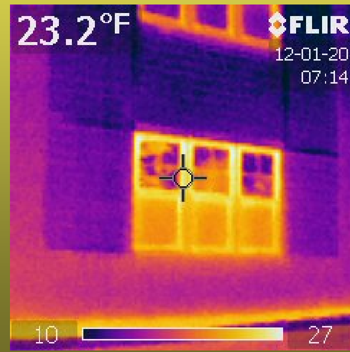

Facility Audit Report

Hollis-Brookline Middle School

FINAL

May 2012

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

A. EXECUTIVE SUMMARY

Program Introduction

The Town of Hollis requested investment grade audits for seven (7) municipal buildings and five (5) school buildings located within the Town. Funding was provided by the United States Department of Energy (DOE) through the New Hampshire Office of Energy and Planning (NHOEP) Energy Efficiency Conservation Block Grant (EECBG) program.

Figure 1: Hollis-Brookline Middle School

Phase one of the evaluation process involves site assessment planning including evaluating utility bills, benchmarking, reviewing available building and mechanical plans and coordinating site reviews with facility managers. Phase two involves a comprehensive and holistic facility evaluation to gather relevant information and data. Analyzing the collected data and developing recommendations for energy efficiency measures is completed in Phase three. This information is presented to the Town and School District within this report.

The objective of the building evaluation completed at the Hollis Brookline Middle School (Figure 1) is to identify measures that reduce the net energy consumption thereby reducing operating costs and the consumption of non-renewable fossil fuel energies. In addition to energy conservation, the evaluations and recommendations presented herein consider occupant comfort and holistic building performance consistent with its intended use and function. The information obtained as part of this evaluation has been used to develop recommended Energy Efficiency Measures (EEMs). These EEMs provide the basis for future building improvements and modifying the manner in which the building systems are operated.

Procedure

Facility audits or evaluations, identify all appropriate EEMs and a financial analysis that considers implementation costs, operating costs, and attainable savings. The objective is to identify the predicted energy savings, the amount the measure will cost, and the estimated payback period for each EEM. The evaluation also identifies any changes to operations and maintenance procedures that will reduce energy consumption. A comprehensive field survey of the facility is completed to evaluate the following:

- *Building Characteristics*
- *Building Use and Function*
- *Envelope Systems*
- *Heating and Cooling Systems*
- *Ventilation Systems*
- *Electrical and Lighting Systems*
- *Domestic Hot Water Systems*
- *Plug Loads*

Following completion of the field evaluation, the data and information are reviewed to develop proposed recommendations for the facility. All information, data, and recommendations are then compiled into a comprehensive report. The final report is then distributed to the municipality or school to assist with implementation and budgeting of the proposed EEMs. The information provided in the reports will assist the owner with determining the best value EEMs for their facilities. The reports also identify potential financial resources available to help fund the EEMs.

Between December 19th 2011 and January 20th 2012, AEC personnel completed site surveys at the Hollis Brookline Middle School (HBMS) to obtain the information necessary to complete an assessment of overall building performance. All building systems that impact energy consumption were evaluated including the building envelope, heating and cooling, ventilation, electrical, plumbing, and mechanical. Secondary observations are also reported herein and include building code compliance, life safety, structural systems, and roofing systems. This evaluation also considers whole building performance that measures how well the integrated building systems in the HBMS function as a composite system.

AEC completed a desktop review of the data provided by the town including historical energy consumption data. The field review included an evaluation of all building systems and data collection including an infra-red thermal imaging survey, indoor air quality measurements, lighting density measurements, and metering of lighting fixtures and HVAC equipment. The HBMS building was modeled using a building energy modeling computer program (eQUEST®) and calibrated to historical energy data. A series of energy efficiency measures (EEMs) were then simulated in the 3-D building model to measure their effect on energy consumption. Capital investment costs for each EEM were developed, and based upon the predicted cost savings associated with the energy efficiency measure, the payback term is calculated. A savings to investment ratio (SIR) for each EEM is then calculated based on the cost of implementation, the predicted energy cost savings, and the predicted service life of the measure/equipment. Other noted recommendations relate to indoor air quality, occupant comfort, code compliance, accessibility, and life safety.

Summary of Findings

The following significant findings are presented for the Hollis Brookline Middle School (HBMS) facility:

1. Mechanical ventilation systems in the original section of the building are inadequate.
2. Heating temperatures are consistently higher than recommended setpoint values.
3. Illumination densities consistently exceed recommended values.

Notable Observations

The following notable observations were made during the desktop data review and/or the building evaluation. Notable observations may be related to data that is outside the normal or expected range, irregularities in building use or function, or problematic systems.

- Energy use intensities (EUI) for the building are lower than expected for a K-12 facility. The ENERGY STAR® rating for the Hollis Brookline Middle School is 95. This is partly attributable to inadequate mechanical ventilation equipment in the original section. That is, providing minimum exchange air ventilation in the entire school requires additional ventilation equipment and energy consumption.
- Exchange air ventilation systems in the original section of the building are limited to unit ventilators. Unit ventilators are incapable of providing the exchange air rates required by ASHRAE 62.1. This is evidenced by elevated CO_2 concentrations in the older section. Because ventilation capacity does not comply with ASHRAE 62.1, the HBMS is ineligible for the ENERGY STAR® certification.
- A major building addition was constructed in 2004 and some of the mechanical equipment was upgraded.
- The two (2) hot water heating boilers have low combustion and thermal efficiencies.
- A lighting retrofit project was completed in 2011. Illumination densities remain significantly higher than recommended; most notably in common spaces and classrooms.

- Lighting fixtures on the exterior of the building, in the cafeteria (CFL lamps), and in the music room (CFL lamps) were not replaced as part of the lighting retrofit project. Illumination densities in the music room and gymnasium are below recommended levels.
- Gaps in entry doors and windows provide a significant amount of thermal energy transfer (typical of older K-12 facility).
- Electrical panels in corridors are outdated and some are not secure. It is recommended that a licensed electrician inspect all panels and replace or restrict access to the panels per current code standards.
- The original envelope is poorly insulated resulting in a significant amount of thermal transfer through the masonry walls, concrete footing walls, and roof. Improving the existing envelope would be a costly initiative.
- An unused access shaft to the roof is located in Classroom 101 and has not been sealed shut allowing substantial air leakage.

Summary of Recommendations

Following is a summary table identifying the proposed recommendations, EEM investment costs, predicted annual energy cost savings, simple payback period and savings to investment ratio. Part G provides a more detailed explanation of these recommendations.

The energy cost savings and resulting payback are based upon each independent measure implemented for the building in its current condition and function. There are interdependencies among measures that will affect the net composite energy savings. Interdependent measures are parametrically related therefore the net energy savings from two dependent measures do not equal the resulting savings determined by the addition of the two measures considered independent of each other. Investment costs are provided for budgetary planning only. They are estimated based on current industry pricing. A detailed cost estimate should be developed prior to appropriating capital funds for the more costly measures. Budgetary cost estimates for the Tier II and more costly Tier III measures are presented in Appendix J.

Table 1: Energy Efficiency Measure Summary

EEM No.	EEM Description	Capital Cost	Annual Cost Savings	Payback (yrs.)	SIR
T1-1	Power down electric devices when not in use. Consolidate printers and old computer equipment and remove from the building.	$0	$900	0	-
T1-2	Disconnect eleven (11) water fountain condensers.	$0	$880	0	-
T1-3	Remove vending machine from faculty room or replace with an ENERGY STAR® rated unit.	$0	$230	0	-
T1-4	Seal and insulate roof access hatch in Classroom 101.	$100	$240	0.4	72.0
T1-5	Install smart-strip time programmable controllers on photocopiers (2).	$120	$165	0.7	13.8
T1-6	Install eCube® thermostat controllers in walk-in refrigerator and freezer.	$800	$510	1.6	7.7
T1-7	Consolidate four (4) compact refrigerators and six (6) standard size refrigerator with four (4) standard sized ENERGY STAR® rated units.	$2,400	$1,104	2.2	6.9
T1-8	Install low-flow aerators (0.7 GPM) on all lavatory sinks.	$300	$130	2.3	5.2
T1-9	Install additional interior lighting controllers to reduce lighting density and runtime (photosensors, dimming controls, motion sensors, timers).	$3,800	$912	4.2	4.8
T1-10	Complete air-sealing on all entry door jambs, partings, headers, thresholds, and moldings (interior and exterior). Seal all envelope penetrations and gaps.	$2,600	$790	3.3	2.1
T2-1	Replace exterior MH wallpack lighting fixtures with LED units (7).	$12,972	$1,540	8.4	2.1
T2-2	Replace existing oil-fired hot water heater with an electric condensing tank unit.	$3,950	$410	9.6	1.8
T2-3	Install four (6) de-stratification fans in the multi-purpose room and six (6) in the gymnasium.	$5,400	$960	5.6	1.7
T2-4	Install CO_2 demand controls on exchange air ventilation systems.	$15,640	$1,400	11.2	1.3
T2-5	Replace walk-in freezer & refrigerator condenser units with high efficiency units (EER>14).	$7,084	$440	16.1	1.1
T3-1	Replace all electrical transformers older than 15 years with high efficiency units.	$36,260	$3,600	10.1	2.0
T3-2	Install pressure actuated dampers on all exhaust fans. Place units on occupancy sensors to limit run time.	$30,412	$2,100	14.5	1.7
T3-3	Replace one boiler with closed-loop geothermal ground-source heat pump system. Interlock second boiler to supplement the GSHP during peak heating demand periods.	$339,250	$19,649	17.3	1.4
T3-4	Retro-commission the 2005 HVAC systems including balancing of heating distribution and supply and return air systems.	$20,010	$1,900	10.5	1.1
T3-5	Replace the existing boiler units with high efficiency (89%) modulating oil-fired boilers, stack heat recovery unit, and VFD pump controllers.	$281,980	$10,220	27.6	1.0

The following table summarizes the renewable energy technologies that were considered for the Hollis Police Department. Scores are determined based upon the feasibility of the technology for the facility. A more focused feasibility study should be completed prior to considering any renewable energy system(s).

Table 2: Renewable Energy Technology Feasibility Scoring Results

Renewable Energy Technology	Grade
Geothermal Heating/Cooling	86%
Roof Photovoltaic	81%
Biomass Heating	80%
Ground Photovoltaic	79%
Wind Turbine Generator	78%
Solar DHW	76%
Solar Thermal	75%
Combined Heat & Power	67%

Insulation resistance values (R-values) were determined based on given information, time of construction and visual observations. The industry standard *International Energy Conservation Code (IECC), 2009* for Commercial Buildings in Climate Zone 5 required values are provided along with the installed values in Table 3. The IECC values are for new construction only, however provide a guide as to how this facilities insulation compares with new construction.

Table 3: Facility Insulation Summary

Insulation Values			
Space	Required (IECC, 2009)	Recommended	Installed
Floor Area 1	NA	10	1.2
Floor Area 2	NA	10	2.0
Floor Area 3 (Gym)	NA	10	1.7
Wall Type 1 (Original)	13+3.8ci	13+3.8ci	3.3
Wall Type 2 (Addition)	13+3.8ci	13+3.8ci	15.8
Wall Type 3 (Addition)	13+3.8ci	13+3.8ci	19.7
Roof 1 (Gym)	38.0	38.0	17.2
Roof 2 (Main)	38.0	38.0	17.1

Master Planning Considerations

The Hollis Brookline Middle School is a cooperative school servicing students from the Towns of Hollis and Brookline for grades 7 and 8. The current facility was constructed in 1975 and originally served as the Hollis High School and Middle School. With an upward trending population, the Hollis Upper Elementary School was constructed in 1980 to accommodate grades 7 and 8. The HBMS facility continued to accommodate the high school students.

Figure 2: Hollis-Brookline Elementary School

A continued upward trending student population led to the construction of the Hollis Brookline High School in 1996 and relocating grade 7 and 8 back to the middle school facility as it operates today. In 2005, a major renovation was completed including the construction of a two-story addition. The lighting in the building was upgraded as part of the 2011 Town-wide lighting upgrade project.

In 2008 a facilities space needs study committee, comprised of eight voting members of Hollis, one non-voting member from the Hollis Brookline Cooperative School Board (HBCSB), and the former chair of the HBCSB representing the Town of Brookline as a non-voting member analyzed the current and predicted special needs of the school. The report incorporated the Hollis Primary School, Hollis Upper Elementary School, Hollis Brookline Middle School and Hollis Brookline High School to consider master planning in terms of special constraints and analyzed options including whether to plan for expansion of one or more schools or dismantling the co-op between Hollis and Brookline and having Brookline build their own school. As of 2008, projections indicated that by 2015 all four schools may exceed capacities which would require either an addition or reconfiguration of the school district to accommodate the increased student population. The report predicted a few years of declining population with an eventual growth; however since the time this report was presented, the economic landscape has changed which has changed current and future population growth. While the report should be considered if this growth is realized again, the student population is trending downward (this is consistent with most New Hampshire communities).

The low efficiency windows on the building provide air leakage and thermal transfer through frames and glazing resulting in nuisance drafts and increased heating and cooling loads. The siding of the building exterior appears to be in acceptable condition and under infrared imaging revealed little thermal transfer. The roof was also observed to be in good condition. The heating system contains two large boilers which are controlled by a direct digital controls (DDC) system. The DDC system is optimized to run during school and event hours and has a scheduled setback when the spaces are unoccupied. Cooling is provided by rooftop air handling units, split air conditioning units, and mini-split air conditioning units.

As of October 1st 2011, the total full-time student enrollment (FTE) for the HBMS was 437. At 220 SF/FTE the number of students per area at HBMS is slightly less than similar sized school districts in New Hampshire. This may provide some capacity for additional students. Functional space within the building includes classrooms, administrative rooms, two gymnasiums, a library, various special use rooms, and mechanical/electrical closets. The current capacity and function of the HBMS appears to support user needs for a K-12 facility.

Considering the recent addition and renovations, a major renovation is not necessary. However, some dated systems do require improvements to meet current code standards including the mechanical ventilation systems in the original sections of the school. Replacing aging equipment at the end of its useful life and a continued preventative maintenance will ensure the HBMS will continue to function in its current capacity.

B. PROCEDURES & METHODOLOGY

Standards and Protocol

The American Society for Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) has developed the most widely accepted process for completing energy audits at commercial facilities. ASHRAE document RP-669, SP-56, *Procedures for Commercial Building Energy Audits* defines several levels of audits. The appropriate level of audit for a particular facility depends on the availability of existing data and information, owner objectives, and owner budget. Levels range from simple benchmarking to a comprehensive review of all building systems. The most comprehensive audit is a Level III audit which was conducted at the HBMS. Level III audits are commonly referred to as "Investment Grade Audits".

Basic elements of a Level III Investment Grade Audit include the following:

- A review of existing facility data including energy usage.
- Benchmarking the facilities energy usage relative to similar use facilities.
- An on-site inspection and survey of all facility systems.
- On-site measurements and data collection.
- Informal interviews with owners, facility managers, and occupants.
- Energy use analysis and development of efficiency measures.
- Developing a simple payback cost estimate for each recommended measure.
- Development of a comprehensive report that clearly presents all findings and provides recommended energy conservation measures and the associated costs.

In addition to the ASHRAE standard for commercial audits, there are industry and code-based standards that must be considered when analyzing building systems and evaluating energy conservation measures. All recommendations must be consistent with the intent of these standards. For example, the US Environmental Protection Agency (EPA) has established a recommended carbon dioxide (CO_2) threshold concentration of 1,000 parts per million (ppm) to promote a healthy indoor air environment. ASHRAE defines recommended temperatures, relative humidity levels, minimum ventilation rates, and energy standards. The Illuminating Engineering Society of North America (IESNA) prescribes recommended lighting densities based on the designated space use. The International Code Council (ICC) is the adopted standard for all building and energy codes (2009) in the state of New Hampshire. New Hampshire has also adopted ASHRAE Standards 62.1 and 90.1.

Table 4: Relevant Industry Codes and Standards

Standard	Description
28 CFR Part 36	ADA Standards for Accessible Design
ANSI/ASHRAE Standard 55	Thermal Environmental Conditions for Occupancy
ANSI/ASHRAE Standard 62.1	Ventilation for Acceptable Indoor Air Quality
ANSI/ASHRAE/IESNA Standard 90.1	Energy Standards for Buildings Except Low-Rise Residential Buildings
ICC 2009	International Building Code (IBC)
ICC 2009	International Existing Building Code (IEBC)
ICC 2009	International Energy Conservation Code (IECC)
ICC 2009	International Mechanical Code (IMC)
ICC 2009	International Fuel Gas Code (IFGC)
IESNA Lighting Handbook	Reference and Application
NFPA 70	National Electrical Code (NEC)

While the primary objective of an energy audit is identify energy conservation measures, such measures cannot adversely affect occupant comfort and indoor air quality. For example, if a building ventilation system is inadequate then it would be recommended that additional ventilation capacity be added. The electrical power required to operate the added ventilation equipment would increase energy consumption. Typically, the net energy usage incorporating the sum of the recommended conservation measures would still be less than the current usage even with the added ventilation equipment.

It is noted that although there is a prescriptive approach to commercial building audits, that every building is unique in many ways. Buildings should be evaluated consistent with the characteristics that define its need and appropriate function. This includes the following:

- *Use*: Current building use and occupant needs.
- *Systems*: Building systems characteristics and integration.
- *Control*: The effectiveness in which the existing building systems controls are utilized.

Desktop Data Review

Ideally, the building owner provides all available information to the engineering firm prior to initiating the facility site review. Information such as utility bills, building plans, repair records, planned improvements, and occupant concerns will help the building engineer identify potential issues before initiating the site review. The Building Engineer can then focus the site review toward problematic and energy intensive building systems.

Facility Site Review

Following the desktop data review, the Engineer initiates the facility site review. This review includes all major building systems including the envelope, electrical, mechanical, heating, cooling, and ventilation. The Engineer not only determines the performance and operating characteristics of all building systems, they also evaluate how the users operate the systems and how they perceive building performance. Photographs of representative systems, major equipment, and any identified issues are obtained to help document existing conditions. Field notes are maintained by the Engineer to further document building and user characteristics.

Data Measurements

In addition to collecting equipment information, several data measurements are obtained as part of the facility site review. This data is necessary to identify potential building issues and to collect the information needed to develop an accurate energy analysis. Measurements include:

- Infra-red thermal imaging survey of the building envelope.
- Indoor air quality (IAQ) measurements (temperature, relative humidity, and CO_2).
- Lighting metering to determine energy use and operating schedules.
- Lighting output density.
- Metering of energy intensive electrical equipment (e.g., motors, compressors, heaters) to determine energy use and operating schedules.
- Metering of energy intensive plug-loads to determine energy use and operating schedules.

Data Gap Review

Once the facility site review and data measurements are substantially complete, the Engineer begins reviewing and processing all of the collected data. Any data gaps discovered during this process are addressed prior to completing the audit report.

Energy Modeling and Conservation Measures

To identify the best value EEMs and ensure that the calculated energy and cost savings are relatively accurate, a DOE approved energy modeling software program is utilized. A three-dimensional model of the building is created using the simulation program (Figure 3). This includes all characteristic envelope systems, HVACR systems, domestic hot water systems, and mechanical systems. The geographic position and orientation of the building is input and regional climatic data is imported from the program database.

After the building is accurately modeled, the program simulates building performance and provides the estimated energy use for electric and heating fuel(s). The Engineer then compares the energy data to actual building data. The cause for any significant differences is determined and the building is re-simulated until the model closely matches the actual data. AEC utilizes eQUEST© for all building simulations and energy modeling.

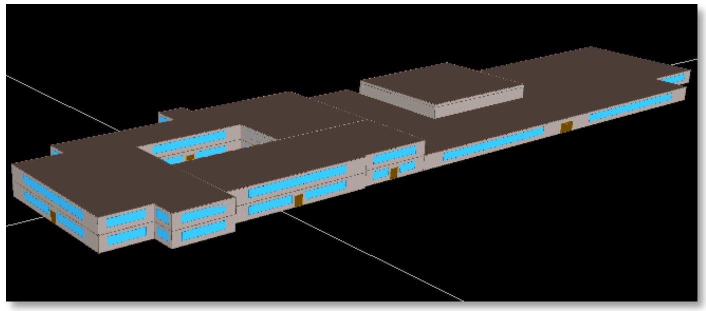


Figure 3: eQUEST® Building Model of HBMS

With the base model complete, the Engineer then implements various energy reducing measures and simulates the performance of the building with the new measure. The resulting energy consumption is then compared to the baseline model and predicted energy savings are analyzed.

Cost Estimating and Payback

The cost for implementing each evaluated EEM is then estimated by the Engineer. This provides a net estimated energy savings per dollar invested. Simple payback calculations determine the number of years required for the capital investment cost to equal the present day cost savings realized from energy reductions. The savings to investment ratio (SIR) is the accumulated annual cost savings (as determined by the expected service life of the material or equipment associated with the EEM) divided by the cost of investment. A SIR equal to 1.0 indicates that the EEM has a “break-even” or net-zero cost. The higher the SIR, the more favorable the return on investment is.

C. FACILITY INFORMATION / EXISTING CONDITIONS

Setting


Figure 4: Aerial Photo of HBMS (2011)

The Hollis Brookline Middle School (HBMS) is located in Hollis, NH (Figure 4). The building and facilities are located on a land parcel owned by the Town of Hollis. The school is located at 25 Main Street (west of Main Street) which is State Route 122.

The facility is accessible by a one-way driveway to the northeast which loops around the building. Two additional exits are provided to the southeast of the building along Love Lane. Love Lane extends east to west connecting Main Street to the athletic fields and few residences further west. Jeffery Smith Lane extends north to south and connects to Main Street and the Hollis Brookline High School. A school baseball field and additional field space have an abutment the school to the west with the softball and soccer fields located further west. Diagonal parking is provided along the east (front) of the building for school staff and visitors with smaller lots located to the south and north of the facility. A row of mature trees follows the diagonal parking to the east and provides screening between the HBMS and residences. The gross area of the HBMS is 96,025 square feet.

History

The HBMS facility was constructed in 1975 and originally served as the Hollis High School for students in grades 7 through 12. Due to an upward trending population in the Town, an additional school (currently Hollis Upper Elementary School) was constructed to accommodate grades 6 through 8 (grades 9 through 12 remained in the HBMS facility). In 1991, Hollis and Brookline formed a cooperative school district which increased the student population. The existing high school facility (located southwest of HBMS) was constructed in 1996 and the Middle School grades were relocated to the existing HBMS facility.

Use, Function & Occupancy Schedule

The HBMS and the land it occupies are owned by the Town of Hollis. The older sections of the building (north end) are single-story spaces with a 1.5 story gymnasium and the recent addition on the south end of the building is a two-story structure. The finish floor elevation on the addition is lower than the original section requiring stairwells for common access. Functional space in the addition includes classrooms, a library, kitchen, and a cafeteria. The north section of the building includes the gymnasium, mini gym, auditorium, and classrooms. The school follows a typical school year schedule with the 2011-2012 school schedule presented in Table 5 below. The typical class schedule starts each day at 0715 and commences at 1424 providing 7 hours and 9 minutes of full (normal) occupancy per day and 35 hours and 45 minutes per week.

Table 5: 2011-2012 School Calendar

Month	No. School Days	Breaks
August	1	Early Release 7th Grade (8/31)
		No Class 8th Grade (8/31)
September	21	Labor Day (09/05)
October	20	Early Release (10/04)
		Columbus Day (10/10)
November	17	Teacher Workshop Day (11/08)
		Veterans Day (11/11)
		Teacher Workshop Day (11/23)
		Thanksgiving Recess (11/24-11/25)
December	17	Early Release (12/07)
		Holiday Recess (12/26-01/02)
January	19	Holiday Recess (12/26-01/02)
		Martin Luther King Day (01/16)
February	18	Early Release (02/09)
		Winter Vacation (02/27-03/02)
March	20	Winter Vacation (02/27-03/02)
		Teacher Workshop Day (03/13)
April	16	Early Release (04/11)
		Spring Vacation (04/23-04/27)
May	22	Early Release (05/24)
		Memorial Day (05/28)
June	11	-

Anecdotal Information

Anecdotal information includes all relevant information collected during the desktop review, as part of occupant interviews, or general observations noted during the site evaluation. Generally, anecdotal information corresponds to issues or concerns that may not be apparent during the building evaluation. It includes complaints about seasonal occupant comfort, maintenance issues, systems or equipment performance issues, recent improvements or changes in use, and previous reports prepared by others. Anecdotal information obtained during the HBMS evaluation includes the following:

Figure 5: Blocked Vent in Room 144

- Air conditioning is provided to the newer wing of the building only. Some rooms are too cold when cooling systems are operating. This is evidenced by a covered vent in Classroom 144 to reduce air flow (Figure 5).
- Air in the Library is uncomfortable ("stuffy") in the mornings and staff open windows to increase ventilation.
- Several staff-members indicated that the Classrooms are consistently cold or consistently too warm.
- The boilers are shut down by mid-May. At this time the domestic hot water system is configured to allow the smaller hot water tank to provide hot water for the building.

Utility Data

Utility data for the Hollis Brookline Middle School (HBMS) was provided by the Town. Table 6 summarizes the total energy consumption for the two-year period including electric and oil usage. Energy consumption and cost for electricity per pay period is shown in Table 7 and Figure 6. The regional electric utility supplier is Public Service Company of New Hampshire (PSNH) and No. 2 heating fuel oil is provided by a local supplier.

Table 6: Annual Energy Consumption (2010 - 2012)

Energy	Period	Consumption	Units	Cost
Electric	February 2010 – January 2011	470,000	Kilowatt hours	$70,208
No. 2 Fuel Oil	February 2010 – January 2011	19,475	Gallons	$41,897
			Total Annual Energy Cost (2010):	*$112,105*
Electric	February 2011 – January 2012	377,000	Kilowatt hours	$64,520
No. 2 Fuel Oil	February 2011 – January 2012	17,499	Gallons	$49,122
			Total Annual Energy Cost (2011):	*$113,642*
			Total Annual Energy Cost (2010 – 2011):	*$225,747*

Over the twelve (12) month period (2010 – 2011) February was the peak demand month, consuming 47,000 kWh of electricity. For the second twelve month period (2011-2012), February was also the peak demand month, consuming 42,000 kWh of electricity. Since February is the shortest month by days and there is a one-week vacation period, it is assumed the electric load is due to heating components which is expected. The electrical consumption generally follows an expected trend over the course of the year with the lowest monthly consumption in August (typical for a K-12 facility). However, electric consumption in summer months is notably higher than expected. For example, energy consumption for July exceeds many of the occupied months including December. This data indicates that the cooling systems in the addition spaces consume a significant amount of energy. The normal trendline (yellow dashed line in Figure 6) for a K-12 facility is a smooth curved line peaking in February and the lowest point occurring in July or August.

Table 7: Monthly Electric Consumption (2010 - 2012)

Month	Year	Electric Consumption (kWh)	Electric Cost
Feb	2010	47,000	$6,559
Mar	2010	38,800	$5,612
Apr	2010	44,000	$6,256
May	2010	41,000	$5,953
June	2010	40,400	$6,103
July	2010	32,600	$5,063
Aug	2010	31,800	$4,717
Sep	2010	36,400	$5,845
Oct	2010	43,800	$6,722
Nov	2010	33,200	$5,106
Dec	2010	38,800	$5,958
Jan	2011	42,200	$6,312
Totals:	*'10 – '11*	*470,000*	*$70,208*
Feb	2011	42,000	$6,158
Mar	2011	34,000	$5,279
Apr	2011	37,600	$5,527
May	2011	28,400	$4,458
June	2011	34,400	$5,299
July	2011	29,400	$5,556
Aug	2011	22,000	$4,403
Sep	2011	27,800	$5,472
Oct	2011	35,600	$6,259
Nov	2011	26,800	$5,083
Dec	2011	27,200	$5,222
Jan	2012	31,800	$5,804
Totals:	*'11 – '12*	*377,000*	*$64,520*
Totals:	*'10 – '12*	*847,000*	*$134,728*

Average annual electric usage for the HBMS (February 2010 through January 2012) is 423,500 kWh at an average cost of $67,364. Based on the building size and function, this usage is as expected. However, optimizing the cooling and ventilation systems during the unoccupied summer session would substantially reduce electrical consumption.

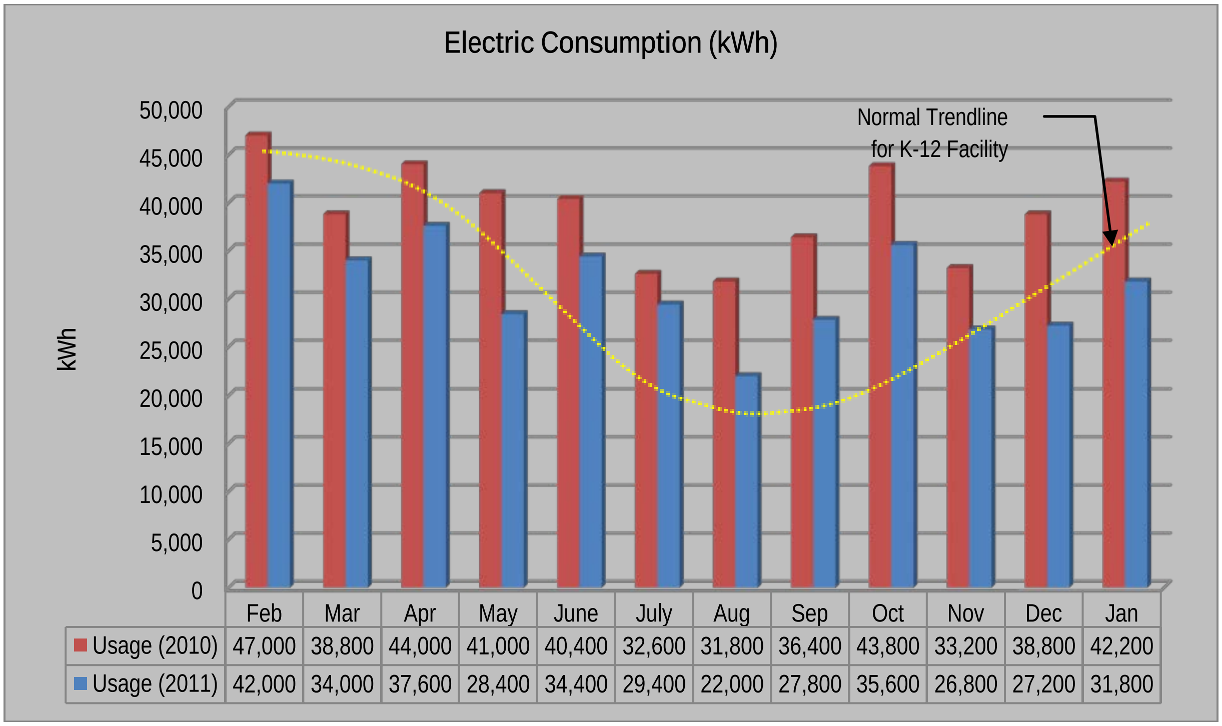


Figure 6: Electric Consumption (2010 - 2012)

To provide the most accurate recommendations for energy conservation, the energy consumption based on end use was determined. Table 8 presents the estimated electrical usage for categories including lighting, plug loads, and mechanical equipment. Mechanical equipment includes all hard-wired, permanently installed equipment including ventilation, exhaust, heating, cooling, pumps, etc. These values were determined using observations from the field audit and typical energy consumption data for appliances observed throughout the building. A more detailed accounting of all electrical equipment by end-use is presented in Part C of this Report.

Table 8: Categorized Electrical Consumption (2011-2012)

Equipment Type	Annual Consumption (kWh/yr)	% of Total Consumption	Annual Cost
Mechanical Equipment	168,384	44%	$23,574
Lighting Fixtures	142,471	37%	$19,946
Plug Loads	75,200	19%	$10,528
Totals:	386,055	100%	$54,048

Electrical consumption is largely consumed by mechanical equipment, at a predicted annual consumption of 168,384 kWh/yr. The mechanical systems are well maintained and run on DDC but measures can still be taken to lower this consumption. Lighting fixtures consume a moderate amount of electricity at an estimated 142,471 kWh/yr. A town wide lighting upgrade project conducted in 2011 included the HBMS and it is assumed consumption is lower than it was before. Measures can still be taken to further reduce the cost to operate lighting fixtures. Plug loads are predicted to consume the least amount of electricity at an estimated 75,200 kWh/yr.

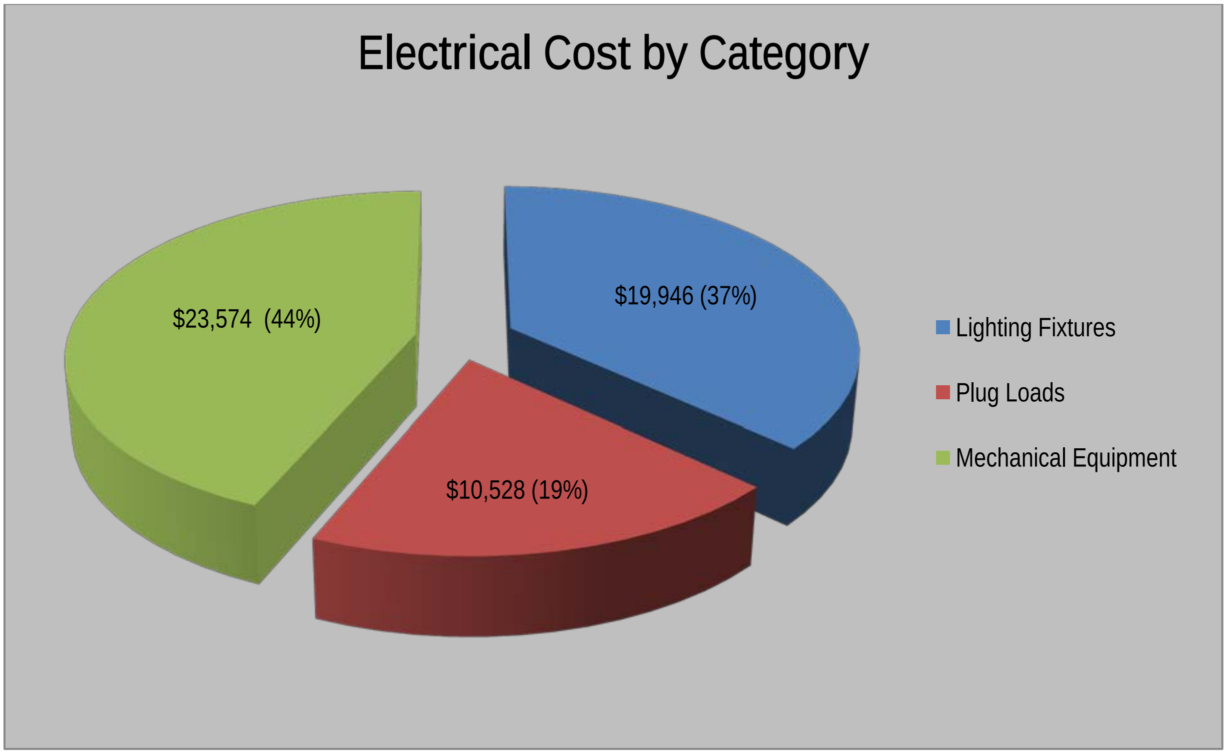


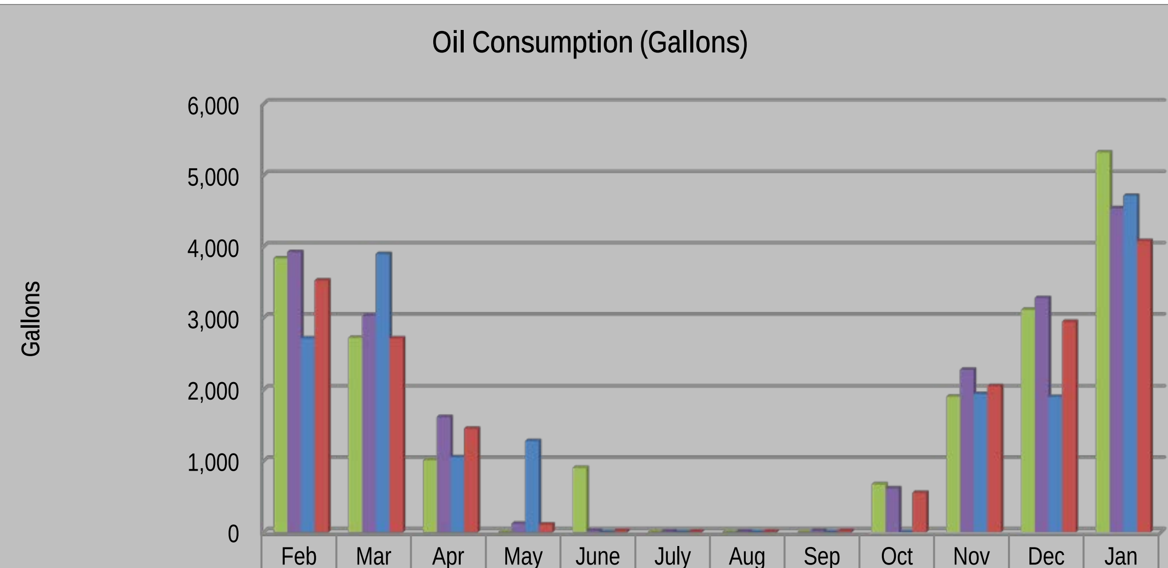
Figure 7: Hollis Brookline Middle School Electrical Cost by Category (2011-2012)

Consumption for mechanical systems is higher than the expected range (40%-50%) at a cost of $23,574. Lighting fixtures consume a moderate amount of electricity but are still within a reasonable electrical consumption at 37% and a cost of $19,946. Plug loads account for the lowest annual cost of $10,528 (2011).

Table 9: Monthly Heating Fuel Consumption (2010 - 2012)

Month	Year	Oil Purchased (Gallons)	Cost of Purchase	Oil Consumed	Cost of Consumption
Feb	2010	3,832	$6,744	3,921	$8,436
Mar	2010	2,726	$4,798	3,030	$6,518
Apr	2010	1,011	$1,779	1,618	$3,481
May	2010	0	$0	122	$262
June	2010	903	$2,041	22	$48
July	2010	0	$0	12	$26
Aug	2010	0	$0	12	$26
Sep	2010	0	$0	22	$48
Oct	2010	673	$1,623	617	$1,328
Nov	2010	1,901	$4,584	2,282	$4,910
Dec	2010	3,111	$7,503	3,278	$7,053
Jan	2011	5,318	$12,825	4,538	$9,762
Totals:	*'10 – '11*	*19,475*	*$41,897*	*19,475*	*$41,897*
Feb	2011	2,721	$6,563	3,523	$8,498
Mar	2011	3,894	$9,391	2,722	$6,565
Apr	2011	1,053	$2,621	1,454	$3,620
May	2011	1,280	$3,087	109	$264
June	2011	0	$0	20	$48
July	2011	0	$0	11	$26
Aug	2011	0	$0	11	$26
Sep	2011	0	$0	20	$48
Oct	2011	0	$0	554	$1,336
Nov	2011	1,940	$6,230	2,051	$6,137
Dec	2011	1,900	$6,103	2,946	$9,460
Jan	2012	4,710	$15,127	4,077	$13,093
Totals:	*'11 – '12*	*17,499*	*$49,122*	*17,499*	*$49,122*
Totals:	*'10 – '12*	*36,974*	*$91,019*	*36,974*	*$91,019*

Heating fuel for space heating and domestic hot water heating at the Hollis Brookline Middle School is provided by a local supplier (Table 9, Figure 8). The building consumed a total of 19,475 gallons of No. 2 oil between February 2010 and January 2011 and 17,499 gallons of No. 2 oil between February 2011 to January 2012. The average annual heating fuel cost for the Hollis Brookline Middle School is $45,510 (2010-2012). The peak months of oil purchased and expected consumption for each twelve month period were in January (2011 and 2012), purchasing 5,318 and 4,710 gallons of fuel, respectively, with an expected usage of 4,538 and 4,077 gallons of fuel.



	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan
Oil Purchased (2010)	3,832	2,726	1,011	0	903	0	0	0	673	1,901	3,111	5,318
Oil Consumed (2010)	3,921	3,030	1,618	122	22	12	12	22	617	2,282	3,278	4,538
Oil Purchased (2011)	2,721	3,894	1,053	1,280	0	0	0	0	0	1,940	1,900	4,710
Oil Consumed (2011)	3,523	2,722	1,454	109	20	11	11	20	554	2,051	2,946	4,077

Figure 8: Fuel Oil Consumption (2010 - 2012)

Considering the building systems including the envelope integrity (insulation and air leakage), mechanical equipment, and use of the facility, the heating fuel usage is expectedly high. Heating of the building is supplied by two (2) H.B. Smith® 81% efficient boilers which were installed in 1994. Domestic hot water (DHW) is supplied by one (1) John Wood® 80% efficient hot water heater installed in 2009. Efficiencies of these units decrease with age and both are considered moderately low efficient units.

Other explanations for the high usage include heating setpoints that are higher than recommended in occupied portions of the building. For example, fifty-three (53) temperature readings were taken at representative locations throughout the school and all measurements exceeded the 70°F maximum recommended setpoint with an average recorded temperature of 72.8°F. Recommended heating setpoints for a K-12 facility range between 67°F and 70°F depending on the occupancy frequency and use of individual spaces.

D. FACILITY SYSTEMS

Building Envelope

The following sections present the building envelope systems and insulation values for each assembly. Assembly values are compared to the *International Energy Conservation Code (IECC), 2009* for commercial buildings located in Climate Zone 5. The IECC code is used as a standard of comparison only and existing buildings are not required to comply with the code unless it undergoes a substantial renovation. New construction and major renovations are required to comply with current energy codes. Building plans were not made available for use during the audit.

Floor Systems

The slab-on-grade concrete floors in building are four (4) inches in thickness. There are three different floor covering systems including vinyl tiles, carpeting, and wood (gymnasium and mini gym). Installed R-values for the three coverings are 1.2, 2.0, and 1.7 respectively (Table 10). Although the IECC does not specify an insulation requirement for unheated slab on grade floors in Climate Zone 5, a minimum value of R-10 is generally recommended. The perimeter of the foundation is insulated with two (2) inches of rigid polystyrene board insulation to a depth of four (4) feet below grade.

Table 10: Floor Insulation Values

Floor Area 1				
Material	Thickness (in.)	R-value	Integrity Factor	Installed R-value
Concrete slab	4.0	0.3	1.0	0.3
Vinyl Tile	¼	0.2	1.0	0.2
Interior air film	NA	0.7	NA	0.7
			Installed Assembly	1.2
			2009 IECC Requirement:	NR
Floor Area 2				
Material	Thickness (in.)	R-value	Integrity Factor	Installed R-value
Concrete slab	4.0	0.3	1.0	0.3
Carpeting	NA	1.0	1.0	1.0
Interior air film	NA	0.7	NA	0.7
			Installed Assembly	2.0
			2009 IECC Requirement:	NR
Floor Area 3 (Gymnasium Floor)				
Material	Thickness (in.)	R-value	Integrity Factor	Installed R-value
Concrete slab	4.0	0.3	1.0	0.3
Wood	¾	0.7	1.0	0.7
Interior air film	NA	0.7	NA	0.7
			Installed Assembly	1.7
			2010 IECC Requirement:	NR

Wall Systems

The building is a single and two-story structure. The original single-story structure is assumed to have the wall system described as Wall Type 1 in Table 11 below. The walls are constructed with 12-inch CMU blocks, an air space, and exterior facing brick. Insulation values in these sections do not meet the current energy code standards (IECC, 2009).


Figure 9: Exterior Wall System

The exterior walls of the newer two-story sections contain two distinct wall systems described as Wall Type 2 and Wall Type 3 in the table below. Wall Type 2 includes an interior air film, 8-inch CMU block with vermiculite insulation infill, an air space, and facing brick on the exterior. The wall systems at window sections which are described as Wall Type 3 in the table below.

Table 11: Wall Assembly Insulation Values

Wall Type 1 (1975 Original Building)				
Material	Thickness (in.)	R-value	Integrity Factor	Installed R-value
Exterior Air Film	NA	0.2	NA	0.2
Facing Brick	4	0.4	0.9	0.4
Air Space	2	1.0	NA	1.0
CMU Block	12	1.3	0.8	1.0
Interior Air Film	NA	0.7	NA	0.7
			Installed Assembly:	3.3
			2009 IECC Requirement:	11.4ci
			Code Compliant?	NO
Wall Type 2 (2005 Addition)				
Material	Thickness (in.)	R-value	Integrity Factor	Installed R-value
Exterior Air Film	NA	0.2	NA	0.2
Facing Brick	4	0.4	0.9	0.4
Air Space	2	1.0	NA	1.0
Vapor Barrier	NA	NA	NA	-
Vermiculite Infill	8	17.0	0.8	13.6
CMU Block	8	1.1	0.8	0.9
Interior Air Film	NA	0.7	NA	0.7
			Installed Assembly:	15.8
			2009 IECC Requirement:	11.4ci
			Code Compliant?	NO
Wall Type 3 (2005 Addition)				
Material	Thickness (in.)	R-value	Integrity Factor	Installed R-value
Exterior Air Film	NA	0.2	NA	0.2
Vinyl Siding	NA	0.8	1.0	0.8
Plywood Sheathing	½	0.6	0.9	0.5
Fiberglass Batt	6	19.0	0.9	17.1
Drywall	½	0.5	0.9	0.4
Interior Air Film	NA	0.7	NA	0.7
			Installed Assembly:	19.7
			2009 IECC Requirement:	11.4ci
			Code Compliant?	NO

Ceiling Systems

Ceilings throughout most of the building are suspended acoustical tile (SAT) systems. The above ceiling plenum space is used for routing of ducting, piping, conduit and electrical cable. The ceilings of the gymnasiums are made of aluminum and are attached below the roof system.

Roofing Systems

The entire building has multiple levels of flat membrane roof sections. The portion of the newer two-story structure along the south and west sides of the building are built with a white roof membrane which reduces localized heat islanding and the amount of energy used for cooling during the summer. The main

Figure 10: Multi-Level Membrane Roof

gymnasium has a built-up ballasted (crushed stone) roof system. The remainder of the building is covered in a black membrane.

Table 12: Roof Insulation Values

Roof Insulation 1 (Gymnasium)				
Material	Thickness (in.)	R-value	Integrity Factor	Installed R-value
Exterior Air Film	NA	0.2	NA	0.2
Membrane Roof-Ballasted	NA	0.3	NA	0.3
Rigid Roof Insulation	4	16.0	1.0	16.0
Reinforced Vapor Barrier	NA	0.0	NA	-
Interior Air Film	NA	0.7	NA	0.7
			Installed Assembly:	17.2
			2009 IECC Requirement:	20.0 ci
			Code Compliant?	NO
Roof Insulation 2 (Main Building)				
Material	Thickness (in.)	R-value	Integrity Factor	Installed R-value
Exterior Air Film	NA	0.2	NA	0.2
Membrane Roof	NA	0.2	NA	0.2
Rigid Roof Insulation	4	16	1.0	16.0
Roof Deck	NA	0.0	NA	-
Interior Air Film	NA	0.7	NA	0.7
			Installed Assembly:	17.1
			2009 IECC Requirement:	20.0 ci
			Code Compliant?	NO

Figure 11: Window IR in Shop Classroom

Fenestration Systems

Fenestration systems on the HBMS building include operable windows, fixed window units, and fully-glazed entry doors. Consistent with IECC requirements, fenestration performance is measured by the U-factor, the solar heat gain coefficient (SHGC), and air leakage as determined by the unit manufacturer. No manufacturer information was available for the windows or doors therefore compliance with IECC standards for commercial buildings located in Climate Zone 5 cannot be established.

Thermal transfer and air leakage commonly occurs at the seals of operable windows and the interface between the window and the wall opening which was observed using infrared imaging. Recommendations include exterior and interior inspection and re-caulking of window jambs, headers, and sills as needed. If the operable window units have adjustable jambs, they should be inspected and adjusted as necessary to maintain a complete air seal.

Figure 12: IR of Exterior Door to Classroom 107

Doors

The door units in HBMS building include metal doors with full window glazing for all main and side entrances as well as steel solid doors with small window glazing for secondary entrances for building personnel and emergency exits. Based on visual observations and thermal imaging, thermal transfer occurs through the hollow metal doors as well as the seals on door jambs, partings, and thresholds which are incomplete allowing air leakage. Recommendations include exterior and interior inspection, weather stripping and re-caulking around windows as needed. Recommendations for hollow doors include injecting them with polyurethane foam insulation.

Air Sealing

Based on the thermal imaging survey and visual observations, air leakage occurs through windows and entry doors. Although this is typical even for a modern building, simple measures can significantly reduce air leakage. Recommended measures for windows include: 1) adjusting jamb seals on operating windows; 2) adding weather-stripping; 3) caulking interior frames and moldings; and, 4) locking/clasping windows to maintain a complete seal.

Air sealing of all door units can be improved with commercial weather-stripping. All door and window units should be regularly inspected (every 2 to 3 years) to ensure proper operation, identify faulty seals, and to identify any deteriorated caulking requiring replacement. Other air sealing recommendations include inspecting all exhaust and ventilation ducts to determine if they have a positive pressure actuated damper. Dampers are recommended on all exterior ducting to prevent passive air leakage.

Thermal Imaging Survey

The thermal imaging survey was conducted indoors on December 29th, 2011 and outdoors on the morning of January 20th, 2012. Outdoor ambient temperature was approximately 28°F during the indoor survey and 17°F during the outdoor survey. The survey was conducted using a FLIR© B-CAM infra-red (IR) camera. The building exterior and interior envelope and major mechanical and electrical equipment were surveyed with the IR camera. IR camera surveys not only identify heat transfer through building envelopes, they also identify trapped moisture, electrical system overloading, heat loss through ducting and piping, high energy lighting fixtures, and energy intensive plug load equipment. Appendix B presents the survey report.

The IR surveys revealed the following notable observations:

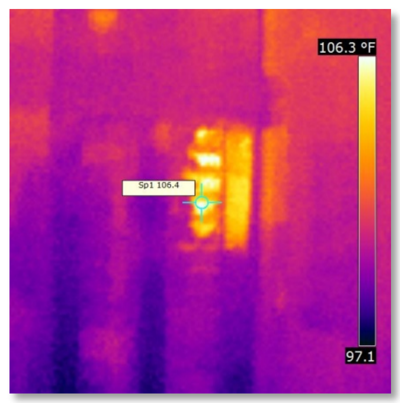


Figure 13: Possible Overloaded Electric Circuit

- The integrity and consistency of the thermal performance of the walls consistent with the construction methods. The highest thermal transfer occurs through exposed foundation walls.
- The vinyl sided addition walls performed better than the original brick clad sections.
- Poorly sealed windows and doors allow thermal transfer and air leakage.
- The glazed entry door units reveal substantial thermal transfer through the frames.
- A door was found slightly propped open on the north side of the building.
- Energy intensive electrical equipment such as copiers and vending machines operate at high temperatures.
- Energy intensive motors produce a high amount of thermal energy.
- Lights in the gymnasium operate at very high temperatures.
- Circuit temperatures on some electrical panels are elevated indicating they may be overloaded (Figure 13).
- A significant amount of thermal transfer occurs at the intersection of the shop class ceiling and wall.
- Insulation around hot water pipes throughout the building is insufficient resulting in thermal loss to unconditioned and semi-conditioned spaces.

Electrical Systems

Supply & Distribution

Three phase grid electricity is supplied to HBMS to the main electrical room by an underground service and a large pad mounted transformer. Several sub-distribution electrical rooms with panels and transformers are located throughout the building. Three-phase grid power is supplied to the building by PSNH via overhead transmission lines.

Figure 14: High-Efficiency Transformer (Powersmiths®)

Some electrical panels were easily accessible and clear of stored items. Storage rooms such as S6 and T10 stored items in front of the panels, limiting access to them. Old and outdated transformers are inefficient and lose a significant amount of energy in the form of heat. This excess heat is typically removed from the building with exhaust fans further increasing electric consumption. Replacing old transformers with modern, energy efficient units (Figure 14) typically provides a simple payback of less than seven (7) years.

Lighting Systems

As presented in Table 13, there are four (4) different lighting fixtures and lamp types at the HBMS facility. Lighting fixtures in the building consist mainly of recessed mounted high performance T8 fluorescent fixtures. CFL fixtures are located in the administrative area, rooms G4 and G5 and the gymnasium stage with 17-watt bulbs. Higher wattage fixtures (65W) are located on the building exterior and 320W fixtures are located in the second floor gymnasium and music room. Metal halide fixtures are mounted on the exterior poles. LED bulbs are located in exit signs.

Table 13: Lighting Fixture Schedule

Fixture Lamp Type	Location(s)	Control	No. Lamps	Watts	Qty.	Total Watts
T8	Throughout	Switch	1-4	32	896	59,200
CFL	Admin, Exterior, Music Rm., Gym, G4, G5	Switch	1,2,8	17, 42, 65	120	15,782
Metal Halide	Exterior	Photocell	1	400	7	1,050
LED	Exit signs	Always on	1	5	69	345
				Totals:	*1,092*	*76,377*

Table 14 presents the energy consumption by lighting fixture type. Lighting fixtures account for an estimated 142,471 kWh of electricity per year. The high performance T8 fluorescent fixtures are the main source of lighting and account for 73% of all lighting energy consumption annually at an estimated 103,897 kWh/yr. CFL fixtures account for 23% of lighting consumption at 32,230 kWh/yr and they are the main source of lighting for the second floor gymnasium, music room, exterior, and some other inside the building. The 320 watt fixtures are very high wattage fixtures which could be replaced with high performance T8 or T5 fixtures which would use significantly less energy. Exterior metal halide fixtures consume an estimated 3,331 kWh/yr representing 2% of lighting consumption. LED fixtures in exit signs use 3,014 kWh/yr or 2% of lighting consumption.

Table 14: Lighting Fixture Energy Consumption

Fixture Lamp Type	Location(s)	Est. Usage (KWH/yr)	% of Total
T8	Throughout	103,897	73%
CFL	Admin, Exterior, Music Rm., Gym, G4, G5	32,230	23%
Metal Halide	Exterior	3,331	2%
LED	Exit signs	3,014	2%
	Totals:	*142,471*	*100%*

Lighting density measurements in HBMS building were obtained to establish if building illumination is consistent with the *Illuminating Engineer Society of North America* (IESNA) standards for the prescribed use. These measurements were obtained during normal operating conditions on December 20th, 2011 between the hours of 1115 and 1403. Table 15 presents the lighting density measurements obtained in units of foot-candles (FCs).

Large yard lights are rented from PSNH. It may be beneficial to replace these units with LED fixtures and connect them to the building meter.

IESNA Standards

Lighting densities were recorded at fifty-five (55) representative locations. Forty-nine (49) of the measurements exceed IESNA recommended standards. Common areas such as hallways, vestibules and the cafeteria greatly exceed recommended standards. These areas are occupied only briefly between class periods and remain illuminated while the building is occupied. Recommended lighting densities in these areas are also much lower than classroom space. Most classroom spaces exceeded recommended standards as well with natural sunlight increasing these measurements. For example, Classroom 17 and Teacher Room T3 (both on the east side of the building) had their lights off and natural lighting exceeded recommended standards. As part of the lighting upgrade project in 2011 these lights were designed to be over-lit with the intention of reducing densities over the life of the bulb. This will ensure proper lighting densities are always met, however is not the most efficient way of lighting.

Figure 15: High Wattage CFL Fixtures in Multi-Purpose Room

Methods to reduce lighting densities include reducing the quantity of fixtures, replacing them with lower-wattage fixtures, and installing lower wattage bulbs in the existing fixtures. Other methods to reduce lighting density include replacing overhead lighting with task lighting, adding multiple control zones, adding daylight controls and adding dimming controls. Newer technology fixtures provide higher lighting density per watt than the existing older fixtures and provide improved lighting quality. Motion controllers are installed in many of the first floor classrooms. The lighting density data is included in Appendix C.

Table 15: Illumination Densities

Location	Lighting Density (FC)	Recommended Density (FC) [1]
Main Corridor NS	39	5-10
Main Corridor EW	48	5-10
Second Floor Corridor NS	38	5-10
Middle stairwell West	49	5-10
Main Corridor NS	47	5-10
Stairwell First Floor EW	42	5-10
Corridor 1st fl NS (Rooms 4-7)	36	5-10
Corridor 1st fl EW(Rooms 8-11)	36	5-10
Corridor 1st fl NS (Rooms 12 - S1)	33	5-10
Library Corridor	37	5-10
Entrance Vestibule	35	5-10
North Corridor NS	37	5-10
North Corridor EW	36	5-10
Classroom 102	34	30
Classroom T5	32	30
Classroom 110	37	30
Gymnasium	44	70
Classroom 112	38	30
Multi-purpose room	17	30
Classroom T16	42	30
Classroom 205	53	30
Classroom 206	43	30
Classroom 209	41	30
Classroom 212	58	30
Classroom 213	50	30
Classroom 214	39	30
Library 205	47	30
Computer Lab 7	51	30
Classroom 11	72	30
Classroom T3	32	30
Classroom 14	60	30
Classroom 17	59	30
120 Guidance Office	39	30
Classroom 121	51	30
Classroom 123	39	30
130 Nurse Office	46	30
Classroom 131	66	30
Classroom 143	31	30
Main Lobby	37	10
Classroom 141	80	30
Classroom 109	45	30
Classroom 103	36	30
Classroom 201	57	30
Music Room 202	14	50
Classroom 208	39	30
Classroom 211	54	30
Classroom 12	48	30
Classroom 9	58	30
Kitchen	55	30
Classroom 5	45	30
Classroom 220	26	30
Classroom 106 (shop)	20	30
Classroom 108	26	30

Plug Loads

Plug loads for the HBMS facility were determined based on equipment nameplate information. The operating time for each item is based on observations, occupant loading, schedule, and typical use for the equipment. Plug loads are categorized as either appliances or electronics and office equipment. Appendix F presents an inventory of all plug load equipment.

Figure 16: Old Refrigerator in Storage Room

Based on this analysis, the total annual plug load is 75,200 kWh/yr. This accounts for 19% of annual consumption for the HBMS. Appliances account for approximately 59% of plug load consumption while office equipment, computers and electronics account for 41%. High appliance loads are attributable to eleven (11) water fountains with condensers, three (3) vending machines, two (2) energy intensive milk chests, and six (6) dated refrigerators (Figure 16). The office equipment, computer and miscellaneous electronic loads are within the expected range however controls to limit operation will reduce energy consumption. The 160 desktop computers and monitors in addition to the high number of printers and copiers attribute to the high load. Office equipment were observed to remain on when the building is unoccupied consuming a considerable amount of electricity even if they are in a low powered state (sleep mode). Placing equipment such as copiers and computers on time scheduled controllers to automatically cut power when the building is unoccupied would ensure energy is not lost through operating equipment.

Table 16: Plug Load Energy Consumption

Category	Location(s)	Est. Usage (kWh/year)	% of Total
Appliances	Throughout	44,608	59%
Office Equipment, Computers, Electronics	Throughout	30,592	41%
	Subtotals	*75,200*	*100%*

Motors

Electrical motors are used for the elevator, air handling unit (AHU) fans, walk-in freezers condensers, unit ventilators, air condition condensing units, exhaust fans and the well pump. Replacement of failed motors with premium efficiency NEMA rated motors is recommended. Variable frequency drives (VFDs) are also recommended for replacement AHU motors.

Emergency Power Systems

There are no emergency power systems at the HBMS.

Plumbing Systems

Domestic Water Supply

Domestic water supply for the HBMS is provided by the Rocky Pond Pump House located to the north. The main water line passes through the middle school, leaves the school and runs northeasterly to an underground vault at the northeast corner of the middle school lot. Water demand includes lavatory, locker rooms (showers, toilets, sinks), and kitchen usage. Demand is expected to be moderate.

Domestic Water Pump Systems

There is one (1) booster pump to increase domestic water pressure for the building.

Domestic Water Treatment Systems

Domestic water is treated at the Rocky Pond Pump House to reduce the pH level by injecting soda ash and for corrosion inhibition by injection of orthophosphate.

Domestic Hot Water Systems

Domestic hot water is provided by two (2) systems. During the heating season the two boilers fired boilers provide domestic hot water by an indirect fired system. When the large boilers are not running there is a 50 gallon, oil fired hot water heat (Figure 17). These two systems are interconnected with valves but function independently. It is recommended that the oil fired hot water tank heater be replaced with a more efficient tankless unit.

Figure 17: Domestic Hot Water Heater

Hydronic Systems

Space conditioning is provided by hot water coils and fin-tube baseboard connected to a hydronic loop. Water is circulated by four (4) 5-horsepower circulation pumps located in the two boiler rooms. Pumps and distribution piping were observed to be in fair condition however some piping insulation can be improved.

Mechanical Systems

Figure 18: Hot Water Boiler

Heating Systems

Heat is provided by two (2) HB Smith® 28A-S/W-08 oil-fired boilers (Figure 18). The rated efficiency of these units when new is 81% and the de-rated efficiency is estimated at less than 78%. Low boiler combustion efficiencies result in a substantial amount of heat loss, reduced system inefficiency, and CO_2 emissions. The two units have rated outputs of 1,709 MBH each which appear to supply a sufficient amount of heat to the building. The unit which is used for DHW has a rated output of 764 MBH.

Cabinet and unit heaters are located throughout the building as forms of heating distribution.

Table 17: Heating Supply Systems

Heating Unit	Unit Description	Area(s) Served	Output (MBH)	Age (yrs.)	AFUE (new)	Control Type
Boiler No. 1	HB Smith®	Throughout	1,709	18	81%	DDC
Boiler No. 2	HB Smith®	Throughout	1,709	18	81%	DDC

Cooling Systems

Cooling is provided throughout the building by rooftop units and condensers. There are three (3) McQuay® 8-ton rooftop air conditioning (AC) units and four (4) Carrier® 4-ton split AC units (Figure 19). Based on the annual electrical energy consumption curve, the AC units operate more frequently during summer school break than expected. Condensers are charged with R-22 refrigerant. It is noted that the use of refrigerant R-22 is no longer permitted (per USEPA) based on its high ozone depletion potential. The Seasonal Energy Efficiency Ratio (SEER) of these units is not available however based on age and condition the estimated de-rated SEER less than 10.

Figure 19: Split AC Unit No. 5

Operating efficiency tends to decrease with system age. As cooling condensing units fail, they should be replaced with the highest rated equipment available. All exterior condensers piping insulation should be rated for outdoor exposure. As prescribed by the 2009 IECC, the current minimum SEER for smaller cooling systems is 13 and larger units are rated at a minimum SEER of 11.2. Modern cooling systems can achieve SEERs up to 24. As example, replacing a unit with a SEER rating of 8 with a new unit rated at 16 would reduce energy consumption by 50% and provide an equivalent cooling capacity.

Pumps

There are four (4) circulation pumps for hydronic heating. Each hydronic loop has with two 5-horsepower pumps to circulate heated water. There are also two 2-horsepower pumps which are used for DHW circulation. It is recommended that when the motors on these pumps need to be replaced that premium rated NEMA motors with VFD controllers be installed.

Controls Systems

The heating and cooling systems are tied into a direct digital controls (DDC) system. Thermostats are located within classrooms to give occupants some control of their heating and cooling zone. Temperatures were measured in thirty-seven (37) representative locations and exceeded recommended temperatures in all 37 locations. It is recommended heating setpoints be between 67°F and 70°F and recommended cooling setpoint temperatures between 73°F and 76°F

Refrigeration

Walk-in commercial refrigerator and freezer units are located in the kitchen with rooftop mounted condensers (Figure 20). These units consume a significant amount of energy annually. Recommendations include replacing failed condensers with high efficiency units. Other recommendations include installing eCube® food temperature sensing thermostat controls. By measuring constant food temperature instead of more variable air temperatures, eCube® controllers significantly reduce the frequency of condenser operation (www.getecube.com).

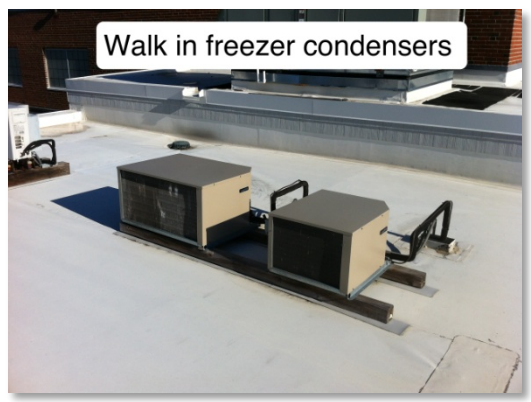


Figure 20: Walk-in Freezer Condensers

Mechanical Equipment Energy Consumption

The electrical energy consumption for mechanical equipment was determined according to nameplate information and building function and occupancy schedules. Table 18 presents a summary of the mechanical equipment and annual energy usage. Appendix E presents the detailed inventory and the associated energy consumption for each piece of mechanical equipment. Total mechanical consumption per year is estimated to be 168,384 kWh per year compared to 142,471 kWh for light fixture loads and 75,200 kWh for lighting.

Table 18: Mechanical Equipment Energy Consumption

Equipment Type	Qty.	Item Manufacturer(s)	Consumption (kWh/yr)	% of Total
Air Handling Unit	6	Trane®, Carrier®	69,139	41%
Hydronic Pump	4	NA	25,032	15%
Energy Recovery Ventilators	2	Boss Aire®	25,000	15%
Exhaust Fans	15	Greenheck®, Penn®	17,765	11%
Walk-in Freezer & Refrigerator	2	Heatcraft®	11,680	7%
Split A/C Units (8-tons)	3	McQuay®	11,131	7%
DHW Pump	2	NA	5,006	3%
Split A/C Units (4-tons)	4	Carrier®	3,630	1%
		Total:	*168,384*	*100%*

The six (6) rooftop air handling units (AHUs) are estimated to consume the highest amount of energy. These units operate throughout the year to provide mechanical exchange air ventilation. The predicted annual consumption for the AHUs is 69,139 kWh/yr which accounts for 41% of total electric consumption of mechanical equipment. The energy recovery ventilators (ERVs) service the two story portion of the building.

Ventilation Systems

Exhaust Ventilation Systems

Exhaust fan units provide several functions including humidity control, odor control, venting of VOC containing materials (e.g., cleaning solvents), chemical gas venting in laboratories, and venting of cooking fumes. Operation frequency and schedules for the fans units should be consistent with the use type and intensity of the vented space. For example, lavatories may be demand ventilated (interlocked with light switch) or they may operate continuously at a low rate during occupied periods. Spaces equipped with exhaust fans are commonly over-ventilated resulting in increased energy consumption. All exhaust controls and rates should be consistent with ASHRAE Standard 62.1. Fan ducting should have pressure actuated dampers to restrict air flow and heat loss when the units are not operating.

Spaces with exhaust ventilation systems in the HBMS include lavatories, the kitchen, and the gymnasium. These units are estimated to consume 29,388 kWh/yr of electricity.

Exchange Air Ventilation Systems

Figure 21: Rooftop Unit 2 Ventilation

Exchange air ventilation systems exhaust interior air with elevated CO_2 concentrations and humidity and replace it with fresh outdoor air. Ventilation rates and system capacity should be designed consistent with the minimum prescribed code standards (ASHRAE 62.1). Systems should be demand (CO_2) controlled with energy recovery capacity (ASHRAE 90.1).

Exchange air ventilation in the HBMS building is provided by six (6) air handling units (AHUs) located on the roof. CO_2 concentrations in the HBMS building revealed that the building is not sufficiently ventilated in many areas. Replacement AHUs should be commercial rated units with economizers, energy recovery units, and demand controllers to optimize system efficiency.

Energy Recovery Ventilation Systems

The HBMS has two (2) Bossaire® energy recovery ventilation (ERV) units on the roof serving the modern addition. These units use exhaust air to pre-condition intake air thereby reducing the energy required to condition the incoming air. It is recommended that all new AHU units have energy recovery units, or ERVs.

Figure 22: Energy Recovery Unit 1

Indoor Air Quality

Indoor air quality (IAQ) is established based upon temperature (°F), relative humidity (%), and carbon dioxide (CO_2) measured in parts per million (ppm). This data provides the best representation of building ventilation performance and occupant comfort. They are also indicative of conditions that are detrimental to building systems including moisture intrusion and the potential for fungi growth (mold and mildew) and related damage of building materials.

Recommended temperatures vary based on the season, occupant activity, and relative humidity levels. Generally, recommended setpoint heating temperatures in northern New England range between 67°F and 70°F and recommended cooling setpoint temperatures range between 73°F and 76°F. Relative humidity (RH) levels fluctuate consistent with seasonal atmospheric conditions. A range between 30% and 65% is recommended (ASHRAE). While there are no known adverse health effects related to elevated CO_2 concentrations, it can cause acute illness including headaches, drowsiness, lethargy, and nausea. For this reason, the U.S. Environmental Protection Agency (EPA) has established a recommended threshold concentration of 1,000 ppm.

The IAQ in the HBMS was measured on December 22nd, 2011 between the hours of 0828 and 1033. The building was normally occupied when the measurements were obtained. Fifty-three (53) IAQ measurements were obtained at representative locations throughout the building. Appendix C presents all of the measurements. Results of the IAQ measurements are summarized as follows:

- Temperatures in the building ranged from 70.5°F in the west stairwell and first floor hallway to 75.5°F in Classroom 211. The average recorded temperature was 72.8°F.
- Relative humidity measurements ranged from 27.3% in the occupied Classroom 220 to 44.3% in occupied Classroom 206. The average relative humidity was 35.0%.
- CO_2 concentrations ranged from 534 ppm in the unoccupied Teachers Room T16 to 2,209 ppm in occupied Classroom 206 with an average of 1,194 ppm.

Table 19: Summary of IAQ Data

IAQ Metric	Low	High	Avg.	Range of Variance	Recommended
Temperature (°F)	70.5	75.5	72.8	5.0	67 – 70
Relative Humidity (%)	27.3	44.3	35.0	14.0	30 – 65
Carbon Dioxide (ppm)	534	2,209	1,194	1,675	<1.000

Measured temperatures throughout the building were relatively high for a K-12 facility with a moderate range of variance of 5.0°F. All temperatures exceeded the recommended setpoints which increases energy consumption and wear on mechanical equipment. Relative humidity varied widely throughout the building with a 14% range of variance and overall higher relative humidity levels. CO_2 concentrations varied widely with thirty-eight (38) of the fifty-three recordings above the EPA recommended threshold indicating under ventilation. The high range of variance for humidity and CO_2 indicates that exchange air ventilation varies dramatically between the original building section and the modern addition. Figure 23 below graphically depicts the relationships between temperature, relative humidity and CO_2 concentrations.

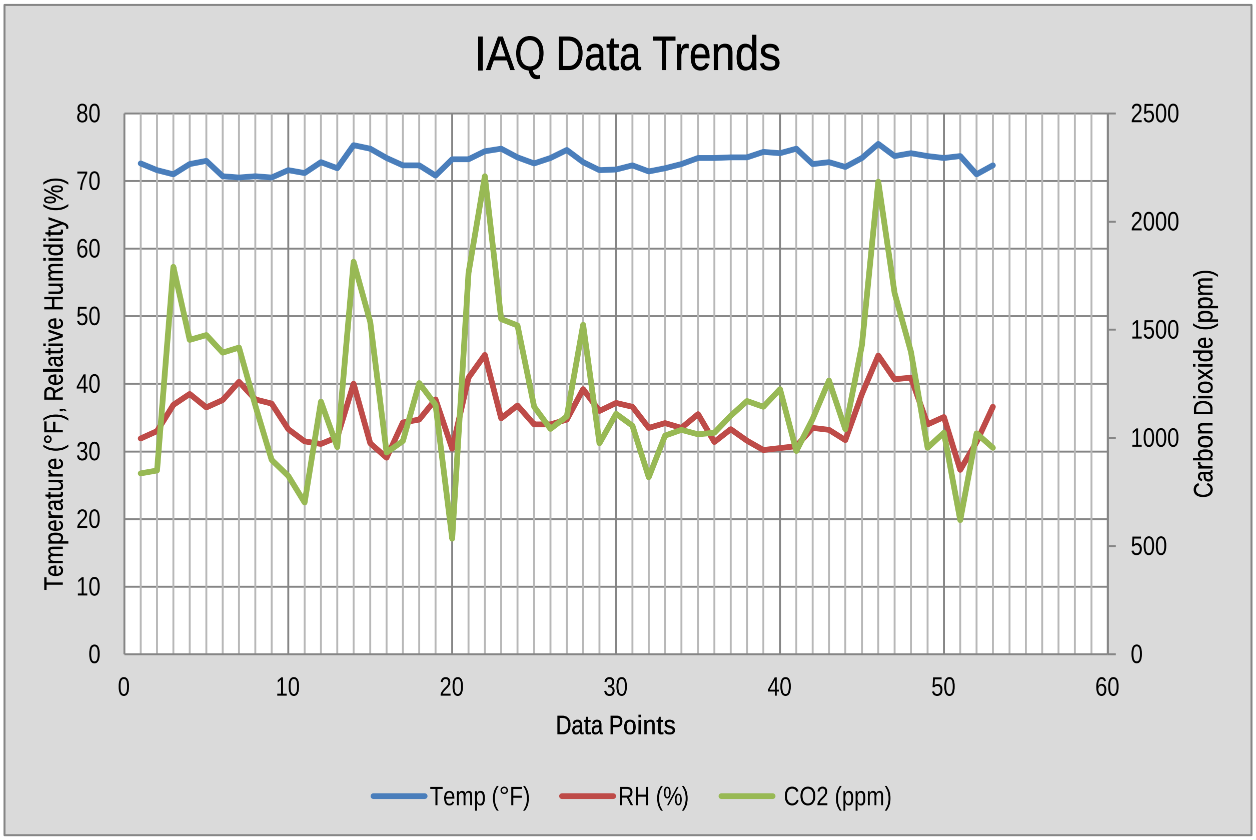


Figure 23: Indoor Air Quality Data Trends

Secondary Observations

Observations noted herein are not directly related to the objective of the energy audit. Investigation of these items is beyond the defined scope of services and these observations are not intended to be inclusive of all building issues and code infractions. They are provided as anecdotal information for the Town's consideration and may warrant further investigation.

Structural Systems

There were no structural system issues noted within the HBMS facility.

Roofing Systems

There were no roofing system issues observed at the HBMS

Building Code

Building code issues include a lack of accessibility to some electrical panels in closets throughout the school. Additionally, electrical distribution panels in corridors were not locked and blank covers were missing. It is recommended that a licensed electrician inspect all distribution/circuit panels in the original section of the building and repair or replace them consistent with current code standards.

The disconnect switch for the gymnasium air handling unit is located on the ceiling mounted unit and is not accessible without a 30 foot ladder. Electrical code requires that disconnect switches be accessible to de-energize equipment in the event of fire.

Life Safety Code

No life safety codes were observed during the field audit. The building contains a wet sprinkler system.

ADA Accessibility

The HBMS facility appears to substantially comply with current ADA standards.

Hazardous Building Materials

Based on the year of original construction and renovations it is assumed no hazardous building materials are on site.

E. BUILDING ENERGY MODELING

Source Data

Required source data input for the eQUEST© model includes geographical location, building use type(s), occupancy schedules, building dimensions, envelope systems, fenestration systems, lighting systems, and all mechanical systems (heating, cooling, ventilation domestic hot water). The building characteristics and systems data was obtained during the building site review. Energy usage was provided by the Town for grid electricity and heating oil.

Model Calibration

The quality of the output data is a function of the accuracy of the input data. While eQUEST© is a sophisticated computer simulation program, like any program there are limitations resulting from unusual building characteristics and operating variables that cannot be discretely defined in the program. To ensure that the model simulates the building operation with high accuracy, an iterative model calibration process is completed where actual building energy usage data is checked against the model output values. This process is repeated until the deviation between the energy usage derived from the baseline building simulation and the actual energy consumption is within an acceptable range.

Summary of Model Results

The HBMS facility was modeled using eQUEST© computer simulation program to calibrate a baseline for each energy use category. Developing an accurate baseline model of the building presented certain challenges including accounting for the high electrical usage and the high heating fuel usage.

The resulting baseline for the model output is provided in Appendix I. Tables 20 and 21 present a summary of the model predicted annual energy usage by category for electrical and heating fuel. The actual electrical consumption of 377,000 kWh/yr is slightly lower than the model prediction of 389,890 kWh/yr.

Table 20: Model Predicted Baseline Electrical Usage

Electric Category	Annual Usage (kWh x 1,000)
Space Cooling	11.5
Refrigeration	11.7
Vent. Fans	112.4
Pumps & Aux.	29.8
Exterior Lighting	5.7
Plug Loads	78.2
Area Lights	140.6
Total Predicted:	**390**
Total Actual:	**377**

Actual heating fuel consumption (2,430.1 MBtu) is slightly higher than the model predicted value (2,272.2 MBtu) based on available data through January 2012.

Table 21: Model Predicted Heating Fuel Usage

Electric Category	Annual Usage (MBtu)
Space Heating	2,234.7
Hot Water	37.5
Total Predicted:	**2,272**
Total Actual:	**2,430**

The energy modeling results are depicted graphically by a monthly bar graph (Figure 24) which breaks down the energy consumption for electricity and gas consumption separately by category. For example, overall electrical consumption is estimated to be lowest in July because school is not in session. "Pumps & Aux." are estimated to operate between October and April for heating purposes. Space heating is estimated to consume over 98% of the gas with the hot water accounting for the remaining gas usage.

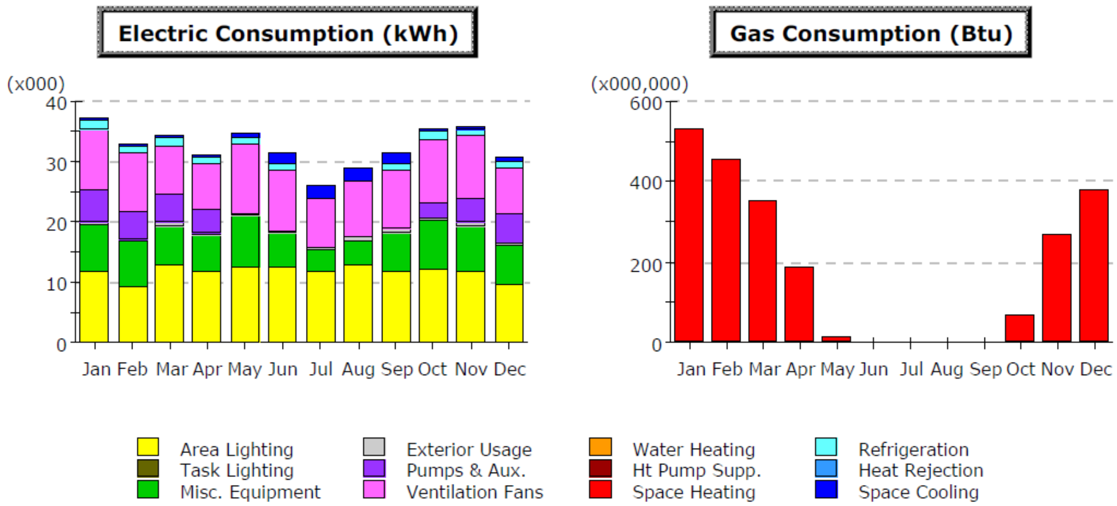


Figure 24: Predicted Monthly Energy Use by Category (Baseline)

F. FACILITY BENCHMARKING

ENERGY STAR for Commercial Buildings

The HBMS was benchmarked using the EPA's ENERGY STAR® Portfolio Manager for Commercial Buildings. This benchmarking program accounts for building characteristics, regional climatic data, and user function. It then ranks a building within its defined category amongst all other buildings entered in the program to date. The defining metric is the building Energy Use Intensity (EUI). If a building scores at or above the 75th percentile within its category then it becomes eligible for ENERGY STAR® certification pending an on-site validation review by a licensed Professional Engineer. Currently the program does not have categories for every commercial building type but they can still be entered into the program and checked against similar buildings to determine where the building ranks compared to the current national average. The average energy intensity for every building type category is constantly changing and theoretically is it reducing as more efficient buildings are constructed and existing buildings implement energy efficiency measures. Therefore, buildings that currently meet the eligibility requirements may not be eligible next year when they apply for annual re-certification.

The Hollis Brookline Middle School is defined as a "K-12 School" use building. Utility data for electric and heating fuel for the preceding twelve (12) months was input into the benchmarking program. Table 22 presents the annual energy use (through January 2012) and Table 23 presents a summary of the Statement of Energy Performance (SEP) benchmarking results. The SEP is presented in Appendix G.

Table 22: Annual Energy Consumption

Energy	Site Usage (kBtu)
Electric – Grid	1,286,324
Propane	2,426,
Total Energy:	3,713,214

Table 23: SEP Benchmarking Summary

Location	Site EUI (kBtu/ft²/yr)	Source EUI (kBtu/ft²/yr)
Hollis Brookline Middle School	39	70
National Median (K-12 School)	76	139
	% Difference:	-49%
	Portfolio Manager Score:	96

Compared to the K-12 school buildings that have entered data into Portfolio Manager to date, the HBMS facility energy use is considerably lower than the national average. The source EUI for the HBMS building is 70 kBtu/ft²/yr while the national average is 139 kBtu/ft²/yr, meaning it uses 49% less energy than the average K-12 school. The HBMS is earns a high score of 96 (out of 100) exceeding the 75th percentile for ENERGY STAR® eligibility. However, because ventilation systems in the original building do not comply with ASHRAE Standard 62.1, the HBMS is not eligible for ENERGY STAR® certification until the corrective measures are implemented. Adding ventilation is expected to increase energy consumption due to an increased electrical load due to new equipment and increase exhaustion of conditioned air resulting in an increase in energy use to produce conditioned air. The Portfolio Manager score is therefore expected to drop some but still remain above the 75th percentile threshold for ENERGY STAR® eligibility.

Regional Benchmarking

Regional benchmarking provides a valuable comparison of local facilities that are similar in use, function, and size. Two data groups were used to complete independent benchmark comparisons for:

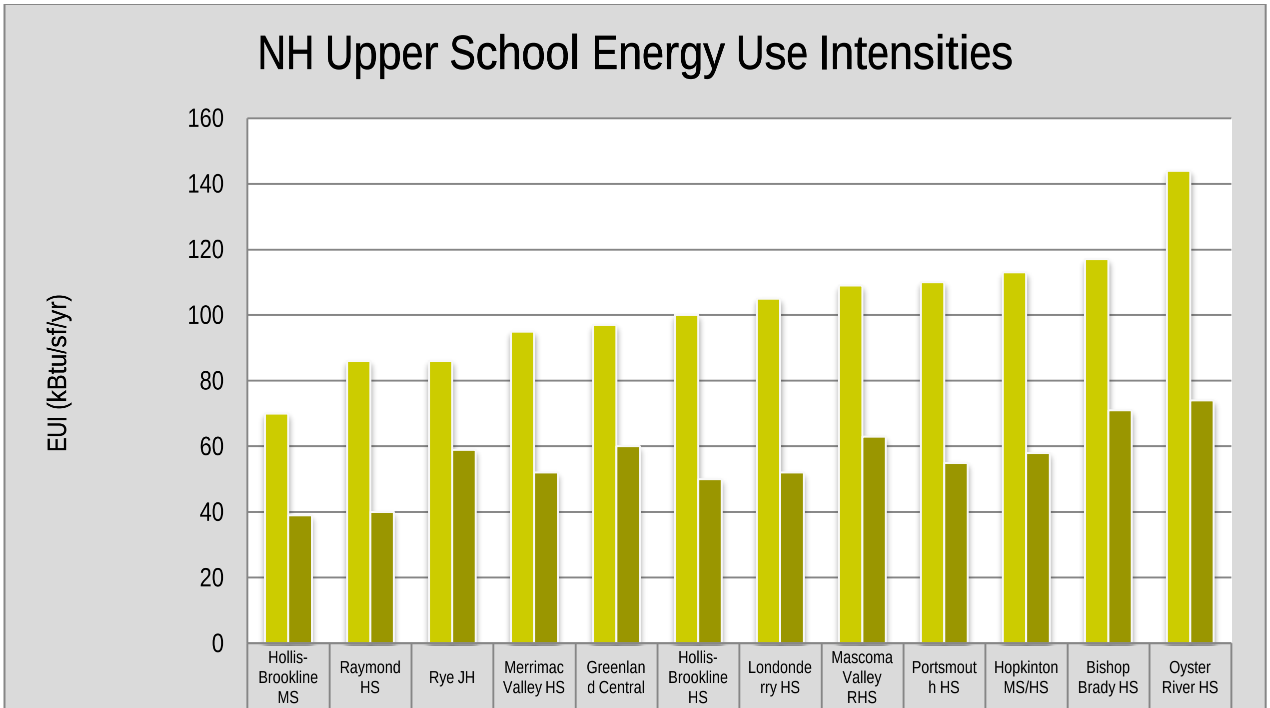
1. Regional School Full Time Enrollment Densities.
2. ENERGY STAR® Energy Use Intensities (source and site).

As an initial comparison, the densities of school area per student (SF/FTE) of eleven (11) schools were compared to the HBMS. The selected schools provide a fair representation of regional junior and senior high school facilities located in the southern New Hampshire region. The selected schools and characteristics are presented in Table 24.

Table 24: Regional School FTE Densities

School	Location	Area (SF)	FTE	Density (SF/FTE)
Bishop Brady High School	Concord, NH	76,332	369	207
Greenland Central School	Greenland, NH	91,226	354	258
Hollis-Brookline High School	Hollis, NH	153,429	904	170
Hollis-Brookline Middle School	Hollis, NH	96,025	437	220
Hopkinton Middle/High School	Hopkinton, NH	74,589	329	227
Londonderry High School	Londonderry, NH	235,520	1,796	131
Mascoma Valley High School	Canaan, NH	57,740	439	132
Merrimack Valley High School	Penacook, NH	141,000	887	159
Oyster River High School	Durham, NH	198,000	675	293
Portsmouth High School	Portsmouth, NH	353,659	1,091	324
Raymond High School	Raymond, NH	106,000	444	239
Rye Junior High School	Rye, NH	67,891	216	314
			Average:	223

Figure 26 presents the source and site Energy Use Intensities (EUIs) for the twelve schools. EUIs are measured in units of energy per area or kBtu per square foot (kBtu/SF). Source EUIs consider all of the energy required to develop the energy and distribute the energy to the site location including inefficiency losses such as electrical distribution grids. Site energy is the energy consumed at the point of service or meter. At 100 kBtu/SF/yr, HBMS has the lowest source EUI of all twelve schools. The site EUI is also lowest for all schools compared and is measured at 39 kBtu/SF/yr.



	Hollis-Brookline MS	Raymond HS	Rye JH	Merrimac Valley HS	Greenland Central	Hollis-Brookline HS	Londonderry HS	Mascoma Valley RHS	Portsmouth HS	Hopkinton MS/HS	Bishop Brady HS	Oyster River HS
Source EUI (kBtu/sf/yr)	70	86	86	95	97	100	105	109	110	113	117	144
Site EUI (kBtu/sf/yr)	39	40	59	52	60	50	52	63	55	58	71	74

Figure 25: NH Upper School Energy Use Intensities

G. RECOMMENDATIONS

Energy Conservation Measures

Based on the observations and measurements of the HBMS, several energy conservation measures (EEMs) are proposed for consideration (Tables 24 to 26). These recommendations are grouped into three tiers based on the cost and effort required to implement the EEM. EEMs are ranked within each tier based on the capital cost for implementation versus the net estimated energy cost savings.

Tier I EEMs are measures that can be quickly implemented with little effort for no or little cost. They include routine maintenance items that can often be completed by facility maintenance personnel and changes in occupant behavior or building operation. Tier II items generally require contracted tradesmen to complete but can generally be implemented at low cost and within operating building maintenance budgets. EEMs that require large capital expenditure and budgetary planning (one year or greater) are categorized as Tier III measures.

Simple payback is calculated for the proposed EEMs. The cost to implement the measure is estimated based on current industry labor and equipment costs and the annual cost savings represents the reduced costs for energy savings. The net energy and cost savings for smaller EEMs is based on the estimated reduction of the associated energy consumption as defined in the model and equipment inventory. Using these costs, the payback period is then calculated as the number of years at which the capital cost of implementation equals the accumulated energy cost savings. Other qualitative considerations that do not influence the Simple Payback Method calculation but should be considered by the owner during the decision-making process include:

- Occupant comfort.
- Relative operation and maintenance requirements.
- Remaining useful life of equipment and systems to be replaced.

Energy cost savings are based current cost of electricity at $0.14 per kWh (PSNH) and the current price of oil of $4.05 per gallon. (NHOEP March 12, 2012)

Tier I Energy Efficiency Measures

Tier I EEMs are measures that can be quickly implemented with little effort for zero or little cost (Table 24). They include routine maintenance items that can often be completed by facility maintenance personnel, and changes to occupant behavior or building operation. Ten (10) Tier I EEMs are recommended.

Recommended Tier I EEMs include reducing the plug load by several simple zero or low-cost measures including: powering down electronics while not in use; consolidating the energy intensive laser jet printers and copiers; disconnecting the eleven (11) water fountain condensers; and removing the vending machines or replacing them with ENERGY STAR® rated models; installing time clocks on photocopiers; and consolidating the compact and full sized refrigerators with four (4) ENERGY STAR® rated units.

Walk-in refrigerators and freezer units are controlled by a thermostat that measures air temperature so when the door is opened and room temperature air enters the unit, the compressor is engaged. Thermostat controllers that replicate food temperature (such as eCube®) reduce operating frequency and ensure that food remains at the desired temperature.

Table 25: Tier I Energy Efficiency Measures

EEM No.	EEM Description	Capital Cost	Annual Cost Savings	Payback (yrs.)	SIR
T1-1	Power down electric devices when not in use. Consolidate printers and old computer equipment and remove from the building.	$0	$900	0	-
T1-2	Disconnect eleven (11) water fountain condensers.	$0	$880	0	-
T1-3	Remove vending machine from faculty room or replace with an ENERGY STAR® rated unit.	$0	$230	0	-
T1-4	Seal and insulate roof access hatch in Classroom 101.	$100	$240	0.4	72.0
T1-5	Install smart-strip time programmable controllers on photocopiers (2).	$120	$165	0.7	13.8
T1-6	Install eCube® thermostat controllers in walk-in refrigerator and freezer.	$800	$510	1.6	7.7
T1-7	Consolidate four (4) compact refrigerators and six (6) standard size refrigerator with four (4) standard sized ENERGY STAR® rated units.	$2,400	$1,104	2.2	6.9
T1-8	Install low-flow aerators (0.7 GPM) on all lavatory sinks.	$300	$130	2.3	5.2
T1-9	Install additional interior lighting controllers to reduce lighting density and runtime (photosensors, dimming controls, motion sensors, timers).	$3,800	$912	4.2	4.8
T1-10	Complete air-sealing on all entry door jambs, partings, headers, thresholds, and moldings (interior and exterior). Seal all envelope penetrations and gaps.	$2,600	$790	3.3	2.1

Mechanical equipment loads and heat loss can be made more efficient by sealing the roof access hatch and sealing around all entry doors. Lighting energy consumption can be reduced by installing additional lighting controls to adjust to the lighting demand of the setting. Simple air sealing and weather-stripping of doors, windows, and envelope penetrations will provide substantial energy savings. Compact refrigerators cost over $100 a year to run each while full sized refrigerators can cost over $200 a year depending on their age.

If the school prefers to keep a vending machine at the facility, it is recommended the current unit be replaced with an Energy Star qualified machine. Since machines are typically rented from a supplier, the school would have to specifically request an Energy Star rated machine. Energy Star qualified machines typically use half the energy a standard unit uses and are typically provided by the supplier at no additional cost depending on the contract between the supplier and the department.

Tier II Energy Efficiency Measures

Tier II items generally require contracted tradesmen to complete but can be implemented at low cost and within operating building maintenance budgets. Two (2) recommended Tier II EEMs are presented in Table 25.

Table 26: Tier II Energy Efficiency Measures

EEM No.	EEM Description	Capital Cost	Annual Cost Savings	Payback (yrs.)	SIR
T2-1	Replace exterior MH wallpack lighting fixtures with LED units (7).	$12,972	$1,540	8.4	2.1
T2-2	Replace existing oil-fired hot water heater with an electric condensing tank unit.	$3,950	$410	9.6	1.8
T2-3	Install four (6) de-stratification fans in the multi-purpose room and six (6) in the gymnasium.	$5,400	$960	5.6	1.7
T2-4	Install CO_2 demand controls on exchange air ventilation systems.	$15,640	$1,400	11.2	1.3
T2-5	Replace walk-in freezer & refrigerator condenser units with high efficiency units (EER>14).	$7,084	$440	16.1	1.1

The metal halide (MH) exterior wallpack lighting fixtures operate a substantial number of hours annually. Replacing these with LED units will reduce energy consumption and the lamp life is much longer than MH lamps. The oil-fired DHW heater is relatively inefficient and replacing this with an electric condensing DHW heater would reduce energy consumption by recovering radiating heat from the boiler units in the mechanical room. De-stratification fans in the high ceiling areas would recirculate hot air that has risen thereby reducing the amount of conditioned air to produce. Installing CO_2 demand controls would optimize exchange air ventilation systems in the addition spaces. The walk-in freezers are equipped with older condensing units which consume a high amount of energy. It is recommended to replace these with high efficiency units (EER>14).

Tier III Energy Efficiency Measures

EEMs that require large capital expenditure and budgetary planning (one year or greater) are categorized as Tier III measures. Three (3) Tier III EEMs are provided in Table 26 for the HBMS facility.

Table 27: Tier III Energy Efficiency Measures

EEM No.	EEM Description	Capital Cost	Annual Cost Savings	Payback (yrs.)	SIR
T3-1	Replace all electrical transformers older than 15 years with high efficiency units.	$36,260	$3,600	10.1	2.0
T3-2	Install pressure actuated dampers on all exhaust fans. Place units on occupancy sensors to limit run time.	$30,412	$2,100	14.5	1.7
T3-3	Replace one boiler with closed-loop geothermal ground-source heat pump system. Interlock second boiler to supplement the GSHP during peak heating demand periods.	$339,250	$19,649	17.3	1.4
T3-4	Retro-commission the 2005 HVAC systems including balancing of heating distribution and supply and return air systems.	$20,010	$1,900	10.5	1.1
T3-5	Replace the existing boiler units with high efficiency (89%) modulating oil-fired boilers, stack heat recovery unit, and VFD pump controllers.	$281,980	$10,220	27.6	1.0

(1) Tier III EEM investment costs include fees for design & engineering, construction management, and a 15% cost contingency.

Electrical transformers loose efficiency with age and result in increased heat load to mechanical spaces. Modern high-efficiency units can reduce metered consumption by as much as 10%. There are significant number of rooftop exhaust ventilation fans on the north section of the original building. Pressure actuated dampers would limit passive air transfer (note that these units should be removed when modern exchange air ventilation systems are added to the building).

Replacing one of the two low efficiency boilers with a closed-loop geothermal ground-source heat pump system would reduce the carbon footprint of the building by switching from fossil fuel to a renewable energy source. Leaving one of the boilers in place would provide a hybrid system to accommodate peak heating loads. The other heating system option is to replace the units with modulating high-efficiency boilers with stack heat recovery and VFD pump controllers.

The energy cost savings and resulting payback are based upon each independent measure implemented for the building in its current condition and function. There are interdependencies among measures that will affect the net realized energy savings. For example, replacing lighting fixtures with lower energy units reduces heat load to the building thereby requiring more heating fuel to compensate for the loss in heat from the inefficient light fixtures. Also, many of the larger capital Tier III EEM projects may include some of the smaller dependent Tier I and II EEMs.

Capital costs are provided for budgetary planning only. They are estimated based on current industry pricing for materials and labor. A detailed cost estimate should be developed prior to appropriating capital funds for the more costly measures.

EEMs Considered but not Recommended

The following measures were identified as part of the building evaluation but are not recommended as best-value EEMs. Considerations include the cost feasibility and payback term and occupant comfort concerns.

1. A lighting retrofit project was recently completed (2011) and replacing the modern fixtures with higher efficiency units is not cost practical at this time.
2. Replacing the CFL lighting fixtures in the gymnasium and music room with super T5 and T8 fixtures (respectively) would reduce energy consumption and dramatically improve lighting quality. However, the SIR for these measures is less than 1.0.
3. The thermal integrity of the original building envelope is low. However, significantly improving the envelope is costly and yields a long payback term. Additional roof insulation is recommended as sections of the roof systems are replaced. Minimum recommended insulation for the roofs is R-38.

O&M Considerations

O&M and considerations are provided for existing systems and for proposed EEMs. They are intended to provide best-value practices for the building manager and to identify any O&M requirements for the proposed EEMs.

1. A new warranted heating boiler will reduce maintenance and repair costs and replacement parts are readily available.
2. A new warranted domestic hot water heating unit will reduce maintenance and repair costs and replacement parts are more readily available.
3. Lamps in LED wallpack fixtures have a significantly longer service life that metal halide lamps. This reduces O&M costs (labor and material).

Indoor Air Quality Measures

Based upon the measured indoor air quality in the Hollis Brookline Middle School, 38 of 53 areas were above the EPA CO_2 recommended threshold of 1,000 ppm. CO_2 concentrations ranged between 534 and 2209, with a building average of 1,194 ppm. The high range indicates ventilation is not consistent and the original sections are under-ventilated. Modern exchange air ventilation systems complying with current mechanical code requirements (ASHRAE 62.1) are recommended.

Renewable Energy Considerations

While renewable energy systems generally require a higher capital investment, they provide a significant reduction in the consumption of non-renewable fossil fuel energies. Other obvious benefits include a reduction in ozone depleting gas emissions (as measured by CO_2 equivalency), otherwise referred to as the “carbon footprint”. Renewable energy systems also reduce the reliance upon fossil fuels derived from foreign nations and mitigate pricing fluctuations in a volatile and unpredictable market.

Evaluating the practicality of a renewable energy system for a specific facility should consider several facility specific variables including:

- Geographical location.
- Building orientation.

- Adjacent and abutting land features.
- Site footprint and open space.
- Building systems configuration and condition.
- Local zoning or permitting restrictions.
- Currently available financial resources (grants, utility provider rebates, tax incentives).

Table 27 provides a summary description of the more common and proven renewable energy technologies. The Table also provides a preliminary feasibility assessment for implementing each technology at the HBMS facility. Additionally, each renewable energy technology is scored and graded based on technology and facility specific characteristics. Appendix H presents the criteria used to develop the score and grade for each renewable energy technology. A more rigorous engineering evaluation should be completed if the Town is considering implementing any renewable energy system.

Table 28: Renewable Energy Considerations

Renewable Energy System	System Description & Site Feasibility
Geothermal Heating & Cooling	System Description: Geothermal heating systems utilize solar energy residing in the upper crust of the earth. Cooling is provided by transferring heat from the building to the ground. There are a variety of heating/cooling transfer systems but the most common consists of a deep well and piping loop network. All systems include a compressor and pumps which require electrical energy. Geothermal systems are a proven and accepted technology in the New England region. Site constraints and building HVAC characteristics determine the practicality.
Score: 86%	*Site Feasibility:* *Considering the existing hydronic heating equipment is compatible with a ground-source water heat pump system, it is a practical technology for the building. There appears to be ample land available for the system to be installed.*
Roof-Mounted Solar Photovoltaic Systems	System Description: Photovoltaic (PV) systems are composed of solar energy collector panels that are electrically connected to DC/AC inverter(s). The inverter(s) then distributes the AC current to the building electrical distribution system. Surplus energy is sent into the utility grid via net metering and reimbursed by the utility at a discounted rate. The capital investment cost for PV systems is high but the technology is becoming increasingly more efficient thereby lowering initial costs.
Score: 81%	*Site Feasibility:* *There is an ample amount of roof space which could accommodate a large-sized (30kW-75kW) system. This would require a design and permitting process with the local utility for a grid-tie connection. Current utility incentives and renewable energy grants would help offset the capital cost for the system. A structural evaluation of the roof framing system would be required to ensure that it could accommodate the increased loading. The existing electrical systems may require upgrade especially if the PV system is interconnected to the grid.*
Biomass Heating Systems	System Description: Biomass heating systems include wood chip fueled furnaces and wood pellet fueled furnaces. For several reasons, wood chip systems are generally practical only in large scale applications. Wood pellet systems can be practical in any size. Wood chip systems are maintenance intensive based on the market availability and procurement of woodchip feedstock and variability of woodchip characteristics (specie, size, moisture content, bark content, Btu value) which affect the operating efficiency of the furnace and heating output. They require a constant feed via a hopper and conveyor system and feed rates must vary according to feedstock Btu value and heating demand. For these reasons they typically require full-time maintenance and are practical only in large scale applications. Wood pellet systems are much less maintenance intensive and feedstock availability and consistency is less of an issue. Both systems reduce the dependency on fossil-fuels and feedstock can be harvested locally.
Score: 80%	*Site Feasibility:* *A conventional pellet boiler unit may not be a practical heating system for the building however a large sized system may be; this requires additional effort for procurement of pellets, storing pellets, periodic filling the pellet hopper during the heating season, and emptying the ash. However, there are new systems with automated feed and ash removal systems that would be a practical application at the HBMS.*

Ground-Mounted Solar Photovoltaic Systems	System Description: A ground-mounted PV system is composed of the same solar collector panels used for a roof-mount system. The collectors are mounted on a frame support system on the ground verses a roof structure. This is advantageous when roof framing cannot accommodate the increased load of the collector panel and the ease of installation and access for maintenance and repair.
Score: 79%	*Site Feasibility:* *There is an ample amount of grounds open at the HBMS where a medium- (10kW-30kW) to large- (30kW-75kW) sized system could be installed. This would require a design and permitting process with the local utility for a grid-tie connection. Current utility incentives and renewable energy grants would help offset the capital cost for the system.*
Wind Turbine Generator	System Description: Wind turbine generators (WTGs) simply convert wind energy into electrical energy via a turbine unit. WTGs may be pole mounted or rooftop mounted however system efficiency improves with increased elevation. Due to cost and site related constraints, WTG technology in New England is only practical for select sites. Constraints include local geographical and manmade features that alter wind direction, turbulence, or velocity. Other technology constraints include local variability of wind patterns and velocity. Additionally, WTGs require permitting (local, state, FAA) and local zoning that may restrict systems due to height limitations, and/or, visual detraction of the local landscape. Presently, WTG technology is not widely used in New England based on the relatively high capital cost compared to the energy savings.
Score: 78%	*Site Feasibility:* *There is adequate site space to install a small (<5kW) to medium-sized pole-mounted wind turbine. However, considering the relatively low mean wind speeds in the region, a WTG unit may not be a cost practical consideration. This would require additional study.*
Solar Domestic Hot Water	System Description: Solar domestic hot water (DHW) systems include a solar energy collector system which transfers the thermal energy to domestic water thereby heating the water. These are typically used in conjunction with an existing conventional DHW system as a supplemental water heating source. Because of the high capital cost, solar DHW systems are only feasible for facilities that have a relatively high demand for DHW.
Score: 76%	*Site Feasibility:* *Based on the moderate demand for domestic hot water, a solar hot-water system may be a practical consideration for the building. The capital cost could be offset with substantial utility rebates and incentives. The system could provide primary DHW during summer months when demand is low. In colder months, it would provide secondary heating.*
Solar Thermal Systems	System Description: Similar to a roof-mounted solar PV system, solar thermal systems are most commonly installed on rooftops. These systems utilize solar energy for heating of outdoor air. The most common application is for pre-heating of outdoor air used for air exchanges systems in buildings. This reduces the heating fuel required to maintain setpoint temperatures in interior spaces.
Score: 75%	*Site Feasibility:* *The building currently has an ample amount of space for a PV system to be installed and the solar-thermal could utilize the existing air handling units. A more focused evaluation is required to determine if this is a cost practical solution.*
Combined Heat & Power (CHP)	System Description: Combined heat and power (CHP) systems are reliant on non-renewable energies. Systems are composed of a fossil-fuel powered combustion engine and electrical generator. Electrical current is distributed to the building distribution system to reduce reliance on grid supplied electricity. Byproduct thermal energy derived from the combustion engine is recovered and used to heat the building (this is generally considered to be renewable energy). Another benefit of CHP systems is that they provide electrical energy during power outages in buildings that do not have emergency power backup. Larger CHP units require a substantially large fuel supply and if natural gas is not available then a LPG tank must be sited.
Score: 67%	*Site Feasibility:* *Considering the relatively small electric and heating demand for the HBMS, a CHP may not be cost practical. There is no natural gas within the Town and costs associated with the infrastructure development for a large propane tank would be high. CHP systems also require intensive maintenance and have a low expected service life.*

H. ENERGY EFFICIENCY INCENTIVE AND FUNDING OPPORTUNITIES

The State of New Hampshire along with the utility companies offer multiple programs designed to improve the energy efficiency of municipal and school buildings through financial incentives and technical support. Some of the currently available programs are presented herein however building managers are encouraged to explore all funding and incentive opportunities as some programs end and new programs are developed. For a current listing of advertised programs and initiatives, visit www.dsireusa.org.

Northeast Energy Efficiency Partnerships

Northeast Collaborative for High Performance Schools (NE-CHPS)

NE-CHPS is a set of building and design standards for all schools from pre-K through community colleges tailored specifically for NH state code requirements, the New England climate, and the environmental priorities of the region. NH Department of Education offers up to a 3% reimbursement for New Construction School projects. To learn more about NE-CHPS and incentive programs please visit: http://neep.org/public-policy/hpse/hpse-nechps .

New Hampshire Public Utilities Commission

New Hampshire Pay for Performance

This program addresses the energy efficiency improvement needs of the commercial and industrial sector. The Program is implemented through a network of qualified Program Partners. Incentives will be paid out on the following three payment schedule: Incentive # 1: Is based on the area of conditioned space in square feet. Incentive #2: Per kWh saved and Per MMBTU saved based on projected savings and paid at construction completion. Incentive #3: Per kWh saved and Per MMBTU saved based on actual energy savings performance one year post construction. Total performance incentives (#2 and #3) will be capped at $300,000 or 50% of project cost on a per project basis. For more information visit http://nhp4p.com.

New Hampshire Public Utilities Commission's Renewable Energy Rebates

The Sustainable Energy Division provides an incentive program for solar electric (photovoltaic or PV) arrays and solar thermal systems for domestic hot water, space and process heat, with a capacity of 100 kW or equivalent thermal output or less. The rebate for PV systems as follows: $1.00 per Watt, capped at 25% of the costs of the system or $50,000, whichever is less. For solar hot water (SHW) systems, the base rebate is $0.07 per rated or modeled kBtu/year, capped at 25% of the cost of the facility or $50,000, whichever is less, as a one-time incentive payment. http://www.puc.state.nh.us/Sustainable%20Energy/RenewableEnergyRebates-CI.html.

New Hampshire Community Development Finance Authority

New Hampshire Community Development Finance Authority Revolving Loan Fund

The Enterprise Energy Fund is a low-interest loan and grant program available to businesses and nonprofit organizations to help finance energy improvements and renewable energy projects in their buildings. The loans will range from $10,000 to $500,000. Larger amounts will be considered on a case by case basis. The program is available to finance improvements to the overall energy efficiency performance of buildings owned by businesses and nonprofits, thereby lowering their overall energy costs and the associated carbon emissions. More information about the program can be found on their website www.nhcdfa.org. These activities may include:

- Improvements to the building's envelope, including air sealing and insulation in the walls, attics and foundations;
- Improvements to HVAC equipment and air exchange;
- Installation of renewable energy systems;
- Improvements to lighting, equipment, and other electrical systems; and
- Conduction of comprehensive, fuel-blind energy audits.

Public Service of New Hampshire (PSNH)

Commercial (Electric) Energy Efficiency Incentive Programs

This program targets any commercial/industrial member building a new facility, undergoing a major renovation, or replacing failed (end-of-life) equipment. The program offers prescriptive and custom rebates for lighting and lighting controls, motors, VFDs, HV AC systems, chillers and custom projects. http://www.psnh.com/SaveEnergyMoney/For-Business/Energy-Saving-Programsand-Incentives.aspx

SmartSTART

The SmartSTART (Savings Through Affordable Retrofit Technologies) advantage is simple – pay nothing out of pocket to have energy efficiency products and services installed in your building. The Smart Start program is limited to PSNH's municipal customers only and includes schools. The program is available on a first-come, first served basis to projects which have been pre-qualified by PSNH. The cost of the improvements is fronted by PSNH which is then repaid over time by the municipality or school using the savings generated by the products themselves. This program is for lighting and lighting controls, air sealing, insulation and other verifiable energy savings measures which have sufficient kilowatt-hour savings. For more information on this program visit: http://www.psnh.com/SaveEnergyMoney/For-BusinesslMunicipal-Smart-Start-Program.aspx

Schools Program

For major renovation or equipment replacement projects, this program offers prescriptive and custom rebates for energy efficient lighting, motors, HVAC, chillers, and variable frequency drives to towns or cities that install energy efficient equipment at their schools. Financial incentives are available for qualifying energy efficient equipment. Technical assistance is also offered through the Schools Program. http://w.Ytw.psnh.com/SaveEnergy MoneyILarge-Power/Schools-Program.aspx

Clean Air - Cool Planet

Community Energy Efficiency

CA-CP works with communities throughout the Northeast to find solutions to climate change and build constituencies for effective climate policies and actions. Much of their work focuses on successful models for energy efficiency and renewable energy planning. They advise and partner with citizens, educators, faith groups, small businesses, municipal governments, and other local leaders. They explore cost-effective opportunities that exist for communities to reduce their emissions as well as their vulnerability to climate impacts. One such example is CA-CP's partnership with the University of New Hampshire, NH Sustainable Energy Association and UNH Cooperative Extension to create www.myenergypian.net . A groundbreaking suite of web and outreach tools for individual action used by households, schools and community groups around the northeast. http://www.cleanair-coolplanet.orglfor_communities/index.php .

Environmental Protection Agency (EPA)

ENERGY STAR Challenge for Schools

EPA is challenging school administrators and building managers to improve energy efficiency throughout their facilities. More than 500 school districts across the country are helping to fight climate change by committing to reducing their energy use with help from ENERGY STAR. Schools that take the ENERGY STAR Challenge can use energy tracking tools, technical guidance, case studies and other ENERGY STAR tools and resources to help them improve their energy efficiency. More information can be found at:
http://www.energystar.gov/index.cfm?c=challenge.bus_challenge

Cool School Challenge

The Cool School Challenge is a program of the Puget Sound Clean Air Agency, developed in collaboration with Redmond Middle School environmental science teacher Mike Town, and Puget Sound Energy's Powerful Choices for the Environment program.

Conceptually modeled after the U.S. Mayor's Climate Protection Agreement, the Cool School Challenge aims to motivate students, teachers, and school districts to reduce carbon dioxide and other greenhouse gas emissions schoolwide. At the heart of the Cool School Challenge is the philosophy that big changes start with small steps, and that taken together, simple individual actions create a world of difference.

The goals of the Cool School Challenge are to:

- Educate young people, and by proxy their families, about climate change and everyday actions they can take to reduce their impact locally and globally;
- Reduce carbon dioxide emissions and other greenhouse gas emissions in and around schools;
- Encourage student leadership and empowerment;
- Foster a community of teachers/students working together to reduce their greenhouse gas emissions; and
- Foster a new generation of environmental/air quality advocates.
- Learn more about the Cool School Challenge at: http://www.coolschoolchallenge.org/.

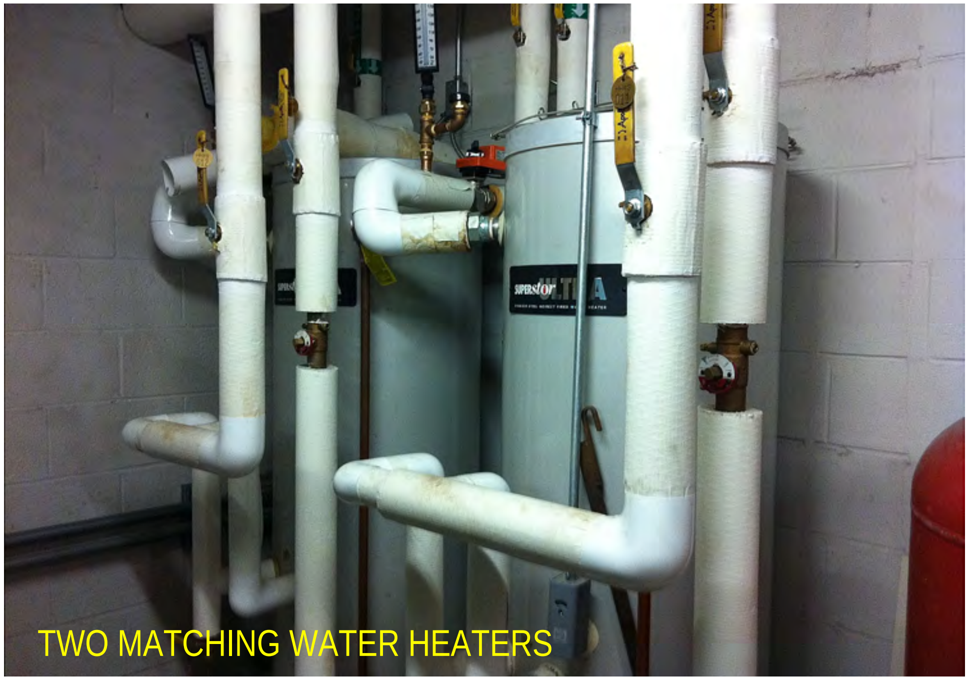
APPENDIX A

Photographs

GYMNASIUM SPACE

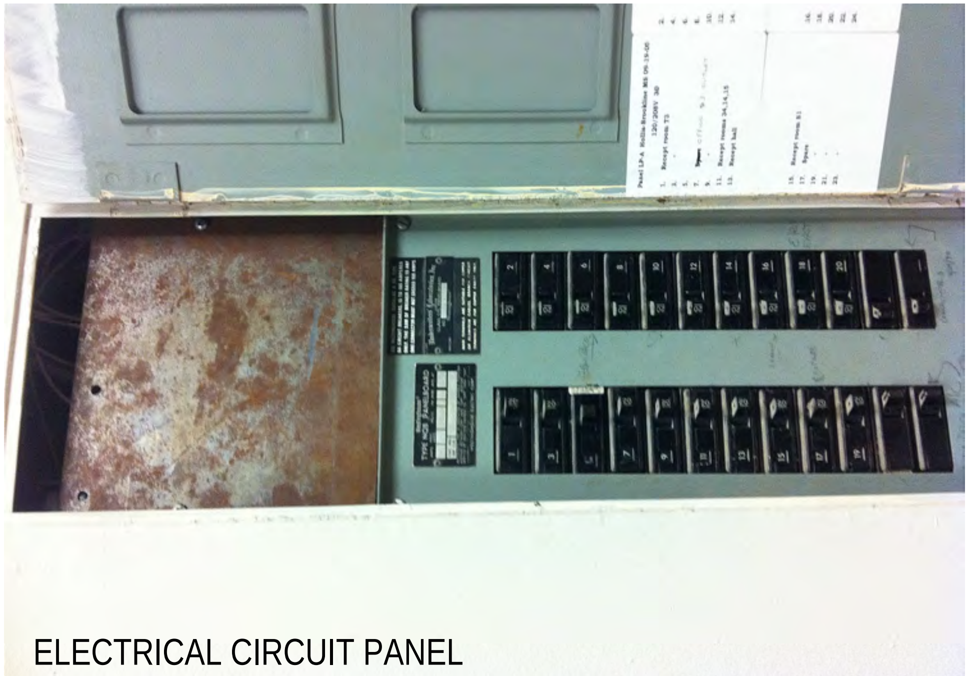
HOT WATER HEATER

OVERHEAD SKYLIGHT



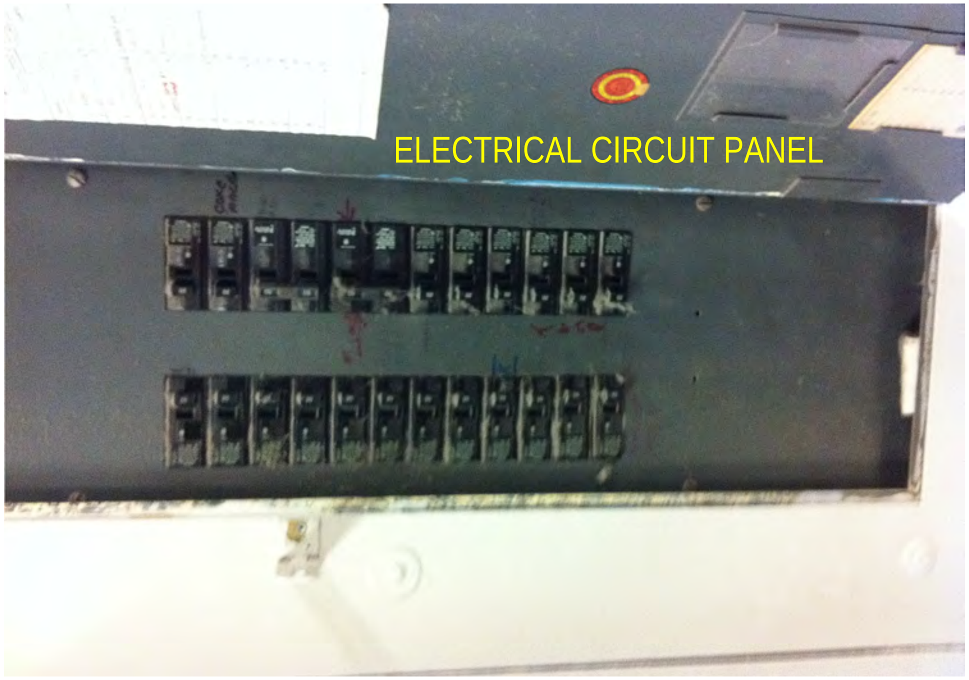
TWO MATCHING WATER HEATERS


MULTI-PURPOSE ROOM CEILING


ELECTRICAL CIRCUIT PANEL


MULTI-PURPOSE ROOM CEILING


LIBRARY SPACE


ELECTRICAL CIRCUIT PANEL


ELECTRICAL PANELS


MAIN HALLWAY AT NORTH END OF BUILDING


ON
OFF
ELECTRICAL PANEL

EXTERIOR WINDOW FRAME

SCIENCE ROOM SPACE AND OVERHEAD HEATER

LIGHT FIXTURE IN THE ART ROOM

EXTERIOR WINDOW


CONSTRUCTION SHOP SPACE

LIGHT SWITCH WITH "SAVE ENERGY" TAG


CONSTRUCTION SHOP CLASSROOM SPACE


YARD LIGHTING

DAYLIGHT SEEN THROUGH GYMNASIUM EXTERIOR DOOR. RECOMMEND AIR-SEALING.

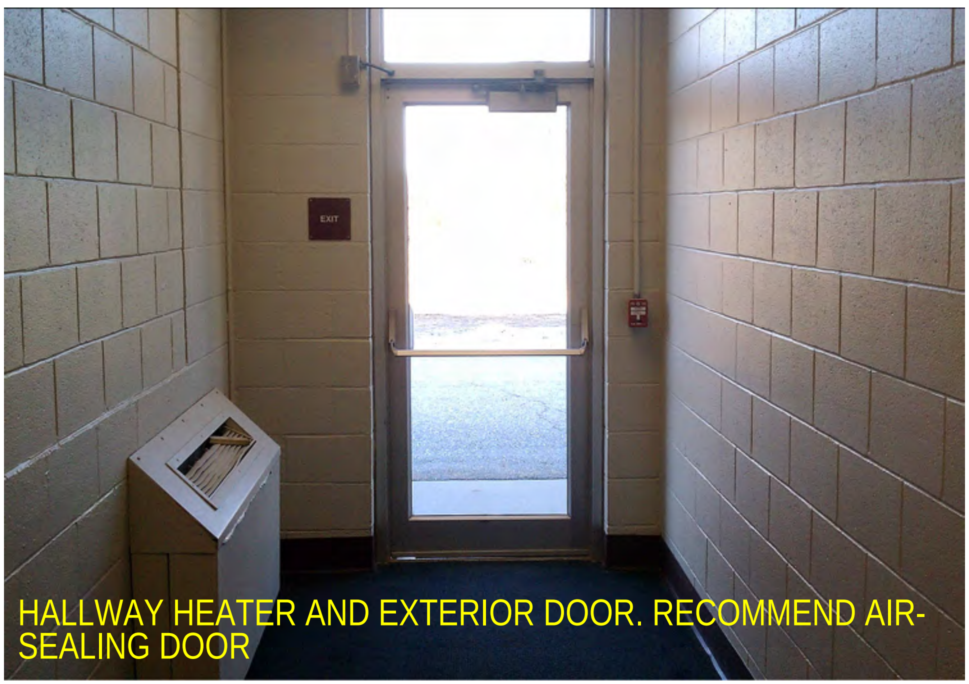
DAYLIGHT SEEN UNDERNEATH EXTERIOR DOOR. RECOMMEND AIR-SEALING.

DAYLIGHT SEEN THROUGH GYMNASIUM EXTERIOR DOOR. RECOMMEND AIR-SEALING.

EXTERIOR WINDOW

CABINET HEATER IN CONSTRUCTION CLASSROOM


UNIT HEATER IN CONSTRUCTION WORKROOM. RECOMMEND SEALING THROUGH WALL PENETRATIONS



HALLWAY HEATER AND EXTERIOR DOOR. RECOMMEND AIR-SEALING DOOR


CONSTRUCTION CLASSROOM WINDOW


CLASSROOM EXTERIOR DOOR. RECOMMEND AIR-SEALING.


INSIDE OF FULL SIZED REFRIGERATOR NEAR-EMPTY. RECOMMEND CONSOLIDATING ALL REFRIGERATORS.


CONSTRUCTION WORKROOM EXHAUST AND ROOF DECK REVEALED THERMAL TRANSFER UNDER IR. RECOMMEND AIR-SEALING.

REFRIGERATORS FOR TEACHERS AND SCIENCE ROOM

BLOCKED INTERIOR DOOR BETWEEN CLASSROOMS

ROOFTOP AND MECHANICAL EQUIPMENT

INSIDE OF REFRIGERATOR
OFF SCIENCE ROOM

TAG OF ROOM WITH BLOCKED DOOR


WHITE ROOF AND MECHANICAL EQUIPMENT


WHITE ROOF AND MECHANICAL EQUIPMENT

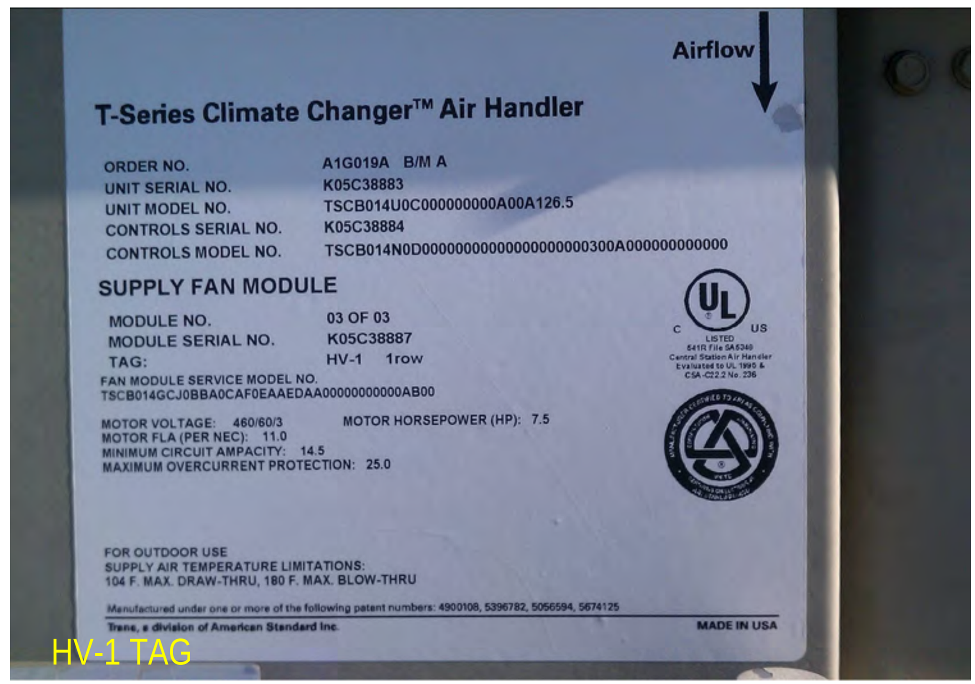

WHITE ROOF AND MECHANICAL EQUIPMENT


WHITE ROOF AND MECHANICAL EQUIPMENT

HV-1 ON THE ROOF

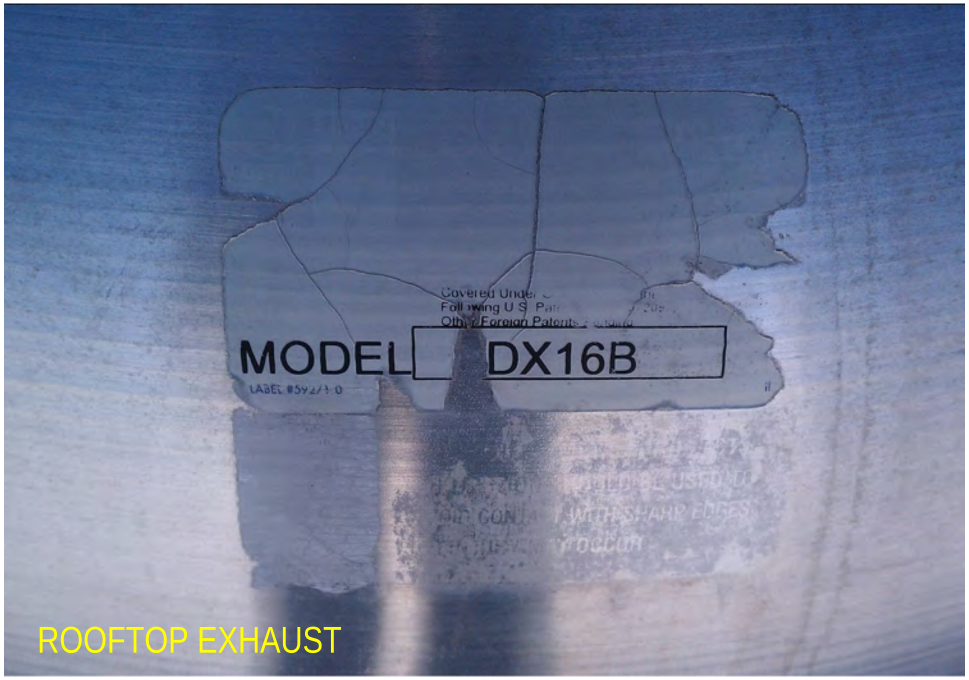
HV-1 IDENTIFICATION TAG

WHITE ROOF AND MECHANICAL EQUIPMENT



HV-1 TAG


WHITE ROOFTOP


MODEL
DX16B
ROOFTOP EXHAUST

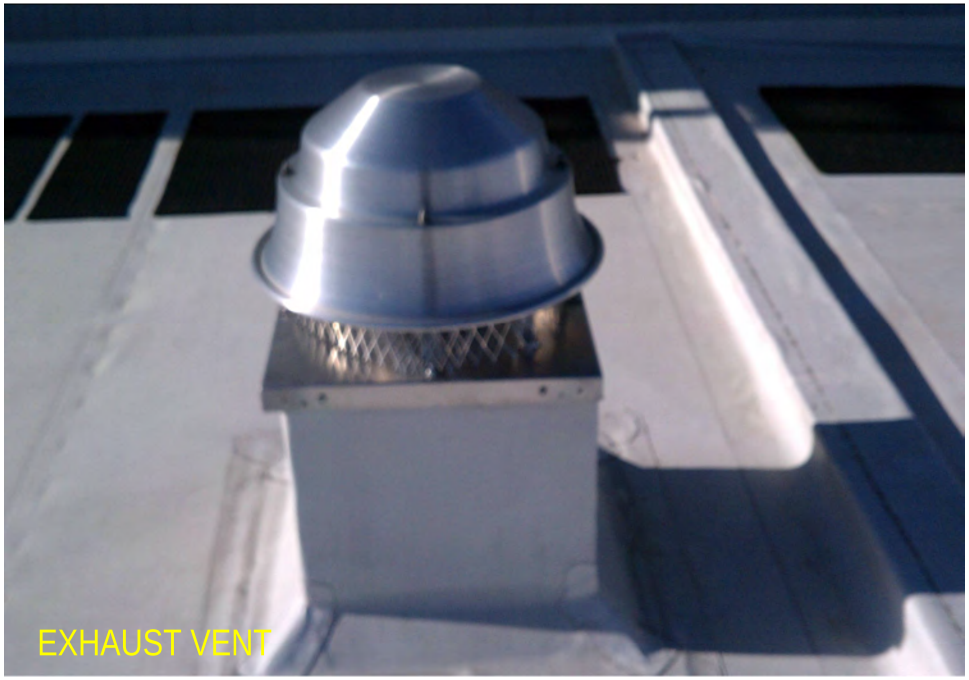

WHITE ROOFTOP


ROOFTOP EXHAUST

RTU-2 TAG

EXHAUST VENT TAG

RTU-2 MECHANICAL EQUIPMENT



EXHAUST VENT


ROOFTOP SPACE


ROOFTOP SPACE


ROOFTOP SPACE

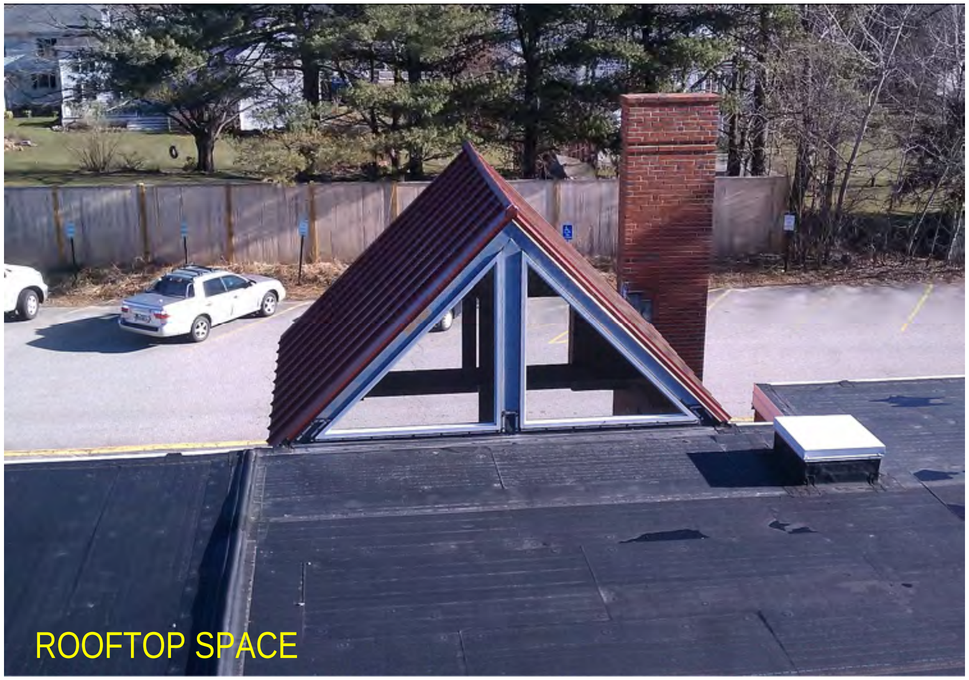

ROOFTOP SPACE


ICE ON ROOFTOP


ROOFTOP SPACE


ROOFTOP SPACE


ROOFTOP SPACE



ROOFTOP SPACE

ROOFTOP SPACE AND MECHANICAL EQUIPMENT

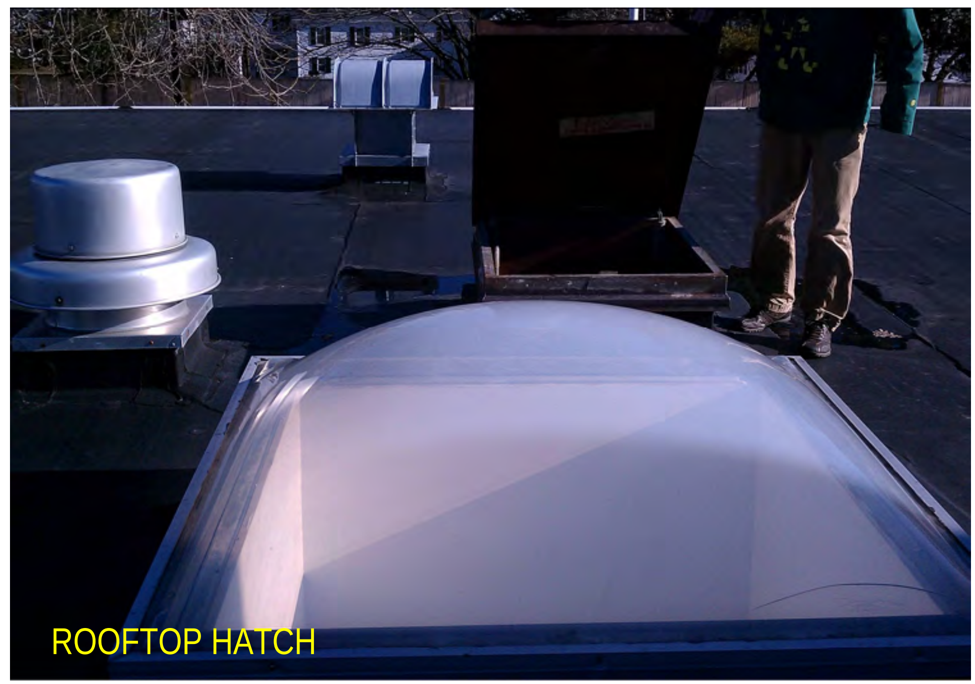
ROOFTOP SPACE AND MECHANICAL EQUIPMENT

ROOFTOP SPACE AND MECHANICAL EQUIPMENT

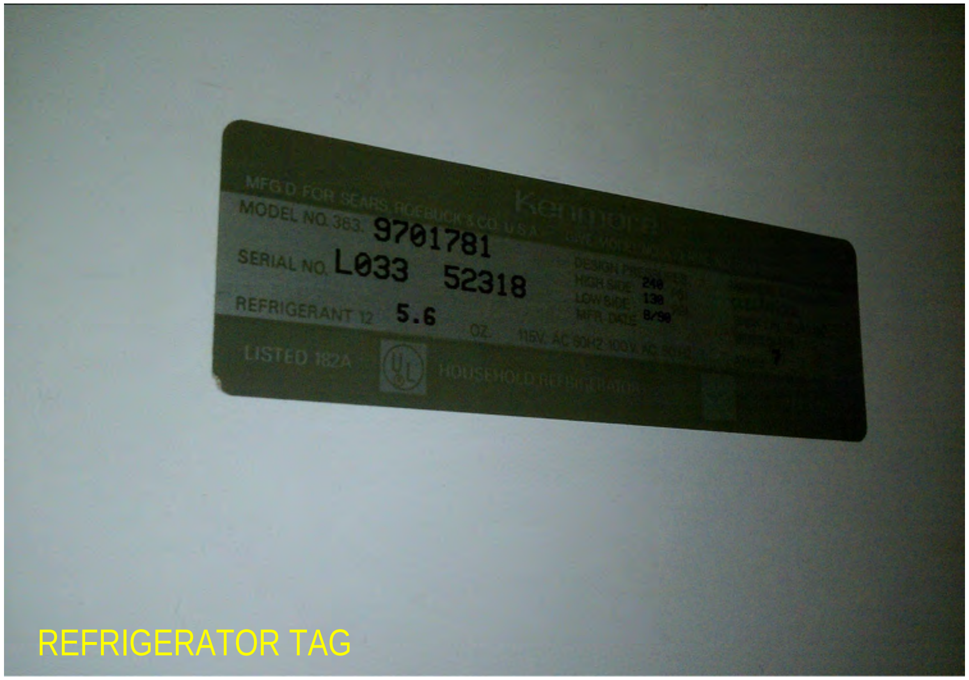
UNUSED HATCH WAS CLOSED BUT NOT SEALED. RECOMMEND SEALING HATCH TO REVENT THERMAL TRANSFER.

ACCESS TO ROOFTOP HATCH THROUGH CLASSROOM

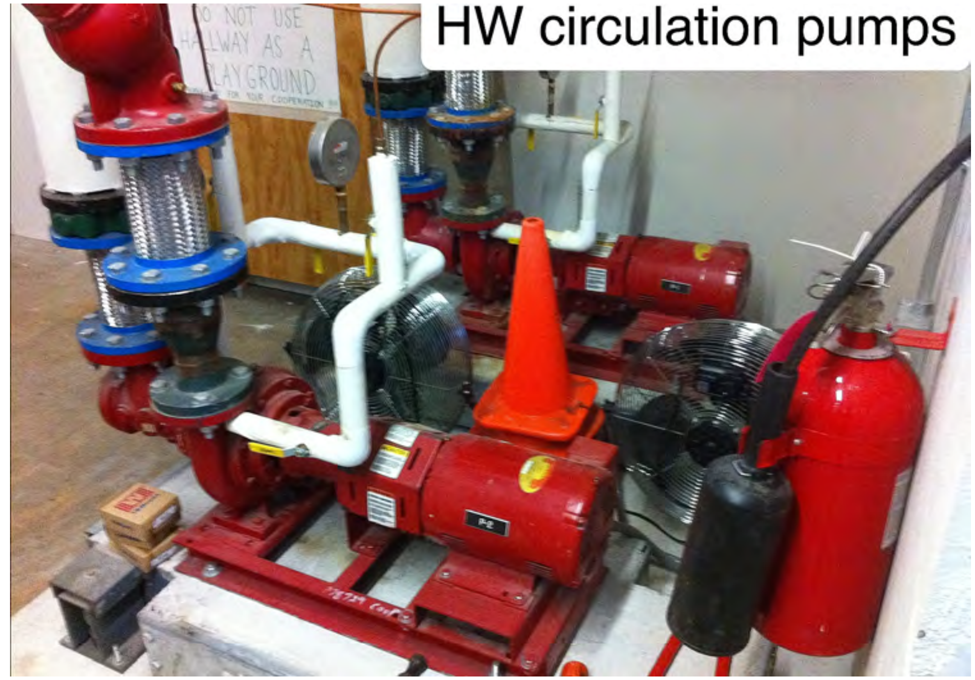
LOOKING DOWN UNUSED HATCH



ROOFTOP HATCH

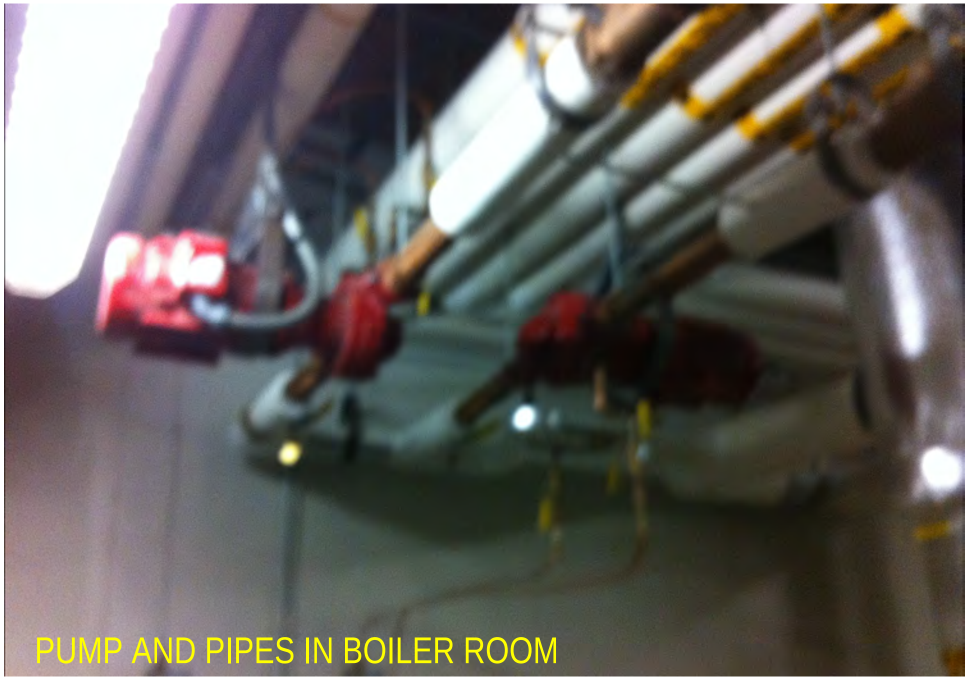


REFRIGERATOR TAG

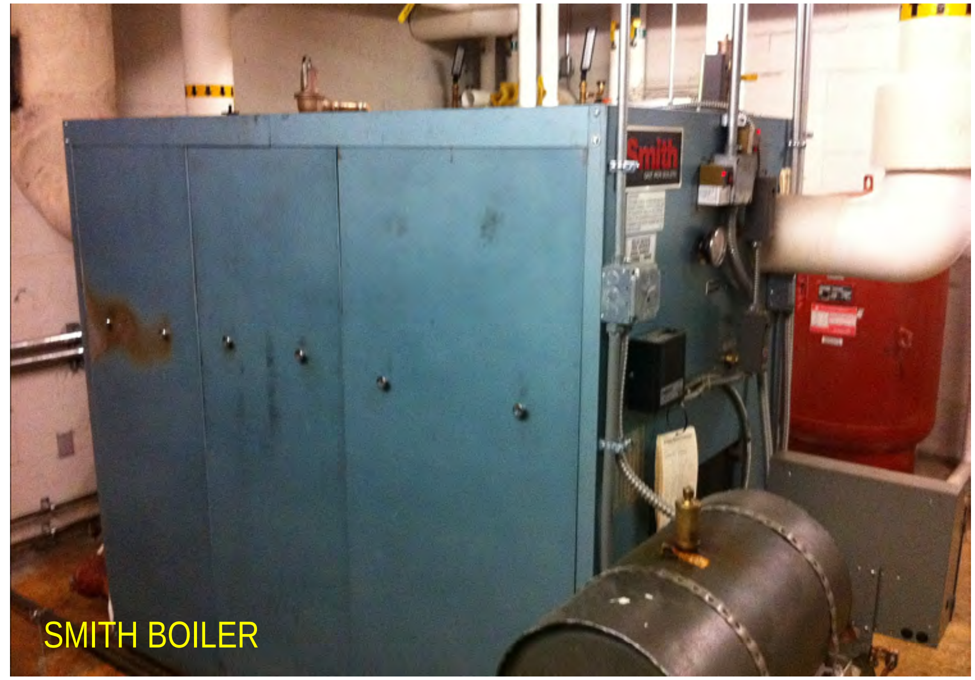

HW circulation pumps

ROOM WITH UNUSED ROOFTOP ACCESS

Pump controls

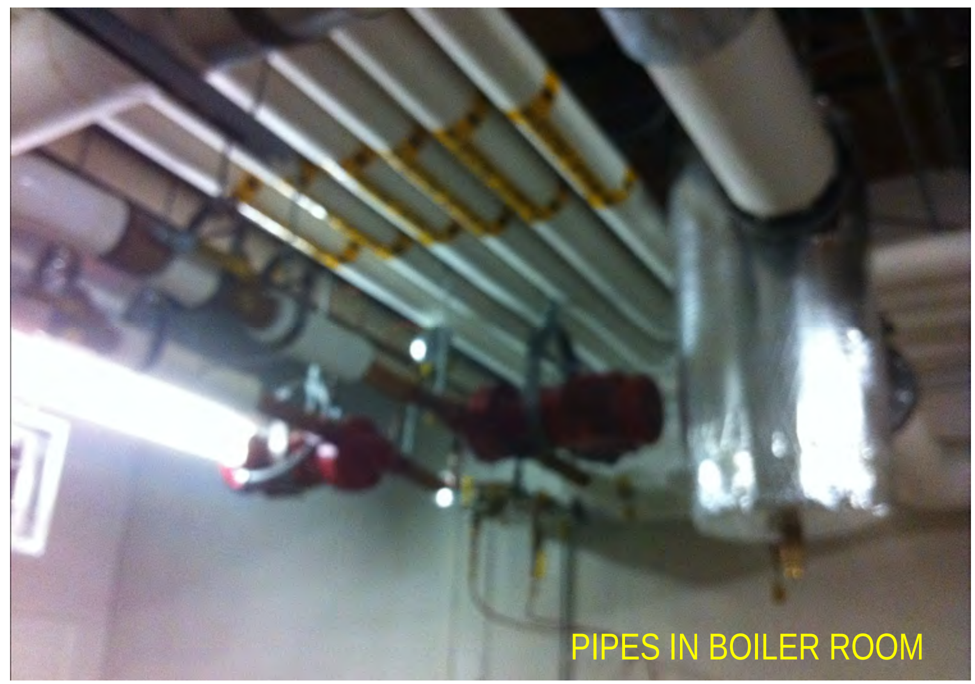


PUMP AND PIPES IN BOILER ROOM

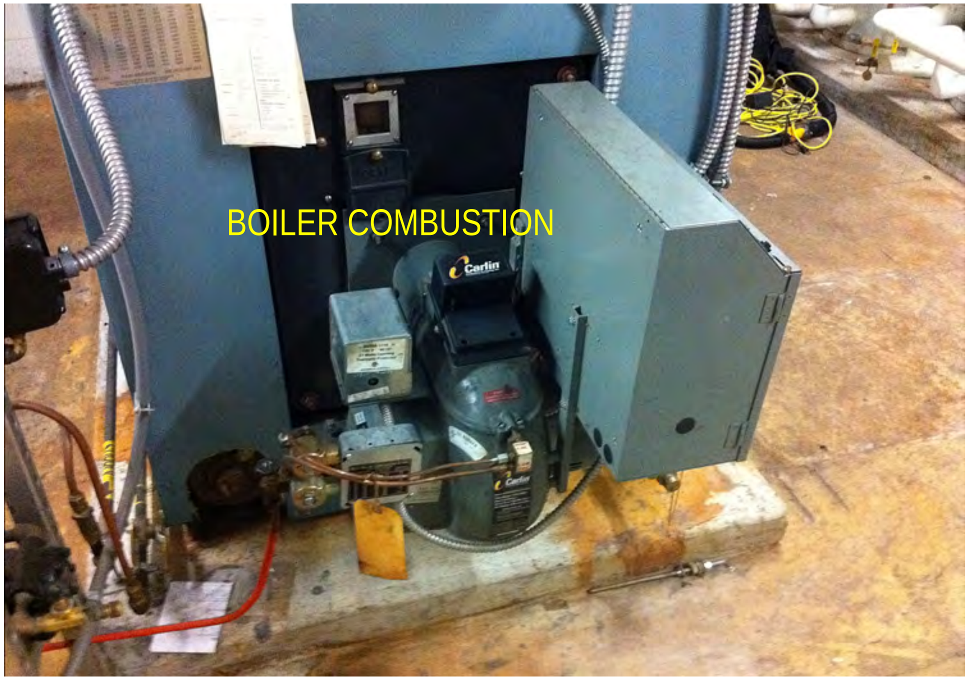


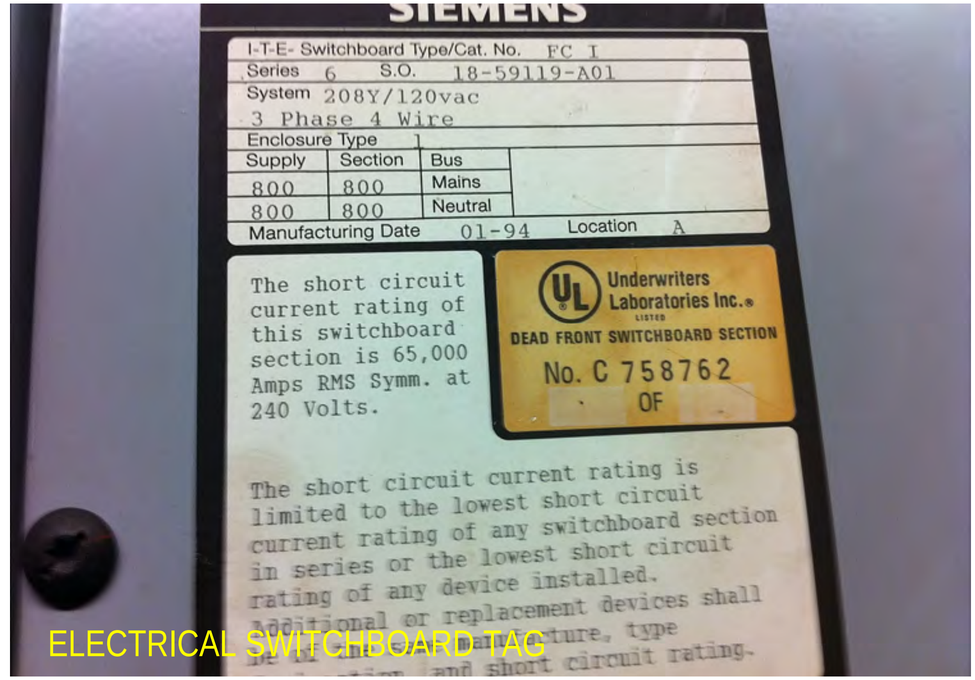
SMITH BOILER

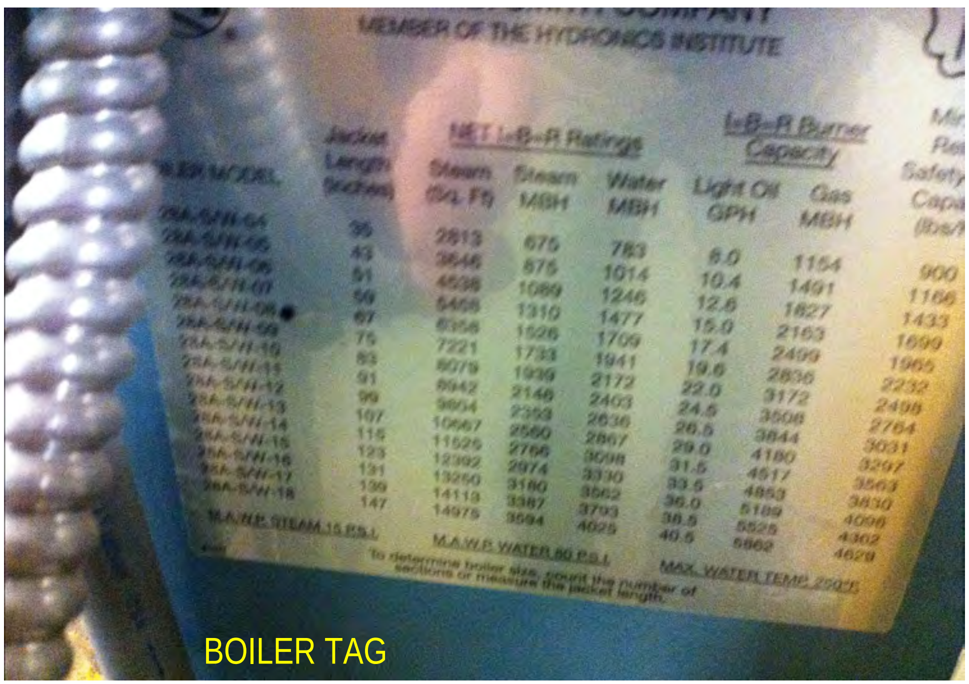
DHW store tanks

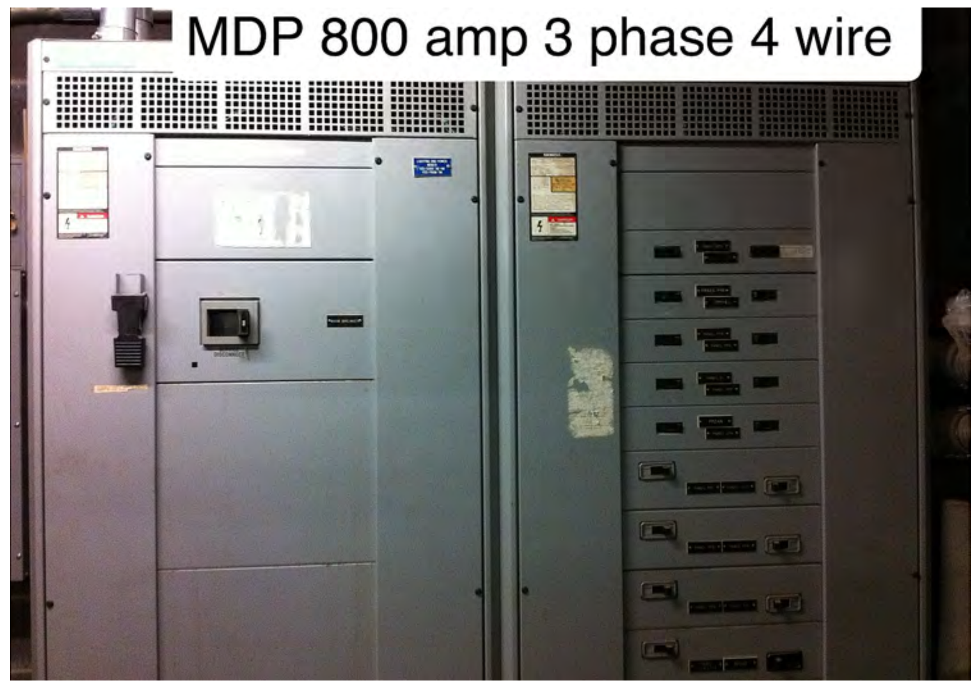


PIPES IN BOILER ROOM

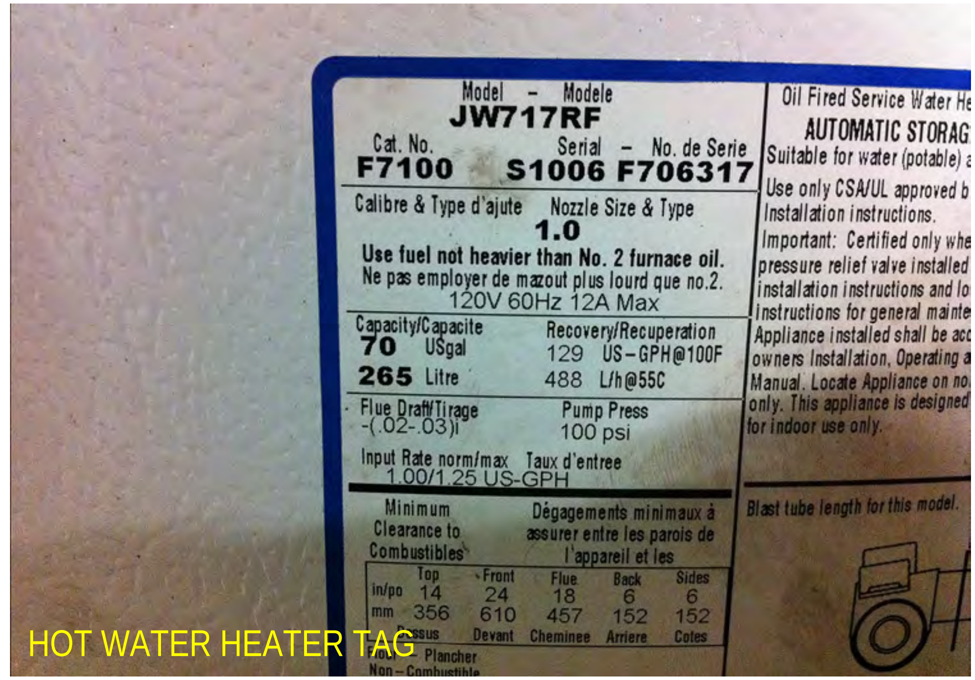

BOILER COMBUSTION
Carlin


SIEMENS
I-T-E- Switchboard Type/Cat. No. FC I
Series 6 S.O. 18-59119-A01
System 208Y/120vac
3 Phase 4 Wire
Enclosure Type 1
Supply Section Bus
800 800 Mains
800 800 Neutral
Manufacturing Date 01-94 Location A
The short circuit current rating of this switchboard section is 65,000 Amps RMS Symm. at 240 Volts.
Underwriters Laboratories Inc.
LISTED
DEAD FRONT SWITCHBOARD SECTION
No. C 758762
OF
The short circuit current rating is limited to the lowest short circuit current rating of any switchboard section in series or the lowest short circuit rating of any device installed.
ELECTRICAL SWITCHBOARD TAG


MEMBER OF THE HYDRONICS INSTITUTE
BOILER TAG

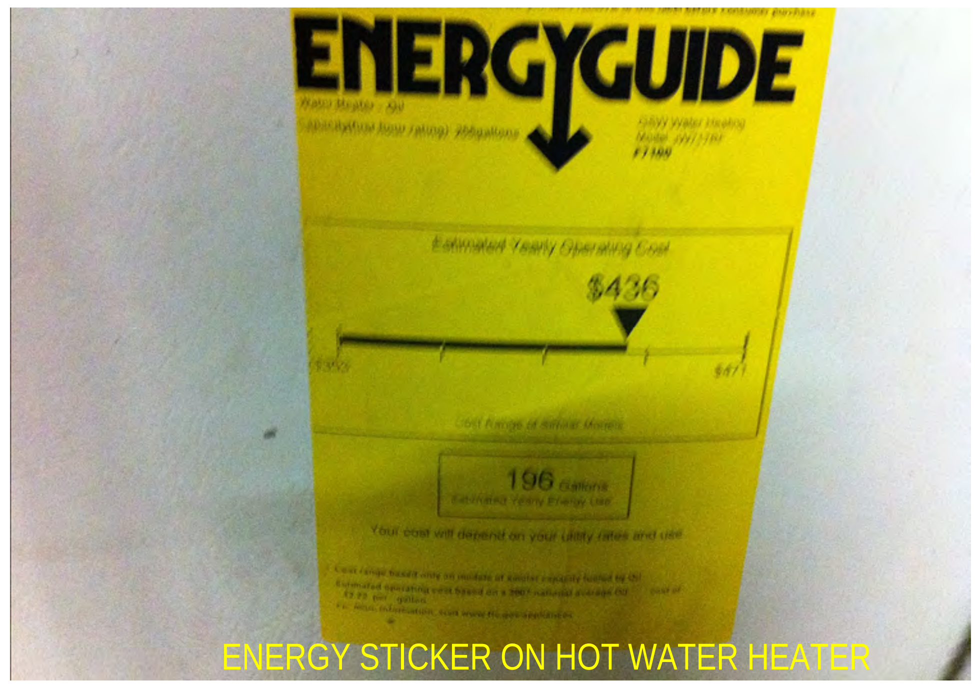

MDP 800 amp 3 phase 4 wire

HOT WATER HEATER



HOT WATER HEATER TAG

ELECTRONIC CONTROLS



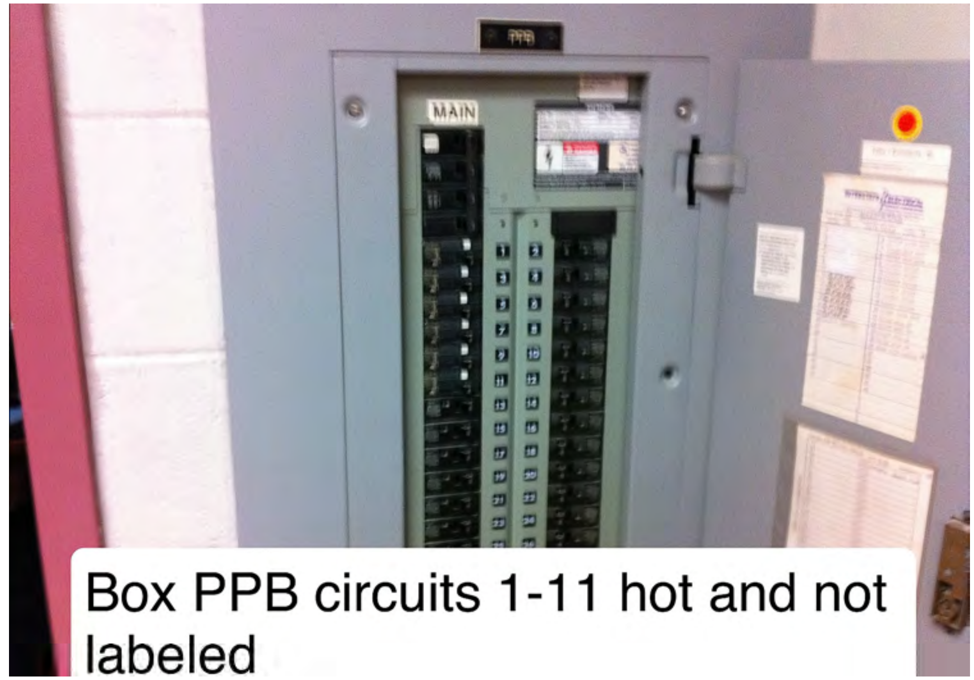
ENERGY STICKER ON HOT WATER HEATER

BOILER MODEL	Jacket Length (Inches)	NET I=B=R Ratings Steam (Sq. Ft)	Steam MBH	Water MBH	I=B=R Burner Capacity Light Oil GPH	Gas MBH	Safe Cap (lbs
28A-S/W-04	35	2813	675	783	8.0	1154	900
28A-S/W-05	43	3646	875	1014	10.4	1491	1166
28A-S/W-06	51	4538	1089	1246	12.6	1827	1433
28A-S/W-07	59	5458	1310	1477	15.0	2163	1699
28A-S/W-08	67	6358	1526	1709	17.4	2499	1965
28A-S/W-09	75	7221	1733	1941	19.6	2836	2232
28A-S/W-10	83	8079	1939	2172	22.0	3172	2498
28A-S/W-11	91	8942	2146	2403	24.5	3508	2764
28A-S/W-12	99	9804	2353	2636	26.5	3844	3031
28A-S/W-13	107	10667	2560	2867	29.0	4180	3297
28A-S/W-14	115	11525	2766	3098	31.5	4517	3563
28A-S/W-15	123	12392	2974	3330	33.5	4853	3830
28A-S/W-16	131	13250	3180	3562	36.0	5189	4096
28A-S/W-17	139	14113	3387	3793	38.5	5525	4362
28A-S/W-18	147	14975	3594	4025	40.5	5862	4629

M.A.W.P. STEAM 15 P.S.I. M.A.W.P. WATER 80 P.S.I. MAX. WATER TEMP. 250°F

To determine boiler size, count the number of sections or measure the jacket length.

BOILER TAG



Box PPB circuits 1-11 hot and not labeled

SMITH BOILER

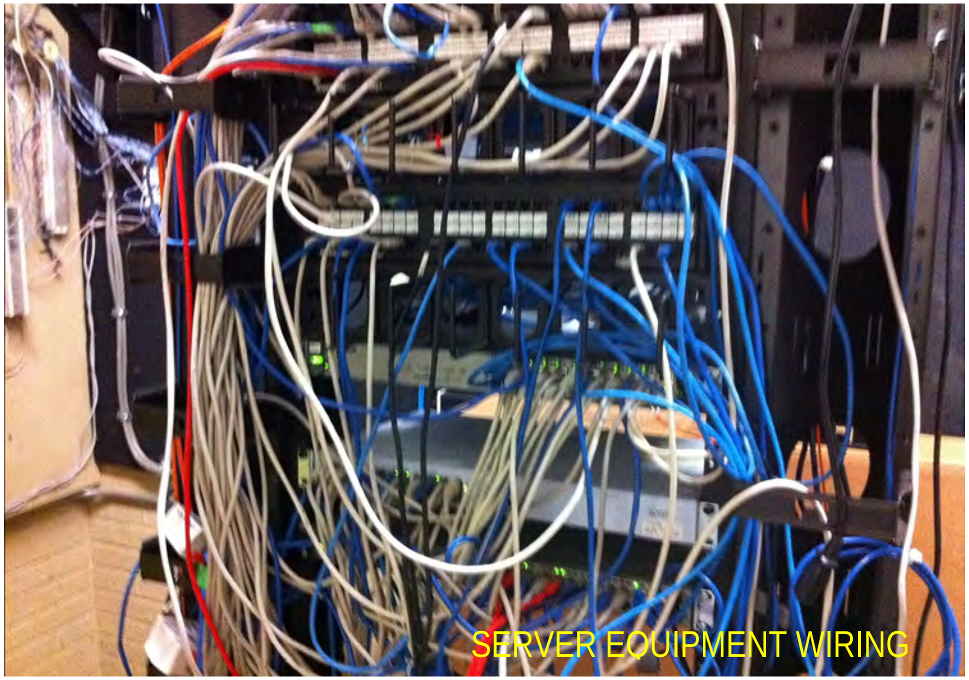
ELECTRICAL SWITCHBOARD TAG


Items in front of panel in S6


Empty full freezer in s8


Room 106


No access to panel in T10


SERVER EQUIPMENT WIRING


AC3 in room U2

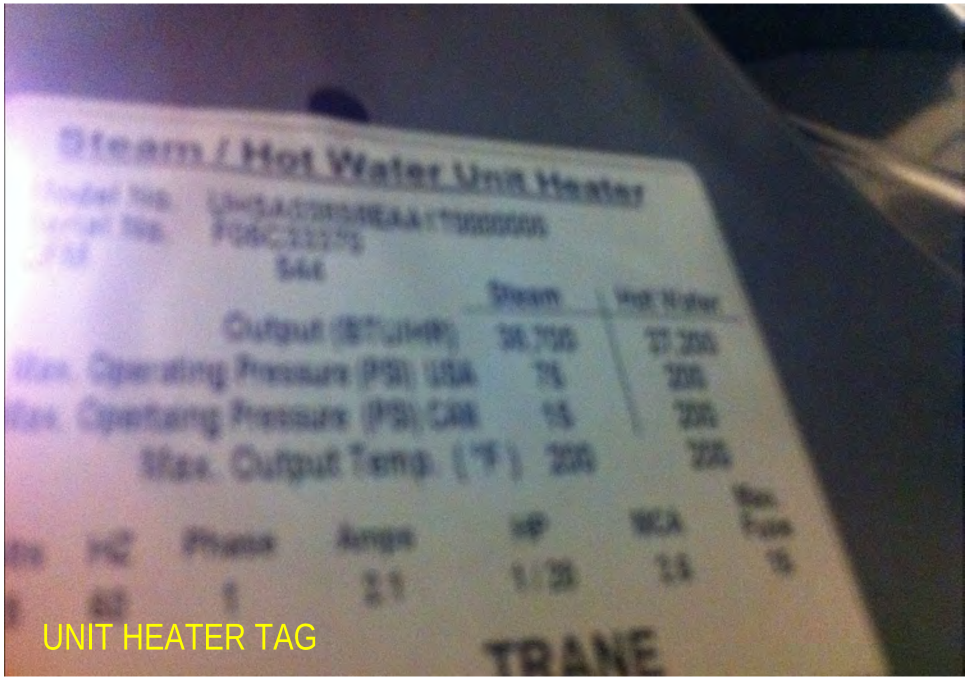

FULL SIZED FRIDGE NEAR-EMPTY IN ROOM 110


AC 4 U7


SPRINKLER PIPING


Unit heater in sprinkler room

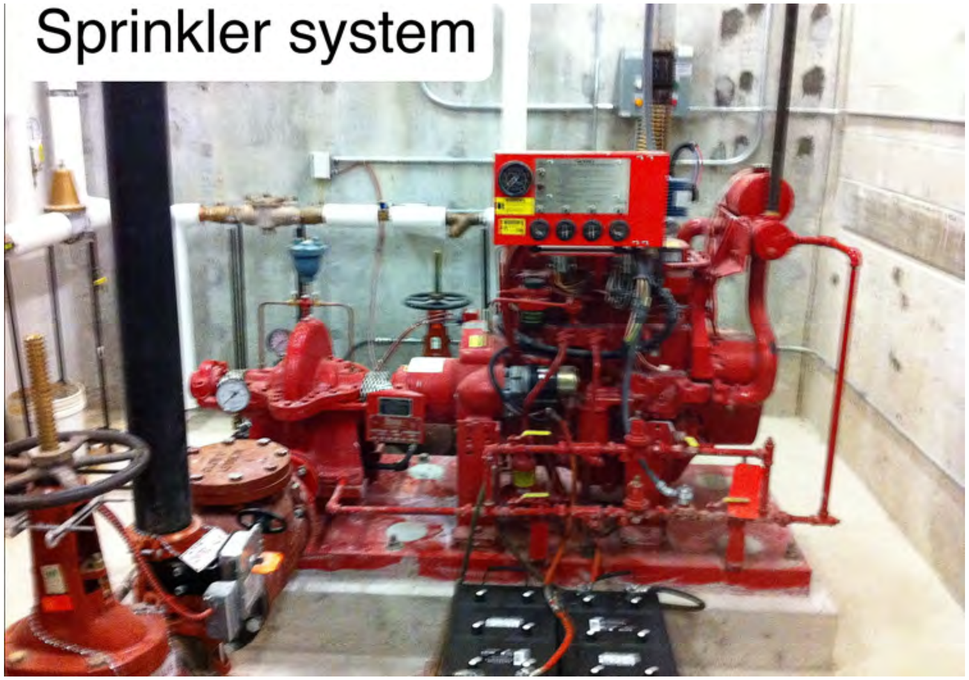

SPRINKLER ROOM CONTROLS



UNIT HEATER TAG


144 to limit AC


KITCHEN SPACE


Sprinkler system


Empty ice cream chest

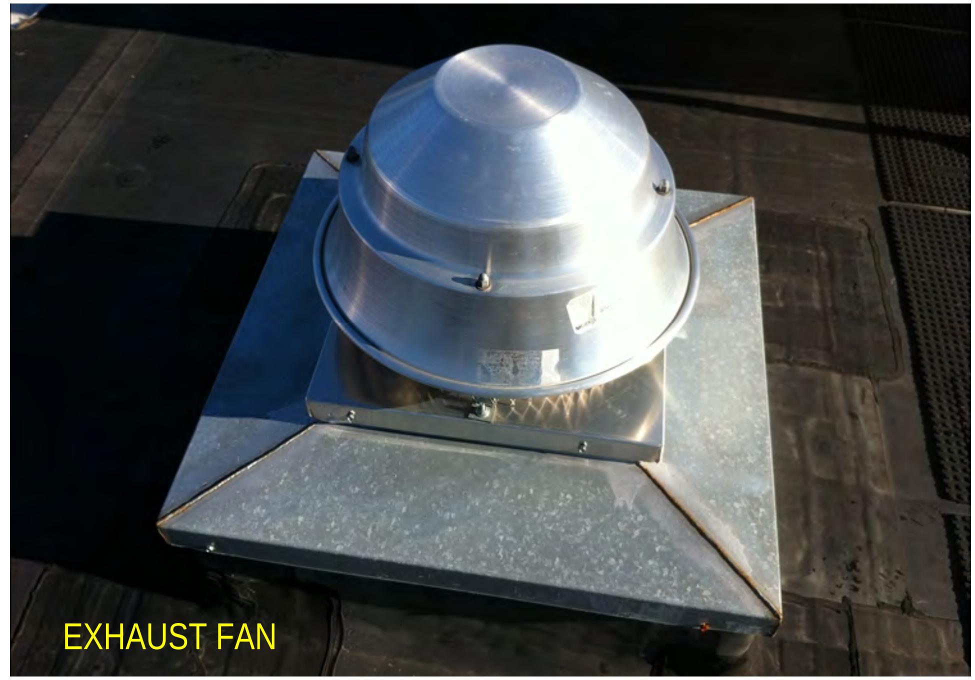
KITCHEN EQUIPMENT


OLD REFRIGERATOR

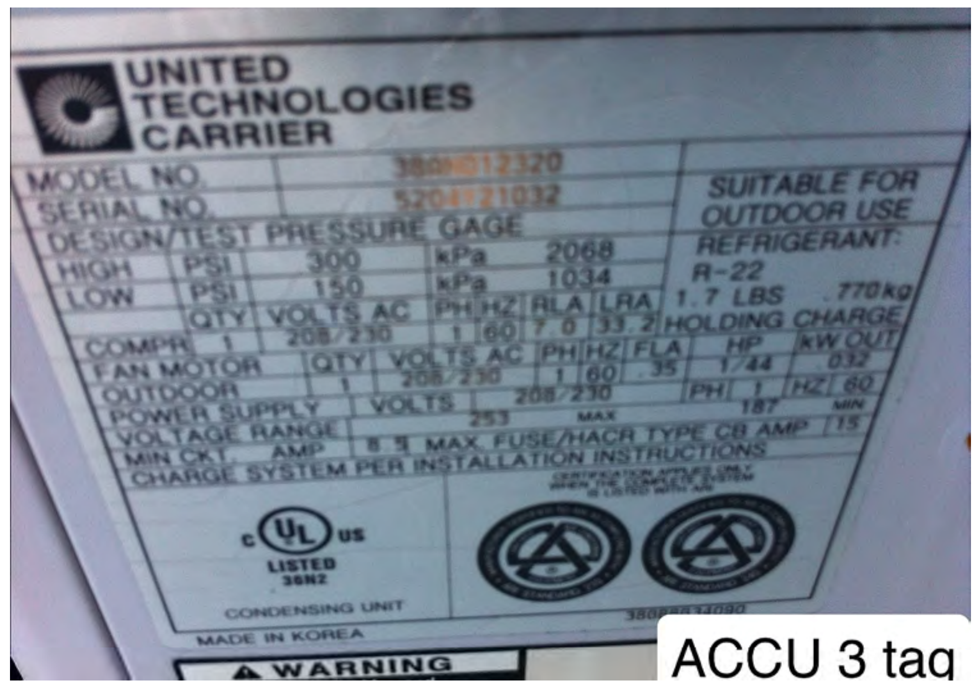

KITCHEN SPACE


Space heater in 220

ACCU 3

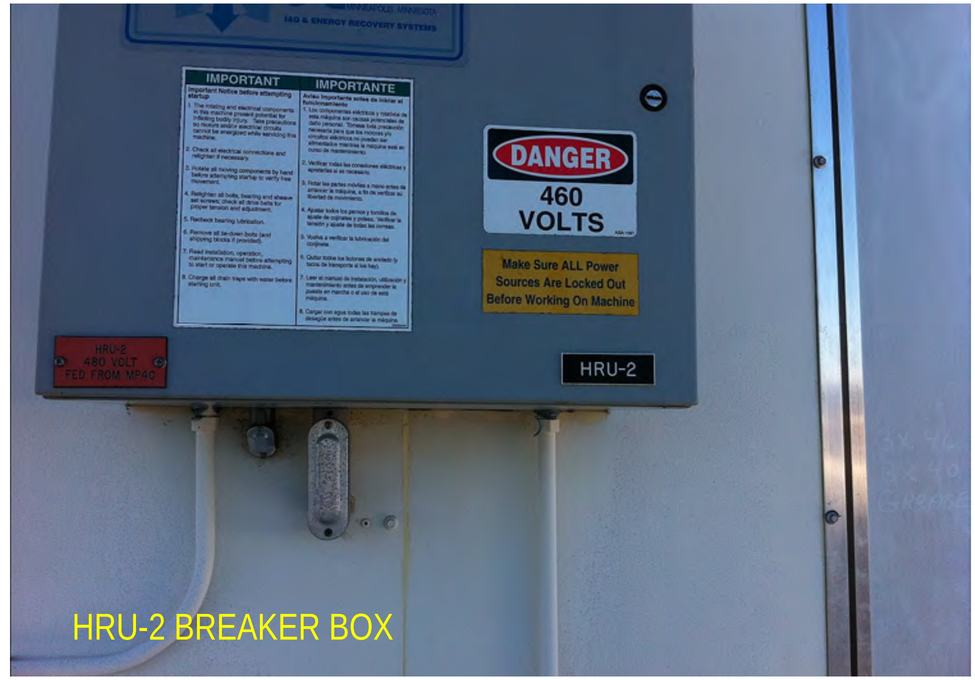

EXHAUST FAN

AUTOMATED LIGHTING CONTROLS



ACCU 3 tag


A DIVISION OF AMERICAN STANDARD INC.
RTU 1 tag


IMPORTANT
IMPORTANTE
DANGER
460 VOLTS
Make Sure ALL Power Sources Are Locked Out Before Working On Machine
HRU-2
HRU-2 BREAKER BOX


RTU1
TRANE
RTU – 1

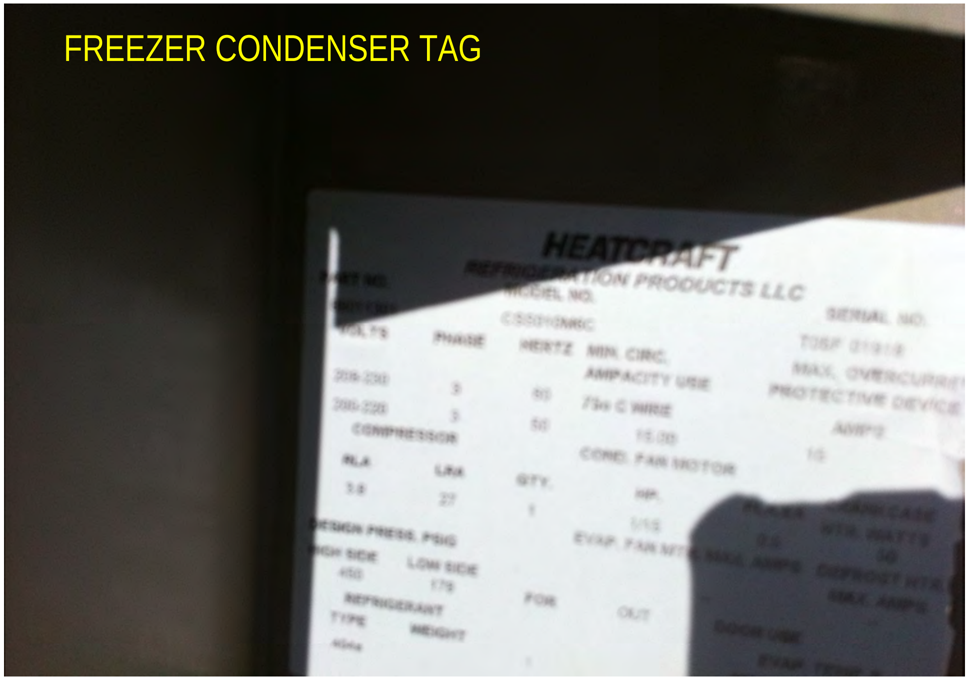

BOSSAire®
MINNEAPOLIS, MINNESOTA
IAQ & ENERGY RECOVERY SYSTEMS
ENERGY RECOVERY NAMETAG


AHU2
AHU 1

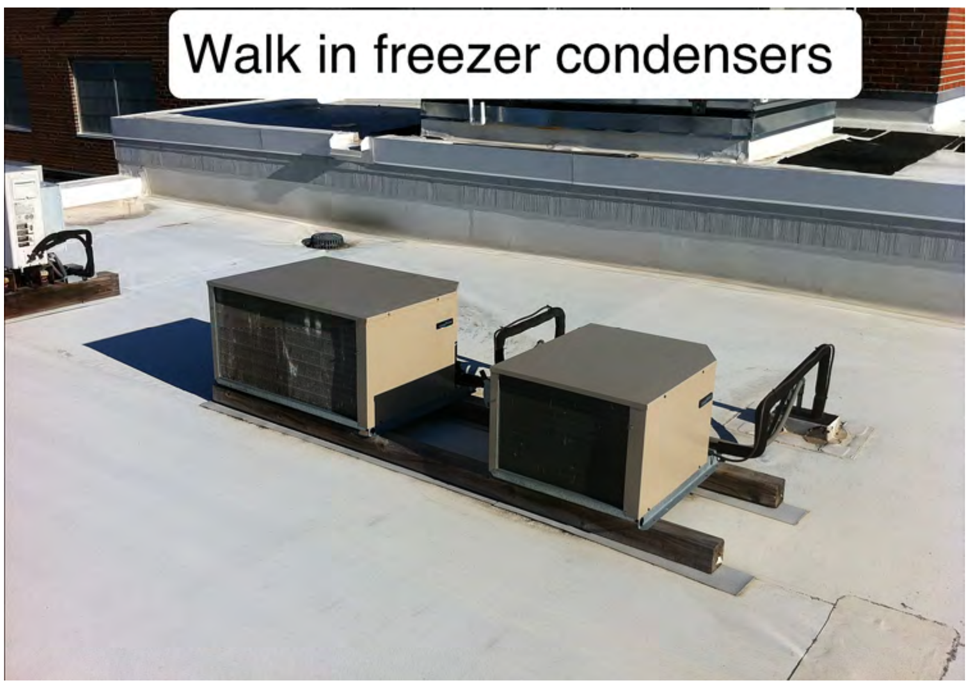

Filters in HRU 1


HTU 2


HRU 1


FREEZER CONDENSER TAG
HEATCRAFT


ACCU 6
Carrier


Walk in freezer condensers

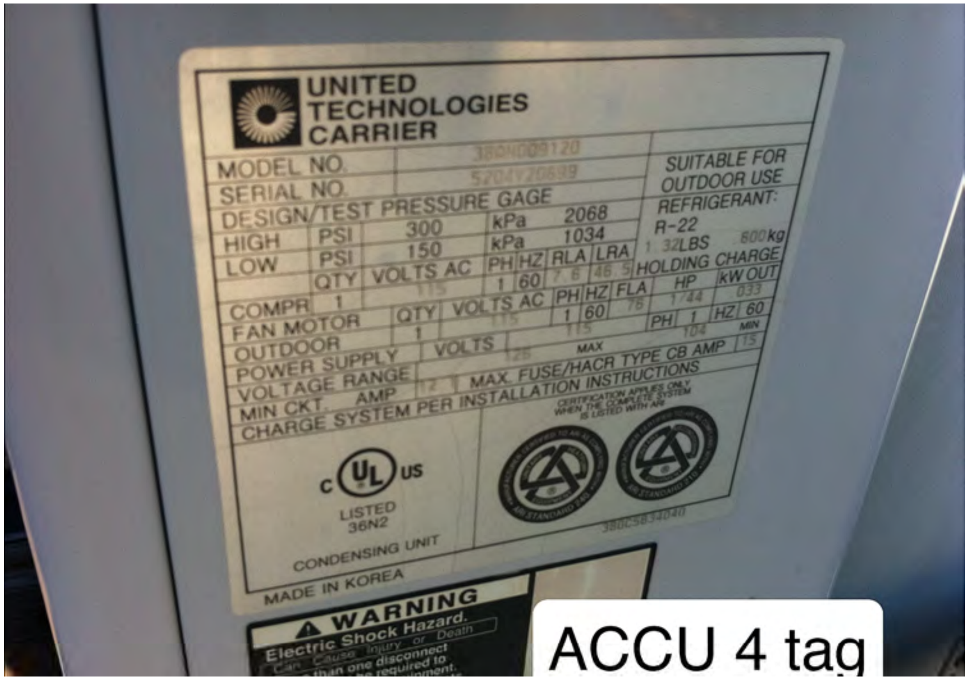

HEATCRAFT
REFRIGERATION PRODUCTS LLC
Walk in freezer tag

ROOFOTP EXHAUST

ROOFTOP AIR CONDITIONER CONDENSER

ACCU 6 Tag

ROOFTOP SPACE

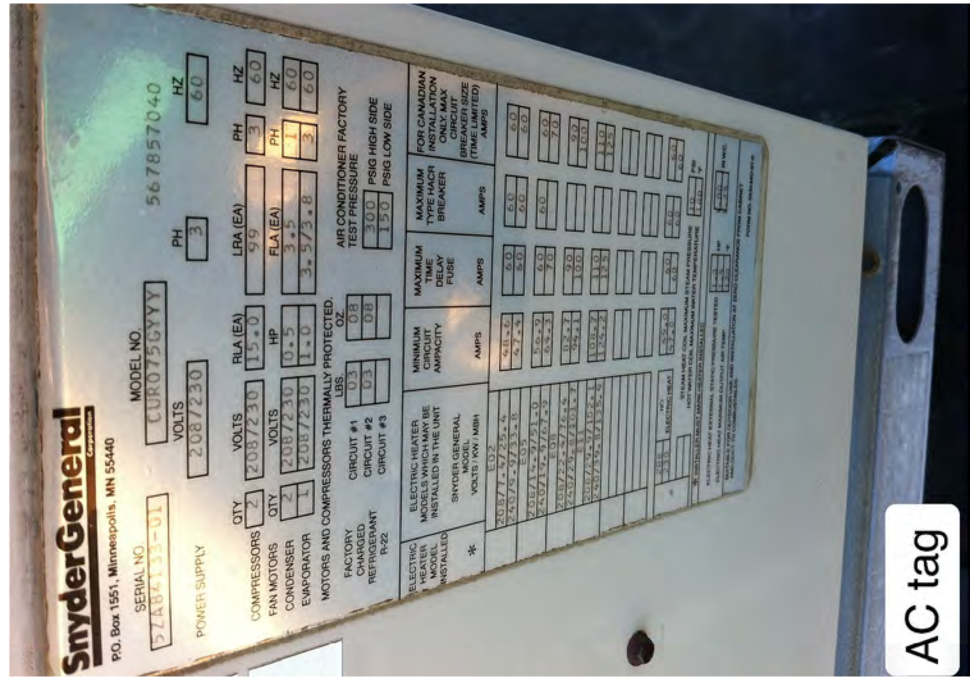

UNITED
TECHNOLOGIES
CARRIER
MODEL NO.
SERIAL NO.
SUITABLE FOR
OUTDOOR USE
DESIGN/TEST PRESSURE GAGE
REFRIGERANT:
HIGH PSI 300 kPa 2068
LOW PSI 150 kPa 1034
R-22
HOLDING CHARGE
QTY VOLTS AC PH HZ RLA LRA
COMPR 1
FAN MOTOR QTY VOLTS AC PH HZ FLA HP kW OUT
OUTDOOR 1
POWER SUPPLY VOLTS PH 1 HZ 60
VOLTAGE RANGE
MIN CKT. AMP MAX. FUSE/HACR TYPE CB AMP
CHARGE SYSTEM PER INSTALLATION INSTRUCTIONS
LISTED
36N2
CONDENSING UNIT
MADE IN KOREA
WARNING
Electric Shock Hazard.
ACCU 4 tag


McQuay
AC 6


ACCU 4
Carrier


ACCU 5


AC 3
McQuay


SnyderGeneral
P.O. Box 1551, Minneapolis, MN 55440
AC tag


INSECT NEST ON ROOFTOP


AC 2
McQuay


BUILDING EXTERIOR


BUILDING EXTERIOR


AC 1


STOP
BUILDING EXTERIOR


BUILDING EXTERIOR


BUILDING EXTERIOR


BUILDING EXTERIOR


BUILDING EXTERIOR

BUILDING EXTERIOR

BUILDING EXTERIOR

BUILDING EXTERIOR

BUILDING EXTERIOR


BUILDING EXTERIOR


BUILDING EXTERIOR


DOOR PROPPED OPEN


BUILDING EXTERIOR

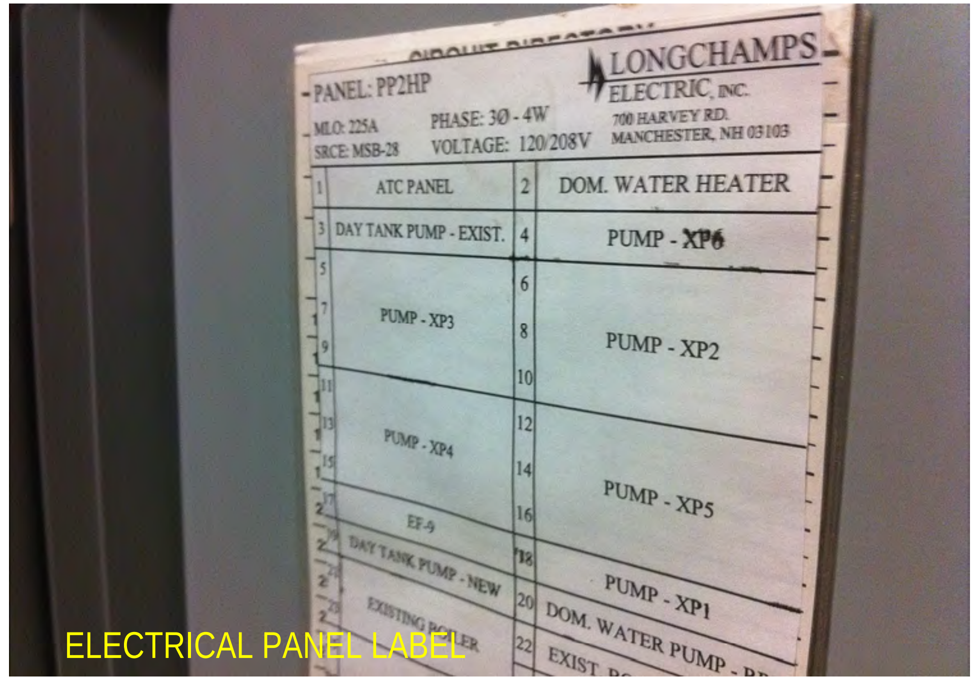

EXTERIOR OUTLET


EXTERIOR WINDOW SEAL


BUILDING EXTERIOR


EXTERIOR OUTLET

BOILER



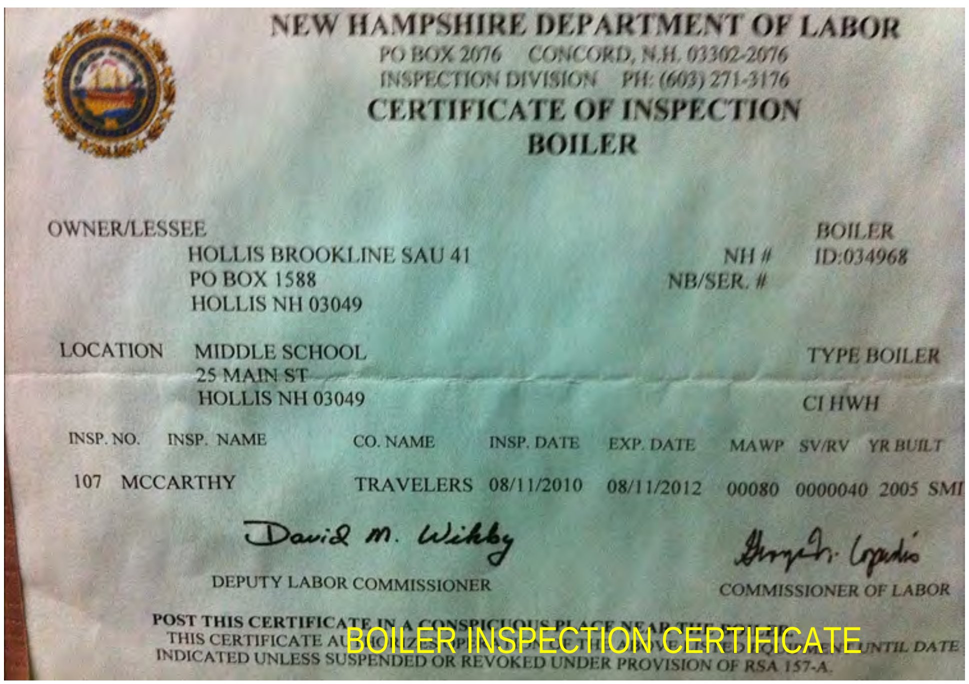
ELECTRICAL PANEL LABEL

GYMNASIUM CEILING


SPRINKLER PUMPS


MISSING CEILING INSULATION. RECOMMEND SEALING ALL PENETRATIONS

PIPES IN BOILER ROOM


NEW HAMPSHIRE DEPARTMENT OF LABOR
PO BOX 2076 CONCORD, N.H. 03302-2076
INSPECTION DIVISION PH: (603) 271-3176
CERTIFICATE OF INSPECTION
BOILER

OWNER/LESSEE
HOLLIS BROOKLINE SAU 41
PO BOX 1588
HOLLIS NH 03049

NH # BOILER ID:034968
NB/SER. #

LOCATION MIDDLE SCHOOL
25 MAIN ST
HOLLIS NH 03049

TYPE BOILER
CI HWH

INSP. NO.	INSP. NAME	CO. NAME	INSP. DATE	EXP. DATE	MAWP	SV/RV	YR BUILT
107	MCCARTHY	TRAVELERS	08/11/2010	08/11/2012	00080	0000040	2005 SMI

David M. Wihby
DEPUTY LABOR COMMISSIONER

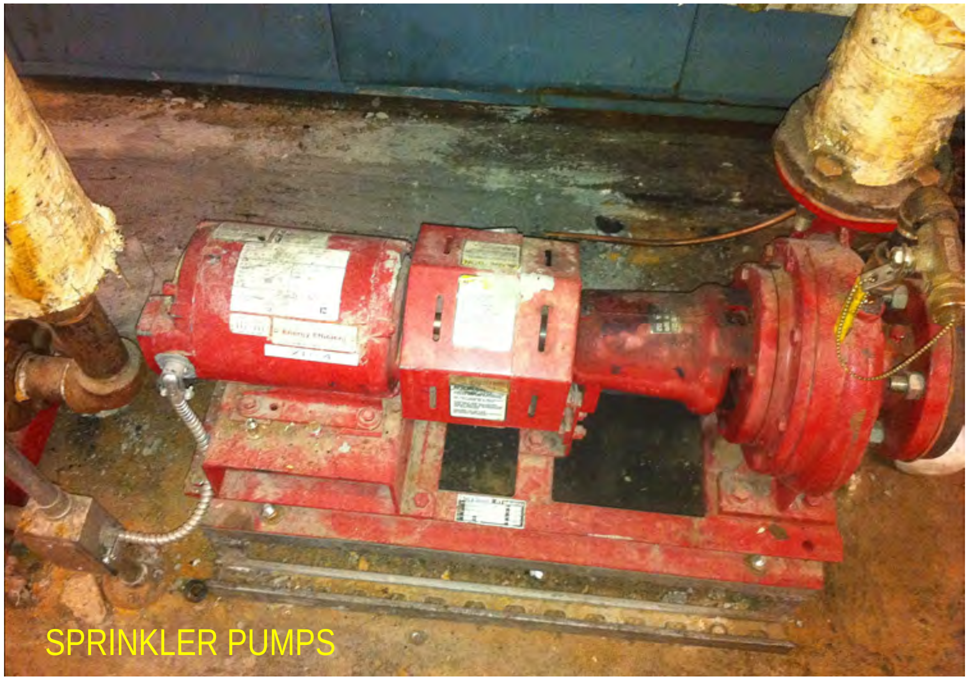
COMMISSIONER OF LABOR

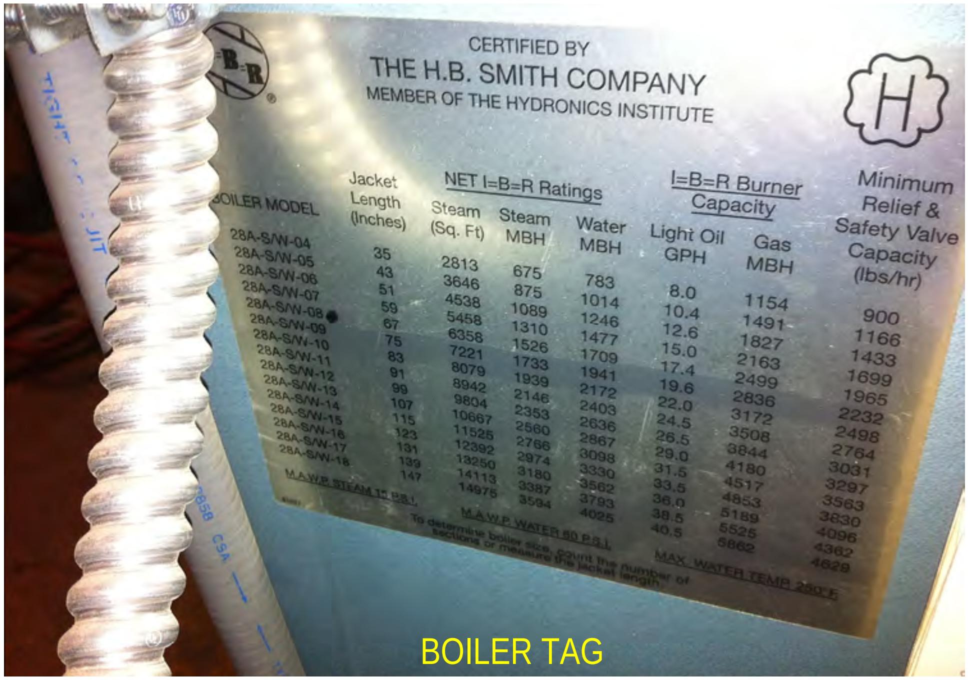
POST THIS CERTIFICATE IN A CONSPICUOUS PLACE NEAR
THIS CERTIFICATE A... UNTIL DATE
INDICATED UNLESS SUSPENDED OR REVOKED UNDER PROVISION OF RSA 157-A.

BOILER INSPECTION CERTIFICATE


PIPES IN BOILER ROOM


SPRINKLER PUMPS


SPRINKLER PUMPS

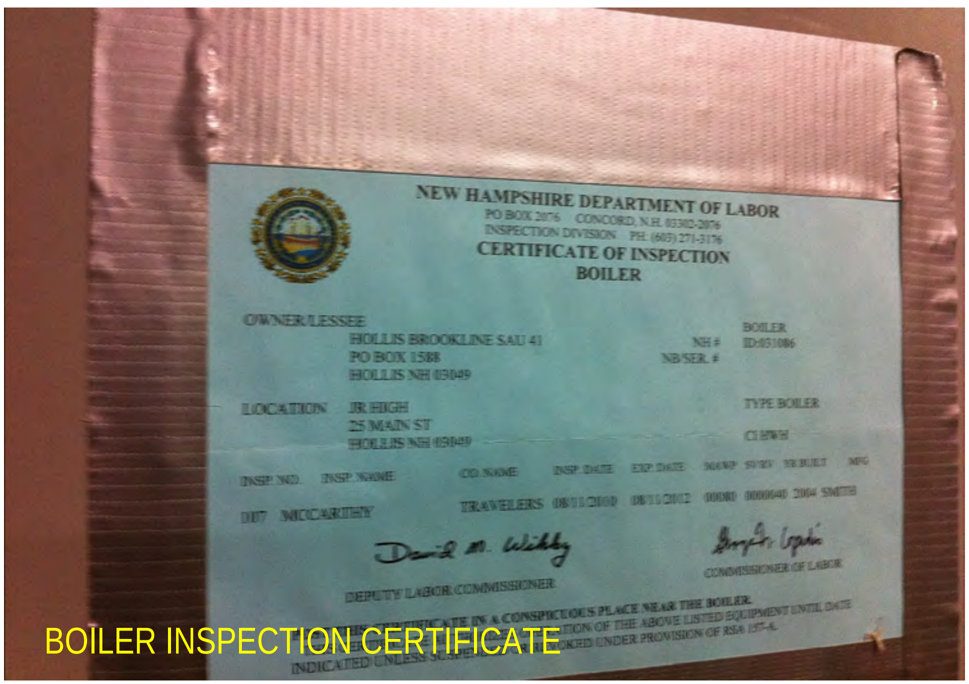


BOILER TAG

INSULATION AROUND PIPING

BOILER TAG

PIPING IN ART ROOM CEILING

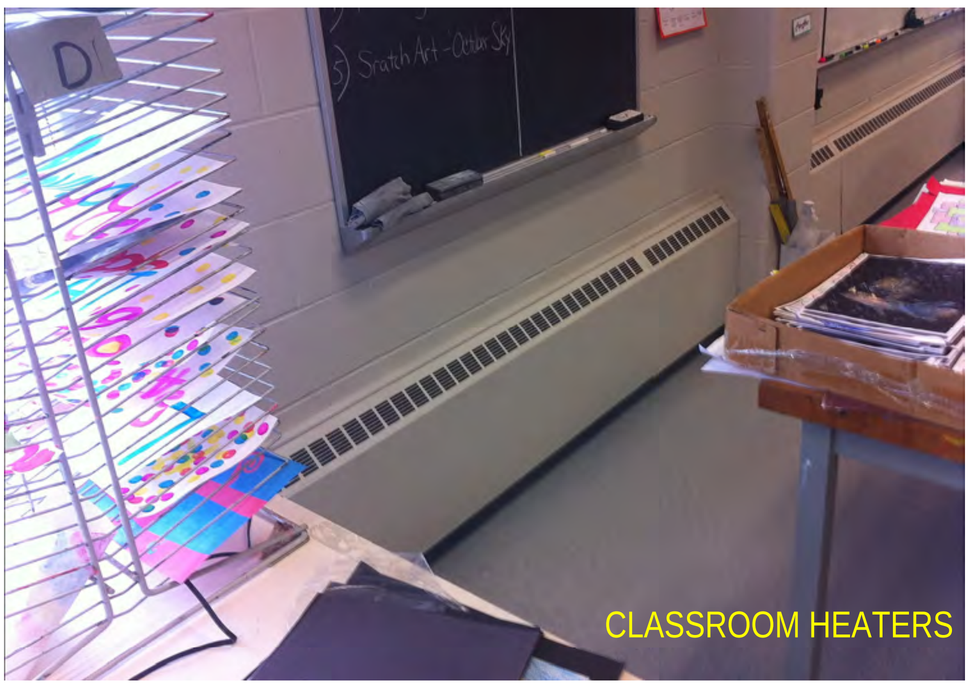


BOILER INSPECTION CERTIFICATE


MUTLI-PURPOSE ROOM SPACE


CONSTRUCTION CLASSROOM


WINDOW SILL WITH BROKEN HINGE


CLASSROOM HEATERS


DAYLIGHT SEEN UNDERNEAT EXTERIOR DOOR

ACCESS TO LIBRARY (ABOVE) AND CLASSROOMS (BELOW)

RAMP UP TO SECOND FLOOR FROM ORIGINAL BUILDING

NORTH-SOUTH HALLWAY OF ORIGINAL BUILDING

HANDICAP ELEVATOR NEXT TO STAIRS

VENDING MACHINE IN CORRIDOR

LIGHTING IN MUSIC ROOM

VENDING MACHINE IN CORRIDOR

LIGHTING IN GYM/MULTI-PURPOSE ROOM

SECOND FLOOR ACCESS TO CENTER COURTYARD

CABINET HEATER IN HALLWAY BY WEST ENTRANCE

LIGHT FIXTURE IN MUSIC ROOM

RAMP NEXT TO MULTI-PURPOSE ROOM LEADING TO SECOND FLOOR CLASSROOMS


FIRST FLOOR COMPUTER LAB


DUAL-SWITCH IN COMPUTER LAB


CABINET HEATER AND EXIT ON WEST SIDE


COMPUTER LAB LIGHT FIXTURE

FIRST FLOOR CLASSROOM WITH EXTERIOR TO COURTYARD


SECOND FLOOR LIBRARY SPACE

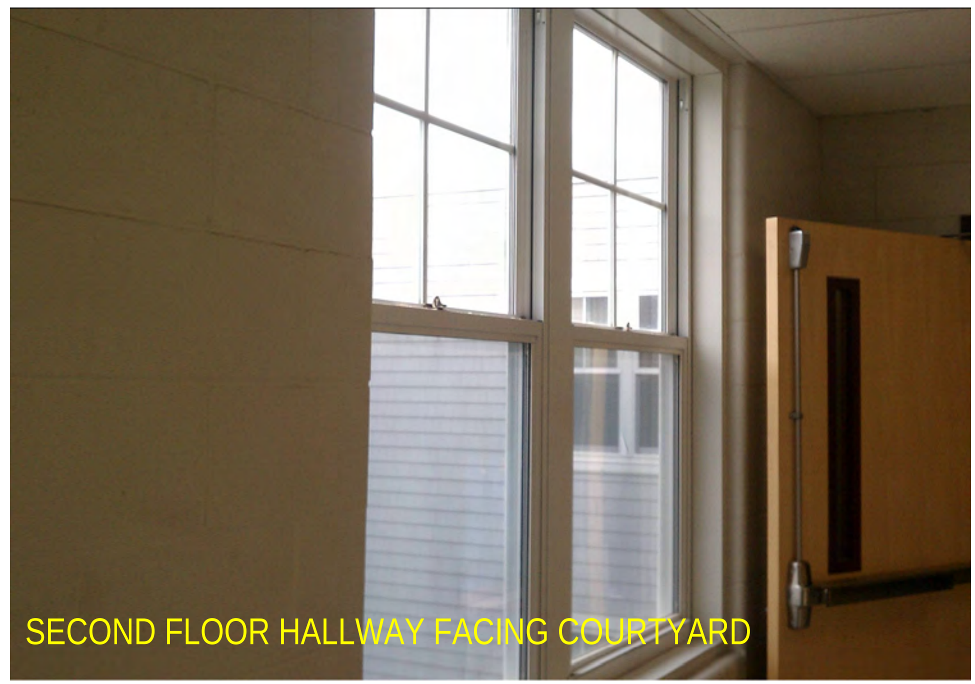
FIRST FLOOR CLASSROOM


FIRST FLOOR HALLWAY


EXTERIOR WALL ON SOUTH COURTYARD SIDE OF BUILDING


WINDOW UNIT AND COURTYARD


LIGHT FIXTURE IN SECOND FLOOR HALLWAY (TYP.)


SECOND FLOOR HALLWAY FACING COURTYARD

ORIGINAL BUILDING CORRIDOR FACING NORTH

ORIGINAL BUILDING CORRIDOR FACING NORTH

CABINET HEATER IN HALLWAY CEILING

ORIGINAL BUILDING CORRIDOR FACING NORTH

GYMNASIUM AND STAGE IN ORIGINAL BUILDING

T8 LIGHT FIXTURE WITH 6 BULBS IN GYMNASIUM

VESTIBUE AT NORTHWEST SIDE OF BUILDING

GYMNASIUM AND STAGE IN ORIGINAL BUILDING

MAIN ENTRANCE AT EAST SIDE OF FACILITY

ADMINISTRATIVE AREA ALONG EAST SIDE OF FACILITY

APPENDIX B

Thermal Imaging Survey Reports

Inspection Report

Report Date	5/29/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Brookline Middle School
Address	90 Main Street, Newmarket, NH 03857	Site Address	25 Main Street, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

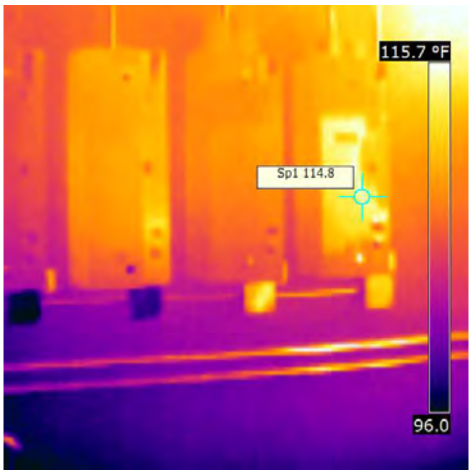


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/29/2011 9:39:01 AM
Image Name	IR_1963.jpg
Emissivity	0.96
Reflected apparent temperature	116.0 °F
Object Distance	5.0 ft

Text Comments

Description

Heat and hot water pump control boxes emit thermal transfer. P-4 (far right, hot water) has highest transfer at this instance, indicating it is working hardest.

Inspection Report

Report Date	5/29/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Brookline Middle School
Address	90 Main Street, Newmarket, NH 03857	Site Address	25 Main Street, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

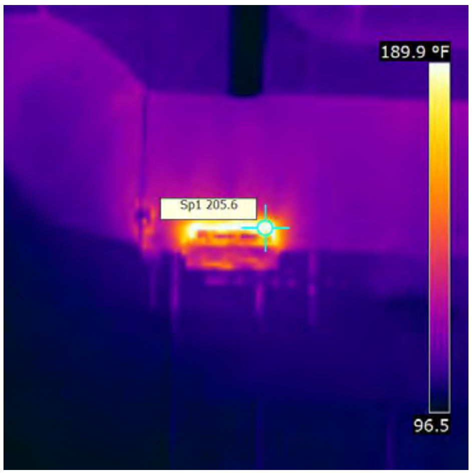


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/29/2011 9:39:33 AM
Image Name	IR_1964.jpg
Emissivity	0.96
Reflected apparent temperature	210.0 °F
Object Distance	12.0 ft

Text Comments

Description

Flue on ductwork reveals high thermal loss. Recommend making all seals on ductwork tight.

Inspection Report

Report Date	5/29/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Brookline Middle School
Address	90 Main Street, Newmarket, NH 03857	Site Address	25 Main Street, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

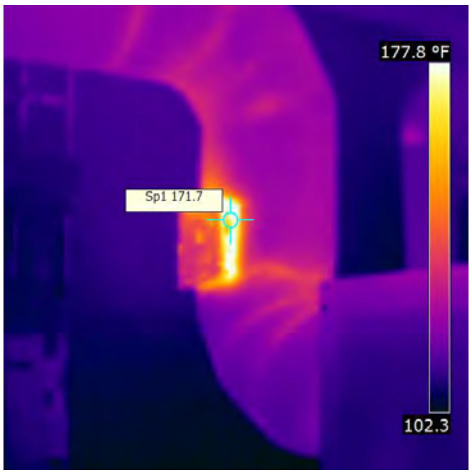


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/29/2011 9:39:51 AM
Image Name	IR_1965.jpg
Emissivity	0.96
Reflected apparent temperature	170.0 °F
Object Distance	8.0 ft

Text Comments

Description

Flue on ductwork reveals high thermal loss. Recommend making all seals on ductwork tight.

Inspection Report

Report Date	5/29/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Brookline Middle School
Address	90 Main Street, Newmarket, NH 03857	Site Address	25 Main Street, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

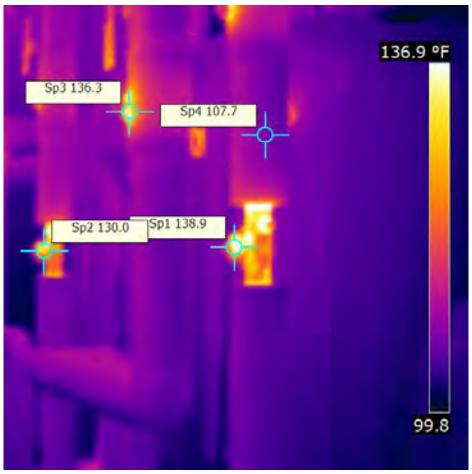


Image and Object Parameters

Text Comments

Camera Model	B-CAM Western S
Image Date	12/29/2011 9:42:43 AM
Image Name	IR_1968.jpg
Emissivity	0.96
Reflected apparent temperature	130.0 °F
Object Distance	5.0 ft

Description

Exposed flanges on hot water pipes reveal high thermal transfer. Insulation around pipes appears to be effective.

Inspection Report

Report Date	5/29/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Brookline Middle School
Address	90 Main Street, Newmarket, NH 03857	Site Address	25 Main Street, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/29/2011 9:43:24 AM
Image Name	IR_1969.jpg
Emissivity	0.96
Reflected apparent temperature	170.0 °F
Object Distance	10.0 ft

Text Comments

Description

Circulating pump in the boiler room produces thermal energy adding a heat load to the space.

Inspection Report

Report Date	5/29/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Brookline Middle School
Address	90 Main Street, Newmarket, NH 03857	Site Address	25 Main Street, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

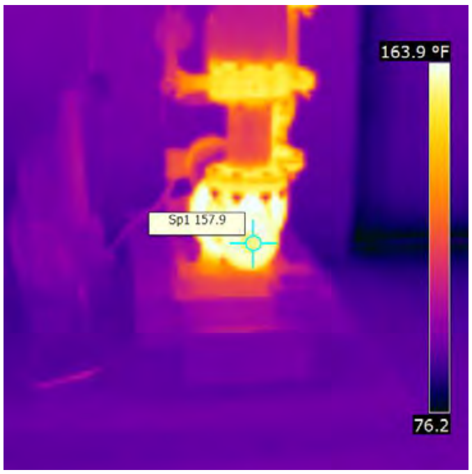


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/29/2011 9:43:45 AM
Image Name	IR_1970.jpg
Emissivity	0.96
Reflected apparent temperature	160.0 °F
Object Distance	6.0 ft

Text Comments

Description

Circulating pump in boiler room produces high thermal energy adding a heat load to the space.

Inspection Report

Report Date	5/29/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Brookline Middle School
Address	90 Main Street, Newmarket, NH 03857	Site Address	25 Main Street, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

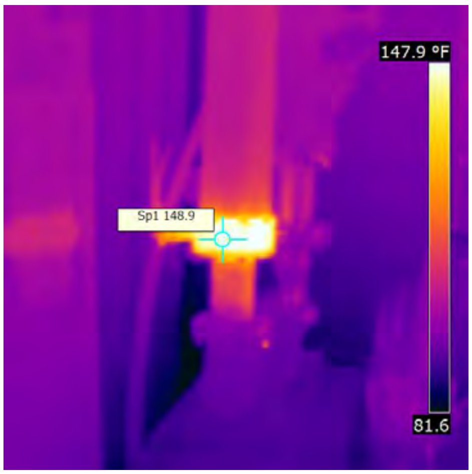


Image and Object Parameters	
Camera Model	B-CAM Western S
Image Date	12/29/2011 9:43:54 AM
Image Name	IR_1971.jpg
Emissivity	0.96
Reflected apparent temperature	150.0 °F
Object Distance	7.0 ft

Text Comments

Description

Uninsulated flange on hot water pipe emits thermal energy adding a heat load to the space.

Inspection Report

Report Date	5/29/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Brookline Middle School
Address	90 Main Street, Newmarket, NH 03857	Site Address	25 Main Street, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

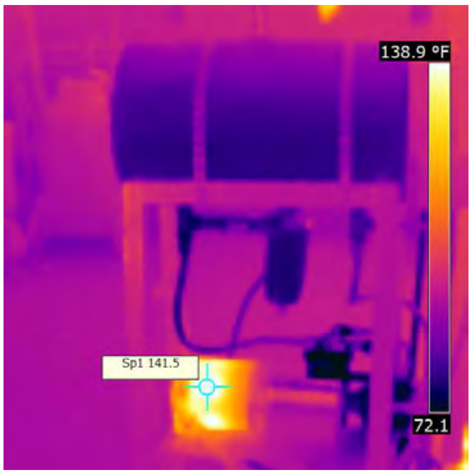


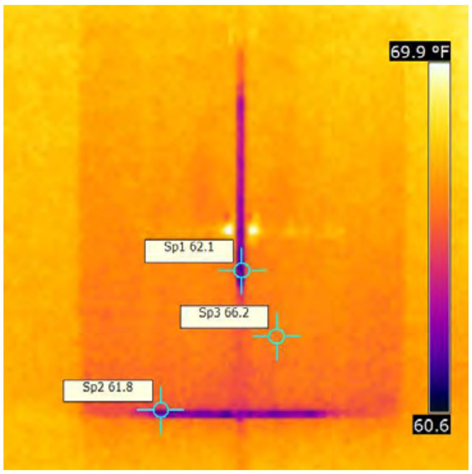
Image and Object Parameters		Text Comments
Camera Model	B-CAM Western S	
Image Date	12/29/2011 9:44:37 AM	
Image Name	IR_1972.jpg	
Emissivity	0.96	
Reflected apparent temperature	144.0 °F	
Object Distance	6.0 ft	

Description
Pump motor creates thermal energy in the boiler room adding a heat load to the space.

Inspection Report

Report Date	5/29/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Brookline Middle School
Address	90 Main Street, Newmarket, NH 03857	Site Address	25 Main Street, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	



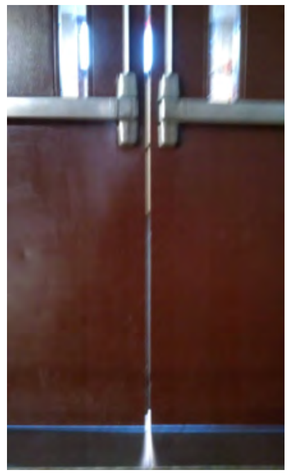


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/29/2011 9:45:28 AM
Image Name	IR_1973.jpg
Emissivity	0.96
Reflected apparent temperature	66.0 °F
Object Distance	10.0 ft

Text Comments

Description

Exterior door IR reveals thermal transfer through poor sealing, Recommend air-sealing all exterior doors and windows. Refer to EEM T1-10 for associated cost and savings.

Inspection Report

Report Date	5/29/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Brookline Middle School
Address	90 Main Street, Newmarket, NH 03857	Site Address	25 Main Street, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

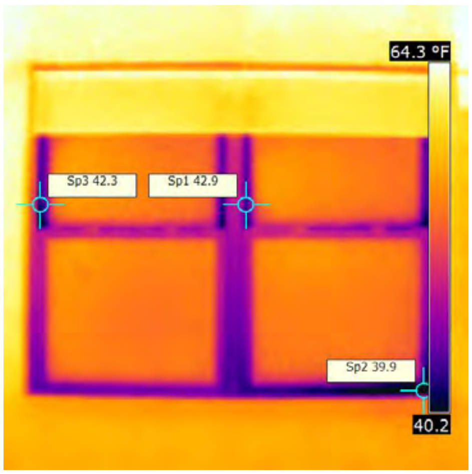


Image and Object Parameters

Text Comments

Camera Model	B-CAM Western S
Image Date	12/29/2011 9:52:03 AM
Image Name	IR_1974.jpg
Emissivity	0.96
Reflected apparent temperature	41.0 °F
Object Distance	10.0 ft

Description

Typical window frame IR reveals thermal loss through framing. Recommend air-sealing all windows and doors. Refer to EEM T1-10 for associated cost and savings.

Inspection Report

Report Date	5/29/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Brookline Middle School
Address	90 Main Street, Newmarket, NH 03857	Site Address	25 Main Street, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

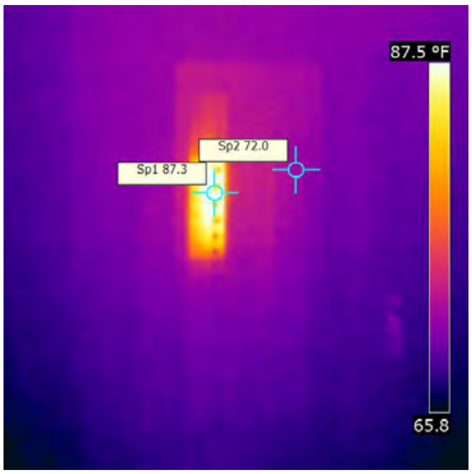


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/29/2011 9:54:26 AM
Image Name	IR_1975.jpg
Emissivity	0.96
Reflected apparent temperature	88.0 °F
Object Distance	6.0 ft

Text Comments

Description

Electrical panel shows electrical load and thermal energy from breakers on left indicating they may be overloaded.

Inspection Report

Report Date	5/29/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Brookline Middle School
Address	90 Main Street, Newmarket, NH 03857	Site Address	25 Main Street, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

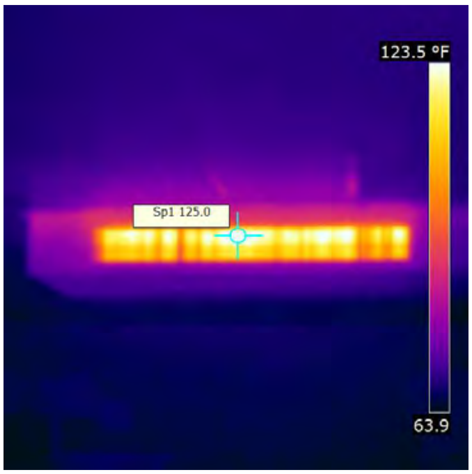


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/29/2011 10:02:19 AM
Image Name	IR_1976.jpg
Emissivity	0.96
Reflected apparent temperature	127.0 °F
Object Distance	12.0 ft

Text Comments

Description

IR of ceiling unit heater in room 105 reveals how thermal enegy is emitted.

Inspection Report

Report Date	5/29/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Brookline Middle School
Address	90 Main Street, Newmarket, NH 03857	Site Address	25 Main Street, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

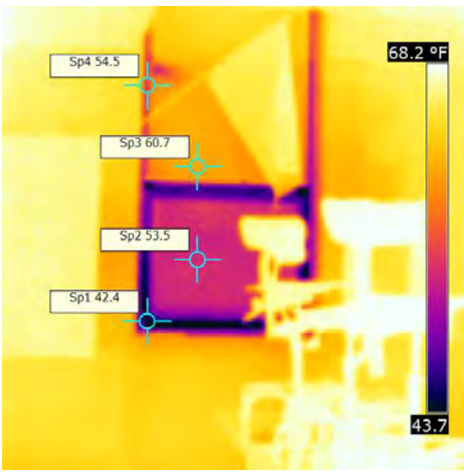


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/29/2011 10:02:46 AM
Image Name	IR_1977.jpg
Emissivity	0.96
Reflected apparent temperature	53.0 °F
Object Distance	10.0 ft

Text Comments

Description

Classroom 105 window with shades down halfway. Shades revealed 7 degrees warmer than window indicating insulating qualities. Recommend shutting all shades at night and air-sealing all windows. Refer to EEM T1-10 for cost and savings.

Inspection Report

Report Date	5/29/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Brookline Middle School
Address	90 Main Street, Newmarket, NH 03857	Site Address	25 Main Street, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

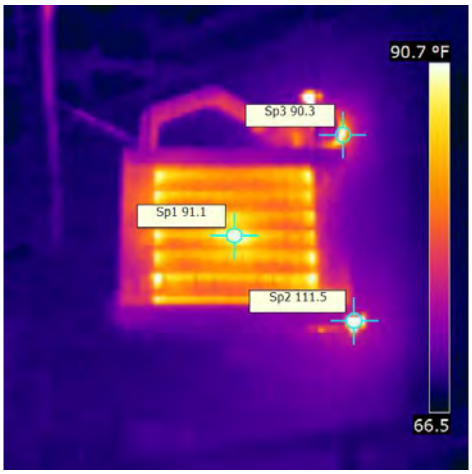


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/29/2011 10:04:24 AM
Image Name	IR_1978.jpg
Emissivity	0.96
Reflected apparent temperature	91.0 °F
Object Distance	12.0 ft

Text Comments

Description

IR of unit heater in technical education room reveals how thermal energy is emitted. Through-wall penetrations for piping reveal some thermal losses. Recommend sealing penetrations.

Inspection Report

Report Date	5/29/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Brookline Middle School
Address	90 Main Street, Newmarket, NH 03857	Site Address	25 Main Street, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

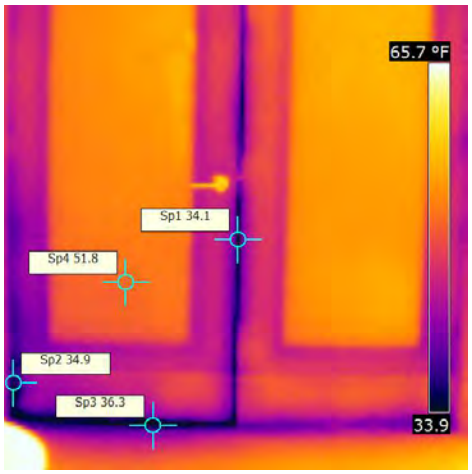


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/29/2011 10:05:02 AM
Image Name	IR_1979.jpg
Emissivity	0.96
Reflected apparent temperature	34.0 °F
Object Distance	8.0 ft

Text Comments

Description

Poor seal on exterior door in techincal education room 106 results in unwanted thermal transfer. Recommend air-sealing all exterior windows and doors. Refer to EEM T1-10 for associated cost and savings.

Inspection Report

Report Date	5/29/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Brookline Middle School
Address	90 Main Street, Newmarket, NH 03857	Site Address	25 Main Street, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

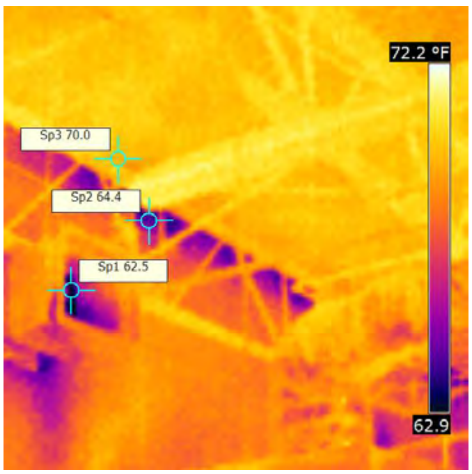


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/29/2011 10:05:37 AM
Image Name	IR_1980.jpg
Emissivity	0.96
Reflected apparent temperature	65.0 °F
Object Distance	25.0 ft

Text Comments

Description

Technical education vent and exposed roof deck. Thermal transfer evident through open vent, through wall around vent and through wall around roof deck. Recommend sealing all penetrations and gaps. Refer to EEM T1-10.

Inspection Report

Report Date	5/29/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Brookline Middle School
Address	90 Main Street, Newmarket, NH 03857	Site Address	25 Main Street, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

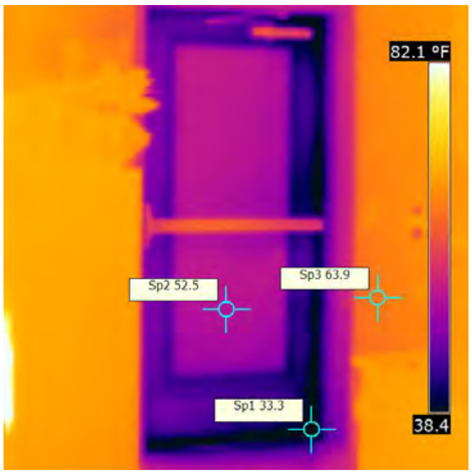


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/29/2011 10:13:01 AM
Image Name	IR_1981.jpg
Emissivity	0.96
Reflected apparent temperature	52.0 °F
Object Distance	10.0 ft

Text Comments

Description

Exterior door in room 107 shows poor seal around door, allowing for unwanted thermal transfer. Recommend air-sealing door. Refer to EEM T1-10 for associated cost and savings.

Inspection Report

Report Date	5/29/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Brookline Middle School
Address	90 Main Street, Newmarket, NH 03857	Site Address	25 Main Street, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

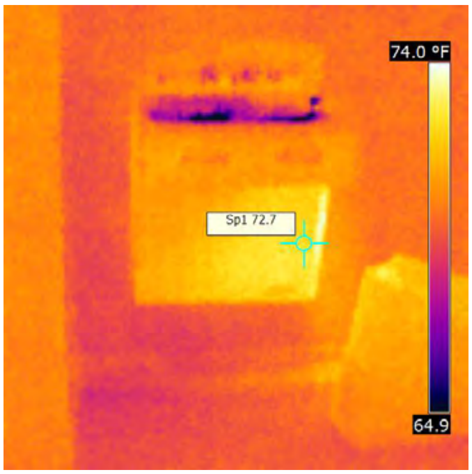


Image and Object Parameters		Text Comments
Camera Model	B-CAM Western S	
Image Date	12/29/2011 10:29:13 AM	
Image Name	IR_1982.jpg	
Emissivity	0.96	
Reflected apparent temperature	73.0 °F	
Object Distance	6.0 ft	

Description
Water fountain condenser in hallway emits thermal energy and uses a lot of electricity. Recommend disconnecting all low use water fountain condensers. Refer to EEM T1-2 for associated savings.

Inspection Report

Report Date	5/29/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Brookline Middle School
Address	90 Main Street, Newmarket, NH 03857	Site Address	25 Main Street, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

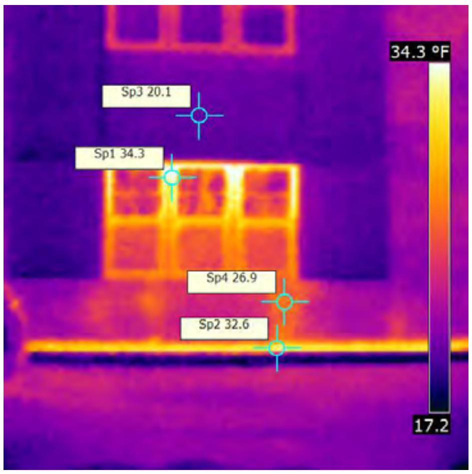


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/20/2012 7:13:25 AM
Image Name	IR_2355.jpg
Emissivity	0.96
Reflected apparent temperature	32.0 °F
Object Distance	25.0 ft

Text Comments

Description

IR of the exterior building. Windows show signs of thermal transfer around the frames. Concrete slab on bottom also shows signs of thermal transfer. Clapboard and brick sidings show different thermal properties. EEM T1-10 for window air-seal.

Inspection Report

Report Date	5/29/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Brookline Middle School
Address	90 Main Street, Newmarket, NH 03857	Site Address	25 Main Street, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

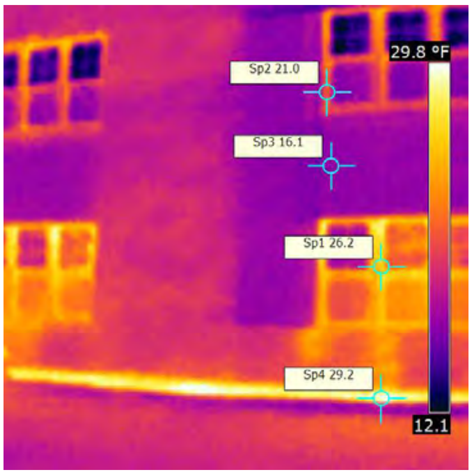


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/20/2012 7:13:41 AM
Image Name	IR_2356.jpg
Emissivity	0.96
Reflected apparent temperature	25.0 °F
Object Distance	25.0 ft

Text Comments

Description

IR of exterior shows thermal transfer through first floor windows and concrete slab. Recommend sealing windows. Refer to EEM T1-10 for cost and savings.

Inspection Report

Report Date	5/29/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Brookline Middle School
Address	90 Main Street, Newmarket, NH 03857	Site Address	25 Main Street, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

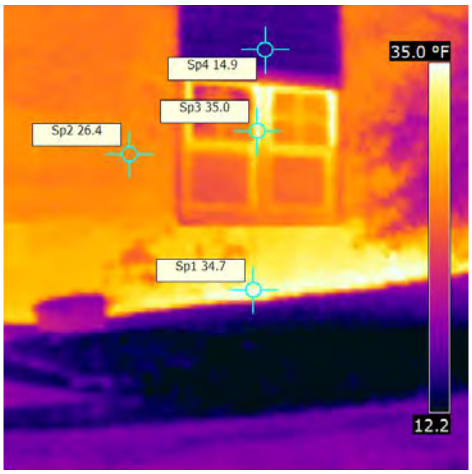


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/20/2012 7:15:31 AM
Image Name	IR_2359.jpg
Emissivity	0.96
Reflected apparent temperature	32.0 °F
Object Distance	20.0 ft

Text Comments

Description

IR of exterior side of the building shows thermal transfer highest through the concrete at the bottom of the wall and through the window frame. Brick and clapboard siding also show varying degrees of thermal transfers.

Inspection Report

Report Date	5/29/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Brookline Middle School
Address	90 Main Street, Newmarket, NH 03857	Site Address	25 Main Street, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

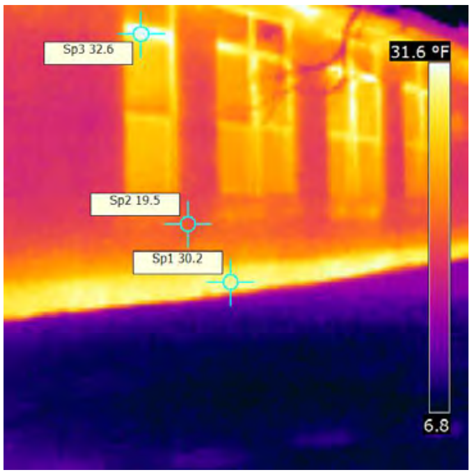


Image and Object Parameters

Text Comments

Camera Model	B-CAM Western S
Image Date	1/20/2012 7:16:40 AM
Image Name	IR_2362.jpg
Emissivity	0.96
Reflected apparent temperature	28.0 °F
Object Distance	20.0 ft

Description

Exterior IR reveals thermal transfer through the window frame and the concrete at the bottom of the wall. Recommend air-sealing windows. Refer to EEM T1-10 for cost and savings.

Inspection Report

Report Date	5/29/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Brookline Middle School
Address	90 Main Street, Newmarket, NH 03857	Site Address	25 Main Street, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

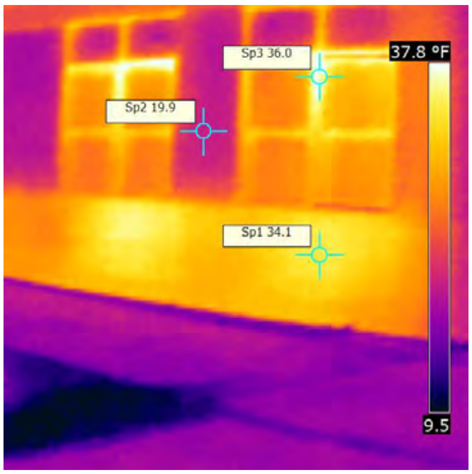


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/20/2012 7:18:05 AM
Image Name	IR_2364.jpg
Emissivity	0.96
Reflected apparent temperature	32.0 °F
Object Distance	15.0 ft

Text Comments

Description

IR of the exterior of the building reveals thermal transfer of varying degrees through the fascade and window frame. Through this picture it is evident the wall below the window has different thermal properties than the wall at window height.

Inspection Report

Report Date	5/29/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Brookline Middle School
Address	90 Main Street, Newmarket, NH 03857	Site Address	25 Main Street, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

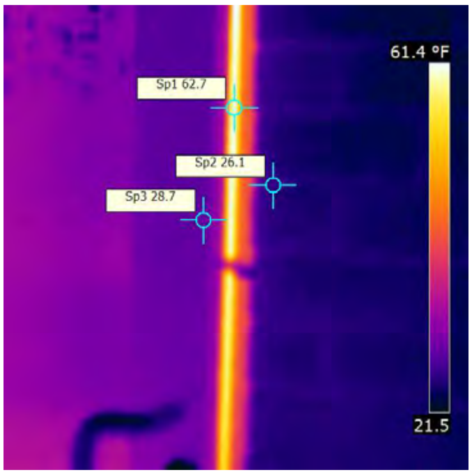


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/20/2012 7:18:38 AM
Image Name	IR_2366.jpg
Emissivity	0.96
Reflected apparent temperature	25.0 °F
Object Distance	3.0 ft

Text Comments

Description

Door propped open allows for loss of thermal energy. Recommend leaving all doors shut.

Inspection Report

Report Date	5/29/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Brookline Middle School
Address	90 Main Street, Newmarket, NH 03857	Site Address	25 Main Street, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

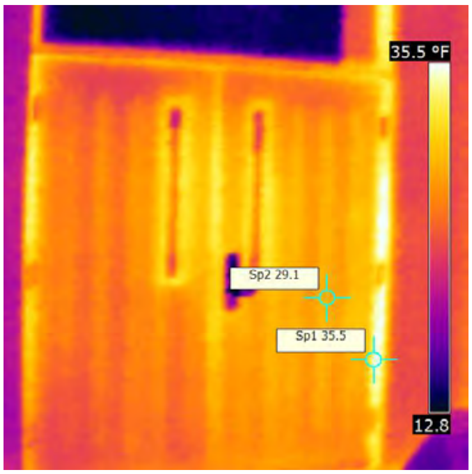


Image and Object Parameters

Text Comments

Camera Model	B-CAM Western S
Image Date	1/20/2012 7:19:41 AM
Image Name	IR_2369.jpg
Emissivity	0.96
Reflected apparent temperature	30.0 °F
Object Distance	8.0 ft

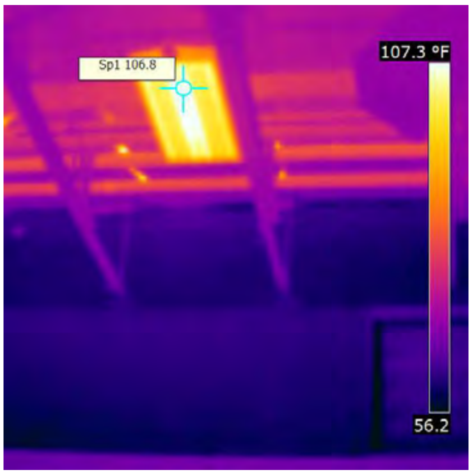
Description

IR of exterior door shows minimal thermal transfer around door frame. Recommend air-sealing door. Refer to EEM T1-10 for associated cost and savings.

Inspection Report

Report Date	5/29/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Brookline Middle School
Address	90 Main Street, Newmarket, NH 03857	Site Address	25 Main Street, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	



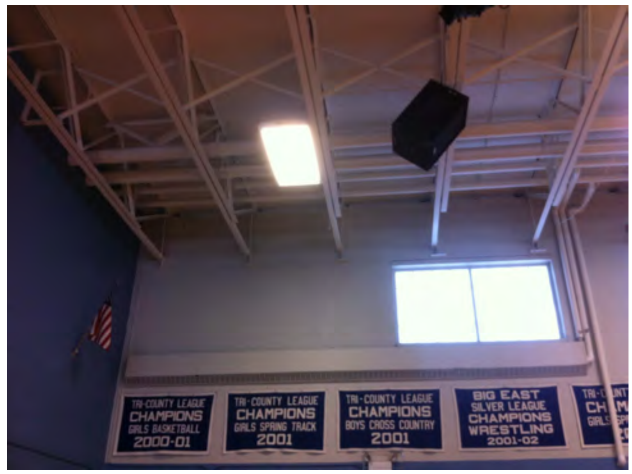


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/20/2012 9:57:40 AM
Image Name	IR_2413.jpg
Emissivity	0.96
Reflected apparent temperature	108.0 °F
Object Distance	20.0 ft

Text Comments

Description

IR of gymnasium light reveals thermal energy produced. Recommend installing de-stratification fans to circulate hot air that has risen and thermal energy produced by lights to circulate to floor level. Refer to EEM T2-3 for cost and savings.

Inspection Report

Report Date	5/29/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Brookline Middle School
Address	90 Main Street, Newmarket, NH 03857	Site Address	25 Main Street, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/20/2012 10:03:23 AM
Image Name	IR_2414.jpg
Emissivity	0.96
Reflected apparent temperature	156.0 °F
Object Distance	5.0 ft

Text Comments

Description

IR of the boiler reveals thermal transfer occuring. Recommend replacing current boilers with geothermal system or new more efficient boilers. Refer to EEMs T3-3 and T3-5 for cost and savings.

AEC

Inspection Report

Report Date	5/29/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Brookline Middle School
Address	90 Main Street, Newmarket, NH 03857	Site Address	25 Main Street, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

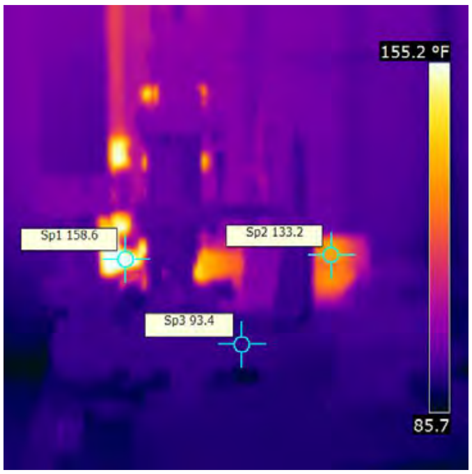


Image and Object Parameters

Text Comments

Camera Model	B-CAM Western S
Image Date	1/20/2012 10:03:46 AM
Image Name	IR_2415.jpg
Emissivity	0.96
Reflected apparent temperature	135.0 °F
Object Distance	10.0 ft

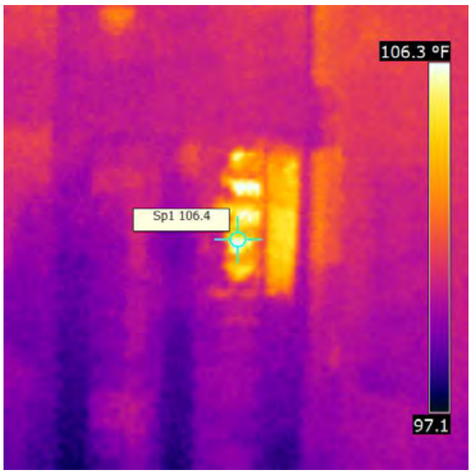
Description

IR of circulation pump reveals thermal enegy produced from background pump, indicating it is running and adding heat load to space, but foreground pump is not running.

Inspection Report

Report Date	5/29/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Brookline Middle School
Address	90 Main Street, Newmarket, NH 03857	Site Address	25 Main Street, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	



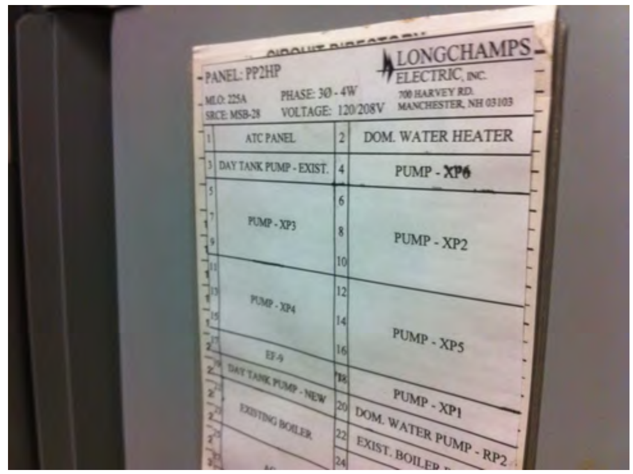


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/20/2012 10:04:04 AM
Image Name	IR_2416.jpg
Emissivity	0.96
Reflected apparent temperature	108.0 °F
Object Distance	4.0 ft

Text Comments

Description

Circuit breaker reveals electrical draw on one pump, presumably the one that was observed running using IR.

Inspection Report

Report Date	5/29/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Brookline Middle School
Address	90 Main Street, Newmarket, NH 03857	Site Address	25 Main Street, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

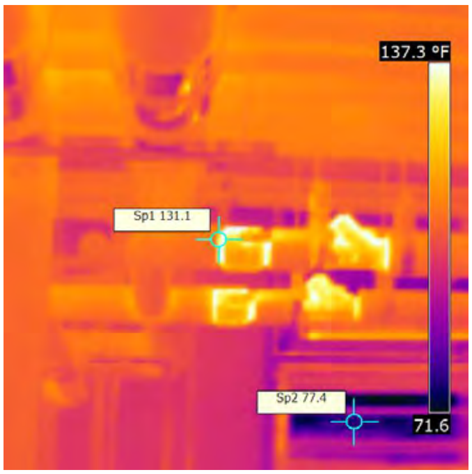


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/20/2012 10:05:09 AM
Image Name	IR_2417.jpg
Emissivity	0.96
Reflected apparent temperature	133.0 °F
Object Distance	12.0 ft

Text Comments

Description

IR in boiler room reveals heating pipes where they are not insulated and open damper allowing thermal transfer to occur. Damper designed to exhaust hot air so room does not get too hot.

Inspection Report

Report Date	5/29/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Brookline Middle School
Address	90 Main Street, Newmarket, NH 03857	Site Address	25 Main Street, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

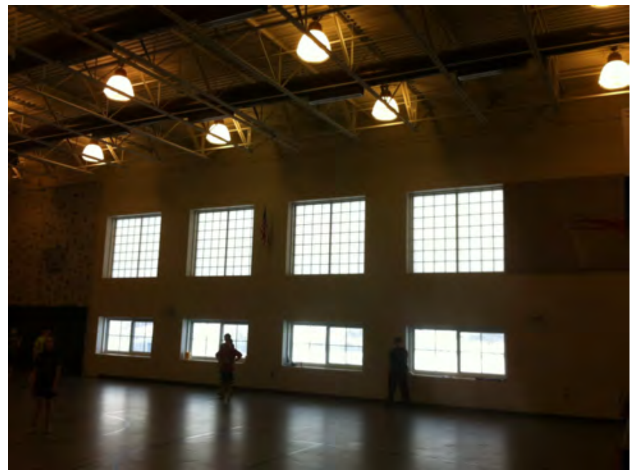


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/20/2012 10:13:42 AM
Image Name	IR_2419.jpg
Emissivity	0.96
Reflected apparent temperature	54.0 °F
Object Distance	30.0 ft

Text Comments

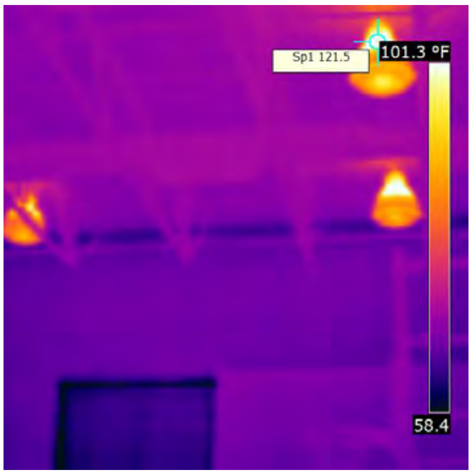
Description

IR of windows in multipurpose room reveals poor seals around windows, particularly lower windows. Recommend weather stripping all entry doors and windows. Refer to EEM T1-10 for associated cost and savings.

Inspection Report

Report Date	5/29/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Brookline Middle School
Address	90 Main Street, Newmarket, NH 03857	Site Address	25 Main Street, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	



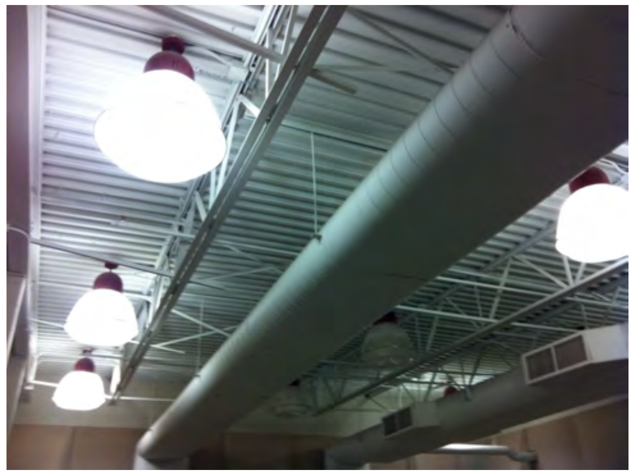


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/20/2012 10:13:46 AM
Image Name	IR_2420.jpg
Emissivity	0.96
Reflected apparent temperature	123.0 °F
Object Distance	25.0 ft

Text Comments

Description

High pressure sodium light bulbs in the gymnasium create a lot of thermal energy. Replacing these fixtures with higher efficiency units not cost practical. Recommend de-stratification fan to circulate hot air at ceiling level to floor. Refer to EEM T2-3.

Inspection Report

Report Date	5/29/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Brookline Middle School
Address	90 Main Street, Newmarket, NH 03857	Site Address	25 Main Street, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

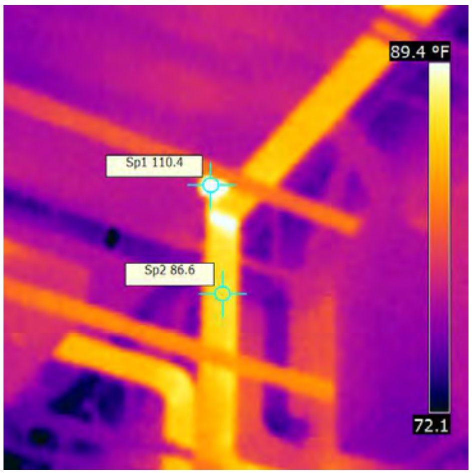


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/20/2012 10:31:17 AM
Image Name	IR_2421.jpg
Emissivity	0.96
Reflected apparent temperature	88.0 °F
Object Distance	12.0 ft

Text Comments

Description

IR of heating pipe in the art room reveals portion of pipe that is uninsulated allowing for thermal transfer.

Inspection Report

Report Date	5/29/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Brookline Middle School
Address	90 Main Street, Newmarket, NH 03857	Site Address	25 Main Street, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

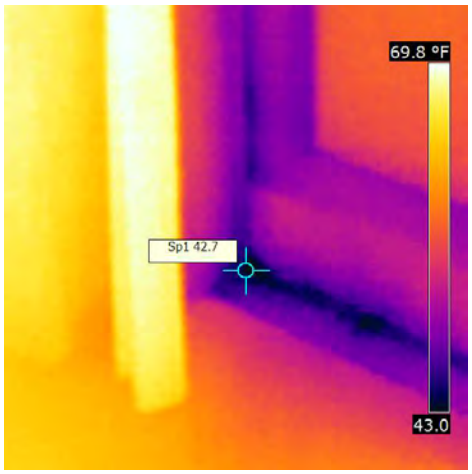


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/20/2012 10:31:39 AM
Image Name	IR_2422.jpg
Emissivity	0.96
Reflected apparent temperature	42.0 °F
Object Distance	3.0 ft

Text Comments

Description

IR of the corner of a window reveals a poor seal allowing thermal transfer to occur. Recommend air-sealing all windows. Refer to EEM T1-10 for associated cost and savings.

Inspection Report

Report Date	5/29/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Brookline Middle School
Address	90 Main Street, Newmarket, NH 03857	Site Address	25 Main Street, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

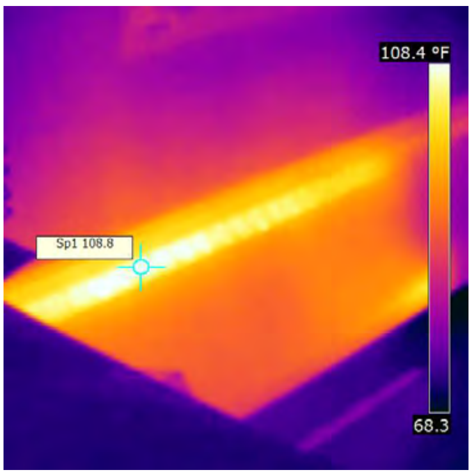


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/20/2012 10:31:50 AM
Image Name	IR_2423.jpg
Emissivity	0.96
Reflected apparent temperature	111.0 °F
Object Distance	5.0 ft

Text Comments

Description

IR of heater reveals how heat is distributed through the unit.

Inspection Report

Report Date	5/29/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Brookline Middle School
Address	90 Main Street, Newmarket, NH 03857	Site Address	25 Main Street, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

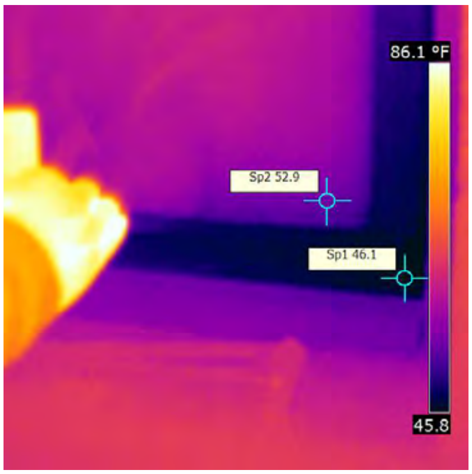


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/20/2012 10:38:23 AM
Image Name	IR_2426.jpg
Emissivity	0.96
Reflected apparent temperature	45.0 °F
Object Distance	3.0 ft

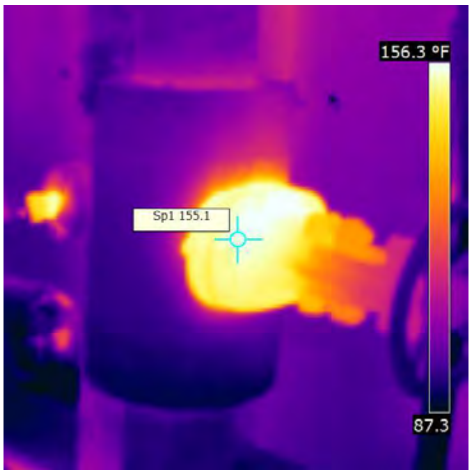
Text Comments

Description

IR of window reavals thermal transfer through the window frame. Recommend air-sealing all windows. Refer to EEM T1-10 for associated cost and savings.

Inspection Report

Report Date	5/29/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Brookline Middle School
Address	90 Main Street, Newmarket, NH 03857	Site Address	25 Main Street, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	



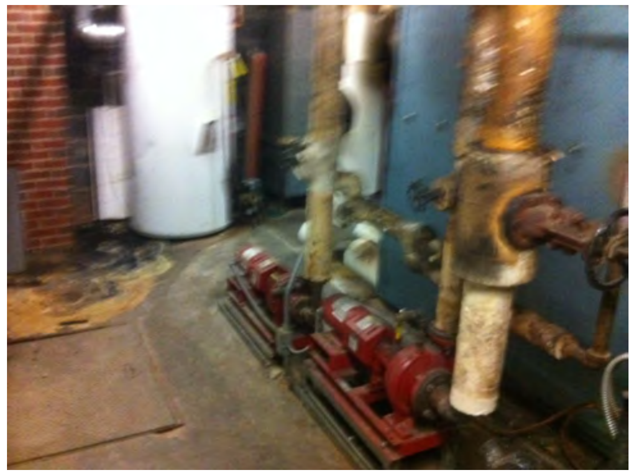


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/20/2012 10:08:04 AM
Image Name	IR_2418.jpg
Emissivity	0.96
Reflected apparent temperature	158.0 °F
Object Distance	4.0 ft

Text Comments

Description

IR of pump pipe reveals uninsulated portion allowing for thermal transfer.

APPENDIX C

Indoor Metering Data

INDOOR METERING DATA

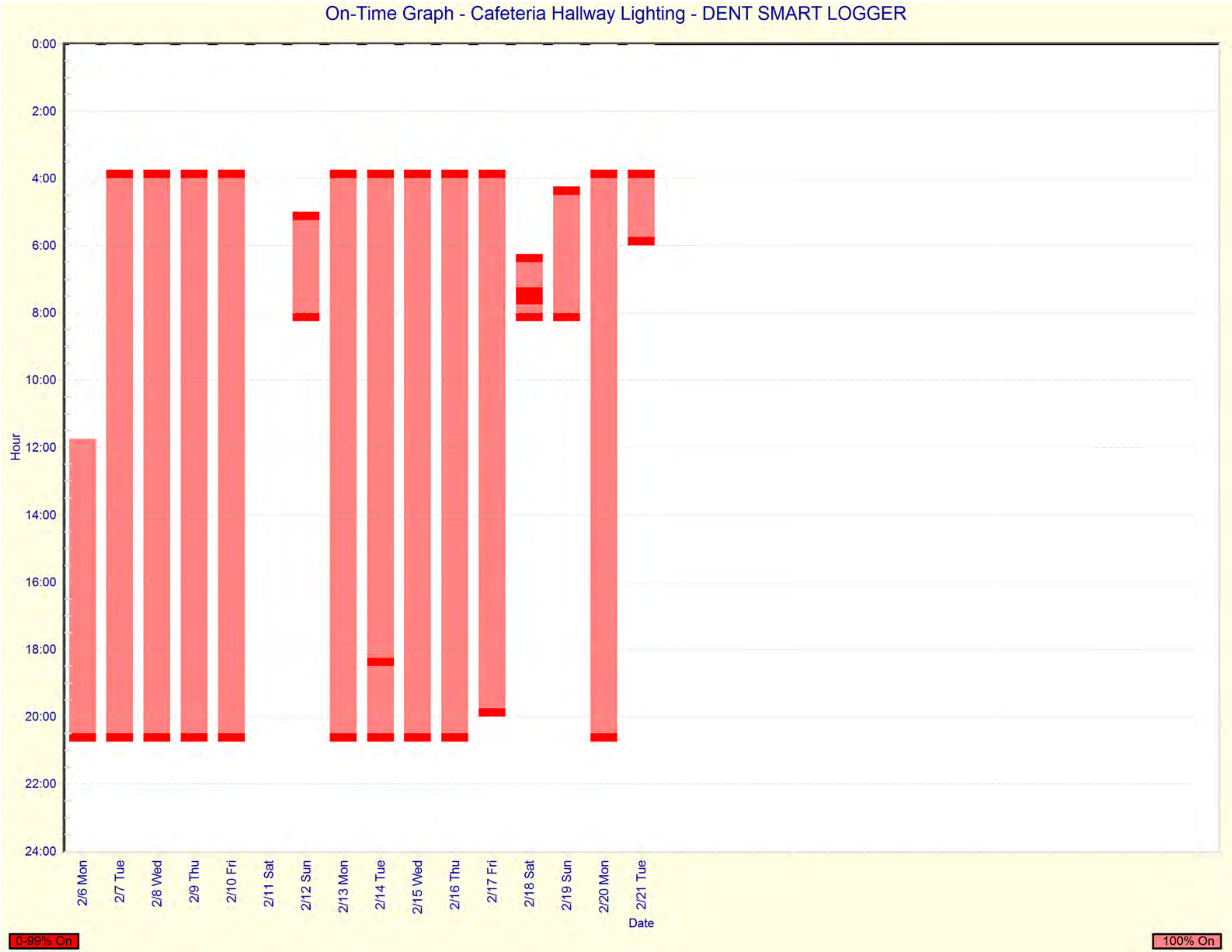
Facility:	Location:	Date:	Ambient Outdoor:
HBMS	Hollis, NH	12/22/2011	Temp= 45 RH= 40 CO2= 315

Location /Use Description	Time	Occupied	Air Quality Temp (°F)	RH (%)	CO2 (ppm)	Lighting Density Vert (FC)	Notes
Main hall ns	828	N	72.6	31.9	836	38.7	
Main hall ew	829	N	71.6	33	850	47.8	
2nd fl ns	830	N	71	36.9	1,791	37.9	Daylight
3rd fl ew	832	N	72.5	38.5	1,454	41.2	
3rd fl ns	833	N	73	36.5	1,476	40.4	
Middle stairwell westside		N				49	3 in middle
1st fl ew	838	N	70.7	37.6	1,394	47.5	
1st fl ew (stairwell)	839	N	70.5	40.3	1,418	42.1	
1st fl ns (rm 4-7)		N				36.2	
1st fl ew (rm 8-11)	841	N	70.7	37.7	1,150	36.4	
1st fl ns (rm 12 - s1)	842	N	70.5	37.1	899	33	
Library hall	842	N	71.6	33.3	825	36.5	
Entrance vestibule	1038	N	71.2	31.5	701	37.4	
Ns n hall	848	N	72.8	31.1	1,168	36.5	
EW n hall	850	N	71.9	32.1	957	35.8	
102	853	Y	75.3	40	1,815	34.4	
T5	855	Y	74.8	31.2	1,536	31.8	
110	857	Y	73.4	29.1	932	37.2	Half on, cold year round
Gym	900	Y	72.3	34.3	986	43.6	
112	902	N	72.3	34.7	1,253	37.7	All comps on
Multi purpose room	903	Y	70.8	37.7	1,153	17.3	
T16	907	N	73.2	30.4	534	42	
205	909	Y	73.2	40.9	1,763	53.1	
206	910	Y	74.4	44.3	2,209	42.7	
209	913	N	74.8	34.9	1,550	41.4	
214							Too hot year round
212	915	Y	73.5	36.8	1,520	57.9	
213	917	N	72.6	34	1,144	49.2	Chilly
214	918	N	73.4	34	1,042	38.7	
250 library	921	Y	74.6	34.7	1,100	47.5	Stuffy, open windows in am
7 comp lab	924	N	72.8	39.2	1,523	50.9	All comps on
11	926	Y	71.6	36	975	72	
T3	927	N	71.7	37.2	1,112	31.8	No lights on, natural window light
14 spanish	929	Y	72.3	36.6	1,057	60	
17	930	N	71.4	33.5	818	57.8	No lights on, natural window light
120 guidance	931	N	71.9	34.2	1,011	39	
121	932	N	72.5	33.5	1,038	50.8	
123	934	Y	73.4	35.5	1,016	8.8	No overhead used, only lamp

130 nurse	936	N	73.4	31.4	1,024	46.4	
131	937	Y	73.5	33.3	1,102	66.1	AC cold in summer new wing only
143	939	N	73.5	31.6	1,170	31.4	
Main lobby	940	Y	74.3	30.2	1,144	37.2	Cold in summer, diff in hall
141	942	Y	74.1	30.5	1,226	80.1	
109	944	Y	74.8	30.8	940	45.4	
103	947	Y	72.5	33.5	1,088	35.6	
201	951	Y	72.8	33.2	1,265	56.8	Poor air circulation, no windows
202	954	N	72.1	31.7	1,040	13.8	Lights on
208	957	N	73.4	38.5	1,430	39.3	Too hot, open windows
211	1000	Y	75.5	44.2	2,185	54.1	
12	1004	Y	73.7	40.7	1,669	47.8	Hard to control temp, rotating lab
15							Hot in winter
9	1006	Y	74.1	40.9	1,399	58.3	Sun too, half light
Kitchen	1020	N	73.7	34	954	55.3	Cold air blows by student line
5	1024	N	73.4	35.1	1,024	44.6	Cold, no heat, hot rm 4
220	1028	Y	73.7	27.3	620	26.4	Heat unstable, space heater, all sun
106 shop	1032	Y	71	31.4	1,021	20.2	
108	1033	Y	72.3	36.6	955	26.4	Cold, kiln 8-12 times/yr, drafty windows
Averages			**72.8**	**35.0**	**1,194**		

Summary
HBMS_CAF.HALL.log

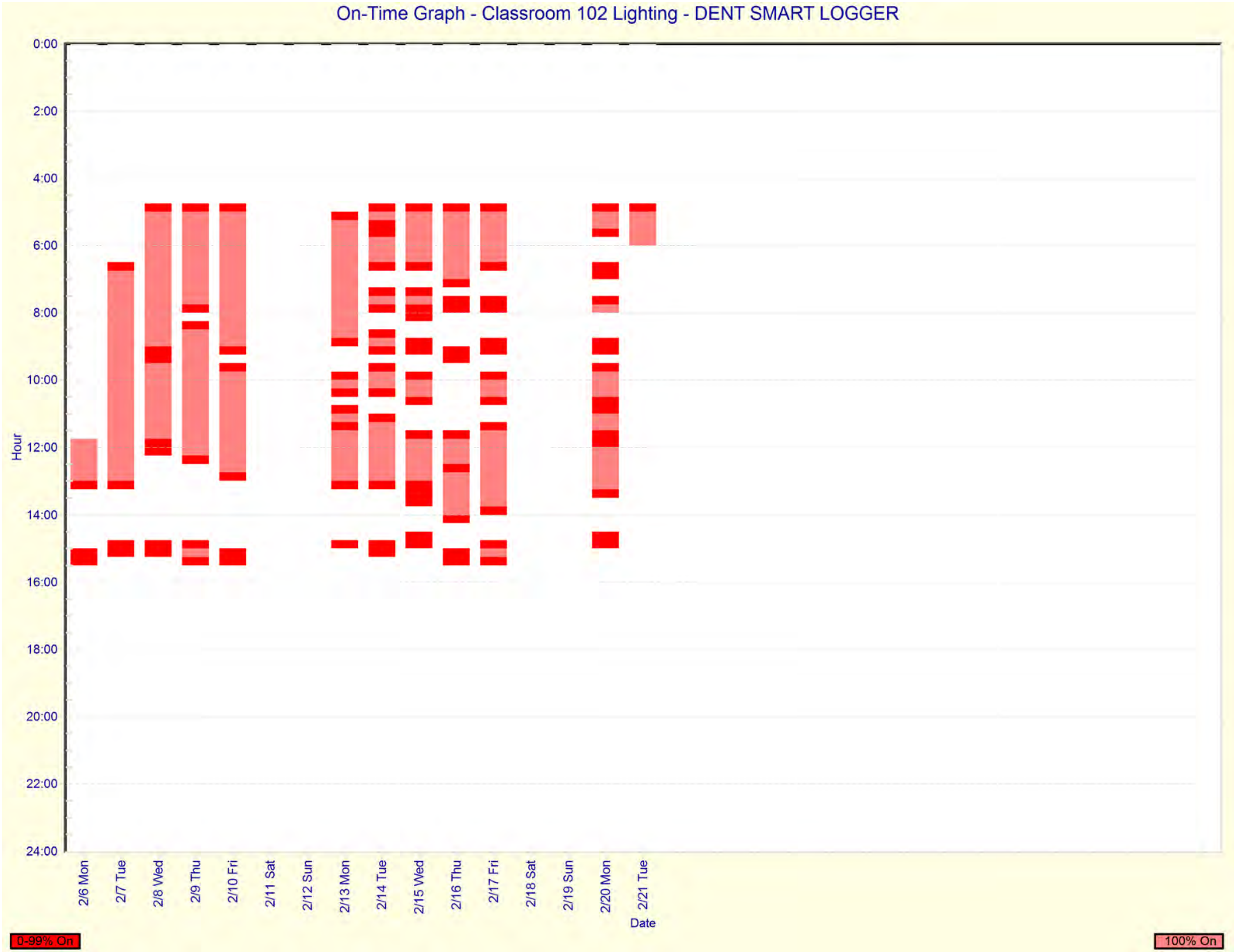
Data File Name:	HBMS_CAF.HALL.log	
Logger Serial Number:	LL11060039	
Description:	DENT SMART LOGGER	
Logger Reset:	2/6/2012	11:40:01 AM
Elapsed Time Since Reset:	354.33	hrs
On-Time Since Reset:	186.30	hrs
Percent On Since Reset:	52.58 %	
Connected Load:	No Load Define	
Energy Cost:	Unknown	
Data Starts:	2/6/2012	11:40:01 AM
Data Ends:	2/21/2012	6:00:29 AM
Data Elapsed Time:	354.34	hrs
Estimated Annual Hours On	4608	hrs
Number of Turn Ons:	21	
Percent On:	52.60	%
Data On-Time:	186.39	hrs
Average On-Time:	8.88	hrs
Longest On-Time:	16.75	hrs
Shortest On-Time:	< 0.01	hrs
Number of Turn Offs:	21	
Percent Off:	47.40	%
Data Off-Time:	167.95	hrs
Average Off-Time:	8.00	hrs
Longest Off-Time:	32.49	hrs
Shortest Off-Time:	< 0.01	hrs



On-Time Graph - Cafeteria Hallway Lighting - DENT SMART LOGGER
Hour
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
24:00
2/6 Mon
2/7 Tue
2/8 Wed
2/9 Thu
2/10 Fri
2/11 Sat
2/12 Sun
2/13 Mon
2/14 Tue
2/15 Wed
2/16 Thu
2/17 Fri
2/18 Sat
2/19 Sun
2/20 Mon
2/21 Tue
Date
0-99% On
100% On

Summary
HBMS_RM102.log

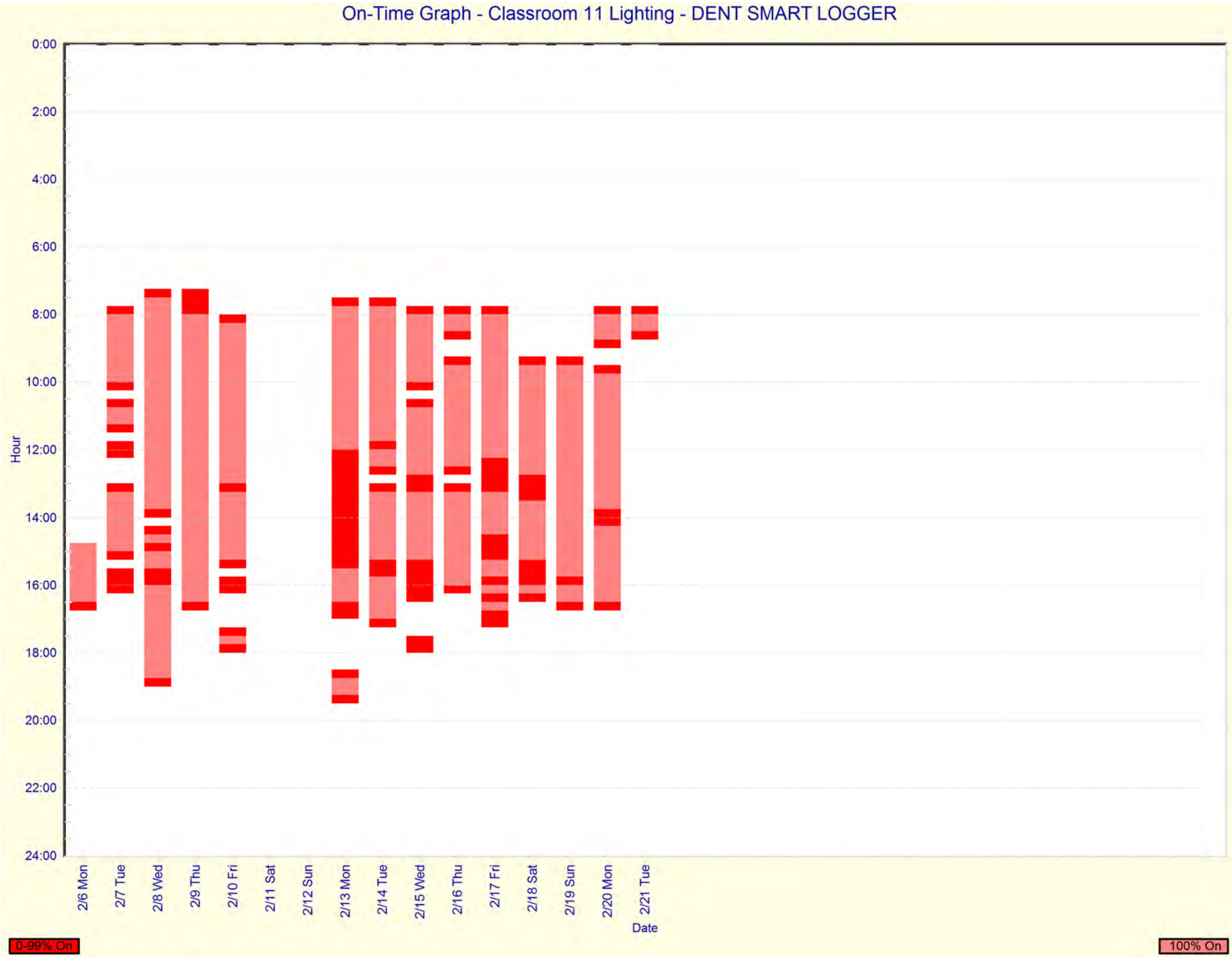
Data File Name:	HBMS_RM102.log	
Logger Serial Number:	LL11060004	
Description:	DENT SMART LOGGER	
Logger Reset:	2/6/2012	11:41:54 AM
Elapsed Time Since Reset:	354.53	hrs
On-Time Since Reset:	66.00	hrs
Percent On Since Reset:	18.62 %	
Connected Load:	No Load Define	
Energy Cost:	Unknown	
Data Starts:	2/6/2012	11:41:54 AM
Data Ends:	2/21/2012	6:14:45 AM
Data Elapsed Time:	354.55	hrs
Estimated Annual Hours On	1633	hrs
Number of Turn Ons:	58	
Percent On:	18.64	%
Data On-Time:	66.09	hrs
Average On-Time:	1.14	hrs
Longest On-Time:	6.56	hrs
Shortest On-Time:	< 0.01	hrs
Number of Turn Offs:	59	
Percent Off:	81.36	%
Data Off-Time:	288.45	hrs
Average Off-Time:	4.89	hrs
Longest Off-Time:	61.71	hrs
Shortest Off-Time:	< 0.01	hrs



On-Time Graph - Classroom 102 Lighting - DENT SMART LOGGER
Hour
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
24:00
2/6 Mon
2/7 Tue
2/8 Wed
2/9 Thu
2/10 Fri
2/11 Sat
2/12 Sun
2/13 Mon
2/14 Tue
2/15 Wed
2/16 Thu
2/17 Fri
2/18 Sat
2/19 Sun
2/20 Mon
2/21 Tue
Date
0-99% On
100% On

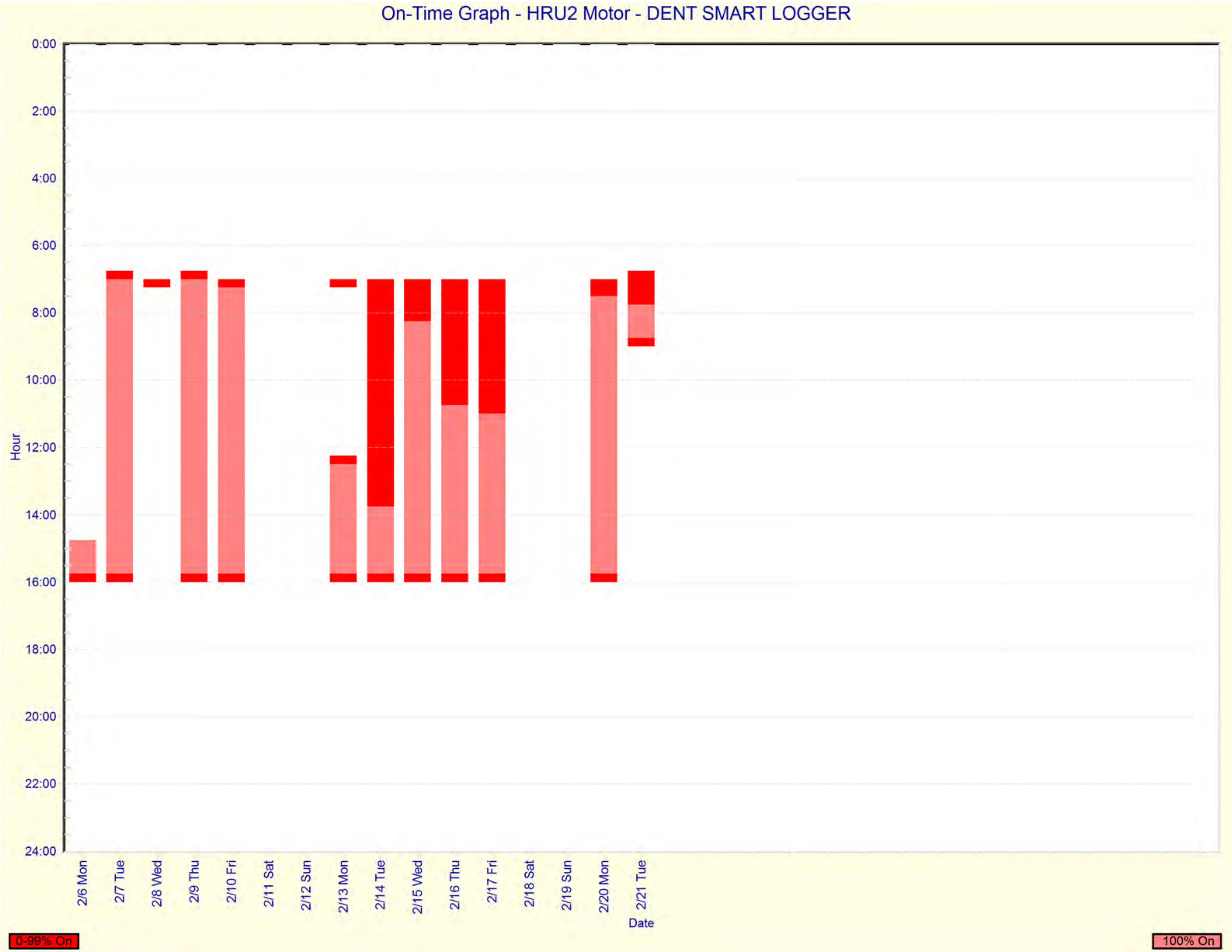
Summary
HBMS_RM11.log

Data File Name:	HBMS_RM11.log	
Logger Serial Number:	LL11040189	
Description:	DENT SMART LOGGER	
Logger Reset:	2/6/2012	2:44:48 PM
Elapsed Time Since Reset:	354.23	hrs
On-Time Since Reset:	98.30	hrs
Percent On Since Reset:	27.75 %	
Connected Load:	No Load Define	
Energy Cost:	Unknown	
Data Starts:	2/6/2012	2:44:48 PM
Data Ends:	2/21/2012	8:59:35 AM
Data Elapsed Time:	354.25	hrs
Estimated Annual Hours On	2432	hrs
Number of Turn Ons:	187	
Percent On:	27.76	%
Data On-Time:	98.36	hrs
Average On-Time:	0.53	hrs
Longest On-Time:	8.70	hrs
Shortest On-Time:	< 0.01	hrs
Number of Turn Offs:	188	
Percent Off:	72.24	%
Data Off-Time:	255.89	hrs
Average Off-Time:	1.36	hrs
Longest Off-Time:	61.64	hrs
Shortest Off-Time:	< 0.01	hrs


On-Time Graph - Classroom 11 Lighting - DENT SMART LOGGER
Hour
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
24:00
2/6 Mon
2/7 Tue
2/8 Wed
2/9 Thu
2/10 Fri
2/11 Sat
2/12 Sun
2/13 Mon
2/14 Tue
2/15 Wed
2/16 Thu
2/17 Fri
2/18 Sat
2/19 Sun
2/20 Mon
2/21 Tue
Date
0-99% On
100% On

Summary
HBMS_HRU2.log

Data File Name:	HBMS_HRU2.log	
Logger Serial Number:	ML11040014	
Description:	DENT SMART LOGGER	
Logger Reset:	2/6/2012	2:34:47 PM
Elapsed Time Since Reset:	354.43	hrs
On-Time Since Reset:	75.70	hrs
Percent On Since Reset:	21.36 %	
Connected Load:	No Load Define	
Energy Cost:	Unknown	
Data Starts:	2/6/2012	2:34:47 PM
Data Ends:	2/21/2012	9:01:43 AM
Data Elapsed Time:	354.45	hrs
Estimated Annual Hours On	1872	hrs
Number of Turn Ons:	178	
Percent On:	21.37	%
Data On-Time:	75.74	hrs
Average On-Time:	0.43	hrs
Longest On-Time:	8.98	hrs
Shortest On-Time:	< 0.01	hrs
Number of Turn Offs:	179	
Percent Off:	78.63	%
Data Off-Time:	278.71	hrs
Average Off-Time:	1.56	hrs
Longest Off-Time:	63.02	hrs
Shortest Off-Time:	< 0.01	hrs



On-Time Graph - HRU2 Motor - DENT SMART LOGGER
Hour
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
24:00
2/6 Mon
2/7 Tue
2/8 Wed
2/9 Thu
2/10 Fri
2/11 Sat
2/12 Sun
2/13 Mon
2/14 Tue
2/15 Wed
2/16 Thu
2/17 Fri
2/18 Sat
2/19 Sun
2/20 Mon
2/21 Tue
Date
0-99% On
100% On

APPENDIX D

Lighting Fixture Inventory

LIGHTING FIXTURE INVENTORY

Facility:	Location:	Date:
HBMS	Hollis, NH	12/22/2011

Location /Use Description	Fixture	Watts/fixture	Qty	Controls	Total watts	Est. Hr/Wk	Est. KWH Consumption/Yr
Exit	Led	5	69	Always On	345	168	3,014
140 main office	CFL	17	5	Switch	85	45	161
G5	T8	32	1	Switch	32	50	67
S2	T8	32	1	Switch	32	2	3
U12	T8	32	2	Switch	64	2	5
U14	T8	32	1	Switch	32	2	3
U15	T8	32	1	Switch	32	2	3
U4	T8	32	2	Switch	64	2	5
U6	T8	32	1	Switch	32	2	3
U7	T8	32	2	Switch	64	2	5
G4	CFL	34	11	Switch	374	50	785
G5	CFL	34	11	Switch	374	50	785
111 gym	CFL	54	3	Switch	162	50	340
4	T8	64	12	Switch	768	42	1,355
5	T8	64	12	Switch	768	42	1,355
6	T8	64	12	Switch	768	42	1,355
7	T8	64	12	Switch	768	42	1,355
8	T8	64	12	Switch	768	42	1,355
9	T8	64	12	Switch	768	42	1,355
10	T8	64	12	Switch	768	42	1,355
11	T8	64	12	Switch	768	42	1,355
12	T8	64	12	Switch	768	42	1,355
13	T8	64	15	Switch	960	42	1,693
14	T8	64	12	Switch	768	42	1,355
15	T8	64	12	Switch	768	42	1,355
16	T8	64	8	Switch	512	42	903
17	T8	64	8	Switch	512	42	903
101	T8	64	15	Switch	960	42	1,693
102	T8	64	18	Switch	1,152	42	2,032
103	T8	64	20	Switch	1,280	42	2,258
104	T8	64	15	Switch	960	42	1,693
105	T8	64	13	Switch	832	42	1,468
106	T8	64	12	Switch	768	42	1,355
107	T8	64	16	Switch	1,024	42	1,806
110	T8	64	18	Switch	1,152	42	2,032
112	T8	64	12	Switch	768	42	1,355
130	T8	64	3	Switch	192	42	339
131	T8	64	5	Switch	320	42	564
141	T8	64	2	Switch	128	42	226
144	T8	64	6	Switch	384	42	677
145	T8	64	1	Switch	64	42	113
147	T8	64	1	Switch	64	42	113
148	T8	64	2	Switch	128	42	226

200	T8	64	3	Switch	192	42	339
200	T8	64	4	Switch	256	42	452
201	T8	64	12	Switch	768	42	1,355
202	T8	64	2	Switch	128	42	226
203	T8	64	1	Switch	64	42	113
204	T8	64	12	Switch	768	42	1,355
205	T8	64	12	Switch	768	42	1,355
206	T8	64	12	Switch	768	42	1,355
207	T8	64	12	Switch	768	42	1,355
208	T8	64	12	Switch	768	42	1,355
209	T8	64	12	Switch	768	42	1,355
210	T8	64	12	Switch	768	42	1,355
211	T8	64	12	Switch	768	42	1,355
212	T8	64	15	Switch	960	42	1,693
213	T8	64	8	Switch	512	42	903
214	T8	64	6	Switch	384	42	677
215	T8	64	6	Switch	384	42	677
220	T8	64	2	Switch	128	42	226
221	T8	64	2	Switch	128	42	226
250	T8	64	42	Switch	2,688	42	4,742
251	T8	64	2	Switch	128	42	226
252	T8	64	2	Switch	128	42	226
261	T8	64	2	Switch	128	42	226
262	T8	64	1	Switch	64	42	113
263	T8	64	4	Switch	256	42	452
111 gym	T8	64	12	Switch	768	50	1,613
140 kitchen	T8	64	1	Switch	64	42	113
140 main office	T8	64	13	Switch	832	45	1,572
1st fl ew (rm 8-11)	T8	64	6	Timer	384	60	968
1st fl ew (stairwell)	T8	64	4	Timer	256	60	645
1st fl ns (rm 12 - s1)	T8	64	12	Timer	768	60	1,935
1st fl ns (rm 4-7)	T8	64	7	Timer	448	60	1,129
2nd fl ns	T8	64	16	Timer	1,024	60	2,580
3rd fl ew	T8	64	5	Timer	320	60	806
3rd fl ns	T8	64	8	Timer	512	60	1,290
Art closet	T8	64	2	Switch	128	2	11
Cross country	T8	64	2	Switch	128	25	134
Entrance vestibule	T8	64	6	Timer	384	60	968
Exterior	T8	64	4	Photocell	256	61	812
G10	T8	64	2	Switch	128	50	269
G4	T8	64	12	Switch	768	50	1,613
G5	T8	64	10	Switch	640	50	1,344
Gym vestibule	T8	64	2	Switch	128	50	269
Kitchen	T8	64	20	Switch	1,280	42	2,258
L2	T8	64	4	Switch	256	10	108
L3	T8	64	4	Motion	256	3	32
L4	T8	64	4	Motion	256	3	32
L5	T8	64	4	Switch	256	10	108

L6	T8	64	4	Switch	256	10	108
Library hall	T8	64	5	Timer	320	60	806
Main hall ew	T8	64	8	Timer	512	60	1,290
Main hall ns	T8	64	27	Timer	1,728	60	4,355
Middle stairwell westside	T8	64	4	Timer	256	60	645
North hall	T8	64	10	Timer	640	60	1,613
North hall	T8 short	64	3	Timer	192	60	484
Ns n hall	T8	64	8	Timer	512	60	1,290
Other stair	T8	64	5	Timer	320	60	806
S1	T8	64	4	Motion	256	2	22
S12	T8	64	1	Switch	64	2	5
S13	T8	64	2	Switch	128	2	11
S14	T8	64	3	Switch	192	2	16
S15	T8	64	1	Switch	64	2	5
S3	T8	64	4	Switch	256	2	22
S4	T8	64	2	Switch	128	2	11
S5	T8	64	1	Switch	64	2	5
S6	T8	64	1	Switch	64	2	5
S8	T8	64	2	Switch	128	2	11
T1	T8	64	1	Switch	64	15	40
T10	T8	64	1	Switch	64	15	40
T11	T8	64	6	Switch	384	15	242
T12	T8	64	1	Switch	64	15	40
T15	T8	64	4	Switch	256	15	161
T16	T8	64	6	Switch	384	15	242
T17	T8	64	2	Switch	128	15	81
T18	T8	64	1	Switch	64	15	40
T2	T8	64	1	Switch	64	15	40
T3	T8	64	6	Switch	384	15	242
T4	T8	64	5	Switch	320	15	202
T5	T8	64	2	Switch	128	15	81
T6	T8	64	1	Switch	64	15	40
T7	T8	64	2	Switch	128	15	81
T8	T8	64	2	Switch	128	15	81
T9	T8	64	2	Switch	128	15	81
U2	T8	64	2	Switch	128	2	11
Exterior	CFL	65	35	Photocell	2,275	61	7,216
109	T8	96	18	Switch	1,728	42	3,048
121	T8	96	3	Switch	288	42	508
122	T8	96	3	Switch	288	42	508
123	T8	96	3	Switch	288	42	508
124	T8	96	2	Switch	192	42	339
142	T8	96	3	Switch	288	42	508
143	T8	96	2	Switch	192	42	339
120 guidance	T8	96	3	Switch	288	42	508
111 gym	CFL	108	24	Switch	2,592	50	5,443
108	T8	128	16	Switch	2,048	42	3,613
Exterior	MH	150	7	Photocell	1,050	61	3,331

202	CFL	320	11	Switch	3,520	42	6,209
203	CFL	320	20	Switch	6,400	42	11,290
Totals:			**1,018**		**75,947**		**142,471**

APPENDIX E

Mechanical Equipment Inventory

MECHANICAL EQUIPMENT INVENTORY

Facility:		Location:			Date:	
HBMS		Hollis, NH			12/22/2011	
Location /Use Description	**Qty**	**Affiliated System**	**V**	**phase**	**Manufacturer**	**Est. kWh/yr**
Roof / Condensers	2	Walk-in Freezer	208	3	Heatcraft	11680

AIR HANDLING UNIT INVENTORY

Facility:		Location:				Date:		
HBMS		Hollis, NH				12/22/2011		

Name / Location	Serves	Affiliated System	HP	V	Phase	Manufacturer	Model	Est. kWh/yr
HV-1	Upper Gym	Ventilation	7.5	460	3	Trane	TSCB014U0C	5,588
RTU-1	Library	Heat AC & Vent		460	3	Trane	THC092A4R0A0E3X	15,826
RTU-2	Computer	AC	1.33	460	3	Trane	THC048A4R0A1KH2B	2,020
RTU-3	Kitchen	Heat & Vent				Trane	TCD181C40CCA	17,570
AHU-1	AC 3 Room U2	AC				Carrier	38HDC048-631	14,068
AHU-2	AC 4 Room U7	AC				Carrier	38HDC048-631	14,068
HRU1	First Floor Addition	Ventilation				Bossaire		15,000
HRU2	Second Floor Addition	Ventilation				Bossaire		10,000
							Total	94,139

AIR CONDITION CONDENSING UNIT INVENTORY

Facility:			Location:					Date:	
HBMS			Hollis, NH					12/22/2011	
Name	**Serves**	**Affiliated System**	**Location**	**Phase**	**Cooling (ton)**	**Manufacturer**	**EER**	**Model**	**Est. kWh/yr**
ACCU-3	Data Room	AC	Roof		1	Carrier		38AN012320	854
ACCU-4	Data Room	AC	Roof		1	Carrier		38AN009120	926
ACCU-5	Data Room	AC	Roof		1	Carrier		38AN009120	926
ACCU-6	Kitchen	AC	Roof		1	Carrier		38AN009120	926
									3630

AC SYSTEM INVENTORY

Facility:		Location:			Date:	
HBMS		Hollis, NH			12/22/2011	
Location /Use Description	**Serves**	**Volt**	**Phase**	**Manufacturer**	**Model**	**Est. kWh/yr**
Roof / AC-1	Admin	208	3	McQuay	CUR075GYYY	2,783
Roof / AC-2	Admin	208	3	McQuay	CUR075GYYY	2,783
Roof / AC-3	Admin	208	3	McQuay	CUR075GYYY	2,783
Roof / AC-6	Computer Room Old	208	3	McQuay	CUR075GGG	2,783
						11,131

BOILER DATA SHEET

Facility:		Location:				Date:	
HBMS		Hollis, NH				12/22/2011	
Location /Use Description	**Manufacturer**	**Model Number**	**Qty**	**Year**	**Capacity (mbh)**	**Efficiency**	**Circ Pump**
Boiler #1	HB Smith	28A-S/W-08	1	1994	1709	81%	Yes
Boiler #2	HB Smith	28A-S/W-08	1	1994	1709	81%	Yes
DHW Heater	John Wood	JW717RF	1	2009		80%	Yes

FAN DATA SHEET

Facility:		Location:		Date:
HBMS		Hollis, NH		12/22/2011

Location /Use Description	Manufacturer	Model Number	HP	Est. kWh/yr
Kitchen Roof/Exhaust	Penn	DX16B	0.5	1,162
Kitchen Roof/Exhaust	Penn	FX13B	1.5	3,487
Gym Roof/ Exhaust	Penn	DX24B	1	2,324
Gym Roof/ Exhaust	Penn	DX11DS	1/7	332
Locker room	Greenheck	3L280	0.5	1,162
Art Room EF9	Greenheck		0.5	1,162
Woodshop	Penn	FX13B	1.5	3,487
Lab	Greenheck	GB1304XCD	0.25	581
LAB	Greenheck	3L200	0.25	581
LAB	Greenheck	3L200	0.25	581
LAB	Greenheck	3L200	0.25	581
LAB	Greenheck	3L200	0.25	581
LAB	Greenheck	3L200	0.25	581
LAB	Greenheck	3L200	0.25	581
LAB	Greenheck	3L200	0.25	581
				17,765

PUMPS DATA SHEET

Facility:	Location:	Date:
HBMS	Hollis, NH	12/22/2011

Location /Use Description	Qty	HP	Volt	Phase	Est. kWh/yr
New Boiler Room P1/P2 Hydronic	2	5	208	3	12,516
New Boiler Room P3/P4 DHW	2	2			5,006
Old Boiler Room	2	5			12,516
Total:	**6**				**30,038**

APPENDIX F

Plug Load Inventory

PLUG LOAD INVENTORY

Facility: HBMS

Location: Hollis, NH

Date: 12/22/2011

Location /Use Description	Unit	Watts/fixture	Qty	Total watts	Est. Hr/Wk	Est. kWh/Yr
106	Band saw	375	6	2,250	1.5	135
144	Coffee maker	1,200	1	1,200	2	96
Kitchen	Commercial fridge	1,185	2	2,370	40	3,792
103	Computer	80	16	1,280	40	2,048
104	Computer	80	2	160	40	256
107	Computer	80	1	80	40	128
108	Computer	80	1	80	40	128
109	Computer	80	1	80	40	128
102	Computer	80	2	160	40	256
140	Computer	80	2	160	40	256
141	Computer	80	1	80	40	128
144	Computer	80	1	80	40	128
131	Computer	80	1	80	40	128
Girls locker room	Computer	80	1	80	40	128
Boys locker room	Computer	80	1	80	40	128
124	Computer	80	1	80	40	128
112	Computer	80	27	2,160	40	3,456
201	Computer	80	17	1,360	40	2,176
Kitchen	Computer	80	1	80	40	128
261	Computer	80	1	80	40	128
204	Computer	80	2	160	40	256
205	Computer	80	2	160	40	256
207	Computer	80	1	80	40	128
208	Computer	80	1	80	40	128
210	Computer	80	1	80	40	128
250	Computer	80	8	640	40	1,024
220	Computer	80	1	80	40	128
15	Computer	80	1	80	40	128
14	Computer	80	1	80	40	128
13	Computer	80	1	80	40	128
12	Computer	80	26	2,080	40	3,328
11	Computer	80	2	160	40	256
10	Computer	80	1	80	40	128
9	Computer	80	1	80	40	128
7	Computer	80	25	2,000	40	3,200
6	Computer	80	2	160	40	256
5	Computer	80	2	160	40	256
4	Computer	80	1	80	40	128
105	Computer	80	1	80	40	128
206	Computer	80	1	80	40	128
209	Computer	80	1	80	40	128
S3	Computer	80	1	80	40	128
T5	Copier	1,440	1	1,440	10	576

T3	Copier	1,440	1	1,440	10	576
250	COW	300	1	300	25	300
140	Desk jet	35	1	35	3	4
T4	Dishwasher	1,000	1	1,000	5	200
110	Dishwasher	1,000	1	1,000	5	200
Kitchen	Drink cooler	350	2	700	40	1,120
110	Dryer	3,360	1	3,360	5	672
Kitchen	Dryer	3,360	1	3,360	5	672
207	DVD	35	1	35	1	1
210	DVD	35	1	35	1	1
211	DVD	35	1	35	1	1
15	DVD	35	1	35	1	1
14	Dvd	35	1	35	1	1
13	DVD	35	1	35	1	1
10	DVD	35	1	35	1	1
109	Fan	20	2	40	1	2
140	Fan	20	1	20	1	1
Kitchen	Fan	20	1	20	1	1
204	Fan	20	1	20	1	1
208	Fan	20	1	20	1	1
212	Fan	20	2	40	1	2
213	Fan	20	1	20	1	1
214	Fan	20	1	20	1	1
220	Fan	20	1	20	1	1
110	Full fridge	600	2	1,200	60	2,880
T5	Full fridge	600	2	1,200	60	2,880
106	Jointer	1,500	1	1,500	1.5	90
201	Keyboard	30	17	510	4	82
T12	Kiln	12,000	1	12,000	0.25	120
123	Lamp	60	1	60	40	96
220	Lamp	60	1	60	40	96
124	Lamp	60	1	60	40	96
103	Laptop	30	6	180	40	288
107	Laptop	30	1	30	40	48
110	Laptop	30	3	90	40	144
102	Laptop	30	1	30	40	48
T4	Laptop	30	1	30	40	48
142	Laptop	30	1	30	40	48
143	Laptop	30	1	30	40	48
121	Laptop	30	1	30	40	48
123	Laptop	30	1	30	40	48
202	Laptop	30	1	30	40	48
208	Laptop	30	1	30	40	48
212	Laptop	30	7	210	40	336
213	Laptop	30	2	60	40	96
214	Laptop	30	3	90	40	144
215	Laptop	30	3	90	40	144
251	Laptop	30	1	30	40	48

17	Laptop	30	5	150	40	240
16	Laptop	30	6	180	40	288
15	Laptop	30	1	30	40	48
14	Laptop	30	1	30	40	48
13	Laptop	30	1	30	40	48
11	Laptop	30	1	30	40	48
9	Laptop	30	1	30	40	48
8	Laptop	30	1	30	40	48
4	Laptop	30	1	30	40	48
122	Laptop	30	1	30	40	48
204	Laptop	30	1	30	40	48
220	Laptop	30	1	30	40	48
200	Laptop	30	2	60	40	96
6	Laptop	30	1	30	40	48
103	Laser jet	500	1	500	2	40
141	Laser jet	500	2	1,000	2	80
143	Laser jet	500	1	500	2	40
144	Laser jet	500	2	1,000	2	80
123	Laser jet	500	1	500	2	40
112	Laser jet	500	1	500	2	40
213	Laser jet	500	1	500	2	40
T3	Laser jet	500	1	500	2	40
7	Laser jet	500	1	500	2	40
T5	Laser jet	500	1	500	2	40
140	Laser jet	500	1	500	2	40
122	Laser jet	500	1	500	2	40
T16	Laser jet	500	1	500	2	40
103	LCD	15	16	240	40	384
104	LCD	15	2	30	40	48
105	LCD	15	1	15	40	24
107	LCD	15	1	15	40	24
108	LCD	15	1	15	40	24
109	LCD	15	1	15	40	24
102	LCD	15	3	45	40	72
140	LCD	15	2	30	40	48
141	LCD	15	1	15	40	24
144	LCD	15	1	15	40	24
131	LCD	15	1	15	40	24
Girls locker room	LCD	15	1	15	40	24
Boys locker room	LCD	15	1	15	40	24
124	LCD	15	1	15	40	24
112	LCD	15	27	405	40	648
201	LCD	15	17	255	40	408
261	Lcd	15	1	15	40	24
204	LCD	15	2	30	40	48
205	LCD	15	2	30	40	48
206	LCD	15	1	15	40	24
207	LCD	15	1	15	40	24

208	Lcd	15	1	15	40	24
209	LCD	15	1	15	40	24
210	LCD	15	1	15	40	24
250	LCD	15	8	120	40	192
S3	LCD	15	1	15	40	24
15	LCD	15	2	30	40	48
14	LCD	15	1	15	40	24
13	LCD	15	1	15	40	24
12	LCD	15	26	390	40	624
11	LCD	15	2	30	40	48
10	LCD	15	1	15	40	24
9	LCD	15	1	15	40	24
7	LCD	15	25	375	40	600
6	LCD	15	2	30	40	48
5	LCD	15	2	30	40	48
4	LCD	15	1	15	40	24
110	Microwave	1,000	4	4,000	2	320
T5	Microwave	800	1	800	2	64
140	Microwave	1,000	1	1,000	2	80
T16	Microwave	1,000	2	2,000	2	160
T3	Microwave	1,000	1	1,000	3	120
Kitchen	Milk chest	1,068	2	2,136	60	5,126
T9	Mini fridge	400	1	400	60	960
140	Mini fridge	400	1	400	60	960
130	Mini fridge	400	1	400	60	960
T3	Mini fridge	400	1	400	60	960
T16	Old fridge	900	1	900	80	2,880
S3	Old fridge	900	1	900	80	2,880
106	Planer	1,500	1	1,500	1.5	90
103	Projector	240	1	240	5	48
102	Projector	240	1	240	5	48
T4	Projector	240	1	240	5	48
209	Projector	240	1	240	5	48
104	Projector	240	1	240	5	48
107	Projector	240	1	240	5	48
204	Projector	240	1	240	5	48
205	Projector	240	1	240	5	48
206	Projector	240	1	240	5	48
211	projector	240	1	240	5	48
12	Projector	240	1	240	5	48
6	Projector	240	1	240	5	48
107	Radio	15	1	15	1	1
131	Radio	15	1	15	1	1
13	Radio	15	1	15	1	1
106	Sander	720	1	720	1.5	43
17	Shredder	200	1	200	1	8
140	Shredder	200	1	200	1	8
144	Space heater	1,100	1	1,100	10	440

220	Space heater	1,100	1	1,100	10	440
110	Stove	2,400	4	9,600	1.5	576
106	Table saw	160	2	320	1.5	19
140	Toaster	1,200	1	1,200	1	48
104	Tv	160	1	160	5	32
108	Tv	160	1	160	5	32
204	Tv	160	1	160	5	32
15	Tv	160	1	160	5	32
14	tv	160	1	160	5	32
9	Tv	160	1	160	5	32
8	Tv	160	1	160	5	32
5	Tv	160	1	160	5	32
109	Tv	160	1	160	5	32
207	Tv	160	1	160	5	32
210	Tv	160	1	160	5	32
211	Tv	160	1	160	5	32
13	Tv	160	1	160	5	32
10	Tv	160	1	160	5	32
204	VCR	25	1	25	1	1
9	Vcr	25	1	25	1	1
T16	Vending machine	1,080	1	1,080	40	1,728
Corridor	Vending machine	1,080	2	2,160	40	3,456
Kitchen	Warmer	2,400	1	2,400	10	960
Kitchen	warming try	2,400	2	4,800	10	1,920
110	Washer	1,200	1	1,200	5	240
Kitchen	Washer	1,200	1	1,200	5	240
202	Water fountain	300	1	300	40	480
Corridor	Water fountain	300	8	2,400	40	3,840
Cafeteria	Water fountain	300	1	300	40	480
109	Water fountan	300	1	300	40	480
S1	Window ac	2,000	1	2,000	10	800
Total:			**537**	**113,581**		**75,200**

APPENDIX G

ENERGY STAR® Statement of Energy Performance

OMB No. 2060-0347

STATEMENT OF ENERGY PERFORMANCE
Hollis Brookline Middle School

Building ID: 1721937
For 12-month Period Ending: January 31, 2012[1]
Date SEP becomes ineligible: N/A

Date SEP Generated: February 16, 2012

Facility
Hollis Brookline Middle School
25 Main St.
Hollis, NH 03049

Facility Owner
Town of Hollis
7 Monument Square
Hollis, NH 03049

Primary Contact for this Facility
Troy Brown
7 Monument Square
Hollis, NH 03049

Year Built: 1975
Gross Floor Area (ft²): 96,025

Energy Performance Rating[2] (1-100) 96

Site Energy Use Summary[3]	
Electricity - Grid Purchase(kBtu)	1,286,324
Fuel Oil (No. 2) (kBtu)	2,426,890
Natural Gas - (kBtu)[4]	0
Total Energy (kBtu)	3,713,214

Energy Intensity[4]	
Site (kBtu/ft²/yr)	39
Source (kBtu/ft²/yr)	70

Emissions (based on site energy use)	
Greenhouse Gas Emissions ($MtCO_2e$/year)	321

Electric Distribution Utility
Public Service Co of New Hampshire [Northeast Utilities]

National Median Comparison	
National Median Site EUI	76
National Median Source EUI	139
% Difference from National Median Source EUI	-49%
Building Type	K-12 School

Stamp of Certifying Professional

Based on the conditions observed at the time of my visit to this building, I certify that the information contained within this statement is accurate.

Meets Industry Standards[5] **for Indoor Environmental Conditions:**	
Ventilation for Acceptable Indoor Air Quality	**N/A**
Acceptable Thermal Environmental Conditions	**N/A**
Adequate Illumination	**N/A**

Certifying Professional
Timothy Nichols
20 Madbury Road STE 3
Durham, NH 03824

Notes:
1. Application for the ENERGY STAR must be submitted to EPA within 4 months of the Period Ending date. Award of the ENERGY STAR is not final until approval is received from EPA.
2. The EPA Energy Performance Rating is based on total source energy. A rating of 75 is the minimum to be eligible for the ENERGY STAR.
3. Values represent energy consumption, annualized to a 12-month period.
4. Values represent energy intensity, annualized to a 12-month period.
5. Based on Meeting ASHRAE Standard 62 for ventilation for acceptable indoor air quality, ASHRAE Standard 55 for thermal comfort, and IESNA Lighting Handbook for lighting quality.

ENERGY STAR® Data Checklist for Commercial Buildings

In order for a building to qualify for the ENERGY STAR, a Professional Engineer (PE) or a Registered Architect (RA) must validate the accuracy of the data underlying the building's energy performance rating. This checklist is designed to provide an at-a-glance summary of a property's physical and operating characteristics, as well as its total energy consumption, to assist the PE or RA in double-checking the information that the building owner or operator has entered into Portfolio Manager.

Please complete and sign this checklist and include it with the stamped, signed Statement of Energy Performance.
NOTE: You must check each box to indicate that each value is correct, OR include a note.

CRITERION	VALUE AS ENTERED IN PORTFOLIO MANAGER	VERIFICATION QUESTIONS	NOTES	☑
Building Name	Hollis Brookline Middle School	Is this the official building name to be displayed in the ENERGY STAR Registry of Labeled Buildings?		☐
Type	K-12 School	Is this an accurate description of the space in question?		☐
Location	25 Main St., Hollis, NH 03049	Is this address accurate and complete? Correct weather normalization requires an accurate zip code.		☐
Single Structure	Single Facility	Does this SEP represent a single structure? SEPs cannot be submitted for multiple-building campuses (with the exception of a hospital, k-12 school, hotel and senior care facility) nor can they be submitted as representing only a portion of a building.		☐

Hollis Brookline Middle School (K-12 School)

CRITERION	VALUE AS ENTERED IN PORTFOLIO MANAGER	VERIFICATION QUESTIONS	NOTES	☑
Gross Floor Area	96,025 Sq. Ft.	Does this square footage include all supporting functions such as kitchens and break rooms used by staff, storage areas, administrative areas, elevators, stairwells, atria, vent shafts, etc. Also note that existing atriums should only include the base floor area that it occupies. Interstitial (plenum) space between floors should not be included in the total. Finally gross floor area is not the same as leasable space. Leasable space is a subset of gross floor area.		☐
Open Weekends?	No	Is this building normally open at all on the weekends? This includes activities beyond the work conducted by maintenance, cleaning, and security personnel. Weekend activity could include any time when the space is used for classes, performances or other school or community activities. If the building is open on the weekend as part of the standard schedule during one or more seasons, the building should select ?yes? for open weekends. The ?yes? response should apply whether the building is open for one or both of the weekend days.		☐
Number of PCs	146	Is this the number of personal computers in the K12 School?		☐
Number of walk-in refrigeration/freezer units	2	Is this the total number of commercial walk-in type freezers and coolers? These units are typically found in storage and receiving areas.		☐
Presence of cooking facilities	Yes	Does this school have a dedicated space in which food is prepared and served to students? If the school has space in which food for students is only kept warm and/or served to students, or has only a galley that is used by teachers and staff then the answer is "no".		☐
Percent Cooled	30 %	Is this the percentage of the total floor space within the facility that is served by mechanical cooling equipment?		☐
Percent Heated	100 %	Is this the percentage of the total floor space within the facility that is served by mechanical heating equipment?		☐
Months	9(Optional)	Is this school in operation for at least 8 months of the year?		☐

High School?	Yes	Is this building a high school (teaching grades 10, 11, and/or 12)? If the building teaches to high school students at all, the user should check 'yes' to 'high school'. For example, if the school teaches to grades K-12 (elementary/middle and high school), the user should check 'yes' to 'high school'.		☐

Energy Consumption

Power Generation Plant or Distribution Utility: Public Service Co of New Hampshire [Northeast Utilities]

Fuel Type: Electricity

Meter: Hollis Brookline MS-Elec (kWh (thousand Watt-hours))
Space(s): Entire Facility
Generation Method: Grid Purchase

Start Date	End Date	Energy Use (kWh (thousand Watt-hours))
01/01/2012	01/31/2012	31,800.00
12/01/2011	12/31/2011	27,200.00
11/01/2011	11/30/2011	26,800.00
10/01/2011	10/31/2011	35,600.00
09/01/2011	09/30/2011	27,800.00
08/01/2011	08/31/2011	22,000.00
07/01/2011	07/31/2011	29,400.00
06/01/2011	06/30/2011	34,400.00
05/01/2011	05/31/2011	28,400.00
04/01/2011	04/30/2011	37,600.00
03/01/2011	03/31/2011	34,000.00
02/01/2011	02/28/2011	42,000.00
Hollis Brookline MS-Elec Consumption (kWh (thousand Watt-hours))		**377,000.00**
Hollis Brookline MS-Elec Consumption (kBtu (thousand Btu))		**1,286,324.00**
Total Electricity (Grid Purchase) Consumption (kBtu (thousand Btu))		**1,286,324.00**
Is this the total Electricity (Grid Purchase) consumption at this building including all Electricity meters?		☐

Fuel Type: Fuel Oil (No. 2)

Meter: Hollis Brookline MS-Oil (Gallons)
Space(s): Entire Facility

Start Date	End Date	Energy Use (Gallons)
01/01/2012	01/31/2012	4,710.30
12/01/2011	12/31/2011	1,900.30
11/01/2011	11/30/2011	1,940.00
10/01/2011	10/31/2011	0.00
09/01/2011	09/30/2011	0.00
08/01/2011	08/31/2011	0.00
07/01/2011	07/31/2011	0.00
06/01/2011	06/30/2011	0.00
05/01/2011	05/31/2011	1,280.00
04/01/2011	04/30/2011	1,053.00

03/01/2011	03/31/2011	3,894.00
02/01/2011	02/28/2011	2,721.00
Hollis Brookline MS-Oil Consumption (Gallons)		**17,498.60**
Hollis Brookline MS-Oil Consumption (kBtu (thousand Btu))		**2,426,889.58**
Total Fuel Oil (No. 2) Consumption (kBtu (thousand Btu))		**2,426,889.58**
Is this the total Fuel Oil (No. 2) consumption at this building including all Fuel Oil (No. 2) meters?		☐

Additional Fuels	
Do the fuel consumption totals shown above represent the total energy use of this building? Please confirm there are no additional fuels (district energy, generator fuel oil) used in this facility.	☐

On-Site Solar and Wind Energy	
Do the fuel consumption totals shown above include all on-site solar and/or wind power located at your facility? Please confirm that no on-site solar or wind installations have been omitted from this list. All on-site systems must be reported.	☐

Certifying Professional

(When applying for the ENERGY STAR, the Certifying Professional must be the same PE or RA that signed and stamped the SEP.)

Name: ____ Date: _____________

Signature: ______________________________________

Signature is required when applying for the ENERGY STAR.

FOR YOUR RECORDS ONLY. DO NOT SUBMIT TO EPA.

Please keep this Facility Summary for your own records; do not submit it to EPA. Only the Statement of Energy Performance (SEP), Data Checklist and Letter of Agreement need to be submitted to EPA when applying for the ENERGY STAR.

Facility
Hollis Brookline Middle School
25 Main St.
Hollis, NH 03049

Facility Owner
Town of Hollis
7 Monument Square
Hollis, NH 03049

Primary Contact for this Facility
Troy Brown
7 Monument Square
Hollis, NH 03049

General Information

Hollis Brookline Middle School	
Gross Floor Area Excluding Parking: (ft^2)	96,025
Year Built	1975
For 12-month Evaluation Period Ending Date:	January 31, 2012

Facility Space Use Summary

Hollis Brookline Middle School	
Space Type	K-12 School
Gross Floor Area(ft^2)	96,025
Open Weekends?	No
Number of PCs	146
Number of walk-in refrigeration/freezer units	2
Presence of cooking facilities	Yes
Percent Cooled	30
Percent Heated	100
Months[o]	9
High School?	Yes
School District[o]	SAU41

Energy Performance Comparison

	Evaluation Periods		Comparisons		
Performance Metrics	**Current** (Ending Date 01/31/2012)	**Baseline** (Ending Date 10/31/2007)	**Rating of 75**	**Target**	**National Median**
Energy Performance Rating	96	80	75	N/A	50
Energy Intensity					
Site (kBtu/ft²)	39	56	60	N/A	76
Source (kBtu/ft²)	70	101	109	N/A	139
Energy Cost					
$/year	$ 113,641.76	$ 79,328.09	$ 175,620.16	N/A	$ 224,579.86
$/ft²/year	$ 1.18	$ 0.83	$ 1.82	N/A	$ 2.33
Greenhouse Gas Emissions					
$MtCO_2e$/year	321	465	496	N/A	634
$kgCO_2e/ft^2$/year	3	5	5	N/A	6

More than 50% of your building is defined as K-12 School. Please note that your rating accounts for all of the spaces listed. The National Median column presents energy performance data your building would have if your building had a median rating of 50.

Notes:
o - This attribute is optional.
d - A default value has been supplied by Portfolio Manager.

APPENDIX H

Renewable Energies Screening Worksheets

RENEWABLE ENERGY SCREENING SUMMARY

Building/Facility:	Hollis-Brookline Middle School	Location:	Hollis, NH
Gross Area (sf):	90,025	Date:	3/21/2012
Use Category:	K-12 School	EUI (kBtu/sf/yr):	70
Heating Fuel(s):	Oil (No. 2)	PM Grade:	96
Heating System(s):	Hydronic	Cooling System(s):	Limited (DX Coils)

RE Technology	Score (out of 70 pts.)	Grade	Notes/Comments
Geothermal Heating/Cooling	60.0	86%	Closed-loop GSHP system.
Roof Photovoltaic	57.0	81%	Large system 30kw - 75kw.
Biomass Heating	56.0	80%	Pellet feed system recommended.
Ground Photovoltaic	55.0	79%	Large system 30kw - 75kw.
Wind Turbine Generator	54.5	78%	Permit requirements are height dependent.
Solar DHW	53.5	76%	DHW demand should be confirmed.
Solar Thermal	52.5	75%	Medium-temperature system.
Combined Heat & Power	47.0	67%	75kW system.

RENEWABLE ENERGY SCREENING WORKSHEET

Building/Facility:	Hollis-Brookline Middle School	Location:	Hollis, NH
Gross Area (sf):	90,025	Date:	3/21/2012
Use Category:	K-12 School	EUI (kBtu/sf/yr):	70
Heating Fuel(s):	Oil (No. 2)	PM Grade:	96
Heating System(s):	Hydronic	Cooling System(s):	Limited (DX Coils)

Technology: **Geothermal Heating & Cooling**

No.	Criteria	Score (1-5 pts.)	Notes/Comments
1	Demonstrated technology	4.5	Well demonstrated technology but does require engineering design.
2	Expected service life/durability	4.5	Well field and loop system has +50 year service life. Equipment has +20 yr service life.
3	Geographical considerations	4.5	Abundant geothermal energy reserves.
4	Energy demand	5	Heating and cooling energy consumption is high.
5	Facility/systems conditions	4.5	Existing system and spacial considerations are met.
6	Facility/systems compatibility	4.5	Existing system and spacial considerations are met.
7	Permitting constraints	5	No special permitting required for a closed-loop system (open-loop would require state permit and is not recommended).
8	Abutter concerns	5	Abutters with water supply wells can be sensitive to geothermal wells but a closed-loop system will have no impact.
9	Capital investment	2.5	High capital cost.
10	O&M requirements	4.5	Very low O&M except routine equipment maintenance.
11	Financial incentives	2.5	Limited incentives in NH.
12	Owner initiatives	4	Owner is open to renewable options.
13	CO2e emissions	4.5	The building currently uses a high amount of oil.
14	Public awareness/education	4.5	Moderately high public use. Information could be displayed in the building so users are aware of geothermal system.
	Total Score:	**60**	
	Total Possible Score:	**70**	
	Grade:	**86%**	

RENEWABLE ENERGY SCREENING WORKSHEET

Building/Facility:	Hollis-Brookline Middle School	Location:	Hollis, NH
Gross Area (sf):	90,025	Date:	3/21/2012
Use Category:	K-12 School	EUI (kBtu/sf/yr):	70
Heating Fuel(s):	Oil (No. 2)	PM Grade:	96
Heating System(s):	Hydronic	Cooling System(s):	Limited (DX Coils)

Technology: **Roof-Mounted Solar PV**

No.	Criteria	Score (1-5 pts.)	Notes/Comments
1	Demonstrated technology	5	Well demonstrated technology with more efficient panel systems in development.
2	Expected service life/durability	3.5	Expected service life of collector panels is 15 years.
3	Geographical considerations	3.5	Limited solar availability in New England.
4	Energy demand	5	High grid electrical demand.
5	Facility/systems conditions	5	Ample amount of south facing roof space.
6	Facility/systems compatibility	5	Ample amount of south facing roof space; newer electrical system
7	Permitting constraints	2.5	Utility grid connection permit is long-lead and may require a designed/engineered system.
8	Abutter concerns	5	School setback from all abutting properties and roads.
9	Capital investment	2.5	High capital cost.
10	O&M requirements	3.5	Increased roof maintenance and panel replacement.
11	Financial incentives	3	Limited incentives in NH.
12	Owner initiatives	4.5	Owner is open to renewable options.
13	CO2e emissions	4.5	Electrical source energy in NH has lower than average CO2 emissions.
14	Public awareness/education	4.5	Moderately high public use facility, would be visible on school grounds.
	Total Score:	**57**	
	Total Possible Score:	**70**	
	Grade:	**81%**	

RENEWABLE ENERGY SCREENING WORKSHEET

Building/Facility:	Hollis-Brookline Middle School	Location:	Hollis, NH
Gross Area (sf):	90,025	Date:	3/21/2012
Use Category:	K-12 School	EUI (kBtu/sf/yr):	70
Heating Fuel(s):	Oil (No. 2)	PM Grade:	96
Heating System(s):	Hydronic	Cooling System(s):	Limited (DX Coils)

Technology: **Biomass Heating Systems (wood, chips, pellets)**

No.	Criteria	Score (1-5 pts.)	Notes/Comments
1	Demonstrated technology	4	Well demonstrated technology. Some woodchip and pellet feed units are newer technology.
2	Expected service life/durability	4	Expected service life is 20 yrs.
3	Geographical considerations	3	Limited fuel in Southern NH.
4	Energy demand	5	Heating energy is high in the building.
5	Facility/systems conditions	4	Woodchips/pellets could be stored inside or outside building.
6	Facility/systems compatibility	4	Woodchips/pellets could be stored inside or outside building.
7	Permitting constraints	5	No special permits required.
8	Abutter concerns	4	Systems are located inside building. Wood or chip feedstock located outside could be a concern.
9	Capital investment	4.5	Low capital cost.
10	O&M requirements	3.5	Wood and woodchip units require constant attending and feedstock must be sourced. Pellet systems with hoppers are less intensive and feedstock is commercially available.
11	Financial incentives	2.5	Limited incentives.
12	Owner initiatives	5	Owner is highly interested biomass heating.
13	CO2e emissions	3.5	Biomass does emit CO2 but the net reduction from the oil system will be significant.
14	Public awareness/education	4	Moderately high public use. Information could be displayed in the building so users are aware of biomass heating system.
	Total Score:	**56**	
	Total Possible Score:	**70**	
	Grade:	**80%**	

RENEWABLE ENERGY SCREENING WORKSHEET

Building/Facility:	Hollis-Brookline Middle School	Location:	Hollis, NH
Gross Area (sf):	90,025	Date:	3/21/2012
Use Category:	K-12 School	EUI (kBtu/sf/yr):	70
Heating Fuel(s):	Oil (No. 2)	PM Grade:	96
Heating System(s):	Hydronic	Cooling System(s):	Limited (DX Coils)

Technology: **Ground-Mounted Solar PV**

No.	Criteria	Score (1-5 pts.)	Notes/Comments
1	Demonstrated technology	5	Well demonstrated technology with more efficient panel systems in development.
2	Expected service life/durability	3.5	Expected service life of collector panels is 15 years.
3	Geographical considerations	3.5	Limited solar availability in New England.
4	Energy demand	5	High grid electrical demand.
5	Facility/systems conditions	5	Newer facility and systems.
6	Facility/systems compatibility	4.5	Multiple areas where system could be installed.
7	Permitting constraints	2.5	Utility grid connection permit is long-lead and may require a designed/engineered system.
8	Abutter concerns	4	Limited abutting properties.
9	Capital investment	3	High capital cost.
10	O&M requirements	3.5	Vegetative cutting and panel replacement.
11	Financial incentives	2.5	Limited incentives in NH.
12	Owner initiatives	4	Owner is open to renewable options.
13	CO2e emissions	4.5	Electrical source energy is NH has lower than average CO2 emissions.
14	Public awareness/education	4.5	Moderately high public use.
	Total Score:	**55**	
	Total Possible Score:	**70**	
	Grade:	**79%**	

RENEWABLE ENERGY SCREENING WORKSHEET

Building/Facility:	Hollis-Brookline Middle School	Location:	Hollis, NH
Gross Area (sf):	90,025	Date:	3/21/2012
Use Category:	K-12 School	EUI (kBtu/sf/yr):	70
Heating Fuel(s):	Oil (No. 2)	PM Grade:	96
Heating System(s):	Hydronic	Cooling System(s):	Limited (DX Coils)

Technology: **Wind Turbine Generator**

No.	Criteria	Score (1-5 pts.)	Notes/Comments
1	Demonstrated technology	4.5	A well demonstrated technology but proper site selection is critical.
2	Expected service life/durability	3.5	Some turbine units have proven unreliable (design flaws). Selection of a reputable manufacturer is critical.
3	Geographical considerations	3	Limited wind energy but a feasibility study is required.
4	Energy demand	5	Electric energy consumption is high.
5	Facility/systems conditions	4.5	Newer building and electrical systems.
6	Facility/systems compatibility	4.5	Newer building and electrical systems.
7	Permitting constraints	3	Special permits are required depending on the height of the pole-mounted turbine. Roof-mounted turbines may be practical however they provide less energy.
8	Abutter concerns	3	Pole-mounted turbines have a large visual impact.
9	Capital investment	4	Moderate capital cost.
10	O&M requirements	3.5	Routine maintenance required. Units are subject to damage from elements.
11	Financial incentives	3	Limited incentives in NH.
12	Owner initiatives	4	Owner is open to renewable options.
13	CO2e emissions	4	Electrical source energy is NH has lower than average CO2 emissions.
14	Public awareness/education	5	High visibility.
	Total Score:	**54.5**	
	Total Possible Score:	**70**	
	Grade:	**78%**	

RENEWABLE ENERGY SCREENING WORKSHEET

Building/Facility:	Hollis-Brookline Middle School	Location:	Hollis, NH
Gross Area (sf):	90,025	Date:	3/21/2012
Use Category:	K-12 School	EUI (kBtu/sf/yr):	70
Heating Fuel(s):	Oil (No. 2)	PM Grade:	96
Heating System(s):	Hydronic	Cooling System(s):	Limited (DX Coils)

Technology: **Solar Domestic Hot Water**

No.	Criteria	Score (1-5 pts.)	Notes/Comments
1	Demonstrated technology	4	Well demonstrated technology although system design and function can vary.
2	Expected service life/durability	3	Expected service life of heating panels is 15 years.
3	Geographical considerations	3.5	Limited solar availability in New England.
4	Energy demand	4.5	Expected DHW demand is low.
5	Facility/systems conditions	4	Large storage currently on site.
6	Facility/systems compatibility	4	Large storage currently on site.
7	Permitting constraints	5	No special permitting required.
8	Abutter concerns	5	Low visibility/impact.
9	Capital investment	2.5	High capital cost.
10	O&M requirements	4	Panel replacement and normal DHW system maintenance.
11	Financial incentives	2.5	Limited incentives in NH.
12	Owner initiatives	4	Owner is open to renewable options.
13	CO2e emissions	3.5	Moderate reduction of oil use based on DHW demand.
14	Public awareness/education	4	Moderately high public use.
	Total Score:	**53.5**	
	Total Possible Score:	**70**	
	Grade:	**76%**	

RENEWABLE ENERGY SCREENING WORKSHEET

Building/Facility:	Hollis-Brookline Middle School	Location:	Hollis, NH
Gross Area (sf):	90,025	Date:	3/21/2012
Use Category:	K-12 School	EUI (kBtu/sf/yr):	70
Heating Fuel(s):	Oil (No. 2)	PM Grade:	96
Heating System(s):	Hydronic	Cooling System(s):	Limited (DX Coils)

Technology: **Solar Thermal HVAC**

No.	Criteria	Score (1-5 pts.)	Notes/Comments
1	Demonstrated technology	3.5	Well demonstrated technology but supply limited. More efficient than regular PV.
2	Expected service life/durability	4	Expected service life of system is 20 years.
3	Geographical considerations	3	Limited solar availability in New England.
4	Energy demand	5	Heating and cooling high.
5	Facility/systems conditions	5	Existing mechanical system could be incorporated into system.
6	Facility/systems compatibility	4	Considerable space required but could be made available. Plumbing complex to protect against freezing.
7	Permitting constraints	2.5	Utility grid connection permit is long-lead and may require a designed/engineered system.
8	Abutter concerns	5	School not visible from abutting properties.
9	Capital investment	2	High capital cost.
10	O&M requirements	3	Vegetative cutting for ground mount, roof maintenance for roof mount, panel replacement.
11	Financial incentives	2.5	Limited incentives in NH.
12	Owner initiatives	4	Owner is open to renewable options.
13	CO2e emissions	4	Electrical source energy is NH has lower than average CO2 emissions.
14	Public awareness/education	5	High visibility depending on placement.
	Total Score:	**52.5**	
	Total Possible Score:	**70**	
	Grade:	**75%**	

RENEWABLE ENERGY SCREENING WORKSHEET

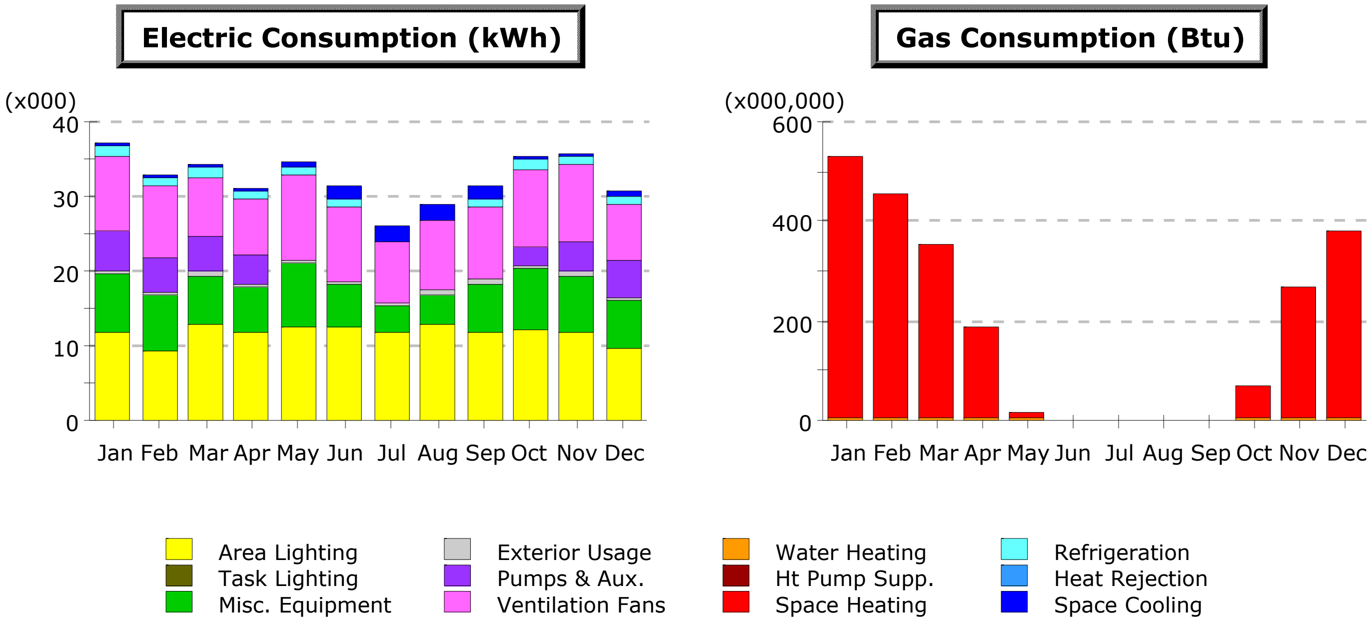
Building/Facility:	Hollis-Brookline Middle School	Location:	Hollis, NH
Gross Area (sf):	90,025	Date:	3/21/2012
Use Category:	K-12 School	EUI (kBtu/sf/yr):	70
Heating Fuel(s):	Oil (No. 2)	PM Grade:	96
Heating System(s):	Hydronic	Cooling System(s):	Limited (DX Coils)

Technology: **Combined Heat & Power System**

No.	Criteria	Score (1-5 pts.)	Notes/Comments
1	Demonstrated technology	5	Smaller CHP units are relatively new technology. Larger units (+75kW) are more reliable.
2	Expected service life/durability	4	Expected service life for a small CHP unit is 10 yrs. Large CHPs have a 20 yr. service life.
3	Geographical considerations	3.5	NH has a low electrical energy cost.
4	Energy demand	4.5	Electric energy consumption is high.
5	Facility/systems conditions	3	Newer building, but some aging electrical panels
6	Facility/systems compatibility	1.5	No natural gas or propane currently on site. Large LP tank would need to be installed.
7	Permitting constraints	5	No special permits required.
8	Abutter concerns	5	Modern CHPs are relatively quiet and would be inside of the building.
9	Capital investment	2	High capital cost.
10	O&M requirements	2	Frequent maintenance required. Large system manufacturers require that they complete maintenance for warranty validation.
11	Financial incentives	2.5	Limited incentives.
12	Owner initiatives	4	Owner is open to renewable options
13	CO2e emissions	1	CHPs consume a large amount of fuel and emissions relative to the re-used energy.
14	Public awareness/education	4	Moderately high public use. Information could be displayed in the building so users are aware of CHP system. However CHP is not entirely renewable.
	Total Score:	**47**	
	Total Possible Score:	**70**	
	Grade:	**67%**	

APPENDIX I

eQUEST® Energy Efficiency Measure Modeling



Electric Consumption (kWh x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	0.52	0.49	0.40	0.31	0.86	1.56	2.17	2.07	1.73	0.45	0.52	0.40	11.50
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	1.20	1.08	1.20	1.16	1.20	1.16	-	0.00	1.16	1.20	1.16	1.20	11.68
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	10.16	9.66	8.12	7.55	11.16	10.03	8.28	9.53	9.65	10.58	10.10	7.60	112.43
Pumps & Aux.	5.24	4.62	4.57	3.89	0.21	-	-	-	0.01	2.24	4.09	4.90	29.78
Ext. Usage	0.57	0.44	0.49	0.47	0.34	0.32	0.34	0.55	0.53	0.55	0.55	0.57	5.71
Misc. Equip.	7.78	7.33	6.48	6.11	8.43	5.86	3.57	3.92	6.69	8.11	7.74	6.15	78.17
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	11.76	9.39	12.96	11.63	12.56	12.44	11.76	12.96	11.63	12.16	11.63	9.75	140.62
Total	37.23	33.01	34.22	31.13	34.75	31.37	26.11	29.01	31.40	35.29	35.80	30.57	389.90

Gas Consumption (Btu x000,000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	525.2	453.4	349.9	185.5	10.0	-	-	-	-	68.6	262.7	379.4	2,234.7
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	4.2	4.1	3.6	3.3	4.2	2.6	1.4	1.4	2.6	3.4	3.5	3.1	37.5
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	529.4	457.5	353.5	188.8	14.2	2.6	1.4	1.4	2.6	72.0	266.3	382.5	2,272.2

APPENDIX J

Cost Estimates

BUDGETARY COST ESTIMATE

Facility: **Hollis-Brookline Middle School**

Date: **3/26/2012**

EEM	Design + Engineering	Installed Cost				Construction Management	Contingency (15%)	Total Investment
		Pricing Unit	Price	Qty	Subtotal			
Replace exterior MH wallpack lighting fixtures with LED units (7).	$ 500	EA	$ 1,400	7	**$ 9,800**	$ 980	$ 1,692	**$12,972**
Replace all electrical transformers older than 15 years with high efficiency units.	$ 1,500	EA	$ 9,100	3	**$ 27,300**	$ 2,730	$ 4,730	**$36,260**
Replace existing oil-fired hot water heater with an electric condensing tank unit.	$ 300	EA	$ 2,850	1	**$ 2,850**	$ 285	$ 515	**$3,950**
Install pressure actuated dampers on all exhaust fans. Place units on occupancy sensors to limit run time.	$ 1,200	EA	$ 1,350	17	**$ 22,950**	$ 2,295	$ 3,967	**$30,412**
Replace one boiler with closed-loop geothermal ground-source heat pump system. Interlock second boiler to supplement the GSHP during peak heating demand periods.	$ 42,000	EA	$ 230,000	1	**$ 230,000**	$ 23,000	$ 44,250	**$339,250**
Install CO_2 demand controls on exchange air ventilation systems.	$ 1,500	EA	$ 11,000	1	**$ 11,000**	$ 1,100	$ 2,040	**$15,640**
Retro-commission the 2005 HVAC systems including balancing of heating distribution and supply and return air systems.	$ 2,000	EA	$ 16,000	1	**$ 14,000**	$ 1,400	$ 2,610	**$20,010**
Replace walk-in freezer & refrigerator condenser units with high efficiency units (EER>14).	$ -	EA	$ 2,800	2	**$ 5,600**	$ 560	$ 924	**$7,084**
Replace the existing boiler units with high efficiency (89%) modulating oil-fired boilers, stack heat recovery unit, and VFD pump controllers.	$ 34,000	EA	$ 192,000	1	**$ 192,000**	$ 19,200	$ 36,780	**$281,980**
Replace CFL lighting fixtures in music room with T8 fixtures and verify illumination densities with IESNA standards.	$ 500	EA	$ 750	11	**$ 8,250**	$ 825	$ 1,436	**$11,011**
Replace CFL lighting fixtures in cafeteria with super-T5 fixtures and verify illumination densities with IESNA standards.	$ 750	EA	$ 750	20	**$ 15,000**	$ 1,500	$ 2,588	**$19,838**