed drives.

Average percent of full load	
Device output	KW input
100%	1.00
90%	0.73
80%	0.51
70%	0.22
50%	0.06
30%	0.03

Herzog, p. 161

Savings Opportunities

“The Top 4 Savings Opportunities”

- Scheduling (includes equipment staging, zoning)
- Sensor & Signal Error
- Simultaneous Heating & Cooling
- Outside Air usage

Better Bricks
http://www.betterbricks.com/operations

http://www.betterbricks.com/building-operations/tools/common-opportunities-0

Class Discussion Topic

What kinds of measures are coming to your mind?

In your school, what are the energy improvements that are needed?

Practical Project 2C – Energy Improvement Project

Sources of Identifying Measures

Energy Audit – some measures are identified

Custodian-Engineer Initiative

- Union support for this role. Value-adding.

Review of Operations

- We are asking you to start with 1 measure or closely related group of measures
- Practice identification and characterization
- **Characterization** includes both **qualitative** (verbal description) of conditions and ways to improve AND **quantitative** (benefits and costs)

Electric Energy Savings

How can we control the electricity usage in the classrooms?

$100,000 in Awards to 10 Green Cup Challenge in NYC !
See the first one on this page ! Click on it
http://www.greenschoolsalliance.org/news.html

The National Winner is PS 166
See how they did it ! Click on it
http://gothamschools.org/2010/05/26/taking-the-green-cup-challenge/

Your school can apply in January http://greencupchallenge.net

BUILDING OPERATOR CERTIFICATION

Break

..

Energy Improvement Measures Project Workshop

Review Project Instructions – Yellow Sheets **Due Week 29**

This week: **Verbal Characterization**

- "In my facility the …… (condition description), Therefore I will …… (measure description)."
- Key Points beyond the obvious
  - What impacts on IEQ ?
  - Who may be affected ?
  - Who needs to be involved in implementing ?

Workshop Next week: Quantitative Dimensions

Project Working Session

- Break into groups – 4 people in group
- Discuss what improvement projects you are considering
- One person in group records for group
- Review Project Worksheet. Does everyone understand?
- Report back to full class discussion

Break

Break for 10 minutes

Energy Audits

How they are done

- Process and Objectives
- The facility operator's role

Reading and using the Energy Audit Report

- Standard sections of the report
- What to look for
- The facility operator's role in Quality Control

Energy Audit

As **Process**

- Why? How? By whom?
- Learning, Planning, Acting

As **Product**

- Deliverables - *the Audit Report*
- Use - *as a guide and management tool*
- Outcomes - *projects, targets of energy savings*
- Per Local Law 87 – includes RCx

Goals of an Energy Audit

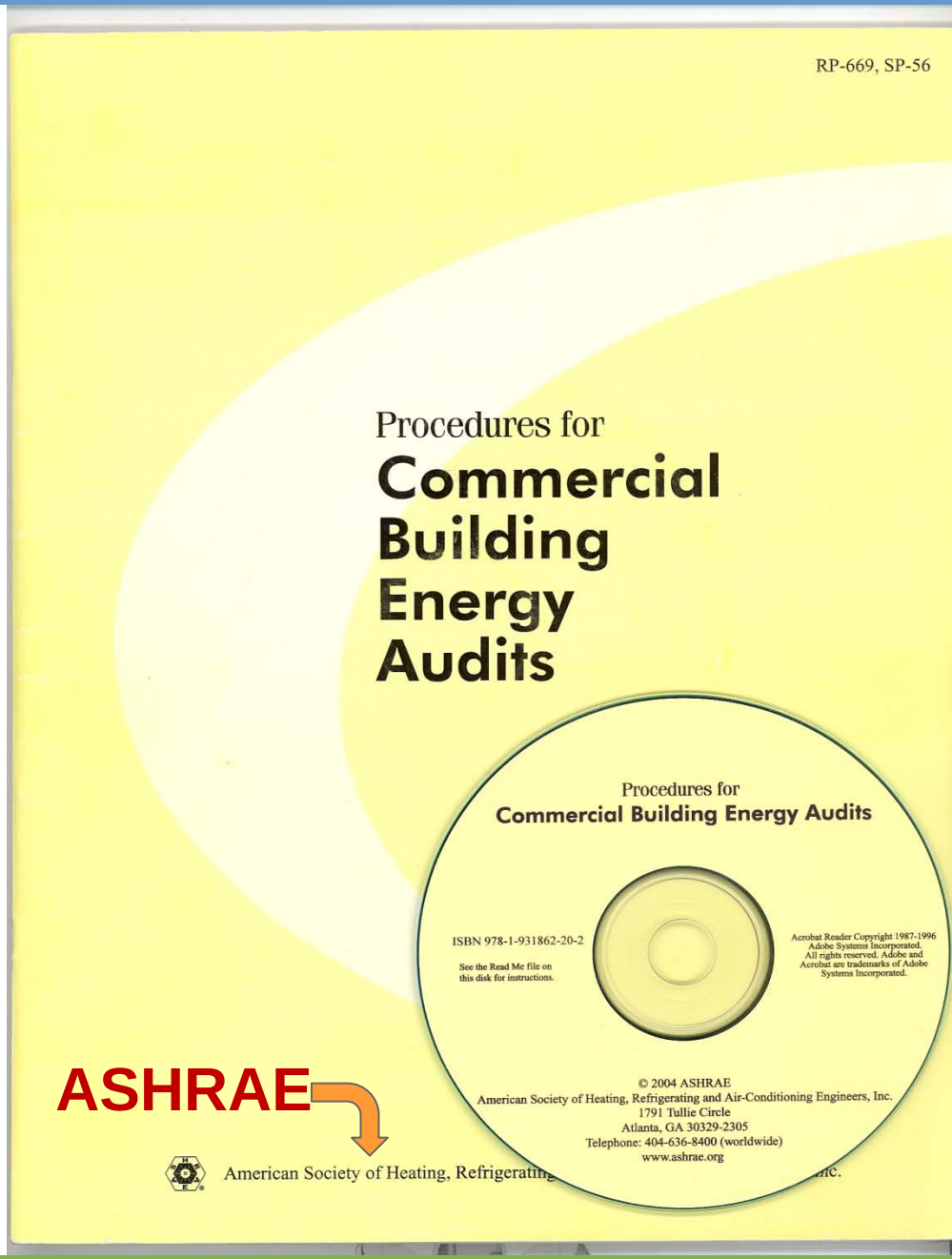
Quantify and understand facility's energy use

- Costs. End-uses. Baselines and Benchmarks.

Identify improvement steps

- Operations & Maintenance, low- cost, repairs, RCx
- Capital Projects – new and/or replacement
- Set performance targets. M&V Plan.

Communicate with upper management



BUILDING OPERATOR CERTIFICATION

Basic Steps of Energy Audit

1. Identify all of the energy-consuming equipment
2. Determine the energy used by each piece of equipment
3. Identify where improvements can be made in each piece of energy-consuming equipment
4. Quantify the energy saved by the improvements made in each piece of energy-consuming equipment
5. Determine the total energy saved by all of the ECM's (Energy Conservation Measures).

Use Energy Audit Strategically

- Get improvement steps you have taken recognized and recorded
- Get your operational priorities included – express them to the audit engineer, review document, provide feedback
- Understand the capital and RCx plans for your facility with your DDF

The Typical Audit Report
Summary of Recommended Measures

MASTER NYPA SUMMARY

Energy Conservation Measure Summary

Comprehensive Energy Audit

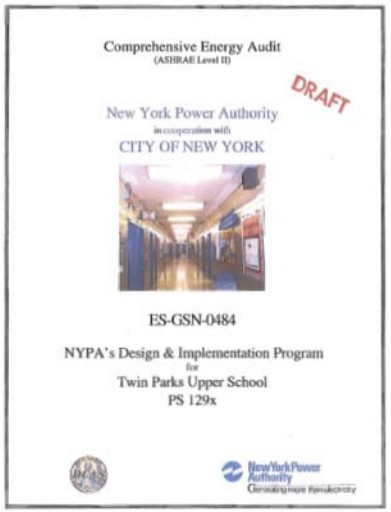
MEASURE DESCRIPTION	TOTAL MEASURE COST [1]	TOTAL DIRECT CONSTRUCTION COSTS [2]	ANNUAL ELECTRIC SAVINGS (kWh)	ANNUAL DEMAND SAVINGS (kW)	ANNUAL FUEL SAVINGS (mmBtu)	ANNUAL ELECTRICAL COST SAVINGS	ANNUAL FUEL COST SAVINGS	TOTAL ANNUAL SAVINGS	SIMPLE PAYBACK
Lighting & Lighting Controls Upgrade	$514,394	$344,301	420,513	1,374.1	0	$65,600	$0	$65,600	7.8
Steam-Trap Replacement	$83,553	$37,200	0	0.0	316	$0	$4,096	$4,096	15.5
Boiler Burner Replacement	$563,778	$330,000	34,300	60.0	1,311	$3,363	$19,359	$24,723	22.8
Premium Efficiency Motor Upgrades	$6,745	$3,948	5,619	21.2	0	$879	$0	$879	7.7
Kitchen Exhaust Fan Replacement	$16,213	$9,490	6,948	21.9	0	$1,086	$0	$1,086	14.9
TOTALS - Recommended Measures	$1,164,683	$724,939	467,381	1,477.1	1,627	$72,928	$23,456	$96,384	12.1

The Audit Report : WHAT TO LOOK FOR

Upper-level Execs may only read the Executive Summary and the Table of Recommended Measures. As Building Managers we should be concerned with

- Is description of site and operation accurate?
  - Age and condition of major equipment
  - Facility schedule
  - Are potential or implemented operational measures correctly captured?
- Do recommended measures have a basis in the descriptions?
- Do projected savings make sense in terms of energy use?
  - >40% savings should elicit a “show-me” reaction

How is audit report typically organized?


Comprehensive Energy Audit
(ASHRAE Level II)

DRAFT

New York Power Authority
in cooperation with
CITY OF NEW YORK

ES-GSN-0484

NYPA's Design & Implementation Program
for
Twin Parks Upper School
PS 129x

- Large document but very repetitive
- Be prepared to thumb back and forth between sections including Appendices

TABLE OF CONTENTS

TITLE	SECTION
EXECUTIVE SUMMARY	1
FACILITY DESCRIPTION	2
UTILITY DESCRIPTION	3
MAINTENANCE AND SAFETY	4
ENERGY CONSERVATION MEASURES	5
PROJECT TIMELINE AND CONCERNS	6
BUILDING INVENTORY	7
APPENDIX A – UTILITY INFORMATION & BUILDING OCCUPANCY	•
APPENDIX B – COST ESTIMATES	•
APPENDIX C – ENERGY SAVINGS CALCULATIONS	•
APPENDIX D – BUILDING LIFE CYCLE ANALYSIS	•
APPENDIX E – EQUIPMENT CUT SHEETS	•
APPENDIX F – ASHRAE FORMS	•
APPENDIX G – BENCHMARKING REPORT	•

Let’s check one element

Does the Burner Replacement recommendation make sense?

Are the boilers in good condition? What does the report have to say about it? What is the baseline condition of the burner operation? Where is it described?

Is replacement feasible? Is auxiliary work taken into account in the cost estimate?

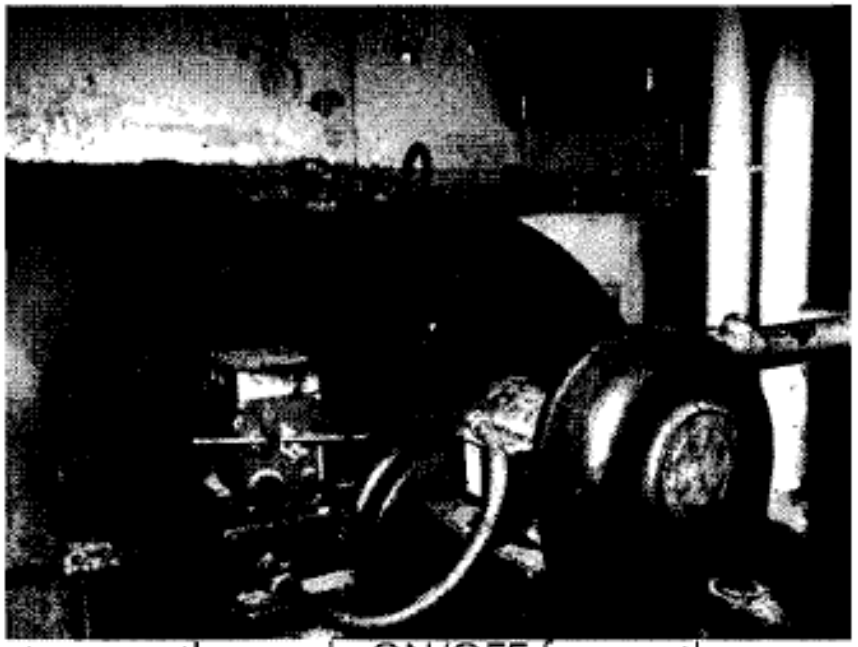
Do the savings make sense? How would we check?

- Compare savings shown to appropriate energy use.
- Where would we find these?

ECM #3 Boiler Burner Replacement
Let's practice reading some audit language

Existing conditions

The existing steam boilers are fire-tube boilers with single stage burners. They utilize #6 Fuel Oil as a fuel source, and operate all year round. The operating steam pressure ranges from 5 PSI to 14 PSI depending on the season and the system application. The boilers are manually sequenced depending on the expected load. The burner themselves, and their associated burner controls, are out dated and have out lived their useful life.



Furthermore, these boiler burners are single stage, so they cycle ON/OFF frequently, resulting in increased energy usage.

ECM #3 Boiler Burner Replacement

Recommendation

Based on our study, we recommend replacing the existing boiler burners with new dual fuel, fully modulating burners, and installing new burner controls on each boiler. The proposed dual fuel burners will utilize natural gas as the primary fuel source and #2 fuel oil as secondary, eliminating the need for the fuel heaters. Switching the primary fuel source to natural gas will help reduce greenhouse gas emissions due to the fact that natural gas combustion emits fewer greenhouse gases than #6 fuel oil combustion. Additionally, the burner controls will optimize combustion in order to achieve the highest combustion efficiencies, further minimizing emissions. The modulating burners will improve overall system efficiencies by allowing each boiler to match the current load with the appropriate firing rate, minimizing cycling losses. This scope of work includes refractory work required to retrofit the new burners, and a new gas feed to the boiler room.

ECM #3 Boiler Burner Replacement
How well developed is the cost estimate?

LABOR & MATERIAL ESTIMATE — WENDEL

	Project : Twins Park School PS 129	Estimated by: JG	
	Project #: 316326	Checked by:	
	Measure: Boiler Burner Replacements	Approved by:	
	Date:	File: Cost Estimate	

Item No.	Description	Qty.	Unit	Material		Labor		Total Cost
				Unit Price	Total	Unit Price	Total	Labor & Material
1	Demo existing burners/controls	1	LS	$12,500.00	$12,500.00	$17,000.00	$17,000.00	$29,500.00
2	Burners & install	1	LS	$123,000.00	$123,000.00	$48,500.00	$48,500.00	$171,500.00
3	Burner Controls	1	LS	$12,500.00	$12,500.00	$12,500.00	$12,500.00	$25,000.00
4	New gas feed and associated work	1	LS	$28,000.00	$28,000.00	$56,000.00	$56,000.00	$84,000.00
5	Fuel System Conversion (#6 to #2)	1	LS	$7,000.00	$7,000.00	$12,000.00	$12,000.00	$19,000.00
6					$0.00		$0.00	$0.00
7					$0.00		$0.00	$0.00
8					$0.00		$0.00	$0.00
9					$0.00		$0.00	$0.00
10					$0.00		$0.00	$0.00
11					$0.00		$0.00	$0.00
12					$0.00		$0.00	$0.00
13					$0.00		$0.00	$0.00
					$0.00		$0.00	$0.00
					$0.00		$0.00	$0.00
				SUBTOTALS:	$183,000.00		$146,000.00	$329,000.00

ECM #3 Boiler Burner Replacement
Do the projected savings make sense?

MASTER NYPA SUMMARY
Energy Conservation Measure Summary
Comprehensive Energy Audit

ECM No.	FACILITY	MEASURE DESCRIPTION	TOTAL MEASURE COST [1]	TOTAL DIRECT CONSTRUCTION COSTS [2]	ANNUAL ELECTRIC SAVINGS (MWh)	ANNUAL DEMAND SAVINGS (kW)	ANNUAL FUEL SAVINGS (mmBtu)	ANNUAL ELECTRICAL COST SAVINGS	ANNUAL FUEL COST SAVINGS	TOTAL ANNUAL SAVINGS	SIMPLE PAYBACK
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		TOTALS - Recommended Measures	$1,164,683	$724,939	467,381	1,477.1	1,627	$72,928	$23,454	$96,384	12.1

NOTES:
1. TOTAL MEASURE COST includes all costs and fees associated with this measure.
2. TOTAL MATERIAL & LABOR

From Measures Table – savings of 1,331 MMBTU

ENERGY PERFORMANCE SUMMARY 08-09 Ave **(YEAR)**

This is a summary of energy account worksheets on succeeding pages.

ENERGY TYPE	TOTAL ANNUAL USE	UNITS	CONVERSION MULTIPLIER To Thousands Btu See Page 17	THOUSANDS BTU (kBtu)	TOTAL ANNUAL COST ($)
ELECTRICITY	1,267,720	KWh	3.413	4,326,728.36	202,560
NATURAL GAS	1,778	Therms	100	177800	3,071
PURCHASED STEAM					
PURCHASED HOT WATER					
PURCHASED CHILLED WATER					
OIL # 6	50,000	GAL	154	7,700,000	91,258.44
PROPANE					
COAL					
OTHER					
				A	B

"Energy Performance Summary, in Appendix F Fossil Fuels = 7,700 MMBTU

1,331 / 7,700 = 17%

Which seems reasonable

BUILDING OPERATOR CERTIFICATION

Close

Reminders for next week:

Clarify and refine the Energy Improvement Measure you have identified for your facility

- Write an initial draft verbal description.
- Think about what impacts it will have and what is required for it.

Be prepared to start doing some quantification
Bring a calculator

Read the Sample Energy Audit – On BOC website

Continue reading Herzog, especially Appendices A & B