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December 21, 2007

<u>VIA OVERNIGHT MAIL</u>
Honorable Jaclyn A. Brilling
Secretary
State of New York
Public Service Commission
Three Empire State Plaza
Albany, New York 12223-1350

Re: Case 05-S-1376 – Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of Consolidated Edison Company of New York, Inc. for Steam Service.

Dear Secretary Brilling:

The Commission's Order Determining Revenue Requirement and Rate Design, issued on September 22, 2006 in the above-referenced proceeding, provides that Consolidated Edison Company of New York, Inc. ("Con Edison" or "Company") will designate up to 30 existing customers with vortex meters, based on their consumption per square foot and/or load factor, who could potentially improve on either of these screening indicators (*i.e.*, low load factors or high consumption per square foot). Con Edison would then retain a consultant to provide site-specific recommendations for potential improvement of steam usage. Finally, the Order provides that the Company will issue a "best practices" report based on these results, which will be filed with the Commission by December 31, 2007.

Enclosed please find an original and five copies of the Company's December 2007 Steam Use Efficiency and Demand Reduction Best Practices Report.

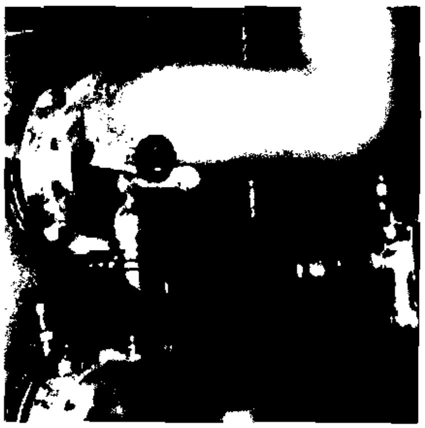
Please contact me if you have any questions regarding this matter.

Very truly yours,

Richard B. Miller

cc: Active Parties (via e-mail w/encl.)





Steam Operations

Steam Use Efficiency and Demand Reduction

Best Practices Report

December 2007

conEdison

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Table of Contents

SECTION 1

Introduction

Con Edison has historically encouraged its steam customers to undertake efficiency and conservation efforts. For example, free monthly seminars on efficient steam use have been offered to customers. Furthermore, Con Edison's website has been offering many steam conservation tips. However, focus in the past has been on overall consumption and not peak demand. Now that steam demand charges are in effect for the largest steam customers, there is also a need for consumer awareness and education concerning measures and practices that will contribute to demand reduction along with more traditional steam consumption reduction measures.

Con Edison has introduced demand billing for its largest steam customers to reduce the peak demand on Con Edison's steam system, which occurs on the coldest weekday mornings (6:00 a.m. to 11 a.m., in the winter). Reductions in demand will allow new buildings to be connected to the system while reducing the need for Con Edison to add steam production capacity, which will help to keep steam costs reasonable for all steam customers. It should be noted that there are no current capacity constraints on the steam system.

The demand charges will be applied to facilities whose steam consumption equaled or exceeded 22,000 Mlb[1] for 12 billing periods ending in April 2006 or in April 2007. After 2007, for newly connected and non-demand-billed customers, demand charges will apply if consumption for 12 billing periods ending in August equaled or exceeded 22,000 Mlb. The new steam demand rate structure is in the Con Edison Tariff for Steam Service as Rate II for steam Service Classifications 2 (SC-2, Annual Power) and Service Classification 3 (SC-3, Apartment Houses).

Under Rate II, steam demand rates will be applied for the billing periods of December through March only. The amount of demand will be calculated by averaging the demand from two highest adjacent 15 minute intervals. The demand charge will be comprised of two subcomponents – an On-Peak Demand Charge and an All-Time Peak Demand Charge. The On-Peak demand charge will apply on weekdays only, between 6:00 a.m. and 11:00 a.m. The All-Time Peak demand charge will apply to all hours during a given billing cycle. The All-Time and On-Peak Demands will vary from month to month. Con Edison has also reduced the steam usage block rates for demand-billed customers during the four demand-billed months. Therefore, customers who have had high monthly load factors (monthly load factor is defined as the average demand during the month divided by the highest on-peak demand during the same month) or customers who are able to reduce their peak demand may see lower steam bills when compared to non-demand bills (if those were still in effect). Additional details on the Rate II steam service tariffs can be found on the Con Edison website[2].

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[1] Steam is billed in Mlb. One Mlb is equal to 1,000 pounds of steam.
[2] www.coned.com/documents/steam/Rates.pdf as of 10/25/2007. This address is subject to change.

The steam demand rates are intended to provide an incentive for consumers to modify or improve facility operations by reducing steam consumption during the peak steam demand period. While the techniques and technology of demand control and reduction for electrical consumption are well developed and are widely known to facility operators, the same is not true for steam demand control and reduction.

In order to assist steam customers in adjusting to steam demand rates, Con Edison retained a building energy systems consultant, Energy Management & Research Associates (EMRA), to perform audits at 30 steam customer locations. The purpose of these audits is to provide site-specific recommendations for potential improvement in steam usage and demand in the audited facilities. The audited locations were selected by Con Edison and included commercial office buildings, large multi-family apartment buildings, and specialty facilities such as hotels and hospitals.

The steam audits have identified a broadly applicable spectrum of steam Demand Reduction Measures (DRM's) and steam Energy Efficiency Measures (EEM's) that appeared in multiple individual audits. These are compiled and summarized in this document, *Steam Use Efficiency and Demand Reduction Best Practices*, to provide steam customers with an effective steam demand and efficiency management resource. DRM's would be implemented solely as on-peak steam demand management practices and are accordingly intended to help those largest steam customers who are subject to steam demand billing. EEM's focus on overall efficiency and steam use reduction, and should be helpful to demand-billed and non-demand-billed customers. DRM's and EEM's are presented according to "end-use" in categories such as heating, domestic hot water, and cooling.

The information presented in this *Steam Use Efficiency and Demand Reduction Best Practices* report is designed to encompass typical findings from the individual audits. Customers who would like to obtain further details on these measures or on other steam efficiency and cost optimization opportunities may call the Con Edison Steam Business Development Group at 212-460-2011.

Methodology

Customer Selection Methodology

The number of selected customers for each customer type was chosen to provide a proportionate representation of the Con Edison steam customer base. The table below provides a breakdown of the number of the identified customers for each customer type.

Customer Type	No. Selected for Auditing
Office	15
Residential (multifamily buildings)	10
Combination (office and residential)[3]	2
Hotel	2
Hospital	1

Half of the customers within each customer type category were selected because they had the lowest winter billing season load factors in their respective category (winter billing season load factor is defined as the average demand during the winter billing season divided by the highest on-peak demand during the same period); the remaining customers were selected because they had a high ratio of winter consumption to building area.

Four charts are included on the following pages that provide samples of typical steam load patterns from the facilities that participated in the steam system survey/audit. Examples of the information provided by these charts are summarized as follows:

- Figure 1 is based on steam consumption data from a hotel and shows both the shoulder (autumn) load pattern and the winter load pattern. This facility operates steam heating and cooling systems and has a significant hot water load from the hotel guest usage, restaurant and health/exercise facilities. Because this facility has a relatively steady steam load during the heating season, it could be among those that will see lower total steam costs under demand billing. Energy efficiency and steam demand reduction efforts can yield additional savings.

- Figure 2 displays the steam load profile of a large multifamily apartment facility that has steam radiators. Once the facility is heated and residents have completed morning routines, which entail peaking domestic hot water (DHW) consumption, the load tends to drop off for the remainder of the day.

- Figure 3 shows a typical load profile for a commercial office building that uses steam for heating. The initial peak is sharper than that of the residential facility, primarily because the heating systems are started in the morning. Heating requirements typically decline in

[3] These were buildings that had a mix of both residential and eommercial spaces. In both instanees the eommcrcial portion of thc spacc was made up of offices. In one site, the commercial area also contained a hotel, retail and theater spaees.

such a building throughout the day due to increasing heat contributions from the occupants, daytime usage levels for systems such as computers and lighting, and solar heat gain through the windows. If on-peak demand reduction measures are not implemented, this facility is likely to see an increase in steam costs under demand billing because of its sharp peak steam demand profile during the peak steam demand period.

- Figure 4 shows a load profile typically seen in a hospital or a mixed use facility with relatively steady load throughout the 24 hour day. Facilities with steady loads, such as this, may realize lower steam costs under demand billing, although energy efficiency and demand reduction efforts can yield additional savings.

Figure 1 - Hotel: Fall to Winter Load Transition

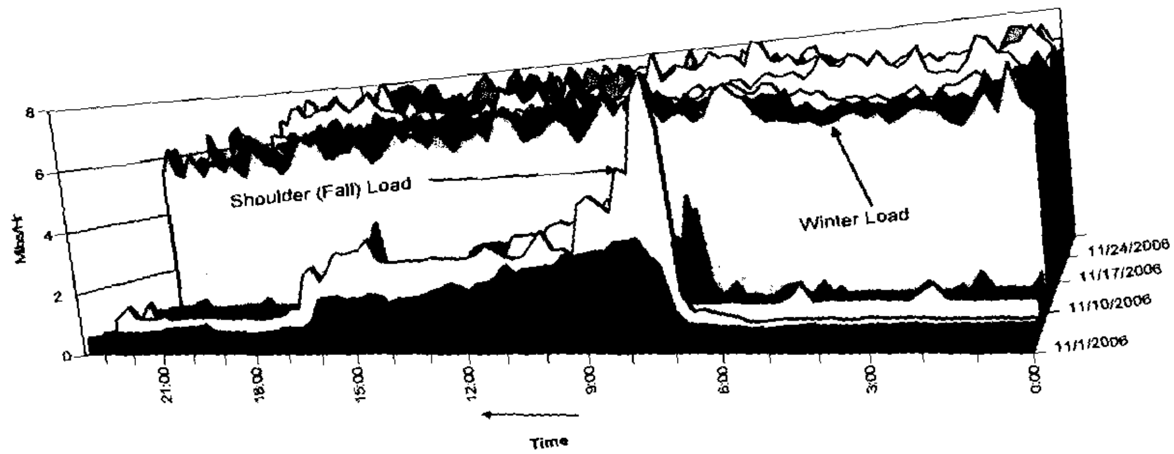


Figure 2 - Multifamily Building Winter Load Profile

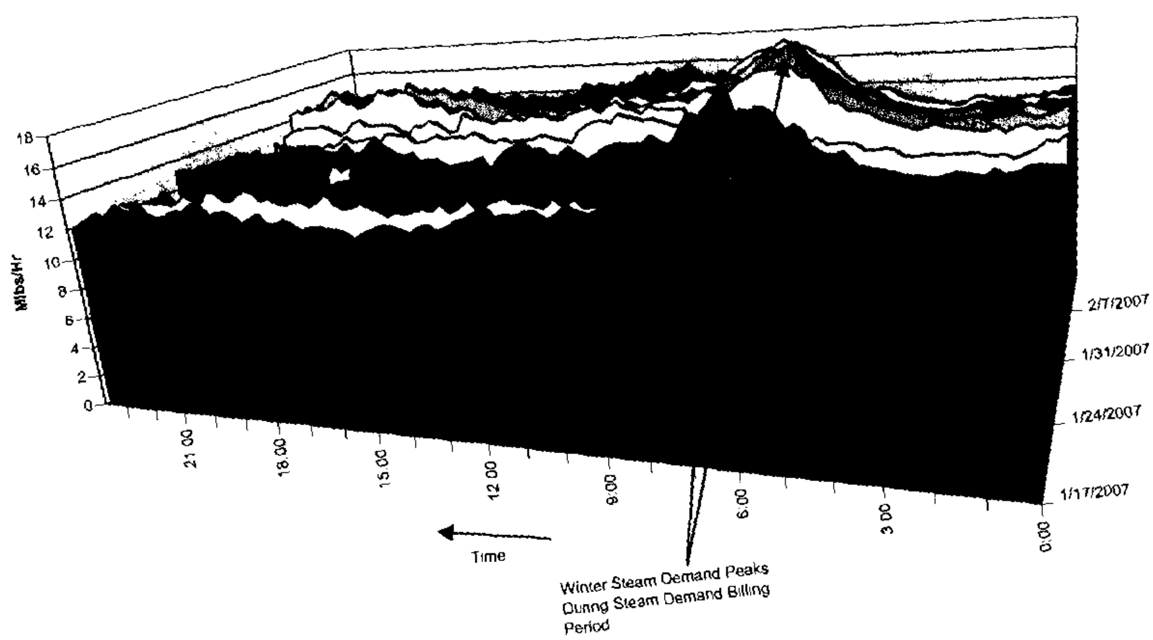
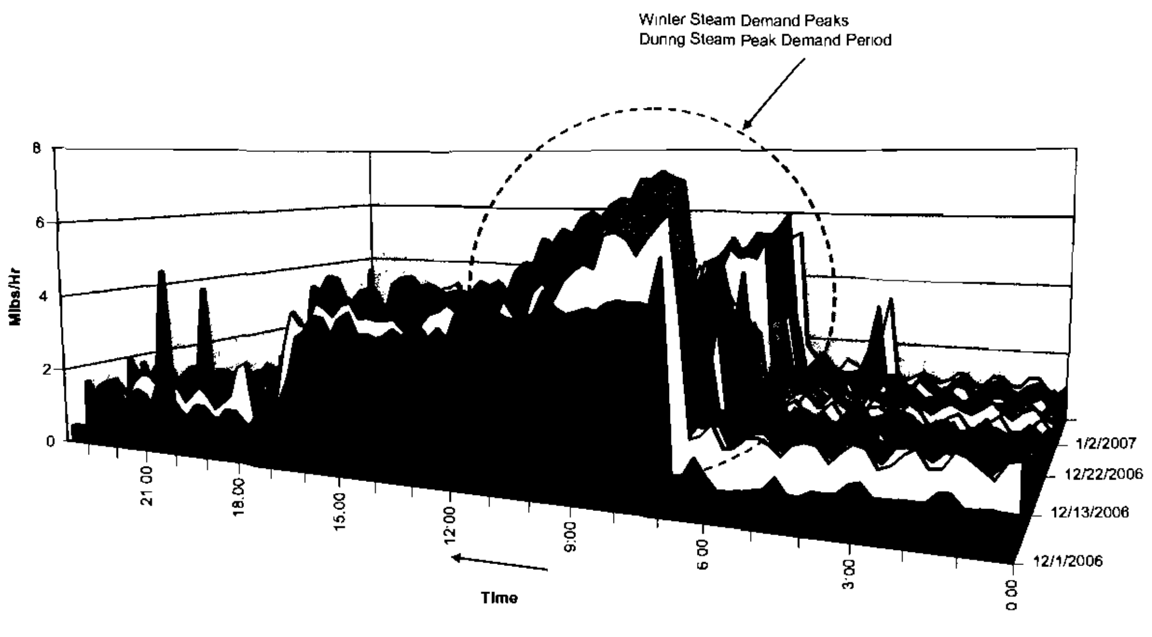
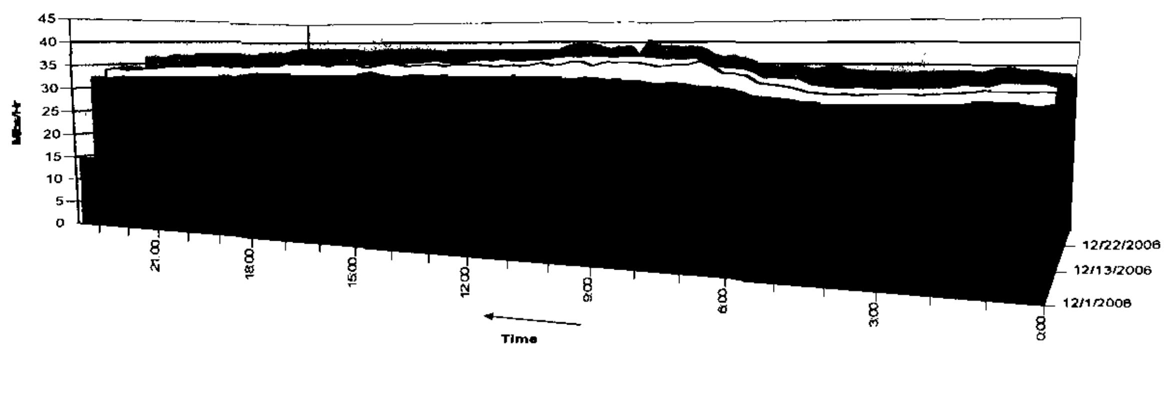


Figure 3 - Commercial Office Winter Load Profile



Fignre 4 - High Load Multi-use Winter Load Profile



Energy Audit Methodology
Site audits of each of the facilities were conducted by teams that included a representative of the Con Edison Steam Business Development Group and one of the consultant team members. The site audits were essential in providing the auditing team with first hand knowledge of each facility and its steam systems, and provided the auditing team the opportunity to discuss the demand rates in detail with each facility.

The site audits were conducted during the heating season for 2006-2007. A second visit was conducted during the cooling season for 21 of 30 facilities that also use steam for cooling. The site audits and site-specific report preparation processes are summarized as follows:

- 15-minute interval data from the steam demand meters in the facilities was processed to produce graphs of facility's steam consumption patterns. These graphs were used to calculate the potential impact of the steam demand rate and to identify conditions that contribute to the steam demand. They were also used during the site audits as part of the review of steam demand rates with facility personnel.
- Historic monthly steam consumption and temperature degree day data for each facility was analyzed to develop baseline consumption for that facility.
- Each facility completed a preliminary audit questionnaire, which was reviewed by the auditing team with facility personnel prior to the initial site visit.
- The site audits were conducted and preliminary reports prepared to summarize the findings for the rest of the project team. The first site audit took place in all facilities during the 2006-2007 winter season to assess heating systems in operation. Depending on the size of the facility, the audit visit lasted anywhere from one to three days.
- A second audit was conducted during the summer 2007 season to assess the facility cooling systems that utilize steam.
- Based on the steam data analysis and the facility surveys, appropriate Energy Efficiency Measures (EEM's) and Demand Reduction Measures (DRM's) were identified. For purposes of this report, EEM's are those measures that will reduce overall consumption and possibly the on-peak steam demand. DRM's are those measures that will reduce the on-peak demand, but not necessarily overall consumption. Preliminary implementation costs and the estimated steam cost reductions were calculated, along with return on investment.
- Site-specific reports were prepared for each facility.
- The results of the facility audits and reports were compiled into this *Steam Use Efficiency and Demand Reduction Best Practices* report[4].

[4] The report was authored primarily by Fredric S. Goldner, CEM and James W. Armstrong, PE, CEM of EMRA.

The measures presented are organized by energy system type and are broken out by DRM and EEM sub-groupings within these areas. Customers who are not demand-billed will not receive financial benefit, under the current rate structures by considering the DRM sub-groupings. The Return on Investment (ROI) level indicated represents the average observed for those instances where it was recommended in the sites audited. Some of the measures presented are a compilation of a number of related recommendations from various sites, or a breakout of a more comprehensive action, and as such it was not possible to present the projected ROI for these. Others, in particular those listed under Facilities Maintenance and Management Practices, are considered essential to improving a facility's operation and provide comfort improvement, extended equipment lifetimes, and other benefits, in addition to steam cost reductions. ROI's were not computed for these measures/actions. The ROI levels presented in Section 2 represent the following:

Average Return on Investment	Simple Return on Investment	Simple payback (Years)
Very High	Greater than 100%	less than 1 year
High	34% to 100%	1.0 to 2.9 years
Moderate	21% to 33%	3.0 to 4.9 years
Low	20% or Less	5 years or greater

SECTION 2 - Description of Potential Demand Reduction and Energy Efficiency Measures

For the purposes of this report, Energy Efficiency Measures (EEM's) are those measures that will reduce overall consumption and possibly the on-peak steam demand. Demand Reduction Measures (DRM's) are those measures that will reduce the on-peak demand, but not necessarily overall consumption.

The economic performances of the various DRM and EEM portfolios are provided here to inform steam customers of measures that MAY be applicable to their own facilities. Economic performance and other data for these measures presented here was derived from specific buildings and as such are provided to encourage other facilities to begin investigating which measures may be applicable for them. Since the applicability and performance of these measures is based on specific buildings, the ROI information is not intended as a basis for investment decisions in other facilities. No investment decisions should be made until at least an energy survey has been conducted.

General EEM's

INSULATE ALL STEAM DISTRIBUTION PIPING, VALVES, AND PIPE FITTINGS

Piping in most buildings is generally well insulated. However in some sites there are pipe runs, mechanical fittings and valve bodies that are bare. In the case of fittings and valves, this is often the case because of the need for periodic access for service (such as traps or unions), need for movement (such as at valve bonnets) or because insulation was not restored after a component replacement.

Figure 5 - Missing pipe insulation

Un-insulated steam system components result in energy waste as they heat up generally unoccupied spaces. This heat could be saved and delivered to the building where it is needed by installing insulation. This reduces the loss of heat to the room from the steam. As many of these pipes contain live steam around the clock, steam demand and consumption are affected.

On valves and fittings, removable insulation jackets provide a very useful solution to such situations. They are ordered to specific sizes and patterns, strap into place and are readily removed and put back on.

In stationary pipes, or areas that do not need to be accessed, install insulation to the thickness levels shown in the chart below.

Figure 6 – Un-insulated PRV and shut-off valve

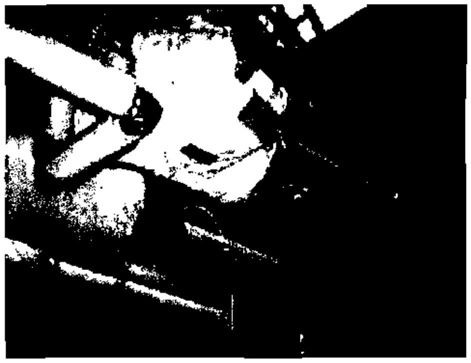


Figure 7 - Insulated Valves with removable jackets

Table 1 - Recommended Fiberglass Insulation Thickness (Inches)

		PIPE SIZES					
Heating Piping Systems	Temperature Range (deg F)	Up to 1"	1.5" to 2.5"	3" to 3.75"	4" to 5"	5" to 6"	8" and larger
Steam and hot water:							
High pressure / temperature	306-450	2.5	2.5	3	3.5	4	4
Medium pressure / temperature	251-305	2	2.5	2.5	3	3.5	3.5
Low pressure / temperature	201-250	1.5	2	2.5	3	3	3
Low temperature	106-200	1	1	1.5	1.5	1.5	1.5

Source – EMRA recommended levels, categories from Energy Conservation Construction Code of New York State (2002)

Table 2 - Annual Potential Savings from 20 Feet of Pipe Insulation

Pressure (PSI)	Pipe Diameter (in inches)	Consumption Savings (Mlb)	Demand Savings (Mlb/hr)	Annual Savings ($)
165	3	147.0	0.02	$3,700
165	6	281.6	0.03	$7,053
45	3	87.0	0.01	$2,182
45	6	167.7	0.02	$4,208
15	3	63.2	0.01	$1,598
15	6	122.3	0.01	$3,049

Assumptions and Notes:

1. Pipe is in service year-round (8,760 hours/year)
2. Dollar savings based on energy and demand charges for a mid-sized commercial office building
3. Savings are based on insulation thicknesses presented in Table 1

Table 3 – Annual Potential Savings from a 1 Inch Thick Valve Insulation Jacket

Valve Size (in inches)	Consumption Savings (Mlb)	Demand Savings (Mlb/hr)	Annual Savings ($)
3	20.1	0.002	$513
4	25.4	0.003	$626
6	40.3	0.005	$996
8	57.8	0.007	$1,430

Assumptions and Notes:

1. Valve is in service year-round (8,760 hours/year)
2. Dollar savings based on energy and demand charges for a mid-sized commercial office building
3. Source of consumption savings data: US Department of Energy Steam Best Practices

Average Return on Investment: Very High

REPAIR STEAM LEAKS

Steam leaks are a source of significant waste. Leaks are most often found at pipe junctions, fittings, or in valves. The leaks may be due to leaking gaskets or loose connections, or pinholes. The size of the leaks and extent of steam loss is hard to measure, and as such, to be on the conservative side even estimating close to the smallest leak possible provides for economics that demands these be addressed immediately. On occasion leaks in valves may require that they be replaced.

Figure 8 – Investing the capital to fix visible steam leaks, such as this one, is typically highly economically viable

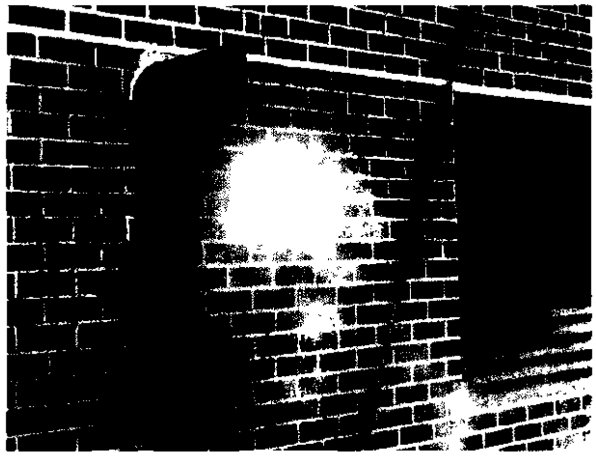


Figure 9 – Relief valve leaks are often overlooked, but waste a lot of money.

Table 4 - Annual Potential Savings from Steam Leak Repair

Leak Pressure (PSI)	Hole Size (inches)	Steam loss – lb/hr	Consumption Savings (Mlb)	Demand Savings (Mlb/hr)	Annual Savings ($)
165	1/16	22	188.5	0.022	$4,718
165	1/8	86	754.1	0.086	$18,897
45	1/16	6	52.6	0.006	$1,324
45	1/8	23	201.5	0.023	$5,055
15	1/16	2	17.5	0.002	$451
15	1/8	8	70.1	0.008	$1,746

Assumptions and Notes:

1. Leaking pipe/fitting is in service year-round (8,760 hours/year)
2. Dollar savings based on energy and demand charges for a mid-sized commercial office building
3. Source of Consumption savings data: CIBO ENERGY EFFICIENCY HANDBOOK, Copyright 1997 Council of Industrial Boiler Owners. Derived from Table 10-1.

Average Return on Investment: Very High

Heating Distribution

Demand Reduction Measures

APPLY STEEMs METHOD TO REDUCE MORNING PEAK STEAM DEMAND

Storage of Thermal Energy in Existing Mechanical Systems (STEEMs) is a steam demand reduction strategy developed by Con Edison for the benefit of the demand-billed steam customers. The main element of this strategy involves using the Building Management System (BMS) or a special-purpose controller to heat a circulating hot water loop to a higher temperature during unoccupied night hours and using the heat energy stored in the loop to displace steam consumption during the morning start-up. Con Edison has tested STEEMs at two customer locations. Comfort conditions were not affected at either location when operating in the STEEMs mode.

A building is a good candidate for implementing STEEMs if it meets all of the following criteria:

- It uses circulating hot water for a significant portion of its space heating
- Each of its terminal heating units (e.g. induction units, fan coil units, and fan powered boxes) has a local thermostatically controlled valve to avoid space overheating
- It has a programmable BMS. In the absence of a BMS, a special-purpose controller is required.

Two STEEMs techniques have been developed:

- *STEEMs Using Dynamic Response*, which requires a building steam flow rate signal for feedback. Although this strategy is more difficult to program than *STEEMs Using Scheduled Reset*, the potential for steam demand reduction using this technique is higher. Furthermore, the water temperature control valves need to be tuned to minimize steam flow rate fluctuations during the STEEMs mode of operation.

- *STEEMs Using Scheduled Reset* does not require building steam flow rate signal for feedback. It is simpler to program than *STEEMs Using Dynamic Response*. However, after the programming is completed, it requires experimentation by building engineers to identify an operating configuration that will maximize the amount of on-peak demand reduction. Furthermore, the water temperature control valves need to be tuned to minimize water temperature overshoot and undershoot.

Implementing STEEMs will not necessarily reduce the total amount of steam usage. STEEMs operation will shift *when* steam is used, and result in the shaving of the steam peak and a reduction in demand costs. Detailed implementation tips are included in the Appendix.

Average Return on Investment: High (assuming a BMS or a specialized controller is in place)

STEAM LOAD SHIFTING

In addition to STEEMs implementation, there are some additional steam demand shifting strategies for facilities to consider, including:

- Pre-heating of spaces such as the lobby, cellar/sub-cellar levels, and other spaces, which have "dedicated" heating systems. Increasing the water temperature for the radiation systems (lobby, office spaces that have converted to radiation) before the peak steam demand period starts (6:00 a.m.), may provide some load shifting from the peak period.
- Reducing or turning off the heat to spaces where heating is not critical, such as loading docks or garages during the peak steam demand period.
- Some building tenants, such as restaurants, open in mid-morning, meaning that their heating systems will start establishing comfortable temperatures during the peak steam period. Pre-heating these spaces before the steam peak or through coordination with other systems based on steam demand (through BMS or local controls) may allow the affect of the subject area's heating to be moderated.

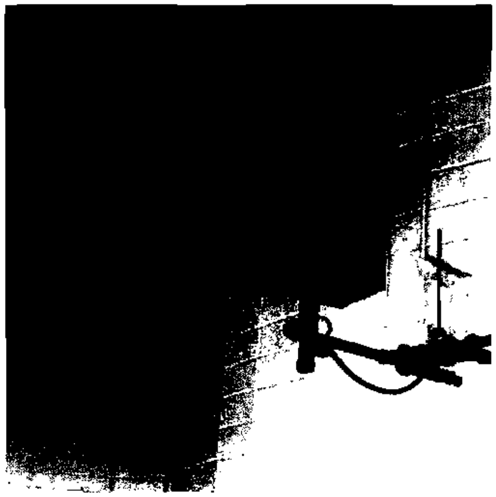


Figure 10 – Minimizing the use of non-essential heating, such as this garage heater, during the on-peak period will help reduce the on-peak demand

- In facilities where there are steam process loads, delay these processes until after the steam peak demand period. As an example, hotels that have on-premises laundries - if possible, laundry operations should be delayed until after 11:00 a.m. during the peak demand steam billing period. This will help reduce peak steam demand charges. This measure may not be necessary if condensate heat recovery allows much of the domestic hot water load to be met during the peak demand period.

To the extent possible, these measures should be implemented through automatic scheduling in the BMS, with input from the customer's steam demand meters to determine the level of pre-heating or heat reduction during the steam peak demand period.

ADJUST AIR HANDLING UNIT (AHU) SCHEDULES IN BMS

In many facilities, the AHU schedules in the BMS were observed to change operating mode to Startup or Occupied mode at or close to 6:00 a.m., which is the beginning of the peak demand period. These schedules can be adjusted to move the mode change to earlier in the day to reduce the possibility of a demand peak occurring when these units are all started. If it is not possible to start up the AHUs before 6:00 a.m., then their start-up should be staggered during the on-peak period.

A recommended procedure is to start up only those air handling units early that serve the spaces that get the coldest over night. Starting up *all* the air handlers earlier, including those that serve spaces that remain warm through the night, may not be justified due to a more significant increase in electric charges. Alternatively, if the air-handling units are already running, set point temperatures should be raised to preheat the building prior to peak hours. From 6:00 a.m. to 11:00 a.m., the set point can be reduced to normal, and steam demand and resulting steam demand charges should be reduced.

Figure 11 – Starting up air handling units before 6:00 a.m. or staggering their start-up will reduce the on-peak demand

Average Return on Investment: Very High

REDUCE VALVE "HUNTING"

Figure 12 shows a typical steam demand profile for a facility in which valve "hunting" is taking place. Hunting, shown by the "sawtooth" pattern of demand oscillation, is often a symptom of a control system requiring coordination adjustment between the control device (e.g. a steam pressure regulator or a water temperature control valve) and controlling point within the system. Hunting will result in accelerated wear and shortened service lives for components such as the temperature control and pressure reducing valves, as well as steam turbine nozzle controls and linkages if this also occurs during the cooling season.

In addition to the impact on control equipment service life, hunting may result in the peak steam demand being higher than necessary each month. The short, sharp peaks that result from hunting may induce higher recorded demand than takes place if the hunting is mitigated, allowing steam demand to smooth out to its actual level. A sample of the hunting induced higher peak versus the peak demand estimated from hunting mitigation is presented in Figure 13. Actual demand reduction achieved by reducing or eliminating the hunting will depend on the cause and the degree to which the hunting can be smoothed. However, in buildings with BMS systems, this should be a very low cost DRM to implement.

Figure 12 - Steam Control Valve Hunting Profile

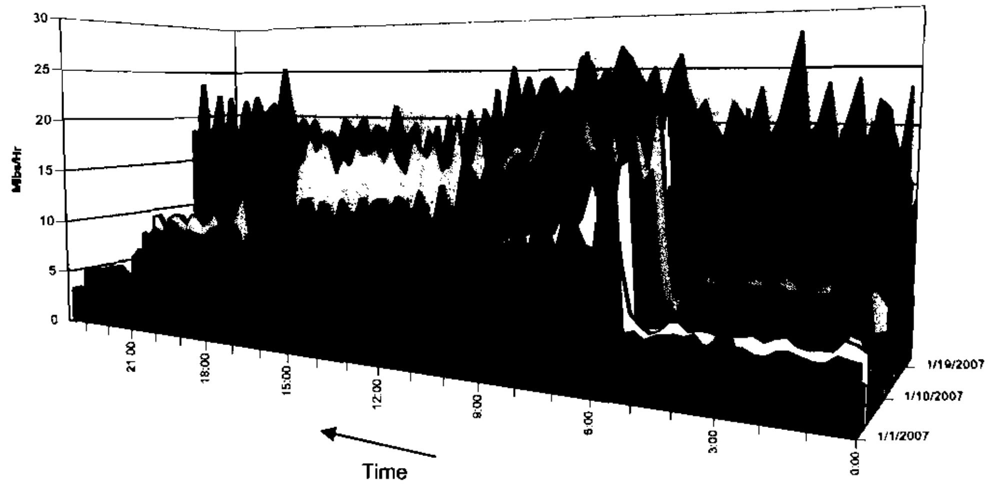
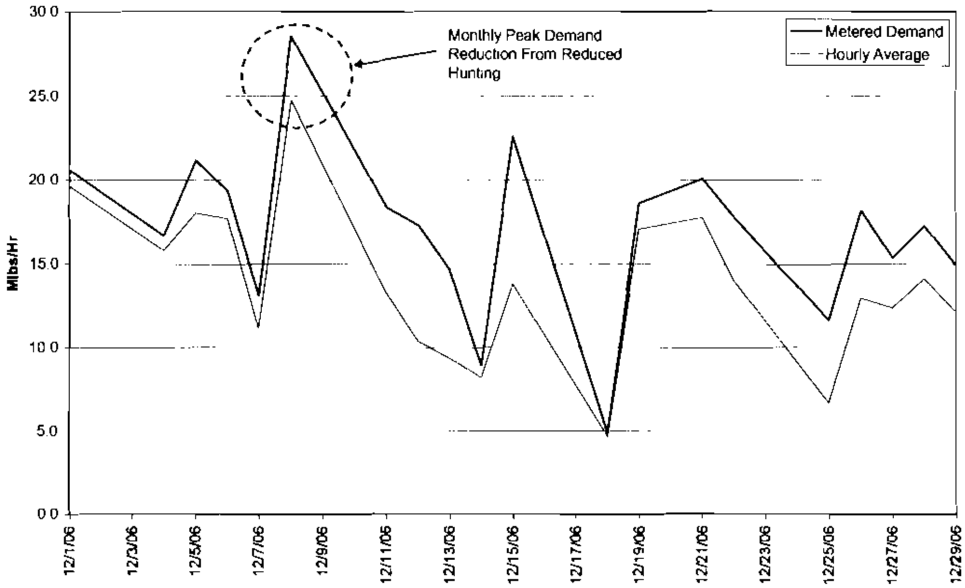


Figure 13 - Hunting Demand vs. Estimated Averaged Demand

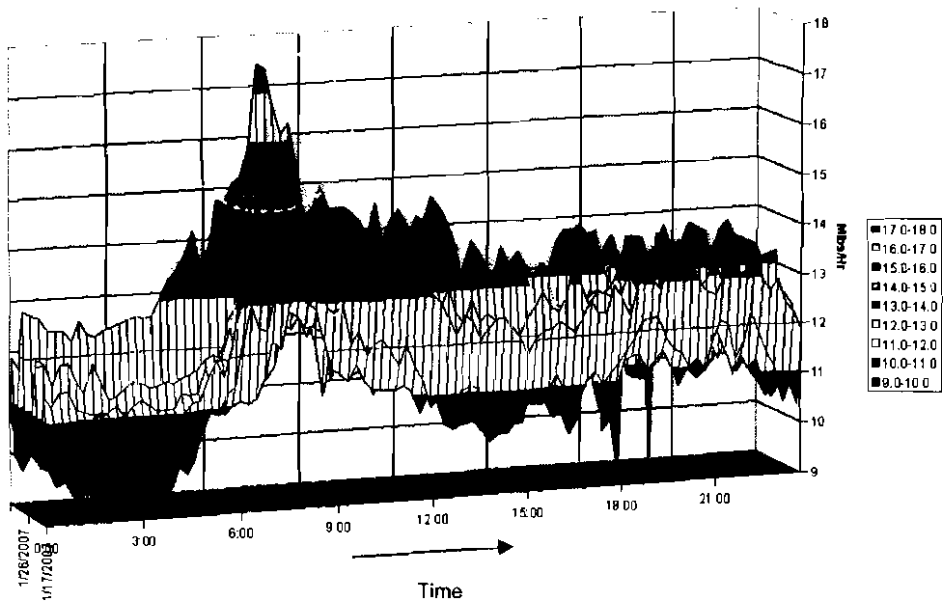


Average Return on Investment: Very High

SEQUENCE/SCHEDULE ZONE VALVES

In facilities equipped with heating distribution systems that employ zones and zone controls, the operation and scheduling of the zones should be such that they do not simultaneously commence operation, imposing a large spike in steam demand during the steam demand billing period. This concept is the same as the staging of electrical loads such as chillers. In facilities with multiple zones, schedules should be set up such that no more than half of those valves are allowed to be open concurrently during the peak demand period. The figure below illustrates the spike caused at a multifamily complex due to simultaneous start-up of all the zone heating systems.

Figure 14 - Multiple Zone Induced Peak Demand



Average Return on Investment: Very High

LOWER STEAM SUPPLY/DISTRIBUTION PRESSURE

In buildings that have a two pipe steam distribution system and employ a Heat Timer MPC control panel, savings may be achievable by reducing the pressure of steam delivered to the building's heating distribution system during the peak period only to avoid opening and closing the solenoid valve during that period.

In order to avoid an increase in overall steam consumption, it may also be necessary to reset the Heating System Sensor (XYZ knob), which senses the temperature of the returning condensate, to a lower temperature so that the heat timer senses that distribution has been established and the cycle clock begins. The starting time for the Heat Timer day settings should be set earlier than, for example, 5:45 a.m., rather than keeping the more common setting of 6:00 a.m.

It should be noted that the demand reduction during the test period in the site where this was done was achieved with no adverse effects on building occupant comfort.

Average Return on Investment: Very High

Energy Efficiency Measures

INSTALL A BMS FOR HEATING SYSTEM CONTROL & MONITORING

In facilities where a BMS does not currently exist, there are a number of benefits that can be accrued by installation of a sophisticated computerized BMS, (sometimes referred to as an Energy Management System or EMS). While a BMS can be costly, it is a valuable tool that can yield significant returns. Most importantly, to optimize such an investment, the operators need to be trained to review, understand, and act upon the information that such a system can provide.

There are a number of providers of BMS systems serving the New York City multi-family residential and commercial building market. It is *highly* advisable to have a full specification developed, which meets the needs of a particular facility, to be used for competitive bidding.

Savings from the installation of a well-designed and maintained BMS/EMS will come from a number of areas including the following:

- Personnel cost optimization - reduced time requirements for "rounds", enabling personnel to respond to complaints and conduct other activities such as maintenance
- Essential support to implementation of other steam DRM's/EEM's, particularly the STEEMs concept
- Accurate control and feedback on space and/or AHU supply and return temperatures
- Greater control and ability to respond to occupant comfort complaints
- Reduction/elimination of overheating of spaces – reduction of system "lag" time
- Identification of conditions, practices, and equipment that are resulting in less than optimal energy utilization or may require maintenance and replacement (PRV stations and DHW heaters – trap failures can be detected by BMS monitoring condensate temperatures).
- Improved utilization of water to cool condensate through monitoring and control of cooling water control valve based on temperature of condensate

- Documentation of conditions for occupant complaint response/resolution
- Support better control and balancing of systems to meet the requirements of various portions of the facility.
- Trending of various key parameters to identify equipment issues and system inefficiencies.

Average Return on Investment: Moderate

INSTALL THERMOSTATIC RADIATOR VALVES

Thermostatic radiator valves (TRV's) provide individual zoning control at the radiator level, allowing the occupant to select and set different temperature set points to meet individual comfort level for that area. Since the valve operation is controlled by the thermostatic element within the valve, once the settings are selected and set, there is no need to manually open and close the steam supply valve to control temperature. Installation of these valves in the overheated rooms prevents discomfort and provides significant savings. In buildings with large southern exposure, installation of TRV's in the rooms with southern exposure will help minimize overheating and help balance the building's heating system.

Figure 15 - Thermostatic radiator valves help prevent space overheating, which saves steam

Average Return on Investment: Moderate

FOR RADIATOR SYSTEMS, REDUCE OVERHEATING

Overheating was found in both multi-family and office buildings surveyed.

Some room temperatures were found to be as high as in the upper 70's to mid-80's, clearly too high, resulting in a considerable amount of heat energy being expelled to the outdoors via natural ventilation or mechanical means. In certain cases, not only were open windows found, but air conditioners were also running. This is a waste of energy. In addition to the steam costs, this accounts for considerable electric energy consumption and costs that can be avoided.

Tangentially, overheating is usually a result of some section of the building having cold spots. To address this, the facility management needs to address the distribution problem, and/or infiltration/draft issues. Caulking and weather-stripping may address the latter.

There are a number of actions that should be employed to capture the energy savings from this measure. These include:

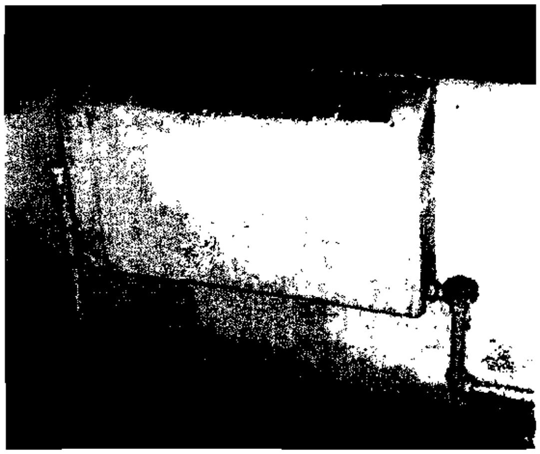


Figure 16 - A number of options is available to prevent a radiator such as this one from overheating the space.

- ❑ In buildings that employ two pipe Vari-Vac steam distribution system (with MEPCO DCC-1000 control panels, or similar devices from other manufacturers), the control panels operate as an outdoor reset control which varies the steam supply valve opening based on the outside temperature and temperature feedback from the condensate return system. To reduce overheating, the compensator on the panel should be adjusted to a more appropriate setting for the building.

- ❑ In buildings that employ two pipe steam distribution systems with Heat Timer control panels, or similar devices from other manufacturers:
    - Reduce the Heat Adjustment (Alpha setting) on the Heat Timer Panel. The exact setting should be determined by a series of lowering and observational tests (survey of space temperatures) conducted by facilities staff.
    - Reset the Heating System Sensor (XYZ knob) to a lower temperature so that the heat timer senses that distribution has been established and the cycle clock begins. There may also be a need to relocate the sensor to a more appropriate location. Check the Heat Timer manual for proper sensor location.
    - Install new, and/or make better use of existing, thermostatic radiator valves (TRVs).
    - Institute an occupant/staff educational program, to be carried out either with direct flyers distributed to offices, as paycheck stuffers, (or to tenants in rent bills), through the company intranet & email systems, and/or bulletins posted in elevators. Tenants should be advised by building management that radiators can and should be turned down or shut off with a valve when a room becomes too warm (rather than opening windows or turning on air conditioners).

Average Return on Investment: High

INSTITUTE NIGHT SETBACK

In buildings where the temperature settings remain constant around the clock, it is advisable to institute a night setback.

In order not to incur a larger than necessary demand charge, it is suggested that the setback operation lasts from either the end of the business day (in office buildings), or from 10:00 p.m. (in multifamily buildings) through about 4:00 a.m. Ending setback operation no later than 4:00 a.m. would give the demand-billed buildings enough time to heat up before the peak demand period of 6:00 a.m. to 11:00 a.m.

Average Return on Investment: Very High (assuming no new equipment is needed to do so)

INSTALL PROGRAMMABLE CLOCK THERMOSTATS IN SMALL, SUBLEASED SPACES

In spaces such as restaurants, professional offices and other storefronts that operate independently from the main distribution systems, install a programmable clock thermostat on the local heating system. Given that the normal operating hours of such spaces begin during the peak demand period, and normal procedure is to switch the system on manually at that hour, these spaces are clearly contributing to the facility's peak demand. The start-up times and early morning settings of such thermostats should be coordinated with the operations of the main building zones to reduce peak demand. In some cases, as determined from experimentation in the facility, it may be more cost effective to preheat these spaces before the 6:00 a.m. start of the peak steam period.

CONSIDER LOWERING CORE AHU WINTER OPERATING TEMPERATURE

This measure is applicable to those systems often found in office buildings that have independent core and perimeter heating, ventilation and air conditioning systems. In such facilities, it is possible to reduce core equipment temperature set points by a couple of degrees (for example, from 72-73°F to 70-71°F) either during the on-peak demand period or throughout the day. Such small variations are unlikely to be perceptible to occupants, while offering a reduction in peak and total steam usage during the period.

Average Return on Investment: High

MAKE USE OF REJECTED HEAT

Some of the heat from data centers may be getting discharged into the area above suspended ceilings that also act as the return air plenum. This is not a good arrangement in the cooling season and tenants should be using the supplemental cooling system for these spaces. However, it may be possible to use the heat from areas such as data centers to offset heating requirements for the facility during the heating season. A facility should investigate the feasibility of allowing data centers and other continuous heat sources to discharge heated air to the return plenums to offset the requirement for steam during the heating season.

SHIFT DOWN HYDRONIC SYSTEM OUTDOOR TEMPERATURE RESET SCHEDULE

Some facilities with circulating hot water systems have an outdoor reset schedule that has been in place since the BMS was originally installed. To minimize thermal losses in the distribution system, a facility should adjust its reset schedule down by several degrees. Since terminal heating units are often oversized, a facility may find that comfort conditions will not be affected. Since there are no first costs associated with this EEM, savings will be realized right away.

Condensate Management

Before implementing condensate management measures, a customer should consult with a competent water treatment vendor or another qualified professional to implement a water treatment plan and/or system design specifications in order to minimize the long-term risks of corrosion and fouling.

Energy Efficiency Measures

INSTALL CONDENSATE HEAT RECOVERY UNITS

In many buildings steam condensate is cooled in a dilution tank by city water and discharged to the sanitary sewer according to New York City guidelines. This is a waste of the purchased heat in that condensate and of the fresh water used to cool the condensate. In locations where the condensate return is near an existing thermal load (examples are listed below), and space for the equipment exists, it is recommended that heat exchanger equipment be installed to recover the heat from the condensate.

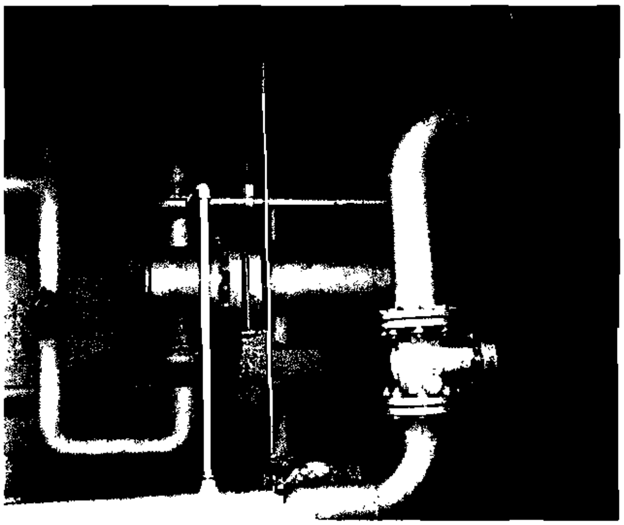


Figure 17 - The condensate heat recovery system such as this one can be enhanced by the addition of an unfired storage tank, if space permits.

Condensate heat recovery requires the installation of a heat exchanger and piping to divert the condensate and the water that needs to be heated to the heat exchanger.

Uses for this recovered heat include:

- ❑ Preheat domestic water that will be used in the domestic hot water (DHW) heater.
    - In addition to the condensate heat recovery system, unfired storage tanks should be added (as practical within space limits) to collect the heated (or preheated) water for availability during periods of high DHW loads. This will help optimize savings from this measure by allowing the system to collect and store the heat recovered for use in periods when condensate return and domestic water usage are not always concurrent.
    - Temperatures of the DHW feed in the tanks can be much higher than the DHW supply to the building, enabling the tanks to store more thermal energy and further offset peak steam demand. A mixing valve is required to supply cold water at the tank discharge to ensure that water delivered to the end users is not too hot. In case of a system

malfunction, this mixing valve should be designed to fail to a closed position to avoid the potential of delivering overheated water to end users.

- Add heat exchangers to utilize condensate for heat recovery to the perimeter and core hot water loops.

- ❑ If space is available, install coils in the outside air supply to the Air Handling Units to allow condensate heat recovery by preheating the outside air with condensate. Implementation of this measure requires additional detailed design and engineering to select the coil size(s) and to define the control mechanisms and operating procedures. Prevention of condensate freezing in the preheat coils will be one of the critical operational concerns addressed.

- ❑ Heating swimming pool and spa water. The advantage of this application is that such end uses supply a very large heat sink 24 hours per day.

To maximize resource recovery, condensate may be reused in more than one of these ways in the same facility. To conserve water, the cool condensate may then be reused for cooling tower make-up.

Average Return on Investment: High

Figure 18 - To maximize resource recovery, condensate can be used for cooling tower make-up after heat has been recovered from it.

ENHANCE CONDENSATE HEAT RECOVERY SYSTEM

In some buildings, heat recovery systems already exist, but can be either enhanced or otherwise improved to capture a greater percentage of the heat in the condensate, and optimize the potential savings that can be realized from such systems. See prior measure for details on how to pursue such opportunities.

Average Return on Investment: High

Figure 19 - Adding a storage tank to an existing condensate heat recovery system will increase the amount of heat recovered from condensate

CONVERT LOWER FLOORS FROM STEAM TO HYDRONIC HEATING

One of the buildings audited for this report had a two-pipe pressure steam distribution system. Given the existence of the radiators, there was an opportunity to create a hydronic loop to heat the first and second floors. Since there was no other use for the significant amount of condensate, this would allow the facility to make use of the large amount of condensate currently being cooled and disposed.

Average Return on Investment: High

OPTIMIZE STEAM CONDENSATE MONITORING AND MANAGEMENT

Even in places where a good pro-active steam trap maintenance program and basic condensate heat recovery are in place, efficiency may be improved, especially with *additional instrumentation* to let operators know how much heat is being recovered and when traps may be starting to fail open.

In the majority of buildings there is no direct indication of steam trap blow-through. As live steam blows through traps, the temperature of the returning condensate will increase. Temperature of inflow to the condensate dilution tank and volume of water added can provide good indications of steam trap performance. Instrumentation points should be added and brought into the BMS for trending and operating staff should be trained in how to interpret the data.

Average Return on Investment: High

Domestic Hot Water (DHW)

Energy Efficiency Measures

ADD OR ADJUST DHW RECIRCULATION CONTROLS

This measure may be applicable primarily to apartment buildings. It is not necessary to run domestic hot water (DHW) recirculation pumps continuously, circulating hot water through the pipes around buildings at 130-140° F. Installing and setting a reverse acting aquastat on the return line will reduce the amount of energy used to provide hot water to the apartments, while retaining the quality of hot water delivery services to the apartments. Additionally, there will be some electrical cost savings from the reduced run time on the pumps. The aquastat should be installed a few feet upstream of the pump and set at 110° F, with the deadband set at +/-5° F, and wired into the domestic hot water circulation pump in the building[5].

In some buildings return line aquastats are already installed, but set so high that the pumps are running continuously. These just need to be reset, as described above.

Average Return on Investment: Very High

REDUCE DHW TEMPERATURES

It was found that the DHW temperature at taps in some buildings was too hot, often at an average above 130° F. This not only wastes steam, (in multifamily buildings New York City housing maintenance code requires delivery of 120° F water to taps), but is also a potentially dangerous situation. Hot water at 132° F will scald human skin. The DHW delivery temperature should be adjusted so that it delivers 120° F DHW to the spaces with taps that are furthest from the mechanical room. This will take some trial and error, as design of piping systems varies, but the temperature of DHW leaving the mechanical room should be somewhere between 125 ° F and 140° F, depending on the size and configuration of the building.

Average Return on Investment: Very High

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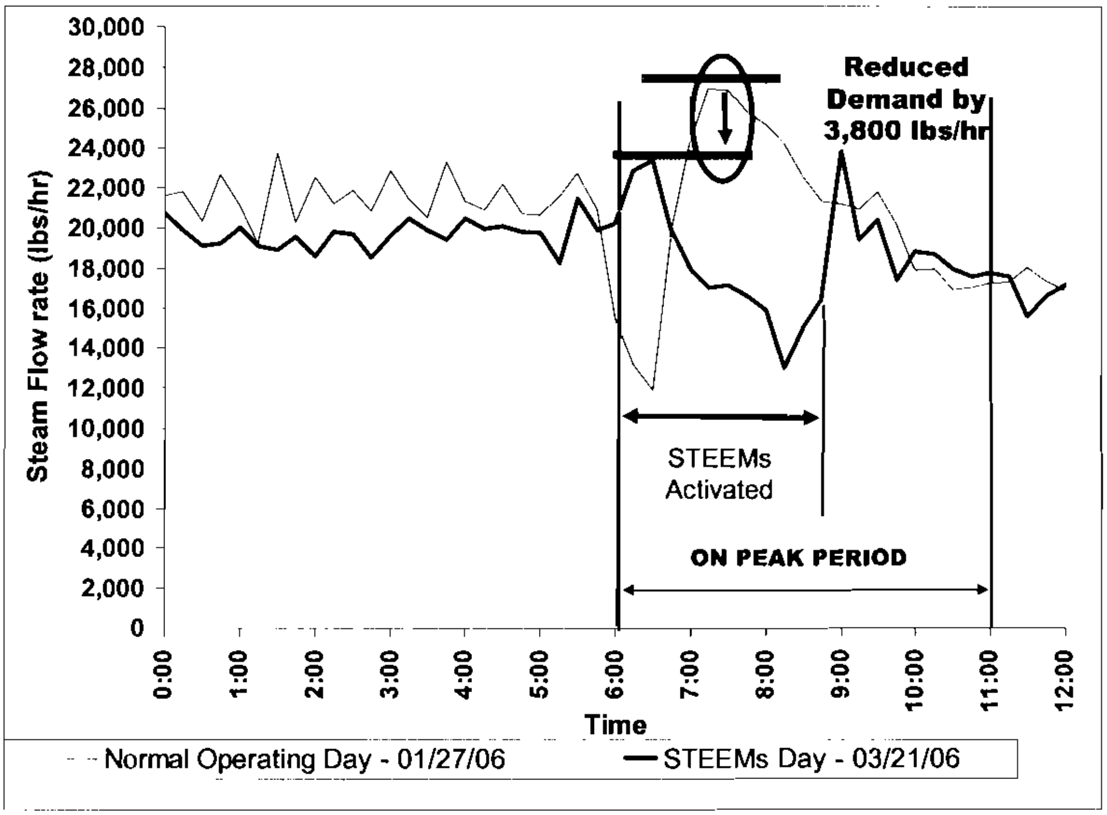
[5] Goldner, F.S.. DHW Recirculation System Control Strategies, Final Report 99-1. Prepared for New York State Energy Research and Development Authority. Prepared by Energy Management & Research Associates. January 1999.

Description of Operation	Explanation
3. The building engineer may specify different ramp-down start times and durations for different circulating hot water loops to maximize the amount of demand reduction. Once an optimal configuration is identified, the building may continue operating this way every morning.	STEEMs operation does not necessarily need to last for 5 hours, which is the duration of the on-peak period. In some buildings, the morning steam peak naturally subsides after 2 to 3 hours every weekday. In these cases, STEEMs may be activated for that time period only.
4. Normal mode of operation shall resume as a result of any of the following: a. Building Engineer's override for each water loop b. Completion of pre-set duration of STEEMs operation	

Figure 24 - ***STEEMs Using Scheduled Reset*** **Result at a Large Office Building**



Detailed STEEMs Operational Description - STEEMs Using Dynamic Response

Storage of Thermal Energy in Existing Mechanical systems (STEEMs) Using Dynamic Response is a steam demand reduction strategy that requires a building steam flow rate signal for feedback. Even though this strategy is more difficult to program than STEEMs Using Scheduled Reset, the potential for steam demand reduction using this technique is higher. Furthermore, the success of this strategy is contingent on tuning the water temperature control valves to minimize steam flow rate fluctuations during the STEEMs mode of operation.

Description of Operation

NOTES:

1. Although the steps described below may be applicable to a variety of building system types, some steps in this sequence may need to be excluded or modified, depending on your specific mechanical system characteristics.
2. It is important to tune the water temperature control valves to minimize steam flow rate fluctuations during the STEEMs mode of operation.
3. Con Edison encourages you to install your own steam meters for STEEMs. **However, if you are considering using high frequency steam pulse signals from Con Edison's meters, please note the following:**
    a. The high frequency pulse signal is provided for steam load or consumption monitoring and for implementation of STEEMs. It is not intended for other control applications.
    b. If you implement *STEEMs Using Dynamic Response*, you should design the load management system/equipment to automatically switch to an alternate mode of operations in the absence of pulse signals from the isolation relay circuit or in the case of a power supply failure.

Description of Operation	Explanation
Program the BMS to automatically run the building in the STEEMs mode of operation every weekday during the winter demand-billed months, or when directed by the Building Engineer: 1. At 4:00 a.m., gradually increase the water temperature set points in all the circulating hot water loops at a constant rate so that the preset highest water temperature is reached at 6 am. To maximize the amount of thermal storage, this high temperature value should be as high as practically possible, but should not exceed 190°F.	Slowly store the thermal energy in your circulating hot water loops. You may increase your All-Time Peak Demand charge if you force your loops to heat up quickly. There may not be a need to run your fans at this time. If the thermostatically controlled valves at the terminal units were fully open during the night, at the time of temperature ramp up, they should be activated to regulate room air temperature to prevent overheating.

Figure 25 – Typical Circulating Hot Water Loop - Normal Control Arrangement

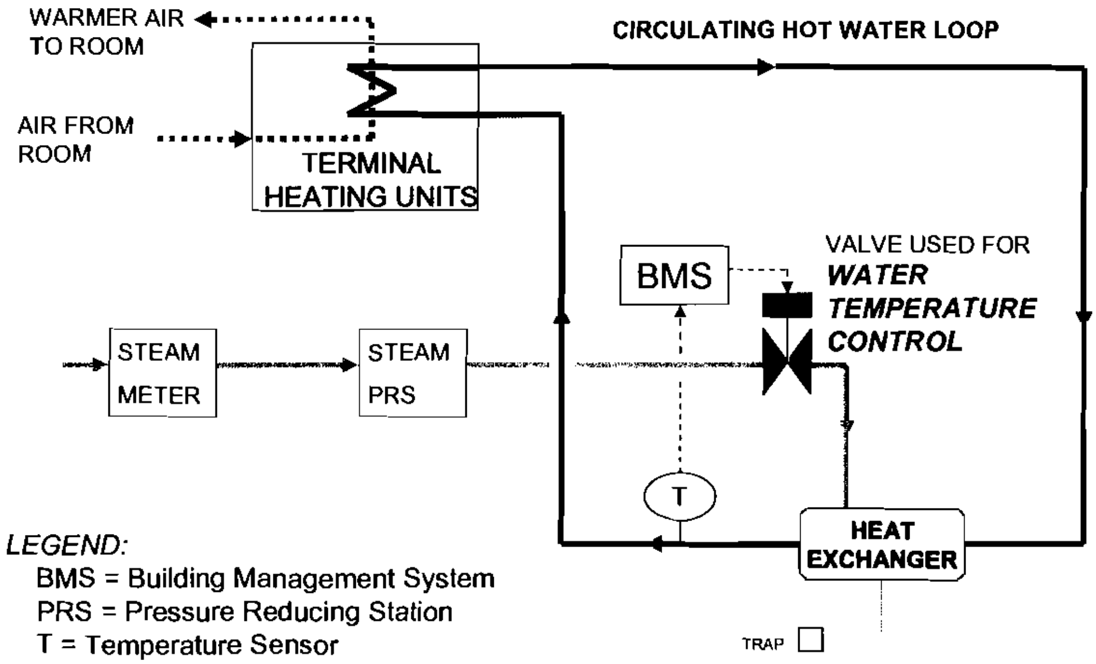


Figure 26 – Typical Circulating Hot Water Loop - Control Arrangement for *STEEMs Using Dynamic Response*

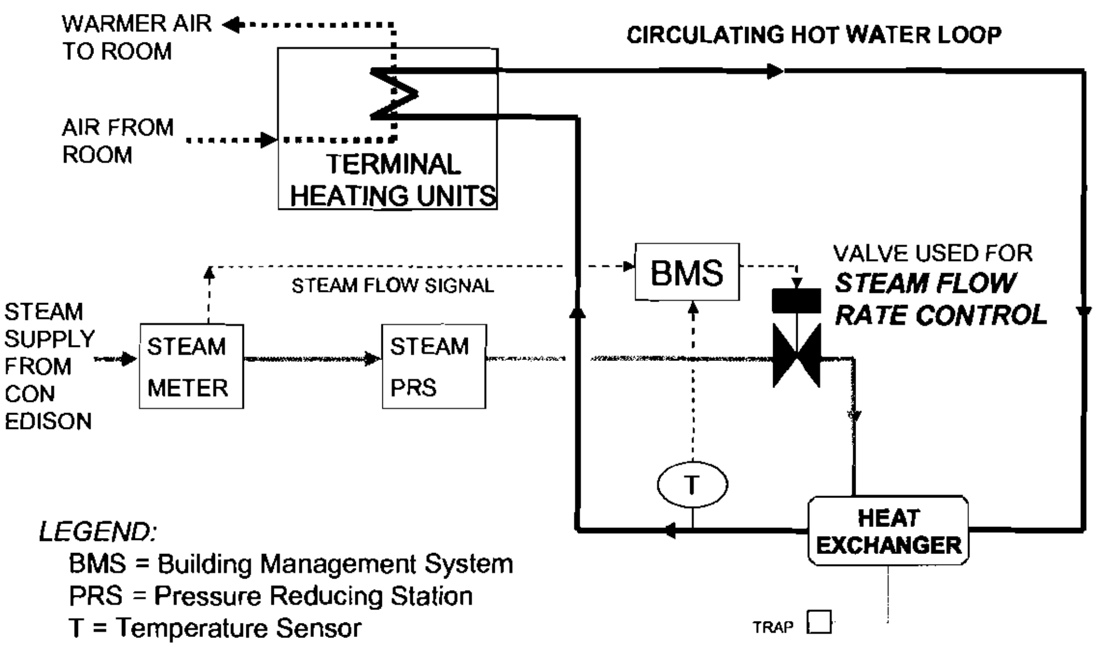


Figure 27 - *STEEMs Using Dynamic Response* Result at a Large Office Building

NOTE: The results in your building will vary, depending on the sizing and quality of tuning of your water temperature control valves, the amount of piping in the heating system, and other system characteristics.