GREENER, GREATER BUILDINGS PLAN OUTREACH
Version 6 2013

Lauren Brust
Director
Steven Winter Associates, Inc.

LOCAL LAW 87: ENERGY AUDITS & RETRO-COMMISSIONING

Sponsored by:

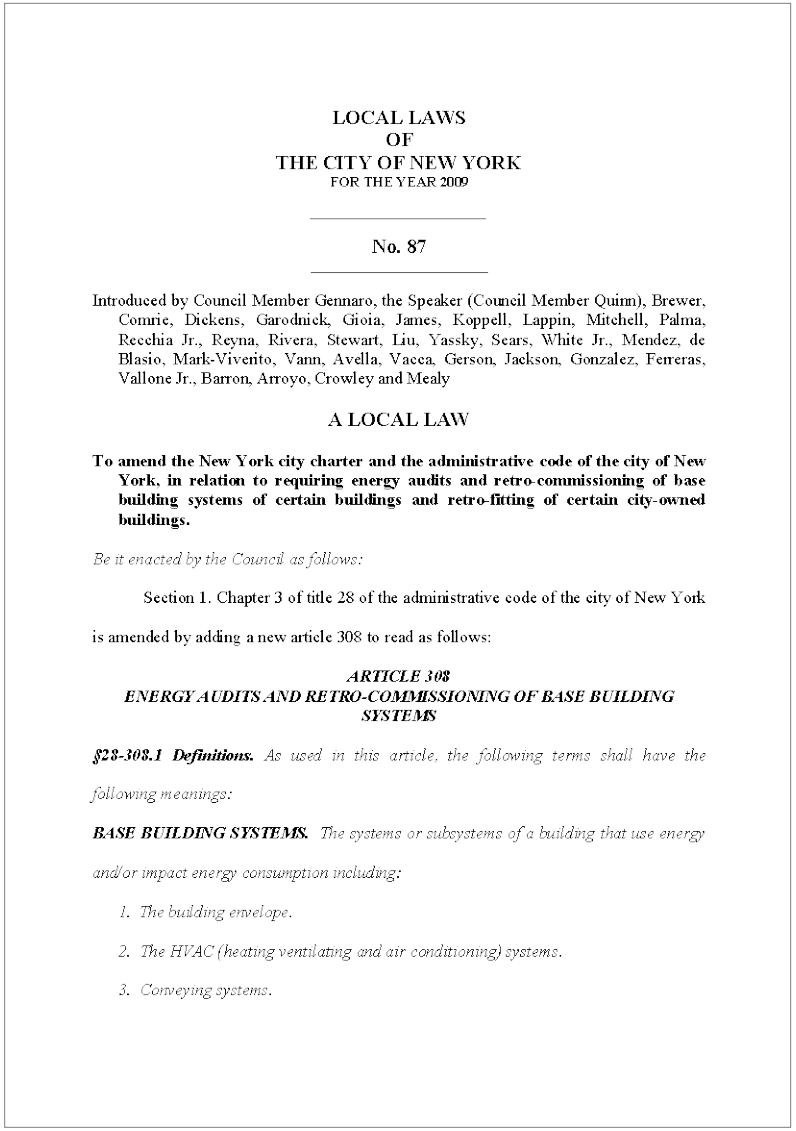
INTRODUCTION – WHAT IS LOCAL LAW 87?

Energy Audit

- Analysis of a building's energy equipment, systems, envelope, and operations
- Identifies cost effective options to save energy
- Provides recommended strategies and cost estimates

Retro-commissioning

- Re-tuning systems in an existing building to improve efficiency



LOCAL LAWS
OF
THE CITY OF NEW YORK
FOR THE YEAR 2009

No. 87

Introduced by Council Member Gennaro, the Speaker (Council Member Quinn), Brewer, Comrie, Dickens, Garodnick, Gioia, James, Koppell, Lappin, Mitchell, Palma, Recchia Jr., Reyna, Rivera, Stewart, Liu, Yassky, Sears, White Jr., Mendez, de Blasio, Mark-Viverito, Vann, Avella, Vacca, Gerson, Jackson, Gonzalez, Ferreras, Vallone Jr., Barron, Arroyo, Crowley and Mealy

A LOCAL LAW

To amend the New York city charter and the administrative code of the city of New York, in relation to requiring energy audits and retro-commissioning of base building systems of certain buildings and retro-fitting of certain city-owned buildings.

Be it enacted by the Council as follows:

Section 1. Chapter 3 of title 28 of the administrative code of the city of New York is amended by adding a new article 308 to read as follows:

ARTICLE 308
ENERGY AUDITS AND RETRO-COMMISSIONING OF BASE BUILDING SYSTEMS

§28-308.1 Definitions. *As used in this article, the following terms shall have the following meanings:*

BASE BUILDING SYSTEMS. *The systems or subsystems of a building that use energy and/or impact energy consumption including:*

1. *The building envelope.*
2. *The HVAC (heating ventilating and air conditioning) systems.*
3. *Conveying systems.*

INTRODUCTION - REQUIREMENTS

Energy Efficiency Report (EER), submit forms for:

- Energy Audit
- Retro-commissioning Report

All “base building” energy systems covered:

- HVAC (Heating, Ventilation and Air Conditioning)
- Electrical and Lighting
- Domestic Hot Water
- Building Envelope
- Conveying Systems

INTRODUCTION – ENFORCEMENT

- NYC Department of Building is responsible for enforcement
- Failure to comply with LL 87 subjects properties to fines of $3,000 the first year and $5,000 for each additional year
- DOB intends to conduct random reviews of documentation

GETTING STARTED

Step 1: Determine if your property is subject to the energy audits and retro-commissioning law.

- www.nyc.gov/LL87
- A single building on a lot over 50,000 square feet
- 2 or more buildings on the same tax lot that together are more than 100,000 square feet
- 2 or more buildings held in condo ownership that together are more than 100,000 square feet

Local Law 87 Covered Buildings List - Audits and Retro-commissioning

BBL	Boro	Block	Lot	Building Square Footage *	Number of Buildings	Tax Class	Street Number	Street Name	Boro	Zip	Year Due
1000010010	1	00001	0010	2725731	1	4	1	GOVERNORS ISLAND	MANHATTAN	10004	2021
1000020002	1	00002	0002	105368	0	4		MARGINAL STREET	MANHATTAN	10004	2022
1000030001	1	00003	0001	945425	1	4		BATTERY PARK	MANHATTAN	10004	2013
1000047501	1	00004	7501	2621563	1	2	1	WATER STREET	MANHATTAN	10004	2014
1000057501	1	00005	7501	1354691	1	2	125	BROAD STREET	MANHATTAN	10004	2015
1000087501	1	00008	7501	169061	1	2	39	WHITEHALL STREET	MANHATTAN	10004	2018
1000090001	1	00009	0001	845018	1	4	34	WHITEHALL STREET	MANHATTAN	10004	2019
1000090014	1	00009	0014	544015	1	4	17	STATE STREET	MANHATTAN	10004	2019
1000090029	1	00009	0029	896956	1	4	24	WHITEHALL STREET	MANHATTAN	10004	2019

GETTING STARTED

Step 2: Determine your property's reporting year.

Last digit of tax block number:	3	4	5	6	7	8	9	0	1	2
Year first energy efficiency report must be complete by 12/31 of:	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022

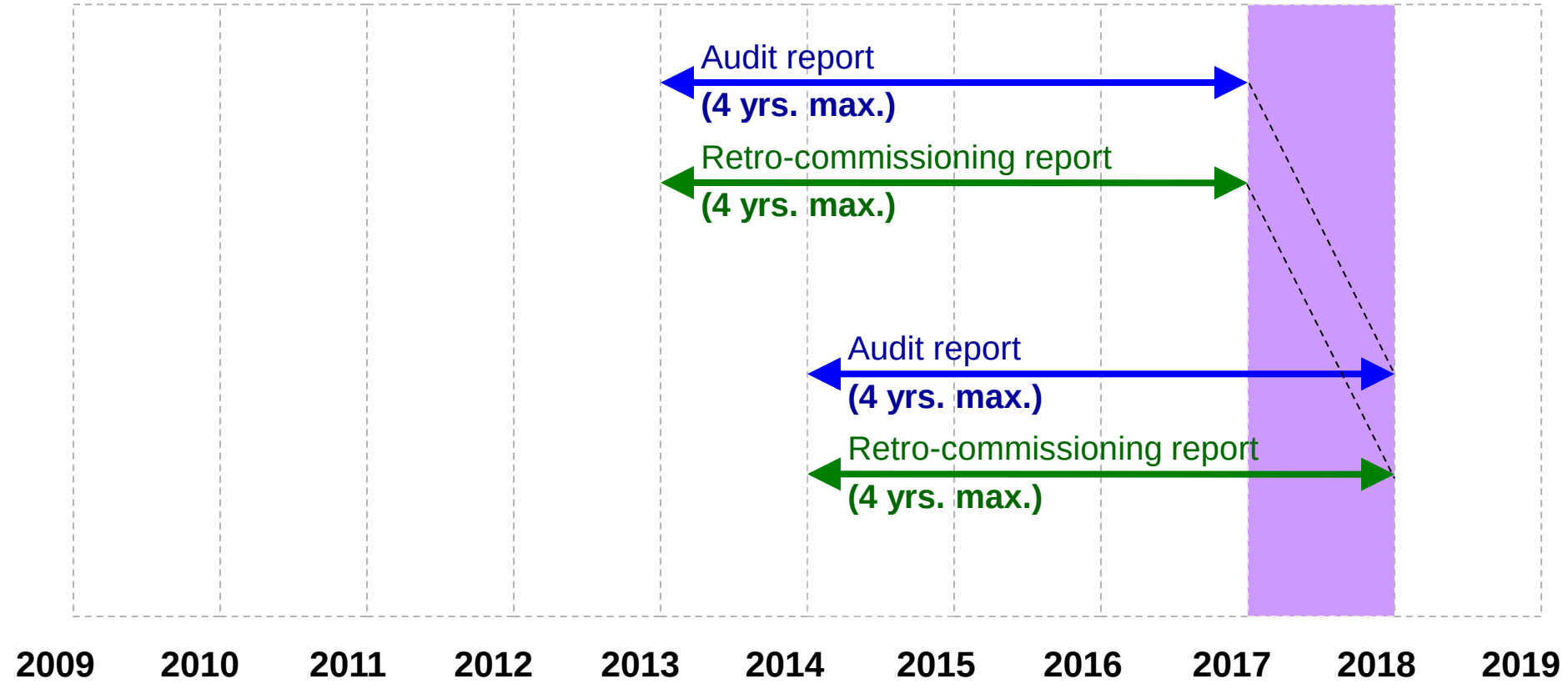
Every 10 years, owners must complete an Energy Audit and Retro-commissioning, and file an Energy Efficiency Report (EER).

Staggered deadlines are based on the last digit of a building's **tax block number.**

GETTING STARTED

Step 2: Determine your property's reporting year.

Standard Compliance Timeline: 2017 EER – Filing block **7



GETTING STARTED

Step 3: Determine if your property is exempt from all or part of the law.

Exemption from **both** Energy Audit and Retro-commissioning

- Less than 10 years old by reporting year
- Undergone “substantial rehabilitation” within 10 years of reporting year

Substantial rehabilitation projects are defined as those that meet all three of the following scope of work items: (1) replacement of heating system (2) work on at least 75% of the units' (kitchens and/or bathrooms) and (3) major work involving the building envelope such as replacing the roof or windows, adding insulation, and implementing air sealing measures.

GETTING STARTED

Step 3: Determine if your property is exempt from all or part of the law.

Energy Audit Exemptions

- EPA ENERGY STAR® label for at least 2 of the last 3 years
- Ineligible for ENERGY STAR® rating, but within top 25% of efficiency in class for at least 2 of the last 3 years
- LEED-EBOM (‘09+) certification within 4 years prior to reporting year

GETTING STARTED

Step 3: Determine if your property is exempt from all or part of the law.

Retro-commissioning Exemptions

- Earned LEED for EBOM 2009 certification in the last 2 years, and earned two commissioning points

GETTING STARTED

Step 4: Determine if your property needs an extension of time to comply with the law.

Time Extensions available if:

- Building is unable to complete the energy audit and retro-commissioning prior to report due date despite good faith efforts
- Building is suffering from financial hardship as defined by LL 87
- Extensions must be filed by October 1 of the year the Energy Efficiency Report is due

ENERGY AUDITS

Step 5: Search for and select a qualified energy auditor.

- Must be a licensed architect or professional engineer OR be a registered design professional with DOB and meet the other qualifications listed in the law and final rule
- Seek a vendor who has done energy audits in buildings of similar size and type to yours
- Consider NYSERDA FlexTech and MPP vendors
- The auditor must not be a member of the building staff

RETRO-COMMISSIONING

Step 5: Search for and select a qualified retro-commissioning agent.

- Must meet various qualifications listed in the law and final rule
- Commercial and industrial buildings should consider NYSERDA FlexTech Consultants who perform retro-commissioning
- Agent must not be a member of the building staff

SUBMIT ENERGY EFFICIENCY REPORT

Step 6: Submit your Energy Efficiency Report and pay filing fee by the end of the reporting year.

This report will consist of the following, as applicable:

- DOB Energy Audit Form
- DOB Retro-Commissioning Form
- Proof that your property is exempted from one or both reports under one of the exemptions listed in Step 4
- Filing fees are as follows:
  - Initial Filing $375
  - Extension Request $155
  - Amendments $145

OR

- Show proof that your property opted for the early compliance path under the law

SUBMIT ENERGY EFFICIENCY REPORT

Step 7: Maintain records for 11 years from the required submission date.

GETTING VALUE

Step 8: Invest in staff training.

- GPRO: Green Professional Building Skills Training, Operations & Maintenance Essentials – gpro.org

- BPI: Building Performance Institute – bpi.org
  Provided by Association for Energy Affordability Inc. – aea.us.org

- BOC: Building Operators Certificate – cunybpl.org

THANK YOU!

New York City's Office of Long-Term Planning and Sustainability

New York City Department of Buildings

New York State Energy Research and Development Authority (NYSERDA)

Con Edison of New York

Images provided by: NYC Citywide Administrative Services (slides 25, 26), IntelliGreen Partners (slides 6, 21, 23, 25, 34) and CodeGreen Solutions (slide 23)

ENERGY AUDITS IN COMMERCIAL BUILDINGS

HOTEL ENGINEERS ASSOCIATION OF NY

FEBRUARY 26, 2014

JON WEISKOPF, PE, CEM, CDSM, LEED AP

Steven Winter Associates, Inc.
Improving the Built Environment Since 1972

What is an energy audit?

An energy audit or better yet, an energy assessment is the assessment of the current state of a building and making recommendations to improve a ***building's performance***.

Something to consider:

- Should an energy audit/assessment really be just about energy?
  - Energy is in the title and definition, but what else should the auditor/assessor be thinking of and considering to maximize the benefits of this work?

Different Types of Energy Audits

The following are industry standard energy audit categories based on level of effort as defined by ASHRAE – 2011 Procedures for Commercial Building Energy Audits.

- Level I – Walk through survey (*not covered in this presentation)*
  - Similar to those performed by Utility Companies
- Level II – Energy Survey and Analysis
  - Standard audit level
  - Required by NYC LL87 and NYSERDA's Flextech Existing Buildings Program
- Level III – Detailed Analysis of Capital Improvements
  - Investment Grade Audit
  - Required by Con Edison's Cost Share Program

The Energy Audit Process

Process	Level		
	1	2	3
Conduct PEA	•	•	•
Conduct walk-through survey	•	•	•
Identify low-cost/no-cost recommendations	•	•	•
Identify capital improvements	•	•	•
Review mechanical and electrical (M&E) design and condition and O&M practices		•	•
Measure key parameters		•	•
Analyze capital measures (savings and costs, including interactions)		•	•
Meet with owner/operators to review recommendations		•	•
Conduct additional testing/monitoring			•
Perform detailed system modeling			•
Provide schematic layouts for recommendations			•

Team Member Roles

- **Building Owner / Manager:**
  - Point person for communication between consultant and building operating staff
- **Building Operating Staff:**
  - Assist consultant with understanding the building and the operation and control of the building equipment
- **Consultant**
  - Provide detailed outline of the audit process and clear expectations on deliverables

Why conduct an energy audit?

1. 3rd party assessment of the building and its operational characteristics
2. Collect and analyze historical energy use to establish a baseline for continuous benchmarking
3. Develop a list of improvements for use with capital planning
4. Most importantly…..

REDUCE OPERATING COSTS AND IMPROVE INDOOR ENVIRONMENTAL QUALITY!

What Level audit to perform and When?

Level II

- Basic energy assessment for incentive purposes
- NYC LL87 Compliance
- Assessment of potential capital improvements for high level budget projections

Level III

- Investment grade for financing purposes
- Construction budget and ROI analysis

What to expect from the audit

Report	Level		
	1	2	3
Estimate savings from utility rate change	•	•	•
Compare EUI to EUIs of similar sites	•	•	•
Summarize utility data	•	•	•
Estimate savings if EUI were to meet target	•	•	•
Estimate low-cost/no-cost savings		•	•
Calculate detailed end-use breakdown		•	•
Estimate capital project costs and savings		•	•
Complete building description and equipment inventory		•	•
Document general description of considered measures		•	•
Recommend measurement and verification (M&V) method		•	•
Perform financial analysis of recommended EEMs		•	•
Write detailed description of recommended measures			•
Compile detailed EEM cost estimates			•

Should the energy audit/assessment really be just about energy?

What is important to maintaining the happiness and functionality of your occupants?

★ As we improve 5 of 5 components of IEQ, energy usage will most likely increase

<u>The major problem is that most energy audits focus so much on energy reduction that the negative impact on IEQ is never considered.</u>

WATER – Not covered by ASHRAE procedures and typically forgotten by energy auditors

Retro-commissioning in Commercial Buildings

Hotel Engineers Association of NY

February 26, 2014

Mike Flatley, CEM, CPMP, LEED AP

Steven Winter Associates, Inc.

Improving the Built Environment Since 1972

What is Retro-Commissioning?

A process where the building's controls, set points and operating schedules are altered or added to enable the building to operate as intended or required and to assist the building staff in creating new building documentation based on the current operational needs of the occupants.

GOALS OF RETRO-Cx PROCESS:

- Reduce energy and demand costs
- Bring equipment to its proper operational state
- Reduce occupant complaints
- Improve indoor environmental quality
- Reduce premature equipment failures
- Improve facility operation and maintenance procedures
- EDUCATION, EDUCATION, EDUCATION!!!!!!!

WHAT IS THE LL87 PROCESS?

1. Investigation and data collection
   a. Step 1 - Pre Functional Form (PFF)
   b. Step 2 – Functional Performance Test (FPT)

2. Analysis

3. Implementation/ Deficiency Correction

4. DOB Filing

Step 1: Investigation and Data Collection

A) Pre Functional checklist Completion of Pre Functional Forms

- Collaborate with building staff on walk through of the systems to identify items that are easily correctable and required to function during testing,
- EDUCATION, EDUCATION, EDUCATION!!!
- Simple corrections can be made on the spot
- Creates the Master List of Findings (MLF)
- Readies the system for testing

☑ AHU PREFUNCTIONAL FORM

PART 1: COMPLETE DATE, LOCATION & TAG # FOR ITEMS IN SYSTEM

CLIENT:_____ AIR HANDLER UNIT, AHU #'S:_____

DATE:_____ TEST FORM:_____ PROJECT:_____PC-_____

ADDRESS:_____

EQUIPMENT LOCATION:_____

SYSTEM DESCRIPTION:_____

COMPONENTS INCLUDED

___ **Supply Fans**	___ **Return and Exhaust Fans**	___ **Coils**
___ **Valves**	___ **VFD**	___ **Dampers**

ASSOCIATED CHECKLISTS: CHW, HW Piping, _____

CHECK	INITIALS	COMMENT OR NOTE #
Manufacturer's cut sheets		
Performance data (fan curves, coil data, etc.)		
Installation and startup manual and plan		
Sequences and control strategies		
O&M manuals		

- *Documentation complete as per contract documents for given trade ___ YES ___ NO*

PART 2: INSTALLATION CHECKS

CHECK		INITIALS	COMMENT OR NOTE #
CABINET AND GENERAL INSTALLATION			
No interferences exist for access requirements (filters, belts, valves, etc.) and for general maintenance			
Permanent labels affixed, including fans			
Casing condition good: no dents and/or leaks			
Plenum and access doors close tightly; door gaskets installed on plenum and access doors – no leaks			
Boot between duct and unit tight and in good condition			
Flex coupling between duct and unit tight and in good condition			
Maintenance access acceptable for unit and components			
Thermal insulation properly installed and according to specification			
Instrumentation installed according to specification (thermometers, pressure gauges, flow meters, etc.)			
Filters installed (replacement type and efficiency label affixed to housing)			
Filters clean and tight fitting			
Vibration isolators properly adjusted and vibration isolation has been properly maintained			
VALVES, PIPING AND COILS (SEE FULL PIPING CHECKLISTS)			
Pipe fittings complete and pipes properly supported	CHW, HW Condensate		
	Steam Unit Heater/PH		
	Reheat Coil		
Pipes properly insulated. No exposed piping, fittings, equipment (as required), etc. Check for wet insulation	CHW, HW Condensate		
	Steam Unit Heater/PH		
	Reheat Coil		
Pipes properly labeled	CHW, HW Condensate		
	Steam Unit Heater/PH		
	Reheat Coil		

CONT'D

CHECK		INITIALS	COMMENT OR NOTE #
VALVES, PIPING AND COILS CONT'D			
Strainers in place and clean	CHW, HW Condensate		
	Steam Unit Heater/PH		
	Reheat Coil		
No leaking apparent around fittings	CHW, HW Condensate		
	Steam Unit Heater/PH		
	Reheat Coil		
All coils are clean and fins are in good condition	CHW, HW Condensate		
	Steam Unit Heater/PH		
	Reheat Coil		
Valves properly labeled	CHW, HW Condensate		
	Steam Unit Heater/PH		
	Reheat Coil		
Test control valves for required modulation; fully open, close off, and fail positions	CHW, HW Condensate		
	Steam Unit Heater/PH		
	Reheat Coil		
Confirm bypass line installed around control valve	CHW, HW Condensate		
	Steam Unit Heater/PH		
	Reheat Coil		
Confirm water piping balancing valves installed in proper direction	CHW, HW Condensate		
	Steam Unit Heater/PH		
	Reheat Coil		
OSAT, MAT, SAT, RAT, chilled water supply sensors properly located and secure (related OSAT sensor shielded)	CHW, HW Condensate		
	Steam Unit Heater/PH		
	Reheat Coil		
P/T plugs and isolation valves installed per drawings	CHW, HW Condensate		
	Steam Unit Heater/PH		
	Reheat Coil		
Traps are properly installed, cleaned, functioning properly. Condensate is properly piped to drain	HW Condensate		
	Steam Unit Heater/PH		
	Reheat Coil		
Sensors calibrated (See calibration section below)	PH Coil		
	CHW, HW Condensate		
	Reheat Coil		
			CONT'D

CHECK		INITIALS	COMMENT OR NOTE #
VALVES, PIPING AND COILS CONT'D			
Coils piped in proper direction	PH Coil		
	CHW, HW Condensate		
	Reheat Coil		
Condensate pump installed and operational (if required)	HW Condensate		
All condensate drain pans clean and slope to drain, per spec	CHW		
Valves positively verified to be installed in proper direction	PH Coil		
	CHW, HW Condensate		
	RH Coil		
Check valve on discharge of condensate pump & piped in correct direction of flow installed	HW Condensate		
Measures taken to deal with condensation	CHW		
FANS AND DAMPERS			
Protective shrouds for belts are in place and secured	Supply Fan		
	Return/Exhaust Fan		
Check fan for free rotation	Supply Fan		
	Return/Exhaust Fan		
Fan has no unusual noise or vibration	Supply Fan		
	Return/Exhaust Fan		
Check correct rotation and stop/start of fan	Supply Fan		
	Return/Exhaust Fan		
Fan and motor alignment correct	Supply Fan		
	Return/Exhaust Fan		
Fan belt tension and condition good	Supply Fan		
	Return/Exhaust Fan		
Fan area clean	Supply Fan		
	Return/Exhaust Fan		
Fan and motor properly lubricated	Supply Fan		
	Return/Exhaust Fan		
Filter pressure differential measuring device installed and functional (magnahelic, inclined manometer, etc.)	Supply Fan		
			CONT'D

CHECK		INITIALS	COMMENT OR NOTE #
FANS AND DAMPERS CONT'D			
All dampers close tightly			
All damper linkages have minimum play			
All dampers stroke fully without binding and spans calibrated (list each damper in notes section)			
Damper end switches installed and functioning			
Low limit freeze stat sensor located to deal with stratification and bypass			
ELECTRICAL AND CONTROLS			
Pilot lights are functioning	Supply Fan		
	Return/Exhaust Fan		
Power disconnects in place and labeled	Supply Fan		
	Return/Exhaust Fan		
Unit disconnect fuse size matches unit max. fuse size	Supply Fan		
	Return/Exhaust Fan		
All electric connections tight	Supply Fan		
	Return/Exhaust Fan		
Confirm that panelboard serving unit is labeled	Supply Fan		
	Return/Exhaust Fan		
HOA switch properly activates/deactivates the unit	Supply Fan		
	Return/Exhaust Fan		
Confirm the BMS control wiring installed at proper terminals	Supply Fan		
	Return/Exhaust Fan		
Confirm BMS graphics installed	Supply Fan		
	Return/Exhaust Fan		
Confirm BMS programming done	Supply Fan		
	Return/Exhaust Fan		
All control devices, pneumatic tubing and wiring complete	Supply Fan		
	Return/Exhaust Fan		
Confirm starter overload breaker is set correctly for unit motor installed	Supply Fan		
	Return/Exhaust Fan		
Control system interlocks hooked up and functional	Supply Fan		
	Return/Exhaust Fan		
			CONT'D

CHECK		INITIALS	COMMENT OR NOTE #
ELECTRICAL AND CONTROLS CONT'D			
Indicate if premium efficiency motor	Supply Fan		
	Return/Exhaust Fan		
Duct static pressure sensor properly located and per drawings and calibrated (> 70% down from fan to critical TU & >5 duct dia's upstream and > 10 duct dia's downstream from takeoffs, etc.)	Supply Fan		
	Return/Exhaust Fan		
Safeties (esp. high duct static) in place and operable	Return/Exhaust Fan		
Building static pressure sensors located to ensure good signal	Return/Exhaust Fan		
VFD			
VFD powered (wired to controlled equipment)	Supply		
	Return		
VFD interlocked to control system	Supply		
	Return		
Static pressure or other controlling sensor calibrated	Supply		
	Return		
Drive location not subject to excessive temperatures	Supply		
	Return		
Drive location not subject to excessive moisture or dirt	Supply		
	Return		
Drive size matches motor size	Supply		
	Return		
Internal setting designating the model is correct	Supply		
	Return		
Input of motor FLA represents 100% to 105% of motor FLA rating	Supply		
	Return		

- *The checklist items of Part 2 are all successfully completed for given trade ___ YES ___ NO*

Master List of Findings

MASTER REPAIR LIST

Project:

GCA Job No.:

Item No.	Date	Equipment	Floor	Issue	Next step	Status	Reported By

B. Functional Testing and Completion of Functional Forms (FF)

Equipment Type	Sample Test Rate	Minimum Quantity
Heating Plant		
Boilers	100%	
Boiler Controls	100%	
Steam Traps	10%	
HW Pumps	100%	
Combustion Air Fans	100%	
Steam Station	100%	
Condensate System		
Condensate Pumps	100%	
Cooling Plant		
Chillers	100%	
Cooling Towers	100%	
CW Pumps	100%	
CHW Pumps	100%	
HX		
Space Conditioning		
AHUs	100%	
DX Units		
Exhaust Fans		Units with motor >10 hp
Radiators		
Fan Coil Units		
Fan Powered VAV Terminals		
Induction Units		
DHW System		
DHW heater	10%	3
Instantaneous HX	10%	3
Conveyence		
EMR AC Units		
Passenger Elevators		
Lighting Systems		
Fixtures	10%	
Controls	10%	
Building Envelope		
Sealants & Weatherstripping	10%	
Plumbing		
Plumbing Fixtures	10%	
Roof Tanks	100%	
Piping		All exposed piping

Step 2: Analysis

1. Evaluate results of PFF checklists and FPT testing in Step 1, Phases 1 & 2

2. Update Master List of Findings

3. Analyze utility bill data and Interval data

4. Develop Energy Conservation Measures

5. Make recommendations…

Step 3: IMPLEMENTATION

1. Analyze and Prioritize deficiencies for Implementation.
   - LL87 vs. other findings

2. Prepare implementation plan and timeline

3. Select contractors and prepare RFPs

4. Schedule verification revisits

SAMPLE FINDINGS – "THE USUAL SUSPECTS"

1. Lack of Automation
2. No reset schedules
3. No economizer cycle
4. VFDs in manual
5. Leaking dampers and valves
6. No night setback
7. Freeze Protection

Questions??

Lauren Brust – lbrust@swinter.com; (212) 564-5800 x101
Mike Flatley – mflatley@swinter.com;
(212) 564-5800 x156
Jon Weiskopf – jweiskopf@swinter.com ;
(212) 564-5800 x170

Local Law 87 RCx Checklist	PFF	FPT	MLF	Building	RCx Report	Comments
Retro-commissioning Required						
1. Operating protocols, calibration and sequencing						
1.1 HVAC temperature and humidity set points and setbacks are appropriate and operating schedules reflect major space occupancy patterns and the current facility requirements		X				
1.2 HVAC sensors are properly calibrated	X	X				
1.3 HVAC controls are functioning and control sequences are appropriate for the current facility requirements.		X		X		
1.4 Loads are distributed equally across equipment when appropriate (i.e. fans, boilers, pumps, etc. that run in parallel).		X				
1.5 Ventilation rates are appropriate for the current facility requirements	X	X		X		
1.6 System automatic reset functions are functioning appropriately, if applicable		X				
1.7 Adjustments have been made to compensate for oversized or undersized equipment so that it is functioning as efficiently as possible.		X				
1.8 Simultaneous heating and cooling does not occur unless intended		X				
1.9 HVAC system economizer controls are properly functioning, if applicable	X	X				
1.10 The HVAC distribution systems, both air and water side, are balanced.				X		
1.11 Light levels are appropriate to the task.	X			X		
1.12 Lighting sensors and controls are functioning properly according to occupancy, schedule, and/or available daylight, where applicable.	X	X				
1.13 Domestic hot water systems have been checked to ensure proper temperature settings.	X	X				
1.14 Water pumps are functioning as designed.	X	X				
1.15 System water leaks have been identified and repaired.	X					

2. Cleaning and Repair							
2.1	HVAC equipment (vents, ducts, coils, valves, soot bin, etc.) is clean	X					
2.2	Filters are clean and protocols are in place to replace, as appropriate.	X					
2.3	Light fixtures are clean.	X					
2.4	Motors, fans, and pumps, including components such as belts, pulleys, and bearings, are in good operating condition.	X					
2.5	Steam traps have been replaced as required to maintain efficient operation, if applicable.	X			X		
2.6	Manual overrides on existing equipment have been remediated.	X	X				
2.7	Boilers have been tuned for optimal efficiency, if applicable.	X	X		X		
2.8	Exposed hot and chilled water and steam pipes three (3) inches or greater in diameter with associated control valves are insulated in accordance with the standards of the New York City Energy Conservation Code as in effect for new systems installed on or after July 1, 2010.	X					
2.9	In all easily accessible locations, sealants and weather stripping are installed where appropriate and are in good condition.	X					

3. Training and documentation							
3.1	Permits for all HVAC, electrical and plumbing equipment are in order.				x		
3.2	Critical operations and maintenance staff have received appropriate training, which may include labor/management training, on all major equipment and systems and general energy conservation techniques.				x		
3.3	Operational and maintenance record keeping procedures (log books, computer maintenance records, etc.) have been implemented.				x		
3.4	The following documentation is on site and accessible to the operators: the operations and maintenance manuals, if such manuals are still available from the manufacturer, the maintenance contracts, and the most recent retro-commissioning report.				x		
Contents of Retro-Commissioning Report							
1. Project and Team Information							
1.1	Building Address					x	
1.2	Experience and certification of person performing retro-commissioning and any staff involved in the project.					x	
1.3	Name, affiliation, and contact information for persons performing retro-commissioning and members of the retro-commissioning team, owner of building, and facility manager of building.					x	
2. Building information							
2.1	List of all HVAC, domestic hot water, electrical equipment, lighting, and conveyance equipment types in the base building systems.					x	
2.2	Benchmarking output.				x	x	
3. Testing Protocol							
3.1	List of all equipment types tested.		x			x	
3.2	For each equipment type tested, a list of the sample rates (percent of each type of equipment tested), the testing methodology, including any diagnostic equipment used, and the test results.					x	
3.3	List of integrated system testing performed.		x			x	
4. Master list of findings							
4.1	Include for each, the name of the retro-commissioning measure and its assigned number, a brief description of the measure, recommended corrections, the benefits attained, estimated annual savings (energy and cost), the estimated implementation cost, and the simple payback.			x			
5. Deficiencies Corrected							
5.1	List of repairs completed during investigation.			x			
5.2	List of deficiencies corrected, including, for each deficiency, the date corrected, by whom the correction was made, the actual cost, and projected savings.			x		x	