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
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The City University of New York

Class 27

Class Announcements

Welcome to Class 27

Countdown to Complete:

3 Weeks

Class Announcements

Project 2C – Energy Improvement Project

This is due on Week 29 – Firm Date

Make sure that all of your Projects are complete because they are required for your BOC Certification.

Today's Objectives and Topics

- Energy Audit - continue discussion
- Project Workshop - Qualitative descriptions
- Introduce Quantitative Elements - Calculations
- Project Workshop - Quantitative Elements
  - > Practice working with quantitative elements

The Energy Audit

- What experiences to date with energy audits?
- Preparing and reviewing with your DDF
- What key take away from reading of the burner replacement ECM?

The Energy Audit

Audit Report

- Importance of having hard copy
- Review **Table of Contents**
- Where would you find…..

TABLE OF CONTENTS

The Energy Audit

More practice reading

Facility Description

FACILITY DESCRIPTION

Overview

Twin Parks PS 129 School is located in the Bronx at 2055 Mapes Ave. It is a 3 and 4-story elementary-middle public school consisting of approximately 134,000 sq.ft. It was originally constructed in 1971. The school is classified as an elementary – middle school for grades 6 through 8 and special education.

There are approximately 1,300 students amongst the school. The students and teachers are in session all year round with the exception of holidays and recess periods. The facility typically holds summer sessions. The facility is typically occupied from 6am to 6pm during the week and 7am to 3pm on Saturday, with the exception of maintenance staff who operates 24-7. The HVAC equipment is manually operated and typically follows the occupancy schedule.

Construction of the facility includes a concrete block structure, a built-up roof (BUR), and approximately 662 windows. The windows were replaced in 1995, with polycarbonate double-hung windows fix and projected windows. The window panel range in sizes but are primarily 4' x 5' single pane windows.

Heating, Ventilation, and Air Conditioning (HVAC) Systems

Heating System

The facility's heating system consists of two Kewanee fire tube steam boilers, 11,070 MBH each, that utilizes #6 fuel oil and are original to the building. These boilers serve perimeter window units in all of the rooms and hallway radiators. There are approximately 96 rooms that have perimeter steam radiation system controlled by space thermostats. In some rooms there are two of these units. In addition, there are 17 classrooms that are equipped with Trane steam unit ventilators controlled by thermostats. There are six air handlers equipped with steam heating coils that provide conditioned fresh air to the building. The steam system currently operates all year

The Energy Audit

More practice reading

Facility Description (cont'd)

Electrical Systems

General Description and Details

The existing electrical system provides both single phase power at 120 Volts and three phase power at 208 Volts. The motors for the air handlers and pumps utilize three phase power, while the lighting system utilizes single phase power. The air handler motors range from 1½ HP to 7½ HP, and it is controlled by a pneumatic system to provide comfort when the building is operable, approximately 12 hours a day.

The facility's lighting system consists of a variety of fluorescent fixtures with a T12 lamp combinations, including pendant mounted 1'x4' fixtures in classrooms and surface mounted in the hallways. The cafeteria and some offices utilize recessed 2x4 fluorescent lighting. Some incandescent lamps or compact fluorescent lamps are found in closet spaces, mechanical rooms and restrooms. Some exit signs utilize compact fluorescent lamps or are LED exit fixtures. The lighting system is controlled by toggle switches that are operated by the staff. The lights typically operate 12 hours a day, however, based on our analysis a portion of the lights occasionally operate 24-7.

The Energy Audit

More practice reading

Equipment Inventory

Building Inventory

Heating, Ventilation & Air Conditioning

EQUIPMENT	FACILITY ID	TYPE	MAKE	STEAM/ HW	MODEL	FUEL TYPE	INPUT [MBH]
Boiler	#1	Fire-Tube	Kewanee	Steam	N/A	Oil	11,070
Boiler	#2	Fire-Tube	Kewanee	Steam	N/A	Oil	11,070

EQUIPMENT	SIZE	TYPE	MAKE	OUTPUT [MBH}
Indirect DHW Tank	1,000 gal	Steam	N/A	3,000

EQUIPMENT	FACILITY ID	CAPACITY (CFM)	HP
HV1	Auditorium	5,400	7.5
HV2	Students Playroom	5,400	5
HV3	Student Lunch room	5,400	5
HV4	Students Lunch and Playroom	7,200	7.5
HV5	Cellar	2,000	1.5
RE-36	Kitchen Exhaust	5,300	3

The Energy Audit

More practice reading **Sample from Lighting Schedule**

Line Item	Floor	Location	Pre Qty	Fixture Code	Existing Description	Post Qty	Post Description	Annual Hours	Post Hours w/ sensors
1	G	METER ROOM	2	I1X100/P-h42	Incandescent "Poker Hat" Fixture w/ (1) 100w Incandescent A Lamp	2	New 4' Industrial Fixture w/ (2) F32T8 Lamps & (1) 2/32 Elec. Normal-Power Ballast	3000	
2	G	SALT STORAGE	1	I1X135/P-h42	Incandescent "Poker Hat" Fixture w/ (1) 135w Incandescent Lamp	1	New 4' Industrial Fixture w/ (2) F32T8 Lamps & (1) 2/32 Elec. Normal-Power Ballast	3000	
3	G	STORAGE (EST)	4	I1X75/P-w22l	Incandescent "Poker Hat" Fixture w/ (1) 75w Incandescent A Lamp	4	New 2' Wrap Fluorescent w/ (2) F17T8 & (1) 2/17 Elec. Low-Power Ballast	3000	
4	G	C17 STORAGE (EST)	4	I1X100/P-w22l	Incandescent "Poker Hat" Fixture w/ (1) 100w Incandescent A Lamp	4	New 2' Wrap Fluorescent w/ (2) F17T8 & (1) 2/17 Elec. Low-Power Ballast	3000	
5	G	C15 STORAGE (EST)	6	I1X135/P-w22l	Incandescent "Poker Hat" Fixture w/ (1) 135w Incandescent Lamp	6	New 2' Wrap Fluorescent w/ (2) F17T8 & (1) 2/17 Elec. Low-Power Ballast	3000	
6	G	C13 KITCHEN STORAGE	5	I1X75/P-h42	Incandescent "Poker Hat" Fixture w/ (1) 75w Incandescent A Lamp	5	New 4' Industrial Fixture w/ (2) F32T8 Lamps & (1) 2/32 Elec. Normal-Power Ballast	3000	
7	G	C11 STORAGE	3	I1X135/P-h42	Incandescent "Poker Hat" Fixture w/ (1) 135w Incandescent Lamp	3	New 4' Industrial Fixture w/ (2) F32T8 Lamps & (1) 2/32 Elec. Normal-Power Ballast	3000	
8	**G**	**C11 STORAGE**	**1**	**add-ctl-ws**	**Add Controls To Existing Lighting**	**1**	**New wall sensor**	**3000**	**2400**
9	G	STORAGE (EST)	2	I1X135/B-h42	Incandescent Bare-Lamp Fixture w/ (1) 135w Incandescent Lamp	2	New 4' Industrial Fixture w/ (2) F32T8 Lamps & (1) 2/32 Elec. Normal-Power Ballast	3000	
10	G	STORAGE (EST)	1	I1X135/P-h42	Incandescent "Poker Hat" Fixture w/ (1) 135w Incandescent Lamp	1	New 4' Industrial Fixture w/ (2) F32T8 Lamps & (1) 2/32 Elec. Normal-Power Ballast	3000	
11	**G**	**STORAGE (EST)**	**1**	**add-ctl-ws**	**Add Controls To Existing Lighting**	**1**	**New wall sensor**	**3000**	**2400**
12	G	C7 SHOP	4	W42/EE-w64L	4' Wrap Fluorescent w/ (2) F40T12/34w Lamps (1) Energy Saving Magnetic Ballast	2	New 8' Wide-Wrap Fixture w/ (4) F32T8 Lamps & (1) 4/32 Elec. low-Power Ballast	2500	

The Energy Audit

More practice reading

Maintenance & Safety section

- **Premium Efficiency Motor Upgrades** – This measure will replace existing motors with new premium efficiency motors on four air handlers. New motors will allow for the facility to reduce the maintenance on the existing motors since the new motors will have new warranties.

- **Kitchen Exhaust Fan Replacement**- The kitchen equipment, such as the ovens and walk-in freezer compressor located inside the kitchen, generate a tremendous amount of heat which is then transferred into the adjacent cafeteria. This causes the cafeterias to be uncomfortably hot throughout the year. Cleaning the kitchen exhaust duct and replacing the fouled exhaust fan will improve ventilation, which will not only alleviate problems with heat removal, but also potential problems with fumes and other cooking effluents. The designated exhaust fan located on the roof has reached its useful life. The replacement of this unit will allow for the kitchen exhaust to be fully functional and operated to exhaust the kitchen air as intended in the original building designed.

Transition to next topic …

OK, end of first topic. Everyone stand-up, stretch, but stay at seat.

Project Workshop – Qualitative Description

Review of Project Descriptions

Class discussion - What kinds of projects?

(List areas) (Discuss further specific areas)

Questions on this part of the project?

Project Workshop – Qualitative Description

Break into new groups which are based on doing similar projects:
- Boiler, Boiler Controls, Boiler Operation
- Thermostats, Steam Traps, Heating Controls
- Lighting & Electrical Savings
- Air Conditioning Savings

Review responses to questions:

> What measurements **before** implementing?
  - what are the baseline conditions?

> What IEQ impacts?

> Who would be affected?

> Who involved in implementing?

Report back to full class

Announcement

If you came to class late today, you are responsible for:

- The material was taught at the start of the class
- The quiz at the start of the class
- Your name is in the attendance

Break

Quantification

Savings - where from?

- Reduction of operating hours - discuss two examples
  - > Some measures with both fuel & electric reduction
- Improve device efficiency - discuss two examples
- Calculation Guidance sheet - review

PROJECT 2C TABLE OF IMPROVEMENT MEASURES AND CALCULATION GUIDANCE

CATEGORY / MEASURES	CALCULATION GUIDANCE
BOILER PLANT	
Test and improve Combustion Efficiency (CE)	1. Test CE. (84 – test) / test = % improvement. 2. For cycling reduction, 1 – 10% improvement based on how bad current operation is assessed to be 3. Estimate how many operating hours/day can be saved; divide by total operating hours/day = % improvement. 4. Note – if you are reducing boiler operating hours, you also have motor savings (see below).
Firing rate modulation – reduce cycling	
Improve boiler sequencing – reduce cycling	
Optimize start-up	
Optimize shut-down	
HEATING SYSTEM	
Balance steam distribution, reduce overheating	1. Most general – use 1- 10% reduction based on how much overheating to be eliminated and how much zoning possible. 2. More specific - 1% reduction for every degree of overheating removed; pro-rated by portion of school affected.
Reduce pneumatic air leakage	
Zone system for after-school programming	
Maintain steam traps (replace disc elements)	

Quantification

Savings – Apply to the right category of energy usage.

- Use your energy usage from Project 2B, Table 2

TABLE 2 ANNUAL ENERGY USE BY END-USE FUNCTION — **GROSS FLOOR AREA =** 40,000 (12)

FOR THE YEAR SEPT 1, 2009 - AUGUST 31, 2010 UNLESS OTHERWISE NOTED

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	FUELS USED	default %	adjusted %	MMBTU	BTU / SF	% of TOTAL MMBTU	$	$ / SF	% OF TOTAL $
			use only if necessary	(2) * (3) or (4)	5)/(12)*1,000,00	(5) / (13)	sub-total * (3) or (4)	(8) / (12)	(8)/(14)
OIL, GAS, STEAM									
HEATING	1490	70%		1043.0	26075	34%	$ 16,800	$ 0.42	20%
HOT WATER	1490	20%		298.0	7450	10%	$ 4,800	$ 0.12	6%
COOKING	1490	10%		149.0	3725	5%	$ 2,400	$ 0.06	3%
OTHER		0%			0	0%	$ -	$ -	0%
SUB-TOTAL	1490	100%	0%	1490.0	37250	49%	$ 24,000	$ 0.60	29%
ELECTRICITY									
LIGHTING	1536.3	45%		691.3	17283	23%	$ 27,000	$ 0.68	32%
MOTORS	1536.3	25%		384.1	9602	13%	$ 15,000	$ 0.38	18%
COMPUTERS & OFF EQUIP	1536.3	10%		153.6	3841	5%	$ 6,000	$ 0.15	7%
AC	1536.3	10%		153.6	3841	5%	$ 6,000	$ 0.15	7%
KITCHEN-REFRIG	1536.3	10%		153.6	3841	5%	$ 6,000	$ 0.15	7%
HEATING & HOT WATER	1536.3	see Note 1			0	0%		$ -	0%
OTHER	1536.3	0%		0.0	0	0%	0	$ -	0%
SUB-TOTAL	1536.3	100%	0	1536.3	38408	51%	$ 60,000	$ 1.50	71%
TOTAL				3026.3		100%	$ 84,000	$ 2.10	100%

BUILDING OPERATOR CERTIFICATION

Quantification

Costs

What kinds of costs?

- Refer back to discussion of who involved in implementing
- Costs not just to you but to whole system

Introduce spreadsheet

- Show formulae on-screen
- Work through an example

Quantification

Costs

	Unit Cost	Hrs or Qty	Cost
Internal manpower, __ man-hours @ $50 per hour =	$ 50.00		$ -
			$ -
			$ -
External manpower, __ man-hours @ $75 per hour =	$ 75.00		$ -
			$ -
			$ -
Materials (itemized)			$ -
			$ -
			$ -
			$ -
			$ -
			$ -
			$ -
Sut-total, direct costs			$ -
Supervision & overhead	10%		$ -
Sut-total			$ -
Contingency	10%		$ -
Total Estimated			$ -

Quantification

M&V

How will you know if your project is working?

- Energy savings - but lot's of "noise" in the data

- Key Performance Indicators
  - What will you measure? Discuss & List.

Break

Project Workshop - Quantification

Break into Groups

- Practice working with Savings Quantification
- Practice working with Cost Estimate

Project Workshop - Quantification

Report back

- Discussion
- Questions?

Close

Project 2C – Energy Improvement Project

Finish your Qualitative Descriptions

First draft of Quantification - Savings & Costs

This is due on Week 29 – Firm Date