EXPERIENCE

1. **The ESCO's experience in auditing & identifying energy efficiency projects. Provide a list of all energy performance contracting projects completed in the past two years. (If the ESCO has completed more than 15 projects within Washington State in the past 2 years, the ESCO may list just the Washington state projects, in either case the list should be no longer than the most recent 30 projects), including contract value, client contact and client phone number.**

WASHINGTON

PROJECT NAME	DES CONTRACT #	CONTRACT VALUE	CLIENT CONTACT	Est. Grants, Incentive & Rebates	CLIENT PHONE
CWU – Boiler Stack Heat Recovery	2009-258 K (4-1) *Awarded 2013*	2,471,500	Pat Nahan	Commerce Grant - $1.2mm	509-856-5919
City of Camas – HVAC System & Controls Improvements	2013-146 G (1-1) *Awarded 2013*	262,193	Eric Levison	CPU/NW Nat - $48k	360-817-1560
Wy'east Middle School & Transportation Bldg	2012-195 G (1-1)	1,677,819	Dave Cone	CPU - $233k	360-604-4042
CWU – Combined Utility Improvements (Nicolson Blvd/Walnut Mall)	2009-258 I (3-1)	1,736,209	Pat Nahan	N/A	509-856-5919
Yakima SD – HVAC Controls & Lighting Upgrade (10 schools) (Lighting Portion Completed)	2011-032 I (4-1)	2,419,488	Jay Baucom	Pacific Power / Cascade Natural - $401k	509-573-7095
CWU – Science Building	2009-258 G (1-1)	331,750	Pat Nahan	BPA - $184k	509-856-5919
CWU – Aquatic Center, Library, Farrell Hall, & Getz Short Apts	2009-258 B (2)	429,515	Pat Nahan	BPA - $22k Commerce Grant - $200k	509-856-5919
Yakima SD – Garfield & McKinley HVAC & Lighting System Upgrade	2011-032 G (1-1)	1,584,349	Jay Baucom	Pacific Power - $164k	509-573-7095
Yakima SD – Hoover & Nob Hill HVAC & Lighting System Upgrade	2011-032 H (2-1)	3,246,896	Jay Baucom	Pacific Power - $35k	509-573-7095

OREGON

PROJECT NAME	DES CONTRACT #	CONTRACT VALUE	CLIENT CONTACT	Est. Grants, Incentive & Rebates	CLIENT PHONE
North Clackamas Aquatic Park	N/A	818,903	Kandi Ho	ODOE - $247k	503-794-8001
Centennial High School	N/A	420,746	Rick Larson	Cool Schools - $15k	503-762-3650

Beavercreek Elementary School	N/A	528,226	Ted Thonstad	Cool Schools - $15k	503-785-8421
Linfield College	N/A	180,300	Terry Wymore	ODOE - $24k	503-883-2723
City of Eugene	N/A	60,121	Steve Loges	N/A	541-682-8814
Portland Art Museum	N/A	1,322,649	Mac McMillan	ETO - $302k Tax Credit - $188k	503-276-4379
Echo Hollow Pools	N/A	571,909	Steve Loges	ETO - $34k	541-682-8814

2. Provide a Matrix of the range of energy and utility management services provided by the ESCO, including the ESCO's capability to provide the following services: energy auditing, financing, design, general contracting, construction management/administration, testing and balancing, commissioning, warranty services, measurement and verification of savings, energy savings guarantees and facilitating utility participation to maximize utility rebates and incentives.

Abacus has been providing ESCO services for the past twenty six years. Our project manager, Mark Kinzer has delivered over $50 million in successful ESCO projects to the Department of Enterprise Services over that time. At Abacus, we take full responsibility for the complete range of services described below as part of every ESCO performance contract, regardless of size.

We are building experts and our reputation for excellence often precedes us. We listen carefully to our Client and consistently take the extra steps to not only implement and perform to meet our Guarantees but to also remedy and enhance the overall building comfort and efficiency for its occupants. Our success is based on our comprehensive Client-Team approach. We involve our entire team from the pre-planning and proposal stages through to commissioning and measurement and verification.

Item	Yrs of Combined Exp	Description of Experience
Energy Auditing	99 + YRS	We have completed hundreds of energy audits covering a wide range of building types, including schools, hospitals, office buildings, manufacturing/industrial facilities, prisons, community colleges, and universities throughout the region. Our audits are widely recognized as being comprehensive, complete, technically sound, and well written. They are the backbone of our business as this is the stage where all of the energy efficiency improvements are conceived and communicated to the Owner. Any lack of clarity at the audit stage will lead to certain confusion later. To understand our breadth and depth of experience in this phase, know that we purchased a minicomputer in 1985 to run DOE2 simulations. Please also note that we have been certified to provide audits by nearly every utility and government agency in the Northwest.
Financing	99 + YRS	If we cannot round up the financing, it is impossible to implement much conservation. Public clients usually take advantage of the low cost of public financing (lease-purchase) programs available. However, we are always willing and able to provide private financing. In fact, Clark College and the Washington State Historical Society had reason to accept our financing.
Design	99 + YRS	Our in-house engineers often team with consultants familiar with the client's facilities to produce comprehensive design documents to

		be used for bidding and permits. Abacus retains full control of the design elements to insure that expected performance is achieved. On small projects we may complete the entire design in-house.
General Contracting	99 + YRS	As the general contractor, we are responsible for providing the management and supervision of all the material, labor, and equipment and services necessary for the construction of the project. These responsibilities may include procurement, providing temp utilities, site supervision, engineering and design measures, disposal of construction waste, project scheduling, and ensuring OSHA safety standards are being met.
Construction Mgmt/Administration	99 + YRS	Abacus has a Construction Manager dedicated to each project. On large projects, we also provide on-site administrative support to the Construction Manager.
Testing and Balancing	99 + YRS	We have some ability to complete TAB tasks but generally use our in-house resources only during the audit phase. We generally subcontract the TAB tasks included as part of the conservation measure implementation.
Commissioning	99 + YRS	Mark Kinzer will be the lead commissioning person for all projects. Nothing is more important to our business than having all measures perform up to expectations.
Warranty Services	99 + YRS	Abacus is your single point of contact for all warranty services. If we need to enlist suppliers or subcontractors to address any deficiency, we will coordinate their efforts. The client will not need to contact them or manage their warranty work.
Measurement & Verification Of Savings	99 + YRS	In twenty six years we have not had one dispute over savings. Puget Sound Energy's Conservation Partners Program contained one of the most rigorous M&V programs in our history. It involved pre- and post-retrofit measurement of over 1,000 loads on a continuous basis with monthly billing for the actual savings generated. Under this utility grade rigor, we delivered the estimated incentive ($45,000) to the f/k/a General Administration in 180 consecutive months. It is hard to imagine any ESCO project with a longer or more successful track record.
Energy Savings Guarantees	99 + YRS	We provide a written guarantee of specific reductions in utility consumption as a part of every ESCO project. If the savings are not met, we will write a check. To date we have never failed to achieve the guaranteed level of savings and almost always significantly exceed them. Some companies utilize an outside insurance policy to back the guarantee, and reduce their risk. It is our opinion that such insurance is a waste of our client's money.
Facilitating Utility Participation to Maximize Utility Rebates & Incentives	99 + YRS	We have been very successful at maximizing available utility incentives and tax credits. We have delivered over $6 million to the f/k/a GA under Puget Sound Energy's CPP program, we delivered $500,000 to Clark College under BPA's Purchase of Energy Savings Program, and we delivered $1.2 million to Central Washington University under BPA's CONAUG Program. During 2012, we secured and successfully completed $5.4mm in performance contracts. Each of these projects have met or exceeded performance expectations. All incentive applications have been approved or are in the process of approval. Our projects presented under Topic #1 above have received over $1.5mm in incentives and utility rebates.

3. The ESCO's experience with measurement and verification (M&V) processes. The ESCO should describe its familiarity with M&V protocols and when each is most appropriately applied.

We are very familiar and experienced with measurement and verification processes for a wide variety of energy saving projects and programs. We have performed measurement and verification of energy

savings on well over 100 projects. The appropriate M&V process for a particular project depends on the reason why the M&V is being conducted, and the utility programs that are involved.

For a utility program that requires M&V to verify energy savings and to finalize a utility incentive, we will adhere to that utility company's process. Often these processes are loosely based upon the IPMVP. Many utility companies required their own M&V rules be adhered to for verification of energy savings, which we do.

When we are conducting measurement and verification for an owner through an ESCO project, then we rely upon the 2012 IPMVP (International Procedures for Measurement and Verification Protocols) to determine the appropriate process to follow.

We work closely with each customer to understand their desires and needs, in order to develop an appropriate approach to our guaranteed energy savings agreements and calculations that both fulfills the 2012 IPMVP (International Performance Measurement and Verification Protocol) and satisfies the owner. The 2012 IPMVP provides four distinct approaches to measure energy savings, and we spend time to educate the owner about the different options available, which ones can be used for the particular projects being implemented, their level of accuracy and precision, their cost to implement, and the details of how it will apply to a particular upgrade project. We have always been able to come to a mutual agreement with the owner to custom tailor a suitable approach to the particular projects being implemented.

The types of projects that we normally install are fairly comprehensive in scope and are normally projected to significantly reduce an owner's utility bills by at least 20%. Most of our clients are primarily concerned with the reduction in their actual utility bills, and keeping the measurement and verification costs low. This usually leads us and the owner to choose the IPMVP Option C Whole Building Approach to determine the measured energy savings from the projects we install. This is an approach that is suitable when the energy savings are greater than 10% of the entire utility bill, the project affects multiple systems, and there already exists a correlation between the weather and the utility bills. This approach meets most owners' primary expectations – they expect to see noticeable savings directly on their bills as their primary goal, and they want to keep M&V costs to a minimum. This approach also meets most owners' level of sophistication – they can easily compare last year's bills to this year's bills and they can do the simple math themselves. When required, we will utilize both routine adjustments (for weather) and non-routine adjustments (for changes in occupancy patterns), but we normally outperform our energy savings guarantee so we often do not make these adjustments. We find most owners' start to get suspicious when you try to explain to them that "your baseline energy use would have been higher this month anyway because it was colder this month, so we are really saving more than just the difference between this year's bill and last year's bill."

For projects we install in existing facilities that do not lend themselves to a whole building utility meter approach, we utilize options A or B from the 2012 IPMVP. These are approaches that allow direct measurements of the systems being affected both before and after the upgrade. Option A is most appropriate when the system operation is fairly constant or predictable, so the key parameters that change can be directly measured, and these measurements are used in engineering calculations to determine the annual energy savings. Option B is most appropriate when the system operation is

highly variable, so all parameters should be measured over a period of time. In both instances (option A and B) the length of time to conduct both the pre-measurement and post-measurements is dependent on how long it takes to capture the usage profile that represents a broad range of the system's expected annual operation and variability.

For projects incorporated into a new facility, where there is no existing system that can be measured, then we utilize option D, known as Calibrated Simulation. This process would use an energy simulation software package, such as eQuest, Trane Trace, Carrier HAP, etc. with hourly weather inputs, to determine the energy use of the new building if it were built without the energy saving strategies that we incorporate. Then the actual energy bills are compared to the energy model, and the energy model is modified with actual weather data, and the difference between the two is the measured energy savings.

4. The ESCO's experience designing, costing and managing the construction of heating plants (including steam), chilled water plants, heating ventilation and air conditioning systems, heat recovery, energy management and controls systems, lighting and lighting control systems, water efficiency, and other utility system improvements including renewable.

Abacus Resource Management Company has provided design, costing, and management of ESPC contracts for twenty six years. As the ESCO, we are the party responsible for designing, implementing, and measuring the results of the ESPC project. We make a wide variety of recommendations of possible retrofit measures specific to each client's needs, including energy and water conservation measures, renewable energy systems, operations and maintenance services and training and distributed energy generation.

The combined experience of our Senior Management Team is represented below:

	Mark Kinzer, PE *ESCO DIRECTOR* *PE, OR & WA*		*Steve Rubbert* *PRESIDENT* *EIT, LEED*		*Rich Davis* *SENIOR ENERGY ENG* *C.E.M, LEED*		*Scott Hanken* *SENIOR PROJ MGR* *CPM*	
Area of Expertise	**Years of Exp**	**# of Bldgs**	**Years of Exp**	**# of Bldgs**	**Years of Exp**	**# of Bldgs**	**Years of Exp**	**# of Bldgs**
HVAC equipment, systems, controls	26	65 +	21	32 +	19	33	29	100+
Central fan systems and packaged fan systems	21	65 +	21	30 +	19	30	29	100+
Boilers	26	75 +	21	22 +	19	21	29	100+
Steam distribution systems	26	65 +	21	15 +	15	16	29	50+
Hydronic heating and cooling systems	26	65 +	21	20 +	17	12	29	100+
Chillers/refrigeration	26	75 +	21	23 +	17	23	29	100+
Motors	26	65 +	21	32 +	19	31	29	100+
Controls (pneumatic, electric, and direct digital)	26	65 +	23	65 +	15	22	29	400+
Electrical systems	26	65 +	23	23 +	19	8	29	100+
Lighting systems and standards	19	65 +	19	35 +	19	22	3	5+
Domestic water heaters	26	65 +	23	38 +	21	38	29	50+
Heat recovery systems	26	65 +	21	22 +	20	32	29	25+
Weatherization	21	65 +	21	28 +	19	22	11	5+
Motor drives	19	65 +	19	65 +	19	65	23	75+
Water Conservation	26	25 +	26	25 +	19	25	6	2
Geothermal Systems	23	16	11	9 +	7	3	11	7

5. **The ESCO's experience securing utility incentives for its customers. Discuss successful strategies implemented for maximizing utility incentives.**

Abacus has unparalleled experience securing utility incentives and tax credits. The single largest incentive would be the $6,120,000 we have delivered to GA via Puget Sound Energy's Conservation Partners Program (CPP). In addition, we have secured additional millions in incentives from a wide range of programs and utilities, including the Federal Department of Energy, Bonneville Power Administration, Seattle City Light, Tacoma Power, PacificCorp, Clark Public Utilities, Puget Sound Energy, Grant County PUD, the City of Ellensburg, Portland General Electric, the Energy Trust of Oregon, and others.

A key strategy that maximizes incentives, is to be skilled, knowledgeable and certified to provide utility audits directly for the sponsoring utility. Abacus maintains energy efficiency analysis consulting contracts or agreements with most major utilities, and all minor utilities that participate in BPA's energy incentive programs. Abacus is a certified energy pool auditor for BPA and annually provides $200,000 in energy audit analysis work alone for BPA and its Washington State client utilities. Often, Abacus can obtain utility sponsorship for the energy audit directly from the utility, reducing the cost of the audit to the client.

This level of relationship with the utility allows Abacus to be familiar with the specific incentive program rules and requirements of the servicing utility, which results in better received energy analysis reports and larger incentives. Abacus is also a very trusted name in providing energy analysis service as we are part of the utilities own energy efficiency evaluation team. Our track record for providing accurate energy analysis for Washington State utilities has proven our results for the past decade.

Other strategies that we use include the use of modified baselines to address systems that currently do not meet code or minimum required system performance. The baseline is adjusted to account for a code compliant facility and then savings applied for the proposed energy efficient system. In this way, customers with non-functional systems can receive energy incentives for new systems which not only provide code compliant conditions, but also do it more efficiently.

We have also been very successful helping our clients apply for and receive energy conservation grants from various public agencies, such as the Washington Office of Superintendent of Public Instruction (OSPI), the Washington Department of Commerce, and ARRA grants.

6. **A description of the experience key staff have, who are responsible for administration of any potential work awarded thru this project. This is to include any sub-consultants routinely used for execution of performance contracting work. This is not to be the resumes or curriculum vitas (CVs) of personnel. Resumes or CVs may be attached as an appendix. Please indicate if the experience was obtained at other than this ESCO. Please identify the responsible licensed P.E.**

The key to our success is our extensive and comprehensive performance contracting experience. Each member of the Abacus team has more than 20 years experience in the energy field.

We will assign an ESPC construction manager depending on the location, details and timing of specific projects. All of our construction managers have in excess of 25 years of construction experience.

Our ESCO team will draw support from our administrative, engineering, and production teams as needed. But most of your involvement will be with the Senior Management Team presented below. Their resumes are included in the Appendix.

This team is led by Mark Kinzer. Mr. Kinzer was a founder of Abacus Resource Management Company (Abacus). His experience with ESCO projects spans 26 years, more than 50 projects totaling over $50 million. Mark will be your primary point of contact and will have complete responsibility for all projects. Mark Kinzer is a Certified Professional Engineer in both Washington (License # 21125) and Oregon (License # 12875PE). Mark's primary duties with Abacus include overall project design, delivery and project management. Mark is the ESPC Director for all Performance Contracts with DES. Mark's expertise includes the completion of central heating/cooling plants, HVAC improvements, energy management systems, building envelope improvements, lighting improvements, water conservation, high voltage power system improvements on projects ranging in size from $100,000 up to $12 million.

Steve Rubbert, the President of Abacus, will be responsible for all contract management functions, and he will coordinate all financing, bonding, and utility incentives. Steve has 20+ years of experience. As President of Abacus, Steve's primary duties include the responsibility of day-to-day operations of Abacus with bottom line P&L responsibilities, contract negotiations, and providing project budget estimates. Steve is responsible for project development and strategic management of all energy efficiency projects. With specific expertise in whole building systems and energy incentive programs, he creates energy efficiency strategies to maximize energy and incentive benefits for customers, while providing functional building upgrades. Steve is also responsible for creating and managing contractor teams for the implementation of energy measures.

Rich Davis will be responsible for the delivery of all energy audits and monitoring and verification efforts. Rich has 20+ years of energy engineering experience. Rich is a Senior Energy Engineer and Engineering Supervisor. Rich is responsible for the execution, oversight and completion of all energy analysis reports provided by Abacus. Rich is responsible for all aspects of energy analysis delivery by our Audit Team. He is responsible for directing, performing and reviewing all energy analysis work on behalf of the company. Rich's expertise is both the identification and calculation methodology of energy efficiency measures in new and existing facilities.

Scott Hanken is a Senior Project Manager and an ESPC Construction Manager with Abacus. Scott is responsible for all aspects of ESCO and energy conservation Project Management with over 25 years of hands-on energy conservation retrofits and project management experience. Scott has a diverse background in technical and managerial areas with expertise including energy conservation strategies, DDC Controls and HVAC Systems. Scott manages projects from inception to completion, including initial client contact; proposal development; task scheduling; field supervision; report

review; budget tracking; client, agency and subcontractor coordination; and invoicing. Scott is skilled in budgeting, project planning, identifying technical solutions and mitigating risks.

We have purposefully not included any specific sub-consultants or subcontractors in this proposal. However, these industry partners are key participants in all of our ESCO work. You will see in our response to questions ten and sixteen how we maximize the client's benefits by customizing a team of supporting sub-consultants and subcontractors for each specific project.

7. A description of the ESCO's familiarity with EPA's Energy Star Portfolio Manager and other benchmarking tools.

There are several benchmarking tools that we use as a reference when we initially screen a facility for potential energy savings opportunities, including the EPA's Energy Star Portfolio Manager. We have entered many buildings into the EPA's online benchmark tool (over fifty), and it is useful to us to initially compare a facility's individual energy use to the EPA's Energy Star reference database. We will often use this tool to obtain an Energy Star score for a building we are evaluating, and see how much energy the building would use if it were to obtain an Energy Star score of 75, or 90 – this is one of the tools we use to screen out the potential energy savings for a facility prior to conducting an investment grade audit. Other benchmarking tools that we have access to and use for reference include: 2009 Northwest Commercial Building Stock Assessment report; Architecture 2030 – 2030 Challenge Targets; 2003 and 2007 CBECS (Energy Consumption Survey, conducted by the US Energy Information Administration); and a major regional utility company's EUI benchmarks for existing facilities. All of these tools provide us a reference source for how much energy an "average" building of various types in this region consume annually, and give us a guideline for projecting how much potential energy savings exist when we compare this to the building we are evaluating.

While these benchmark tools are useful, we rely more heavily on our own experience at working with upgrading facilities throughout Washington State and Oregon. We know from experience how low the energy use of a building can go after implementation of specific energy efficiency measures for a wide variety of projects and different facility types. We have our own internal database of energy use by region and by facility type, that we have measured directly through utility meters after the upgrades. This is our best and most reliable source of benchmarking a facility, to allow us to quickly estimate how much energy is currently being wasted and how much energy can be saved through various upgrades. This methodology allows us to use our in-depth knowledge of specific facilities and systems and controls, to compare to new buildings that we evaluate, rather than relying on an "average" generated by a benchmark tool, which is based on many different buildings that have different system types, different occupants, different operators, and different controls.

8. A discussion of problems experienced on projects and the remedy for those problems.

Abacus has been providing ESCO services to DES client agencies since 1987. During these past twenty six years we have encountered about every problem imaginable. When you are in the business of retrofitting aged and worn out buildings and energy systems, you should expect problems. Tomorrow will always bring some new ones. Many of the problems revolve around misunderstandings between the client, ESCO, and subcontractors. This is the "we thought you were

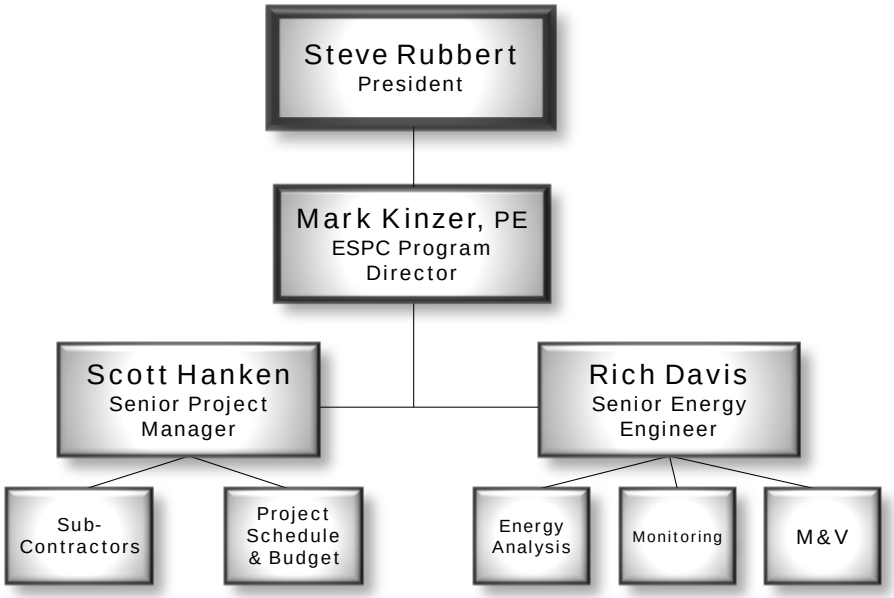
going to do this on this day and instead you did that on that day." We minimize this problem, and mitigate it when it does arise, by constant communication between the DES project manager, our project manager, the Owner's facility representative(s) and our subcontractors.

We sometimes encounter problems with costs. Despite our best efforts, a few times our guaranteed maximum cost ends up not covering the actual cost. When this happens we simply pay for the overage.

There are always equipment performance issues. During construction, our commissioning efforts flush out most of the hidden errors. During the M&V period, we continuously compare actual performance to our expectations and improve performance. During the warranty period, we lead the charge to insure the Owner receives justice and the supplier or installing contractor corrects any deficiency. Even after the warranty period we have encountered situations where the Owner feels slighted. In those cases we again go to bat for the owner and do what we can to correct the problem. Sometimes it can be as simple as explaining to the Owner their light bulbs have been on for 20,000 hours and it was time for them to fail.

9. What is the makeup of a typical project team with regards to local (WA, ID, OR) vs outside region staffing.

All of our work is performed in-house with the exception of our Sub-consultants. All sub-consultants are local to the region and/or to the Client Agency. We prefer to utilize sub-consultant service providers familiar with the building and its systems whenever possible.



MANAGEMENT APPROACH

10. The ESCO's organizational structure and management approach to the project. Clearly describe the roles and responsibilities of typical ESCO staff who will be assigned to any

project obtained under this selection and of any sub-consultants included on the ESCO's team. For sub-consultants, describe the ESCO's prior experience working with the sub-consultant.

We are a small business. Our team members have primary roles and responsibilities, but in the end, our organizational structure and management approach is that all team members participate at a very high level covering whatever bases need to be covered to ensure the client receives the maximum benefits. Our client-team approach has certain discipline built in, for example, Mr. Kinzer will be your primary point of contact. This will ensure effective communication and avoid issues remaining unresolved. Yet, the client-team offers the flexibility and cohesiveness needed to really understand the client's needs and collaborate with them on the best solutions. For example, any member of the client's organization will be able to discuss any issue with any team member and be assured that our entire team will hear the concerns and respond to them.

All of our team members have worked in large structured companies in the past. We all decided that bigger is, well, bigger. We each arrived at Abacus because our drive is to be the best in Energy Efficient Services and not the biggest.

Despite our small size and flexible nature, we are driven by the need to identify the countless details that define all ESCO projects and, one by one, apply the appropriate resources at the appropriate time until all of those details are woven into another miraculous facility improvement. It is our constant attention to the details that led to Central Washington University awarding us more than twenty separate ESCO contracts.

To answer the roles and responsibilities question specifically, Mark Kinzer will be the ESPC Program Director. He will have overall responsibility for excellence in all aspects of the project. Steve Rubbert will coordinate all contracting, financing, bonding, and utility incentive activities. Steve also serves as a backup resource to Mr. Kinzer. Scott Hanken and Mr. Kinzer both perform in the role of senior project manager, depending on project complexity and location. Rich Davis will be responsible for the energy audit and post installation monitoring. Mark Kinzer will guide our Engineering Team in preparing project design documents. We may assemble a customized team of sub-consultants, based in part on the client's preferences (many clients already have consultants that know their facilities and design standards so we try to capitalize on that legacy knowledge), and the specific details of the project. Mr. Kinzer has led design teams working on virtually every type of public building and energy system. Depending on project timing and project technical details, one our construction managers will be responsible to manage the construction phase. Finally, Mark Kinzer will be the responsible party for commissioning the work and ensuring all performance expectations are being met.

11. The ESCO's policies and procedures for managing and delivering its committed work products in a timely fashion within contractual obligations, including project development, construction, and post implementation verification.

Our policy is to diligently manage the scope, schedule, budget, and customer expectations to a successful completion of every project.

Our procedures start with accepting only those engagements which we can accomplish. We are a small company with defined resources and we do not intend to change that structure.

Once we have accepted an engagement, we use several business strategies to manage our delivery. These include careful and complete documentation of the scope, schedule, and budget: frequent dialog with the customer to manage expectations (and documentation of those conversations); weekly review of progress and prioritization of additional resources if needed; allowing ample time for quality control; and personal presentation of all progress and final submittals.

We begin all of our projects with the end in mind. Milestones are established at the initial project meeting for all deliverables from the initial audit to the final M&V report documenting the savings. These are important in order to meet successful project requirements and constraints such as: grant application deadlines, timely board project approval, sufficient lead times for subcontractor and equipment selection & delivery, timely construction and project completion, incentive processing and M&V reporting.

Since we carefully manage our workload, we are able to respond quickly and effectively to accomplish whatever tasks are necessary. Some examples are the quick-turn energy audits and grant applications we were able to accomplish for the Yakima School District and Central Washington University in 2010. Our timely efforts allowed those customers to capture grant funds from OSPI and the Dept of Commerce for several energy efficiency projects each.

12. The ESCO's approach to marketing the DES Energy Program to potential client agencies in conjunction with DES Personnel.

In cases where DES has made the first contact with a client agency, Abacus is willing and able to collaborate with DES on a preliminary assessment of conservation opportunities and help DES demonstrate the workings and benefits of the ESCO program. We would do this at no cost to the client agency or DES.

In cases where Abacus makes the first contact with the client agency, we would invite DES to collaborate in a similar manner. Abacus is willing and able to perform all program marketing steps from first contact to final project development.

Due to our company size, we do not anticipate a broad marketing campaign. We expect to continue developing projects with our existing client agencies and perhaps add up to six additional clients by reference from our existing customers and Washington State utilities that regularly utilize our auditing services.

Being qualified auditors for most utilities in Washington State, Abacus is also well positioned to market DES' program in conjunction with utility sponsored conservation programs.

13. What is the minimum size project your firm would consider viable.

There is no minimum size project requirement for our firm. No project is too large or too small to be considered.

14. The ESCO's approach to effectively communicate project information with the DES Energy Program prior to sharing with client agency.

We maintain close communication with DES throughout the project from start to finish. The length of our tenure in the Washington ESCO program means that we are well acquainted with most all DES project managers, and their preferred communication styles and methods. We strive to provide as much information as possible to the DES manager for review, questions, approvals and comments prior to presentation to the client agency.

Information presented to DES includes all pertinent project information such as:
Existing building EUI and benchmarking
Energy efficiency concepts and measure specifics
Perceived owner objectives, budgets and timelines
Incentive, grants and tax credit information
Audit findings and proposed M&V methodology
Documented meeting notes and decisions
Project budgets, subcontractor and material quotations
Warranty and close out documentation

15. The ESCO's approach to project development from marketing to delivering the ESP.

We receive leads for most of our new clients through word of mouth referrals (happy existing customers) or from local utilities familiar with our work. However, we occasionally also participate in select tradeshows focused on specific customer groups such as aquatic centers, K-12 education or universities.

For virtually all of our projects, we start with a no-cost facility scoping audit that allows us to become familiar with the target facility(s), owner desired scope of work, budget, timing, and potential measures. From the scoping audit we can provide DES & the owner with generally expected results to assist in deciding if and how to proceed with the investment grade audit. This allows the owner to understand what the likely outcome of a thorough analysis and project development will be before making a large investment in time or money.

We also use the scoping audit review as an opportunity for the owner to describe specifics about expected outcomes or areas of focus for facility improvements that may have other owner benefits in addition to energy efficiency.

If the scoping audit yields attractive expected results, which meets the owner requirements for investment, then we prepare a quotation for the investment grade audit (IGA). The IGA will provide detail scope of work and energy efficiency analysis of the preliminary identified energy efficiency measures (EEMs) along with any additional measures uncovered during the audit process. Budgets are established for each measure for consideration and review by DES and the owner. Burdened costs, possible grants, incentives, tax credits, maintenance and utility savings are all included in the

IGA summary table to provide the owner with a true estimated net simple payback for each of the EEMs analyzed.

Once the IGA is ready, we present the results and our recommendations to DES and the owner for consideration. We answer questions and help the owner explore any alternates for consideration of the final scope of work. IGA results are also compared with owner requirements for investment and any requested adjustments noted. Once the final scope of work is selected, we proceed with creating the energy services proposal (ESP).

The ESP is crafted based on the scope of work selected from the IGA. Details of scope, savings, estimates, equipment selection, scheduling and performance are all refined and finalized. Detailed costing, preliminary incentive agreements, energy and performance guarantees are all documented in detail. The ESP is submitted to the DES project manager for review before presentation to the owner. Once any DES requested revisions are incorporated and approved, we present the ESP to DES and the owner. A review is provided to ensure that the original project intent and the owner requirements for investment have been satisfied by the final ESP or modified by all parties in agreement.

16. The method for contracting the installation of the measures, maintaining cost competitive pricing, and whether the ESCO uses open book pricing.

We subcontract for the installation of all work. The majority of our construction is done by subcontractors experienced not only with the nature of the work, but also working in the client's facility. We sometimes contract with the Owner's facility maintenance staff for some elements of the work. Examples of Owner performed subcontracts include everything from mechanical/electrical/plumbing, to cleaning and controls. We have even constructed a project using inmate labor in a prison in order to maximize the owner's resources and the facility savings.

It is important to remember that most ESCO work is done in occupied facilities. It is critical that all subcontractor team members perform their tasks in concert around the Owner's day to day activities. This can be as simple as "no smoking on school property" or as complicated as coordinating a one hour power outage in a data center.

We select the subcontractors based on price and performance. Generally this involves the pre-qualification of a pool of contractors to establish that the performance bar is cleared. These subcontractors are then invited to deliver fixed price bids for the work. Sub-contracts are usually awarded to the lowest bidder.

In order to maximize the Owner's buying power, we usually separate the work into multiple subcontracts (by trade) with Abacus providing the general contractor functions. It is also common for us to purchase certain major equipment when this is advantageous to the Owner.

We prepare complete contract documents which form the basis for the fixed price subcontracts. Our design documents are customized to match the design standards of each client. These documents

are also used to secure all required permits and are eventually updated to reflect as-built conditions which become part of the operation and maintenance records delivered to the Owner.

Abacus offers open book pricing on all projects with the client having full access to all project cost records.

17. The ESCO's procedures for timely closeout of construction projects delivery of O&M Manuals, commissioning reports and other pertinent paperwork to the DES Energy Program and the client agency.

It is our policy to track Project Closing Documentation from the commencement of the project. We find this creates a timely and efficient closing process for all parties involved. Preliminary paperwork we secure includes all Intents for Wages Paid; copies of Permit documentation; and all disposal manifests. We closely track weekly prevailing wage reporting and apprentice forms for all applicable subcontractors throughout construction. We ensure Affidavits of Wages paid are filed in a timely manner upon subcontractor completion on the job. This is also an effective tool for our DES Project Manager and our Client to know when subs are complete on the job site. We secure all Warranties and O&M documentation from our Subcontractors as their role in the ESPC project closes. Commissioning reports and retention invoicing is generated upon the direction of the ESCP Director after all installation is complete and the savings have been verified.

18. The ESCO's procedures for timely submittal of required documentation to Departments of Revenue, Employment Security, and Labor & Industries.

Once we have insured successful Commissioning of our installation, we begin the preparation of the closeout process. This includes creating binders with all closeout documentation as outlined in the DES ESCO Completion Checklist. At this stage in our process, we have reviewed every week of certified payroll for all subcontractors and ensured Affidavits of Wages Paid have been submitted and approved. We also prepare the "Energy Completion Notice" and "Notice of Completion of Public Works Contract" forms on behalf of our DES Project Manager. Once our PM notifies us the 45-day retention period has begun, we contact the Department of Revenue, Employment Security, and Labor & Industries to confirm receipt of the Notice of Completion of Public Works and make sure no questions or additional information is required by the agency. We rely on the written release from each of these agencies prior to the request for our Final Retention Payment. This occurs after the 45-day period set by the DES Project manager.

19. The ESCO's approach to mitigate risks associated with guaranteed cost, savings, and performance.

Our approach to mitigating risk relative to guaranteed cost is to have excellent engineering details so the scope of work is clearly identified. Then we do our own independent cost estimate and invite our industry partners to prepare outside estimates. We compare them and develop an estimate that represents a consensus. We are able to hold the costs to the estimate by inviting competition for the materials and labor, by having a reputation of running well managed projects, and by paying our bills in a timely manner.

Our approach to managing risk relative to energy savings is again the application of excellent engineering. Our project managers have over 20 years of ESCO experience each and the project manager actively participates in every phase of the project, including savings estimates. Then being engineers, we apply a pretty good safety factor to our guarantees.

Relative to performance, we manage risk by applying tried and true solutions, working with manufacturers and subcontractors who have provided us with years of excellent performance, and again using excellent engineering and project management.

20. The ESCO's approach to sharing EPACT tax credits with client agencies.

If applicable, we look at EPACT tax credits as part of the overall financial benefit of the project, similar to utility incentives. As such, we are open to negotiating the value of the EPACT tax credit with the client agency. To date, the majority of our projects have not utilized the EPACT tax credit because the main scope of work is typically more HVAC and controls, not necessarily primary lighting, which is easier to qualify for the credit.

21. The ESCO's experience and approach to meeting the public works requirements for apprenticeship training programs as directed by Chapter 39.04.320 RCW.

Meeting the requirement of RCW 39.04.320 (Apprenticeship Training Programs) has not been any problem on past projects and we would not anticipate any issues on future work. We have found that union and non-union contractors are willing and able to meet this requirement.

22. How Minority and Women Owned Business (MWBE) enterprises will be utilized on the project.

Abacus is not a MWBE enterprise. However, we often find that MWBE enterprises are a part of our sub-consultant or subcontractor team. Whenever there is an MWBE participation goal established for a project, we have no trouble meeting that goal.

23. The ESCO's policies and procedures for recycling materials such as lamps, ballasts, fixtures, ceiling tiles, and other recyclable materials;

We recycle everything that is practical, oftentimes spending a little more than we might if we discarded to landfill. We usually set up recycling bins on the job site and hire laborers to dismantle items into recyclable components. When onsite space limitations preclude that, we will set up the recycling stations off site perhaps at a subcontractor's storage yard. We maintain logs of recycled products and the Owner is invited to inspect the recycling operation.

24. How potential hazardous materials encountered in the installation of energy efficiency measures will be managed; and whether the ESCO has been cited by the Washington Department of Ecology, Federal Environmental Protection Agency, or any other regulatory agency for inappropriate handling, transportation or disposal of hazardous materials. If cited what was the ESCOs remedy. Being cited does not automatically constitute disqualification as an ESCO.

We have on many occasions encountered unexpected hazardous materials during the execution of our projects. Because of our comprehensive HazMat Management Plan and the diligence we instill in all team members to follow the plan and we have never been cited for any violation.

We begin all projects by asking the Owner to disclose any knowledge of potential hazardous materials that may be encountered in our work. Most Owners have a very accurate accounting of what they have in their facilities. Some do not. Regardless, we proceed with caution each and every day. Our HazMat Management Plan is summarized below:

Hazardous Materials Management

Abacus performs all of its work and requires that all of our sub-consultants perform their duties using industry standardized safety guidelines. We also practice safe and judicious handling of all hazardous materials. In addition to maintaining current records of Material Safety Data Sheets for any materials used in the line of duty, we adhere to standardized OSHA guidelines for the safe handling of all hazardous materials that may be encountered while installing energy conservation projects. The enforcement of this policy starts with our work force and the correct identification of hazardous situations as well as potentially hazardous materials.

We require our work crews, either on staff or subcontracted, to adhere to safe working practices and highly encourage them to hold periodic safety "tailgate" meetings. These safety meetings are intended to alert employees and crews to potential job-site hazards as well as allow the employees an open forum to voice their concerns about the working environment. This meeting is conducted by either the Project Manager or Construction Forman and has the sole subject of safety. No other topics are covered during this time. This helps to instill a sense of caution and promotes safe working practices for all involved. Additionally, if project personnel encounter a potentially hazardous situation or material they will know how to handle the situation if the procedures have been covered in the safety meeting.

Asbestos

As mentioned earlier, Abacus takes safety very seriously and adheres to strict OSHA standards as a baseline for our safety program. One example of a hazardous material that is commonly encountered during retrofit projects is Asbestos. We have a strict "do not disturb" policy when it comes to Asbestos. In fact, Abacus personnel are not even allowed to work under OSHA's Classification IV for Asbestos work. This classification refers to maintenance and custodial construction activities during which employees contact but do not disturb Asbestos containing materials or presumed Asbestos containing materials and activities to clean up dust, waste and debris resulting from Class I, II and III activities.

Concerning the building owners responsibilities for Asbestos, Abacus adheres to OSHA's "New Asbestos Standard for Construction 29 CFR 1926.1101" which states;

REQUIREMENTS FOR BUILDING/FACILITY OWNERS

Most asbestos-related construction activities involve previously installed building materials. Building owners often are the only and/or best sources of information concerning them. Therefore they are assigned specific information conveying and retention duties under the new asbestos standard. Where a building/facility owner also is an employer with employees who may be exposed to asbestos-containing materials, the duties of employers also apply.

The following materials must be treated as asbestos-containing, unless specified procedures are followed to determine otherwise:

- TSI and surfacing materials in buildings or substrates constructed no later than 1980
- Asphalt and vinyl flooring material installed not later than 1980
- Any other materials that the building owner has actual knowledge that it is, or should have known it to be, asbestos-containing

Notification Requirements

Before work is begun, building/facility owners must identify the presence, location, and quantity of ACM/PACM and notify the following persons:

- Prospective employers applying for or bidding for work whose employees reasonably can be expected to work in or adjacent to areas containing such material
- Employees of the owner who will work in or adjacent to areas containing such material
- On multi-employer worksites, all employers of employees who will be performing work within or adjacent to areas containing such materials
- Tenants who will occupy areas containing such materials
- Notification may be in writing or by personal communication to the affected person(s) or their authorized representatives.

NOTE: When materials labeled as containing asbestos according to the requirements of this standard are installed on non-residential roofs, the contractor must notify the building owner of the presence and location of such asbestos-containing materials. This facilitates the owner's future notification requirements.

Signs and Labels

Building/facility owners must post signs at the entrance to mechanical rooms/areas in which employees reasonably can be expected to enter and which contain TSI and surfacing ACM/PACM. The signs must identify the material which is present, its location, and appropriate work practices that will ensure ACM/PACM will not be disturbed.

Previously installed ACM/PACM that is identified by a building owner or employer must be labeled in areas where the label will clearly be noticed. Posting of signs may be used as an alternative to labels.

The wording for label(s) is:

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD

Labels must also contain a warning statement against breathing asbestos fibers.

Records Retention

Where a building/facility owner has communicated and/or received notification concerning the identification, location, and quantity of ACM/PACM, written records of such notifications and their

content must be maintained by the building owner for the duration of ownership and transferred to successive owners.

Where a building/facility owner has relied on data to demonstrate that PACM is not asbestos-containing, such data must be maintained for as long as they are relied upon to rebut the presumption.

COMPETENT PERSON

The new standard requires that a competent person be designated for all worksites covered by the standard. The competent person must have the qualifications and authority required by 29 CFR 1926.20-32, the basic construction requirements.

The standard specifies additional duties and training for the competent person on asbestos worksites.

The competent person must make frequent and regular inspections of the job site, materials, and equipment. On jobsites where Class I or II work is being performed, the competent person must perform or supervise the following duties:

- Set-up the regulated area, enclosure, or other containment
- Ensure (by on-site inspection) the integrity of the enclosure or containment
- Set up procedures to control entry to and exit from the enclosure and/or area
- Supervise all employee exposure monitoring
- Ensure that employees working within the enclosure and/or using glove bags wear protective clothing and respirators
- Ensure through on-site supervision, that employees set up and remove engineering controls, use work practices and personal protective equipment in compliance with all requirements
- Ensure that employees use the hygiene facilities and observe the decontamination procedures
- Ensure through on-site inspection that engineering controls are functioning properly and employers are using proper work practices
- Ensure that notification requirements are met
- For Class I jobs, on-site inspections must be made at least once during each work shift, and at any time at employee request.

For Class II and III jobs, on-site inspections must be made frequently enough to assess whether conditions have changed, as well as at any reasonable time at employee request.

Bulb, Lamp and Ballast Recycling

A number of companies recycle fluorescent lamps and incandescent bulbs. Copper coils and aluminum or brass end pieces are smelted and reused as raw materials for non-food products. Glass can be purified and used to make fiberglass. Mercury is distilled from the phosphor powder and reused in new lamps and thermometers.

Heavy metals like mercury can contaminate soil and water. State hazardous waste regulations prohibit businesses from disposing of waste lamps and light bulbs in sanitary landfills if those lamps and bulbs contain levels of heavy metals that exceed hazardous waste limits.

It is our policy to ensure that all sub-consultants dispose of the demolished remains of all lighting components. The following offers some generalized information on the definition and handling of bulb, lamps, and ballasts:

Material Categories

- Fluorescent Bulbs - tube or compact globe
- HID (High-Intensity Discharge) Lamps - mercury vapor, metal halide, high-pressure sodium vapor, low-pressure sodium vapor
- Incandescent lamps
- Lamp Ballasts - metal unit that converts energy for use in a fluorescent lamp (transformer); may contain PCBs

Firm Type Descriptions

- Collector / Hauler - provides curbside collection for businesses
- Consolidator / Sorting Facility - collects lamps from many locations and stores them in a central facility before shipping them to a lamp recycling company; may ship them directly from collection locations.
- Lamp Recycling Company - breaks apart and ships components to various markets.

The six major categories of lamps

- Fluorescent Lamps - the tube-style lamps were originally used as overhead lighting in offices; now available in compact globe shapes for both home and office use.
- Mercury Vapor Lamps - the first high intensity discharge (HID) lamp; blue-white light; originally used as farmyard lights.
- Metal Halide Lamps - newer, more efficient HID lights found in homes, offices, and retail display lighting.
- High-Pressure Sodium Vapor Lamps - white-yellow HID lamps used for street lights and outdoor security lighting.
- Low-Pressure Sodium Vapor Lamps - orange HID lights used primarily in commercial settings.
- Incandescent Lights - the standard electric light bulbs used in homes and offices.

Storage, Collection, and Transport Information

- To safely handle your waste lamps and bulbs, place them in the box in which they were purchased or in special cartons provided by a lamp recycler.
- Store the lamps in a safe place to avoid breakage, and separate broken mercury-containing lamps in a heavy plastic bag placed in a rigid container. Lamp generators may collect waste lamps from several locations and store them in a central facility to ease transport and recycling. Mark the area as a hazardous waste or waste lamp storage area. Label the containers.
- Do not place broken fluorescent lamps in metal receptacles. Metal boxes will absorb mercury and become hazardous waste.
- Most lamp recycling companies offer transportation services. Waste lamp generators may also contract with a solid or hazardous waste transporter to take the lamps to a recycler or safely transport their lamps themselves.

COMPUTATION OF ENERGY BASELINE AND POST-INSTALLATION ENERGY USE

25. Describe the methodology used to calculate Baseline energy use and savings of different types of EEMs. This should include a description of various software tools that are utilized in the calculation process. Include the methodology used for campus settings that are master metered.

The methodology that we use to calculate the baseline energy use and energy savings is highly dependent upon the actual upgrades that we are implementing. The majority of our projects save

over 20% of a facility's entire energy use, so we are fortunate that in most cases we can use the existing customer utility meters for electricity and natural gas as the baseline energy use, and we can also use these same meters to determine the post-upgrade energy use. This is what most owner's care about, the systems already exist so there is no cost to install meters, and there are no engineering calculations that are needed to calculate the energy use based on metered data. The metered data, which is the same data the owner sees on their actual utility bills, is used by subtracting the post-upgrade monthly bills from the pre-upgrade monthly bills in a simple and straight forward calculation. This is the methodology that we use for most of our projects. When we do work with a sophisticated client that wants the actual weather taken into account, or when there are severe weather events that occur, then we will use a statistical regression model, per IPMVP guidelines, to adjust the energy savings. In this approach, we determine what the existing energy bills correlation to the weather was over time, using a statistical regression model, usually linear in nature. This resulting statistical formula is then applied to the post-upgrade weather to determine how much energy the pre-upgrade facility would have used if it was operated in the current weather scenario (called the adjusted baseline energy use). We then compare this adjusted baseline energy use to the actual energy bills, to determine the energy savings. When we use this approach we use the statistical package of Microsoft Excel for the statistical regression model, and we utilize an online weather database package (such as www.degreedays.net) to obtain historical degree day information for a particular weather location.

Campus settings: For all the EEMs where the main utility meter does not apply, such as for large centrally metered campuses, or for smaller scale EEMs) then we utilize standard engineering formulas with metered data to calculate the baseline and post-upgrade energy use. There is a wide variety of systems that we upgrade, including lights, controls, drives, motors, HVAC systems, boilers, chillers, pumps, fans, cooling towers, dehumidifiers, humidifiers, envelope measures, etc. For each of these systems we are able to use standard engineering formulas to accurately describe the energy that they consume. For all these systems we calculate the existing energy use, and we will use electrical meters, or Btu meters, or other appropriate meters to measure the key variables that affect the energy use, or define the energy use. We use the metered data along with the engineering formulas to calculate the baseline energy used before the upgrade. If the system we are determining energy use for is weather dependent, then we utilize a software program (such as BinMaker Pro) to determine what the average annual weather patterns are for a location, broken down into occupied and unoccupied times throughout the year. For the post-upgrade energy use, we make additional measurements of the systems after the upgrade, using the same meters that we used before the upgrade, and we then incorporate this post-upgrade metered data into the same engineering formulas that we used for the baseline energy use calculation. The difference between the baseline and the post-upgrade energy use is the savings for these EEMs.

Energy Savings is the core focus of our company, and we own a wide variety of meters that we use to measure existing systems and post-upgrade systems. The following table lists the meters that we currently own.

Equipment Types- real power, pressures, flow etc.	Brand & Model	Number of Units Available @ ARMCo
True Power Meter (kW & kWh)	Dent ElitePro	1
True RMS Multimeter	Fluke 189	4
AC/DC True RMS Clamp Meter	Fluke 36, Fluke T5-600	6
4 Channel External Loggers	Onset H08-004-02, Onset U12	80
Combustion analyzer	Davis Instruments	1
CT Sensors	0-20 amps / 0-50 amps / 0-100 amps/ 0-200 amps 0-600 amps	150
4-20 MA sensors & pressure sensors	Onset H08 & U12 series	12
0-10 volt DC sensors & sensors	Onset H08 & U12 series	10
Btu Meter	Onicon	10
Flow Hood	Shortridge Instruments	1
Light Level & Temperature Logger	Onset H08 & U12 series	110
Relative Humidity / Temperature Logger	Onset H08-003-02	8
Relative Humidity / Temperature Logger	Onset H08 & U12 series	8
Motor- On/Off Logger	Onset H06-004-02	20
Temperature Sensor - 50ft Cable	Onset	60
Temperature Sensor - 20ft Cable	Onset	60
High Temperature Thermometer	Davis Instruments	6

High Temperature Sensor	Onset	4
Anemometer	Extech Environmental Meter	5
Pressure/vacuum transducer	Fluke PV 350	3
Light Intensity Meter	Osram DS2000, Extech Environmental Meter	4
Air/Fluid external Temperature sensors	Onset TD, TA	26
Ballast Tester	Sensor Switch	4
CO2 sensor	TelAire	4
Digital Thermometer	Taylor	6
Infrared Temperature Gun	Raytek Raynger ST, Raytek MT6	4
Digital Video Camera	Sony	1
Digital Camera	Kodak, Pentex, Fujifilm	5
Laser Distance Meter	Leica Disto D2	4

26. Describe potential scenarios where a modified baseline may be proposed.

When appropriate, we will propose a modified baseline for purposes of measurement and verification of energy savings.

One common scenario where we propose a modified baseline occurs when a facility is not currently providing the code required ventilation air. Often facilities will block off an outside air intake during a cold winter spell, and leave it operating that way. While this can make it easier to keep a building warm in the winter, it can deprive people of the fresh air needed to keep odors low inside the building. We typically measure the outside airflow being delivered, and determine the appropriate code required outside airflow, and then calculate the additional heating and cooling energy needed throughout the course of a year to condition this ventilation air to the indoor setpoints. We then add this additional energy use to the existing monthly energy bills to determine the adjusted baseline energy use. We also carefully analyze what other impacts this additional ventilation air may have on the HVAC systems, and calculate any other inter-dependent causal effects as needed. In one instance an indoor pool facility hat was under-ventilated, and bringing in this additional code required ventilation air also dehumidified the indoor pool room (because the outside air has less moisture in it

than the indoor air, and because brining in this fresh air causes the removal of more indoor air through the exhaust fan). This lowering of the indoor humidity also reduced the capacity of the existing mechanical dehumidification that was in use.

Another common scenario where we propose a modified baseline is when an existing system is not currently maintaining reasonable, owner stipulated indoor setpoints. For instance, a heating system that is not capable of maintaining a 70 F indoor setpoint when the outside air falls below 35 F. In this instance, we would calculate the additional heating energy that would be needed to maintain these setpoints, and add this extra energy to the monthly energy use of the facility, to determine the adjusted baseline energy use.

The last common scenario where we propose a modified baseline is generally for utility incentive programs, when we are replacing a system that has exceeded its life expectancy. Many utility programs will require us to develop a modified baseline that shows how much energy would be used if the owner would replace the existing system with a new system that meets the current energy code. Then we compare the proposed high efficiency system to the adjusted baseline (code efficient) system, to determine the energy savings for the purposes of the utility incentive program. We are happy to do this for any owner's that are interested.

27. Describe the ESCO's utilization of M&V processes in the establishment of baseline energy use and the post installation energy use.

Abacus utilizes the 2012 IPMVP to establish the baseline energy use and the post installation energy use of all the projects that we install. Whenever practical we prefer to use option C (whole building approach) because it is what owners are most interested in, it is simple and straight-forward, and it keeps the M&V costs at a minimum. Energy conservation is our core business, we have been doing it for many years, and we are very adept and skilled in implementing upgrades that can lower a facilities energy use significantly.

Abacus has one of only twelve certified M&V professionals in Oregon on our staff to spearhead our M&V efforts. This individual is certified by the organization that developed and maintains the IPMVP, currently in its 2012 version, the Efficiency Valuation Organization. We are firm believers in keeping our M&V process open for scrutiny, and in keeping it as straight-forward and simple as possible to allow the owners and other interested parties to see what we are doing.

The 2012 IPVMP provides guidance for four distinct approaches to conducting M&V, called Options A, B C & D, and we use whatever option is most appropriate for the particular project we are working on.

For projects using Options A (Retrofit Isolation: Key Parameter Measurement) or B (Retrofit Isolation: All Parameter Measurement), we will install meters to measure the key variables affected by our upgrade before the project is installed. We also develop standard engineering formulas to calculate the baseline energy use, based upon typical weather for a year, and based upon the measured data. We make additional measurements of the key variable after the projects are installed, and we use the same standard engineering formulas to calculate the post installation energy use.

For projects using Option C (Whole Facility) we utilize the existing utility meters to determine the baseline energy use. We then utilize the same utility meters to determine the post installation energy use.

For projects using Option D (Calibrated Simulation) we utilize an hourly energy simulation software package, with actual weather data, to determine the baseline energy use. We then utilize the actual utility meters installed to calculate the post upgrade energy use.

SAVINGS AND EQUIPMENT PERFORMANCE GUARANTEES

28. The ESCO's project cost guarantee policies and procedures; including remedies when project costs exceed ESCO estimates.

Our ESCO contract model (like DES's contract) guarantees the Owner a maximum price for the work. If our costs to complete the work exceed this maximum, then Abacus absorbs all costs above the guaranteed maximum. The project cost accounting records will reflect any such additional costs incurred by Abacus but the additional costs will not be passed along to the Owner.

Unfortunately, we have experienced this unpleasant situation on a couple of projects. It has in each case been caused by volatility in the bidding climate attributable to steep increases in material prices or shortages of labor.

29. The ESCO's energy savings guarantee policies and procedures, including remedies when actual savings are lower than ESCO's estimates and guarantees, and the length of savings guarantees.

In twenty six years, we have never had a project not perform above the guaranteed level of savings. Yet, in the eventuality of that happening, we develop a clear savings and performance guarantee as a part of each project.

We guarantee a minimum level of annual energy savings measured in terms of energy units (kWh or therms) and not dollars. The basis for determining the savings is clearly described in the IMPVP M&V plan. During the first year, we compile actual savings data and review performance with the Owner on a monthly basis. In later years this frequency may change to quarterly or even annually.

In the savings guarantee there is a formula for converting energy units to dollars. It is usually the rate schedule in effect at the time of measurement or that in effect at the time the guarantee was made. If the energy savings in any year fall below the guarantee, Abacus will pay the Owner for the shortfall using this conversion formula from energy units to dollars.

30. The ESCO's equipment performance guarantee policies and procedures, including remedies when performance of equipment is not met.

The policy is to be very specific in the ESCO Agreement about the specific performance criteria being guaranteed during each year the agreement remains in effect. The guarantee is most commonly defined in terms of energy consumption, comfort conditions, lighting levels, or some other specific criteria.

Our procedure for assuring success in this area is to set reasonable expectations within this guarantee, to maintain regular contact with the Owner regarding actual performance during the agreement term, and to document the actual performance on a monthly or annual basis as required by the agreement.

When an Owner perceives that actual performance does not meet the guaranteed performance, we have almost always identified the deficiency beforehand and are already working to improve performance so as to achieve the guaranteed performance. This proactive approach catches any performance problems early and minimizes any shortfall in actual energy savings.

Implementing our policy deploys several techniques such as remote monitoring via an internet connection into the energy systems, installation of data logging equipment and trend data analysis on a monthly basis (or even weekly if issues are suspected), monthly utility bill analysis, and regular conversions with our customers.

When all remedies fail to achieve the guaranteed performance levels we are liable for the monetary compensation to the Owner as specified in the agreement. However, in 26 years of completing projects for the State of Washington, we have not had to make any such payments.

31. Provide information on the ESCO's warranty enforcement role and the ESCO's responsibility, if any, when there is an equipment failure beyond the warranty period when the client agency has financed the project and assumed ownership of the installed equipment.

The warranty terms are clearly defined by tasks, duration, and responsibility in each agreement. Each agreement may be slightly different from the next as each Owner chooses to accept or transfer the risks of equipment warranty. However, in all agreements, Abacus is the primary point of contact on any warranty concerns an Owner may have.

Our policy is to actively and effectively resolve all warranty claims. We may identify performance issues through our monitoring and verification efforts or the Owner may bring issues to our attention.

When we receive any call about equipment performance, we quickly resolve whose responsibility it is to provide service according to the specific warranty terms in the agreement. If it is our responsibility, we contact the appropriate service provider whether that is the installing contractor, the manufacturer, or another party. If the service is the Owner's responsibility, we lend technical support to facilitate the best corrective action so that the desired performance is restored. This sometimes involves our asking the manufacturer to offer special considerations in light of some unexpected condition.

One example of this might be an entire batch of lamps or ballasts experiencing premature failure but after the one year warranty period. We have successfully lobbied the manufacturer to provide free replacement materials.

Each project, and potentially each piece of equipment, may have different terms and conditions relative to the warranty responsibility of Abacus. The important task is to get these terms and conditions clearly written. We use a task/responsibility matrix, like the following example, to document responsibility. Keep in mind, this is an example only. The responsibility check mark varies from project to project as we negotiate specific terms of our ESCO contract.

If we can't immediately resolve who is responsible for the warranty service, we will seek the advice of the DES project manager and try to resolve the issue of responsibility.

Nearly all of our ESPC agreements have contained terms whereby the Owner has accepted the responsibility to operate and service the energy equipment after the first year anniversary of the Commencement of Energy Savings. Some have contained extended warranty periods for certain equipment and a few have transferred service and warranty to Abacus for the entire financing period.

We often purchase extended warranty periods for major equipment where premature failure would compromise the project's cost effectiveness. We are also willing to include operation and maintenance of some or all of the energy equipment for the life of the loan period. The details are all left up to the Owner to decide what options fit their needs best.

The key to success in this area is to have things clearly defined in the agreement.

MAINTENANCE RESPONSIBILITIES

Activity Description	Construction Period	Commissioning Period	Warranty Period	After Warranty
Troubleshooting equipment and components	ESCO	ESCO	OWNER	OWNER
Troubleshooting Controls	ESCO	ESCO	OWNER	OWNER
Preventative Maintenance	ESCO	ESCO	OWNER	OWNER
Repairs required as a result of construction	ESCO	ESCO	ESCO	OWNER
Repairs of existing conditions	OWNER	OWNER	OWNER	OWNER
All other repairs	OWNER	OWNER	OWNER	OWNER

FINANCING ABILITY

32. The ESCO's project financing ability. Describe capability for carrying costs until completion of the installation of energy efficiency measures. Describe capability and willingness to fully finance project over a financing term including how the interest rate the ESCO would use is determined. Provide letters of commitment from funding sources or from ESCO's Chief Financial Officer if self-funded. Tax-exempt municipal lease financing does not qualify for ESCO financing ability.

Abacus has provided private financing on three State of Washington ESPC projects in the past (Clark College, Washington State Historical Museum, and Capitol Museum) and we are willing and able to do so on future work. The Owner has the choice of using our private financing on each project.

When directed by the Owner, we would provide private financing from traditional outside sources. We would likely solicit financing proposals from multiple sources to insure cost competitiveness. The terms and conditions would be created based on the unique requirements of each project. A commitment from a typical financing source is attached to this response. The most recent rate quote we received found the competitive rate/terms to be 2.85% – 3.0% for a 15 year loan with a 1% loan fee. Rates and terms will naturally vary based on the specific project, owner credit and current market conditions.

Abacus has sufficient credit facilities and we are willing to carry project construction costs through the commencement of energy savings. The owner may elect to finance the progress payments for construction activities and combine into the finance package at the commencement of energy savings, requiring no owner capital payments, and repayment utilizing energy incentive dollars and energy savings.

We also work with our clients in conjunction with local energy loan programs such as the LOCAL program in Washington or the SELP loan in Oregon.

GUARANTEE LETTER – NEXT PAGE

Chris Youngs
Senior Vice President
Energy Services

Banc of America Public Capital Corp
370 17th Street, Ste. 3590
CO1-004-35-00
Email: chris.youngs@baml.com
Tel: (303) 617-1290
Fax: (206) 585-9712

February 14, 2013

Steve Rubbert
Abacus Resource Management Company
12655 SW Center Street
Suite 250
Beaverton, OR 97005

Re: State of Washington, Department of Enterprise Services, Request for Qualification Energy Program Project No. 2013-133

Dear Mr. Rubbert:

On behalf of Banc of America Public Capital Corp ("BAPCC"), please accept this letter as confirmation that BAPCC is interested in providing financial services to the State of Washington and Abacus Resource Management Company for energy efficiency projects.

BAPCC is a leading provider of equipment finance solutions to the state, local and federal government markets with one of the most complete offerings of tax-exempt and taxable municipal financing products available. A large portion of our transactions are structured as tax-exempt municipal lease purchase or installment purchase agreements; however, we are familiar with other non-traditional funding mechanisms as well. Our market expertise includes QECBs, QZABs, QSCBs and NewCREB transactions for energy efficiency projects.

As purely an indication of the current private placement market, 15 year tax-exempt rates for similar credits is currently ranging between 2.85-3.00%. Pricing and structure shall be subject to the capital markets at the time of finance proposal and based upon then current Swap rates, the final financed amount and weighted average life of the financing, and the credit of the ultimate issuer. Please note that this letter is not a commitment, offer or proposal to lend, and does not create any obligation of Bank of America or BAPCC.

In 2007, Bank of America announced our $20 billion, 10-year lending and investment commitment for environmental saving initiatives. Having finished this commitment four years ahead of schedule, Bank of America has now started a new $50 billion, 10-year environmental business and operational commitment for environmental initiatives to address climate change, demands on natural resources, and advance lower-carbon economic solutions.

We look forward to being of service to the State of Washington and Abacus Resource Management Company. Pease do not hesitate to contact us with any questions or comments.

Sincerely yours,

Chris Youngs
Senior Vice President

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Sincerely yours,

Chris Youngs
Senior Vice President

BUILDING ENERGY USE INDEX

		ELECTRIC			GAS			TOTAL	
ELEMENTARY SCHOOLS:	**SQ. FT OF BUILDING**	**KWH**	**$**	**BTU/SF**	**THERMS**	**$**	**BTU/SF**	**BTU/SF**	**$**
Adams	77,683	881,280	61,255	38,719	19,875	28,875	25,585	64,304	90,130
Barge Lincoln	54,640	641,072	46,010	40,044	20,601	27,809	37,703	77,747	73,818
Garfield	31,091	599,512	41,157	65,811	45,627	58,229	146,753	212,564	99,386
Gilbert	53,984	631,307	44,443	39,913	27,813	37,576	51,521	91,434	82,020
Hoover	54,449	338,127	28,398	21,195	27,813	37,576	51,081	72,275	65,975
Martin Luther King	54,750	338,127	28,398	21,078	29,191	44,803	53,317	74,395	73,201
McClure	53,984	692,080	47,962	43,755	22,331	40,084	41,366	85,121	88,046
McKinley	31,091	662,147	45,703	72,687	26,781	36,650	86,137	158,824	82,353
Nob Hill	36,889	272,034	21,857	25,169	15,895	24,421	43,089	68,258	46,278
Ridgeview	54,750	597,360	42,833	37,238	18,900	34,281	34,521	71,759	77,114
Robertson	45,054	536,055	38,018	40,608	15,914	21,429	35,322	75,930	59,447
Roosevelt	59,268	759,840	50,269	43,756	12,473	17,716	21,045	64,801	67,985
Whitney	53,115	542,923	42,754	34,886	14,197	21,685	26,729	61,615	64,439
Discovery Lab	18,224	177,958	13,860	33,328	1,317	2,429	7,227	40,555	16,289
MIDDLE SCHOOLS:									
Franklin	89,023	1,020,315	68,586	39,117	39,104	58,610	43,926	83,043	127,196
Lewis & Clark	90,086	980,363	69,506	37,142	38,673	58,392	42,929	80,071	127,898
Washington	86,744	1,060,168	69,143	41,713	29,675	45,071	34,210	75,923	114,214
Wilson	87,744	961,424	65,208	37,397	47,362	70,646	53,977	91,374	135,854

DRAFT WORK PLAN FOR YAKIMA SCHOOLS ENERGY GRANT APPLICATION

CONCEPT TEST SCHOOL – MLK ELEMENTARY

Collect energy records, previous audits (if any), list of desired improvements.	5/23
Preliminary building walkthrough.	5/25
Preliminary audit complete.	6/1
Review findings and refine plan for other audits.	6/2

ROUND 1 SCHOOLS

Identify 6-8 other high priority/opportunity schools.	6/2
Collect energy records, previous audits (if any), list of desired improvements.	6/2
Preliminary audits complete.	7/21
Review findings and strategize grant application.	7/28
Finalize audits and draft grant application.	8/4
Review grant application.	8/10
Grants ready to submit.	8/17

DRAFT WORKPLAN FOR SUMMER 2010 IMPLEMENTATION

Not sure how much, if any actual implementation work YSD contemplates this summer but will likely not get any grants if work is already installed. So, might be better to wait until after grant awards. We are very accustomed to installing conservation measures in occupied schools. Often have to hit holiday windows and nights but we can get it done any time of the year.

If you decide to hire Abacus to be your ESCO to take responsibility for implementation, you can select us as soon as we are on the State list (should be 1st week in June).

The standard ESCO model is we do the audits at $0.08/SF (much less for twin buildings). However, if we don't find cost effective measures, then the audit is free. If we find things to implement, that audit fee gets rolled into the overall project cost. I will send you a typical pricing sheet for an ESCO project.

As far as I am concerned you can award an ESCO agreement to us with the first task order being to audit MLK ES. So you need $4300 funding to authorize the contract. We will probably be done before you get the paperwork in order but we need to get moving if we are to hit the grant application deadline.

Then you just add addenda to that agreement for additional schools. If you authorize 300,000 SF of schools, you will need $24,000 to authorize the work. However, I have seldom been paid the audit fee so it becomes mostly an accounting placeholder for you. They always go to a project and the audit gets rolled into all the other costs. Kind of strings us out on the audit work but that is the business we are in.

When it gets to implementation, that becomes another addenda authorizing design/construction/commissioning/verification of savings. Not sure how familiar you are with the ESCO process. Probably worth an hour discussion.

I am thinking most of the implementation gets done in the 12 months after the grant award. But, as mentioned above, we can possibly jump on some things this summer if you want.

DRAFT OF OVERALL CASH FLOW CONCEPT

The overall goal is to maximize the improvements made to each school. Do the long term upgrades to envelope, electrical, mechanical, and control systems so that the schools are solid for the next 20 years.

This energy grant program represents a unique opportunity to do this. Normally projects are limited to shorter payback measures that can basically pay for themselves.

The District having bond money to put towards improvements will prove very beneficial in the grant scoring.

The grants might be limited to $2M but it is unclear if this is per agency or per project. We will have to read the rules when they are published.

The scoring criteria will be:

Leverage: How many other dollars are being contributed compared to grant dollars?

Energy Savings: They want projects to penetrate deeply into the building, not just lipstick.

Guarantee of Savings: This is how they hope to sell the voters on the $500M bond to come.

Expediency: This is a jobs creation bill.

So, here is how I think it will go.

We will find $0.30-0.60/SF in annual energy savings depending on the current operation. Using available energy loan programs, that pays for $3-5/SF in funds.

The energy savings will qualify you to receive around $1/SF in onetime utility incentives.

Then if the District contributes $5/SF your total non-grant contribution is about $10/SF.

The minimum leverage allowed will be 1:1 so you could apply for $10/SF. However, it will be safer (better chance to get award) if you go in at 2:1. So ask for $5/SF.

The net result is you can do $15 worth of building improvements for your $5 in bond money. That looks good to the board. And $15/SF can make a big difference in attacking the deferred maintenance in a school.

If the grant is limited to $2M/district then you might want to prioritize your most needy 400,000 SF (and just in case the limit is $1M, then 200,000 SF). I won't be satisfied unless we find a way to get you $4M by the time this opportunity runs its complete cycle.

ABACUS
RESOURCE
MANAGEMENT
COMPANY

July 18, 2010

Donna Albert
Department of General Administration
Division of Engineering and Architectural Services
206 General Administration Building
Olympia, WA 98504

SUBJECT: Energy Audit Proposal

Dear Donna:

Abacus Resource Management Company (ARMCo) is pleased to submit the following proposal to complete Energy Savings Performance Contracting work for Yakima School District. This proposal is for conducting energy audits and assistance with preparing Energy Conservation Grant applications to the OSPI iGrant and the Department of Commerce Energy Grant Programs.

SCOPE
The initial audits will be conducted at Garfield and McKinnley Elementary Schools. The scope will be confined to the approximate 31,000 square foot main building at each site (portable buildings are not included). The audits will be conducted so as to qualify for the grant programs listed above as well as for possible conservation incentives from Pacificorp for electrical savings and from Cascade Natural Gas for gas savings.

The audit process will compile records of existing construction and sequences of operation. This record data, along with measurements of actual energy system performance, will be used to develop the baseline energy use profile which will be calibrated to historical meter data. Proposed energy system improvements will be detailed and estimates of energy savings and project cost will be generated. Energy cost savings will be estimated using the past 12-month average utility cost data.

A Preliminary Energy Audit will be submitted for review. Any changes required from the review process will be made. The Final Energy Audit will be submitted as part of the Energy Services Proposal documenting the terms and conditions for implementing those cost effective measures. The audit will include an estimate of possible utility incentives, grants, and a cash flow projection reflecting options for project financing.

ARMCO will also complete all required documents required for application to Pacificorp and Cascade Natural Gas for their evaluation of possible conservation incentives.

P.O. Box 4189, Seattle, WA 98194

ABACUS
RESOURCE
MANAGEMENT
COMPANY

FEE
The cost for the energy audit is a lump sum fee of $4,800. The Energy Services Proposal will include an offer to include the cost of the audit into the overall project cost. If YSD elects to not implement the Energy Services Proposal, this fee will be due upon completion of the Proposal. If YSD elects to implement the Energy Services Proposal, the audit fee will be included in the energy services project. If ARMCo is not able to identify cost effective measure(s) and submit a viable Energy Services Proposal, then no fee will be charged for the audit.

We look forward to your authorization to proceed with this work. If you have any questions, please call me at (503) 819-5593.

Sincerely,

Abacus Resource Management Company

Mark Kinzer
Project Manager

P.O. Box 4189, Seattle, WA 98194

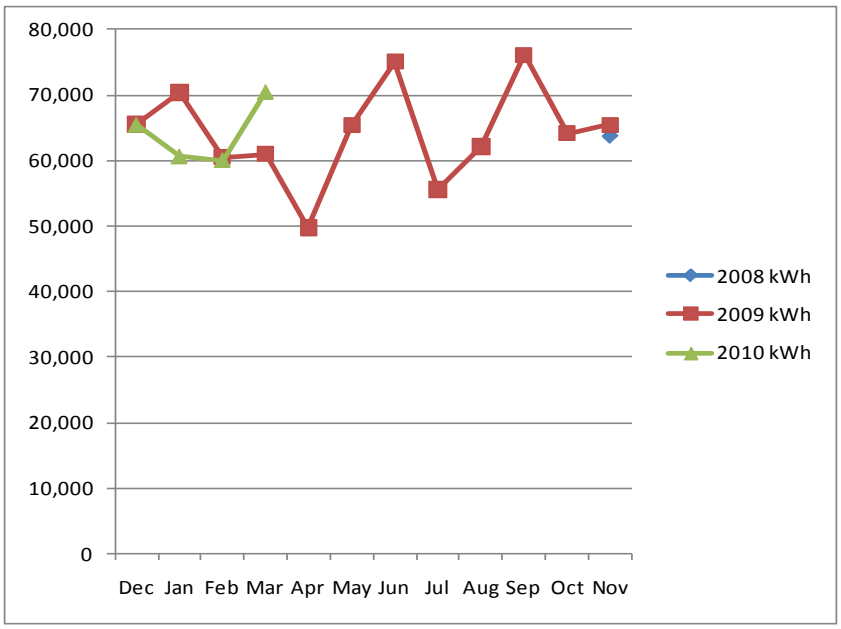
METHOD OF CALCULATING ENERGY AND ENERGY COST SAVINGS

Actual energy cost savings will be computed based on actual electric and gas bills. Savings will be tabulated on a monthly basis for each school with a total for both schools summed to an annual total for the purposes of the energy savings guarantee.

A. Baseline Energy Use: Is defined in Section "A" Below.
B. Future Energy Use: Will be derived from the utility bills.
C. Energy Savings: Will be the difference between the baseline use and the current bill.
D. Energy Cost Savings: Will equal the energy savings times $1.06 per therm (the baseline gas rate) and $0.048 per KWH (the baseline electric rate). Both rates are the composite cost including all tariffs, fees, and taxes.

A. BASELINE ENERGY CONSUMPTION

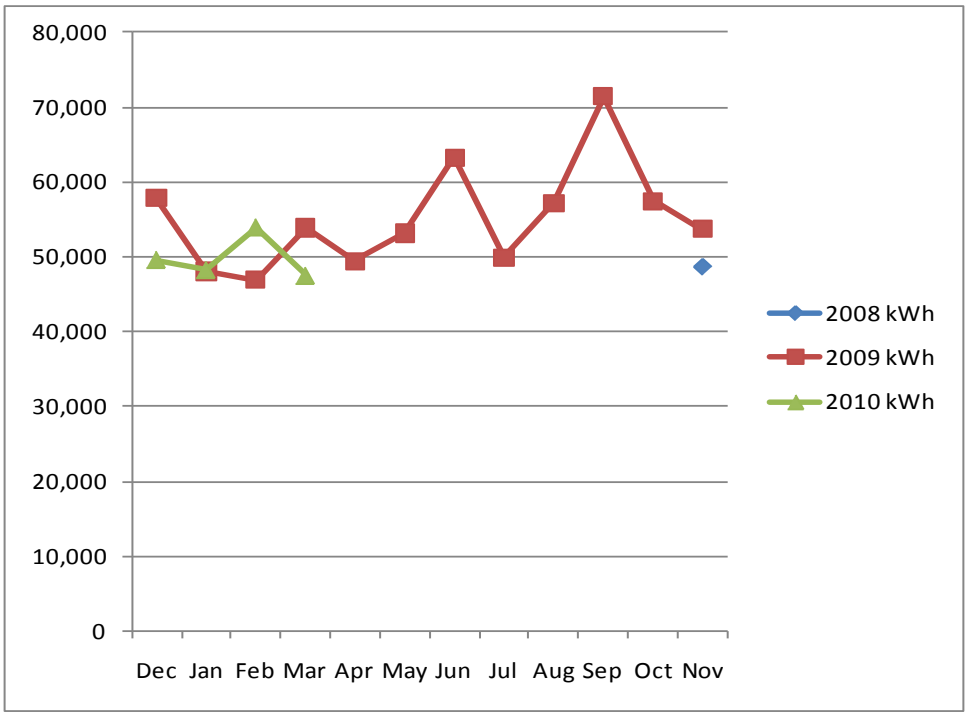
(1) Monthly Electrical Energy Use Garfield Elementary



	2008 kWh	2009 kWh	2010 kWh	Avg kWh
Dec		65,488	65,447	65,467
Jan		70,366	60,578	65,472
Feb		60,535	60,015	60,275
Mar		60,983	70,509	65,746
Apr		49,749		49,749
May		65,364		65,364
Jun		75,043		75,043
Jul		55,562		55,562
Aug		62,131		62,131
Sep		76,118		76,118
Oct		64,154		64,154
Nov	63,682	65,447		64,564
TOTAL		770,940	256,549	769,646

	2008 $	2009 $	2010 $	Avg $
Jan		$4,469	$4,454	$4,462
Feb		$4,682	$4,372	$4,527
Mar		$4,220	$4,368	$4,294
Apr		$4,161	$4,888	$4,524
May		$3,609		$3,609
Jun		$4,397		$4,397
Jul		$4,996		$4,996
Aug		$3,729		$3,729
Sep		$4,134		$4,134
Oct		$5,028		$5,028
Nov		$4,441		$4,441
Dec	$4,260	$4,454		$4,357
TOTAL		$52,321	$18,082	$52,498

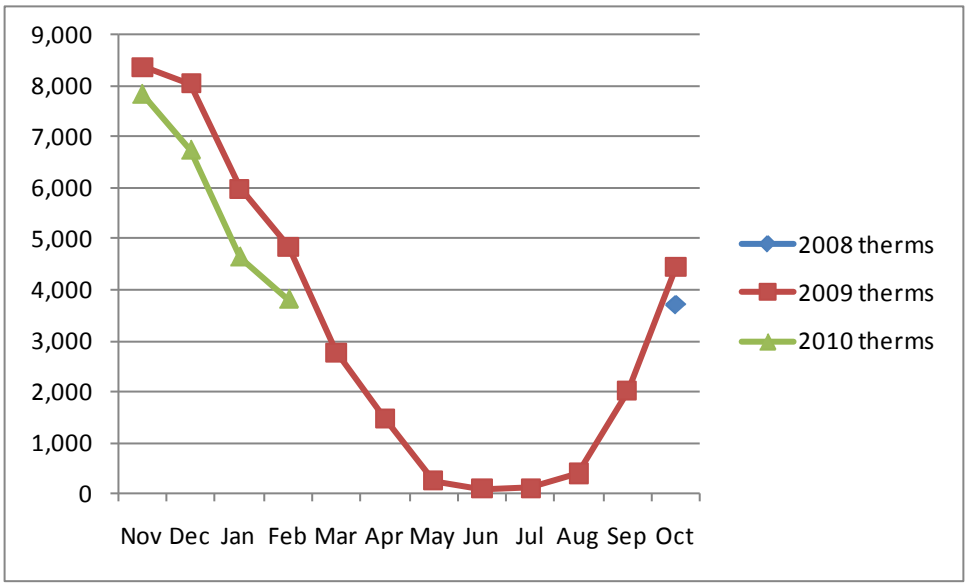
(2) Monthly Electrical Energy Use McKinley Elementary



	2008 kWh	2009 kWh	2010 kWh	Avg kWh
Dec		57,825	49,621	53,723
Jan		48,048	48,270	48,159
Feb		46,920	53,975	50,448
Mar		53,880	47,491	50,686
Apr		49,427		49,427
May		53,158		53,158
Jun		63,238		63,238
Jul		49,886		49,886
Aug		57,175		57,175
Sep		71,462		71,462
Oct		57,418		57,418
Nov	48,596	53,710		51,153
TOTAL		662,147	199,357	655,932

	2008 $	2009 $	2010 $	Avg $
Jan		$3,921	$3,590	$3,755
Feb		$3,387	$3,657	$3,522
Mar		$3,382	$3,927	$3,654
Apr		$3,695	$3,576	$3,635
May		$3,602		$3,602
Jun		$3,753		$3,753
Jul		$4,171		$4,171
Aug		$3,480		$3,480
Sep		$3,879		$3,879
Oct		$4,770		$4,770
Nov		$3,909		$3,909
Dec	$3,465	$3,755		$3,610
TOTAL		$45,703	$14,749	$45,741

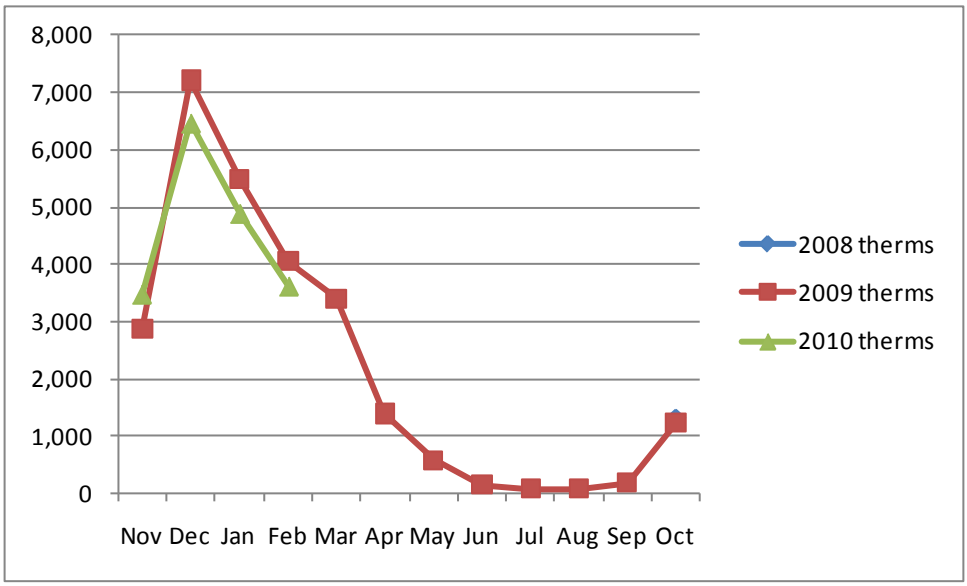
(3) Monthly Gas Energy Use Garfield Elementary



	2008 therms	2009 therms	2010 therms	Avg therms
Nov		8,366	7,842	8,104
Dec		8,045	6,744	7,395
Jan		5,988	4,644	5,316
Feb		4,845	3,813	4,329
Mar		2,768		2,768
Apr		1,483		1,483
May		259		259
Jun		103		103
Jul		112		112
Aug		394		394
Sep		2,022		2,022
Oct	3,697	4,443		4,070
TOTAL		38,828	23,043	36,355

	2008 $	2009 $	2010 $	Avg $
Jan		$12,776	$9,539	$11,157
Feb		$12,398	$8,221	$10,309
Mar		$9,193	$5,725	$7,459
Apr		$7,457	$4,762	$6,110
May		$4,305		$4,305
Jun		$2,849		$2,849
Jul		$391		$391
Aug		$173		$173
Sep		$169		$169
Oct		$499		$499
Nov		$2,513		$2,513
Dec	$5,586	$5,506		$5,546
TOTAL		$58,229	$28,246	$51,480

(4) Monthly Gas Energy Use McKinley Elementary



	2008 therms	2009 therms	2010 therms	Avg therms
Nov		2,879	3,477	3,178
Dec		7,211	6,471	6,841
Jan		5,487	4,892	5,190
Feb		4,052	3,619	3,836
Mar		3,405		3,405
Apr		1,403		1,403
May		591		591
Jun		153		153
Jul		88		88
Aug		92		92
Sep		187		187
Oct	1,317	1,233		1,275
TOTAL		26,781	18,459	26,238

	2008 $	2009 $	2010 $	Avg $
Jan		$4,000	$3,887	$3,943
Feb		$9,867	$7,065	$8,466
Mar		$7,613	$5,377	$6,495
Apr		$5,624	$4,026	$4,825
May		$4,749		$4,749
Jun		$1,969		$1,969
Jul		$778		$778
Aug		$208		$208
Sep		$126		$126
Oct		$114		$114
Nov		$217		$217
Dec	$1,411	$1,386		$1,399
TOTAL		$36,650	$20,356	$33,289

Detailed Energy Analysis Report for
Specific Energy Savings Projects at the

Garfield Elementary School
Yakima School District
Yakima, Washington

Prepared by:

ABACUS
RESOURCE
MANAGEMENT
COMPANY

July 26, 2010

Disclaimer

The intent of this Detailed Energy Report is to quantify energy savings for specific energy saving projects that the owner has expressed interest in implementing. This report is believed to be reasonably accurate, but the findings are calculations based on assumptions and the actual results may vary. As a result, Abacus Resource Management is not liable if projected estimated savings or economics are not actually achieved. All savings and cost estimates in the report have been reviewed for accuracy, but they are not to be construed as a design document or as guarantees.

Yakima School District (owner of facility) shall independently evaluate any advice or direction provided in this report. In no event will Abacus Resource Management Company be liable for the failure of the customer to achieve a specified amount of energy savings, the operation of the customer's facilities, or any incidental or consequential damages of any kind in connection with this report or the installation of recommended measures.

Contacts

Site Address Garfield Elementary School 612 North 6th Avenue Yakima, WA 98902
Owner Contact Yakima School District Jay Baucom, Assistant Director of Operations & Maintenance: 509-573-7095 Jerry ___, On-site Custodian: 509-728-8034
Pacific Power Contact Jim Jean: 503-813-6490
Cascade Natural Gas Contact Bob Cuti: 360-909-8961
Energy Consultant Contact Abacus Resource Management Co. 14845 SW Murray Scholls Drive, Suite 110-138 Beaverton, OR 97007 Mark Kinzer, P.E. Phone: 503-819-5593 (markk@abacusrm.com) Rich Davis, C.E.M. Phone: (503) 936-7163 (richd@abacusrm.com)

Utility Rate Assumptions

Pacific Power

36 (Large General Service < 1,000 kW)	
$0.04497	**per kWh (> 40,000)**
$1.48000	per kW 101-300 kW Load Charge
$3.88000	**per kW Demand Demand Charge**
1-Jan-10	Effective Date of Rate

Cascade Natural Gas

$1.05797	per therm
504	Cascade Natural Gas Rate
1-Aug-09	Effective Date of Rate

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EXECUTIVE SUMMARY

Introduction and Background

Yakima School District is interested in pursuing opportunities to lower the utility use of their schools. This report presents detailed findings of several specific energy efficiency measures (EEMs) identified at the Garfield Elementary School.

Incentives available for Energy Efficiency Projects

Pacific Power offers incentives for owners to implement electric-saving measures. If the owner is interested in pursuing any of these opportunities they should discuss them with Pacific Power prior to purchasing equipment or issuing contracts for construction. Some projects will require inspections and verifications of savings before and/or after they are installed in order to qualify for incentives. All measures will require submitting official forms to the sponsoring agency prior to purchasing any equipment.

Cascade Natural Gas offers incentives for owners to implement natural gas-saving measures. If the owner is interested in pursuing any of these opportunities they should discuss them with Cascade Natural Gas prior to purchasing equipment or issuing contracts for construction. Some projects will require inspections and verifications of savings before and/or after they are installed in order to qualify for incentives. All measures will require submitting official forms to the sponsoring agency prior to purchasing any equipment.

Brief Description of Facility and Energy Using Systems

Facility Description: The School is comprised of a main building, a gymnasium building, and several portable buildings. The portable buildings are not covered as part of this study, only the permanent main and gymnasium building are covered.

The main building is a single story masonry building constructed in two stages. The western half was built in 1971, and the eastern half was constructed in 1975. The building footprint is about 28,000 square feet. The building contains twelve classrooms, a library, offices, meeting rooms, individual instruction rooms, restrooms and storage rooms. There are minimal windows and a flat insulated roof.

The gymnasium building is a 24' tall structure that contains a gymnasium which also serves as a cafeteria. There is also a kitchen and locker rooms in this building. The building was constructed in the 1950's, and has a footprint of about 4,600 square feet. There are minimal windows and a flat insulated roof.

Energy Supply: The building receives electricity from Pacific Power, and natural gas from Cascade Natural Gas.

Lighting: Lighting is predominantly T12 fluorescent lights with magnetic ballasts. There are also some incandescent lights in use. A comprehensive lighting upgrade is evaluated as EEM 1 in this report. The light levels in the classrooms is exceedingly high (over 100 foot-candles), and this will be lowered to a more appropriate range during the upgrade (40 foot-candle target in classrooms, 20 foot-candle target in corridors).

HVAC: The main building has four constant volume multizone rooftop air handlers on the roof. Each unit serves seven zones, and mixes hot air and cold air in order to send the proper temperature air to the spaces. It mixes these airstreams through electric actuators and a long shaft, and the maintenance staff is constantly working on these and the dampers to satisfy occupant comfort.

Two of these units are 21 years old, and two are 10 years old. All of these units are fairly problematic and almost constantly in need of repair and tuning, in order to keep the spaces comfortable. As a result, these systems typically operate 24 hours a day.

A comprehensive HVAC upgrade is evaluated as EEM 2 in this report to replace these units with high efficiency VAV systems, instead of replacing them with the same type of unit that exists.

The gymnasium building has two constant volume single zone rooftop packaged air handlers on the roof. Each is equipped with a natural gas heating furnace and air conditioning. There are two relief vents on the roof – daylight is visible from the inside of the gym.

Upon inspection these roof vents are equipped with manual dampers that are left partially open.

Installing automatic actuators on these dampers is evaluated as part of EEM 2 in this report, along with operating these units with reduced operating hours through the use of a new DDC system.

There is also a natural gas furnace that heats and ventilates the kitchen. It is equipped with a return air/outside air mixing box that is designed to bring in 100% outside air when the kitchen exhaust hood is operating.

Summary Table of EEMs

The table on the next page list the EEMs recommended in this report.

EEM	EEM Description	kWh Saved / Year	Avg kW Saved / Month	Therms Saved / Year	Electric $ Saved / Year	Natural Gas $ Saved / Year	Utility $ Saved / Year	Total Project Cost	Base Project Cost	Installed Cost $	Raw Simple Payback (Years)	PP Incentive Estimated $	CNG Incentive Estimated $	Owner Final Cost $	Owner Final Payback (Years)
1	Lighting Upgrade (New Pendant Fixtures)	80,137	35	0	$4,958	$0	$4,958	$245,310	n/a	$245,310	49	$13,825	$0	$231,485	47
2	HVAC & Controls Upgrade (New HVAC Main Bldg, New DDC Main & Gym Bldgs)	447,784	0	27,664	$20,137	$29,267	$49,404	$790,500	$500,000	$290,500	6	$67,168	$27,664	$195,669	4
TOTALS		**527,921**	**35**	**27,664**	**$25,095**	**$29,267**	**$54,362**	**$1,035,810**	**$500,000**	**$535,810**	**10**	**$80,993**	**$27,664**	**$427,154**	**8**

Notes				
1	Pacific Power Lighting Incentive has been estimated using the FinExpress Stipulated Incentive Sheet			
2	Pacific Power HVAC Incentive has been estimated at	$0.15 per kWh and	$50.00 per kW, capped at	60% of Incremental Project Cost
3	Cascade Natural Gas Incentive has been estimated at	$1.00 per therm		
4	EEM2 Base Project Cost includes Code Required Fire / Smoke Dampers, (4) New Multizone Air Handlers (100 tons total)			

The table below illustrates the existing energy use on a per square foot basis, and the proposed energy use after both EEMs above are installed. The proposed energy use is right in line with the standard guidelines developed by the University of Washington for public schools.

	Existing		Proposed	
	units	EUI	units	EUI
Electric Use (kWh)	769,646	84,487	241,724	26,535
Natural Gas Use (therms)	36,355	116,930	8,691	27,953
Total Energy Use (Btus/sf/year)		201,417		54,488

Next Steps for the Owner

Review this Report and Decide which EEMs to Implement. The EEMs identified in this report affect different systems and have different budgets. If the owner has potential funding and commitment to implement any of these measures in the next year or two then notify the serving utility companies which measures would be considered. Indicate the timeframe you are considering and the potential budget.

Pacific Power and Cascade Natural Gas will notify you of the next steps to participate in their incentive program. The particular EEMs that you are interested in implementing will determine what the next steps are, in order to qualify for incentives from Pacific Power and/or Cascade Natural Gas.

Other Energy Saving Opportunities not included in Summary Table

The following energy saving opportunities are not included in the summary table of this report. They are briefly described here, along with the reason why they are not included.

Solar Electric Generation: Even with available incentives and tax credits solar photovoltaic would have a payback well over 60 years.

Solar Water Heating of Domestic Hot Water: Glazed solar collectors could be mounted on the roof and used to heat or pre-heat the domestic hot water. These systems also have a payback over 30 years.

Envelope Upgrade: This upgrade could increase the occupant comfort and save some heating and cooling energy by replacing single pane windows with double pane insulated windows, and by adding insulation to the asbestos panels beneath the windows. The payback is about 50 years for this upgrade, which exceeds the owner's threshold.

EEM 1: UPGRADE LIGHTS

The interior lights consist primarily of 4' T12 fluorescent lamps with magnetic ballasts. While these lights were some of the most energy efficient sources when they were installed in the 1970's, today there are more efficient sources of light. T8 fluorescent lamps combined with high efficiency electronic ballasts can generate the same amount of light while using about 30% less energy.

Large areas of this school are over-illuminated. By lowering the light levels to more appropriate light levels, additional energy savings can be achieved. The classroom light levels range from 60 – 100 foot-candles, while 40 foot-candles is considered good practice today. The corridor and restroom light levels also exceed 60 foot-candles, while 10-20 foot-candles is considered good practice today. In both the classrooms and corridors we propose to lower the light levels to good practice.

The proposed new T8 lamps will have a color rendering index of 80 or higher, which generates a higher quality of light that makes it easier to see objects under this higher quality light. (The existing lamps have a color rendering index of 70).

The typical upgrades include:

Location	Upgrade
Classrooms, Library, Offices, Corridor	Remove 2'x4' recessed troffers with prismatic lenses and (4) T12 lamps. Install two new rows of pendant mounted fixtures that contain (3) T8 lamps per cross section. The new fixtures will throw light up onto the ceiling (approximately 80% up light) that ounces off the ceiling before reaching the student desks. The new fixtures will also throw about 20% of their total light directly down to the desks through a perforated lens. This style of fixture will minimize the bright glare that currently exists with the existing fixtures. This will lower the light levels in the classrooms from 60-100 foot-candles to about 30-40 foot-candles.
Gymnasium	Replace each 8' industrial fixtures (2) VHO 215 watt lamps and magnetic ballast) with a new fixture that contains (6) 32-watt T8 lamps, and high ballast factor, high efficiency electronic ballasts.

Fluorescent Fixtures in Restrooms	Retrofit each wall-mounted fixture (leaves existing fixture in place, replaces internal components) – remove (2) 4' T12 lamps and magnetic ballast – install (1) 32-watt T8 lamp and a low ballast factor high efficiency electronic ballast. This will lower the light levels from 50-80 foot-candles to a more appropriate level of 20 foot-candles.
Exit Signs	No change – the exit signs are no longer using electric lights, they have glow-in the dark faces attached to them and the lamps have either burnt out or been removed.
Miscellaneous Incandescent lights in restrooms, storage closets, exterior over classroom exits.	Some fixtures can be retrofitted with a hardwired conversion kit – this leaves the fixture in place, but removes the screw-in lamp socket, and installs hard-wired magnetic ballasts and new lamp holders that only accept 13-watt twin so that each fixture will use 13-watt twin-tube compact fluorescent lamps and hard-wired magnetic ballasts. Some fixtures can be replaced – the fixture is removed, and a new fixture is installed in its place. In areas where a 4' fixture can be installed the fixtures would contain (1) 32-watt T8 lamp. In areas where a smaller fixture is required (for aesthetics or physical constrictions) the fixture would contain (1), (2) or (3) 13-watt compact fluorescent lamps, and magnetic ballasts. These fixtures would not have a screw-in socket so incandescent lamps could not be used.

The room by room detailed upgrades are found on the following sheet.

Location Information		Existing Fixtures					Proposed Fixtures				
Location	Operation Schedule	Fixture Type (E)	Custom Description / Additional Info.	Qty. (E)	Watts	Custom Wattage	Fixture Type (P)	Custom Description / Additional Info.	Qty. (P)	Watts	Custom Wattage
Gymnasium	B	2F96T12VHO	Industrial w/ Wireguard	15	390		4LF32T8Elec/Highbay-	New Fixtures	15	154	
Stage	C	Incandescent150W	Lampholders	3	150		Prem 2T8 3100 lum<0.8 B	New Fixtures	3	48	
Kitchen	A	2LF40T12Mag	Wrap	15	72		Custom	New 2T8, BF=.85	15	--->	55
Kitchen RR	A	Incandescent120W	Vanity	1	120		Custom	New 1T8 (2')	1	--->	20
Kitchen Corridor	A	Incandescent75W	Recessed	2	75		CFL26W/Hardwire	Retrofit Kit	2	30	
Kitchen Storage	A	Incandescent150W	Lampholders	1	150		Prem 1T8 3100 lum<0.8 B	New Fixtures	1	24	
Kitchen Locked Rm	A	Incandescent150W	Lampholders	2	150		Prem 1T8 3100 lum<0.8 B	New Fixtures	2	24	
Electric Room	C	Incandescent150W	Lampholders	2	150		Prem 1T8 3100 lum<0.8 B	New Fixtures	2	24	
Furnace Room	C	Incandescent150W	Lampholders	2	150		Prem 1T8 3100 lum<0.8 B	New Fixtures	2	24	
PE Office	A	4LF40T12 Mag	Wrap	2	144		Prem 2T8 3100 lum<0.8 BF		2	48	
Girls Locker Rooms	A	Incandescent200W	Drum w/ (3) 75w Lamps	6	200		Prem 1T8 3100 lum<0.8 B	New Fixtures	6	24	
Boys Locker Rooms	A	Incandescent200W	Drum w/ (3) 75w Lamps	6	200		Prem 1T8 3100 lum<0.8 B	New Fixtures	6	24	
Main School Entrance	B	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	5	144		Prem 3T8 3100 lum<0.8 B	New Direct/Indirect Fixtures	5	73	
Main Office	B	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	8	144		Prem 3T8 3100 lum<0.8 B	New Direct/Indirect Fixtures	8	73	
Main Office	C	2LF40T12Mag	U-tubes, 2'x2' Recessed w/ Prismatic Lens	2	72		Prem 3T8 3100 lum<0.8 B	New Direct/Indirect Fixtures	1	73	
Health Room	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	3	144		Prem 3T8 3100 lum<0.8 B	New Direct/Indirect Fixtures	3	73	
Health Room	A	2LF40T12Mag	U-tubes, 2'x2' Recessed w/ Prismatic Lens	2	72		Prem 3T8 3100 lum<0.8 B	New Direct/Indirect Fixtures	1	73	
Principal Office	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	4	144		Prem 3T8 3100 lum<0.8 B	New Direct/Indirect Fixtures	4	73	

Location Information		Existing Fixtures					Proposed Fixtures				
Location	Operation Schedule	Fixture Type (E)	Custom Description / Additional Info.	Qty. (E)	Watts	Custom Wattage	Fixture Type (P)	Custom Description / Additional Info.	Qty. (P)	Watts	Custom Wattage
Work Room	B	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	11	144		Prem 3T8 3100 lum<0.8 E	New Direct/Indirect Fixtures	11	73	
Classroom 8	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	17	144		Prem 3T8 3100 lum<0.8 E	New Direct/Indirect Fixtures	17	73	
Classroom 8	A	1LF40T12Mag	Under Cabinet Light	3	43		Prem 1T8 3100 lum<0.8 E	New Direct/Indirect Fixtures	3	24	
Classroom 8 RRs	A	2LF40T12Mag	Wall Mount	2	72		Prem 1T8 3100 lum<0.8 E	Delamp	2	24	
Classroom 7	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	16	144		Prem 3T8 3100 lum<0.8 E	New Direct/Indirect Fixtures	16	73	
Classroom 7	A	1LF40T12Mag	Under Cabinet Light	3	43		Prem 1T8 3100 lum<0.8 BF		3	24	
Classroom 7/6 RRs	A	2LF40T12Mag	Wall Mount	2	72		Prem 1T8 3100 lum<0.8 E	Delamp	2	24	
Classroom 6	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	16	144		Prem 3T8 3100 lum<0.8 E	New Direct/Indirect Fixtures	16	73	
Classroom 6	A	1LF40T12Mag	Under Cabinet Light	3	43		Prem 1T8 3100 lum<0.8 BF		3	24	
Classroom 5	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	16	144		Prem 3T8 3100 lum<0.8 E	New Direct/Indirect Fixtures	16	73	
Classroom 5	A	1LF40T12Mag	Under Cabinet Light	3	43		Prem 1T8 3100 lum<0.8 BF		3	24	
Classroom 5/4 RRs	A	2LF40T12Mag	Wall Mount	2	72		Prem 1T8 3100 lum<0.8 E	Delamp	2	24	
Classroom 4	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	16	144		Prem 3T8 3100 lum<0.8 E	New Direct/Indirect Fixtures	16	73	
Classroom 4	A	1LF40T12Mag	Under Cabinet Light	3	43		Prem 1T8 3100 lum<0.8 BF		3	24	
Classroom 3	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	16	144		Prem 3T8 3100 lum<0.8 E	New Direct/Indirect Fixtures	16	73	
Classroom 3	A	1LF40T12Mag	Under Cabinet Light	3	43		Prem 1T8 3100 lum<0.8 BF		3	24	
Classroom 3/2 RRs	A	2LF40T12Mag	Wall Mount	2	72		Prem 1T8 3100 lum<0.8 E	Delamp	2	24	
Classroom 2	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	16	144		Prem 3T8 3100 lum<0.8 E	New Direct/Indirect Fixtures	16	73	
Classroom 2	A	1LF40T12Mag	Under Cabinet Light	3	43		Prem 1T8 3100 lum<0.8 BF		3	24	
Classroom 1	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	11	144		Prem 3T8 3100 lum<0.8 E	New Direct/Indirect Fixtures	11	73	
Teachers Lounge	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	12	144		Prem 3T8 3100 lum<0.8 E	New Direct/Indirect Fixtures	12	73	
Instruction Rooms	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	4	144		Prem 3T8 3100 lum<0.8 E	New Direct/Indirect Fixtures	4	73	

Location Information		Existing Fixtures					Proposed Fixtures				
Location	Operation Schedule	Fixture Type (E)	Custom Description / Additional Info.	Qty. (E)	Watts	Custom Wattage	Fixture Type (P)	Custom Description / Additional Info.	Qty. (P)	Watts	Custom Wattage
Jan Closet	C	Incandescent100W	**Lampholders**	1	100		Prem 1T8 3100 lum<0.8 E	**New Fixture**	1	24	
Jan Closet	C	2LF40T12Mag	**Strip**	1	72		Prem 2T8 3100 lum<0.8 BF		1	48	
(4) Sm RRs	A	2LF40T12Mag	**Wall Mount**	4	72		Prem 1T8 3100 lum<0.8 E	**Delamp**	4	24	
Indiv Instruction	A	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	4	144		Prem 3T8 3100 lum<0.8 E	**New Direct/Indirect Fixtures**	4	73	
Corridor from Lounge around to CR 2	B	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	15	144		Prem 3T8 3100 lum<0.8 E	**New Direct/Indirect Fixtures**	15	73	
Corridor from N exit to Library	B	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	5	144		Prem 3T8 3100 lum<0.8 E	**New Direct/Indirect Fixtures**	5	73	
Corridor from Library to CR 17	B	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	14	144		Prem 3T8 3100 lum<0.8 E	**New Direct/Indirect Fixtures**	14	73	
Classroom 9	A	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	16	144		Prem 3T8 3100 lum<0.8 E	**New Direct/Indirect Fixtures**	16	73	
Classroom 9	A	1LF40T12Mag	**Under Cabinet Light**	3	43		Prem 1T8 3100 lum<0.8 BF		3	24	
Classroom 9/10 RRs	A	2LF40T12Mag	**Wall Mount**	2	72		Prem 1T8 3100 lum<0.8 E	**Delamp**	2	24	
Classroom 10	A	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	16	144		Prem 3T8 3100 lum<0.8 E	**New Direct/Indirect Fixtures**	16	73	
Classroom 10	A	1LF40T12Mag	**Under Cabinet Light**	3	43		Prem 1T8 3100 lum<0.8 BF		3	24	
Classroom 11	A	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	16	144		Prem 3T8 3100 lum<0.8 E	**New Direct/Indirect Fixtures**	16	73	
Classroom 11	A	1LF40T12Mag	**Under Cabinet Light**	3	43		Prem 1T8 3100 lum<0.8 BF		3	24	
Classroom 11/12 RRs	A	2LF40T12Mag	**Wall Mount**	2	72		Prem 1T8 3100 lum<0.8 E	**Delamp**	2	24	
Classroom 12	A	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	16	144		Prem 3T8 3100 lum<0.8 E	**New Direct/Indirect Fixtures**	16	73	
Classroom 12	A	1LF40T12Mag	**Wall Mount**	2	43		Prem 1T8 3100 lum<0.8 BF		2	24	
Classroom 13	A	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	16	144		Prem 3T8 3100 lum<0.8 E	**New Direct/Indirect Fixtures**	16	73	
Classroom 13	A	1LF40T12Mag	**Under Cabinet Light**	3	43		Prem 1T8 3100 lum<0.8 BF		3	24	
Classroom 13 RR	A	2LF40T12Mag	**Wall Mount**	1	72		Prem 1T8 3100 lum<0.8 E	**Delamp**	1	24	

Location Information		Existing Fixtures					Proposed Fixtures				
Location	Operation Schedule	Fixture Type (E)	Custom Description / Additional Info.	Qty. (E)	Watts	Custom Wattage	Fixture Type (P)	Custom Description / Additional Info.	Qty. (P)	Watts	Custom Wattage
Classroom 14	A	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	16	144		Prem 3T8 3100 lum<0.8 B	**New Direct/Indirect Fixtures**	16	73	
Classroom 14	A	1LF40T12Mag	**Under Cabinet Light**	3	43		Prem 1T8 3100 lum<0.8 BF		3	24	
Classroom 14/15 RRs	A	2LF40T12Mag	**Wall Mount**	2	72		Prem 1T8 3100 lum<0.8 B	**Delamp**	2	24	
Classroom 15	A	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	16	144		Prem 3T8 3100 lum<0.8 B	**New Direct/Indirect Fixtures**	16	73	
Classroom 15	A	1LF40T12Mag	**Under Cabinet Light**	3	43		Prem 1T8 3100 lum<0.8 BF		3	24	
Classroom 16	A	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	16	144		Prem 3T8 3100 lum<0.8 B	**New Direct/Indirect Fixtures**	16	73	
Classroom 16	A	1LF40T12Mag	**Under Cabinet Light**	3	43		Prem 1T8 3100 lum<0.8 BF		3	24	
Classroom 16/17 RRs	A	2LF40T12Mag	**Wall Mount**	2	72		Prem 1T8 3100 lum<0.8 B	**Delamp**	2	24	
Classroom 17	A	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	16	144		Prem 3T8 3100 lum<0.8 B	**New Direct/Indirect Fixtures**	16	73	
Classroom 17	A	1LF40T12Mag	**Under Cabinet Light**	3	43		Prem 1T8 3100 lum<0.8 BF		3	24	
KIVA Classroom	A	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	22	144		Prem 3T8 3100 lum<0.8 B	**New Direct/Indirect Fixtures**	22	73	
KIVA Classroom	A	1LF40T12Mag	**Under Cabinet Light**	3	43		Prem 1T8 3100 lum<0.8 BF		3	24	
Small Classroom	A	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	6	144		Prem 3T8 3100 lum<0.8 B	**New Direct/Indirect Fixtures**	6	73	
Library	B	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	42	144		Prem 3T8 3100 lum<0.8 B	**New Direct/Indirect Fixtures**	42	73	
Library Work Room	A	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	6	144		Prem 3T8 3100 lum<0.8 B	**New Direct/Indirect Fixtures**	6	73	
Library Offices	A	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	9	144		Prem 3T8 3100 lum<0.8 B	**New Direct/Indirect Fixtures**	9	73	
Story Telling Room	A	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	8	144		Prem 3T8 3100 lum<0.8 B	**New Direct/Indirect Fixtures**	8	73	
Planning Room	A	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	4	144		Prem 3T8 3100 lum<0.8 B	**New Direct/Indirect Fixtures**	4	73	
Lounge	B	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	4	144		Prem 3T8 3100 lum<0.8 B	**New Direct/Indirect Fixtures**	4	73	

Location Information		Existing Fixtures					Proposed Fixtures				
Location	Operation Schedule	Fixture Type (E)	Custom Description / Additional Info.	Qty. (E)	Watts	Custom Wattage	Fixture Type (P)	Custom Description / Additional Info.	Qty. (P)	Watts	Custom Wattage
Mens Restroom	A	Custom	2LF30T12 Mag	2	--->	120	Custom	Prem 1T8 3'	2	--->	20
Womens Restroom	A	Custom	2LF30T12 Mag	2	--->	120	Custom	Prem 1T8 3'	2	--->	20
Storage	A	2LF40T12Mag	Strip	1	72		Prem 2T8 3100 lum<0.8 BF		1	48	
Electric Room	A	2LF40T12Mag	Strip	1	72		Prem 2T8 3100 lum<0.8 BF		1	48	
Electric Room	A	Incandescent100W	Lampholders	1	100		Prem 1T8 3100 lum<0.8 B	New Fixture	1	24	
Boys Restroom	B	Incandescent100W	Recessed	2	100		CFL26W/Hardwire		2	30	
Boys Restroom	B	2LF40T12Mag	Wall Mount	1	72		Prem 1T8 3100 lum<0.8 B	Delamp	1	24	
Girls Restroom	B	Incandescent100W	Recessed	2	100		CFL26W/Hardwire		2	30	
Girls Restroom	B	2LF40T12Mag	Wall Mount	1	72		Prem 1T8 3100 lum<0.8 B	Delamp	1	24	
Exterior	D	Incandescent150W	Surface, 12" sq, (2) 75w Inc each	16	150		CFL26W/Hardwire	New Fixtures	16	30	

EEM 2: NEW HVAC AND CONTROLS FOR ENERGY SAVINGS

This measure will remove the (4) multizone air handlers on the roof, and install (4) new VAV air handlers in their place. The existing ductwork distribution will be utilized, and the code required fire dampers will be installed.

A new DDC system will be installed to control the operating times of the units, and the space temperatures for occupied and unoccupied times.

These two buildings consistently use the most energy per square foot in the entire district. This is attributed to the unique and complex nature of the multi-zone air handlers, and the necessity to operate the systems 24 hours a day in order to maintain occupant comfort (if the systems shut off overnight, some zones cannot recovery their temperature in a reasonable amount of time – therefore they are left to operate).

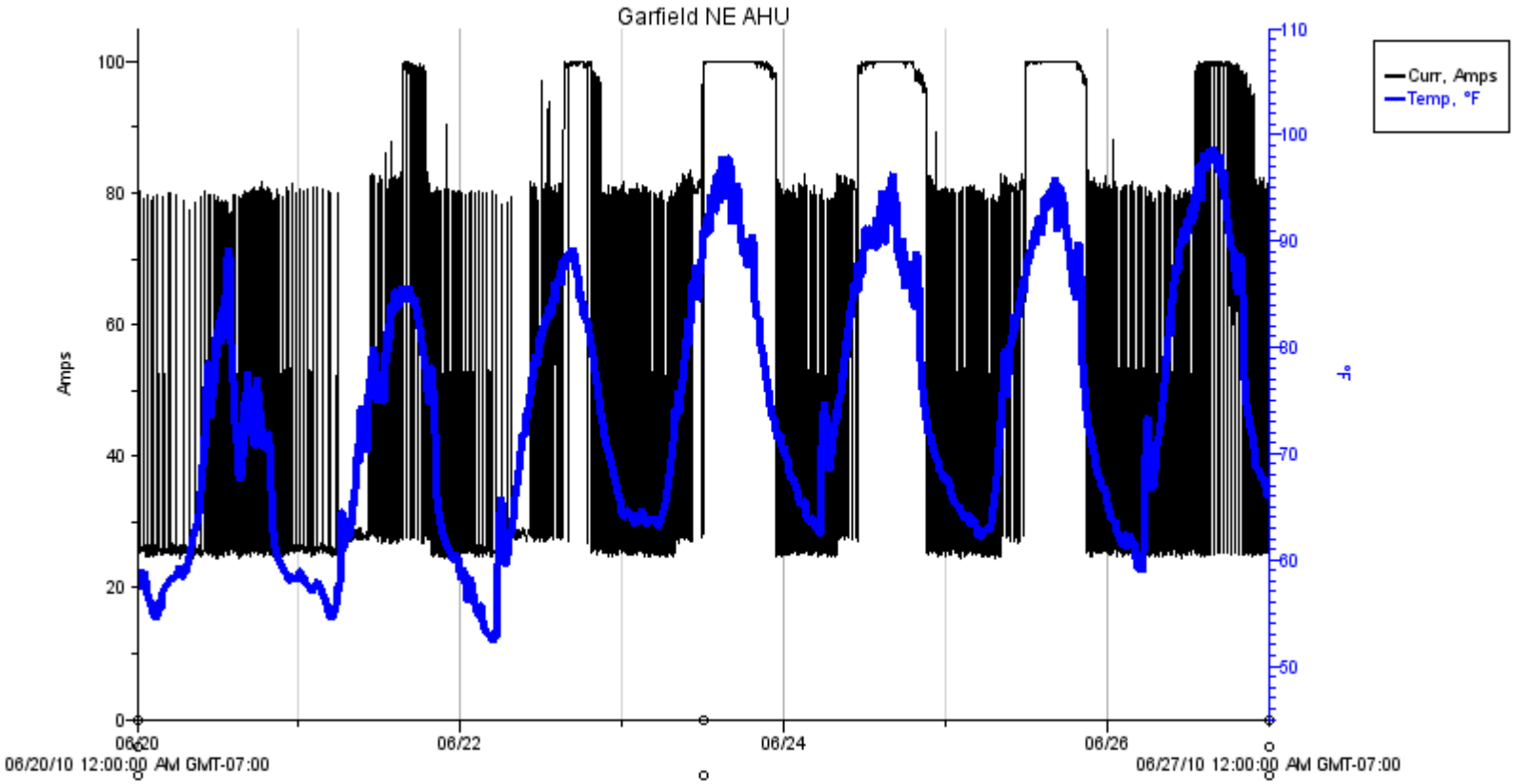
Two of the units have already exceeded their life expectancy, and two of the units are only 2 years away from reaching their life expectancy, and they are currently in need of repairs. The lowest first-cost replacement for these units is to replace them with similar units; however this would maintain current energy use. If instead the District would replace these with high efficiency variable air volume units it will cost more up-front, but it can lead to substantial energy savings that will pay for this additional upfront cost well before the units reach their life expectancy. The system we envision is a variable air volume unit equipped with variable speed drives, and a single VAV damper for each of the zones. Each zone will also have a hot water reheat coil that tempers the air supplied. There will be natural gas boilers that provide hot water to the reheat coils for each new air handler.

The (2) roof vents of the gymnasium building will be equipped with automatic actuators to open and close the dampers as needed through the new DDC system. The rooftop units serving the gymnasium will also be connected to the new DDC system, and the roof vents will only modulate as needed when the rooftop units operate in free-cooling economizer mode.

It is assumed that while occupied the spaces will be heated to 70 F, and cooled to 76 F, and while unoccupied the spaces will be allowed to drift down at night to 55 F, and also allowed o drift up to 80 F.

It is anticipated that the HVAC systems will be turned on an average of one hour prior to school starting, and will stop about half an hour after school ends. It is assumed the units will only operate in the summer when occupied and the occupants utilize the manual over-rides (see next paragraph).

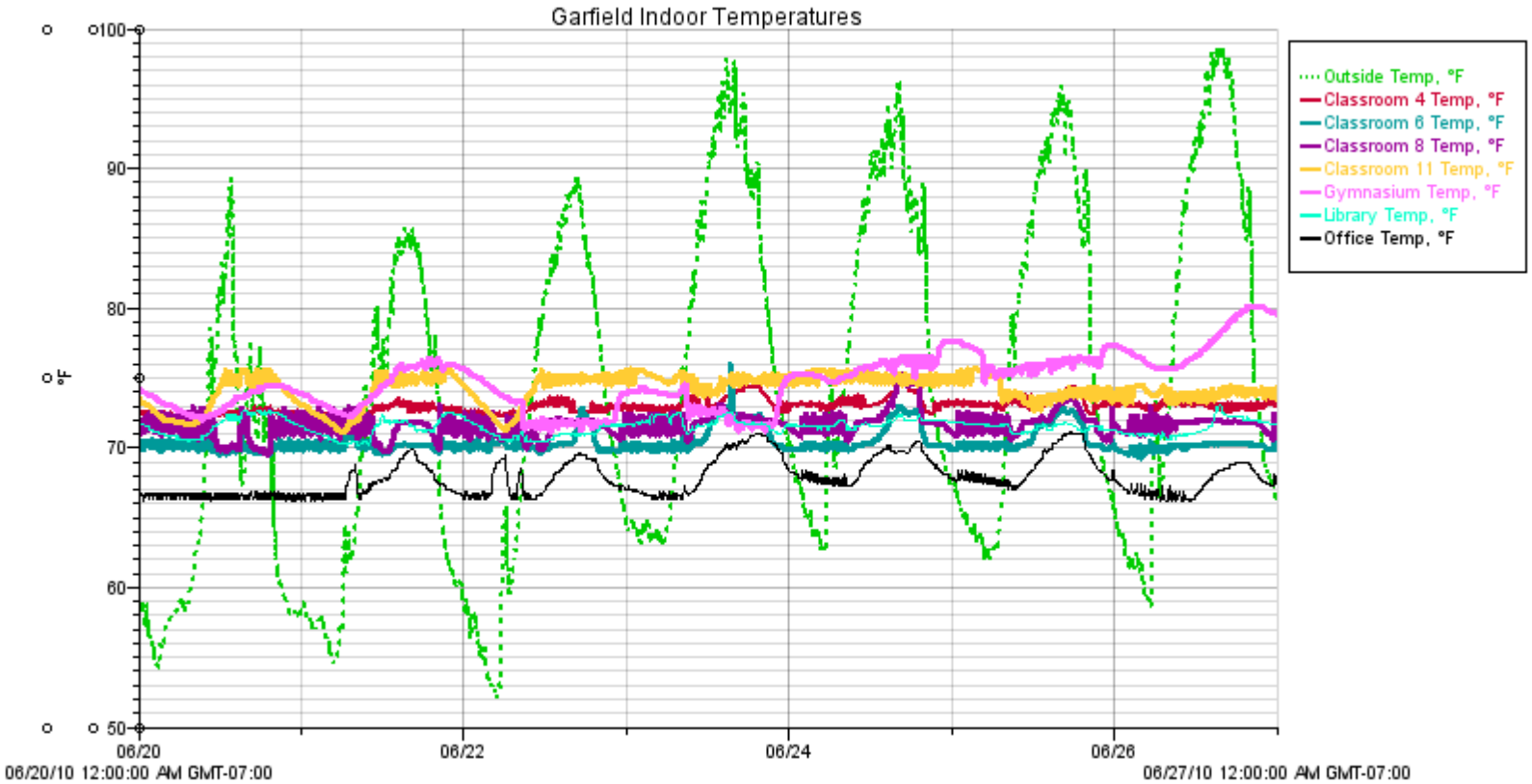
New thermostats will be installed and select locations can be equipped with manual over-ride buttons. The DDC operator can program the over-ride button to automatically turn on the HVAC serving the appropriate zone for a specified amount of time (1 or 2 hours is suggested). This will allow occupants to use the spaces during normally unoccupied times – but only as needed.



This graph shows the outside air tempreature (blue line, read on scale to the right) and power (amps) of the southeast air handling unit (black line, read on scale to the left) over a one week period.

This illustrates that the fan always opertes 24 hours a day. When only the fans are on this unit draws about 24 amps, when one stage of compressor cycles on the power jumps up to about 80 amps, when the second stage of compressor cycles on the power increases to over 100 amps (sensor maxed out at 100 amps). This shows that the compressor (black line) is cycling on and off whenever the outside air temperature is about 55 F, and it remains on for long periods of time on 6/23, 6/24 and 6/25.

This data was used to develop a relationship of the Air Conditioning Power vs OA Temperature, and was used to calculate the existing baseline air conditioning and fan energy use for the building.



This graph shows the indoor and outdoor temperature over a seven day period. The dashed green line is the outside air temperature, which ranged from 55 F to 95 f during this test period.

The solid lines represent indoor temperatures taken at different locations, including the gymnasium, library, office and four classrooms. These results indicate that the spaces are maintaining temperatures 24 hours a day.

The following table summarizes the HVAC systems at the facility.

HVAC Unit	SF hp	RF hp	Total hp	Tons	SEER
AC-1 (NW)	10	3	13	30	8.28
AC-2 (SW)	10	3	13	30	8.28
AC-3 (SE)	7.5	3	10.5	20	7.17
AC-4 (NE)	7.5	3	10.5	20	7.17
Gym AC-1	3	1	4	7.5	10
Gym AC-2	3	1	4	7.5	10
Kitchen Furnace	1		1		
TOTAL	42	14	56	115	

The tables on the following page calculate the existing HVAC energy use, and the proposed HVAC energy use, and savings.

Occupied Analysis

Hours		Fans		AC kW		Ventilation		Envelope	
	Hours / Year	Fan Power (kW)	Fan kWh	AC kW	AC kWh	Gas (Btus / hr)	Gas Therms	Gas (Btus / hr)	Gas Therms
102.5	0	41	0	*169*	0	0	0	0	0
97.5	4	41	162	158	631	0	0	0	0
92.5	7	41	284	146	1,021	0	0	0	0
87.5	16	41	649	146	2,331	0	0	0	0
82.5	35	41	1,420	128	4,480	0	0	0	0
77.5	84	41	3,407	85	7,164	0	0	0	0
72.5	124	41	5,030	75	9,277	0	0	0	0
67.5	151	41	6,125	55	8,344	0	0	0	0
62.5	199	41	8,072	41	8,074	0	0	0	0
57.5	194	41	7,869	25	4,836	0	0	0	0
52.5	222	41	9,005	12	2,752	43,754	125	11,838	34
47.5	213	41	8,640	0	0	131,261	358	35,513	97
42.5	144	41	5,841	0	0	218,768	404	59,188	109
37.5	239	41	9,695	0	0	306,276	938	82,863	254
32.5	158	41	6,409	0	0	393,783	798	106,539	216
27.5	97	41	3,935	0	0	481,290	599	130,214	162
22.5	44	41	1,785	0	0	568,798	321	153,889	87
17.5	10	41	406	0	0	656,305	84	177,564	23
12.5	2	41	81	0	0	743,812	19	201,240	5
7.5	1	41	41	0	0	831,320	11	224,915	3
2.5	0	41	0	0	0	918,827	0	248,590	0
TOTALS	1,944		78,856		48,911		3,656		989
									4,645

Unoccupied Analysis

Hours	Fans		AC kW		Ventilation		Envelope		Existing Energy Use		
Hours / Year	Fan Power (kW)	Fan kWh	AC kW	AC kWh	Gas (Btus / hr)	Gas Therms	Gas (Btus / hr)	Gas Therms	Fan kWh	AC kWh	Gas Therms
4	41	162	*169*	678	0	0	0	0	162	678	0
19	41	771	158	2,996	0	0	0	0	933	3,627	0
42	41	1,704	146	6,127	0	0	0	0	1,988	7,148	0
110	41	4,462	146	16,026	0	0	0	0	5,111	18,357	0
262	41	10,628	128	33,535	0	0	0	0	12,047	38,015	0
265	41	10,749	85	22,601	0	0	0	0	14,157	29,765	0
323	41	13,102	75	24,166	0	0	0	0	18,132	33,444	0
370	41	15,009	55	20,445	0	0	0	0	21,134	28,789	0
574	41	23,284	41	23,290	0	0	0	0	31,356	31,365	0
570	41	23,121	25	14,209	78,757	576	21,308	156	30,991	19,045	731
583	41	23,649	12	7,227	166,264	1,243	44,983	336	32,654	9,980	1,737
730	41	29,612	0	0	253,771	2,375	68,658	643	38,252	0	3,473
529	41	21,458	0	0	341,279	2,315	92,333	626	27,299	0	3,454
782	41	31,721	0	0	428,786	4,299	116,009	1,163	41,416	0	6,654
771	41	31,275	0	0	516,293	5,103	139,684	1,381	37,684	0	7,498
488	41	19,795	0	0	603,801	3,778	163,359	1,022	23,730	0	5,560
200	41	8,113	0	0	691,308	1,773	187,034	480	9,898	0	2,660
123	41	4,989	0	0	778,815	1,228	210,710	332	5,395	0	1,667
42	41	1,704	0	0	866,323	466	234,385	126	1,785	0	617
14	41	568	0	0	953,830	171	258,060	46	608	0	231
15	41	608	0	0	1,041,337	200	281,735	54	608	0	254
6,816		276,483		171,301		23,526		6,365	355,339	220,212	34,537
8,760								29,891		575,551	

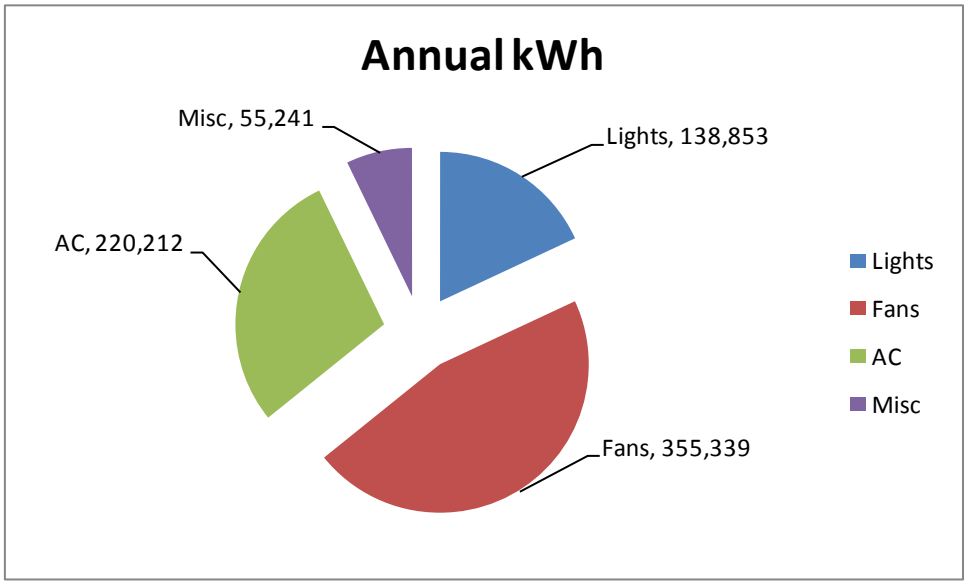
SAVINGS	276,483		171,301		23,526		4,137	46%	29%	95%
			447,784				**27,664**		75%	

Assumptions

30,000	cfm total airflow
16,205	cfm ventilation air
55	Occupied Balance Point Temperature (F)
62	Unoccupied Balance Point Temperature (F)
78%	Heating system efficiency
4,735	Overall Building U x A constant
50%	of night envelope heating will be saved due to night low limit operation

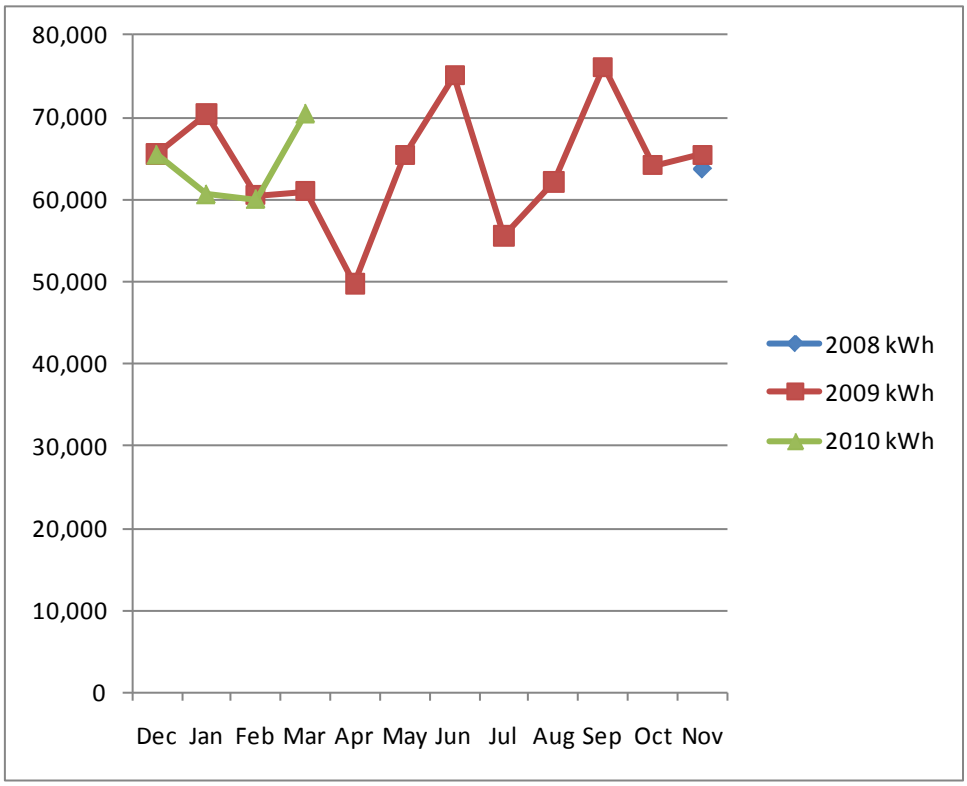
APPENDIX

The end-uses analysis of electric energy use (kWh) is illustrated below.



	Annual kWh	% of Total kWh Use
Lights	138,853	18%
Fans	355,339	46%
AC	220,212	29%
Misc	55,241	7%
Total	769,646	100%

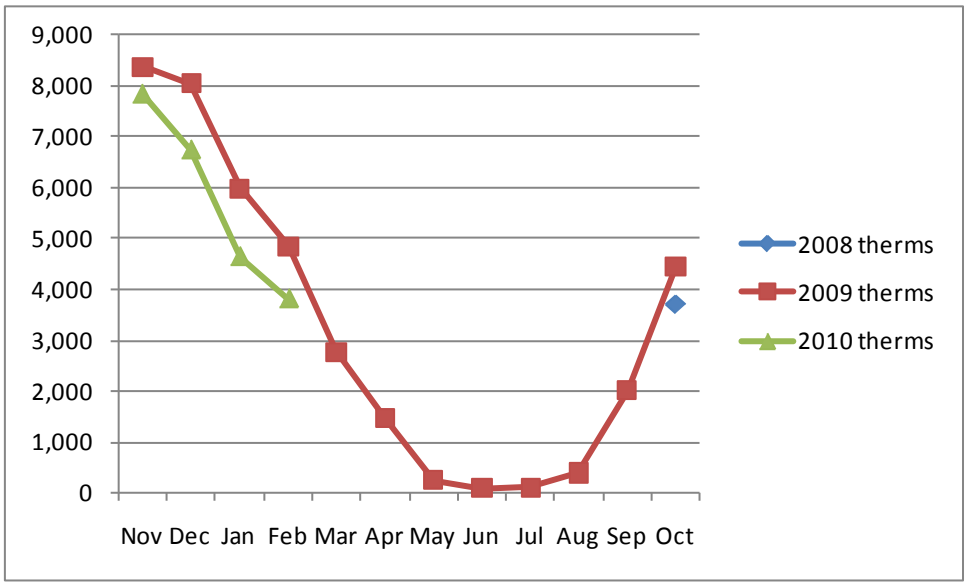
The recent historical electrical energy use (kWh) is illustrated below.



	2008 kWh	2009 kWh	2010 kWh	Avg kWh
Dec		65,488	65,447	65,467
Jan		70,366	60,578	65,472
Feb		60,535	60,015	60,275
Mar		60,983	70,509	65,746
Apr		49,749		49,749
May		65,364		65,364
Jun		75,043		75,043
Jul		55,562		55,562
Aug		62,131		62,131
Sep		76,118		76,118
Oct		64,154		64,154
Nov	63,682	65,447		64,564
TOTAL		770,940	256,549	769,646

	2008 $	2009 $	2010 $	Avg $
Jan		$4,469	$4,454	$4,462
Feb		$4,682	$4,372	$4,527
Mar		$4,220	$4,368	$4,294
Apr		$4,161	$4,888	$4,524
May		$3,609		$3,609
Jun		$4,397		$4,397
Jul		$4,996		$4,996
Aug		$3,729		$3,729
Sep		$4,134		$4,134
Oct		$5,028		$5,028
Nov		$4,441		$4,441
Dec	$4,260	$4,454		$4,357
TOTAL		$52,321	$18,082	$52,498

The recent historical natural gas use (therms) is illustrated below.



	2008 therms	2009 therms	2010 therms	Avg therms
Nov		8,366	7,842	8,104
Dec		8,045	6,744	7,395
Jan		5,988	4,644	5,316
Feb		4,845	3,813	4,329
Mar		2,768		2,768
Apr		1,483		1,483
May		259		259
Jun		103		103
Jul		112		112
Aug		394		394
Sep		2,022		2,022
Oct	3,697	4,443		4,070
TOTAL		38,828	23,043	36,355

	2008 $	2009 $	2010 $	Avg $
Jan		$12,776	$9,539	$11,157
Feb		$12,398	$8,221	$10,309
Mar		$9,193	$5,725	$7,459
Apr		$7,457	$4,762	$6,110
May		$4,305		$4,305
Jun		$2,849		$2,849
Jul		$391		$391
Aug		$173		$173
Sep		$169		$169
Oct		$499		$499
Nov		$2,513		$2,513
Dec	$5,586	$5,506		$5,546
TOTAL		$58,229	$28,246	$51,480

Garfield Elementary School

EEM	EEM Description	kWh Saved / Year	Avg kW Saved / Month	Therms Saved / Year	Electric $ Saved / Year	Natural Gas $ Saved / Year	Utility $ Saved / Year	Total Project Cost	Base Project Cost	Installed Cost $	Raw Simple Payback (Years)	PP Incentive Estimated $	CNG Incentive Estimated $	Owner Final Cost $	Owner Final Payback (Years)
1	Lighting Upgrade (New Pendant Fixtures)	80,137	35	0	$4,958	$0	$4,958	$245,310	n/a	$245,310	49	$13,825	$0	$231,485	47
2	HVAC & Controls Upgrade (New HVAC Main Bldg, New DDC Main & Gym Bldgs)	447,784	0	27,664	$20,137	$29,267	$49,404	$790,500	$500,000	$290,500	6	$67,168	$27,664	$195,669	4
TOTALS		**527,921**	**35**	**27,664**	**$25,095**	**$29,267**	**$54,362**	**$1,035,810**	**$500,000**	**$535,810**	**10**	**$80,993**	**$27,664**	**$427,154**	**8**

Notes

1 Pacific Power Lighting Incentive has been estimated using the FinExpress Stipulated Incentive Sheet

2 Pacific Power HVAC Incentive has been estimated at $0.15 per kWh and $50.00 per kW, capped at 60% of Incremental Project Cost

3 Cascade Natural Gas Incentive has been estimated at $1.00 per therm

4 EEM2 Base Project Cost includes Code Required Fire / Smoke Dampers, (4) New Multizone Air Handlers (100 tons total)

	Existing		Proposed	
	units	EUI	units	EUI
Electric Use (kWh)	769,646	84,487	241,724	26,535
Natural Gas Use (therms)	36,355	116,930	8,691	27,953
Total Energy Use (Btus/sf/year)		201,417		54,488

Detailed Energy Analysis Report for
Specific Energy Savings Projects at the

McKinley Elementary School
Yakima School District
Yakima, Washington

Prepared by:

ABACUS
RESOURCE
MANAGEMENT
COMPANY

July 26, 2010

Disclaimer

The intent of this Detailed Energy Report is to quantify energy savings for specific energy saving projects that the owner has expressed interest in implementing. This report is believed to be reasonably accurate, but the findings are calculations based on assumptions and the actual results may vary. As a result, Abacus Resource Management is not liable if projected estimated savings or economics are not actually achieved. All savings and cost estimates in the report have been reviewed for accuracy, but they are not to be construed as a design document or as guarantees.

Yakima School District (owner of facility) shall independently evaluate any advice or direction provided in this report. In no event will Abacus Resource Management Company be liable for the failure of the customer to achieve a specified amount of energy savings, the operation of the customer's facilities, or any incidental or consequential damages of any kind in connection with this report or the installation of recommended measures.

Contacts

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Cascade Natural Gas Contact Bob Cuti: 360-909-8961
Energy Consultant Contact Abacus Resource Management Co. 14845 SW Murray Scholls Drive, Suite 110-138 Beaverton, OR 97007 Mark Kinzer, P.E. Phone: 503-819-5593 (markk@abacusrm.com) Rich Davis, C.E.M. Phone: (503) 936-7163 (richd@abacusrm.com)

Utility Rate Assumptions

Pacific Power

36 (Large General Service < 1,000 kW)	
$0.04497	**per kWh (> 40,000)**
$1.48000	per kW 101-300 kW Load Charge
$3.88000	**per kW Demand Demand Charge**
1-Jan-10	Effective Date of Rate

Cascade Natural Gas

$1.05797	per therm
504	Cascade Natural Gas Rate
1-Aug-09	Effective Date of Rate

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EXECUTIVE SUMMARY

Introduction and Background

Yakima School District is interested in pursuing opportunities to lower the utility use of their schools. This report presents detailed findings of several specific energy efficiency measures (EEMs) identified at the McKinley Elementary School.

Incentives available for Energy Efficiency Projects

Pacific Power offers incentives for owners to implement electric-saving measures. If the owner is interested in pursuing any of these opportunities they should discuss them with Pacific Power prior to purchasing equipment or issuing contracts for construction. Some projects will require inspections and verifications of savings before and/or after they are installed in order to qualify for incentives. All measures will require submitting official forms to the sponsoring agency prior to purchasing any equipment.

Cascade Natural Gas offers incentives for owners to implement natural gas-saving measures. If the owner is interested in pursuing any of these opportunities they should discuss them with Cascade Natural Gas prior to purchasing equipment or issuing contracts for construction. Some projects will require inspections and verifications of savings before and/or after they are installed in order to qualify for incentives. All measures will require submitting official forms to the sponsoring agency prior to purchasing any equipment.

Brief Description of Facility and Energy Using Systems

Facility Description: The School is comprised of a main building, a gymnasium building, and several portable buildings. The portable buildings are not covered as part of this study, only the permanent main and gymnasium building are covered.

The main building is a single story masonry building constructed in two stages. The western half was built in 1971, and the eastern half was constructed in 1975. The building footprint is about 28,000 square feet. The building contains twelve classrooms, a library, offices, meeting rooms, individual instruction rooms, restrooms and storage rooms. There are minimal windows and a flat insulated roof.

The gymnasium building is mainly 24’ tall with 12’ tall sides that house the locker rooms and kitchen. The gymnasium/cafeteria is in the center along with a stage. The building was constructed in the 1950’s. The building footprint is about 4,600 square feet. There are minimal windows and a flat insulated roof.

Energy Supply: The building receives electricity from Pacific Power, and natural gas from Cascade Natural Gas.

Lighting: Lighting is predominantly T12 fluorescent lights with magnetic ballasts. There are also some incandescent lights in use. A comprehensive lighting upgrade is evaluated as EEM 1 in this report. The light levels in the classrooms is exceedingly high (over 100 foot-candles), and this will be lowered to a more appropriate range during the upgrade (40 foot-candle target in classrooms, 20 foot-candle target in corridors).

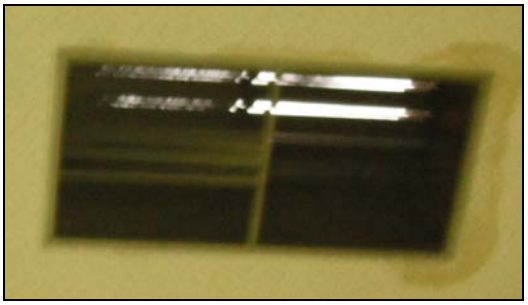
HVAC: The main building has four constant volume multizone rooftop air handlers on the roof. Each unit serves seven zones, and mixes hot air and cold air in order to send the proper temperature air to the spaces. It mixes these airstreams through electric actuators and a long shaft, and the maintenance staff is constantly working on these and the dampers to satisfy occupant comfort.

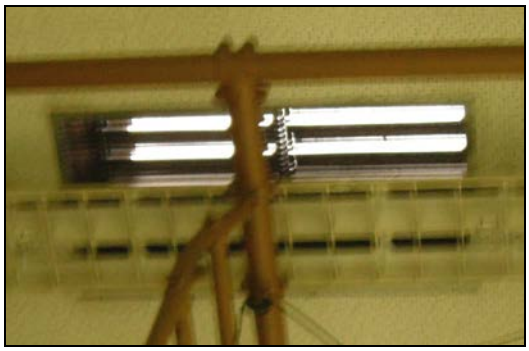
Two of these units are 21 years old, and two are 10 years old. All of these units are fairly problematic and almost constantly in need of repair and tuning, in order to keep the spaces comfortable. As a result, these systems typically operate 24 hours a day.

A comprehensive HVAC upgrade is evaluated as EEM 2 in this report to replace these units with high efficiency VAV systems, instead of replacing them with the same type of unit that exists.

The gymnasium building has two constant volume single zone rooftop packaged air handlers on the roof. Each is equipped with a natural gas heating furnace and air conditioning.

There are two relief vents on the roof – daylight is visible from the inside of the gym.





Upon inspection these roof vents are equipped with manual dampers that are left partially open.

Installing automatic actuators on these dampers is evaluated as part of EEM 2 in this report, along with operating these units with reduced operating hours through the use of a new DDC system.

There is also a natural gas furnace that heats and ventilates the kitchen. It is equipped with a return air/outside air mixing box that is designed to bring in 100% outside air when the kitchen exhaust hood is operating.

Summary Table of EEMs

The table on the next page list the EEMs recommended in this report.

EEM	EEM Description	kWh Saved / Year	Avg kW Saved / Month	Therms Saved / Year	Electric $ Saved / Year	Natural Gas $ Saved / Year	Utility $ Saved / Year	Total Project Cost	Base Project Cost	Incremental Project Cost $	Raw Simple Payback (Years)	PP Incentive Estimated $	CNG Incentive Estimated $	Owner Final Cost $	Owner Final Payback (Years)
1	Lighting Upgrade (New Pendant Fixtures)	80,137	35	0	$4,958	$0	$4,958	$243,330	n/a	$243,330	49	$13,825	$0	$229,505	46
2	HVAC & Controls Upgrade (New VAV HVAC Main Bldg, New Dampers Gym Bldg, New DDC Main & Gym Bldgs)	388,658	0	17,013	$17,478	$17,999	$35,477	$790,500	$500,000	$290,500	8	$58,299	$17,013	$215,189	6
TOTALS		**468,795**	**35**	**17,013**	**$22,436**	**$17,999**	**$40,435**	**$1,033,830**	**$500,000**	**$533,830**	**13**	**$72,124**	**$17,013**	**$444,693**	**11**

Notes				
1	Pacific Power Lighting Incentive has been estimated using the FinExpress Stipulated Incentive Sheet			
2	Pacific Power HVAC Incentive has been estimated at	$0.15 per kWh and	$50.00 per kW, capped at	60% of Incremental Project Cost
3	Cascade Natural Gas Incentive has been estimated at	$1.00 per therm		
4	EEM2 Base Project Cost includes Code Required Fire / Smoke Dampers, (4) New Multizone Air Handlers (100 tons total)			

All incentives will be determined by the appropriate utility, they have only been estimated in the table above by ARMCO.

The table below illustrates the existing energy use on a per square foot basis, and the proposed energy use after both EEMs above are installed. The proposed energy use is right in line with the standard guidelines developed by the University of Washington for public schools.

	Existing		Proposed	
	units	EUI (Btus/sf/yr)	units	EUI (Btus/sf/yr)
Electric Use (kWh)	655,932	72,005	187,137	20,543
Natural Gas Use (therms)	26,238	84,391	9,225	29,672
Total Energy Use (Btus/sf/year)		156,396		50,215

Next Steps for the Owner

Review this Report and Decide which EEMs to Implement. The EEMs identified in this report affect different systems and have different budgets. If the owner has potential funding and commitment to implement any of these measures in the next year or two then notify the serving utility companies which measures would be considered. Indicate the timeframe you are considering and the potential budget.

Pacific Power and Cascade Natural Gas will notify you of the next steps to participate in their incentive program. The particular EEMs that you are interested in implementing will determine what the next steps are, in order to qualify for incentives from Pacific Power and/or Cascade Natural Gas.

Other Energy Saving Opportunities not included in Summary Table

The following energy saving opportunities are not included in the summary table of this report. They are briefly described here, along with the reason why they are not included.

Solar Electric Generation: Even with available incentives and tax credits solar photovoltaic would have a payback well over 60 years.

Solar Water Heating of Domestic Hot Water: Glazed solar collectors could be mounted on the roof and used to heat or pre-heat the domestic hot water. These systems also have a payback over 30 years.

Envelope Upgrade: This upgrade could increase the occupant comfort and save some heating and cooling energy by replacing single pane windows with double pane insulated windows, and by adding insulation to the asbestos panels beneath the windows. The payback is about 50 years for this upgrade, which exceeds the owner's threshold.

EEM 1: UPGRADE LIGHTS

The interior lights consist primarily of 4' T12 fluorescent lamps with magnetic ballasts. While these lights were some of the most energy efficient sources when they were installed in the 1970's, today there are more efficient sources of light. T8 fluorescent lamps combined with high efficiency electronic ballasts can generate the same amount of light while using about 30% less energy.

Large areas of this school are over-illuminated. By lowering the light levels to more appropriate light levels, additional energy savings can be achieved. The classroom light levels range from 60 – 100 foot-candles, while 40 foot-candles is considered good practice today. The corridor and restroom light levels also exceed 60 foot-candles, while 10-20 foot-candles is considered good practice today. In both the classrooms and corridors we propose to lower the light levels to good practice.

The proposed new T8 lamps will have a color rendering index of 80 or higher, which generates a higher quality of light that makes it easier to see objects under this higher quality light. (The existing lamps have a color rendering index of 70).

The typical upgrades include:

Location	Upgrade
Classrooms, Library, Offices, Corridor	Remove 2'x4' recessed troffers with prismatic lenses and (4) T12 lamps. Install two new rows of pendant mounted fixtures that contain (3) T8 lamps per cross section. The new fixtures will throw light up onto the ceiling (approximately 80% up light) that ounces off the ceiling before reaching the student desks. The new fixtures will also throw about 20% of their total light directly down to the desks through a perforated lens. This style of fixture will minimize the bright glare that currently exists with the existing fixtures. This will lower the light levels in the classrooms from 60-100 foot-candles to about 30-40 foot-candles.
Gymnasium	Replace each 8' industrial fixtures (2) VHO 215 watt lamps and magnetic ballast) with a new fixture that contains (6) 32-watt T8 lamps, and high ballast factor, high efficiency electronic ballasts.

Fluorescent Fixtures in Restrooms	Retrofit each wall-mounted fixture (leaves existing fixture in place, replaces internal components) – remove (2) 4' T12 lamps and magnetic ballast – install (1) 32-watt T8 lamp and a low ballast factor high efficiency electronic ballast. This will lower the light levels from 50-80 foot-candles to a more appropriate level of 20 foot-candles.
Exit Signs	No change – already using LED lamps in exit signs.
Miscellaneous Incandescent lights in restrooms, storage closets, exterior over classroom exits.	Some fixtures can be retrofitted with a hardwired conversion kit – this leaves the fixture in place, but removes the screw-in lamp socket, and installs hard-wired magnetic ballasts and new lamp holders that only accept 13-watt twin so that each fixture will use 13-watt twin-tube compact fluorescent lamps and hard-wired magnetic ballasts. Some fixtures can be replaced – the fixture is removed, and a new fixture is installed in its place. In areas where a 4' fixture can be installed the fixtures would contain (1) 32-watt T8 lamp. In areas where a smaller fixture is required (for aesthetics or physical constrictions) the fixture would contain (1), (2) or (3) 13-watt compact fluorescent lamps, and magnetic ballasts. These fixtures would not have a screw-in socket so incandescent lamps could not be used.

The room by room detailed upgrades are found on the following sheet.

Location Information		Existing Fixtures					Proposed Fixtures				
Location	Operation Schedule	Fixture Type (E)	Custom Description / Additional Info.	Qty. (E)	Watts	Custom Wattage	Fixture Type (P)	Custom Description / Additional Info.	Qty. (P)	Watts	Custom Wattage
Gymnasium	B	2F96T12VHO	Industrial w/ Wireguard	15	390		4LF32T8Elec/Highbay-	New Fixtures	15	154	
Stage	C	Incandescent150W	Lampholders	3	150		Prem 2T8 3100 lum<0.8 B	New Fixtures	3	48	
Kitchen	A	2LF40T12Mag	Wrap	15	72		Custom	New 2T8, BF=.85	15	--->	55
Kitchen RR	A	Incandescent120W	Vanity	1	120		Custom	New 1T8 (2')	1	--->	20
Kitchen Corridor	A	Incandescent75W	Recessed	2	75		CFL26W/Hardwire	Retrofit Kit	2	30	
Kitchen Storage	A	Incandescent150W	Lampholders	1	150		Prem 1T8 3100 lum<0.8 B	New Fixtures	1	24	
Kitchen Locked Rm	A	Incandescent150W	Lampholders	2	150		Prem 1T8 3100 lum<0.8 B	New Fixtures	2	24	
Electric Room	C	Incandescent150W	Lampholders	2	150		Prem 1T8 3100 lum<0.8 B	New Fixtures	2	24	
Furnace Room	C	Incandescent150W	Lampholders	2	150		Prem 1T8 3100 lum<0.8 B	New Fixtures	2	24	
PE Office	A	4LF40T12 Mag	Wrap	2	144		Prem 2T8 3100 lum<0.8 BF		2	48	
Girls Locker Rooms	A	Incandescent200W	Drum w/ (3) 75w Lamps	6	200		Prem 1T8 3100 lum<0.8 B	New Fixtures	6	24	
Boys Locker Rooms	A	Incandescent200W	Drum w/ (3) 75w Lamps	6	200		Prem 1T8 3100 lum<0.8 B	New Fixtures	6	24	
Main School Entrance	B	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	5	144		Prem 3T8 3100 lum<0.8 B	New Direct/Indirect Fixtures	5	73	
Main Office	B	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	8	144		Prem 3T8 3100 lum<0.8 B	New Direct/Indirect Fixtures	8	73	
Main Office	C	2LF40T12Mag	U-tubes, 2'x2' Recessed w/ Prismatic Lens	2	72		Prem 3T8 3100 lum<0.8 B	New Direct/Indirect Fixtures	1	73	
Health Room	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	3	144		Prem 3T8 3100 lum<0.8 B	New Direct/Indirect Fixtures	3	73	
Health Room	A	2LF40T12Mag	U-tubes, 2'x2' Recessed w/ Prismatic Lens	2	72		Prem 3T8 3100 lum<0.8 B	New Direct/Indirect Fixtures	1	73	
Principal Office	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	4	144		Prem 3T8 3100 lum<0.8 B	New Direct/Indirect Fixtures	4	73	

Location Information		Existing Fixtures					Proposed Fixtures				
Location	Operation Schedule	Fixture Type (E)	Custom Description / Additional Info.	Qty. (E)	Watts	Custom Wattage	Fixture Type (P)	Custom Description / Additional Info.	Qty. (P)	Watts	Custom Wattage
Work Room	B	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	11	144		Prem 3T8 3100 lum<0.8 E	New Direct/Indirect Fixtures	11	73	
Classroom 8	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	17	144		Prem 3T8 3100 lum<0.8 E	New Direct/Indirect Fixtures	17	73	
Classroom 8	A	1LF40T12Mag	Under Cabinet Light	3	43		Prem 1T8 3100 lum<0.8 E	New Direct/Indirect Fixtures	3	24	
Classroom 8 RRs	A	2LF40T12Mag	Wall Mount	2	72		Prem 1T8 3100 lum<0.8 E	Delamp	2	24	
Classroom 7	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	16	144		Prem 3T8 3100 lum<0.8 E	New Direct/Indirect Fixtures	16	73	
Classroom 7	A	1LF40T12Mag	Under Cabinet Light	3	43		Prem 1T8 3100 lum<0.8 BF		3	24	
Classroom 7/6 RRs	A	2LF40T12Mag	Wall Mount	2	72		Prem 1T8 3100 lum<0.8 E	Delamp	2	24	
Classroom 6	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	16	144		Prem 3T8 3100 lum<0.8 E	New Direct/Indirect Fixtures	16	73	
Classroom 6	A	1LF40T12Mag	Under Cabinet Light	3	43		Prem 1T8 3100 lum<0.8 BF		3	24	
Classroom 5	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	16	144		Prem 3T8 3100 lum<0.8 E	New Direct/Indirect Fixtures	16	73	
Classroom 5	A	1LF40T12Mag	Under Cabinet Light	3	43		Prem 1T8 3100 lum<0.8 BF		3	24	
Classroom 5/4 RRs	A	2LF40T12Mag	Wall Mount	2	72		Prem 1T8 3100 lum<0.8 E	Delamp	2	24	
Classroom 4	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	16	144		Prem 3T8 3100 lum<0.8 E	New Direct/Indirect Fixtures	16	73	
Classroom 4	A	1LF40T12Mag	Under Cabinet Light	3	43		Prem 1T8 3100 lum<0.8 BF		3	24	
Classroom 3	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	16	144		Prem 3T8 3100 lum<0.8 E	New Direct/Indirect Fixtures	16	73	
Classroom 3	A	1LF40T12Mag	Under Cabinet Light	3	43		Prem 1T8 3100 lum<0.8 BF		3	24	
Classroom 3/2 RRs	A	2LF40T12Mag	Wall Mount	2	72		Prem 1T8 3100 lum<0.8 E	Delamp	2	24	
Classroom 2	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	16	144		Prem 3T8 3100 lum<0.8 E	New Direct/Indirect Fixtures	16	73	
Classroom 2	A	1LF40T12Mag	Under Cabinet Light	3	43		Prem 1T8 3100 lum<0.8 BF		3	24	
Classroom 1	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	11	144		Prem 3T8 3100 lum<0.8 E	New Direct/Indirect Fixtures	11	73	
Teachers Lounge	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	12	144		Prem 3T8 3100 lum<0.8 E	New Direct/Indirect Fixtures	12	73	
Instruction Rooms	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	4	144		Prem 3T8 3100 lum<0.8 E	New Direct/Indirect Fixtures	4	73	

Location Information		Existing Fixtures					Proposed Fixtures				
Location	Operation Schedule	Fixture Type (E)	Custom Description / Additional Info.	Qty. (E)	Watts	Custom Wattage	Fixture Type (P)	Custom Description / Additional Info.	Qty. (P)	Watts	Custom Wattage
Jan Closet	C	Incandescent100W	**Lampholders**	1	100		Prem 1T8 3100 lum<0.8 E	**New Fixture**	1	24	
Jan Closet	C	2LF40T12Mag	**Strip**	1	72		Prem 2T8 3100 lum<0.8 BF		1	48	
(4) Sm RRs	A	2LF40T12Mag	**Wall Mount**	4	72		Prem 1T8 3100 lum<0.8 E	**Delamp**	4	24	
Indiv Instruction	A	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	4	144		Prem 3T8 3100 lum<0.8 E	**New Direct/Indirect Fixtures**	4	73	
Corridor from Lounge around to CR 2	B	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	15	144		Prem 3T8 3100 lum<0.8 E	**New Direct/Indirect Fixtures**	15	73	
Corridor from N exit to Library	B	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	5	144		Prem 3T8 3100 lum<0.8 E	**New Direct/Indirect Fixtures**	5	73	
Corridor from Library to CR 17	B	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	14	144		Prem 3T8 3100 lum<0.8 E	**New Direct/Indirect Fixtures**	14	73	
Classroom 9	A	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	16	144		Prem 3T8 3100 lum<0.8 E	**New Direct/Indirect Fixtures**	16	73	
Classroom 9	A	1LF40T12Mag	**Under Cabinet Light**	3	43		Prem 1T8 3100 lum<0.8 BF		3	24	
Classroom 9/10 RRs	A	2LF40T12Mag	**Wall Mount**	2	72		Prem 1T8 3100 lum<0.8 E	**Delamp**	2	24	
Classroom 10	A	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	16	144		Prem 3T8 3100 lum<0.8 E	**New Direct/Indirect Fixtures**	16	73	
Classroom 10	A	1LF40T12Mag	**Under Cabinet Light**	3	43		Prem 1T8 3100 lum<0.8 BF		3	24	
Classroom 11	A	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	16	144		Prem 3T8 3100 lum<0.8 E	**New Direct/Indirect Fixtures**	16	73	
Classroom 11	A	1LF40T12Mag	**Under Cabinet Light**	3	43		Prem 1T8 3100 lum<0.8 BF		3	24	
Classroom 11/12 RRs	A	2LF40T12Mag	**Wall Mount**	2	72		Prem 1T8 3100 lum<0.8 E	**Delamp**	2	24	
Classroom 12	A	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	16	144		Prem 3T8 3100 lum<0.8 E	**New Direct/Indirect Fixtures**	16	73	
Classroom 12	A	1LF40T12Mag	**Wall Mount**	2	43		Prem 1T8 3100 lum<0.8 BF		2	24	
Classroom 13	A	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	16	144		Prem 3T8 3100 lum<0.8 E	**New Direct/Indirect Fixtures**	16	73	
Classroom 13	A	1LF40T12Mag	**Under Cabinet Light**	3	43		Prem 1T8 3100 lum<0.8 BF		3	24	
Classroom 13 RR	A	2LF40T12Mag	**Wall Mount**	1	72		Prem 1T8 3100 lum<0.8 E	**Delamp**	1	24	

Location Information		Existing Fixtures					Proposed Fixtures				
Location	Operation Schedule	Fixture Type (E)	Custom Description / Additional Info.	Qty. (E)	Watts	Custom Wattage	Fixture Type (P)	Custom Description / Additional Info.	Qty. (P)	Watts	Custom Wattage
Classroom 14	A	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	16	144		Prem 3T8 3100 lum<0.8 B	**New Direct/Indirect Fixtures**	16	73	
Classroom 14	A	1LF40T12Mag	**Under Cabinet Light**	3	43		Prem 1T8 3100 lum<0.8 BF		3	24	
Classroom 14/15 RRs	A	2LF40T12Mag	**Wall Mount**	2	72		Prem 1T8 3100 lum<0.8 B	**Delamp**	2	24	
Classroom 15	A	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	16	144		Prem 3T8 3100 lum<0.8 B	**New Direct/Indirect Fixtures**	16	73	
Classroom 15	A	1LF40T12Mag	**Under Cabinet Light**	3	43		Prem 1T8 3100 lum<0.8 BF		3	24	
Classroom 16	A	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	16	144		Prem 3T8 3100 lum<0.8 B	**New Direct/Indirect Fixtures**	16	73	
Classroom 16	A	1LF40T12Mag	**Under Cabinet Light**	3	43		Prem 1T8 3100 lum<0.8 BF		3	24	
Classroom 16/17 RRs	A	2LF40T12Mag	**Wall Mount**	2	72		Prem 1T8 3100 lum<0.8 B	**Delamp**	2	24	
Classroom 17	A	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	16	144		Prem 3T8 3100 lum<0.8 B	**New Direct/Indirect Fixtures**	16	73	
Classroom 17	A	1LF40T12Mag	**Under Cabinet Light**	3	43		Prem 1T8 3100 lum<0.8 BF		3	24	
KIVA Classroom	A	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	22	144		Prem 3T8 3100 lum<0.8 B	**New Direct/Indirect Fixtures**	22	73	
KIVA Classroom	A	1LF40T12Mag	**Under Cabinet Light**	3	43		Prem 1T8 3100 lum<0.8 BF		3	24	
Small Classroom	A	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	6	144		Prem 3T8 3100 lum<0.8 B	**New Direct/Indirect Fixtures**	6	73	
Library	B	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	42	144		Prem 3T8 3100 lum<0.8 B	**New Direct/Indirect Fixtures**	42	73	
Library Work Room	A	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	6	144		Prem 3T8 3100 lum<0.8 B	**New Direct/Indirect Fixtures**	6	73	
Library Offices	A	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	9	144		Prem 3T8 3100 lum<0.8 B	**New Direct/Indirect Fixtures**	9	73	
Story Telling Room	A	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	8	144		Prem 3T8 3100 lum<0.8 B	**New Direct/Indirect Fixtures**	8	73	
Planning Room	A	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	4	144		Prem 3T8 3100 lum<0.8 B	**New Direct/Indirect Fixtures**	4	73	
Lounge	B	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	4	144		Prem 3T8 3100 lum<0.8 B	**New Direct/Indirect Fixtures**	4	73	

Location Information		Existing Fixtures					Proposed Fixtures				
Location	Operation Schedule	Fixture Type (E)	Custom Description / Additional Info.	Qty. (E)	Watts	Custom Wattage	Fixture Type (P)	Custom Description / Additional Info.	Qty. (P)	Watts	Custom Wattage
Mens Restroom	A	Custom	2LF30T12 Mag	2	--->	120	Custom	Prem 1T8 3'	2	--->	20
Womens Restroom	A	Custom	2LF30T12 Mag	2	--->	120	Custom	Prem 1T8 3'	2	--->	20
Storage	A	2LF40T12Mag	Strip	1	72		Prem 2T8 3100 lum<0.8 BF		1	48	
Electric Room	A	2LF40T12Mag	Strip	1	72		Prem 2T8 3100 lum<0.8 BF		1	48	
Electric Room	A	Incandescent100W	Lampholders	1	100		Prem 1T8 3100 lum<0.8 B	New Fixture	1	24	
Boys Restroom	B	Incandescent100W	Recessed	2	100		CFL26W/Hardwire		2	30	
Boys Restroom	B	2LF40T12Mag	Wall Mount	1	72		Prem 1T8 3100 lum<0.8 B	Delamp	1	24	
Girls Restroom	B	Incandescent100W	Recessed	2	100		CFL26W/Hardwire		2	30	
Girls Restroom	B	2LF40T12Mag	Wall Mount	1	72		Prem 1T8 3100 lum<0.8 B	Delamp	1	24	
Exterior	D	Incandescent150W	Surface, 12" sq, (2) 75w Inc each	16	150		CFL26W/Hardwire	New Fixtures	16	30	

EEM 2: NEW HVAC AND CONTROLS FOR ENERGY SAVINGS

This measure will remove the (4) multizone air handlers on the roof, and install (4) new VAV air handlers in their place. The existing ductwork distribution will be utilized, and the code required fire dampers will be installed.

A new DDC system will be installed to control the operating times of the units, and the space temperatures for occupied and unoccupied times.

These two buildings consistently use the most energy per square foot in the entire district. This is attributed to the unique and complex nature of the multi-zone air handlers, and the necessity to operate the systems 24 hours a day in order to maintain occupant comfort (if the systems shut off overnight, some zones cannot recovery their temperature in a reasonable amount of time – therefore they are left to operate).

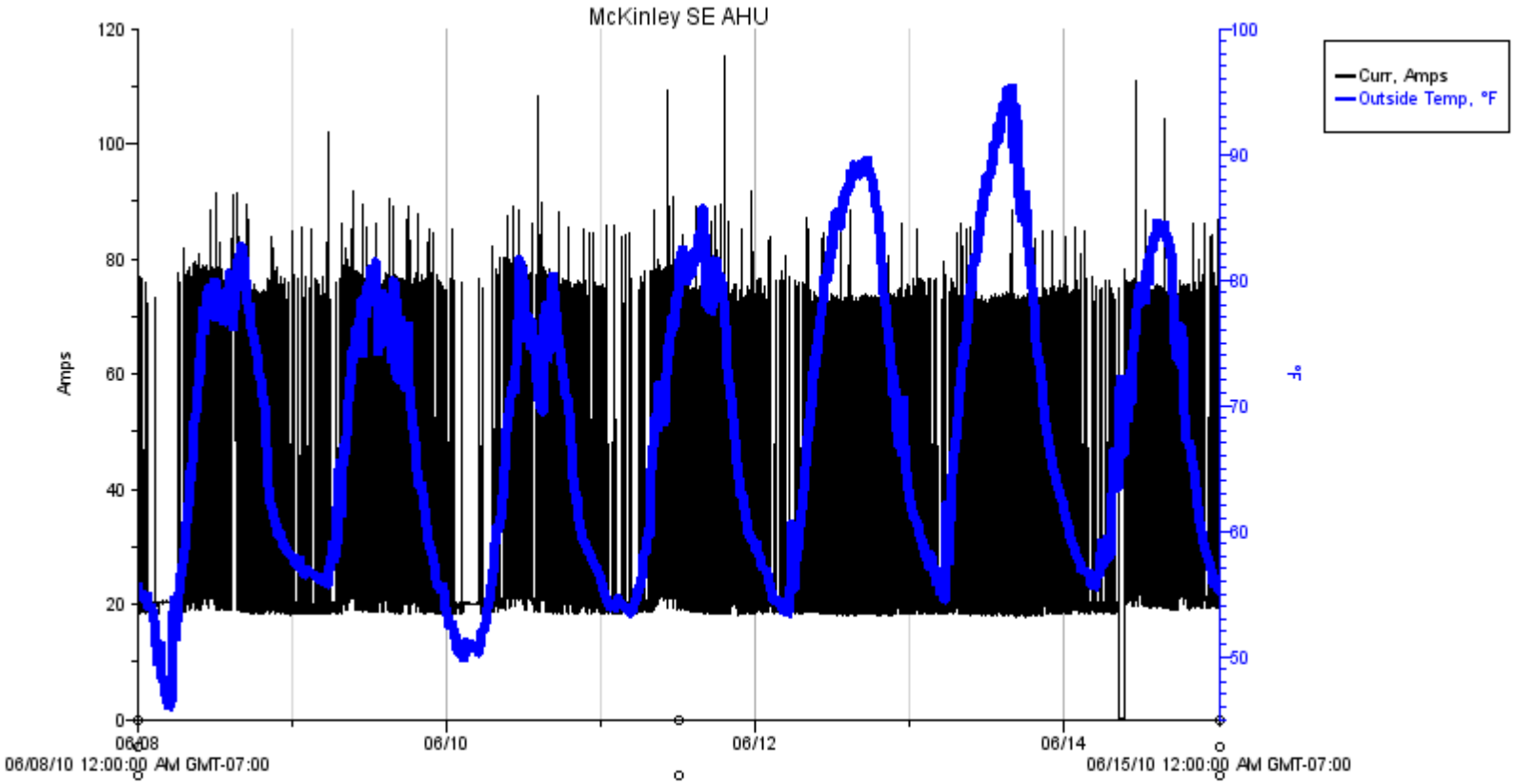
Two of the units have already exceeded their life expectancy, and two of the units are only 2 years away from reaching their life expectancy, and they are currently in need of repairs. The lowest first-cost replacement for these units is to replace them with similar units; however this would maintain current energy use. If instead the District would replace these with high efficiency variable air volume units it will cost more up-front, but it can lead to substantial energy savings that will pay for this additional upfront cost well before the units reach their life expectancy. The system we envision is a variable air volume unit equipped with variable speed drives, and a single VAV damper for each of the zones. Each zone will also have a hot water reheat coil that tempers the air supplied. There will be natural gas boilers that provide hot water to the reheat coils for each new air handler.

The (2) roof vents of the gymnasium building will be equipped with automatic actuators to open and close the dampers as needed through the new DDC system. The rooftop units serving the gymnasium will also be connected to the new DDC system, and the roof vents will only modulate as needed when the rooftop units operate in free-cooling economizer mode.

It is assumed that while occupied the spaces will be heated to 70 F, and cooled to 76 F, and while unoccupied the spaces will be allowed to drift down at night to 55 F, and also allowed o drift up to 80 F.

It is anticipated that the HVAC systems will be turned on an average of one hour prior to school starting, and will stop about half an hour after school ends. It is assumed the units will only operate in the summer when occupied and the occupants utilize the manual over-rides (see next paragraph).

New thermostats will be installed and select locations can be equipped with manual over-ride buttons. The DDC operator can program the over-ride button to automatically turn on the HVAC serving the appropriate zone for a specified amount of time (1 or 2 hours is suggested). This will allow occupants to use the spaces during normally unoccupied times – but only as needed.

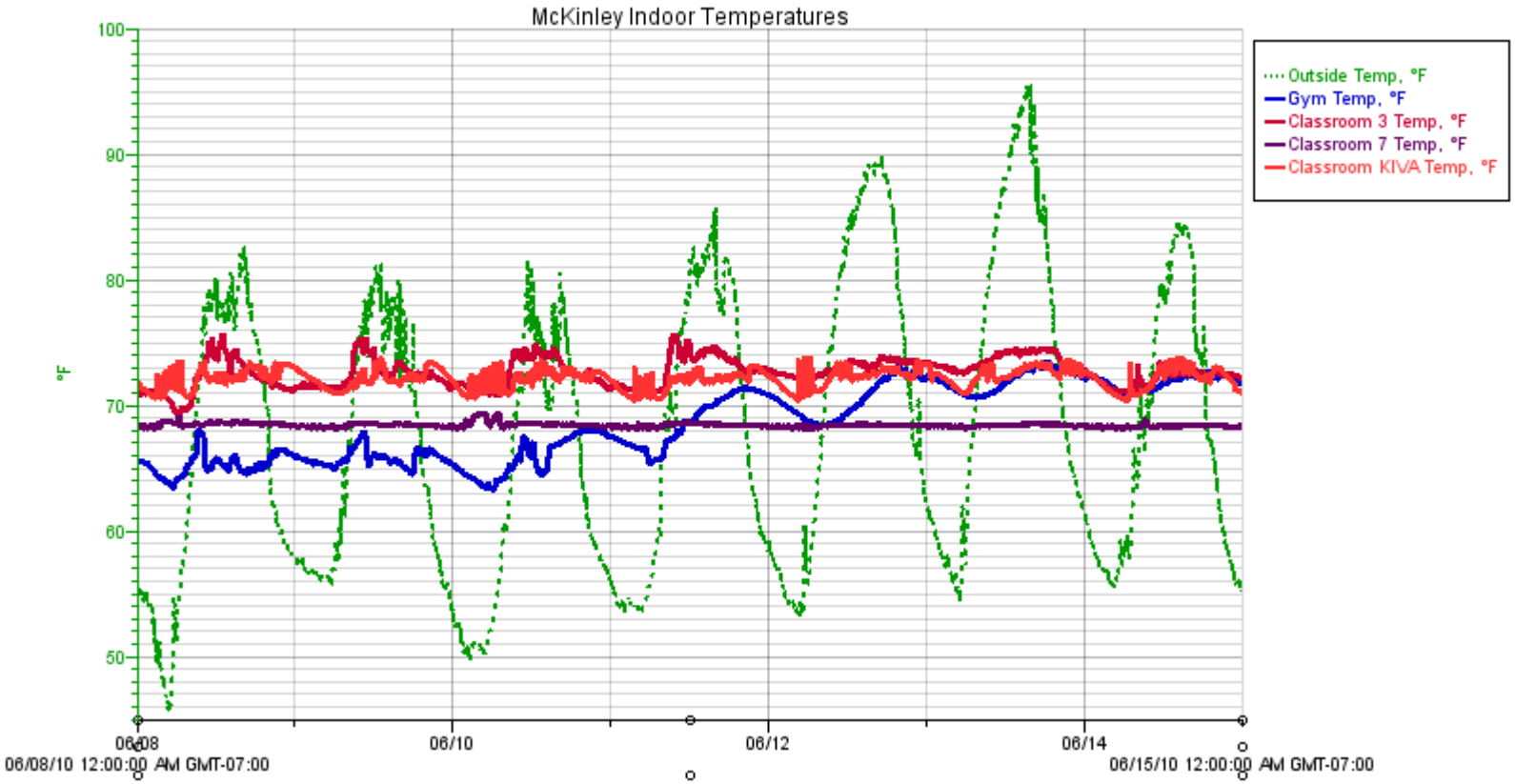


This graph shows the outside air tempreature (blue line, read on scale to the right) and power (amps) of the southeast air handling unit (black line, read on scale to the left) over a one week period.

This illustrates that the fan normally operates 24 hours a day (though it was off for about one hour on 6/14, presumably for filter replacements).

When only the fans are on this unit draws about 20 amps, when the compressor cycles on the power jumps up to about 80 amps. This shows that the compressor (black line) is cycling on and off whenever the outside air temperature is about 55 F. The only time the compressors remain off for more than an hour is on 6/08 and 6/10, very early in the morning (3-5 am).

This data was used to develop a relationship of the Air Conditioning Power vs OA Temperature, and was used to calculate the existing baseline air conditioning and fan energy use for the building.



This graph shows the indoor and outdoor temperature over a seven day period. The dashed green line is the outside air temperature, which ranged from 45 F to 95 f during this test period.

The solid lines represent indoor temperatures taken at different locations, including the gymnasium and three classrooms. These results indicate that the spaces are maintaining temperatures 24 hours a day. The gymnasium set point was adjusted during this test period – it had been temporarily lowered for graduation ceremonies to 66 F, and then raised back up to its normal 72 F.

The following table summarizes the HVAC systems at the facility.

	SF hp	RF hp	Total hp	Tons	SEER
AC-1 (NW)	10	1	11	30	9
AC-2 (SW)	15	1	16	30	9
AC-3 (SE)	7.5	3	10.5	20	7
AC-4 (NE)	7.5	3	10.5	20	7
Gym AC-1	3	1	4	7.5	10
Gym AC-2	3	1	4	7.5	10
Kitchen Furnace	1		1		
TOTAL	47	10	57	115	

The tables on the following page calculate the existing HVAC energy use, and the proposed HVAC energy use, and savings.

Occupied Analysis

Hours		Fans		AC kW		Ventilation		Envelope	
OAT	Hours / Year	Fan Power (kW)	Fan kWh	AC kW	AC kWh	Gas (Btus / hr)	Gas Therms	Gas (Btus / hr)	Gas Therms
102.5	0	36	0	89	0	0	0	0	0
97.5	4	36	144	88	353	0	0	0	0
92.5	7	36	252	86	601	0	0	0	0
87.5	16	36	577	84	1,341	0	0	0	0
82.5	35	36	1,262	61	2,120	0	0	0	0
77.5	84	36	3,029	64	5,353	0	0	0	0
72.5	124	36	4,472	67	8,265	0	0	0	0
67.5	151	36	5,446	52	7,887	0	0	0	0
62.5	199	36	7,177	41	8,070	0	0	0	0
57.5	194	36	6,996	32	6,113	0	0	0	0
52.5	222	36	8,006	23	5,007	24,425	70	14,430	41
47.5	213	36	7,681	0	0	73,275	200	43,289	118
42.5	144	36	5,193	0	0	122,125	225	72,148	133
37.5	239	36	8,619	0	0	170,975	524	101,007	309
32.5	158	36	5,698	0	0	219,825	445	129,867	263
27.5	97	36	3,498	0	0	268,675	334	158,726	197
22.5	44	36	1,587	0	0	317,525	179	187,585	106
17.5	10	36	361	0	0	366,375	47	216,444	28
12.5	2	36	72	0	0	415,224	11	245,304	6
7.5	1	36	36	0	0	464,074	6	274,163	4
2.5	0	36	0	0	0	512,924	0	303,022	0
TOTALS	1,944		70,107		45,109		2,041		1,206

Unoccupied Analysis

Hours	Fans		AC kW		Ventilation		Envelope		Existing Energy Use		
Hours / Year	Fan Power (kW)	Fan kWh	AC kW	AC kWh	Gas (Btus / hr)	Gas Therms	Gas (Btus / hr)	Gas Therms	Fan kWh	AC kWh	Gas Therms
4	36	144	*89*	355	0	0	0	0	144	355	0
19	36	685	88	1,678	0	0	0	0	829	2,032	0
42	36	1,515	86	3,604	0	0	0	0	1,767	4,205	0
110	36	3,967	84	9,218	0	0	0	0	4,544	10,559	0
262	36	9,449	61	15,868	0	0	0	0	10,711	17,988	0
265	36	9,557	64	16,887	0	0	0	0	12,586	22,240	0
323	36	11,648	67	21,528	0	0	0	0	16,120	29,793	0
370	36	13,343	52	19,326	0	0	0	0	18,789	27,212	0
574	36	20,700	41	23,276	0	0	0	0	27,877	31,346	0
570	36	20,556	32	17,961	43,965	321	25,973	190	27,552	24,074	511
583	36	21,025	23	13,150	92,815	694	54,833	410	29,031	18,157	1,214
730	36	26,326	0	0	141,665	1,326	83,692	783	34,007	0	2,427
529	36	19,077	0	0	190,515	1,292	112,551	763	24,270	0	2,414
782	36	28,201	0	0	239,365	2,400	141,410	1,418	36,820	0	4,651
771	36	27,805	0	0	288,215	2,849	170,270	1,683	33,503	0	5,240
488	36	17,599	0	0	337,065	2,109	199,129	1,246	21,097	0	3,886
200	36	7,213	0	0	385,914	990	227,988	585	8,799	0	1,859
123	36	4,436	0	0	434,764	686	256,847	405	4,796	0	1,165
42	36	1,515	0	0	483,614	260	285,706	154	1,587	0	431
14	36	505	0	0	532,464	96	314,566	56	541	0	161
15	36	541	0	0	581,314	112	343,425	66	541	0	178
6,816		245,806		142,852		13,133		7,759	315,913	187,961	24,139
8,760										503,874	

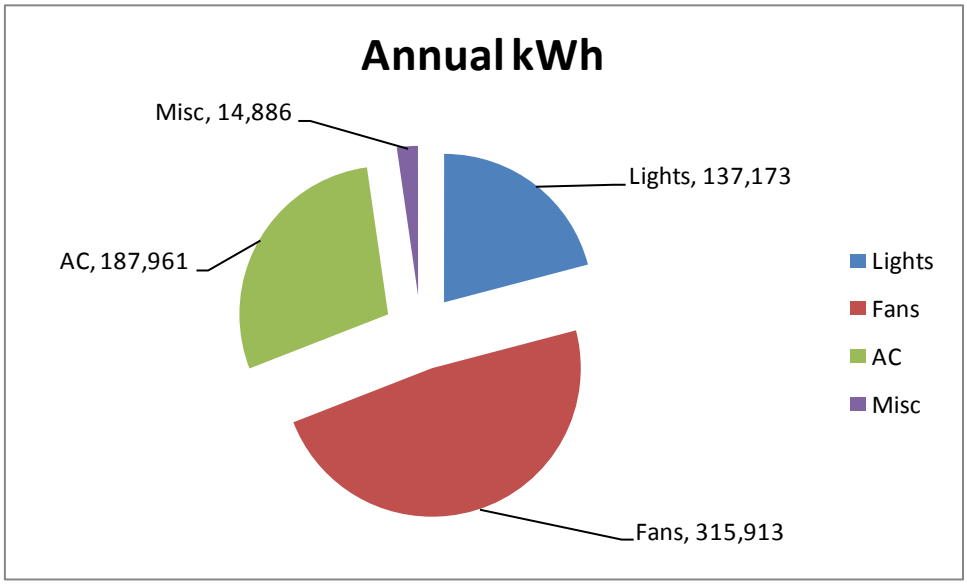
SAVINGS	245,806		142,852		13,133		3,879	48%	29%	92%
TOTAL SAVINGS			**388,658**	kWh			**17,013**	therms	77%	

Assumptions

30,000	cfm total airflow
9,046	cfm ventilation airflow
55	Occupied Balance Point Temperature (F)
62	Unoccupied Balance Point Temperature (F)
78%	Heating system efficiency
5,772	Overall Building U x A constant
50%	of night envelope heating will be saved due to night low limit operation

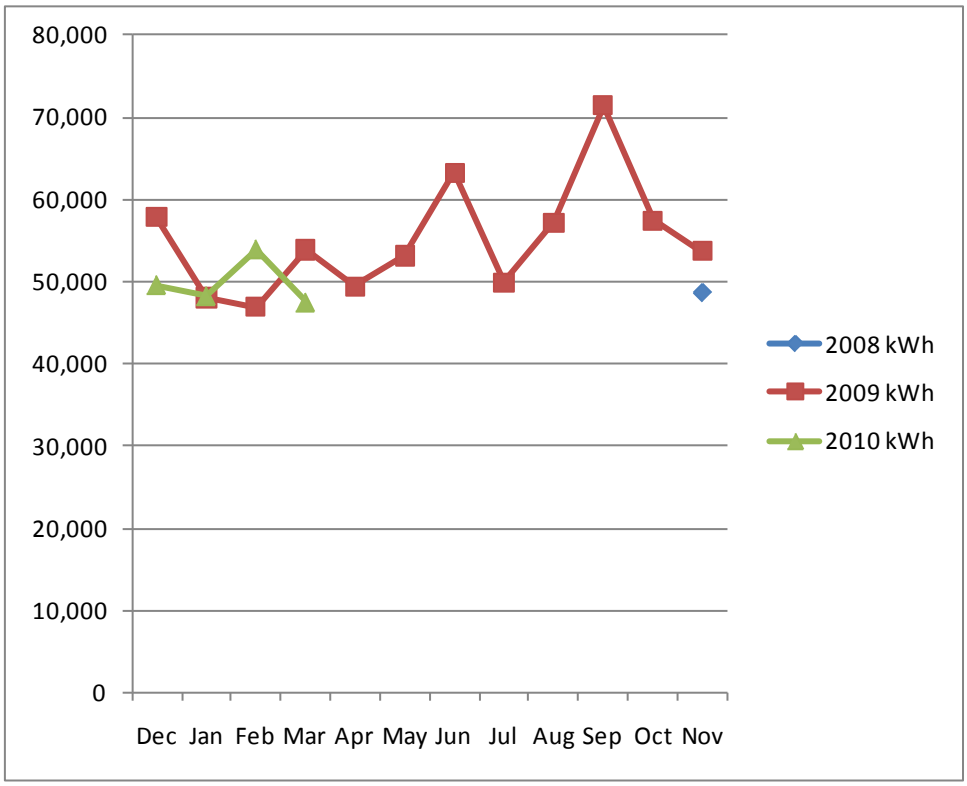
APPENDIX

The end-uses analysis of electric energy use (kWh) is illustrated below.



	Annual kWh	% of Total kWh Use
Lights	137,173	21%
Fans	315,913	48%
AC	187,961	29%
Misc	14,886	2%
Total	655,932	100%

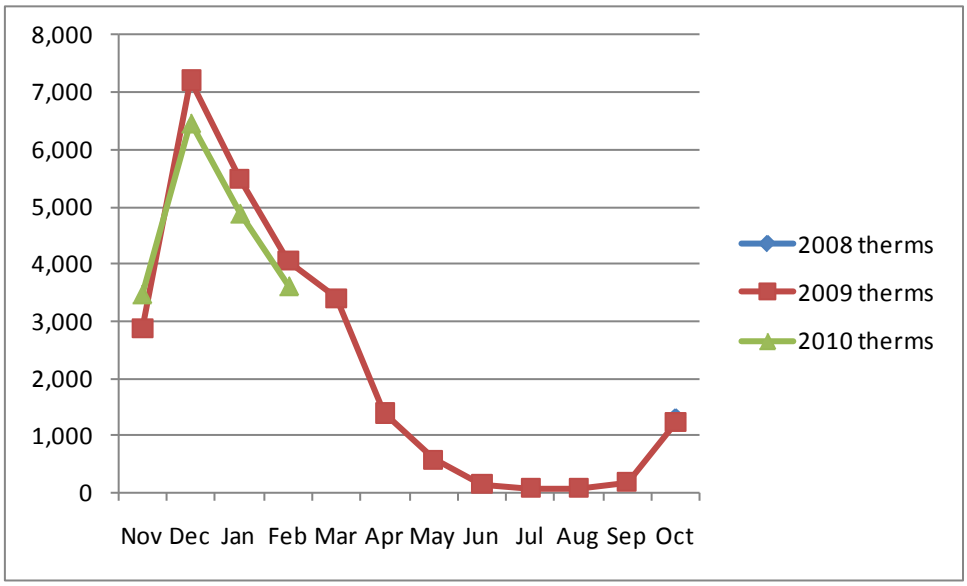
The recent historical electrical energy use (kWh) is illustrated below.



	2008 kWh	2009 kWh	2010 kWh	Avg kWh
Dec		57,825	49,621	53,723
Jan		48,048	48,270	48,159
Feb		46,920	53,975	50,448
Mar		53,880	47,491	50,686
Apr		49,427		49,427
May		53,158		53,158
Jun		63,238		63,238
Jul		49,886		49,886
Aug		57,175		57,175
Sep		71,462		71,462
Oct		57,418		57,418
Nov	48,596	53,710		51,153
TOTAL		662,147	199,357	655,932

	2008 $	2009 $	2010 $	Avg $
Jan		$3,921	$3,590	$3,755
Feb		$3,387	$3,657	$3,522
Mar		$3,382	$3,927	$3,654
Apr		$3,695	$3,576	$3,635
May		$3,602		$3,602
Jun		$3,753		$3,753
Jul		$4,171		$4,171
Aug		$3,480		$3,480
Sep		$3,879		$3,879
Oct		$4,770		$4,770
Nov		$3,909		$3,909
Dec	$3,465	$3,755		$3,610
TOTAL		$45,703	$14,749	$45,741

The recent historical natural gas use (therms) is illustrated below.



	2008 therms	2009 therms	2010 therms	Avg therms
Nov		2,879	3,477	3,178
Dec		7,211	6,471	6,841
Jan		5,487	4,892	5,190
Feb		4,052	3,619	3,836
Mar		3,405		3,405
Apr		1,403		1,403
May		591		591
Jun		153		153
Jul		88		88
Aug		92		92
Sep		187		187
Oct	1,317	1,233		1,275
TOTAL		26,781	18,459	26,238

	2008 $	2009 $	2010 $	Avg $
Jan		$4,000	$3,887	$3,943
Feb		$9,867	$7,065	$8,466
Mar		$7,613	$5,377	$6,495
Apr		$5,624	$4,026	$4,825
May		$4,749		$4,749
Jun		$1,969		$1,969
Jul		$778		$778
Aug		$208		$208
Sep		$126		$126
Oct		$114		$114
Nov		$217		$217
Dec	$1,411	$1,386		$1,399
TOTAL		$36,650	$20,356	$33,289

McKinley Elementary School

EEM	EEM Description	kWh Saved / Year	Avg kW Saved / Month	Therms Saved / Year	Electric $ Saved / Year	Natural Gas $ Saved / Year	Utility $ Saved / Year	Total Project Cost	Base Project Cost	Incremental Project Cost $	Raw Simple Payback (Years)	PP Incentive Estimated $	CNG Incentive Estimated $	Owner Final Cost $	Owner Final Payback (Years)
1	Lighting Upgrade (New Pendant Fixtures)	80,137	35	0	$4,958	$0	$4,958	$243,330	n/a	$243,330	49	$13,825	$0	$229,505	46
2	HVAC & Controls Upgrade (New VAV HVAC Main Bldg, New Dampers Gym Bldg, New DDC Main & Gym Bldgs)	388,658	0	17,013	$17,478	$17,999	$35,477	$790,500	$500,000	$290,500	8	$58,299	$17,013	$215,189	6
TOTALS		**468,795**	**35**	**17,013**	**$22,436**	**$17,999**	**$40,435**	**$1,033,830**	**$500,000**	**$533,830**	**13**	**$72,124**	**$17,013**	**$444,693**	**11**

Notes				
1	Pacific Power Lighting Incentive has been estimated using the FinExpress Stipulated Incentive Sheet			
2	Pacific Power HVAC Incentive has been estimated at	$0.15 per kWh and	$50.00 per kW, capped at	60% of Incremental Project Cost
3	Cascade Natural Gas Incentive has been estimated at	$1.00 per therm		
4	EEM2 Base Project Cost includes Code Required Fire / Smoke Dampers, (4) New Multizone Air Handlers (100 tons total)			

Existing	Proposed

Measurement & Verification (M&V) Report for Specific Energy Savings Projects Installed at the

Garfield Elementary School
Yakima School District
Yakima, Washington

Prepared by:

ABACUS
RESOURCE
MANAGEMENT
COMPANY

January 17, 2010

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Utility Rate Assumptions

The following costs were used in our Energy Services Agreement, and they will be used to determine the annual energy cost savings. These costs will be applied to the measured energy savings to determine the measured energy cost savings.

cost per kWh	$0.048
cost per therm	$1.06

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EXECUTIVE SUMMARY

Introduction and Background

Yakima School District has hired ARMCO (Abacus Resource Management Company) to implement specific energy efficiency measures (EEMs) identified at the Garfield Elementary School. This report is issued to document the measured and verified energy savings that result from these upgrades. This report is also issued to compare the actual measured and verified energy savings against the energy savings that were guaranteed by ARMCO as part of this project.

Brief Description of Facility and Energy Using Systems

Facility Description: The School is comprised of a main building, a gymnasium building, and several portable buildings. The portable buildings are not covered as part of this study, only the permanent main and gymnasium building are covered.

The main building is a single story masonry building constructed in two stages. The western half was built in 1971, and the eastern half was constructed in 1975. The building footprint is about 28,000 square feet. The building contains twelve classrooms, a library, offices, meeting rooms, individual instruction rooms, restrooms and storage rooms. There are minimal windows and a flat insulated roof.

The gymnasium building is a 24’ tall structure that contains a gymnasium which also serves as a cafeteria. There is also a kitchen and locker rooms in this building. The building was constructed in the 1950’s, and has a footprint of about 4,600 square feet. There are minimal windows and a flat insulated roof.

Energy Supply: The building receives electricity from Pacific Power, and natural gas from Cascade Natural Gas.

Lighting: Lighting was predominantly T12 fluorescent lights with magnetic ballasts. There were also some incandescent lights in use. A comprehensive lighting upgrade has been implemented including fixture replacements, fixture retrofits, and new occupancy sensors. The detailed description of these upgrades is provided under EEM 1 of this report.

HVAC: The main building had four constant volume multizone rooftop air handlers on the roof. Each unit served seven zones, and mixed hot air and cold air in order to send the proper temperature air to the spaces. It mixed these airstreams through electric actuators and a long shaft, and the maintenance staff was constantly working on these and the dampers to satisfy occupant comfort.

Two of these units were 21 years old, and two were 10 years old. All of these units were fairly problematic and almost constantly in need of repair and tuning, in order to keep the spaces comfortable. As a result, these systems typically operated 24 hours a day.

A comprehensive HVAC upgrade was implemented at this school to replace these units with high efficiency VAV systems. Details of this upgrade are presented in the EEM 2 section of this report.

The gymnasium building has two constant volume single zone rooftop packaged air handlers on the roof. Each is equipped with a natural gas heating furnace and air conditioning. There are two relief vents on the roof – daylight is visible from the inside of the gym.

Upon inspection these roof vents were equipped with manual dampers that were left partially open.

Installing automatic actuators on these dampers was implemented as part of EEM 2 in this school, along with operating these units with reduced operating hours through the use of a new DDC system.

Summary Table of EEMs

The table on the next page list the EEMs installed at this school, the predicted energy savings, the guaranteed energy savings, and the measured and verified energy savings (which will be filled out after twelve months have elapsed and the savings are verified from the actual utility bills).

		Energy Audit Predicted Savings			Guaranteed Savings Target [1]	Measured and Verified Energy Savings					
EEM	EEM Description	kWh Saved / Year	Avg kW Saved / Month	Therms Saved / Year	Utility $ Saved / Year	kWh Saved / Year	Avg kW Saved / Month	Therms Saved / Year	Electric $ Saved / Year [2]	Natural Gas $ Saved / Year [2]	Utility $ Saved / Year [2]
1	Lighting Upgrade & Occupancy Sensors	80,137	35	0	See Total Savings Below	See Total Savings Below					
2	HVAC & Controls Upgrade (New HVAC Main Bldg, New DDC Main & Gym Bldgs)	447,784	0	27,664							
TOTALS		**527,921**	**35**	**27,664**	**$26,935**	**The total energy savings will be measured directly from the utility bills, and entered into this table after December 31, 2012**					

Notes	
1	The guaranteed savings target is as an approximation, because the actual guarantee is for combined savings at two schools. A summary report will present the combined guaranteed savings and the measured and verified energy savings from both schools together, to match the actual guarantee in the contract.
2	The utility energy savings will be calculated based on the utility rates at the time the agreement was put into place, which is $0.048 per kWh $1.06 per therm

EEM 1 DETAILS: UPGRADE LIGHTS

The interior lights consisted primarily of 4' T12 fluorescent lamps with magnetic ballasts. While these lights were some of the most energy efficient sources when they were installed in the 1970's, today there are more efficient sources of light. T8 fluorescent lamps combined with high efficiency electronic ballasts can generate the same amount of light while using about 30% less energy.

Large areas of this school are over-illuminated. By lowering the light levels to more appropriate light levels, additional energy savings is achieved. The classroom light levels ranged from 60 – 100 foot-candles, while 40 foot-candles is considered good practice today. The corridor and restroom light levels also exceeded 60 foot-candles, while 10-20 foot-candles is considered good practice today. In both the classrooms and corridors the light levels were lowered to good practice levels.

New fixtures were installed throughout the main building classrooms, offices and corridors. New, high efficiency fixtures were installed with (2) T8 lamps per fixture and high efficiency electronic ballasts.

The typical upgrades included:

Location	Upgrade
Classrooms, Library, Offices, Corridor	Remove 2'x4' recessed troffers with prismatic lenses and (4) T12 lamps. Install new 2'x4' recessed troffers that incorporate a direct/indirect lighting approach using a custom lens. New fixtures contained (2) T8 lamps per fixture. New layouts were developed so that the total # of fixtures was reduced. Manual switches are now supplemented with overhead, dual technology occupancy sensors.
Gymnasium	Replace each 8' industrial fixtures (2) VHO 215 watt lamps and magnetic ballast) with a new fixture that contains (6) 54-watt T5/HO lamps, high efficiency electronic ballasts, a prismatic lens and a wire guard. Manual switches are now supplemented with overhead, dual technology occupancy sensors.

Fluorescent Fixtures in Restrooms	Replace each wall-mounted fixture that has (2) 4' T12 lamps and magnetic ballast – with a new fixture that contains (1) 32-watt T8 lamp and a low ballast factor high efficiency electronic ballast. Install wall-switch occupancy sensors.
Exit Signs	No change – the exit signs are no longer using electric lights, they have glow-in the dark faces attached to them and the lamps have either burnt out or been removed.
Miscellaneous Incandescent lights in restrooms, storage closets, exterior over classroom exits.	Some interior fixtures were retrofitted with LED screw-in lamps, and some interior fixtures were replaced with new fluorescent fixtures that use (1) or (2) 32-watt T8 lamps, depending on the light levels required. The exterior incandescent fixtures were replaced with new fixtures that utilize compact fluorescent lamps.

The room by room detailed upgrades are found on the following pages, followed by the room by room description of the controls installed.

Location Information		Existing Fixtures					Proposed Fixtures				
Location	Operation Schedule	Fixture Type (E)	Custom Description / Additional Info.	Qty. (E)	Watts	Custom Wattage	Fixture Type (P)	Custom Description / Additional Info.	Qty. (P)	Watts	Custom Wattage
Gymnasium	A	2F96T12VHO	Industrial w/ Wireguard	15	390		4LF55T5HO-	New Fixtures	15	234	
Stage	C	Incandescent150W	Lampholders	3	150		Prem 2T8 3100 lum<0.8 B	New Fixtures	3	48	
Kitchen	A	2LF40T12Mag	Wrap	15	72		Prem 2T8 3100 lum<0.8 B	New Fixture (0.85 BF)	14	48	
Kitchen RR	A	Incandescent120W	Vanity	1	120		Custom	LED - 12 watt	3	--->	12
Kitchen Corridor	A	Incandescent75W	Recessed	2	75		Prem 2T8 3100 lum<0.8 B	LED - 12 watt	1	48	12
Kitchen Storage	A	Incandescent150W	Lampholders	1	150		Custom	LED - 12 watt	1	--->	12
Kitchen Locked Rm	A	Incandescent150W	Lampholders	2	150		Custom	LED - 12 watt	2	--->	12
Electric Room	C	Incandescent150W	Lampholders	2	150		Prem 2T8 3100 lum<0.8 B	LED - 12 watt	2	48	12
Furnace Room	C	Incandescent150W	Lampholders	2	150		Custom	LED - 12 watt	1	--->	12
PE Office	A	4LF40T12 Mag	Wrap	2	144		Prem 2T8 3100 lum<0.8 BF		2	48	
Girls Locker Rooms	A	Incandescent200W	Drum w/ (3) 75w Lamps	6	200		Prem 1T8 3100 lum<0.8 B	New Fixtures	6	24	
Boys Locker Rooms	A	Incandescent200W	Drum w/ (3) 75w Lamps	6	200		Prem 1T8 3100 lum<0.8 B	New Fixtures	6	24	
Main School Entrance	B	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	5	144		Prem 2T8 3100 lum<0.8 B	New Fixtures	4	48	
Main Office	B	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	8	144		Prem 2T8 3100 lum<0.8 B	New Fixture (0.85 BF)	8	48	
Main Office	E	2LF40T12Mag	U-tubes, 2'x2' Recessed w/ Prismatic Lens	2	72		Prem 2T8 3100 lum<0.8 B	New Fixture (0.85 BF)	1	48	
Health Room	E	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	3	144		Prem 2T8 3100 lum<0.8 B	New Fixture (0.85 BF)	2	48	
Health Room	E	2LF40T12Mag	U-tubes, 2'x2' Recessed w/ Prismatic Lens	2	72		Prem 1T8 3100 lum<0.8 B	New Fixture (0.85 BF)	1	24	
Principal Office	E	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	4	144		Prem 2T8 3100 lum<0.8 B	New Fixture (0.85 BF)	4	48	

Location Information		Existing Fixtures					Proposed Fixtures				
Location	Operation Schedule	Fixture Type (E)	Custom Description / Additional Info.	Qty. (E)	Watts	Custom Wattage	Fixture Type (P)	Custom Description / Additional Info.	Qty. (P)	Watts	Custom Wattage
Work Room	E	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	11	144		Prem 2T8 3100 lum<0.8 E	New Fixture (0.85 BF)	8	48	
Classroom 8	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	17	144		Prem 2T8 3100 lum<0.8 E	New Fixture (0.85 BF)	13	48	
Classroom 8	A	1LF40T12Mag	Under Cabinet Light	3	43		Prem 1T8 3100 lum<0.8 E	New Fixtures	2	24	
Classroom 8 RRs	A	2LF40T12Mag	Wall Mount	2	72		Prem 1T8 3100 lum<0.8 E	Delamp	2	24	
Classroom 7	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	16	144		Prem 2T8 3100 lum<0.8 E	New Fixture (0.85 BF)	12	48	
Classroom 7	A	1LF40T12Mag	Under Cabinet Light	3	43		Prem 1T8 3100 lum<0.8 BF		2	24	
Classroom 7/6 RRs	A	2LF40T12Mag	Wall Mount	2	72		Prem 1T8 3100 lum<0.8 E	Delamp	2	24	
Classroom 6	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	16	144		Prem 2T8 3100 lum<0.8 E	New Fixture (0.85 BF)	16	48	
Classroom 6	A	1LF40T12Mag	Under Cabinet Light	3	43		Prem 1T8 3100 lum<0.8 BF		2	24	
Classroom 5	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	16	144		Prem 2T8 3100 lum<0.8 E	New Fixture (0.85 BF)	16	48	
Classroom 5	A	1LF40T12Mag	Under Cabinet Light	3	43		Prem 1T8 3100 lum<0.8 BF		2	24	
Classroom 5/4 RRs	A	2LF40T12Mag	Wall Mount	2	72		Prem 1T8 3100 lum<0.8 E	Delamp	2	24	
Classroom 4	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	16	144		Prem 2T8 3100 lum<0.8 E	New Fixture (0.85 BF)	12	48	
Classroom 4	A	1LF40T12Mag	Under Cabinet Light	3	43		Prem 1T8 3100 lum<0.8 BF		2	24	
Classroom 3	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	16	144		Prem 2T8 3100 lum<0.8 E	New Fixture (0.85 BF)	13	48	
Classroom 3	A	1LF40T12Mag	Under Cabinet Light	3	43		Prem 1T8 3100 lum<0.8 BF		2	24	
Classroom 3/2 RRs	A	2LF40T12Mag	Wall Mount	2	72		Prem 1T8 3100 lum<0.8 E	Delamp	2	24	
Classroom 2	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	16	144		Prem 2T8 3100 lum<0.8 E	New Fixture (0.85 BF)	15	48	
Classroom 2	A	1LF40T12Mag	Under Cabinet Light	3	43		Prem 1T8 3100 lum<0.8 BF		3	24	
Classroom 1	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	11	144		Prem 2T8 3100 lum<0.8 E	New Fixture (0.85 BF)	11	48	
Teachers Lounge	E	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	12	144		Prem 2T8 3100 lum<0.8 E	New Fixture (0.85 BF)	12	48	
Instruction Rooms	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	4	144		Prem 2T8 3100 lum<0.8 E	New Fixture (0.85 BF)	4	48	

Location Information		Existing Fixtures					Proposed Fixtures				
Location	Operation Schedule	Fixture Type (E)	Custom Description / Additional Info.	Qty. (E)	Watts	Custom Wattage	Fixture Type (P)	Custom Description / Additional Info.	Qty. (P)	Watts	Custom Wattage
Jan Closet	C	Incandescent100W	**Lampholders**	1	100		Prem 2T8 3100 lum<0.8 E	**New Fixture (0.85 BF)**	1	48	
Jan Closet	C	2LF40T12Mag	**Strip**	1	72		Prem 2T8 3100 lum<0.8 BF		1	48	
(4) Sm RRs	A	2LF40T12Mag	**Wall Mount**	4	72		Prem 1T8 3100 lum<0.8 E	**Delamp**	4	24	
Indiv Instruction	A	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	4	144		Prem 2T8 3100 lum<0.8 E	**New Fixture (0.85 BF)**	4	48	
Corridor from Lounge around to CR 2	B	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	15	144		Prem 2T8 3100 lum<0.8 E	**New Fixture**	15	48	
Corridor from N exit to Library	B	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	5	144		Prem 2T8 3100 lum<0.8 E	**New Fixture**	5	48	
Corridor from Library to CR 17	B	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	14	144		Prem 2T8 3100 lum<0.8 E	**New Fixture**	14	48	
Classroom 9	A	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	16	144		Prem 2T8 3100 lum<0.8 E	**New Fixture (0.85 BF)**	11	48	
Classroom 9	A	1LF40T12Mag	**Under Cabinet Light**	3	43		Prem 1T8 3100 lum<0.8 BF		3	24	
Classroom 9/10 RRs	A	2LF40T12Mag	**Wall Mount**	2	72		Prem 1T8 3100 lum<0.8 E	**Delamp**	2	24	
Classroom 10	A	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	16	144		Prem 2T8 3100 lum<0.8 E	**New Fixture (0.85 BF)**	12	48	
Classroom 10	A	1LF40T12Mag	**Under Cabinet Light**	3	43		Prem 1T8 3100 lum<0.8 BF		3	24	
Classroom 11	A	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	16	144		Prem 2T8 3100 lum<0.8 E	**New Fixture (0.85 BF)**	12	48	
Classroom 11	A	1LF40T12Mag	**Under Cabinet Light**	3	43		Prem 1T8 3100 lum<0.8 BF		3	24	
Classroom 11/12 RRs	A	2LF40T12Mag	**Wall Mount**	2	72		Prem 1T8 3100 lum<0.8 E	**Delamp**	2	24	
Classroom 12	A	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	16	144		Prem 2T8 3100 lum<0.8 E	**New Fixture (0.85 BF)**	12	48	
Classroom 12	A	1LF40T12Mag	**Wall Mount**	2	43		Prem 1T8 3100 lum<0.8 BF		3	24	
Classroom 13	A	4LF40T12 Mag	**2'x4' Recessed w/ Prismatic Lens**	16	144		Prem 2T8 3100 lum<0.8 E	**New Fixture (0.85 BF)**	12	48	
Classroom 13	A	1LF40T12Mag	**Under Cabinet Light**	3	43		Prem 1T8 3100 lum<0.8 BF		3	24	
Classroom 13 RR	A	2LF40T12Mag	**Wall Mount**	1	72		Prem 1T8 3100 lum<0.8 E	**Delamp**	1	24	

Location Information		Existing Fixtures					Proposed Fixtures				
Location	Operation Schedule	Fixture Type (E)	Custom Description / Additional Info.	Qty. (E)	Watts	Custom Wattage	Fixture Type (P)	Custom Description / Additional Info.	Qty. (P)	Watts	Custom Wattage
Classroom 14	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	16	144		Prem 2T8 3100 lum<0.8 E	New Fixture (0.85 BF)	12	48	
Classroom 14	A	1LF40T12Mag	Under Cabinet Light	3	43		Prem 1T8 3100 lum<0.8 BF		3	24	
Classroom 14/15 RRs	A	2LF40T12Mag	Wall Mount	2	72		Prem 1T8 3100 lum<0.8 E	Delamp	2	24	
Classroom 15	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	16	144		Prem 2T8 3100 lum<0.8 E	New Fixture (0.85 BF)	12	48	
Classroom 15	A	1LF40T12Mag	Under Cabinet Light	3	43		Prem 1T8 3100 lum<0.8 BF		2	24	
Classroom 16	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	16	144		Prem 2T8 3100 lum<0.8 E	New Fixture (0.85 BF)	12	48	
Classroom 16	A	1LF40T12Mag	Under Cabinet Light	3	43		Prem 1T8 3100 lum<0.8 BF		3	24	
Classroom 16/17 RRs	A	2LF40T12Mag	Wall Mount	2	72		Prem 1T8 3100 lum<0.8 E	Delamp	2	24	
Classroom 17	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	16	144		Prem 2T8 3100 lum<0.8 E	New Fixture (0.85 BF)	12	48	
Classroom 17	A	1LF40T12Mag	Under Cabinet Light	3	43		Prem 1T8 3100 lum<0.8 BF		3	24	
KIVA Classroom	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	22	144		Prem 2T8 3100 lum<0.8 E	New Fixture (0.85 BF)	11	48	
KIVA Classroom	A	1LF40T12Mag	Under Cabinet Light	3	43				3		
Small Classroom	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	6	144		Prem 2T8 3100 lum<0.8 E	New Fixture (0.85 BF)	6	48	
Library	B	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	42	144		Prem 2T8 3100 lum<0.8 E	New Fixture (0.85 BF)	32	48	
Library Work Room	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	6	144		Prem 2T8 3100 lum<0.8 E	New Fixture (0.85 BF)	4	48	
Library Offices	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	9	144		Prem 2T8 3100 lum<0.8 E	New Fixture (0.85 BF)	3	48	
Story Telling Room	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	8	144		Prem 2T8 3100 lum<0.8 E	New Fixture (0.85 BF)	8	48	
Planning Room	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	4	144		Prem 2T8 3100 lum<0.8 E	New Fixture (0.85 BF)	4	48	
Lounge	E	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	4	144		Prem 2T8 3100 lum<0.8 E	New Fixture (0.85 BF)	4	48	

Location Information		Existing Fixtures					Proposed Fixtures				
Location	Operation Schedule	Fixture Type (E)	Custom Description / Additional Info.	Qty. (E)	Watts	Custom Wattage	Fixture Type (P)	Custom Description / Additional Info.	Qty. (P)	Watts	Custom Wattage
Mens Restroom	A	Custom	2LF30T12 Mag	2	--->	120	Custom	Prem 1T8 3'	2	--->	20
Womens Restroom	A	Custom	2LF30T12 Mag	2	--->	120	Custom	Prem 1T8 3'	2	--->	20
Storage	A	2LF40T12Mag	Strip	1	72		Prem 2T8 3100 lum<0.8 BF		1	48	
Electric Room	A	2LF40T12Mag	Strip	1	72		Prem 2T8 3100 lum<0.8 BF		1	48	
Electric Room	A	Incandescent100W	Lampholders	1	100			LED - 12 watt	1		12
Boys Restroom	B	Incandescent100W	Recessed	2	100		Prem 2T8 3100 lum<0.8 B	New Fixture (0.85 BF)	2	48	12
Boys Restroom	B	2LF40T12Mag	Wall Mount	1	72		Prem 1T8 3100 lum<0.8 B	Delamp	1	24	
Girls Restroom	B	Incandescent100W	Recessed	2	100		Prem 2T8 3100 lum<0.8 B	New Fixture (0.85 BF)	2	48	12
Girls Restroom	B	2LF40T12Mag	Wall Mount	1	72		Prem 1T8 3100 lum<0.8 B	New Fixture (0.85 BF)	1	24	
Exterior	D	Incandescent150W	Surface, 12" sq, (2) 75w Inc each	16	150		CFL26W/Hardwire	New Fixtures	18	30	
Classroom 8 RR Hall	A	2LF40T12Mag	2'x4' Recessed w/ Prismatic Lens	1	72		Prem 1T8 3100 lum<0.8 B	New Fixtures	1	24	
Classroom 5/4 RR Hall	A	2LF40T12Mag	2'x4' Recessed w/ Prismatic Lens	1	72		Prem 1T8 3100 lum<0.8 B	New Fixtures	1	24	
Classroom 3/2 RR Hall	A	2LF40T12Mag	2'x4' Recessed w/ Prismatic Lens	1	72		Prem 1T8 3100 lum<0.8 B	New Fixtures	1	24	
Classroom 6 RR Hall	A	2LF40T12Mag	2'x4' Recessed w/ Prismatic Lens	1	72		Prem 1T8 3100 lum<0.8 B	New Fixtures	1	24	
Classroom 9/10 RR Hall	A	2LF40T12Mag	2'x4' Recessed w/ Prismatic Lens	1	72		Prem 1T8 3100 lum<0.8 B	New Fixtures	1	24	
Classroom 11/12 RR Hall	A	2LF40T12Mag	2'x4' Recessed w/ Prismatic Lens	1	72		Prem 1T8 3100 lum<0.8 B	New Fixtures	1	24	
Classroom 14/15 RR Hall	A	2LF40T12Mag	2'x4' Recessed w/ Prismatic Lens	1	72		Prem 1T8 3100 lum<0.8 B	New Fixtures	1	24	
Classroom 16/17 RR Hall	A	2LF40T12Mag	2'x4' Recessed w/ Prismatic Lens	1	72		Prem 1T8 3100 lum<0.8 B	New Fixtures	1	24	
Classroom 1 RR	A	2LF40T12Mag	2'x4' Recessed w/ Prismatic Lens	2	72		Prem 1T8 3100 lum<0.8 B	New Fixtures	2	24	

Location	Proposed fixture	Watts	Custom Description / Additional Info.	Custom Watts	Qty	Sched	Control Type
Gymnasium	4LF55T5HO-	234	New Fixtures		15	A	Dual Tech Sensor
Stage	Prem 2T8 3100 lum<0.8 BF	48	New Fixtures		3	C	Dual Tech Sensor
Kitchen	Prem 2T8 3100 lum<0.8 BF	48	New Fixture (0.85 BF)		14	A	Dual Tech Sensor
Kitchen RR	Custom	--->	LED - 12 watt	12	3	A	Dual Tech Sensor
Kitchen Corridor	Prem 2T8 3100 lum<0.8 BF	48	LED - 12 watt	12	1	A	Dual Tech Sensor
Kitchen Storage	Custom	--->	LED - 12 watt	12	1	A	Dual Tech Sensor
Kitchen Locked Rm	Custom	--->	LED - 12 watt	12	2	A	Dual Tech Sensor
Electric Room	Prem 2T8 3100 lum<0.8 BF	48	LED - 12 watt	12	2	C	Dual Tech Sensor
Furnace Room	Custom	--->	LED - 12 watt	12	1	C	Dual Tech Sensor
PE Office	Prem 2T8 3100 lum<0.8 BF	48			2	A	Dual Tech Sensor

Location	Proposed fixture	Watts	Custom Description / Additional Info.	Custom Watts	Qty	Sched	Control Type
Girls Locker Rooms	Prem 1T8 3100 lum<0.8 BF	24	**New Fixtures**		6	A	**Dual Tech Sensor**
Boys Locker Rooms	Prem 1T8 3100 lum<0.8 BF	24	**New Fixtures**		6	A	**Dual Tech Sensor**
Main School Entrance	Prem 2T8 3100 lum<0.8 BF	48	**New Fixtures**		4	B	**Dual Tech Sensor**
Main Office	Prem 2T8 3100 lum<0.8 BF	48	**New Fixture (0.85 BF)**		8	B	**Dual Tech Sensor**
Main Office	Prem 2T8 3100 lum<0.8 BF	48	**New Fixture (0.85 BF)**		1	E	**Dual Tech Sensor**
Health Room	Prem 2T8 3100 lum<0.8 BF	48	**New Fixture (0.85 BF)**		2	E	**Dual Tech Sensor**
Health Room	Prem 1T8 3100 lum<0.8 BF	24	**New Fixture (0.85 BF)**		1	E	**Dual Tech Sensor**
Principal Office	Prem 2T8 3100 lum<0.8 BF	48	**New Fixture (0.85 BF)**		4	E	**Dual Tech Sensor**
Work Room	Prem 2T8 3100 lum<0.8 BF	48	**New Fixture (0.85 BF)**		8	E	**Dual Tech Sensor**
Classroom 8	Prem 2T8 3100 lum<0.8 BF	48	**New Fixture (0.85 BF)**		13	A	**Dual Tech Sensor**
Classroom 8	Prem 1T8 3100 lum<0.8 BF	24	**New Fixtures**		2	A	**Dual Tech Sensor**

Location	Proposed fixture	Watts	Custom Description / Additional Info.	Custom Watts	Qty	Sched	Control Type
Classroom 8 RRs	Prem 1T8 3100 lum<0.8 BF	24	**Delamp**		2	A	**Dual Tech Sensor**
Classroom 7	Prem 2T8 3100 lum<0.8 BF	48	**New Fixture (0.85 BF)**		12	A	**Dual Tech Sensor**
Classroom 7	Prem 1T8 3100 lum<0.8 BF	24			2	A	**Dual Tech Sensor**
Classroom 7/6 RRs	Prem 1T8 3100 lum<0.8 BF	24	**Delamp**		2	A	**Dual Tech Sensor**
Classroom 6	Prem 2T8 3100 lum<0.8 BF	48	**New Fixture (0.85 BF)**		16	A	**Dual Tech Sensor**
Classroom 6	Prem 1T8 3100 lum<0.8 BF	24			2	A	**Dual Tech Sensor**
Classroom 5	Prem 2T8 3100 lum<0.8 BF	48	**New Fixture (0.85 BF)**		16	A	**Dual Tech Sensor**
Classroom 5	Prem 1T8 3100 lum<0.8 BF	24			2	A	**Dual Tech Sensor**
Classroom 5/4 RRs	Prem 1T8 3100 lum<0.8 BF	24	**Delamp**		2	A	**Dual Tech Sensor**
Classroom 4	Prem 2T8 3100 lum<0.8 BF	48	**New Fixture (0.85 BF)**		12	A	**Dual Tech Sensor**
Classroom 4	Prem 1T8 3100 lum<0.8 BF	24			2	A	**Dual Tech Sensor**

Location	Proposed fixture	Watts	Custom Description / Additional Info.	Custom Watts	Qty	Sched	Control Type
Classroom 3	Prem 2T8 3100 lum<0.8 BF	48	**New Fixture (0.85 BF)**		13	A	**Dual Tech Sensor**
Classroom 3	Prem 1T8 3100 lum<0.8 BF	24			2	A	**Dual Tech Sensor**
Classroom 3/2 RRs	Prem 1T8 3100 lum<0.8 BF	24	**Delamp**		2	A	**Dual Tech Sensor**
Classroom 2	Prem 2T8 3100 lum<0.8 BF	48	**New Fixture (0.85 BF)**		15	A	**Dual Tech Sensor**
Classroom 2	Prem 1T8 3100 lum<0.8 BF	24			3	A	**Dual Tech Sensor**
Classroom 1	Prem 2T8 3100 lum<0.8 BF	48	**New Fixture (0.85 BF)**		11	A	**Dual Tech Sensor**
Teachers Lounge	Prem 2T8 3100 lum<0.8 BF	48	**New Fixture (0.85 BF)**		12	E	**Dual Tech Sensor**
Instruction Rooms	Prem 2T8 3100 lum<0.8 BF	48	**New Fixture (0.85 BF)**		4	A	**Dual Tech Sensor**
Jan Closet	Prem 2T8 3100 lum<0.8 BF	48	**New Fixture (0.85 BF)**	**0**	1	C	**Dual Tech Sensor**
Jan Closet	Prem 2T8 3100 lum<0.8 BF	48			1	C	**Dual Tech Sensor**
(4) Sm RRs	Prem 1T8 3100 lum<0.8 BF	24	**Delamp**		4	A	**Dual Tech Sensor**

Location	Proposed fixture	Watts	Custom Description / Additional Info.	Custom Watts	Qty	Sched	Control Type
Indiv Instruction	Prem 2T8 3100 lum<0.8 BF	48	**New Fixture (0.85 BF)**		4	A	**Dual Tech Sensor**
Corridor from Lounge around to CR 2	Prem 2T8 3100 lum<0.8 BF	48	**New Fixture**		15	B	**Dual Tech Sensor**
Corridor from N exit to Library	Prem 2T8 3100 lum<0.8 BF	48	**New Fixture**		5	B	**Dual Tech Sensor**
Corridor from Library to CR 17	Prem 2T8 3100 lum<0.8 BF	48	**New Fixture**		14	B	**Dual Tech Sensor**
Classroom 9	Prem 2T8 3100 lum<0.8 BF	48	**New Fixture (0.85 BF)**		11	A	**Dual Tech Sensor**
Classroom 9	Prem 1T8 3100 lum<0.8 BF	24			3	A	**Dual Tech Sensor**
Classroom 9/10 RRs	Prem 1T8 3100 lum<0.8 BF	24	**Delamp**		2	A	**Dual Tech Sensor**
Classroom 10	Prem 2T8 3100 lum<0.8 BF	48	**New Fixture (0.85 BF)**		12	A	**Dual Tech Sensor**
Classroom 10	Prem 1T8 3100 lum<0.8 BF	24			3	A	**Dual Tech Sensor**
Classroom 11	Prem 2T8 3100 lum<0.8 BF	48	**New Fixture (0.85 BF)**		12	A	**Dual Tech Sensor**
Classroom 11	Prem 1T8 3100 lum<0.8 BF	24			3	A	**Dual Tech Sensor**

Location	Proposed fixture	Watts	Custom Description / Additional Info.	Custom Watts	Qty	Sched	Control Type
Classroom 11/12 RRs	Prem 1T8 3100 lum<0.8 BF	24	**Delamp**		2	A	**Dual Tech Sensor**
Classroom 12	Prem 2T8 3100 lum<0.8 BF	48	**New Fixture (0.85 BF)**		12	A	**Dual Tech Sensor**
Classroom 12	Prem 1T8 3100 lum<0.8 BF	24			3	A	**Dual Tech Sensor**
Classroom 13	Prem 2T8 3100 lum<0.8 BF	48	**New Fixture (0.85 BF)**		12	A	**Dual Tech Sensor**
Classroom 13	Prem 1T8 3100 lum<0.8 BF	24			3	A	**Dual Tech Sensor**
Classroom 13 RR	Prem 1T8 3100 lum<0.8 BF	24	**Delamp**		1	A	**Dual Tech Sensor**
Classroom 14	Prem 2T8 3100 lum<0.8 BF	48	**New Fixture (0.85 BF)**		12	A	**Dual Tech Sensor**
Classroom 14	Prem 1T8 3100 lum<0.8 BF	24			3	A	**Dual Tech Sensor**
Classroom 14/15 RRs	Prem 1T8 3100 lum<0.8 BF	24	**Delamp**		2	A	**Dual Tech Sensor**
Classroom 15	Prem 2T8 3100 lum<0.8 BF	48	**New Fixture (0.85 BF)**		12	A	**Dual Tech Sensor**
Classroom 15	Prem 1T8 3100 lum<0.8 BF	24			2	A	**Dual Tech Sensor**

Location	Proposed fixture	Watts	Custom Description / Additional Info.	Custom Watts	Qty	Sched	Control Type
Classroom 16	Prem 2T8 3100 lum<0.8 BF	48	**New Fixture (0.85 BF)**		12	A	**Dual Tech Sensor**
Classroom 16	Prem 1T8 3100 lum<0.8 BF	24			3	A	**Dual Tech Sensor**
Classroom 16/17 RRs	Prem 1T8 3100 lum<0.8 BF	24	**Delamp**		2	A	**Dual Tech Sensor**
Classroom 17	Prem 2T8 3100 lum<0.8 BF	48	**New Fixture (0.85 BF)**		12	A	**Dual Tech Sensor**
Classroom 17	Prem 1T8 3100 lum<0.8 BF	24			3	A	**Dual Tech Sensor**
KIVA Classroom	Prem 2T8 3100 lum<0.8 BF	48	**New Fixture (0.85 BF)**		11	A	**Dual Tech Sensor**
KIVA Classroom	0	#N/A			3	A	**Dual Tech Sensor**
Small Classroom	Prem 2T8 3100 lum<0.8 BF	48	**New Fixture (0.85 BF)**		6	A	**Dual Tech Sensor**
Library	Prem 2T8 3100 lum<0.8 BF	48	**New Fixture (0.85 BF)**		32	B	**Dual Tech Sensor**
Library Work Room	Prem 2T8 3100 lum<0.8 BF	48	**New Fixture (0.85 BF)**		4	A	**Dual Tech Sensor**
Library Offices	Prem 2T8 3100 lum<0.8 BF	48	**New Fixture (0.85 BF)**		3	A	**Dual Tech Sensor**

Location	Proposed fixture	Watts	Custom Description / Additional Info.	Custom Watts	Qty	Sched	Control Type
Story Telling Room	Prem 2T8 3100 lum<0.8 BF	48	New Fixture (0.85 BF)		8	A	Dual Tech Sensor
Planning Room	Prem 2T8 3100 lum<0.8 BF	48	New Fixture (0.85 BF)		4	A	Dual Tech Sensor
Lounge	Prem 2T8 3100 lum<0.8 BF	48	New Fixture (0.85 BF)		4	E	Dual Tech Sensor
Mens Restroom	Custom	--->	Prem 1T8 3'	20	2	A	Dual Tech Sensor
Womens Restroom	Custom	--->	Prem 1T8 3'	20	2	A	Dual Tech Sensor
Storage	Prem 2T8 3100 lum<0.8 BF	48			1	A	Dual Tech Sensor
Electric Room	Prem 2T8 3100 lum<0.8 BF	48			1	A	Dual Tech Sensor
Electric Room	0	#N/A	LED - 12 watt	12	1	A	Dual Tech Sensor
Boys Restroom	Prem 2T8 3100 lum<0.8 BF	48	New Fixture (0.85 BF)	12	2	B	Dual Tech Sensor
Boys Restroom	Prem 1T8 3100 lum<0.8 BF	24	Delamp		1	B	Dual Tech Sensor

Location	Proposed fixture	Watts	Custom Description / Additional Info.	Custom Watts	Qty	Sched	Control Type
Girls Restroom	Prem 2T8 3100 lum<0.8 BF	48	New Fixture (0.85 BF)	12	2	B	Dual Tech Sensor
Girls Restroom	Prem 1T8 3100 lum<0.8 BF	24	New Fixture (0.85 BF)		1	B	Dual Tech Sensor
Exterior	CFL26W/Hardwire	30	New Fixtures		18	A	Dual Tech Sensor
Classroom 8 RR Hall	Prem 1T8 3100 lum<0.8 BF	24	New Fixtures		1	A	Dual Tech Sensor
Classroom 5/4 RR Hall	Prem 1T8 3100 lum<0.8 BF	24	New Fixtures		1	A	Dual Tech Sensor
Classroom 3/2 RR Hall	Prem 1T8 3100 lum<0.8 BF	24	New Fixtures		1	A	Dual Tech Sensor
Classroom 6 RR Hall	Prem 1T8 3100 lum<0.8 BF	24	New Fixtures		1	A	Dual Tech Sensor
Classroom 9/10 RR Hall	Prem 1T8 3100 lum<0.8 BF	24	New Fixtures		1	A	Dual Tech Sensor
Classroom 11/12 RR Hall	Prem 1T8 3100 lum<0.8 BF	24	New Fixtures		1	A	Dual Tech Sensor
Classroom 14/15 RR Hall	Prem 1T8 3100 lum<0.8 BF	24	New Fixtures		1	A	Dual Tech Sensor
Classroom 16/17 RR Hall	Prem 1T8 3100 lum<0.8 BF	24	New Fixtures		1	A	Dual Tech Sensor
Classroom 1 RR	Prem 1T8 3100 lum<0.8 BF	24	New Fixtures		2	A	Dual Tech Sensor

EEM 2 DETAILS: NEW HVAC AND CONTROLS FOR ENERGY SAVINGS

This measure removed the (4) constant volume multizone air handlers on the roof, and installed (4) new VAV multizone air handlers in their place. The existing ductwork distribution was utilized, and the code required fire dampers were installed.

A new DDC system was also installed to control the operating times of the units, and the space temperatures for occupied and unoccupied times.

Each air handler has a variable speed drive that modulates to maintain a pressure setpoint, and has a cold deck, bypass deck, and hot deck. There are natural gas furnaces in each air handler that provide hot air to the zones that require heating.

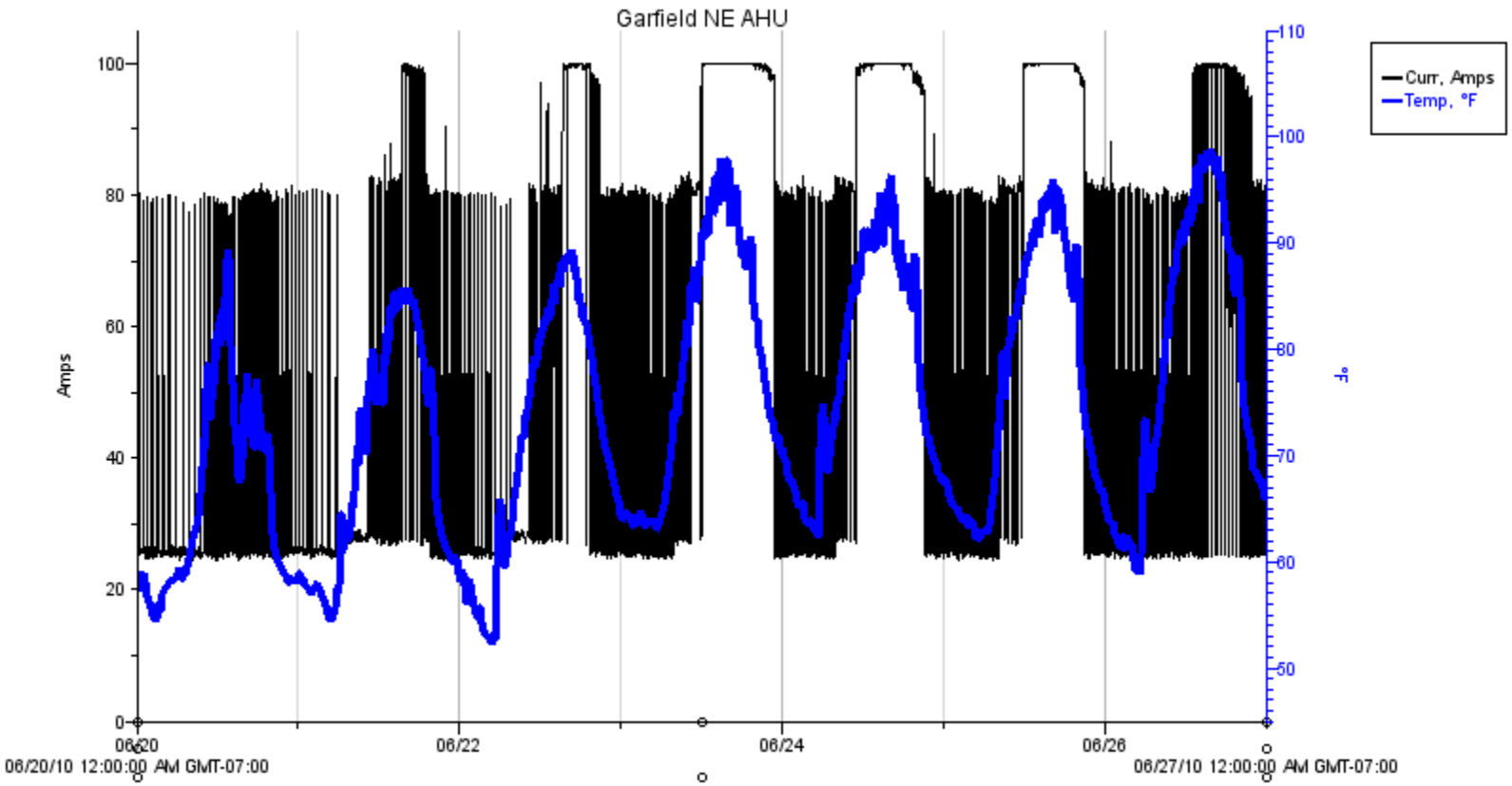
One of the roof vents in the gymnasium building was permanently closed, and the other was equipped with an automatic actuator to open and close the dampers as needed through the new DDC system. The (2) rooftop units serving the gymnasium were also connected to the new DDC system, and the roof vents will only modulate as needed when the rooftop units operate in free-cooling economizer mode.

It is assumed that while occupied the spaces will be heated to 70 F, and cooled to 76 F, and while unoccupied the spaces will be allowed to drift down at night to 55 F, and also allowed o drift up to 80 F.

It is anticipated that the HVAC systems will be turned on an average of one hour prior to school starting, and will stop about half an hour after school ends. It is assumed the units will only operate in the summer when occupied and the occupants utilize the manual over-rides (see next paragraph).

New thermostats have been installed throughout the main school and gymnasium and they are all equipped with manual over-ride buttons. The DDC operator can program the over-ride button to automatically turn on the HVAC serving the appropriate zone for a specified amount of time (1 hour is suggested). This will allow occupants to use the spaces during normally unoccupied times – but only as needed.

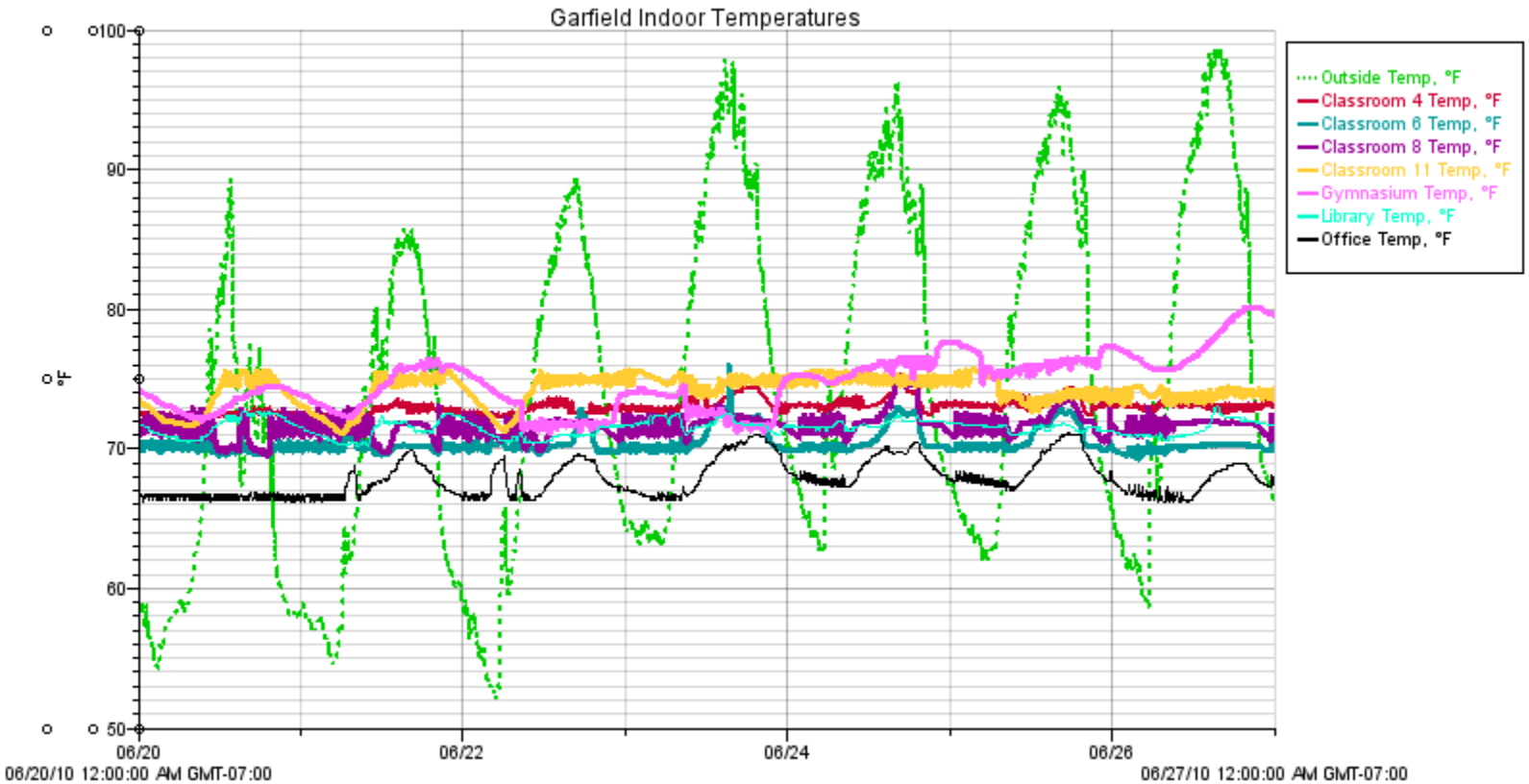
Pre-Upgrade Trend of one AHU electric power over a one week time period



This graph shows the outside air tempreature (blue line, read on scale to the right) and power (amps) of the southeast air handling unit (black line, read on scale to the left) over a one week period.

This illustrates that the fan always operted 24 hours a day prior to the upgrade. When only the fans are on this unit consumed about 24 amps, when one stage of compressor cycled on the power increases to about 80 amps, when the second stage of compressor cycled on the power increases to over 100 amps (sensor maxed out at 100 amps). This shows that the compressor (black line) was cycling on and off whenever the outside air temperature is about 55 F, and it remained on for long periods of time on 6/23, 6/24 and 6/25.

Pre-Upgrade Trend of indoor space temperatures over a one week time period



This graph showed the indoor and outdoor temperature over a seven day period before the upgrade. The dashed green line is the outside air temperature, which ranged from 55 F to 95 f during this test period.

The solid lines represent indoor temperatures taken at different locations, including the gymnasium, library, office and four classrooms. These results indicate that the spaces were maintaining temperatures 24 hours a day before the upgrade.

VERIFICATION OF EEM 1 LIGHTING SYSTEMS AND OCCUPANCY SENSORS OPTIMAL OPERATION

The lighting systems were inspected on a room by room basis to document what was actually installed, and to ensure that they were operating properly, and to ensure they are meeting the required WAC and IESNA light levels.

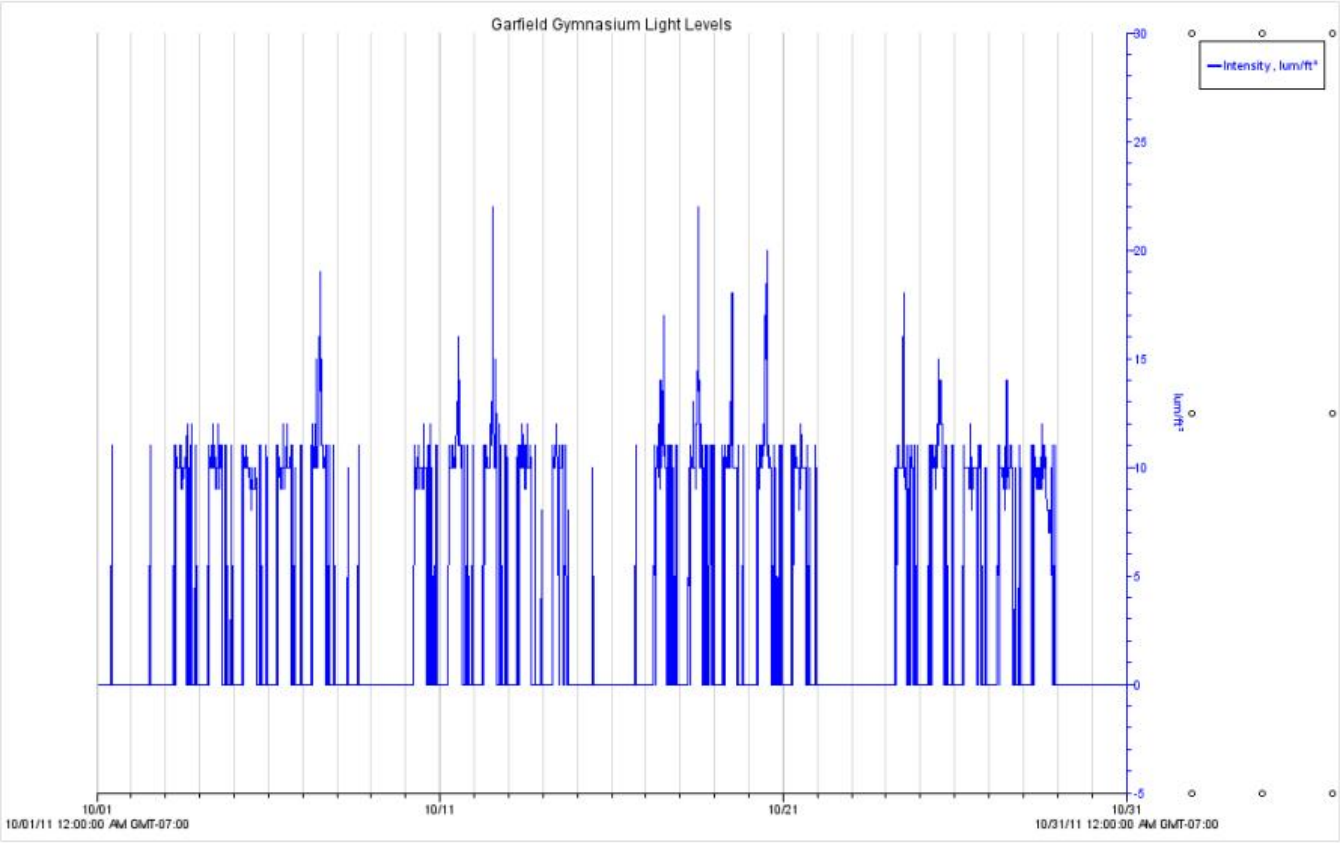
The occupancy sensors in each room were inspected after school hours to ensure that the occupancy sensors would detect occupants to automatically turn the lights on when someone entered the space. They were also tested to ensure that they turned the lights off after the spaces had been vacant for a period of time.

Long term portable data loggers were installed to monitor the lights over several weeks, to ensure that no lights were being left on overnights. The results of these portable loggers are presented on the following pages, to document that the occupancy sensors are automatically turning the lights off when the spaces are vacant.

Light Level graphs in the following pages include data from:

- Gymnasium
- Classroom 12
- Kitchen
- KIVA
- Library
- Library Work Room
- PE Office
- Classroom 3
- Classroom 5
- Classroom 6
- Classroom 13
- Classroom 15

Note: The light levels shown on the graphs are not the horizontal light levels measured at the work space; they are the vertical light levels measured on the wall and are not reflective of the light levels on the work space. They are only used to determine when the overhead lights are on and off, not what the actual light levels are.

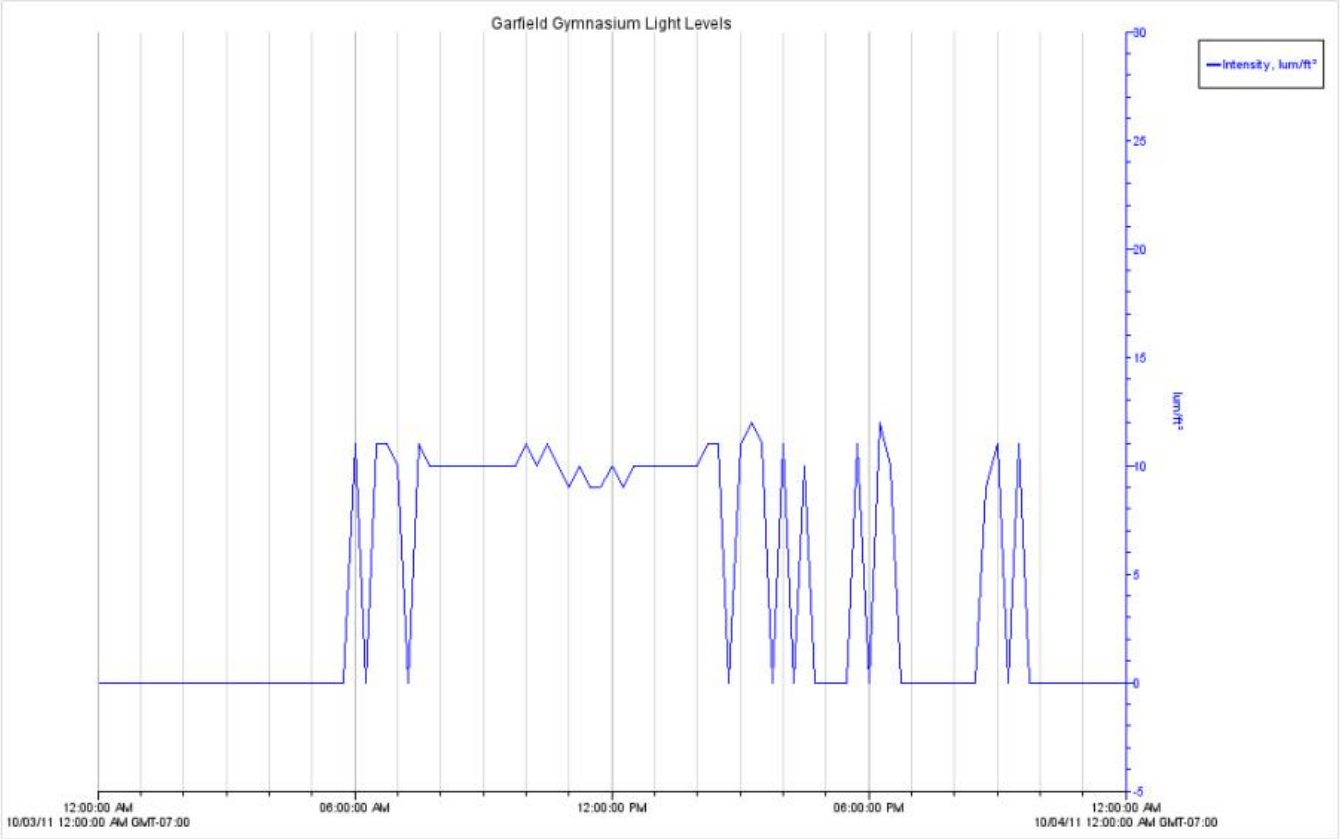


Graph shows 30 days of data.

Blue line is the light level.

Lights are on steadily throughout the middle of each school day, but they cycle off and on especially in the mornings and afternoons, when spaces are intermittently used. Lights are off overnight every night. Lights are briefly on a few weekend days, typically for less than one hour per day.

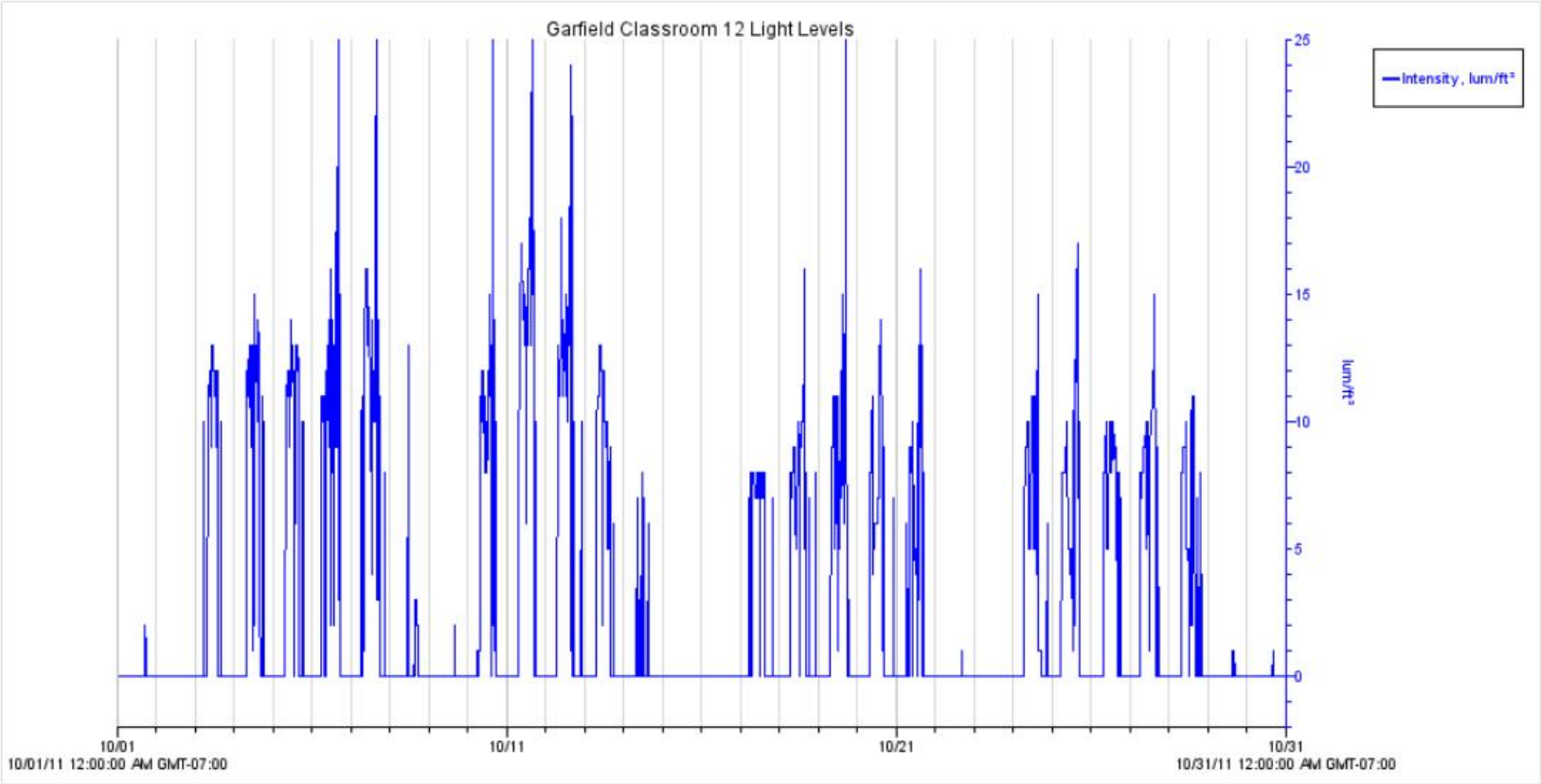
See following page for a typical daily usage pattern.



Graph shows 1 day of data.

Blue line is the light level.

Lights are briefly on in the morning as custodians and staff move through the space. Lights turn off in the afternoon when the spaces are vacant. Lights are only on for brief times in the afternoon and evening as the custodial staff work in the room and pass through the room. Lights are off overnight.

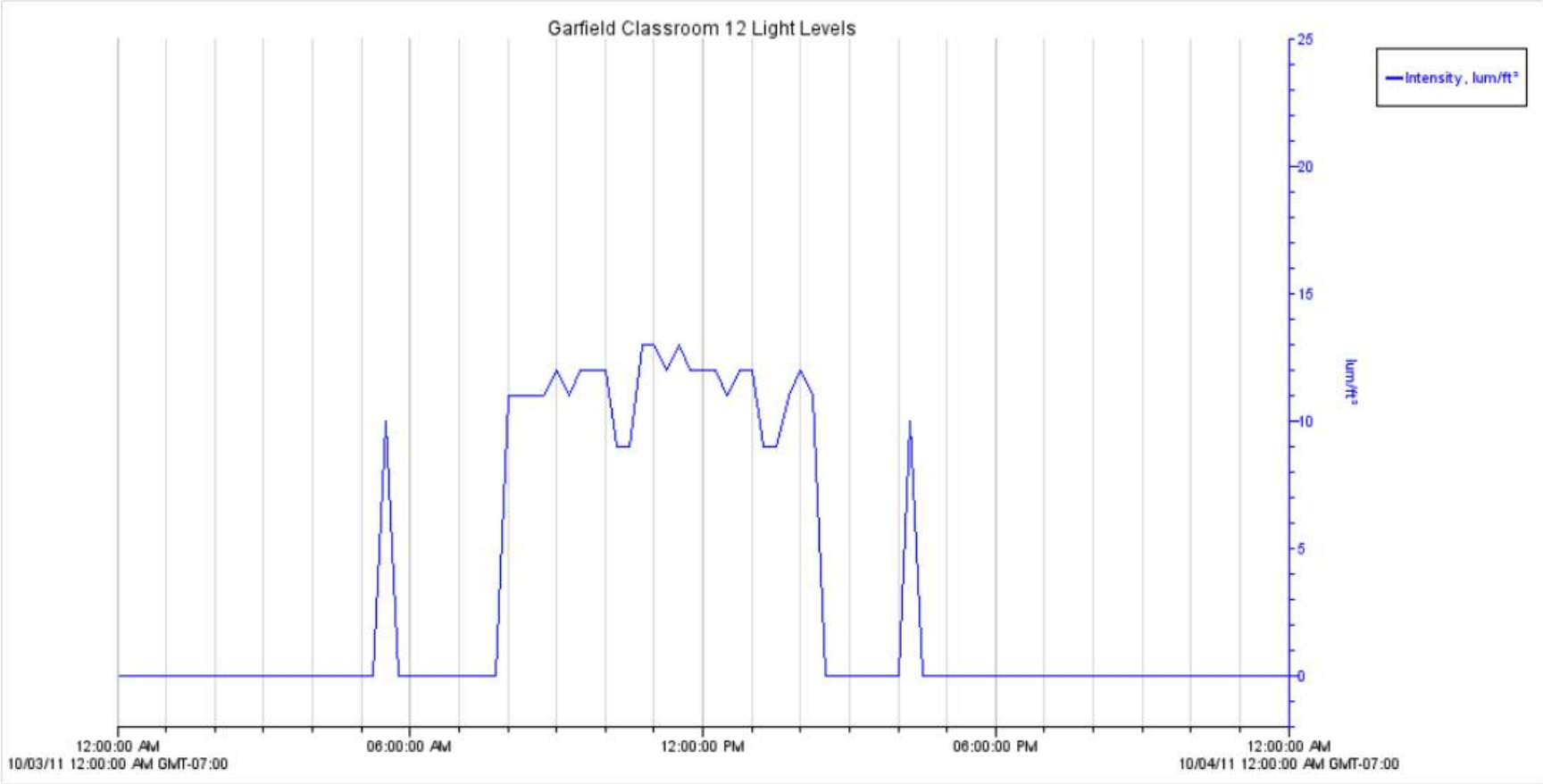


Graph shows 30 days of data.

Blue line is the light level.

Lights are on steadily throughout the middle of each school day, but they cycle off and on especially in the mornings and afternoons, when spaces are intermittently used. Lights are off overnight every night. Lights are briefly on a few weekend days, typically for less than one hour per day.

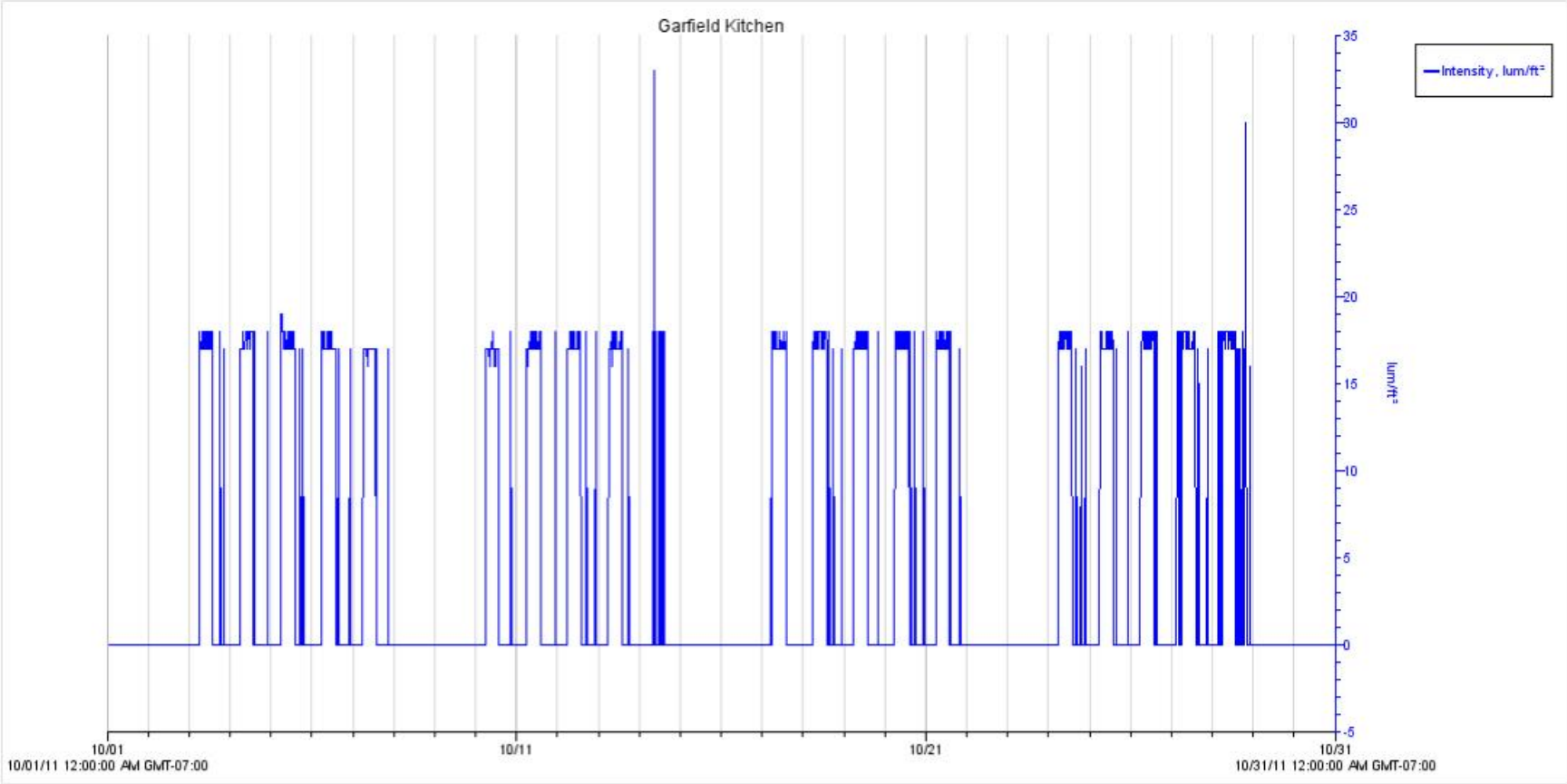
See following page for a typical daily usage pattern.



Graph shows 1 day of data.

Blue line is the light level.

Lights are briefly on in the morning as custodians and staff move through the space. Lights turn off in the afternoon when the spaces are vacant. Lights are only on for brief times in the afternoon and evening as the custodial staff work in the room and pass through the room. Lights are off overnight.

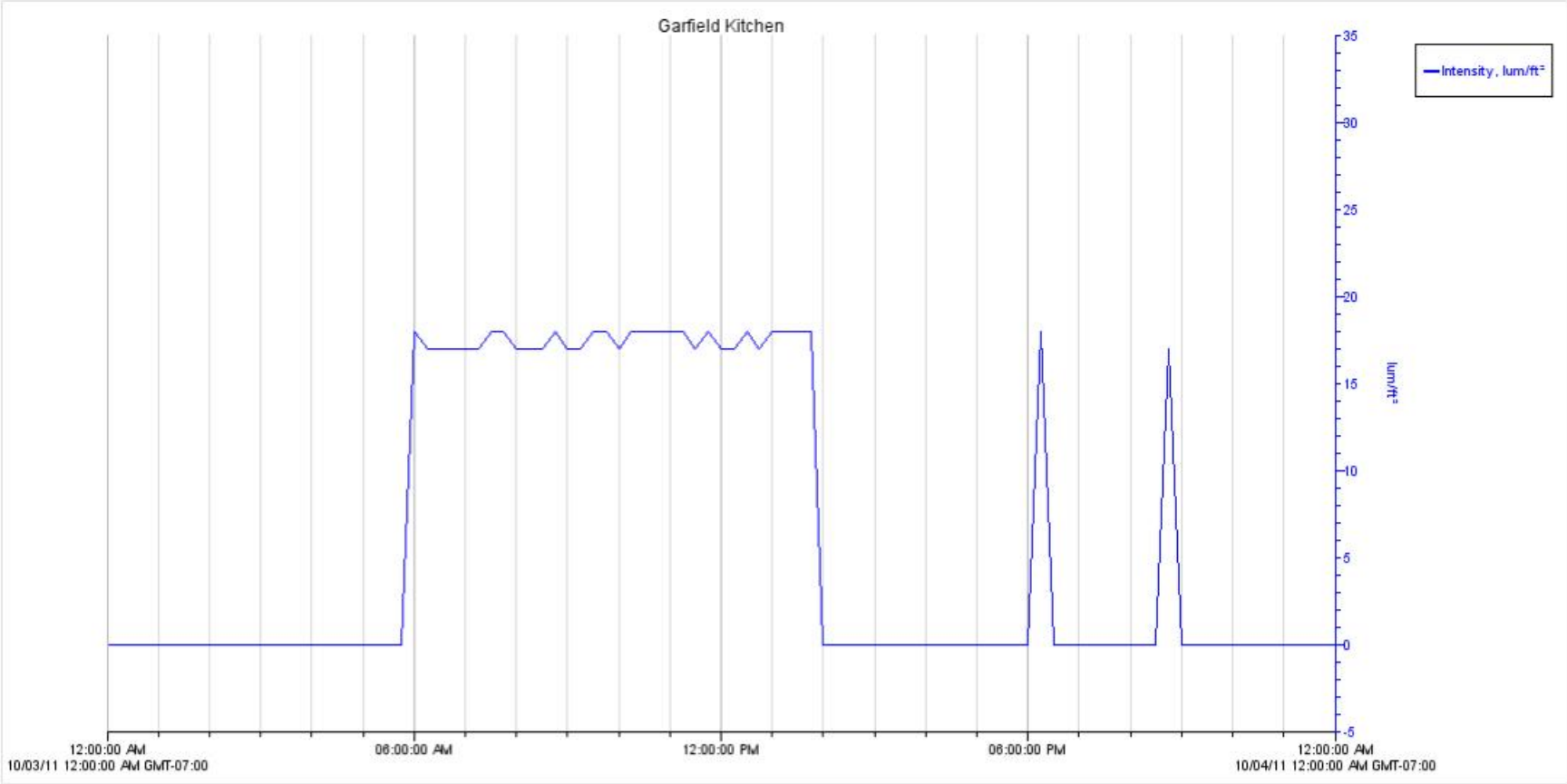


Graph shows 30 days of data.

Blue line is the light level.

Lights are on steadily throughout the school day, but they cycle off and on especially in the late afternoons and evening, when spaces are intermittently used. Lights are off overnight every night. Lights are not on at all over the weekends.

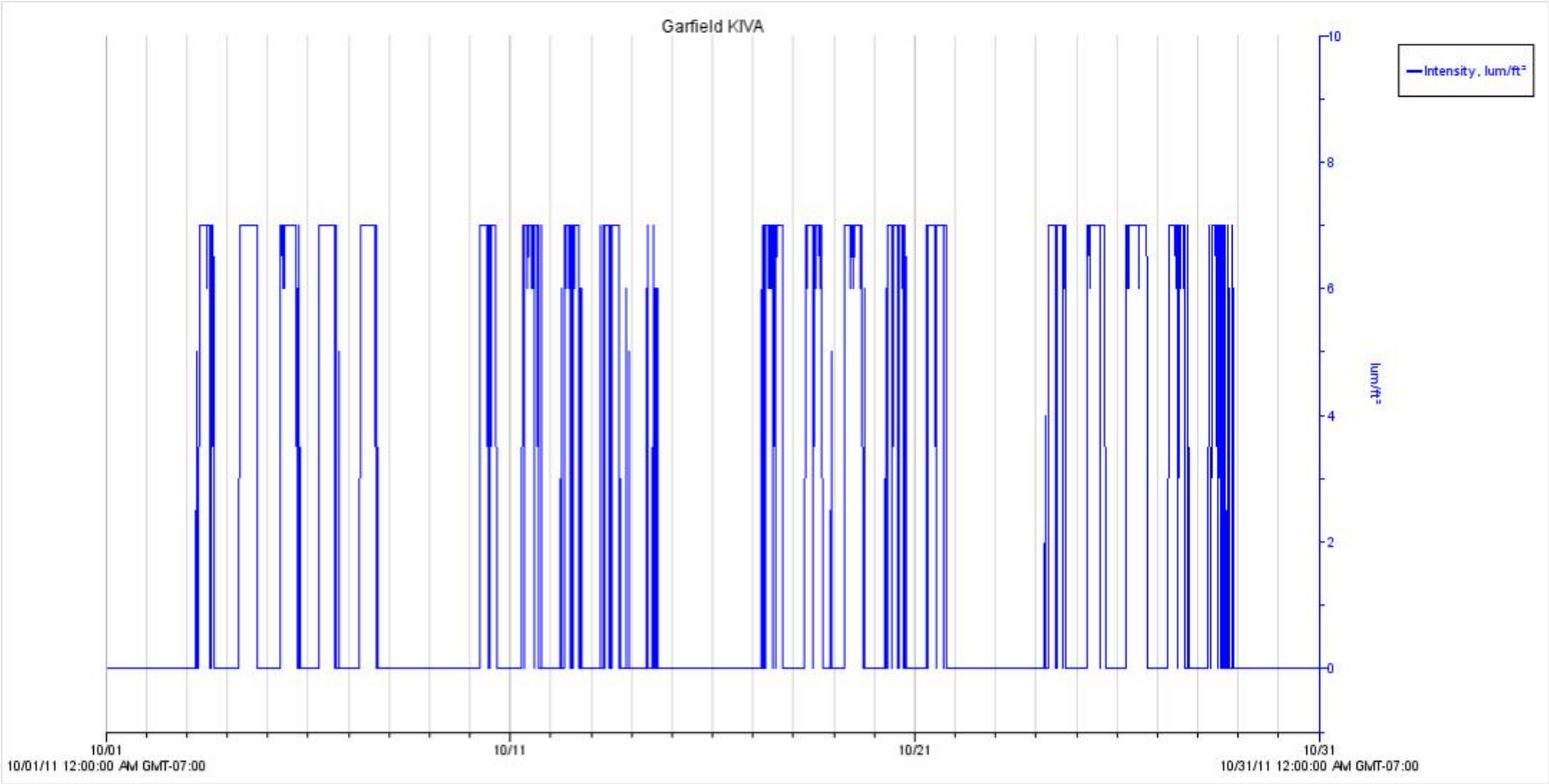
See following page for a typical daily usage pattern.



Graph shows 1 day of data.

Blue line is the light level.

Lights are on all morning into early afternoon, and then they are turned off, and only briefly come back on in the evening as custodians are cleaning. Lights are off overnight.

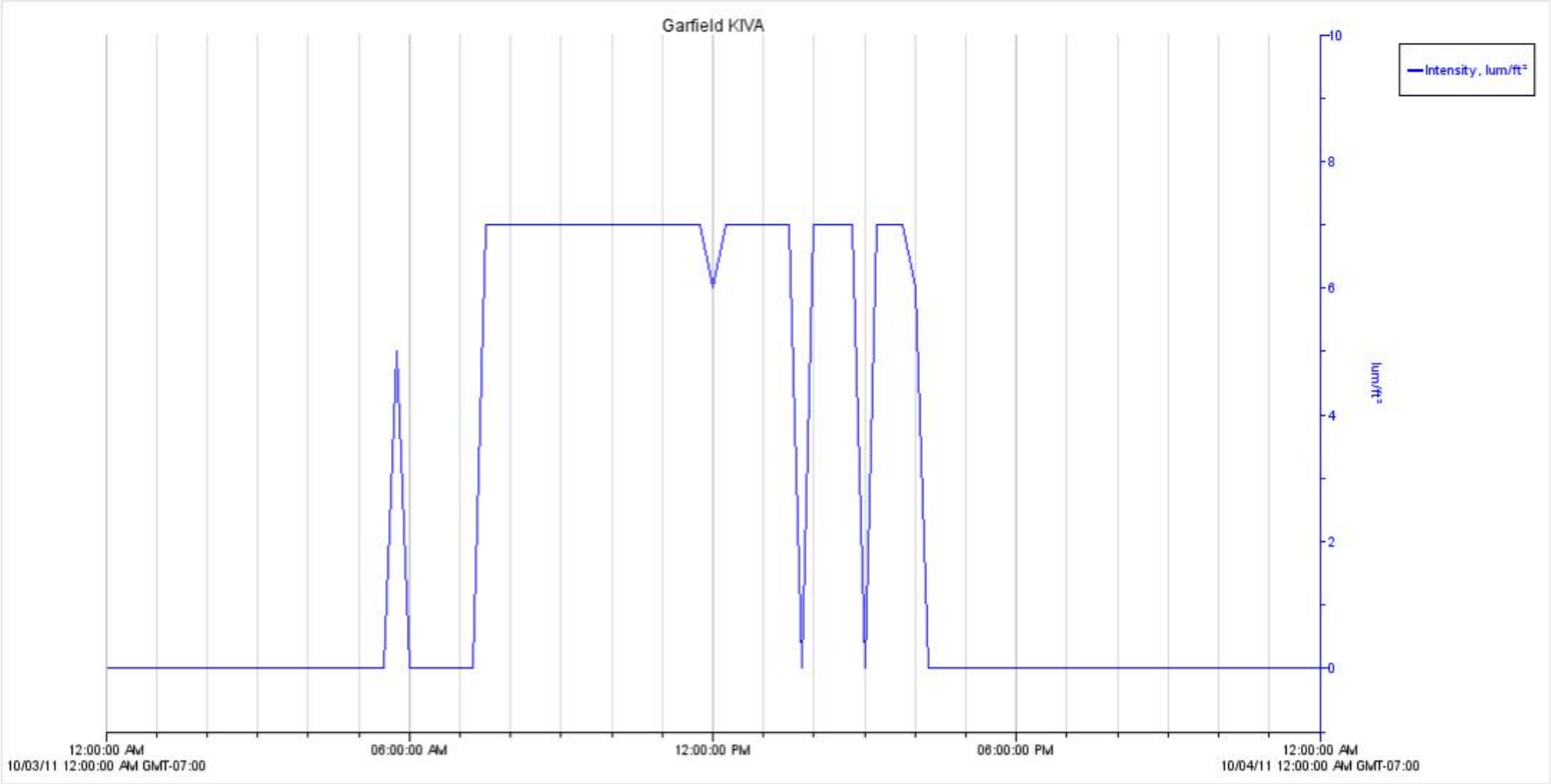


Graph shows 30 days of data.

Blue line is the light level.

Lights are on briefly in the morning as custodians pass through, then remain on most of the school day, and are on briefly in the afternoon as they are cleaned. Lights are off overnight every night. Lights are off all weekends.

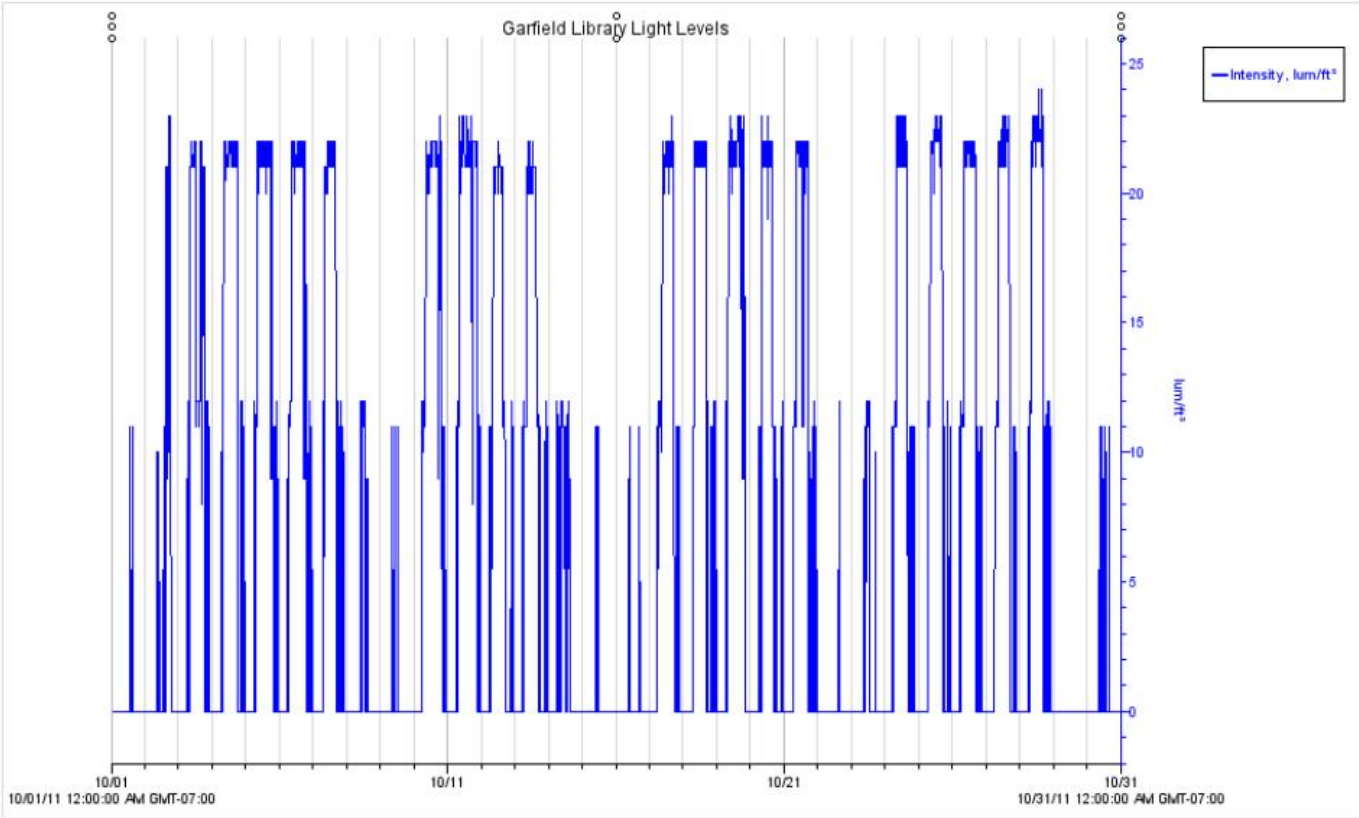
See following page for a typical daily usage pattern.



Graph shows 1 day of data.

Blue line is the light level.

Lights are briefly on in the morning as custodians and staff move through the space. Lights turn off in the afternoon when the spaces are vacant. Lights are only on for brief times in the afternoon and evening as the custodial staff work in the room and pass through the room. Lights are off overnight.

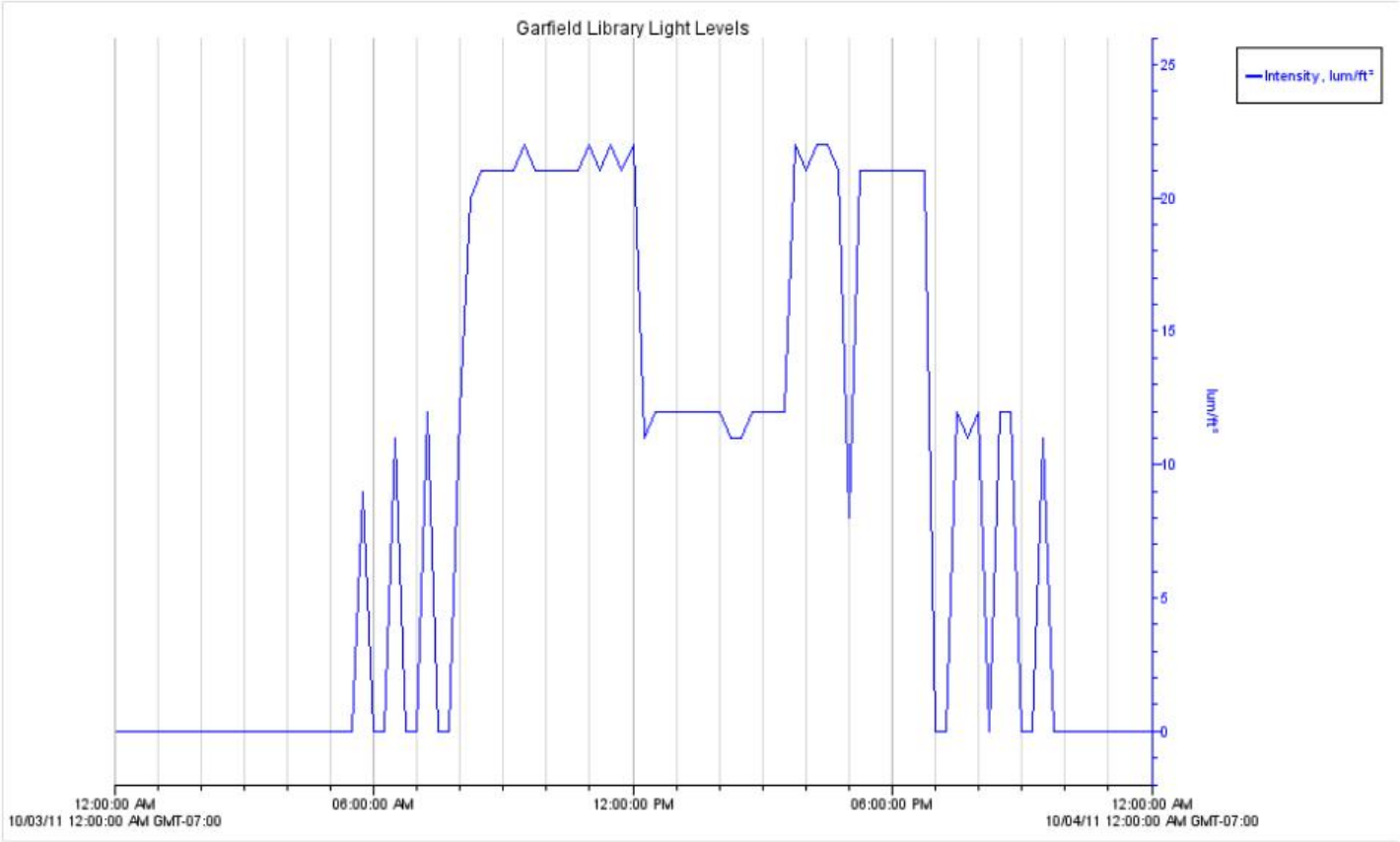


Graph shows 30 days of data.

Blue line is the light level.

Lights are on briefly in the morning as custodians pass through the spaces, then remain on steadily throughout the school day, then cycle on in the afternoons and evenings as the spaces are intermittently used and cleaned. Lights are off overnight every night. Lights are briefly on a few weekend days, typically for less than one hour per day.

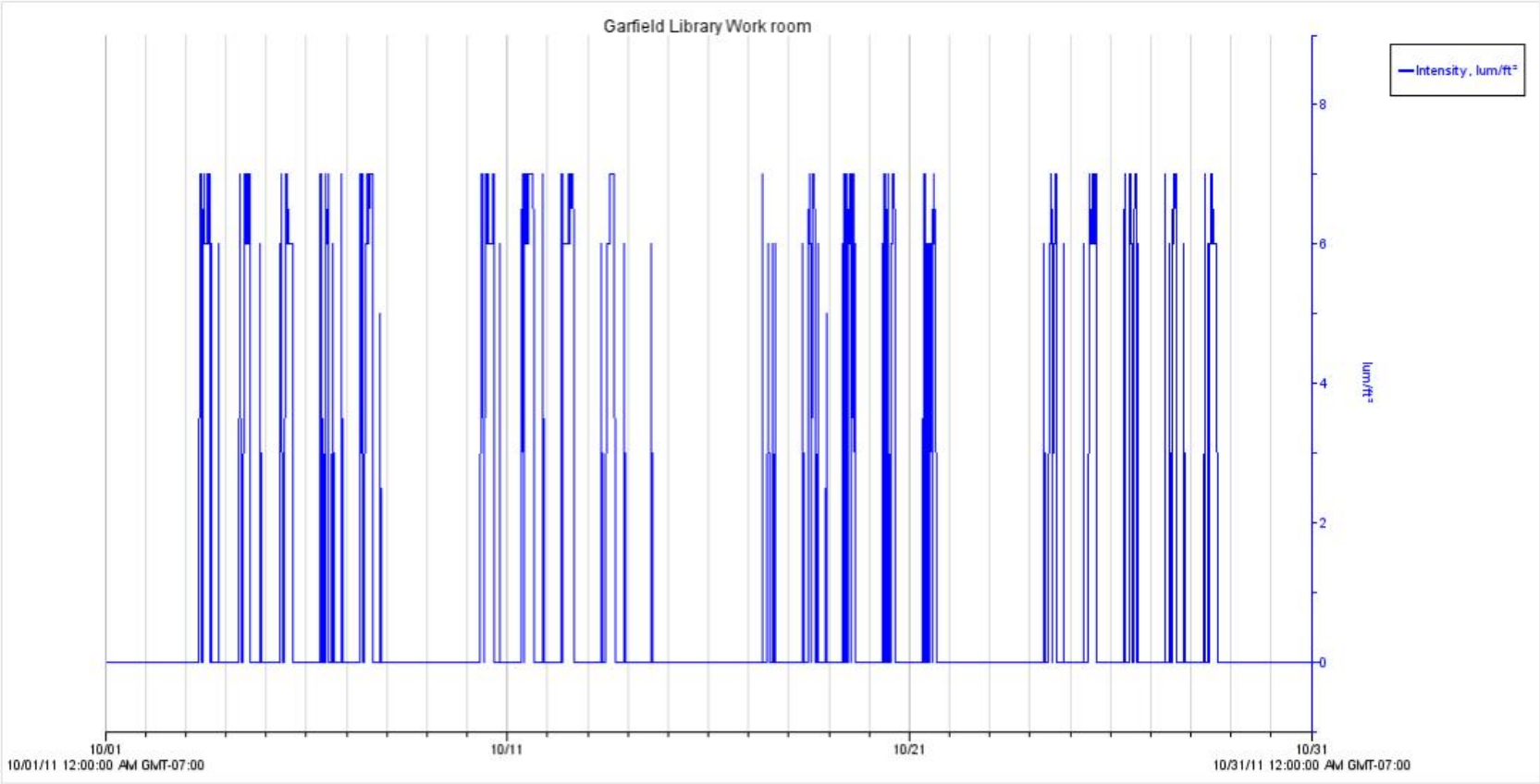
See following page for a typical daily usage pattern.



Graph shows 1 day of data.

Blue line is the light level.

Lights are briefly on in the morning as custodians and staff move through the space. Lights are on steadily throughout the day, and then are intermittently off in the evenings as the space is intermittently used and cleaned. Lights are off overnight.

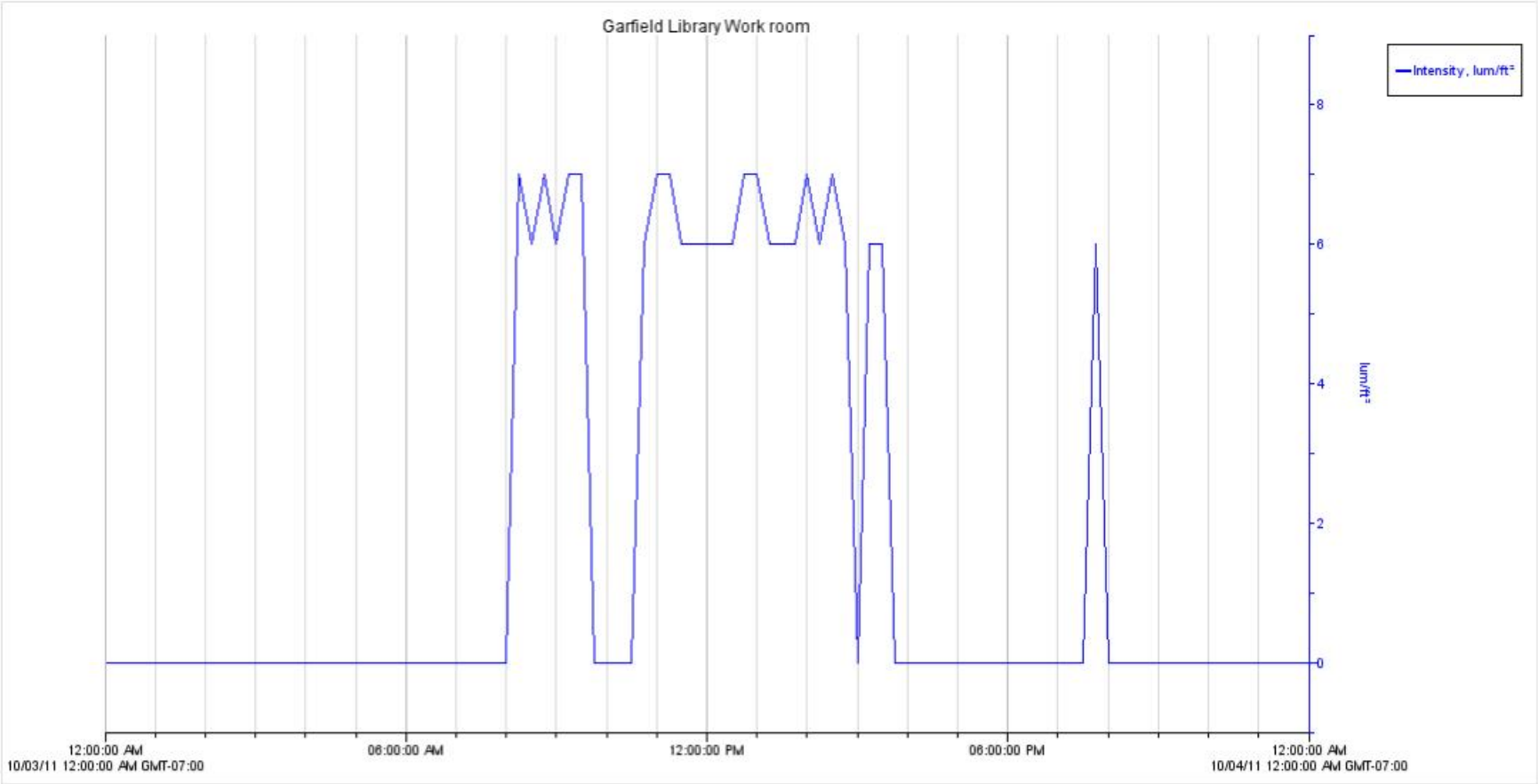


Graph shows 30 days of data.

Blue line is the light level.

Lights are on steadily throughout the middle of each school day, but they cycle off and on especially in the mornings and afternoons, when spaces are intermittently used. Lights are off overnight every night. Lights are off all weekend days.

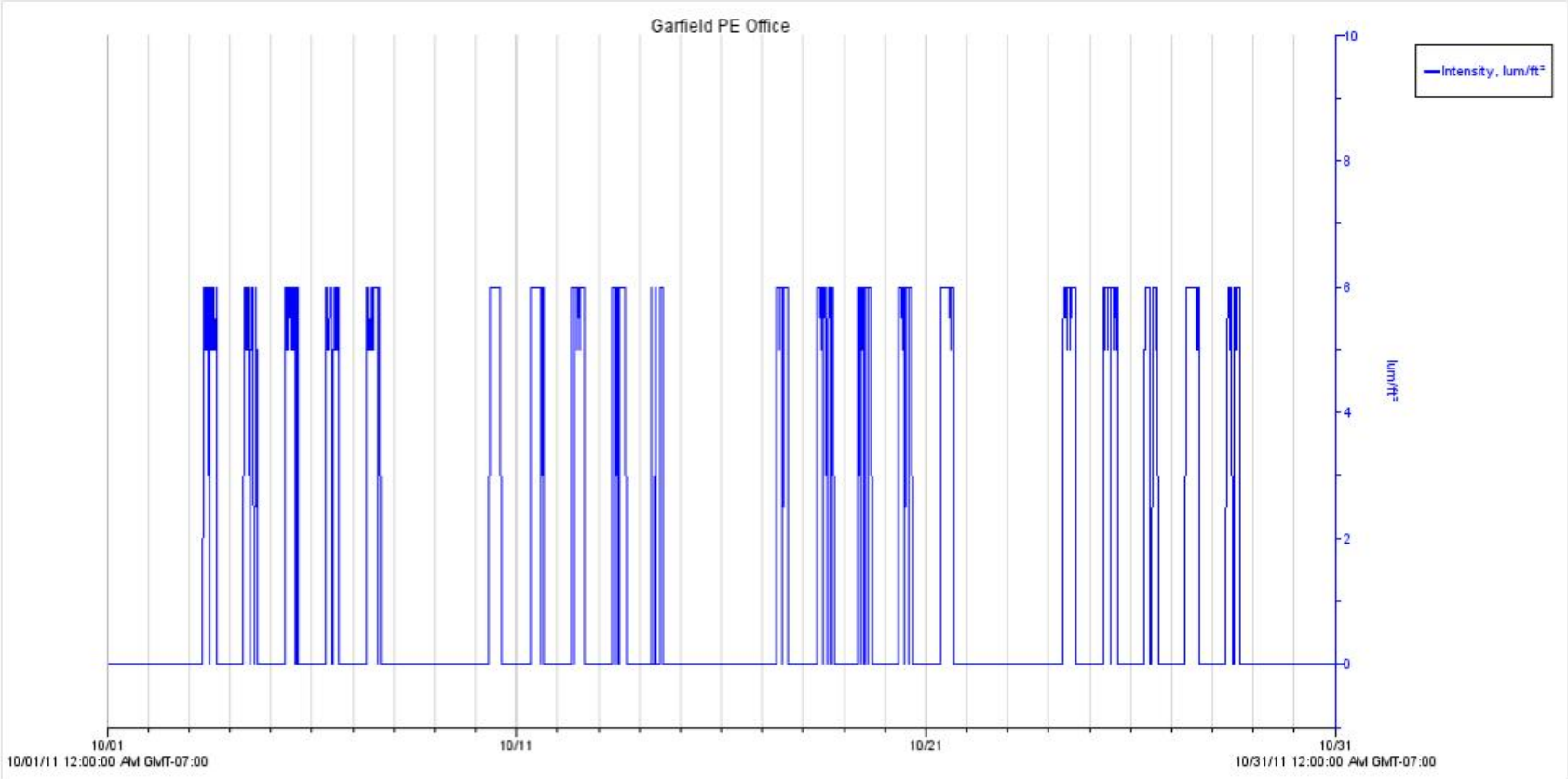
See following page for a typical daily usage pattern.



Graph shows 1 day of data.

Blue line is the light level.

Lights are briefly on in the morning as custodians and staff move through the space. Lights turn off in the afternoon when the spaces are vacant. Lights are only on for brief times in the afternoon and evening as the custodial staff work in the room and pass through the room. Lights are off overnight.

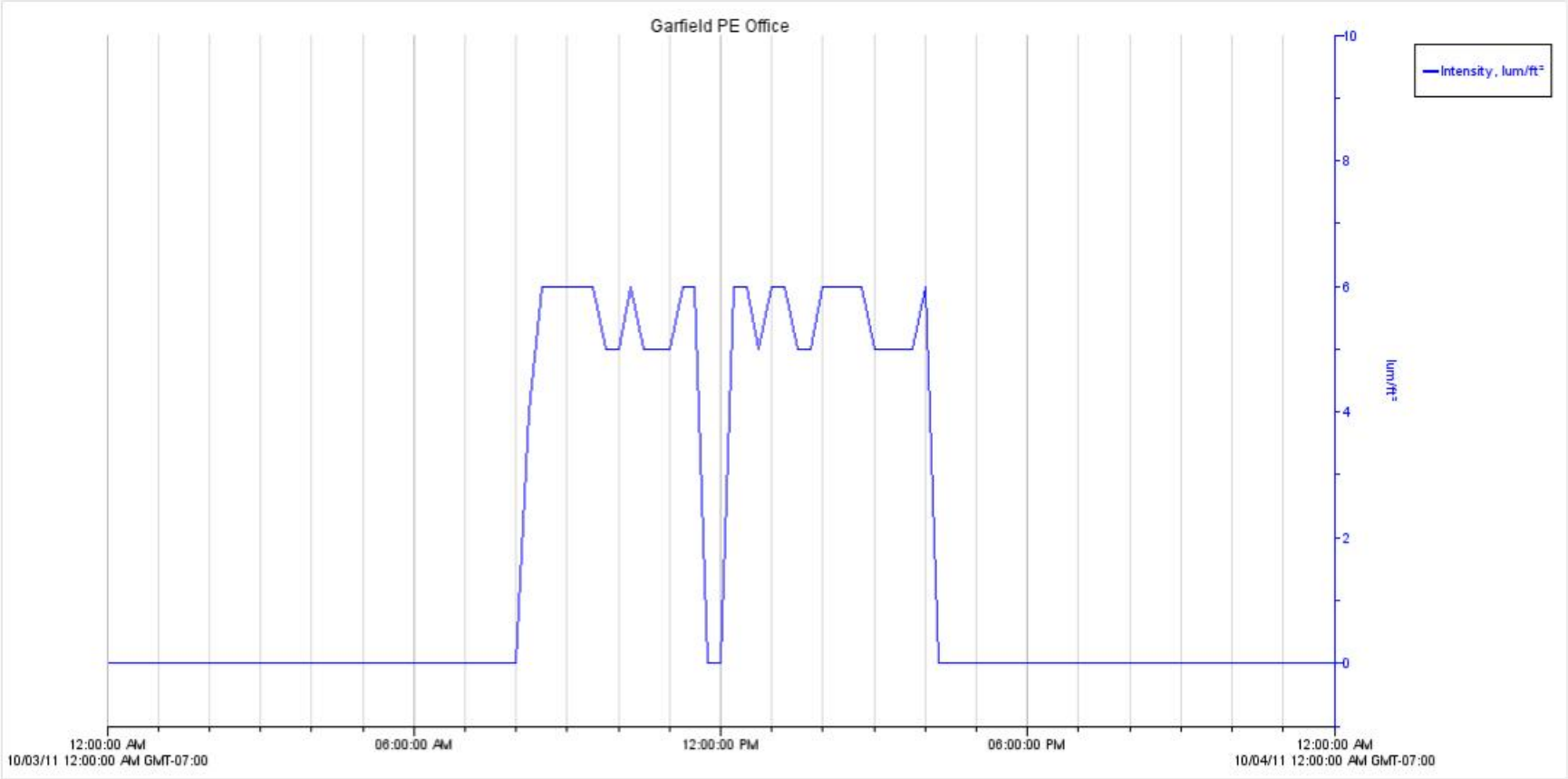


Graph shows 30 days of data.

Blue line is the light level.

Lights are on steadily throughout the middle of each school day, but they cycle off and on over lunch hour, when spaces are intermittently used. Lights are off overnight every night. Lights are off all weekends.

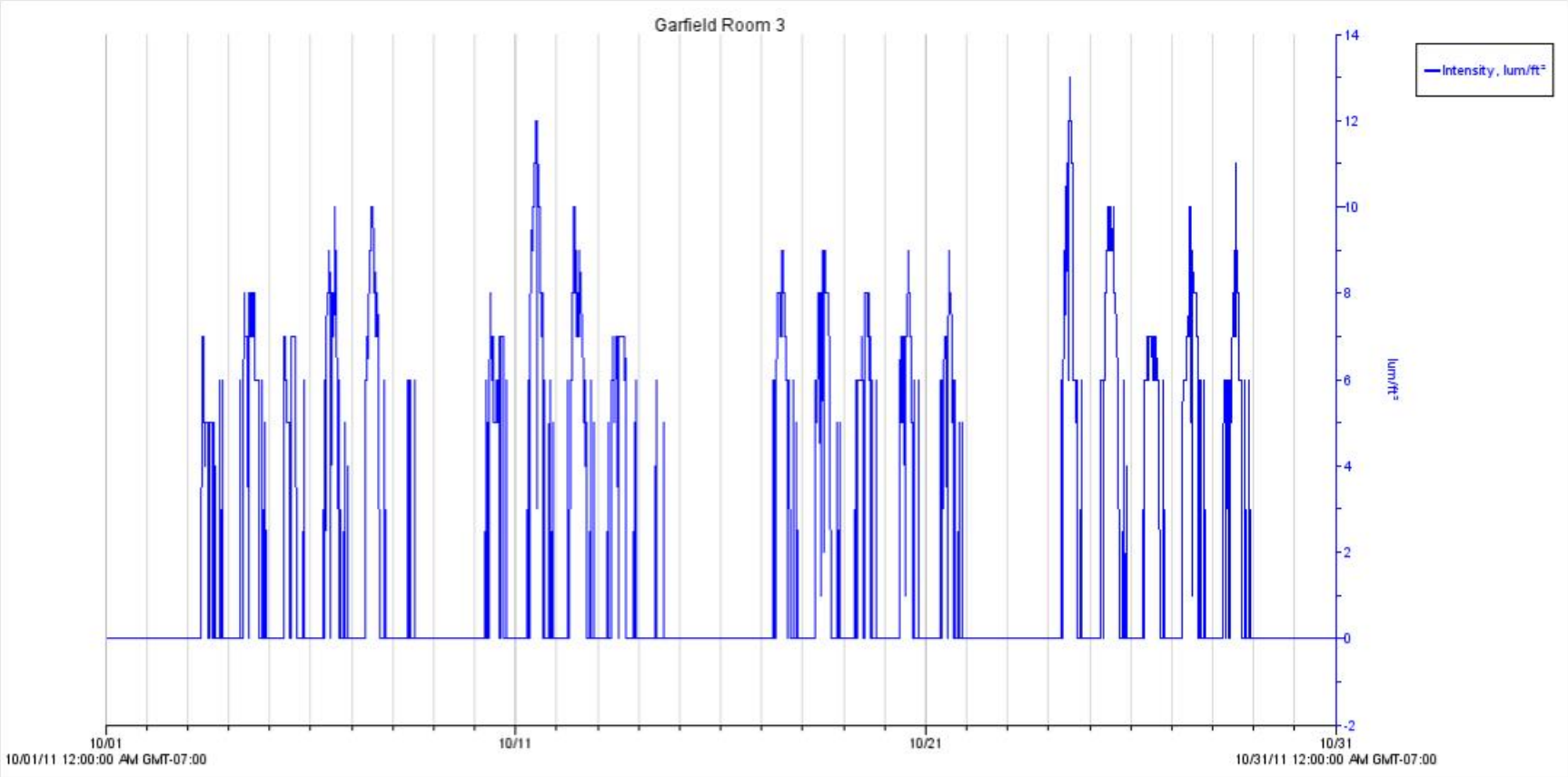
See following page for a typical daily usage pattern.



Graph shows 1 day of data.

Blue line is the light level.

Lights turn on around 8 am through 4 pm, and are off during the lunch hour. Lights are off overnight.

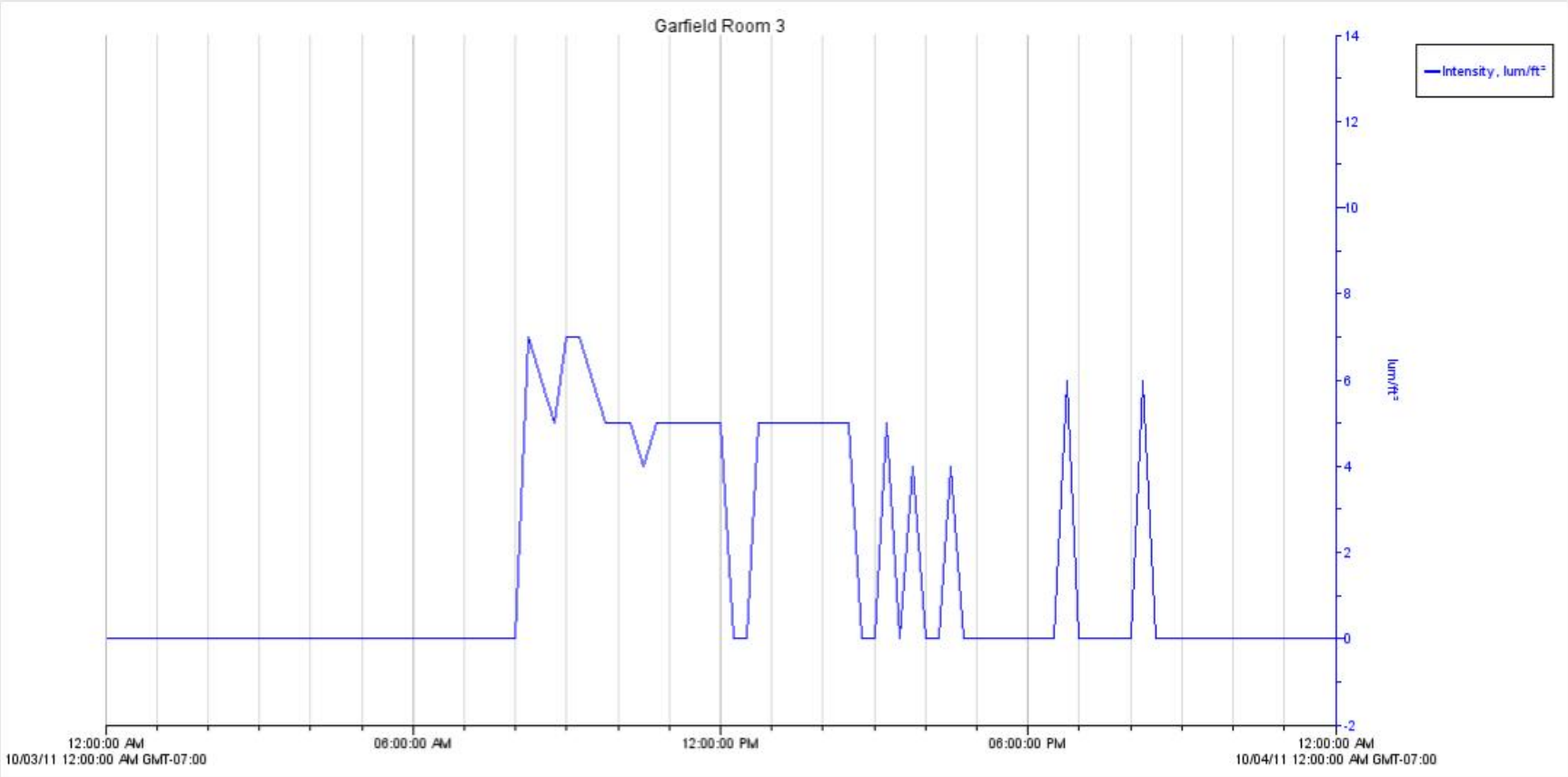


Graph shows 30 days of data.

Blue line is the light level.

Lights are on steadily throughout much of the school day, but they cycle off and on especially in the afternoons, when spaces are intermittently used. Lights are off overnight every night. Lights are off all weekends.

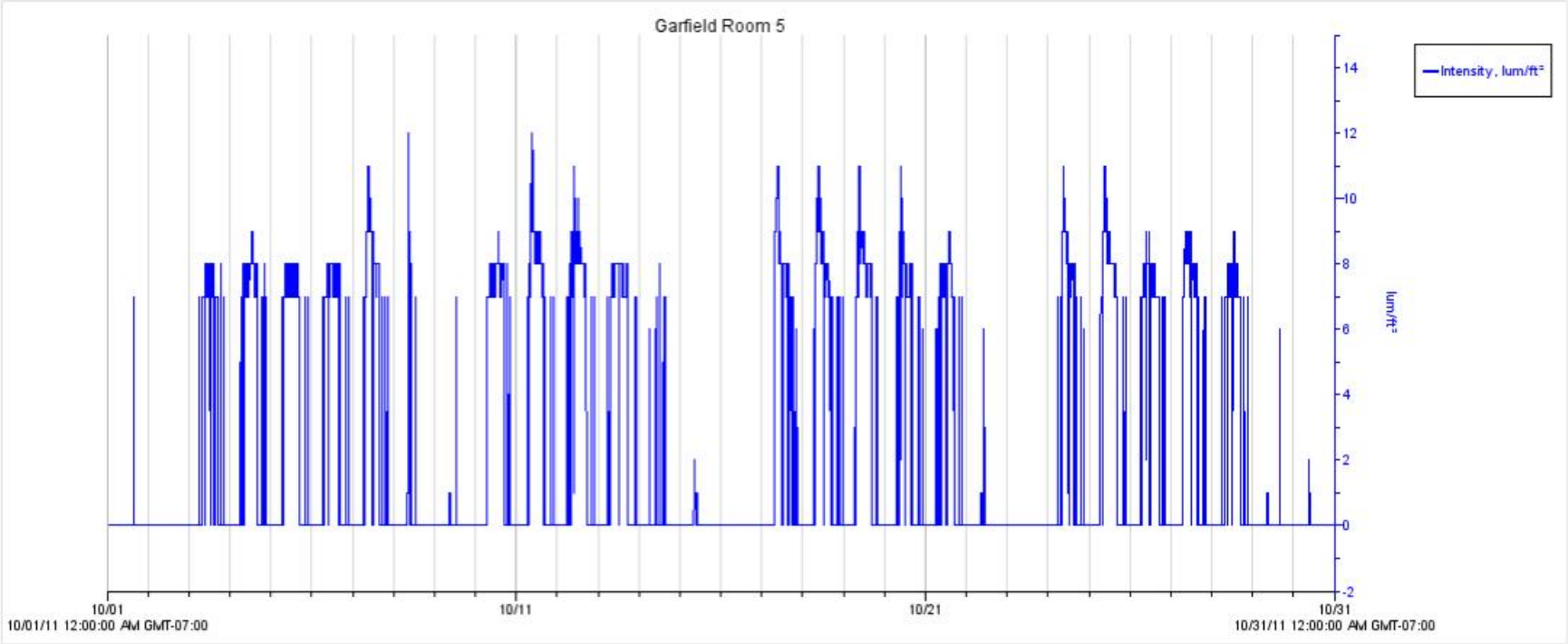
See following page for a typical daily usage pattern.



Graph shows 1 day of data.

Blue line is the light level.

Lights are briefly on steadily from 8am through 3 pm, though they turn off over lunch period. Lights cycle on in the afternoon and evening as the space is intermittently occupied and cleaned. Lights are off overnight.

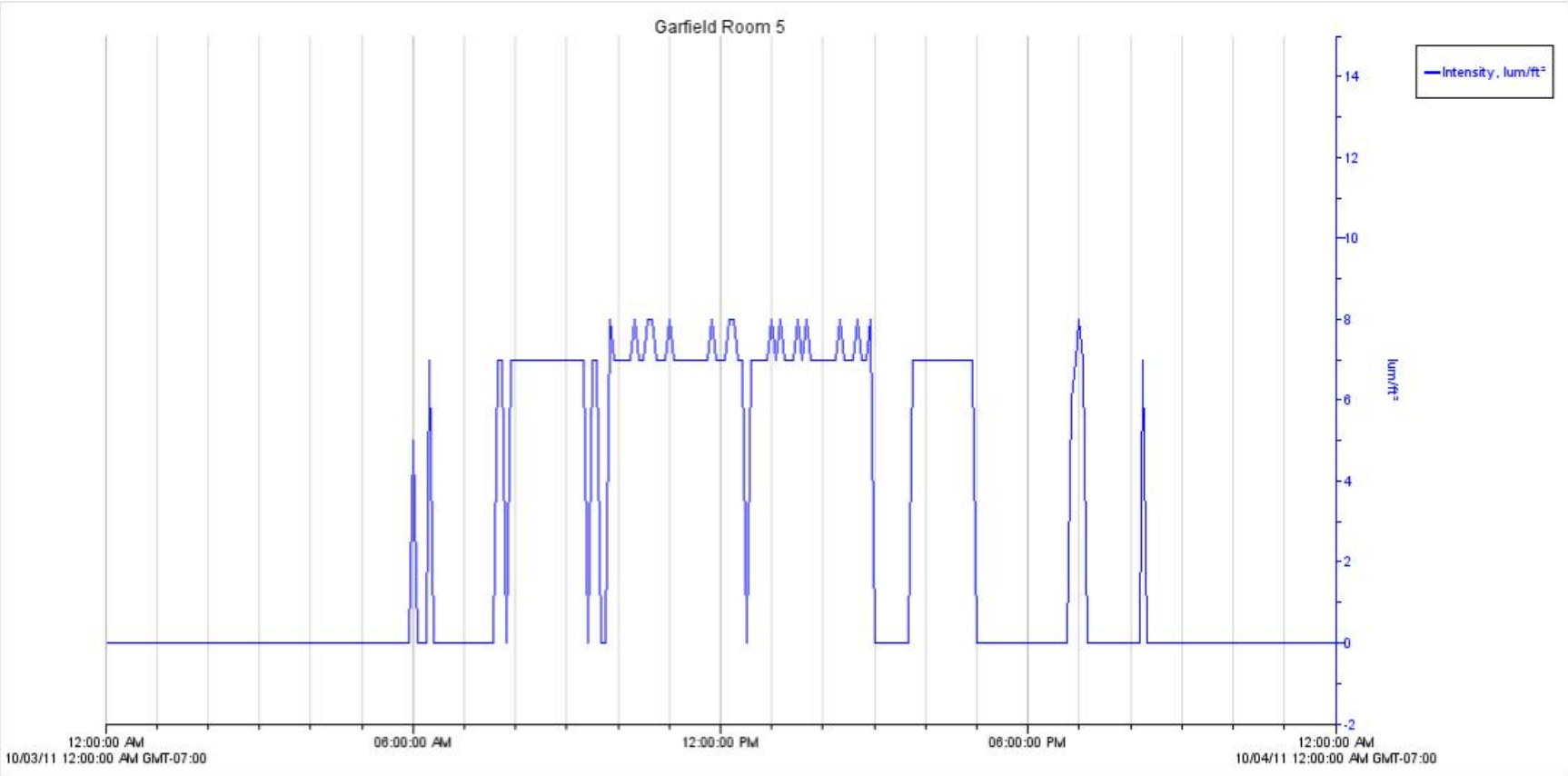


Graph shows 30 days of data.

Blue line is the light level.

Lights are on steadily throughout the middle of each school day, but they cycle off and on especially in the mornings and afternoons, when spaces are intermittently used. Lights are off overnight every night. Lights are briefly on a few weekend days, typically for less than one hour per day.

See following page for a typical daily usage pattern.



Graph shows 1 day of data.

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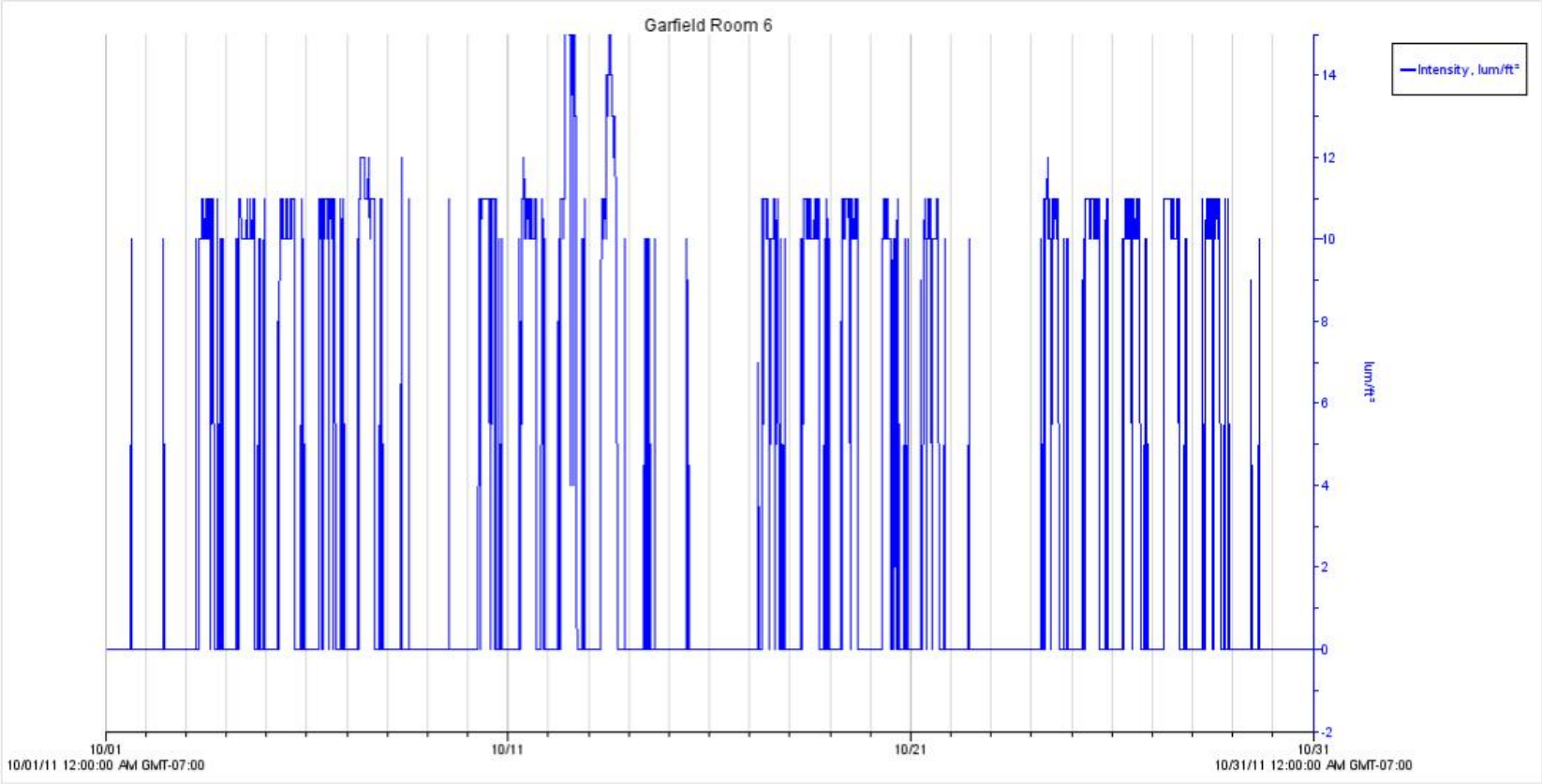

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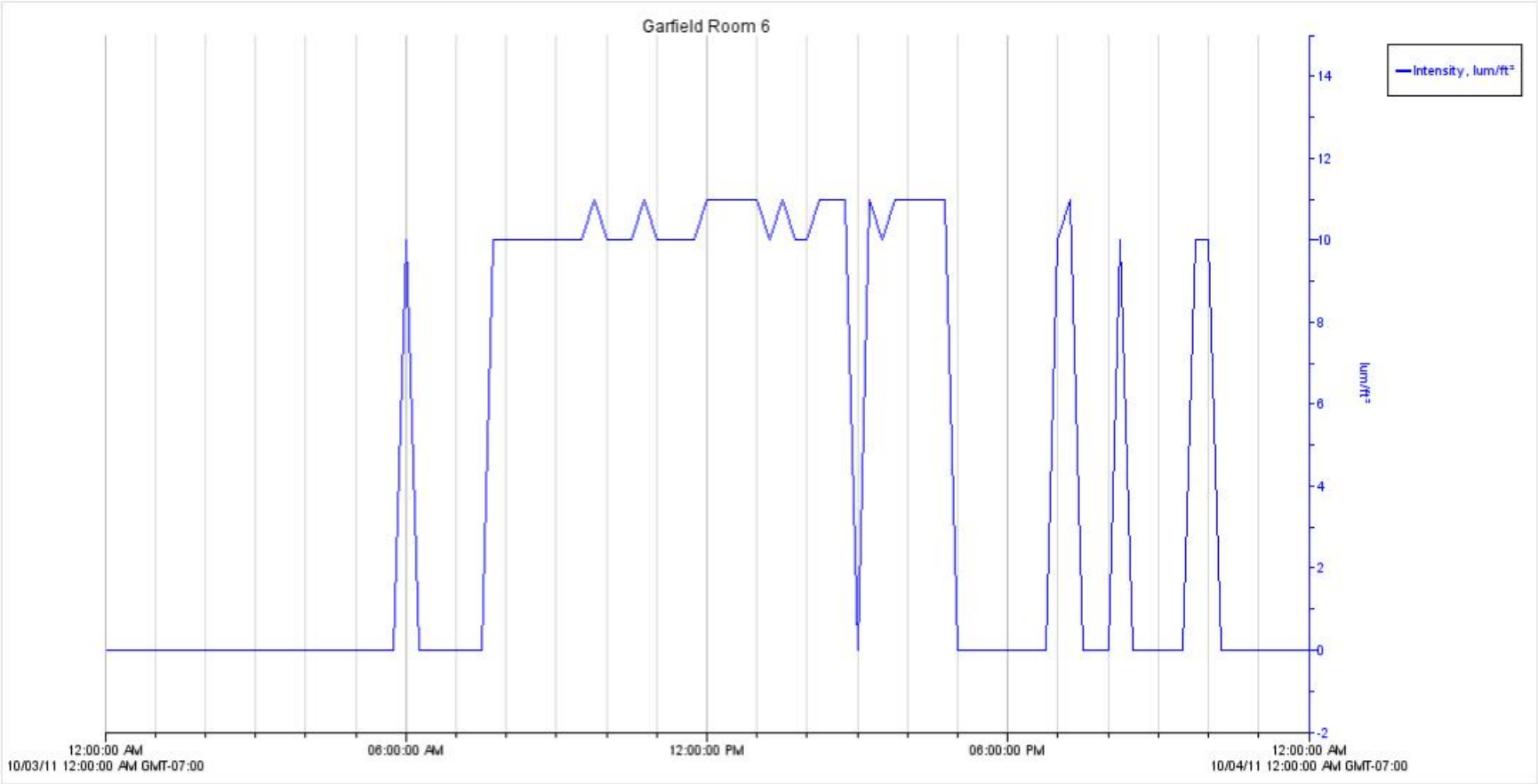
See following page for a typical daily usage pattern.



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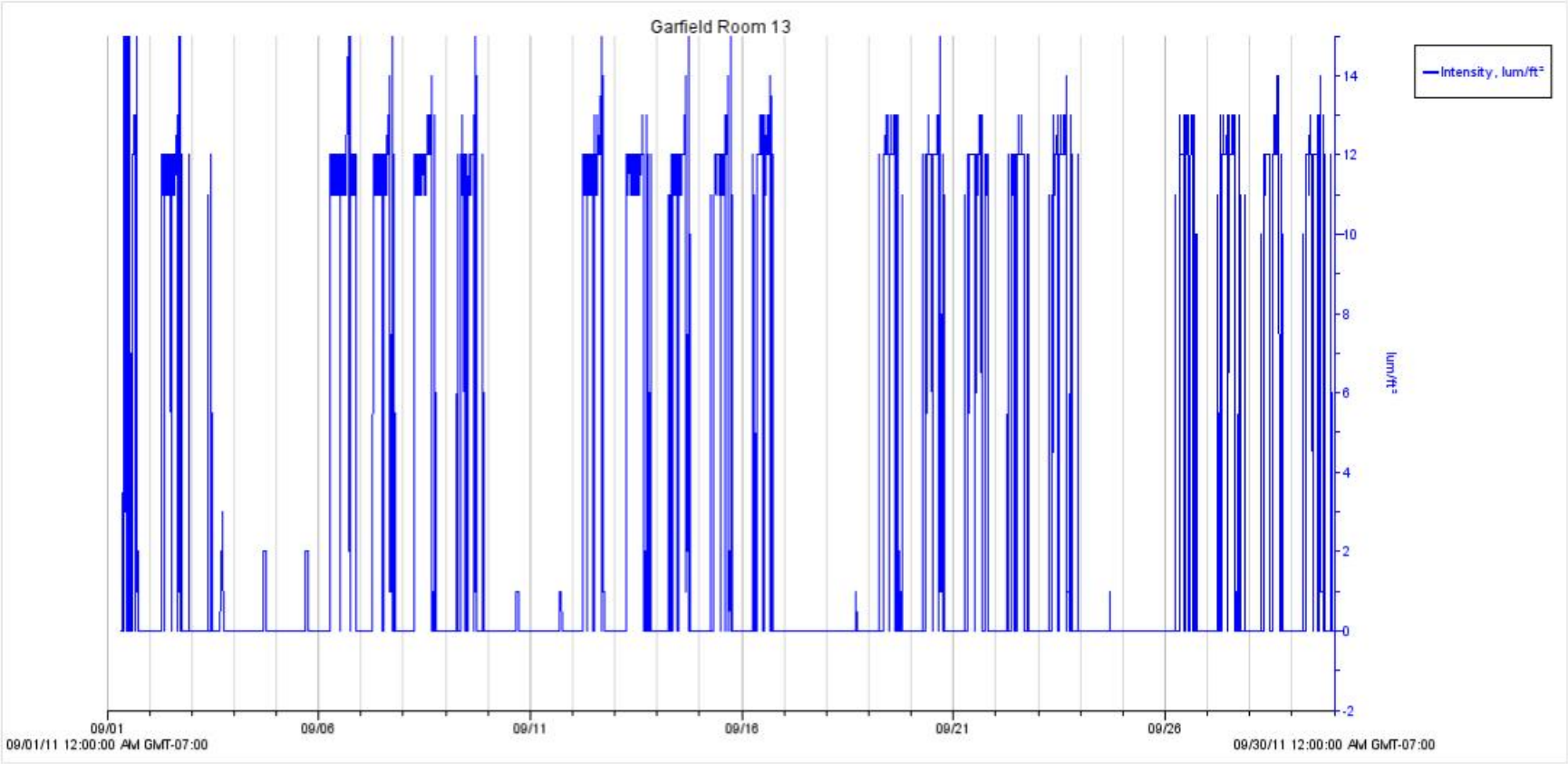
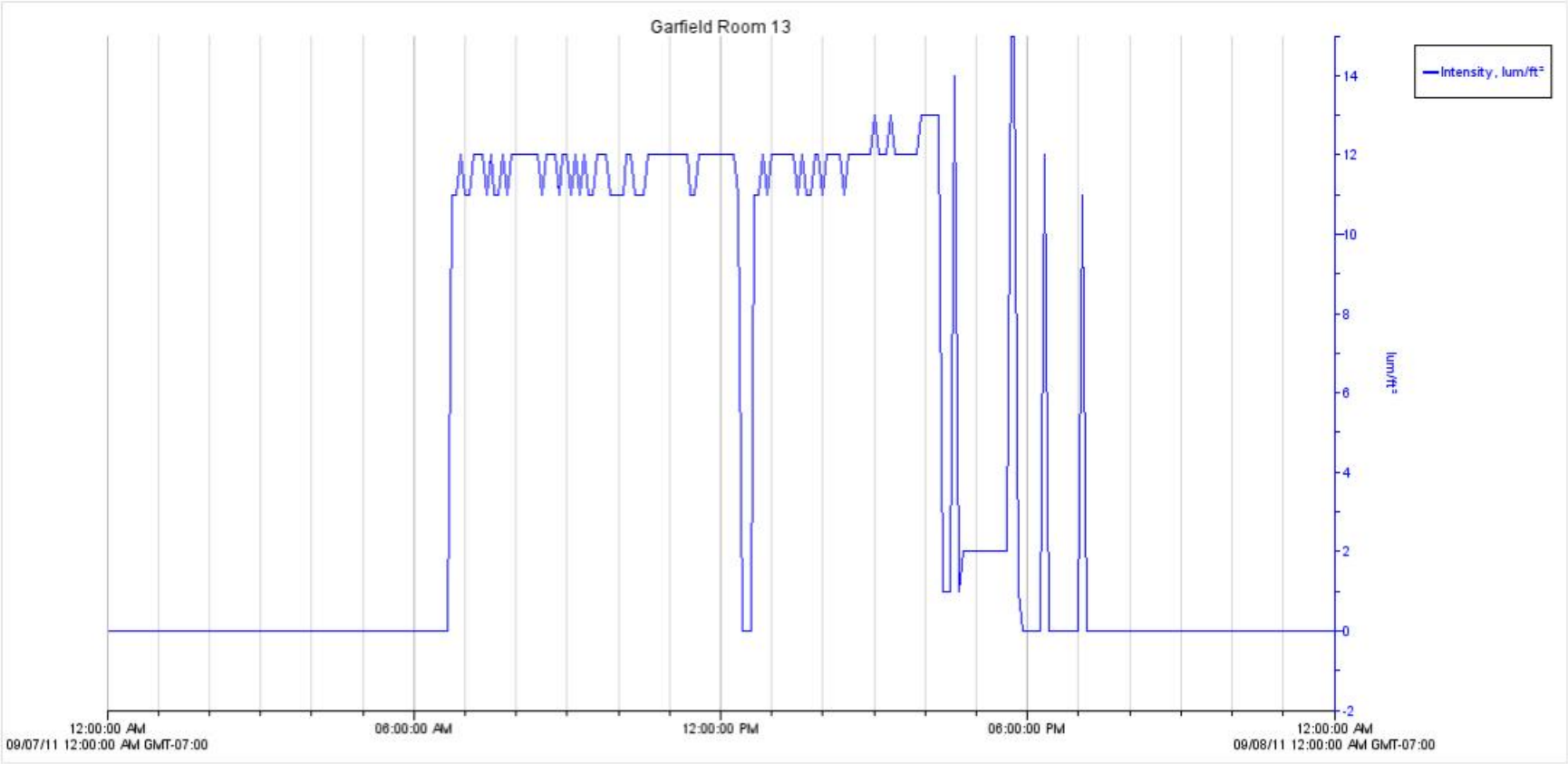


Graph shows 30 days of data.

Blue line is the light level.

Lights are on steadily throughout the middle of each school day, but they cycle off and on especially in the mornings and afternoons, when spaces are intermittently used. Lights are off overnight every night. Lights are briefly on a few weekend days, typically for less than one hour per day.

See following page for a typical daily usage pattern.



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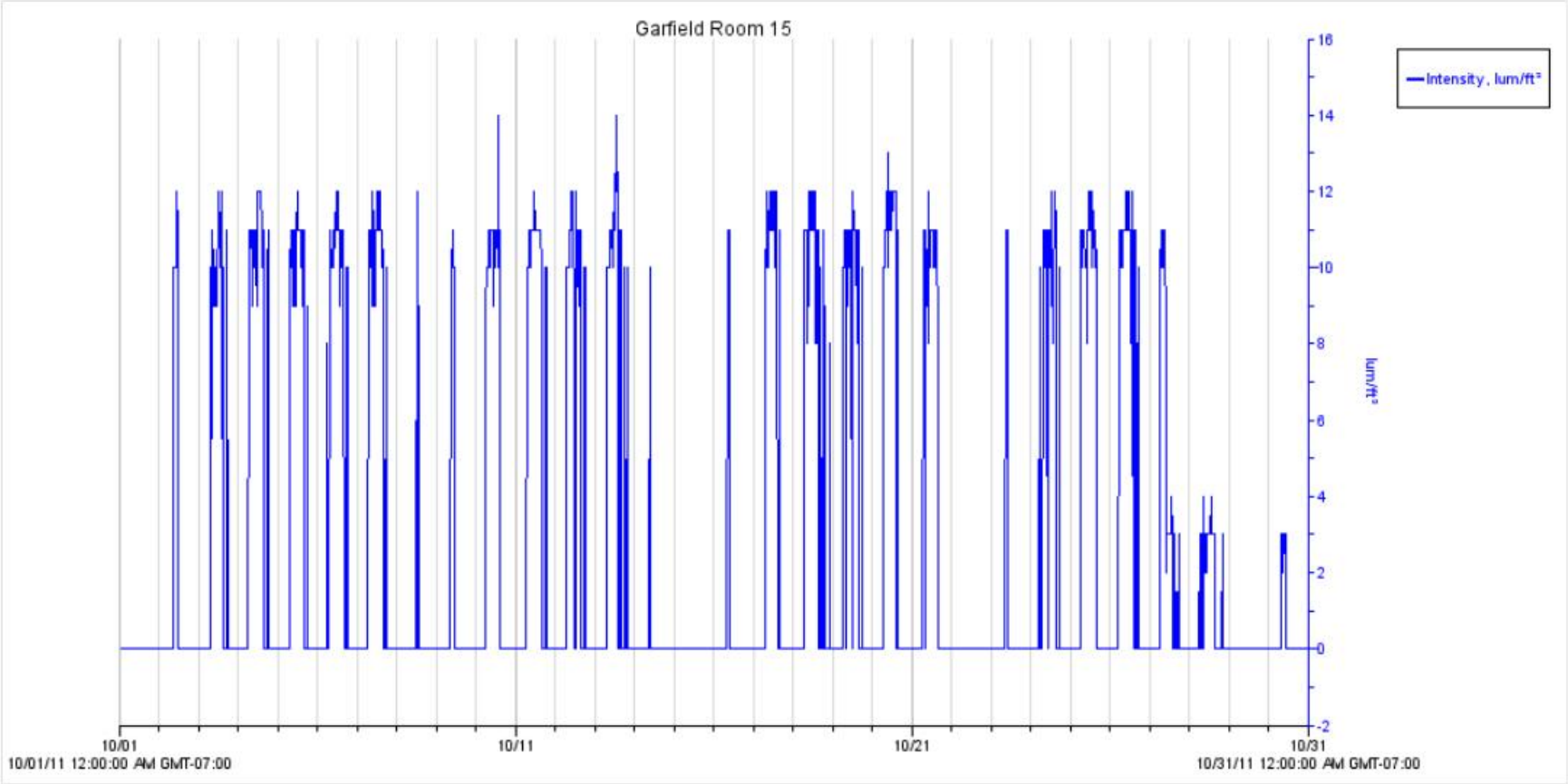

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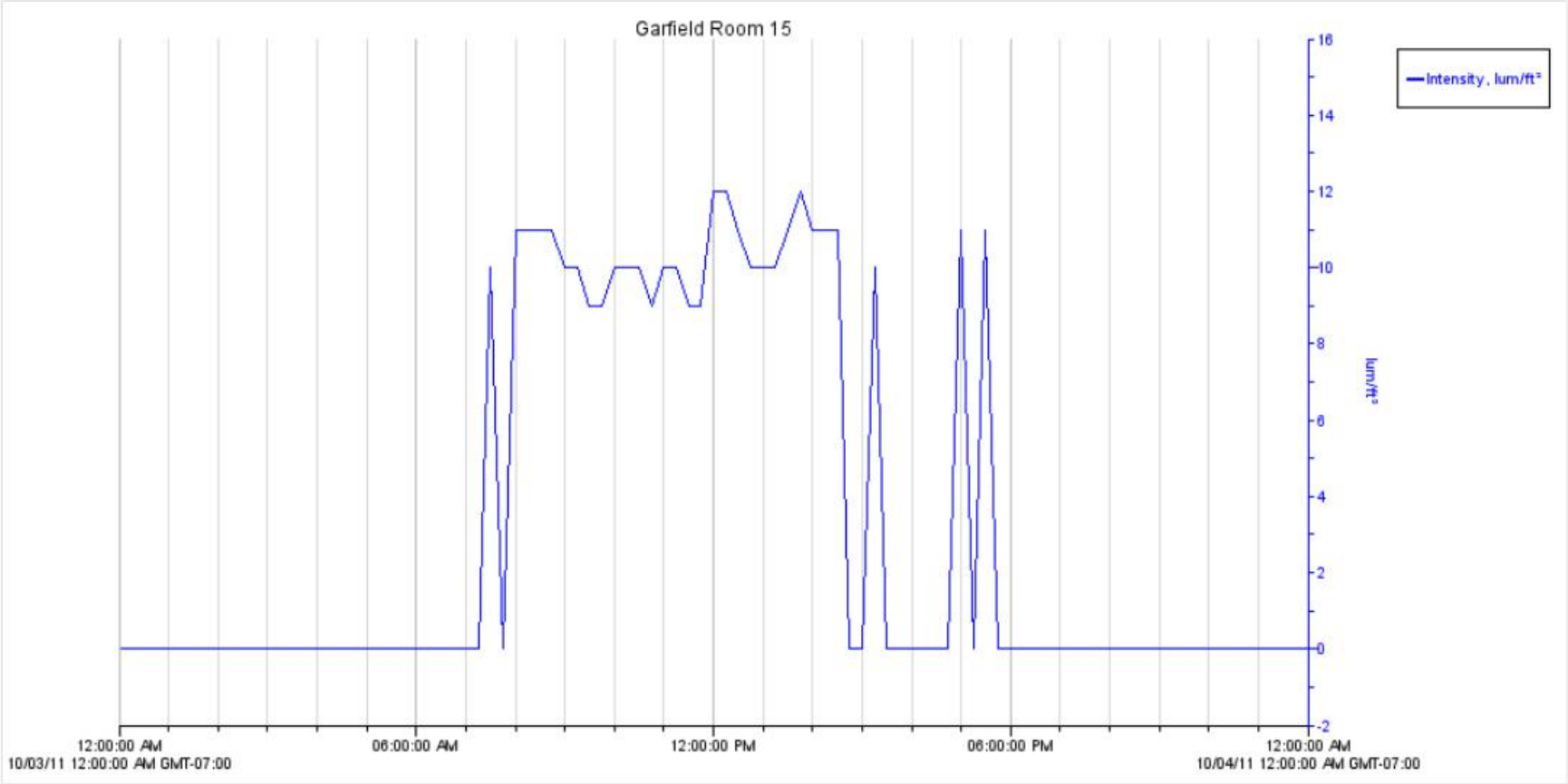
See following page for a typical daily usage pattern.



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Blue line is the light level.

Lights are briefly on in the morning as custodians and staff move through the space. Lights turn off in the afternoon when the spaces are vacant. Lights are only on for brief times in the afternoon and evening as the custodial staff work in the room and pass through the room. Lights are off overnight.

VERIFICATION OF EEM 2 HVAC & CONTROL SYSTEMS OPTIMAL OPERATION

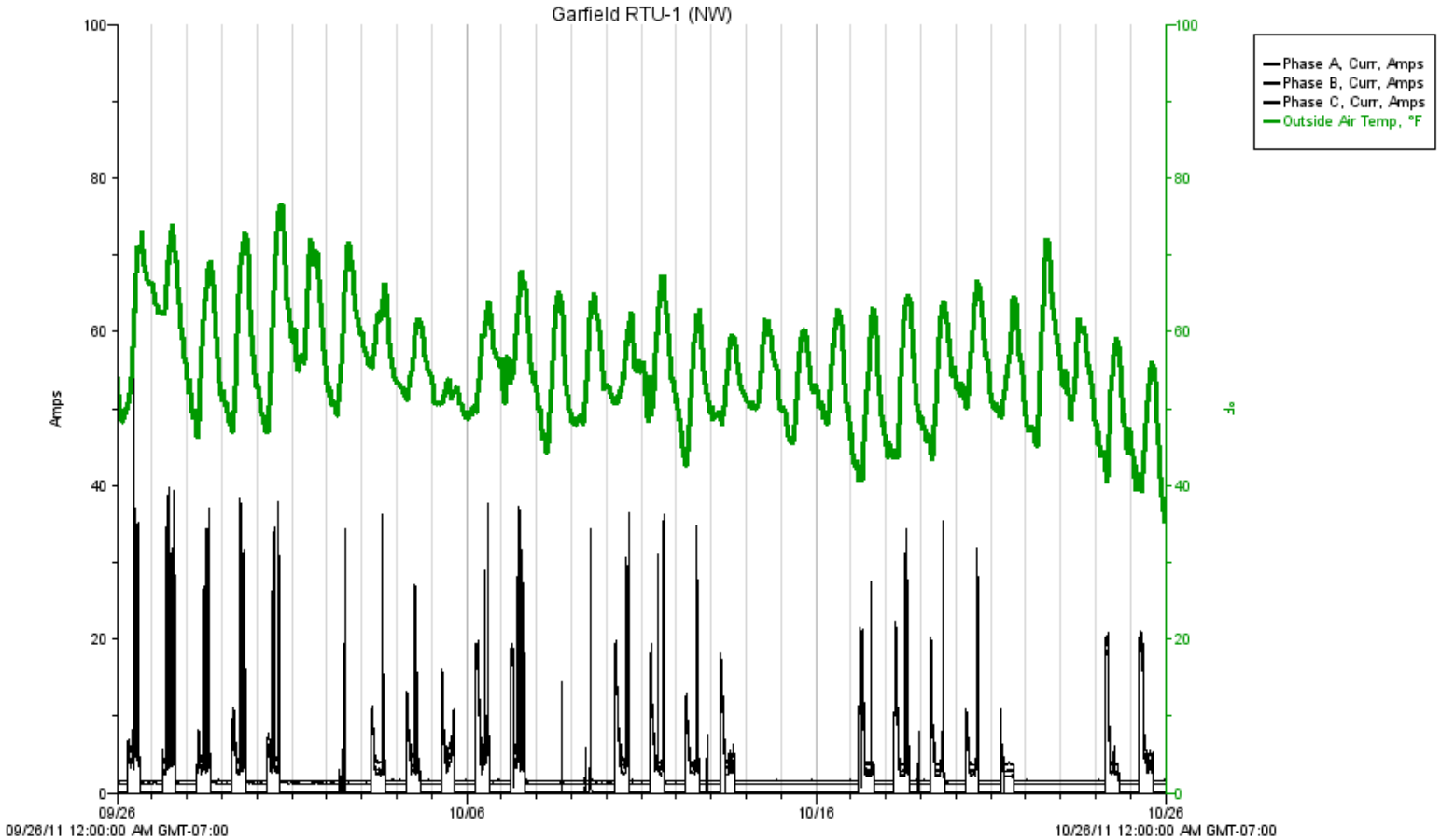
The HVAC and DDC systems were inspected on-site and remotely for several months after installation to document how the systems were performing, and to fine-tune the sequences of operation for optimal operation.

Long term portable data loggers were installed on the power feed coming into each unit to measure the actual power consumed by the units over several weeks, to ensure that the systems are operating efficiently – short run-times, VSDs ramping up and down as needed, no Air Conditioning units running when the outside air is below 60 F, etc.

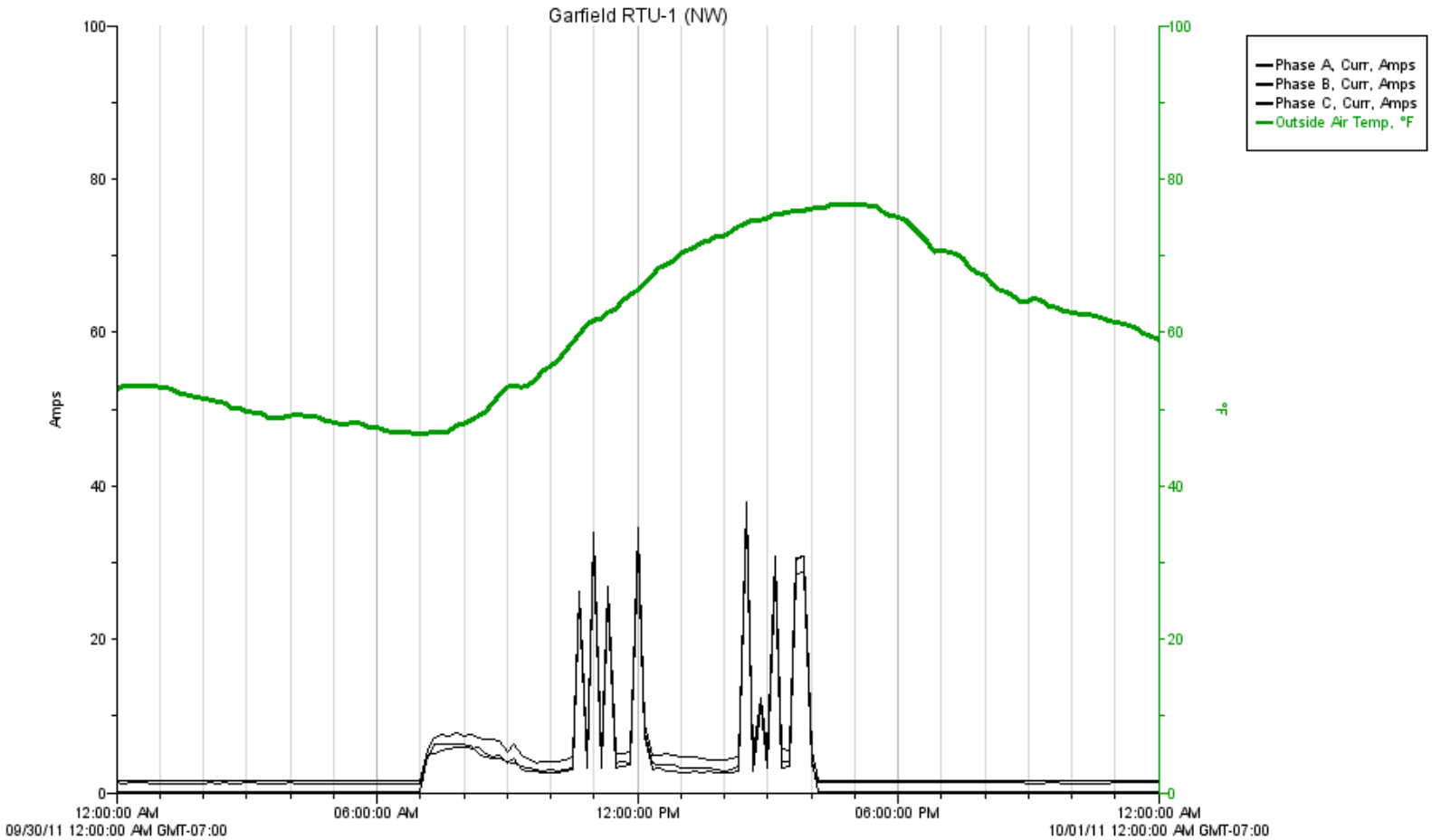
The results of these portable loggers are presented on the following pages, to document that the total power consumed by these units is operating as intended, in order to meet or exceed the guaranteed energy savings for the projects.

Amp readings graphs in the following pages include data from:

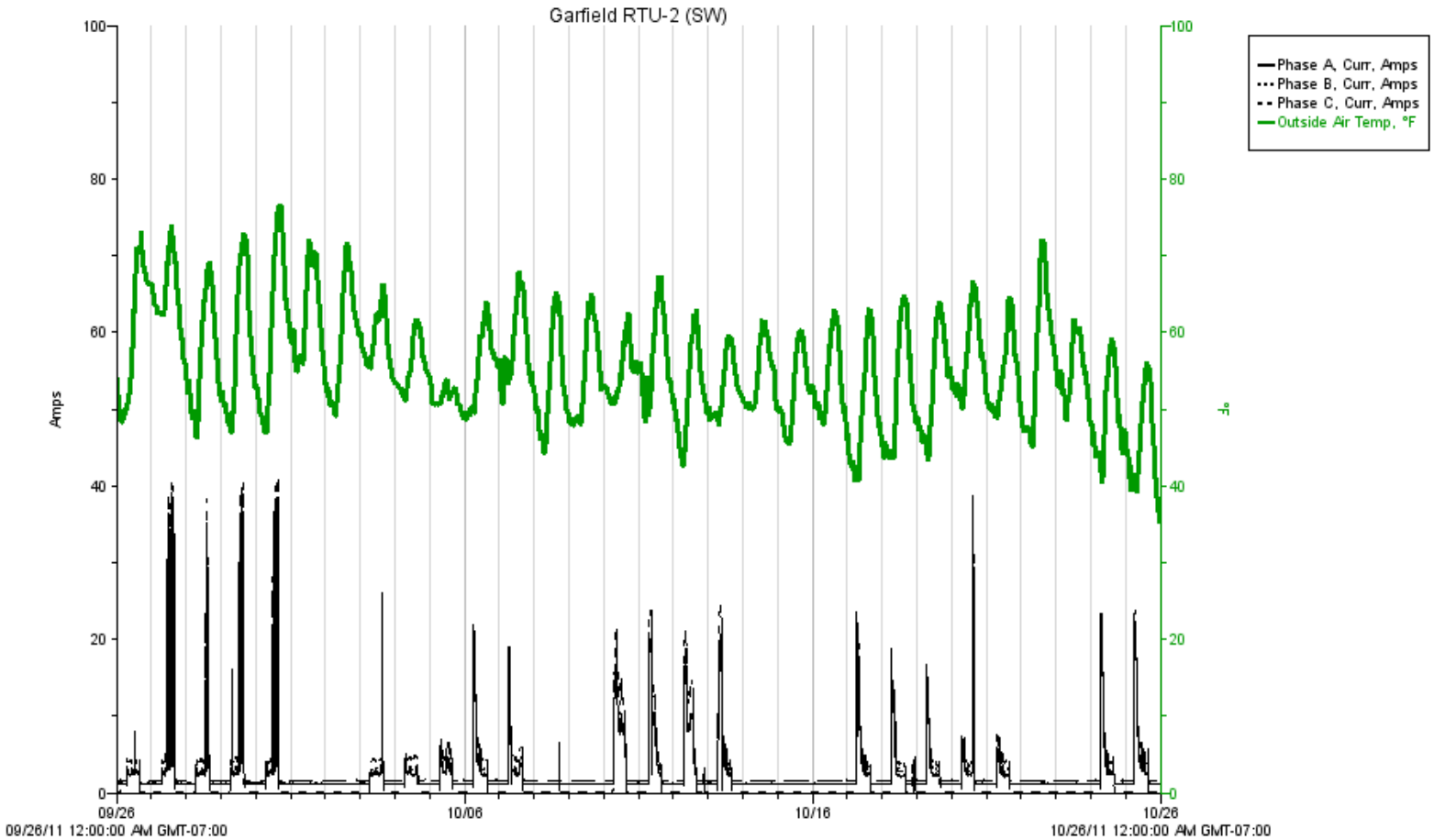
- RTU-1
- RTU-2
- RTU-3
- RTU-4



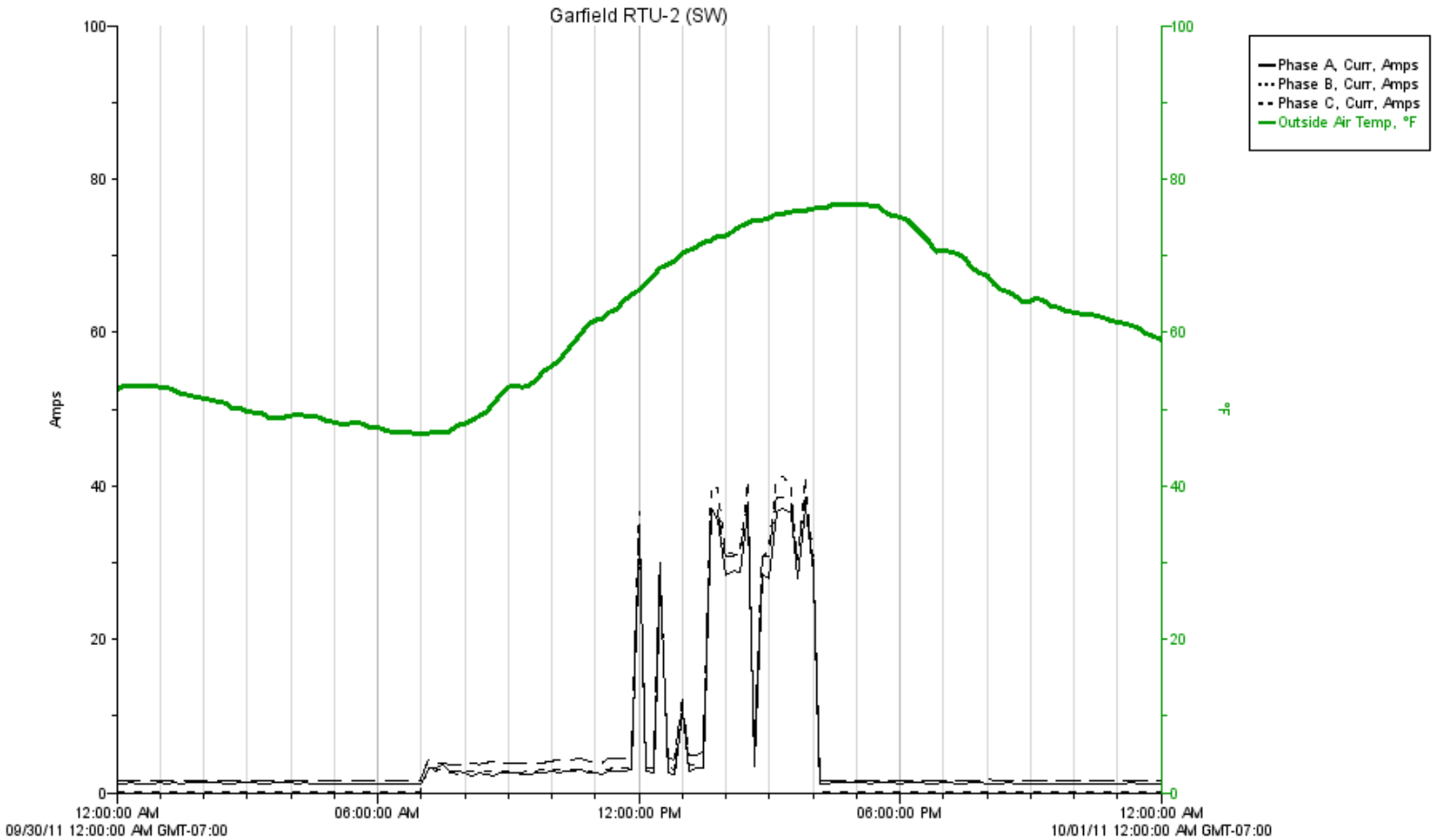
Graph shows 30 days of data for RTU-1.
Black line is the amp reading for all three phases of power coming into the Air Handler, measured inside the air handler.
Green line is the outside air temperature.
Units normally only operate M-F during scheduled hours, unless there is an after-hours over-ride event, in which case the units only operate for an hour at a time.
See following page for a typical daily usage pattern.



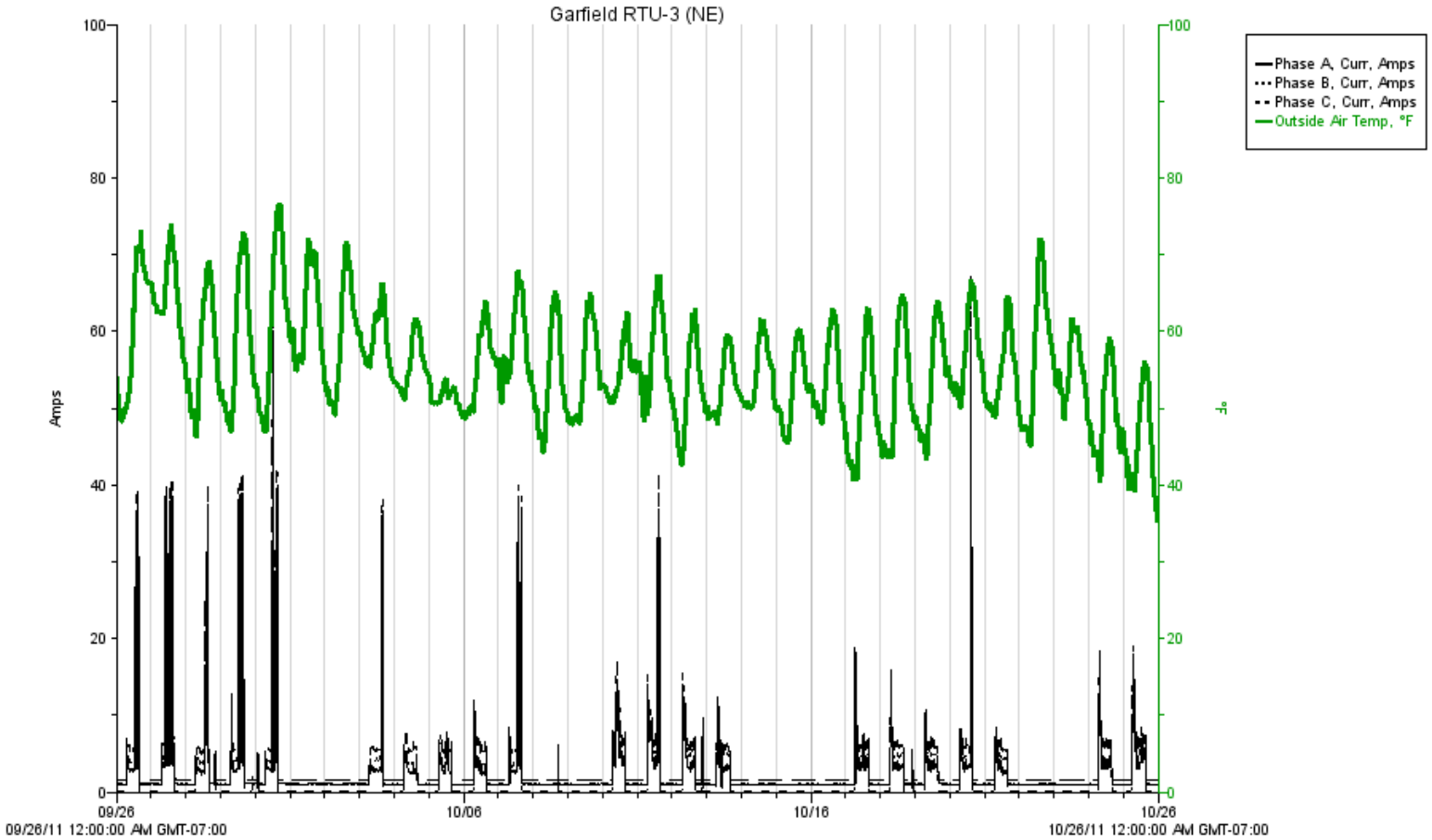
Graph shows 1 day of data for RTU-1.
Black line is the amp reading for all three phases of power coming into the Air Handler, measured inside the air handler.
Green line is the outside air temperature.
Unit normally only operate during scheduled hours (7am to 4pm), unless there is an after-hours over-ride event, in which case the units only operate for an hour at a time. Air conditioning power spikes only occur as outside air rises over 60 F.



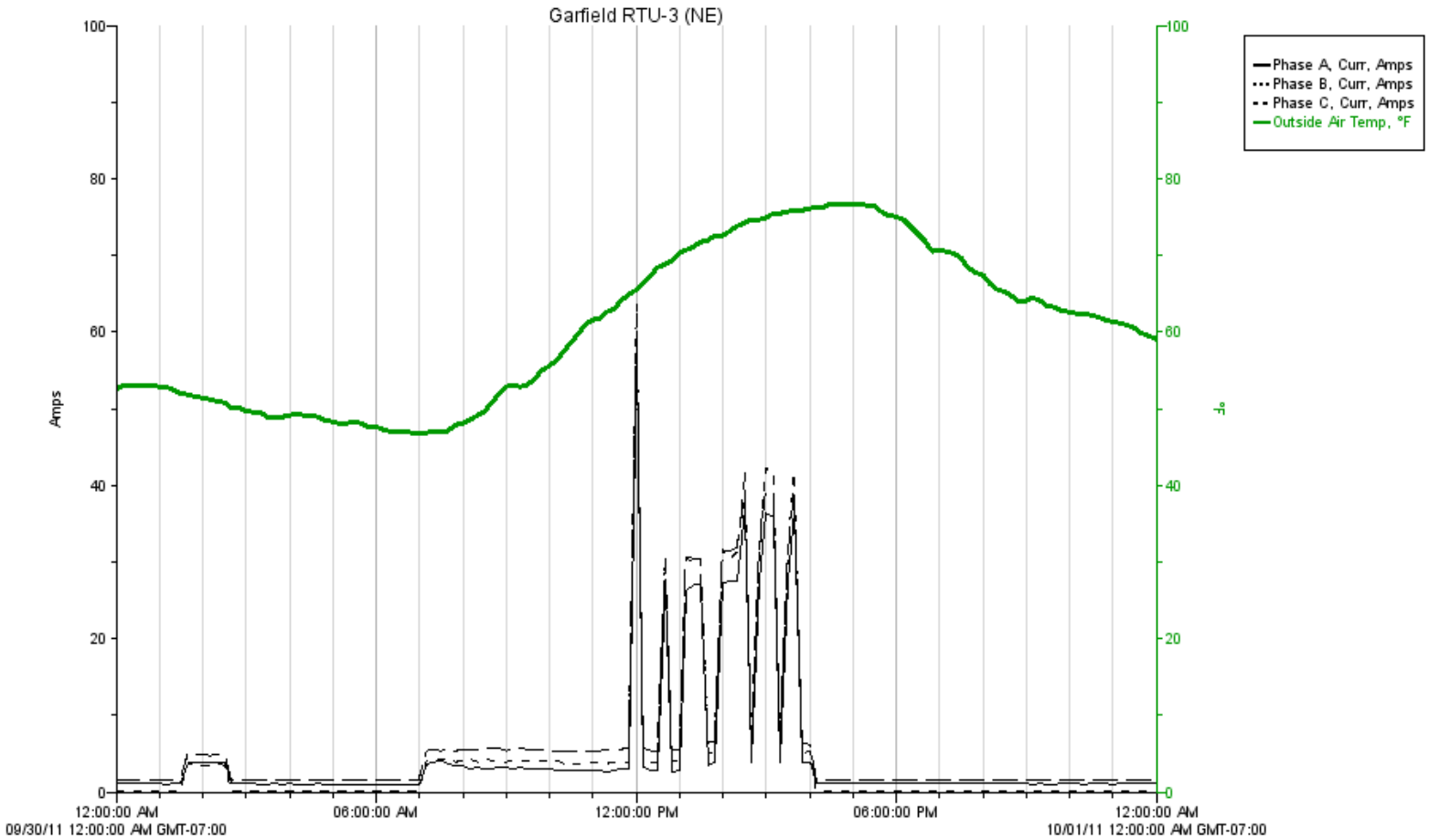
Graph shows 30 days of data for RTU-2.
Black line is the amp reading for all three phases of power coming into the air handler, measured inside the air handler.
Green line is the outside air temperature.
Units normally only operate M-F during scheduled hours, unless there is an after-hours over-ride event, in which case the units only operate for an hour at a time.
See following page for a typical daily usage pattern.



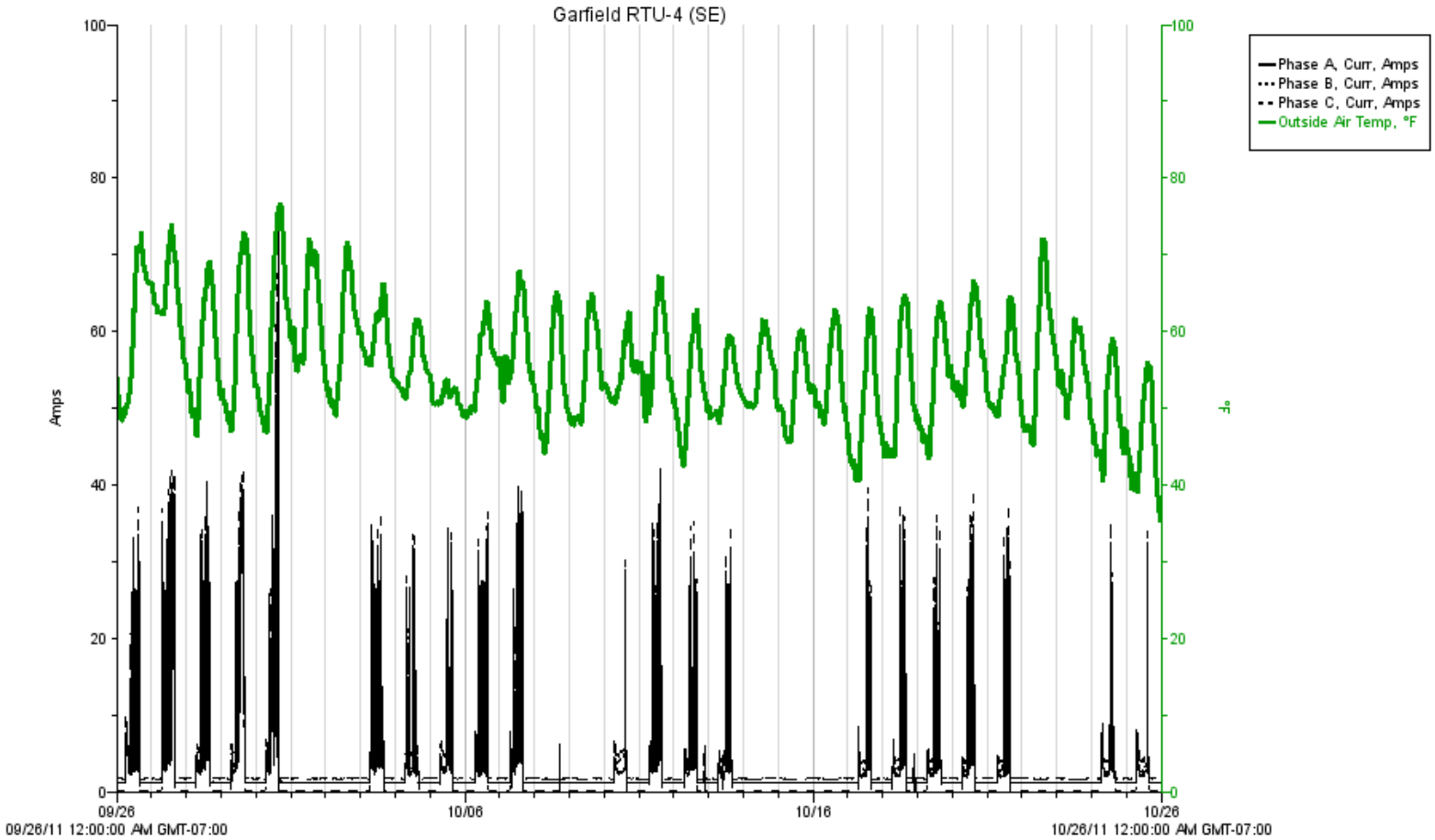
Graph shows 1 day of data for RTU-2.
Black line is the amp reading for all three phases of power coming into the Air Handler, measured inside the air handler.
Green line is the outside air temperature.
Unit normally only operate during scheduled hours (7am to 4pm), unless there is an after-hours over-ride event, in which case the units only operate for an hour at a time. Air conditioning power spikes only occur as outside air rises over 60 F.



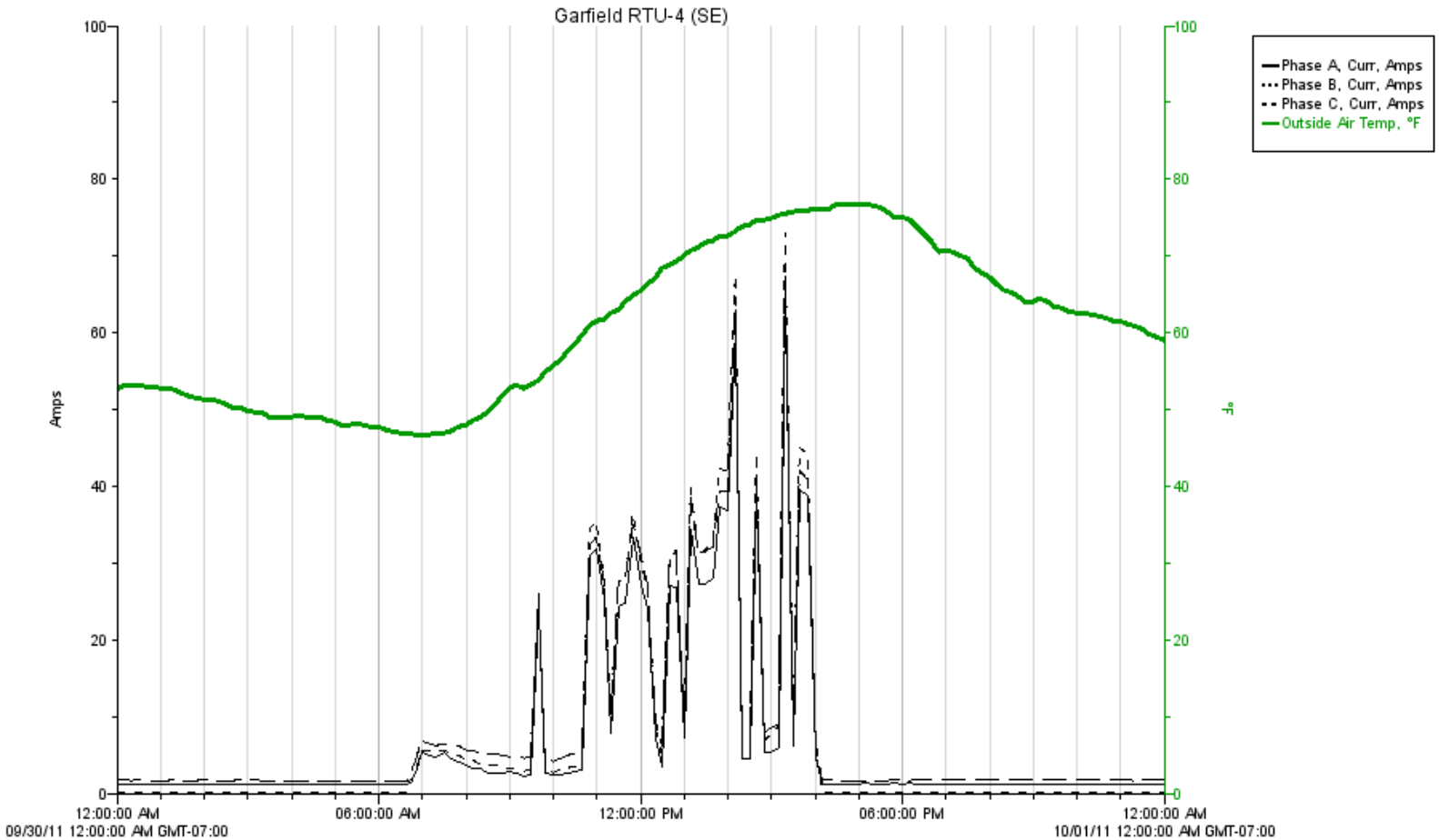
Graph shows 30 days of data for RTU-3.
Black line is the amp reading for all three phases of power coming into the air handler, measured inside the air handler.
Green line is the outside air temperature.
Units normally only operate M-F during scheduled hours, unless there is an after-hours over-ride event, in which case the units only operate for an hour at a time.
See following page for a typical daily usage pattern.



Graph shows 1 day of data for RTU-3.
Black line is the amp reading for all three phases of power coming into the Air Handler, measured inside the air handler.
Green line is the outside air temperature.
Unit normally only operate during scheduled hours (7am to 4pm), unless there is an after-hours over-ride event, in which case the units only operate for an hour at a time (this occurred at 1:30 am and lasted one hour. Air conditioning power spikes only occur as outside air rises over 60 F.



Graph shows 30 days of data for RTU-4.
Black line is the amp reading for all three phases of power coming into the air handler, measured inside the air handler.
Green line is the outside air temperature.
Units normally only operate M-F during scheduled hours, unless there is an after-hours over-ride event, in which case the units only operate for an hour at a time.
See following page for a typical daily usage pattern.



Graph shows 1 day of data for RTU-4.
Black line is the amp reading for all three phases of power coming into the Air Handler, measured inside the air handler.
Green line is the outside air temperature.
Unit normally only operate during scheduled hours (7am to 4pm), unless there is an after-hours over-ride event, in which case the units only operate for an hour at a time. Air conditioning power spikes only occur as outside air rises over 55 F.

MEASUREMENT OF ENERGY SAVINGS DIRECTLY FROM UTILITY BILLS

The measurement of actual energy savings used for the energy savings guarantee will be based on the actual utility bills from January 1, 2012 through December 31, 2012.

We are presenting here the baseline utility bills that are used for the existing condition, and the recent bills that were collected during the construction period.

As the 2012 utility bills arrive they will be compared to the baseline energy bills to determine the actual measured energy savings.

The energy savings will be multiplied by the utility rates used in our contract to determine the annual $ savings.

Utility Rate Assumptions

The following costs were used in our Energy Services Agreement, and they will be used to determine the annual energy cost savings. These costs will be applied to the measured energy savings to determine the measured energy cost savings.

cost per kWh	$0.048
cost per therm	$1.06

ENERGY USE AFTER UPGRADE - Measured Electric Energy Savings

Electric Savings Analysis

Baseline Energy Use				
Month	2008 kWh	2009 kWh	2010 kWh	Avg kWh BASELINE
Jan		70,366	60,578	65,472
Feb		60,535	60,015	60,275
Mar		60,983	70,509	65,746
Apr		49,749		49,749
May		65,364		65,364
Jun		75,043		75,043
Jul		55,562		55,562
Aug		62,131		62,131
Sep		76,118		76,118
Oct		64,154		64,154
Nov	63,682	*65,447*		64,564
Dec	65,488	*65,447*		65,467
TOTAL	129,170	770,898	191,102	769,646

Energy Use During Construction			
Month	2011 kWh	Saved kWh	Saved kWh
Jan			
Feb			
Mar			
Apr			
May			
Jun			
Jul	12,375	43,187	78%
Aug	25,841	36,290	58%
Sep	43,268	32,850	43%
Oct	26,157	37,997	59%
Nov	29,245	35,319	55%
Dec			
TOTAL	136,886	185,643	58%

Energy Use After Upgrade			
Month	2012 kWh	Saved kWh	Saved kWh
Jan			
Feb			
Mar			
Apr			
May			
Jun			
Jul			
Aug			
Sep			
Oct			
Nov			
Dec			
TOTAL			

Note 1: Construction of these projects started in July, 2011, and was substantially complete in the fall of 2011. The energy savings achieved during the construction period are shown here for reference only; they are not a part of the energy savings guarantee.

Note 2: The energy savings guarantee period is from January 1, 2011 through December 31, 2012.

ENERGY USE AFTER UPGRADE - Measured Natural Gas Energy Savings

Natural Gas Savings Analysis

Baseline Energy Use				
Month	2008 therms	2009 therms	2010 therms	Avg therms BASELINE
Jan		5,988	4,644	5,316
Feb		4,845	3,813	4,329
Mar		2,768		2,768
Apr		1,483		1,483
May		259		259
Jun		103		103
Jul		112		112
Aug		394		394
Sep		2,022		2,022
Oct	3,697	4,443		4,070
Nov	8,366	7,842		8,104
Dec	8,045	6,744		7,395
TOTAL	20,108	37,003	8,457	36,355

Energy Use During Construction			
Month	2011 therms	Saved therms	Saved therms
Jan			
Feb			
Mar			
Apr			
May			
Jun			
Jul	41	71	63%
Aug	89	305	77%
Sep	129	1,893	94%
Oct	403	3,667	90%
Nov	1,578	6,526	81%
Dec			
TOTAL	2,240	12,462	85%

Energy Use After Upgrade			
Month	2012 therms	Saved therms	Saved therms
Jan			
Feb			
Mar			
Apr			
May			
Jun			
Jul			
Aug			
Sep			
Oct			
Nov			
Dec			
TOTAL			

Note 1: Construction of these projects started in July, 2011, and was substantially complete in the fall of 2011. The energy savings achieved during the construction period are shown here for reference only; they are not a part of the energy savings guarantee.

Note 2: The energy savings guarantee period is from January 1, 2011 through December 31, 2012.

Measurement & Verification (M&V) Report for Specific Energy Savings Projects Installed at the

McKinley Elementary School
Yakima School District
Yakima, Washington

Prepared by:

ABACUS
RESOURCE
MANAGEMENT
COMPANY

January 17, 2011

Contacts

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Pacific Power Contact Hallie Gallinger: 503-813-5215
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Energy Consultant Contact Abacus Resource Management Co. 14845 SW Murray Scholls Drive, Suite 110-138 Beaverton, OR 97007 Mark Kinzer, P.E. Phone: 503-819-5593 (markk@abacusrm.com) Rich Davis, C.E.M. Phone: (503) 936-7163 (richd@abacusrm.com)

Utility Rate Assumptions

The following costs were used in our Energy Services Agreement, and they will be used to determine the annual energy cost savings. These costs will be applied to the measured energy savings to determine the measured energy cost savings.

cost per kWh	$0.048
cost per therm	$1.06

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Measured Electric Energy Savings **51**
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EXECUTIVE SUMMARY

Introduction and Background

Yakima School District has hired ARMCO (Abacus Resource Management Company) to implement specific energy efficiency measures (EEMs) identified at the McKinley Elementary School. This report is issued to document the measured and verified energy savings that result from these upgrades. This report is also issued to compare the actual measured and verified energy savings against the energy savings that were guaranteed by ARMCO as part of this project.

Brief Description of Facility and Energy Using Systems

Facility Description: The School is comprised of a main building, a gymnasium building, and several portable buildings. The portable buildings are not covered as part of this study, only the permanent main and gymnasium building are covered.

The main building is a single story masonry building constructed in two stages. The western half was built in 1971, and the eastern half was constructed in 1975. The building footprint is about 28,000 square feet. The building contains twelve classrooms, a library, offices, meeting rooms, individual instruction rooms, restrooms and storage rooms. There are minimal windows and a flat insulated roof.

The gymnasium building is mainly 24’ tall with 12’ tall sides that house the locker rooms and kitchen. The gymnasium/cafeteria is in the center along with a stage. The building was constructed in the 1950’s. The building footprint is about 4,600 square feet. There are minimal windows and a flat insulated roof.

Energy Supply: The building receives electricity from Pacific Power, and natural gas from Cascade Natural Gas.

Lighting: Lighting was predominantly T12 fluorescent lights with magnetic ballasts. There were also some incandescent lights in use. A comprehensive lighting upgrade has been implemented including fixture replacements, fixture retrofits, and new occupancy sensors. The detailed description of these upgrades is provided under EEM 1 of this report.

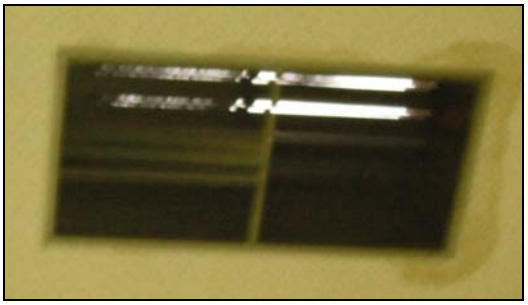
HVAC: The main building had four constant volume multizone rooftop air handlers on the roof. Each unit served seven zones, and mixed hot air and cold air in order to send the proper temperature air to the spaces. It mixed these airstreams through electric actuators and a long shaft, and the maintenance staff was constantly working on these and the dampers to satisfy occupant comfort.

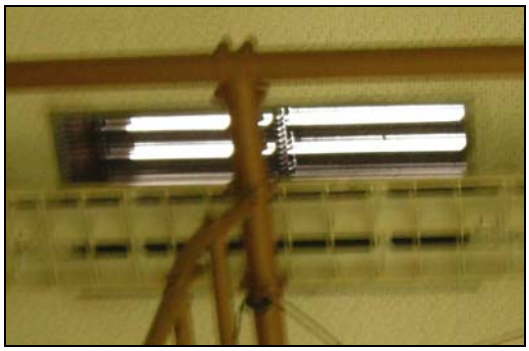
Two of these units were 21 years old, and two were 10 years old. All of these units were fairly problematic and almost constantly in need of repair and tuning, in order to keep the spaces comfortable. As a result, these systems typically operated 24 hours a day.

A comprehensive HVAC upgrade was implemented at this school to replace these units with high efficiency VAV systems. Details of this upgrade are presented in the EEM 2 section of this report.

The gymnasium building has two constant volume single zone rooftop packaged air handlers on the roof. Each is equipped with a natural gas heating furnace and air conditioning.

There are two relief vents on the roof – daylight is visible from the inside of the gym.





Upon inspection these roof vents are equipped with manual dampers that are left partially open.

Installing automatic actuators on these dampers was implemented as part of EEM 2 in this school, along with operating these units with reduced operating hours through the use of a new DDC system.

Summary Table of EEMs

The table on the next page list the EEMs installed at this school, the predicted energy savings, the guaranteed energy savings, and the measured and verified energy savings (which will be filled out after twelve months have elapsed and the savings are verified from the actual utility bills).

		Energy Audit Predicted Savings			Guaranteed Savings Target [1]	Measured and Verified Energy Savings					
EEM	EEM Description	kWh Saved / Year	Avg kW Saved / Month	Therms Saved / Year	Utility $ Saved / Year	kWh Saved / Year	Avg kW Saved / Month	Therms Saved / Year	Electric $ Saved / Year [2]	Natural Gas $ Saved / Year [2]	Utility $ Saved / Year [2]
1	Lighting Upgrade (New Pendant Fixtures)	80,137	35	0	See Total Savings Below	See Total Savings Below					
2	HVAC & Controls Upgrade (New VAV HVAC Main Bldg, New Dampers Gym Bldg, New DDC Main & Gym Bldgs)	388,658	0	17,013							
TOTALS		**468,795**	**35**	**17,013**	**$26,935**	**The total energy savings will be measured directly from the utility bills, and entered into this table after December 31, 2012**					

Notes	
1	The guaranteed savings target is as an approximation, because the actual guarantee is for combined savings at two schools. A summary report will present the combined guaranteed savings and the measured and verified energy savings from both schools together, to match the actual guarantee in the contract.
2	The utility energy savings will be calculated based on the utility rates at the time the agreement was put into place, which is $0.048 per kWh $1.06 per therm

EEM 1 DETAILS: UPGRADE LIGHTS

The interior lights consisted primarily of 4' T12 fluorescent lamps with magnetic ballasts. While these lights were some of the most energy efficient sources when they were installed in the 1970's, today there are more efficient sources of light. T8 fluorescent lamps combined with high efficiency electronic ballasts can generate the same amount of light while using about 30% less energy.

Large areas of this school were over-illuminated. By lowering the light levels to more appropriate light levels, additional energy savings is achieved. The classroom light levels ranged from 60 – 100 foot-candles, while 40 foot-candles is considered good practice today. The corridor and restroom light levels also exceeded 60 foot-candles, while 10-20 foot-candles is considered good practice today. In both the classrooms and corridors we have lowered the light levels to good practice.

New fixtures were installed throughout the main building classrooms, offices and corridors. New, high efficiency fixtures were installed with (2) T8 lamps per fixture and high efficiency electronic ballasts.

The typical upgrades included:

Location	Upgrade
Classrooms, Library, Offices, Corridor	Remove 2'x4' recessed troffers with prismatic lenses and (4) T12 lamps. Install new 2'x4' recessed troffers that incorporate a direct/indirect lighting approach using a custom lens. New fixtures contained (2) T8 lamps per fixture. New layouts were developed so that the total # of fixtures was reduced. Manual switches are now supplemented with overhead, dual technology occupancy sensors.
Gymnasium	Replace each 8' industrial fixtures (2) VHO 215 watt lamps and magnetic ballast) with a new fixture that contains (6) 54-watt T5/HO lamps, high efficiency electronic ballasts, a prismatic lens and a wire guard. Manual switches are now supplemented with overhead, dual technology occupancy sensors.

Fluorescent Fixtures in Restrooms	Replace each wall-mounted fixture that has (2) 4' T12 lamps and magnetic ballast – with a new fixture that contains (1) 32-watt T8 lamp and a low ballast factor high efficiency electronic ballast. Install wall-switch occupancy sensors.
Exit Signs 	No change – already using LED lamps in exit signs.
Miscellaneous Incandescent lights in restrooms, storage closets, exterior over classroom exits. 	Some interior fixtures were retrofitted with LED screw-in lamps, and some interior fixtures were replaced with new fluorescent fixtures that use (1) or (2) 32-watt T8 lamps, depending on the light levels required. The exterior incandescent fixtures were replaced with new fixtures that utilize compact fluorescent lamps.

The room by room detailed upgrades are found on the following pages, followed by the room by room description of the controls installed.

Location Information		Existing Fixtures					Proposed Fixtures				
Location	Operation Schedule	Fixture Type (E)	Custom Description / Additional Info.	Qty. (E)	Watts	Custom Wattage	Fixture Type (P)	Custom Description / Additional Info.	Qty. (P)	Watts	Custom Wattage
Gymnasium	A	2F96T12VHO	Industrial w/ Wireguard	15	390		4LF55T5HO-	New Fixtures	15	234	
Stage	C	Incandescent150W	Lampholders	3	150		Prem 2T8 3100 lum<0.8 B	New Fixtures	3	48	
Kitchen	A	2LF40T12Mag	Wrap	15	72		Custom	New 2T8, BF=.85	14	--->	55
Kitchen RR	A	Incandescent120W	Vanity	1	120		Custom	LED 12 watt	1	--->	12
Kitchen Corridor	A	Incandescent75W	Recessed	1	75		CFL22W/Hardwire	LED 12 watt	1	26	
Kitchen Storage	A	Incandescent150W	Lampholders	1	150		Prem 2T8 3100 lum<0.8 B	LED 12 watt	1	48	
Kitchen Locked Rm	A	Incandescent150W	Lampholders	1	150		Prem 2T8 3100 lum<0.8 B	LED 12 watt	1	48	
Electric Room	C	Incandescent150W	Lampholders	2	150		Prem 2T8 3100 lum<0.8 B	LED 12 watt	2	48	
Furnace Room	C	Incandescent150W	Lampholders	1	150		Custom	LED 12 watt	1	--->	12
PE Office	A	4LF40T12 Mag	Wrap	2	144		Prem 4T8 3100 lum<0.8 BF		2	95	
Girls Locker Rooms	A	Incandescent200W	Drum w/ (3) 75w Lamps	6	200		Prem 1T8 3100 lum<0.8 B	New Fixtures	6	24	
Boys Locker Rooms	A	Incandescent200W	Drum w/ (3) 75w Lamps	6	200		Prem 1T8 3100 lum<0.8 B	New Fixtures	6	24	
Main School Entrance	B	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	5	144		Prem 2T8 3100 lum<0.8 B	New Fixtures	3	48	
Main Office	E	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	8	144		Custom	Prem 2T8 3100 lum =0.85 BF, New Fixt.	6	--->	55
Main Office	E	2LF40T12Mag	U-tubes, 2'x2' Recessed w/ Prismatic Lens	2	72		Custom	Prem 2T8 3100 lum =0.85 BF, New Fixt.	2	--->	55
Health Room	E	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	3	144		Custom	Prem 2T8 3100 lum =0.85 BF, New Fixt.	3	--->	55
Health Room	E	2LF40T12Mag	U-tubes, 2'x2' Recessed w/ Prismatic Lens	2	72		Prem 1T8 3100 lum<0.8 BF		1	24	55
Principal Office	E	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	4	144		Custom	Prem 2T8 3100 lum =0.85 BF, New Fixt.	4	--->	55

Location Information		Existing Fixtures					Proposed Fixtures				
Location	Operation Schedule	Fixture Type (E)	Custom Description / Additional Info.	Qty. (E)	Watts	Custom Wattage	Fixture Type (P)	Custom Description / Additional Info.	Qty. (P)	Watts	Custom Wattage
Work Room	E	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	11	144		Custom	Prem 2T8 3100 lum =0.85 BF, New Fixt.	8	--->	55
Classroom 8	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	17	144		Custom	Prem 2T8 3100 lum =0.85 BF, New Fixt.	11	--->	55
Classroom 8	A	1LF40T12Mag	Under Cabinet Light	2	43		Prem 1T8 3100 lum<0.8 E	New Fixtures	2	24	
Classroom 8 RRs	A	2LF40T12Mag	Wall Mount	2	72		Prem 1T8 3100 lum<0.8 E	Delamp	2	24	
Classroom 7	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	16	144		Custom	Prem 2T8 3100 lum =0.85 BF, New Fixt.	10	--->	55
Classroom 7	A	1LF40T12Mag	Under Cabinet Light	2	43		Prem 1T8 3100 lum<0.8 BF		2	24	
Classroom 7/6 RRs	A	2LF40T12Mag	Wall Mount	2	72		Prem 1T8 3100 lum<0.8 E	Delamp	2	24	
Classroom 6	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	16	144		Custom	Prem 2T8 3100 lum =0.85 BF, New Fixt.	16	--->	55
Classroom 6	A	1LF40T12Mag	Under Cabinet Light	2	43		Prem 1T8 3100 lum<0.8 BF		2	24	
Classroom 5	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	16	144		Custom	Prem 2T8 3100 lum =0.85 BF, New Fixt.	15	--->	55
Classroom 5	A	1LF40T12Mag	Under Cabinet Light	2	43		Prem 1T8 3100 lum<0.8 BF		2	24	
Classroom 5/4 RRs	A	2LF40T12Mag	Wall Mount	2	72		Prem 1T8 3100 lum<0.8 E	Delamp	2	24	
Classroom 4	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	16	144		Custom	Prem 2T8 3100 lum =0.85 BF, New Fixt.	13	--->	55
Classroom 4	A	1LF40T12Mag	Under Cabinet Light	2	43		Prem 1T8 3100 lum<0.8 BF		2	24	
Classroom 3	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	16	144		Custom	Prem 2T8 3100 lum =0.85 BF, New Fixt.	10	--->	55
Classroom 3	A	1LF40T12Mag	Under Cabinet Light	2	43		Prem 1T8 3100 lum<0.8 BF		2	24	
Classroom 3/2 RRs	A	2LF40T12Mag	Wall Mount	2	72		Prem 1T8 3100 lum<0.8 E	Delamp	2	24	
Classroom 2	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	16	144		Custom	Prem 2T8 3100 lum =0.85 BF, New Fixt.	16	--->	55
Classroom 2	A	1LF40T12Mag	Under Cabinet Light	2	43		Prem 1T8 3100 lum<0.8 BF		2	24	
Classroom 1	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	11	144		Custom	Prem 2T8 3100 lum =0.85 BF, New Fixt.	11	--->	55
Teachers Lounge	E	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	12	144		Custom	Prem 2T8 3100 lum =0.85 BF, New Fixt.	12	--->	55
Instruction Rooms	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	4	144		Custom	Prem 2T8 3100 lum =0.85 BF, New Fixt.	4	--->	55

Location Information		Existing Fixtures					Proposed Fixtures				
Location	Operation Schedule	Fixture Type (E)	Custom Description / Additional Info.	Qty. (E)	Watts	Custom Wattage	Fixture Type (P)	Custom Description / Additional Info.	Qty. (P)	Watts	Custom Wattage
Jan Closet	C	Incandescent100W	Lampholders	1	100		Prem 2T8 3100 lum<0.8 BF		1	48	
Jan Closet	C	2LF40T12Mag	Strip	1	72		Prem 2T8 3100 lum<0.8 BF		1	48	
(4) Sm RRs	A	2LF40T12Mag	Wall Mount	4	72		Prem 1T8 3100 lum<0.8 E	Delamp	4	24	
Indiv Instruction	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	4	144		Custom	Prem 2T8 3100 lum =0.85 BF, New Fixt.	4	--->	55
Corridor from Lounge around to CR 2	B	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	15	144		Prem 2T8 3100 lum<0.8 E	New Fixture	15	48	
Corridor from N exit to Library	B	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	5	144		Prem 2T8 3100 lum<0.8 E	New Fixture	5	48	
Corridor from Library to CR 17	B	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	14	144		Prem 2T8 3100 lum<0.8 E	New Fixture	10	48	
Classroom 9	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	16	144		Custom	Prem 2T8 3100 lum =0.85 BF, New Fixt.	10	--->	55
Classroom 9	A	1LF40T12Mag	Under Cabinet Light	2	43		Prem 1T8 3100 lum<0.8 BF		2	24	
Classroom 9/10 RRs	A	2LF40T12Mag	Wall Mount	2	72		Prem 1T8 3100 lum<0.8 E	Delamp	2	24	
Classroom 10	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	16	144		Custom	Prem 2T8 3100 lum =0.85 BF, New Fixt.	11	--->	55
Classroom 10	A	1LF40T12Mag	Under Cabinet Light	3	43		Prem 1T8 3100 lum<0.8 BF		3	24	
Classroom 11	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	16	144		Custom	Prem 2T8 3100 lum =0.85 BF, New Fixt.	11	--->	55
Classroom 11	A	1LF40T12Mag	Under Cabinet Light	2	43		Prem 1T8 3100 lum<0.8 BF		2	24	
Classroom 11/12 RRs	A	2LF40T12Mag	Wall Mount	2	72		Prem 1T8 3100 lum<0.8 E	Delamp	2	24	
Classroom 12	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	16	144		Custom	Prem 2T8 3100 lum =0.85 BF, New Fixt.	12	--->	55
Classroom 12	A	1LF40T12Mag	Wall Mount	3	43		Prem 1T8 3100 lum<0.8 BF		3	24	
Classroom 13	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	16	144		Custom	Prem 2T8 3100 lum =0.85 BF, New Fixt.	12	--->	55
Classroom 13	A	1LF40T12Mag	Under Cabinet Light	2	43		Prem 1T8 3100 lum<0.8 BF		2	24	
Classroom 13 RR	A	2LF40T12Mag	Wall Mount	1	72		Prem 2T8 3100 lum<0.8 E	Delamp	1	48	

Location Information		Existing Fixtures					Proposed Fixtures				
Location	Operation Schedule	Fixture Type (E)	Custom Description / Additional Info.	Qty. (E)	Watts	Custom Wattage	Fixture Type (P)	Custom Description / Additional Info.	Qty. (P)	Watts	Custom Wattage
Classroom 14	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	16	144		Custom	Prem 2T8 3100 lum =0.85 BF, New Fixt.	11	--->	55
Classroom 14	A	1LF40T12Mag	Under Cabinet Light	2	43		Prem 1T8 3100 lum<0.8 BF		2	24	
Classroom 14/15 RRs	A	2LF40T12Mag	Wall Mount	2	72		Prem 1T8 3100 lum<0.8 B	Delamp	2	24	
Classroom 15	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	16	144		Custom	Prem 2T8 3100 lum =0.85 BF, New Fixt.	12	--->	55
Classroom 15	A	1LF40T12Mag	Under Cabinet Light	2	43		Prem 1T8 3100 lum<0.8 BF		2	24	
Classroom 16	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	16	144		Custom	Prem 2T8 3100 lum =0.85 BF, New Fixt.	11	--->	55
Classroom 16	A	1LF40T12Mag	Under Cabinet Light	2	43		Prem 1T8 3100 lum<0.8 BF		2	24	
Classroom 16/17 RRs	A	2LF40T12Mag	Wall Mount	2	72		Prem 1T8 3100 lum<0.8 B	Delamp	2	24	
Classroom 17	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	16	144		Custom	Prem 2T8 3100 lum =0.85 BF, New Fixt.	11	--->	55
Classroom 17	A	1LF40T12Mag	Under Cabinet Light	2	43		Prem 1T8 3100 lum<0.8 BF		2	24	
KIVA Classroom	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	22	144		Custom	Prem 2T8 3100 lum =0.85 BF, New Fixt.	11	--->	55
KIVA Classroom	A	1LF40T12Mag	Under Cabinet Light	3	43				3		
Small Classroom	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	6	144		Custom	Prem 2T8 3100 lum =0.85 BF, New Fixt.	6	--->	55
Library	B	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	42	144		Custom	Prem 2T8 3100 lum =0.85 BF, New Fixt.	34	--->	55
Library Work Room	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	6	144		Custom	Prem 2T8 3100 lum =0.85 BF, New Fixt.	3	--->	55
Library Offices	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	9	144		Custom	Prem 2T8 3100 lum =0.85 BF, New Fixt.	9	--->	55
Story Telling Room	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	8	144		Custom	Prem 2T8 3100 lum =0.85 BF, New Fixt.	4	--->	55
Planning Room	A	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	4	144		Custom	Prem 2T8 3100 lum =0.85 BF, New Fixt.	3	--->	55
Lounge	B	4LF40T12 Mag	2'x4' Recessed w/ Prismatic Lens	4	144		Custom	Prem 2T8 3100 lum =0.85 BF, New Fixt.	4	--->	55

Location Information		Existing Fixtures					Proposed Fixtures				
Location	Operation Schedule	Fixture Type (E)	Custom Description / Additional Info.	Qty. (E)	Watts	Custom Wattage	Fixture Type (P)	Custom Description / Additional Info.	Qty. (P)	Watts	Custom Wattage
Mens Restroom	A	Custom	2LF30T12 Mag	2	--->	120	Prem 1T8 3100 lum<0.8 B	Prem 1T8 3'	1	24	
Womens Restroom	A	Custom	2LF30T12 Mag	2	--->	120	Prem 1T8 3100 lum<0.8 B	Prem 1T8 3'	1	24	
Storage	A	2LF40T12Mag	Strip	1	72		Prem 2T8 3100 lum<0.8 BF		1	48	
Electric Room	A	2LF40T12Mag	Strip	1	72		Prem 2T8 3100 lum<0.8 BF		1	48	
Electric Room	A	Incandescent100W	Lampholders	1	100			LED 12 watt	1		
Boys Restroom	B	Incandescent100W	Recessed	2	100		CFL22W/Hardwire		2	26	
Boys Restroom	B	2LF40T12Mag	Wall Mount	1	72		Prem 1T8 3100 lum<0.8 B	Delamp	1	24	
Girls Restroom	B	Incandescent100W	Recessed	2	100		CFL22W/Hardwire		2	26	
Girls Restroom	B	2LF40T12Mag	Wall Mount	1	72		Prem 1T8 3100 lum<0.8 B	Delamp	1	24	
Exterior	D	Incandescent150W	Surface, 12" sq, (2) 75w Inc each	16	150		CFL26W/Hardwire	New Fixtures	18	30	
Classroom 9 RR Hall	A	2LF40T12Mag	Recessed	1	72		Prem 1T8 3100 lum<0.8 B	New Fixtures	1	24	
Classroom 12 RR Hall	A	2LF40T12Mag	Recessed	1	72		Prem 1T8 3100 lum<0.8 B	New Fixtures	1	24	
Classroom 14 RR Hall	A	2LF40T12Mag	Recessed	1	72		Prem 1T8 3100 lum<0.8 B	New Fixtures	1	24	
Classroom 16 RR Hall	A	2LF40T12Mag	Recessed	1	72		Prem 1T8 3100 lum<0.8 B	New Fixtures	1	24	

Location	Proposed fixture	Watts	Custom Description / Additional Info.	Custom Watts	Qty	Sched	Control Type
Gymnasium	4LF55T5HO-	234	New Fixtures		15	A	Dual Tech Sensor
Stage	Prem 2T8 3100 lum<	48	New Fixtures		3	C	Dual Tech Sensor
Kitchen	Custom	--->	New 2T8, BF=.85	55	14	A	Dual Tech Sensor
Kitchen RR	Custom	--->	LED 12 watt	12	1	A	Dual Tech Sensor
Kitchen Corridor	CFL22W/Hardwire	26	LED 12 watt	0	1	A	Dual Tech Sensor
Kitchen Storage	Prem 2T8 3100 lum<	48	LED 12 watt	0	1	A	Dual Tech Sensor
Kitchen Locked Rm	Prem 2T8 3100 lum<	48	LED 12 watt	0	1	A	Dual Tech Sensor
Electric Room	Prem 2T8 3100 lum<	48	LED 12 watt	0	2	C	Dual Tech Sensor
Furnace Room	Custom	--->	LED 12 watt	12	1	C	Dual Tech Sensor
PE Office	Prem 4T8 3100 lum<	95			2	A	Dual Tech Sensor
Girls Locker Rooms	Prem 1T8 3100 lum<	24	New Fixtures		6	A	Dual Tech Sensor

Location	Proposed fixture	Watts	Custom Description / Additional Info.	Custom Watts	Qty	Sched	Control Type
Boys Locker Rooms	Prem 1T8 3100 lum<	24	New Fixtures		6	A	Dual Tech Sensor
Main School Entrance	Prem 2T8 3100 lum<	48	New Fixtures		3	B	Dual Tech Sensor
Main Office	Custom	--->	Prem 2T8 3100 lum =0.85 BF, New Fixt.	55	6	E	Dual Tech Sensor
Main Office	Custom	--->	Prem 2T8 3100 lum =0.85 BF, New Fixt.	55	2	E	Dual Tech Sensor
Health Room	Custom	--->	Prem 2T8 3100 lum =0.85 BF, New Fixt.	55	3	E	Dual Tech Sensor
Health Room	Prem 1T8 3100 lum<	24	0	55	1	E	Dual Tech Sensor
Principal Office	Custom	--->	Prem 2T8 3100 lum =0.85 BF, New Fixt.	55	4	E	Dual Tech Sensor
Work Room	Custom	--->	Prem 2T8 3100 lum =0.85 BF, New Fixt.	55	8	E	Dual Tech Sensor

Location	Proposed fixture	Watts	Custom Description / Additional Info.	Custom Watts	Qty	Sched	Control Type
Classroom 8	Custom	--->	Prem 2T8 3100 lum =0.85 BF, New Fixt.	55	11	A	Dual Tech Sensor
Classroom 8	Prem 1T8 3100 lum<	24	New Fixtures		2	A	Dual Tech Sensor
Classroom 8 RRs	Prem 1T8 3100 lum<	24	Delamp		2	A	Dual Tech Sensor
Classroom 7	Custom	--->	Prem 2T8 3100 lum =0.85 BF, New Fixt.	55	10	A	Dual Tech Sensor
Classroom 7	Prem 1T8 3100 lum<	24			2	A	Dual Tech Sensor
Classroom 7/6 RRs	Prem 1T8 3100 lum<	24	Delamp		2	A	Dual Tech Sensor
Classroom 6	Custom	--->	Prem 2T8 3100 lum =0.85 BF, New Fixt.	55	16	A	Dual Tech Sensor
Classroom 6	Prem 1T8 3100 lum<	24			2	A	Dual Tech Sensor

Location	Proposed fixture	Watts	Custom Description / Additional Info.	Custom Watts	Qty	Sched	Control Type
Classroom 5	Custom	--->	Prem 2T8 3100 lum =0.85 BF, New Fixt.	55	15	A	Dual Tech Sensor
Classroom 5	Prem 1T8 3100 lum<	24			2	A	Dual Tech Sensor
Classroom 5/4 RRs	Prem 1T8 3100 lum<	24	Delamp		2	A	Dual Tech Sensor
Classroom 4	Custom	--->	Prem 2T8 3100 lum =0.85 BF, New Fixt.	55	13	A	Dual Tech Sensor
Classroom 4	Prem 1T8 3100 lum<	24			2	A	Dual Tech Sensor
Classroom 3	Custom	--->	Prem 2T8 3100 lum =0.85 BF, New Fixt.	55	10	A	Dual Tech Sensor
Classroom 3	Prem 1T8 3100 lum<	24			2	A	Dual Tech Sensor
Classroom 3/2 RRs	Prem 1T8 3100 lum<	24	Delamp		2	A	Dual Tech Sensor
Classroom 2	Custom	--->	Prem 2T8 3100 lum =0.85 BF, New Fixt.	55	16	A	Dual Tech Sensor
Classroom 2	Prem 1T8 3100 lum<	24			2	A	Dual Tech Sensor

Location	Proposed fixture	Watts	Custom Description / Additional Info.	Custom Watts	Qty	Sched	Control Type
Classroom 1	Custom	--->	Prem 2T8 3100 lum =0.85 BF, New Fixt.	55	11	A	Dual Tech Sensor
Teachers Lounge	Custom	--->	Prem 2T8 3100 lum =0.85 BF, New Fixt.	55	12	E	Dual Tech Sensor
Instruction Rooms	Custom	--->	Prem 2T8 3100 lum =0.85 BF, New Fixt.	55	4	A	Dual Tech Sensor
Jan Closet	Prem 2T8 3100 lum<	48	0	0	1	C	Dual Tech Sensor
Jan Closet	Prem 2T8 3100 lum<	48			1	C	Dual Tech Sensor
(4) Sm RRs	Prem 1T8 3100 lum<	24	Delamp		4	A	Dual Tech Sensor
Indiv Instruction	Custom	--->	Prem 2T8 3100 lum =0.85 BF, New Fixt.	55	4	A	Dual Tech Sensor
Corridor from Lounge around to CR 2	Prem 2T8 3100 lum<	48	New Fixture		15	B	Dual Tech Sensor
Corridor from N exit to Library	Prem 2T8 3100 lum<	48	New Fixture		5	B	Dual Tech Sensor
Corridor from Library to CR 17	Prem 2T8 3100 lum<	48	New Fixture		10	B	Dual Tech Sensor

Location	Proposed fixture	Watts	Custom Description / Additional Info.	Custom Watts	Qty	Sched	Control Type
Classroom 9	Custom	--->	Prem 2T8 3100 lum =0.85 BF, New Fixt.	55	10	A	Dual Tech Sensor
Classroom 9	Prem 1T8 3100 lum<	24			2	A	Dual Tech Sensor
Classroom 9/10 RRs	Prem 1T8 3100 lum<	24	Delamp		2	A	Dual Tech Sensor
Classroom 10	Custom	--->	Prem 2T8 3100 lum =0.85 BF, New Fixt.	55	11	A	Dual Tech Sensor
Classroom 10	Prem 1T8 3100 lum<	24			3	A	Dual Tech Sensor
Classroom 11	Custom	--->	Prem 2T8 3100 lum =0.85 BF, New Fixt.	55	11	A	Dual Tech Sensor
Classroom 11	Prem 1T8 3100 lum<	24			2	A	Dual Tech Sensor
Classroom 11/12 RRs	Prem 1T8 3100 lum<	24	Delamp		2	A	Dual Tech Sensor
Classroom 12	Custom	--->	Prem 2T8 3100 lum =0.85 BF, New Fixt.	55	12	A	Dual Tech Sensor
Classroom 12	Prem 1T8 3100 lum<	24			3	A	Dual Tech Sensor

Location	Proposed fixture	Watts	Custom Description / Additional Info.	Custom Watts	Qty	Sched	Control Type
Classroom 13	Custom	--->	Prem 2T8 3100 lum =0.85 BF, New Fixt.	55	12	A	Dual Tech Sensor
Classroom 13	Prem 1T8 3100 lum<	24			2	A	Dual Tech Sensor
Classroom 13 RR	Prem 2T8 3100 lum<	48	Delamp		1	A	Dual Tech Sensor
Classroom 14	Custom	--->	Prem 2T8 3100 lum =0.85 BF, New Fixt.	55	11	A	Dual Tech Sensor
Classroom 14	Prem 1T8 3100 lum<	24			2	A	Dual Tech Sensor
Classroom 14/15 RRs	Prem 1T8 3100 lum<	24	Delamp		2	A	Dual Tech Sensor
Classroom 15	Custom	--->	Prem 2T8 3100 lum =0.85 BF, New Fixt.	55	12	A	Dual Tech Sensor
Classroom 15	Prem 1T8 3100 lum<	24			2	A	Dual Tech Sensor

Location	Proposed fixture	Watts	Custom Description / Additional Info.	Custom Watts	Qty	Sched	Control Type
Classroom 16	Custom	--->	Prem 2T8 3100 lum =0.85 BF, New Fixt.	55	11	A	Dual Tech Sensor
Classroom 16	Prem 1T8 3100 lum<	24			2	A	Dual Tech Sensor
Classroom 16/17 RRs	Prem 1T8 3100 lum<	24	Delamp		2	A	Dual Tech Sensor
Classroom 17	Custom	--->	Prem 2T8 3100 lum =0.85 BF, New Fixt.	55	11	A	Dual Tech Sensor
Classroom 17	Prem 1T8 3100 lum<	24			2	A	Dual Tech Sensor
KIVA Classroom	Custom	--->	Prem 2T8 3100 lum =0.85 BF, New Fixt.	55	11	A	Dual Tech Sensor
KIVA Classroom	0				3	A	Dual Tech Sensor
Small Classroom	Custom	--->	Prem 2T8 3100 lum =0.85 BF, New Fixt.	55	6	A	Dual Tech Sensor
Library	Custom	--->	Prem 2T8 3100 lum =0.85 BF, New Fixt.	55	34	B	Dual Tech Sensor

Location	Proposed fixture	Watts	Custom Description / Additional Info.	Custom Watts	Qty	Sched	Control Type
Library Work Room	Custom	--->	Prem 2T8 3100 lum =0.85 BF, New Fixt.	55	3	A	Dual Tech Sensor
Library Offices	Custom	--->	Prem 2T8 3100 lum =0.85 BF, New Fixt.	55	9	A	Dual Tech Sensor
Story Telling Room	Custom	--->	Prem 2T8 3100 lum =0.85 BF, New Fixt.	55	4	A	Dual Tech Sensor
Planning Room	Custom	--->	Prem 2T8 3100 lum =0.85 BF, New Fixt.	55	3	A	Dual Tech Sensor
Lounge	Custom	--->	Prem 2T8 3100 lum =0.85 BF, New Fixt.	55	4	B	Dual Tech Sensor
Mens Restroom	Prem 1T8 3100 lum<	24	Prem 1T8 3'	0	1	A	Dual Tech Sensor
Womens Restroom	Prem 1T8 3100 lum<	24	Prem 1T8 3'	0	1	A	Dual Tech Sensor
Storage	Prem 2T8 3100 lum<	48			1	A	Dual Tech Sensor

Location	Proposed fixture	Watts	Custom Description / Additional Info.	Custom Watts	Qty	Sched	Control Type
Electric Room	Prem 2T8 3100 lum<	48			1	A	Dual Tech Sensor
Electric Room	0		LED 12 watt	0	1	A	Dual Tech Sensor
Boys Restroom	CFL22W/Hardwire	26	0	0	2	B	Dual Tech Sensor
Boys Restroom	Prem 1T8 3100 lum<	24	Delamp		1	B	Dual Tech Sensor
Girls Restroom	CFL22W/Hardwire	26	0	0	2	B	Dual Tech Sensor
Girls Restroom	Prem 1T8 3100 lum<	24	Delamp		1	B	Dual Tech Sensor
Exterior	CFL26W/Hardwire	30	New Fixtures		18	D	
Classroom 9 RR Hall	Prem 1T8 3100 lum<	24	New Fixtures		1	A	Dual Tech Sensor
Classroom 12 RR Hall	Prem 1T8 3100 lum<	24	New Fixtures		1	A	Dual Tech Sensor
Classroom 14 RR Hall	Prem 1T8 3100 lum<	24	New Fixtures		1	A	Dual Tech Sensor
Classroom 16 RR Hall	Prem 1T8 3100 lum<	24	New Fixtures		1	A	Dual Tech Sensor

EEM 2 DETAILS: NEW HVAC AND CONTROLS FOR ENERGY SAVINGS

This measure removed the (4) constant volume multizone air handlers on the roof, and installed (4) new VAV multizone air handlers in their place. The existing ductwork distribution was utilized, and the code required fire dampers were installed.

A new DDC system was also installed to control the operating times of the units, and the space temperatures for occupied and unoccupied times.

Each air handler has a variable speed drive that modulates to maintain a pressure setpoint, and has a cold deck, bypass deck, and hot deck. There are natural gas furnaces in each air handler that provide hot air to the zones that require heating.

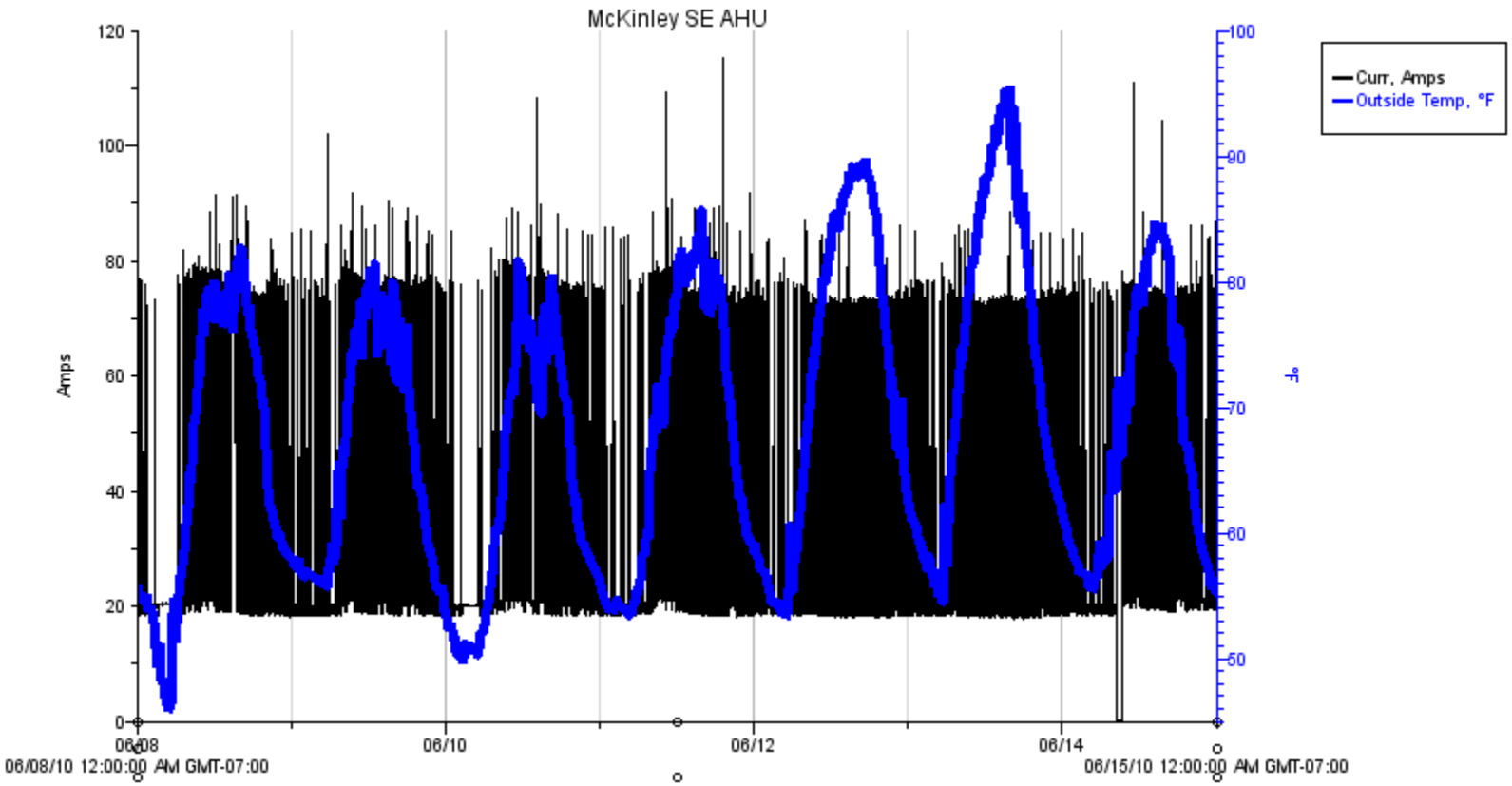
One of the roof vents in the gymnasium building was permanently closed, and the other was equipped with an automatic actuator to open and close the dampers as needed through the new DDC system. The (2) rooftop units serving the gymnasium were also connected to the new DDC system, and the roof vents will only modulate as needed when the rooftop units operate in free-cooling economizer mode.

It is assumed that while occupied the spaces will be heated to 70 F, and cooled to 76 F, and while unoccupied the spaces will be allowed to drift down at night to 55 F, and also allowed o drift up to 80 F.

It is anticipated that the HVAC systems will be turned on an average of one hour prior to school starting, and will stop about half an hour after school ends. It is assumed the units will only operate in the summer when occupied and the occupants utilize the manual over-rides (see next paragraph).

New thermostats have been installed throughout the main school and gymnasium and they are all equipped with manual over-ride buttons. The DDC operator can program the over-ride button to automatically turn on the HVAC serving the appropriate zone for a specified amount of time (1 hour is suggested). This will allow occupants to use the spaces during normally unoccupied times – but only as needed.

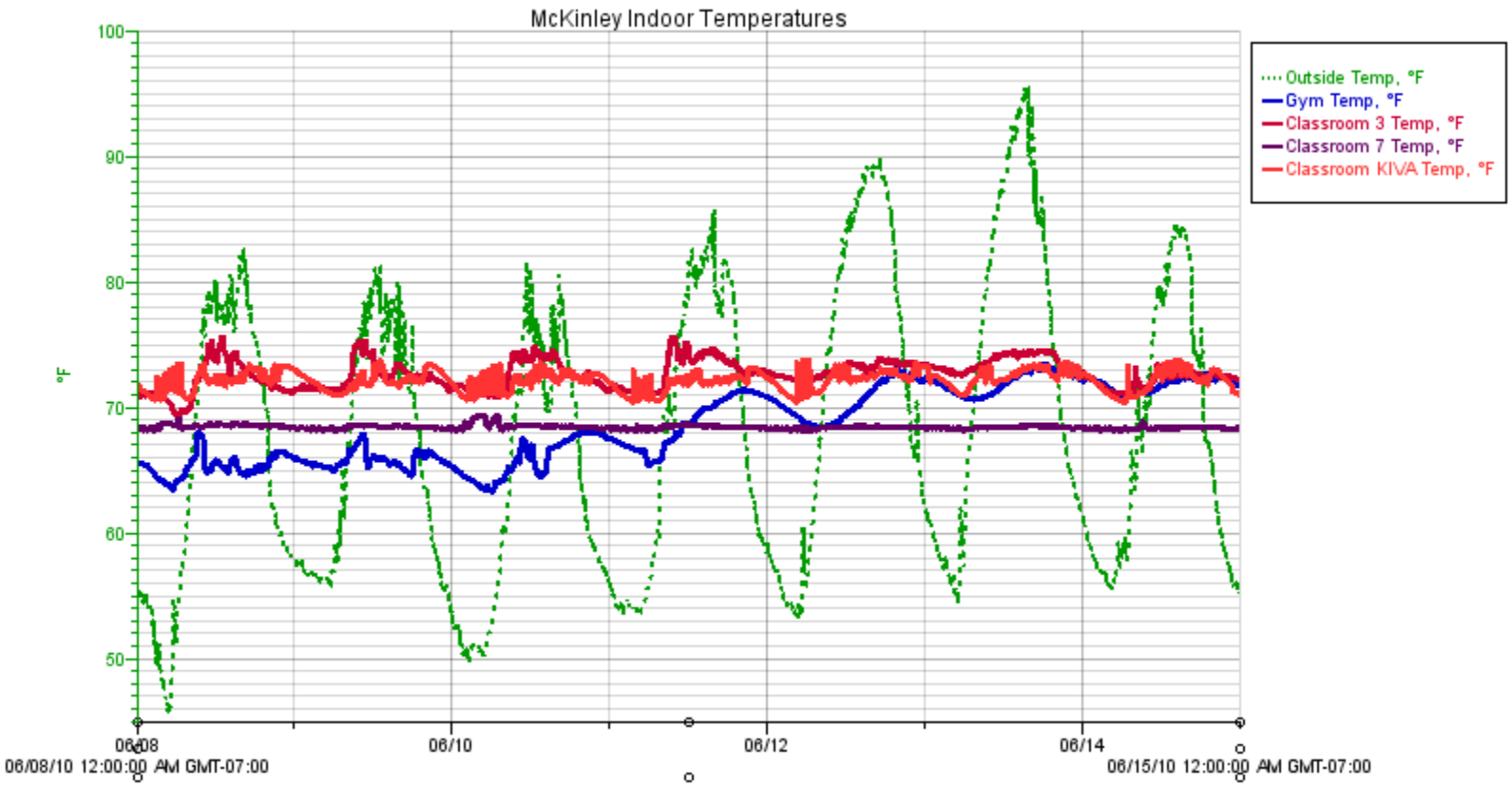
Pre-Upgrade Trend of one AHU electric power over a one week time period



This graph shows the outside air tempreature (blue line, read on scale to the right) and power (amps) of the southeast air handling unit (black line, read on scale to the left) over a one week period.

This illustrates that the fan always operted 24 hours a day prior to the upgrade. When only the fans are on this unit consumed about 24 amps, when one stage of compressor cycled on the power increases to about 80 amps, when the second stage of compressor cycled on the power increases to over 100 amps (sensor maxed out at 100 amps). This shows that the compressor (black line) was cycling on and off whenever the outside air temperature is about 55 F, and it remained on for long periods of time on 6/23, 6/24 and 6/25.

Pre-Upgrade Trend of indoor space temperatures over a one week time period



This graph showed the indoor and outdoor temperature over a seven day period before the upgrade. The dashed green line is the outside air temperature, which ranged from 55 F to 95 f during this test period.

The solid lines represent indoor temperatures taken at different locations, including the gymnasium, library, office and four classrooms. These results indicate that the spaces were maintaining temperatures 24 hours a day before the upgrade.

VERIFICATION OF EEM 1 LIGHTING SYSTEMS AND OCCUPANCY SENSORS OPTIMAL OPERATION

The lighting systems were inspected on a room by room basis to document what was actually installed, and to ensure that they were operating properly, and to ensure they are meeting the required WAC and IESNA light levels.

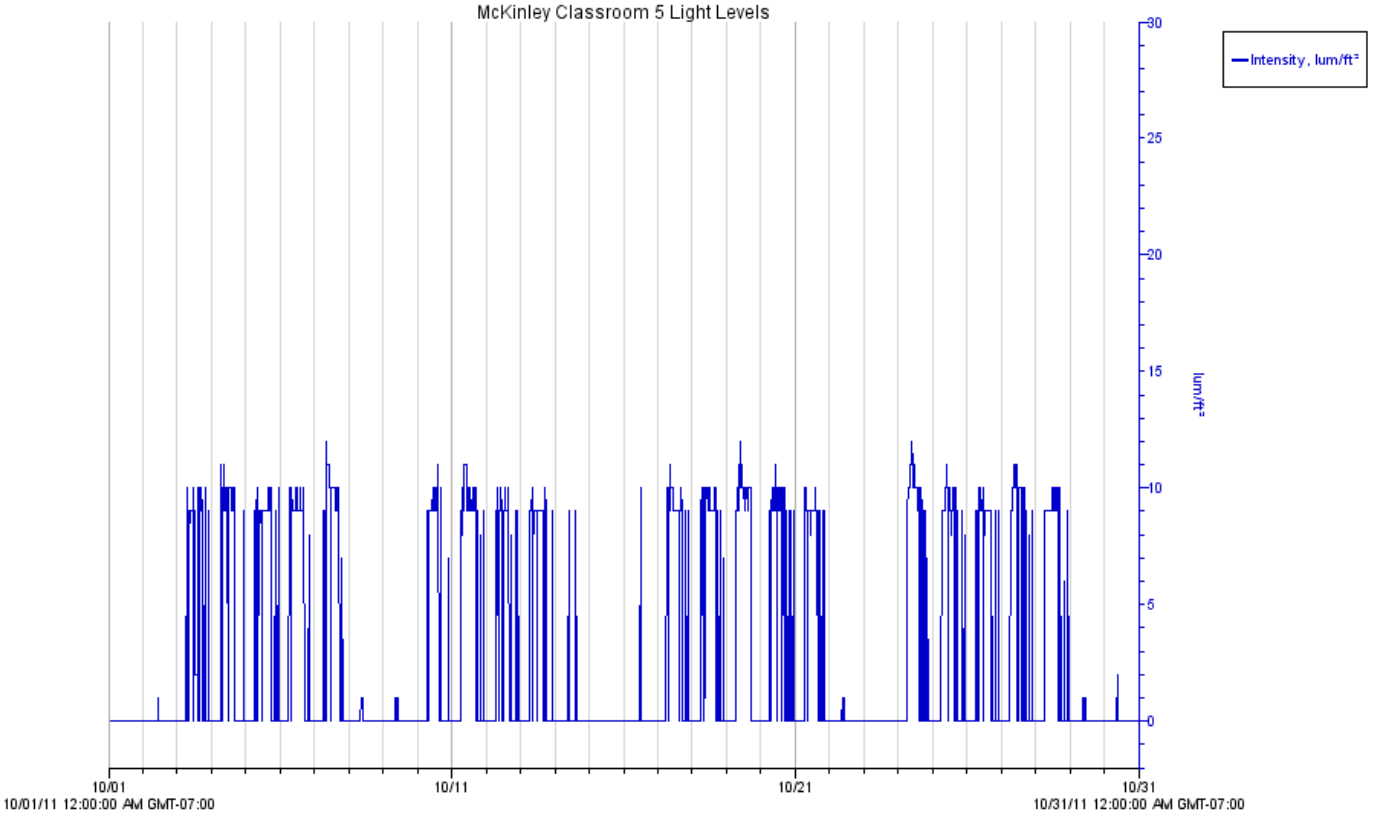
The occupancy sensors in each room were inspected after school hours to ensure that the occupancy sensors would detect occupants to automatically turn the lights on when someone entered the space. They were also tested to ensure that they turned the lights off after the spaces had been vacant for a period of time.

Long term portable data loggers were installed to monitor the lights over several weeks, to ensure that no lights were being left on overnights. The results of these portable loggers are presented on the following pages, to document that the occupancy sensors are automatically turning the lights off when the spaces are vacant.

Light Level graphs in the following pages include data from:

- Classroom 5
- Classroom 13
- Classroom 15
- Classroom 17
- KIVA Classroom
- Library

Note: The light levels shown on the graphs are not the horizontal light levels measured at the work space; they are the vertical light levels measured on the wall and are not reflective of the light levels on the work space. They are only used to determine when the overhead lights are on and off, not what the actual light levels are.

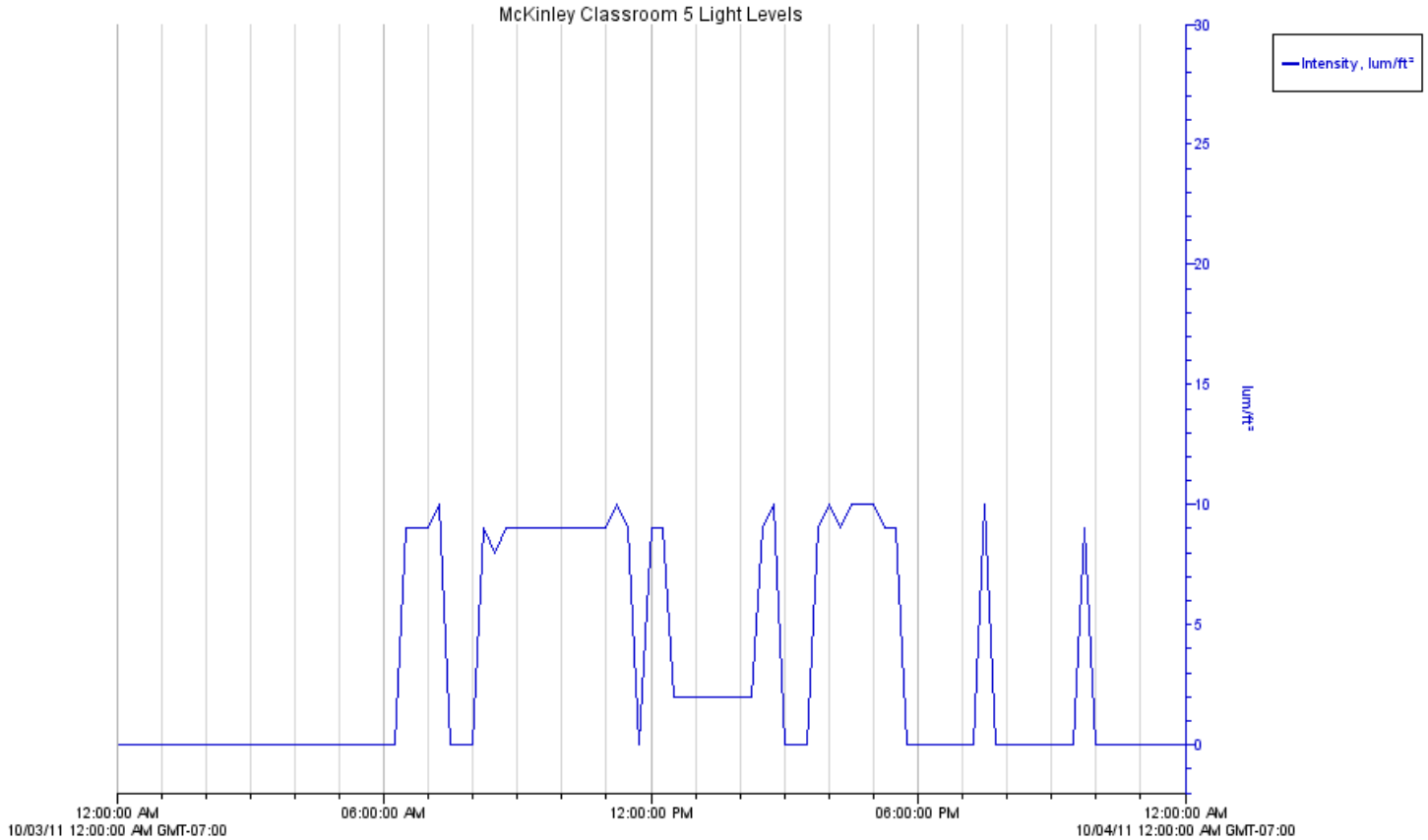


Graph shows 30 days of data.

Blue line is the light level.

Lights are on steadily throughout the majority of the school day, but they cycle off and on in the mornings and afternoons, and over lunch, when spaces are intermittently used. Lights are off overnight every night. Lights are very briefly on a few weekend days, typically for less than one hour per day.

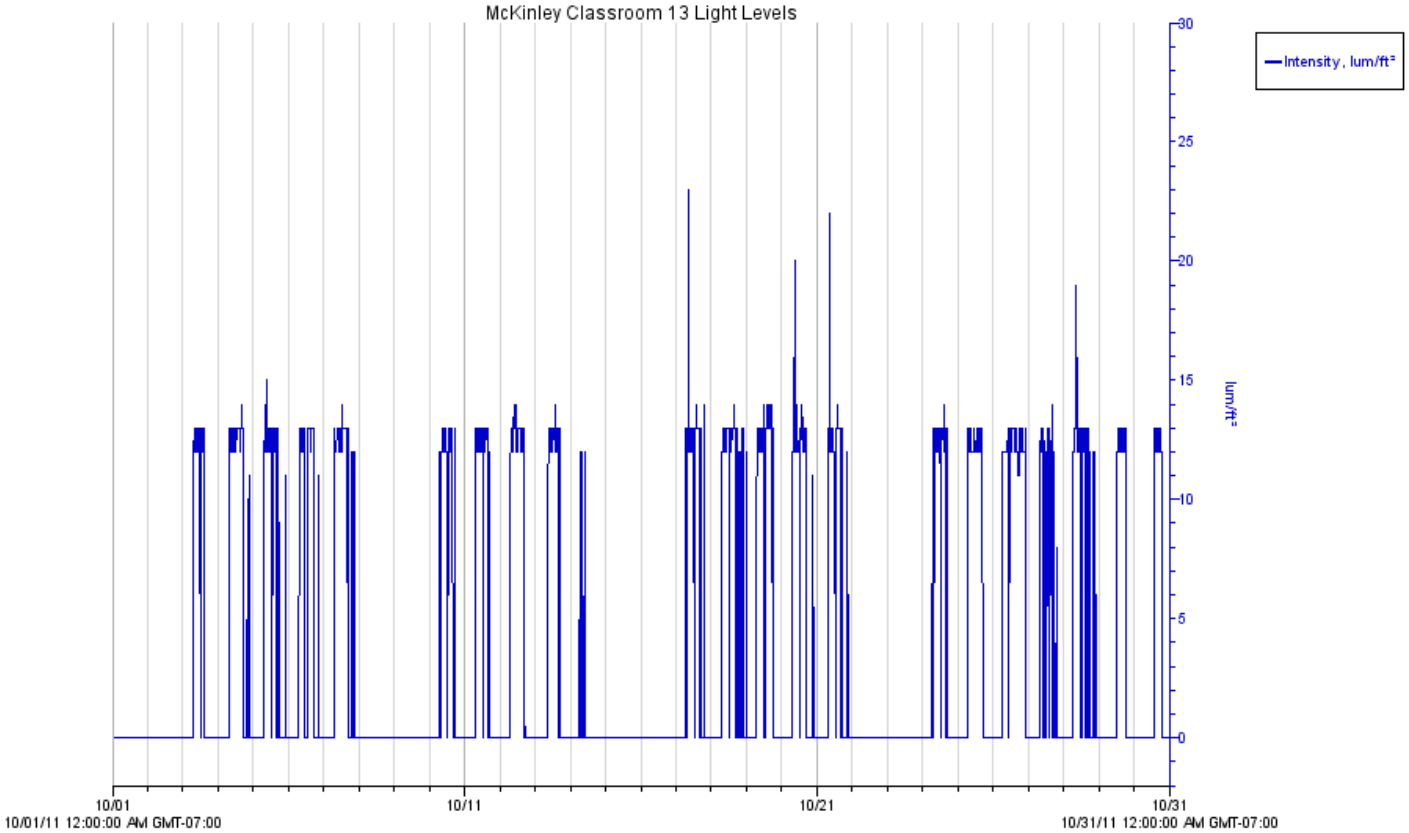
See following page for a typical daily usage pattern.



Graph shows 1 day of data.

Blue line is the light level.

Lights are briefly on in the morning as custodians and staff move through the space. Lights turn on during the day, but are off over lunch and in the afternoons when the spaces are vacant. Lights are only on for brief times in the afternoon and evening as the custodial staff work in the room and pass through the room. Lights are off overnight.

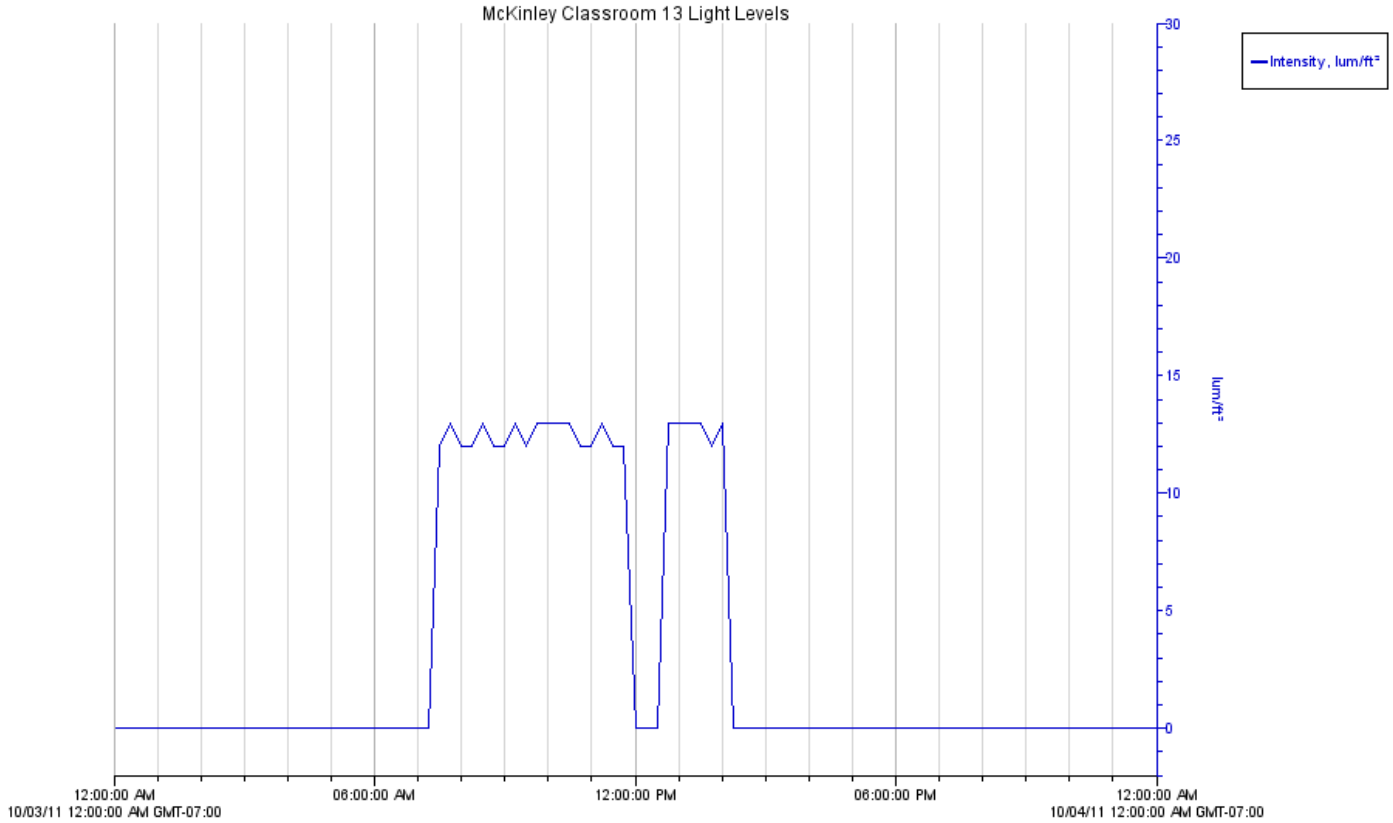


Graph shows 30 days of data.

Blue line is the light level.

Lights are on steadily throughout the middle of each school day, but they normally turn off over the lunch period. Lights are off overnight every night. Lights are on for a few hours on one weekend, when the space was occupied.

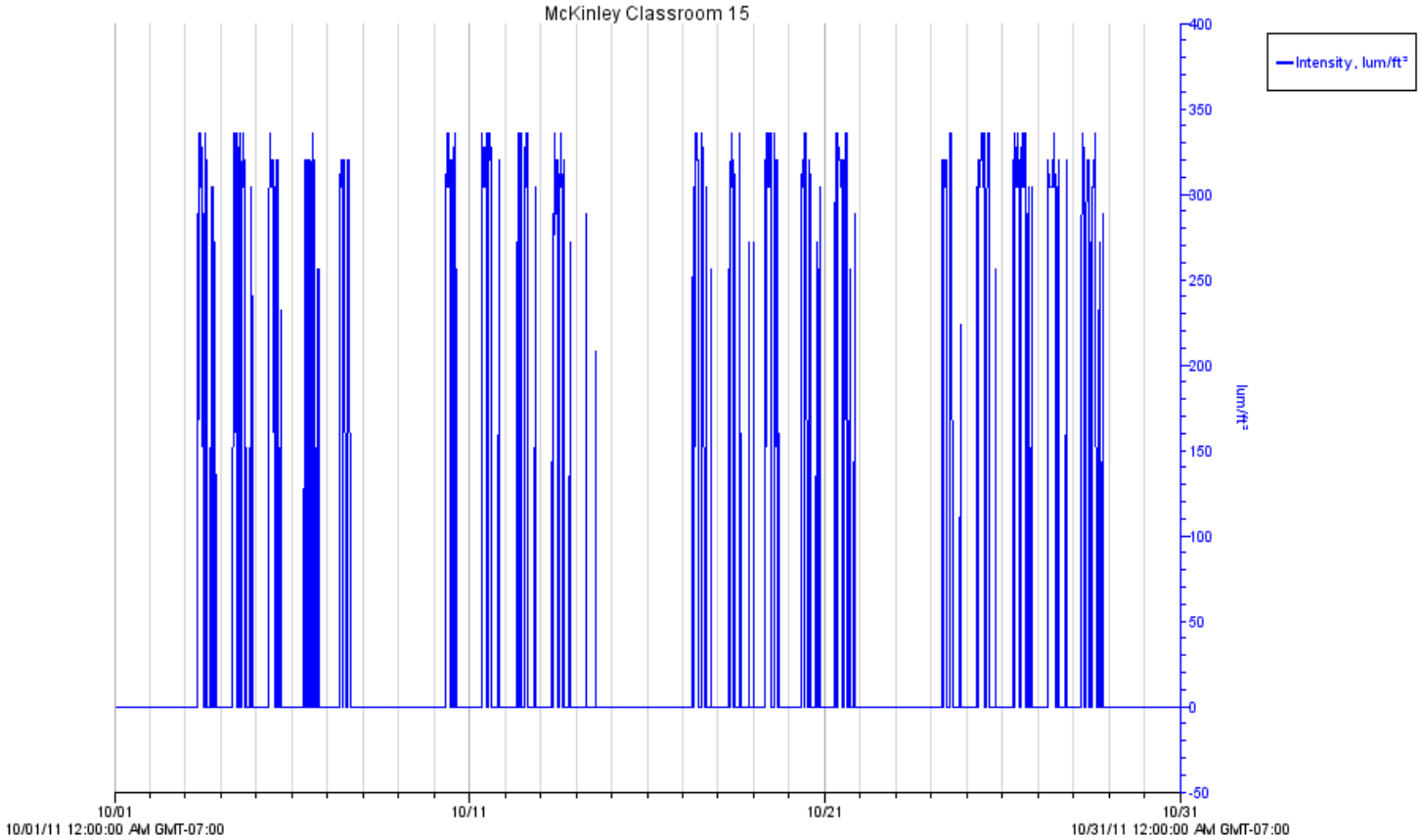
See following page for a typical daily usage pattern.



Graph shows 1 day of data.

Blue line is the light level.

Lights are briefly on from 8am to noon; then again from 1pm to 2pm. Lights remain off the rest of the afternoon, and overnight.

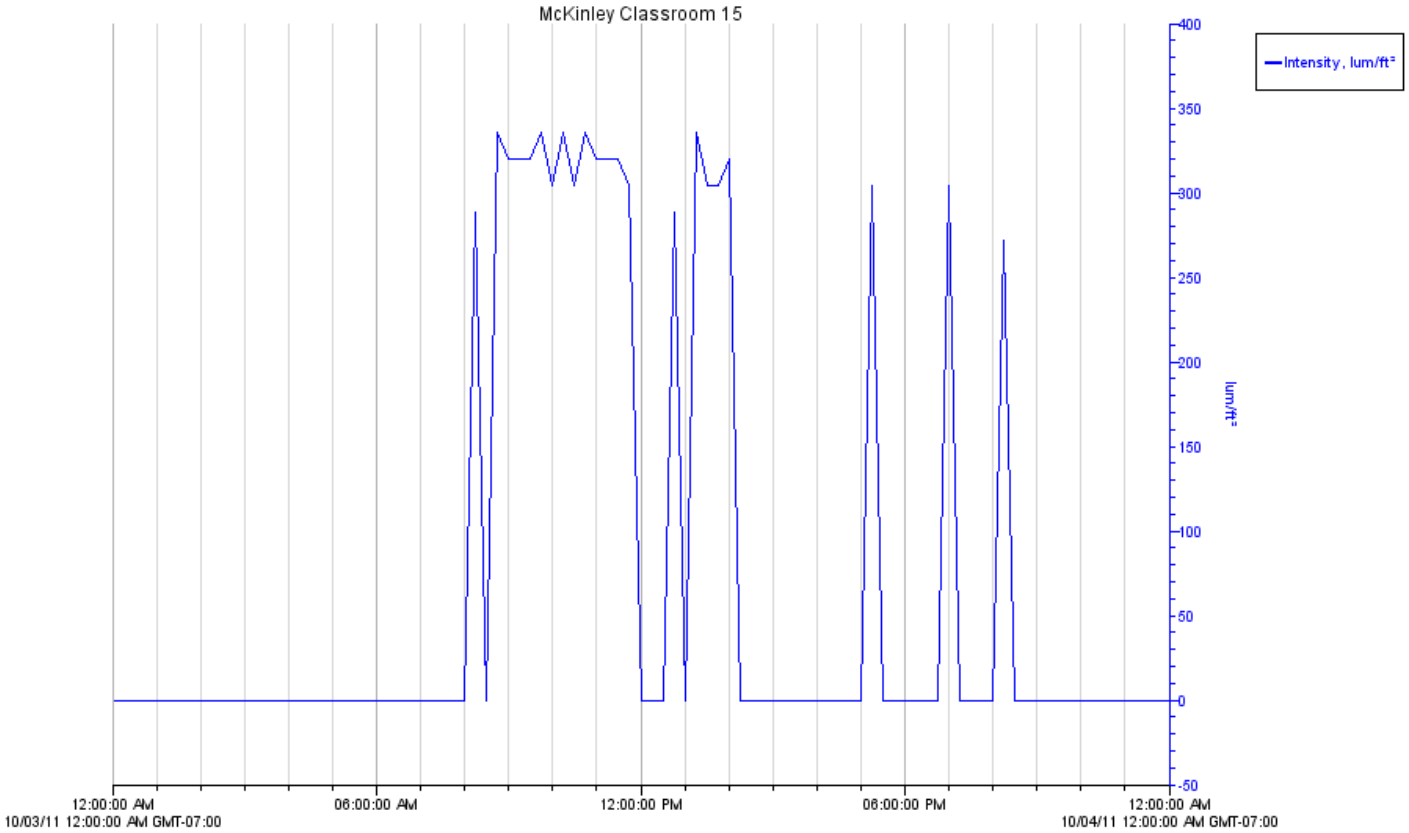


Graph shows 30 days of data.

Blue line is the light level.

Lights are on steadily throughout the middle of each school day, but they cycle off and on especially in the mornings and afternoons, when spaces are intermittently used. Lights are off overnight every night. Lights are briefly on a few weekend days, typically for less than one hour per day.

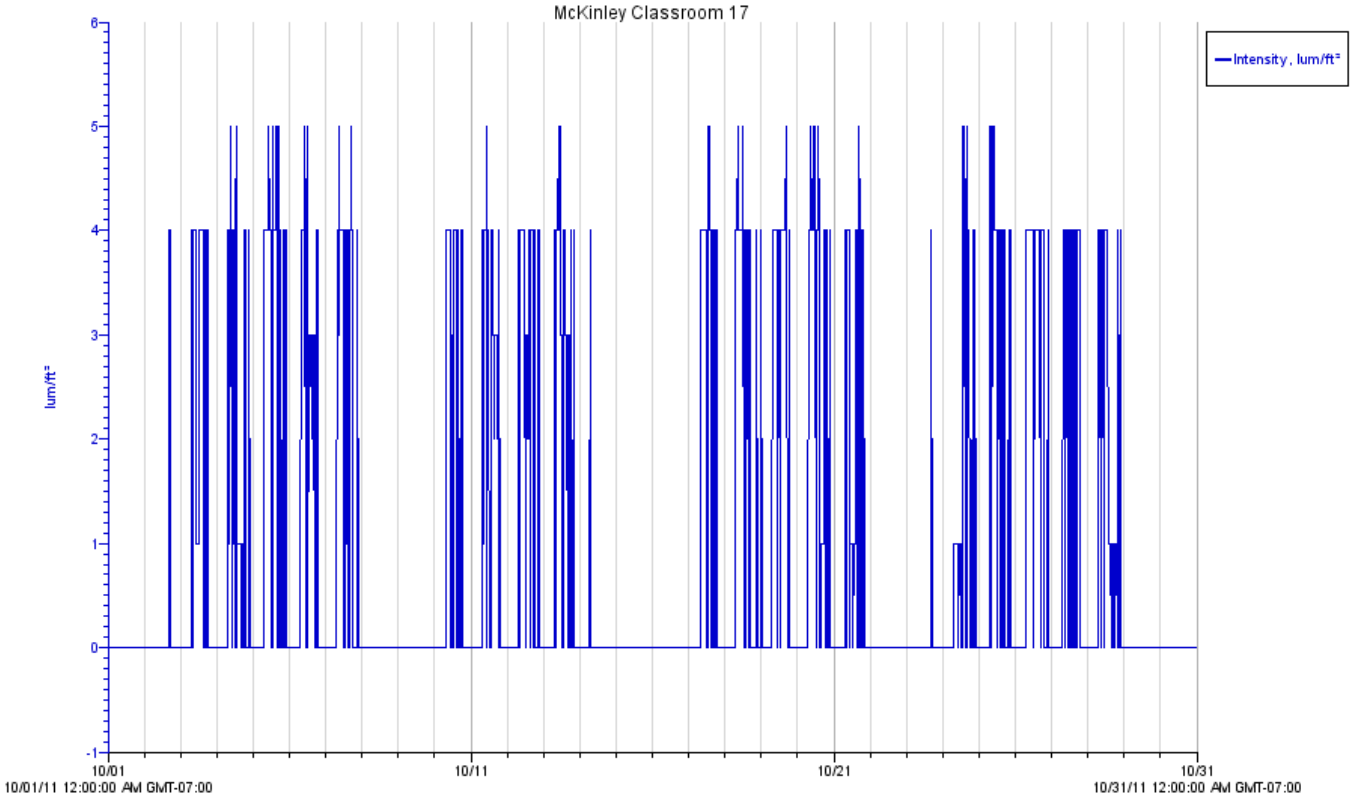
See following page for a typical daily usage pattern.



Graph shows 1 day of data.

Blue line is the light level.

Lights are briefly on in the morning, and then remain on most of the day, although they are off over the lunch period. Lights are on briefly in the evening as the cleaning staff enters the room. Lights remain off overnight.

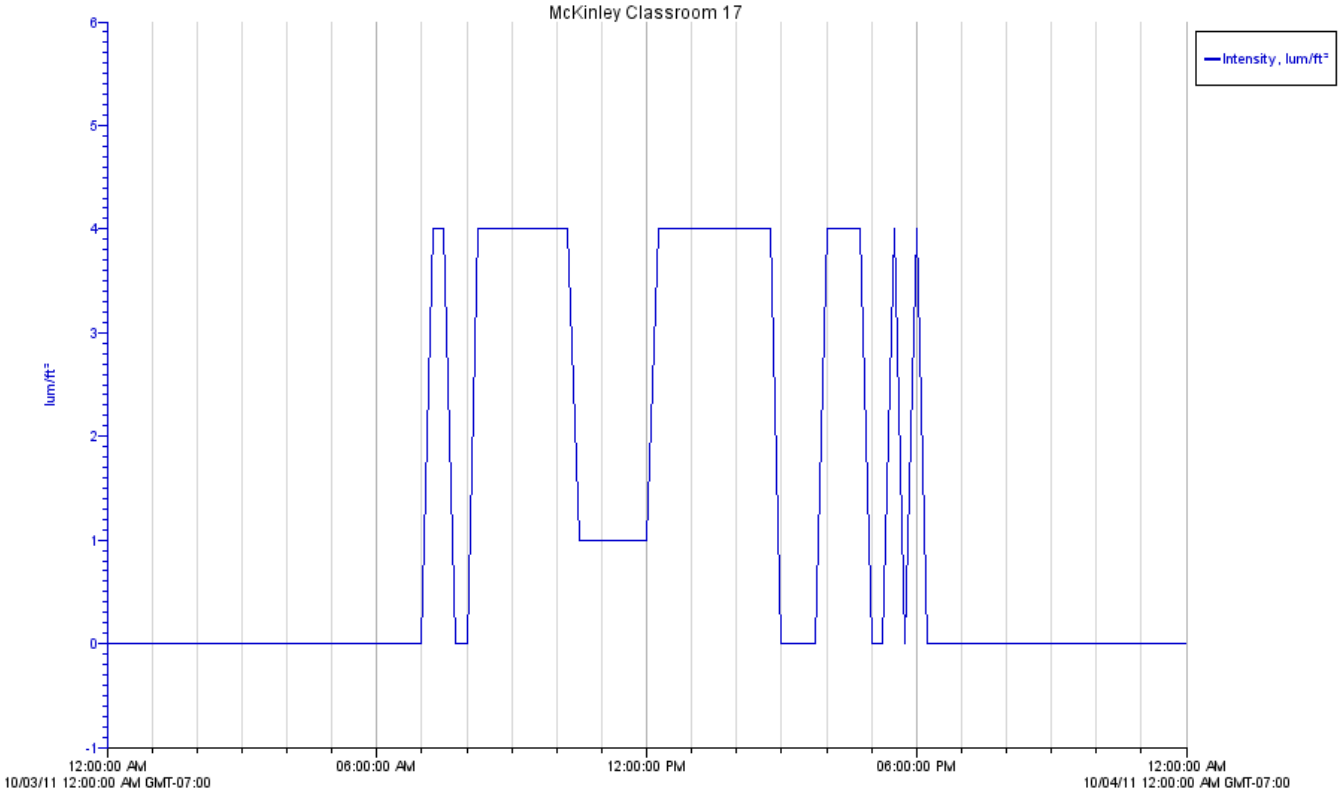


Graph shows 30 days of data.

Blue line is the light level.

Lights are on during school days, and remain off over most weekends – they are on for about one hour on one Sunday. Lights are off overnight every night.

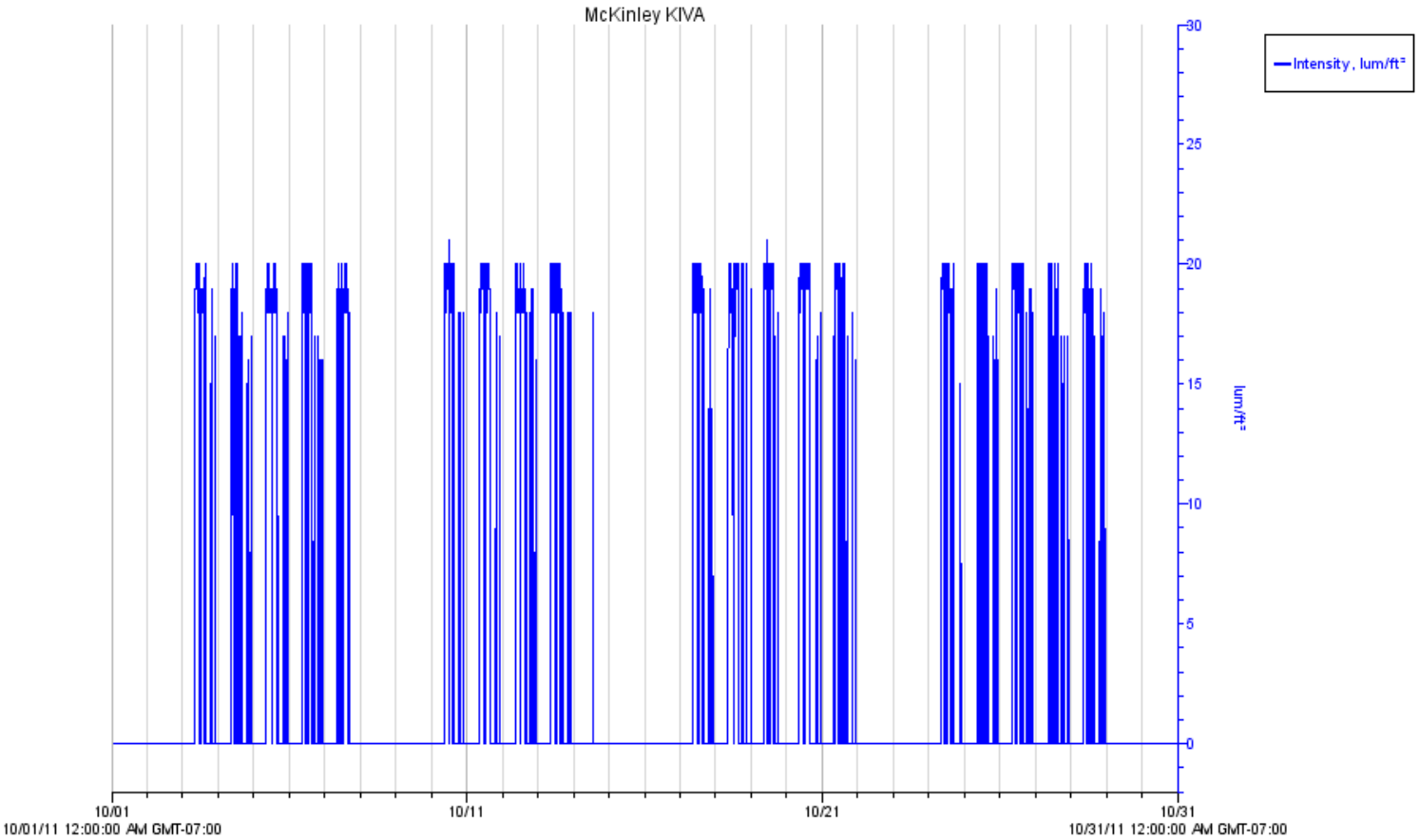
See following page for a typical daily usage pattern.



Graph shows 1 day of data.

Blue line is the light level.

Lights are briefly on in the morning, then remain on during the school day, though part of the lights are off over the lunch period. Lights are briefly on in the late afternoon and evening as cleaning staff use the space. Lights are off overnight.

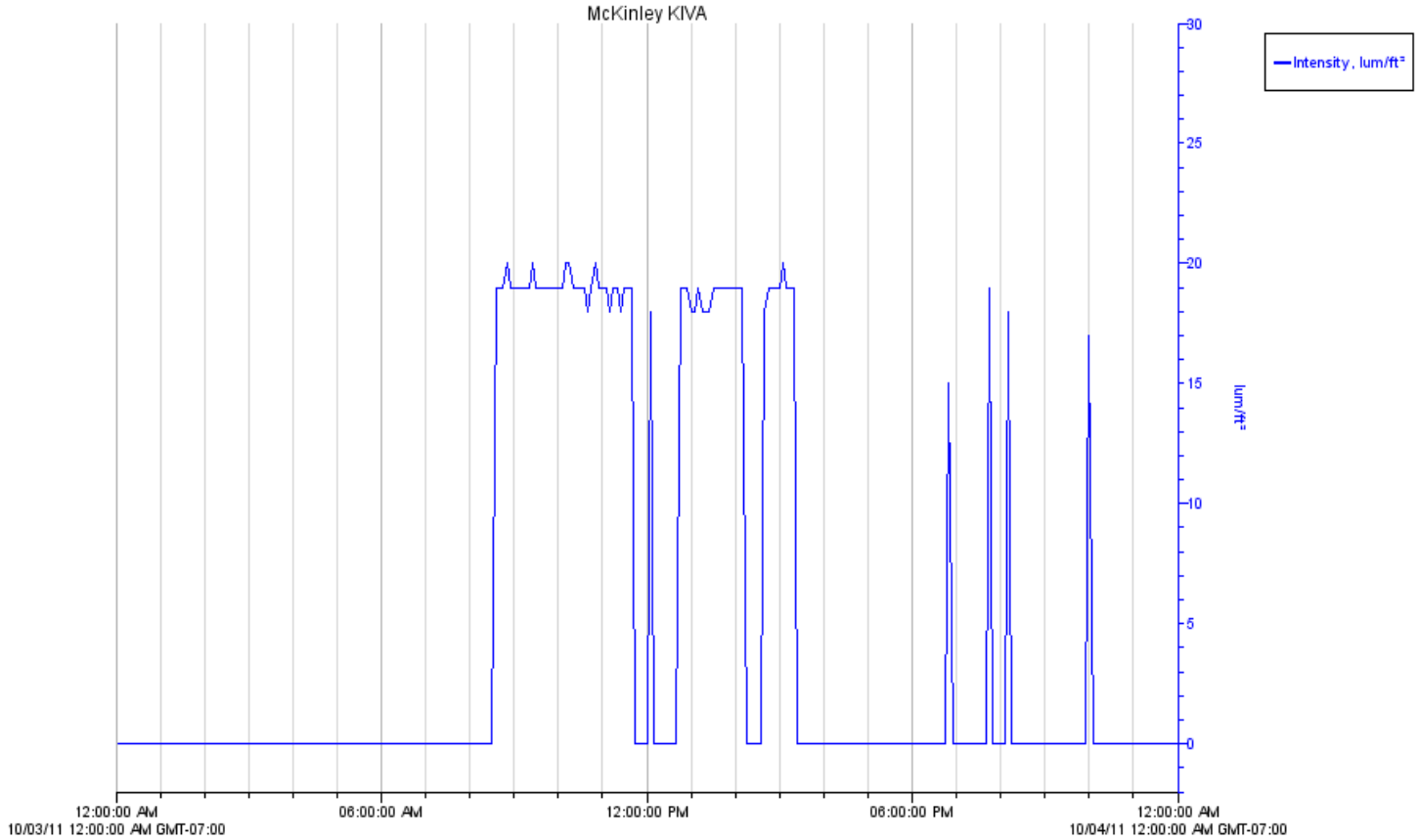


Graph shows 30 days of data.

Blue line is the light level.

Lights are on during school days, and remain off over the weekends. Lights are off overnight every night. .

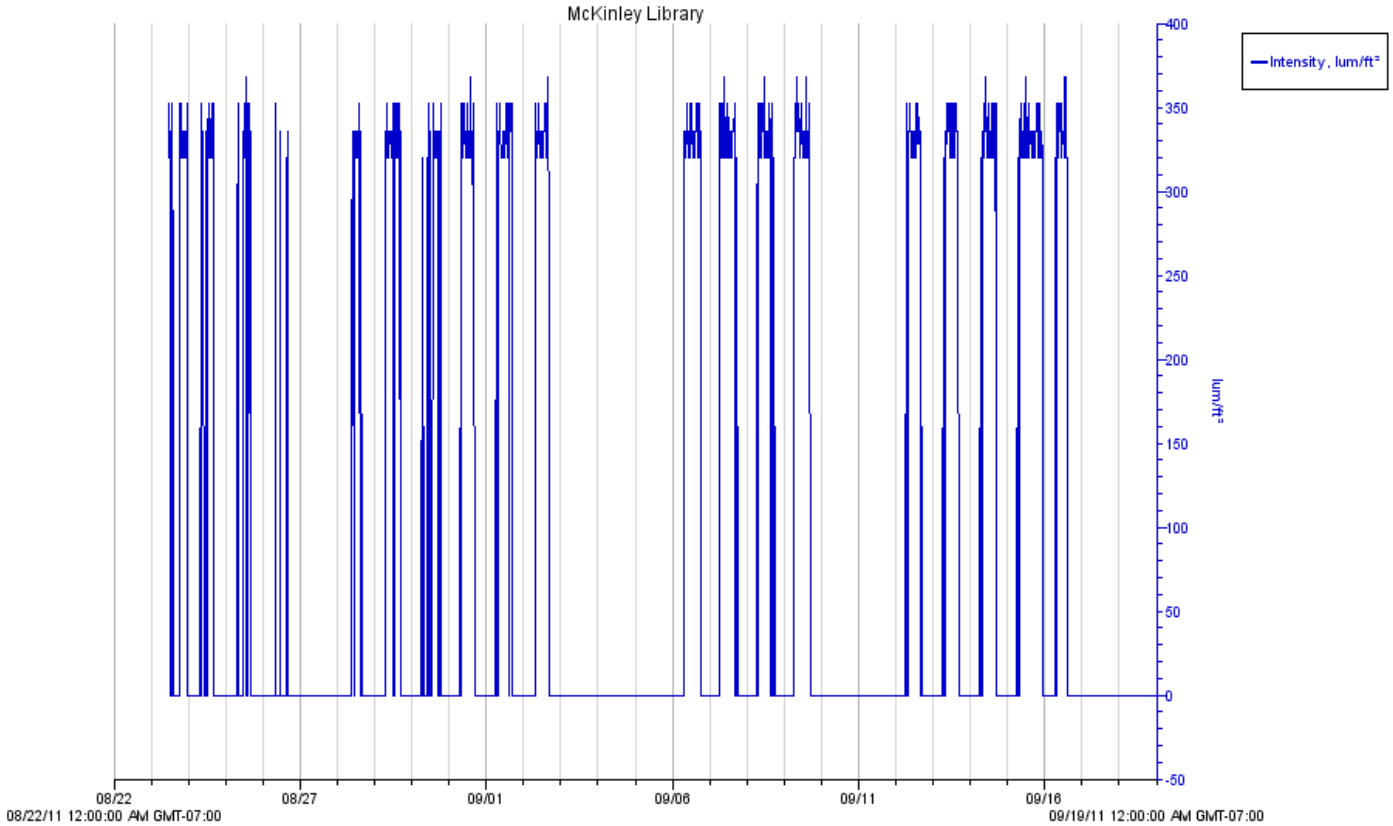
See following page for a typical daily usage pattern.



Graph shows 1 day of data.

Blue line is the light level.

Lights are on from 8:30am to noon, then again from 1pm. They are briefly on in the evening when the cleaning staff occupies the space. Lights are off overnight.

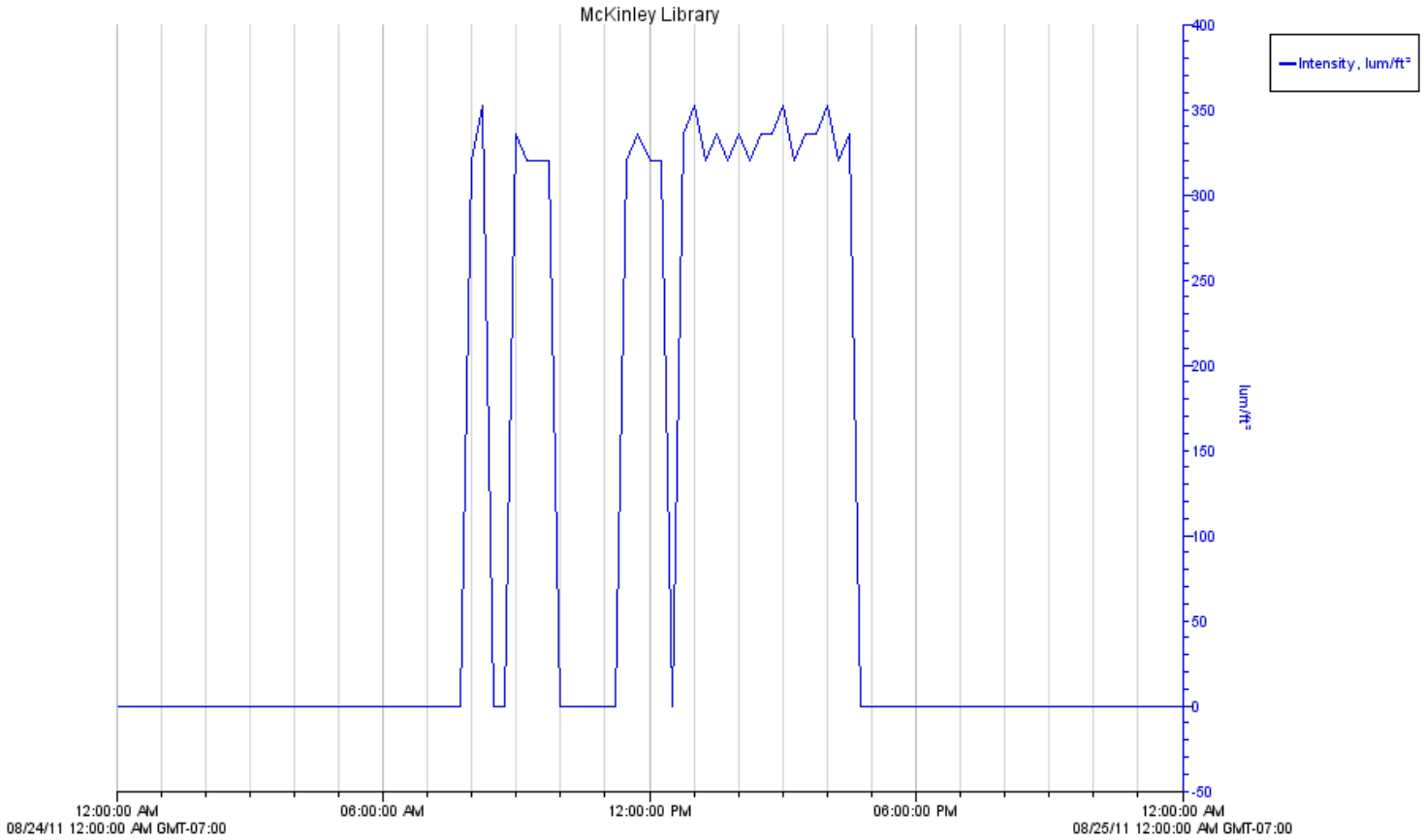


Graph shows 30 days of data.

Blue line is the light level.

Lights are on each school day. Lights are off overnight every night. Lights are briefly on a few weekend days, typically for less than one hour per day.

See following page for a typical daily usage pattern.



Graph shows 1 day of data.

Blue line is the light level.

Lights are briefly on in the morning as custodians and staff move through the space. Lights turn off in the afternoon when the spaces are vacant. Lights are off overnight.

VERIFICATION OF EEM 2 HVAC & CONTROL SYSTEMS OPTIMAL OPERATION

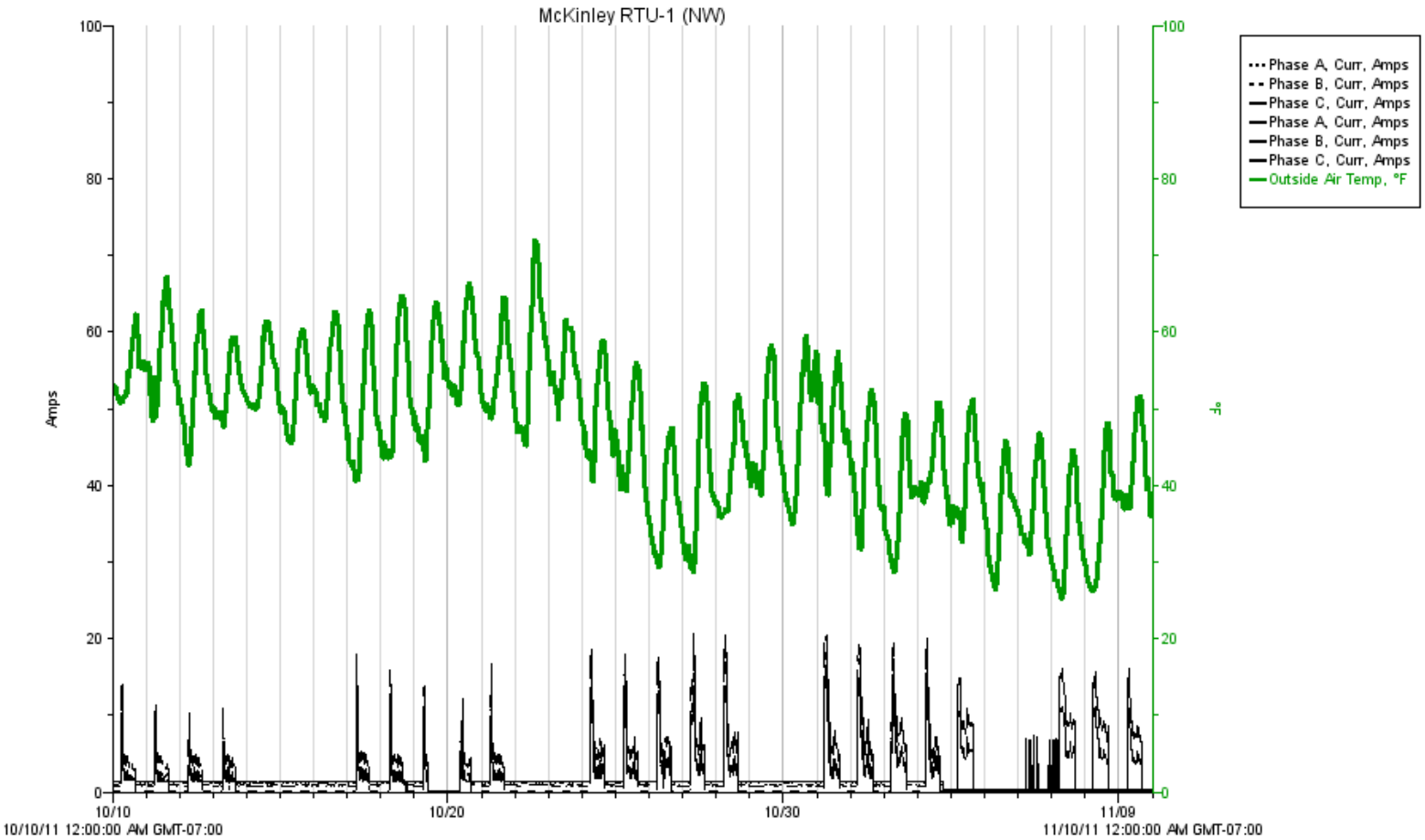
The HVAC and DDC systems were inspected on-site and remotely for several months after installation to document how the systems were performing, and to fine-tune the sequences of operation for optimal operation.

Long term portable data loggers were installed on the power feed coming into each unit to measure the actual power consumed by the units over several weeks, to ensure that the systems are operating efficiently – short run-times, VSDs ramping up and down as needed, no Air Conditioning units running when the outside air is below 60 F, etc.

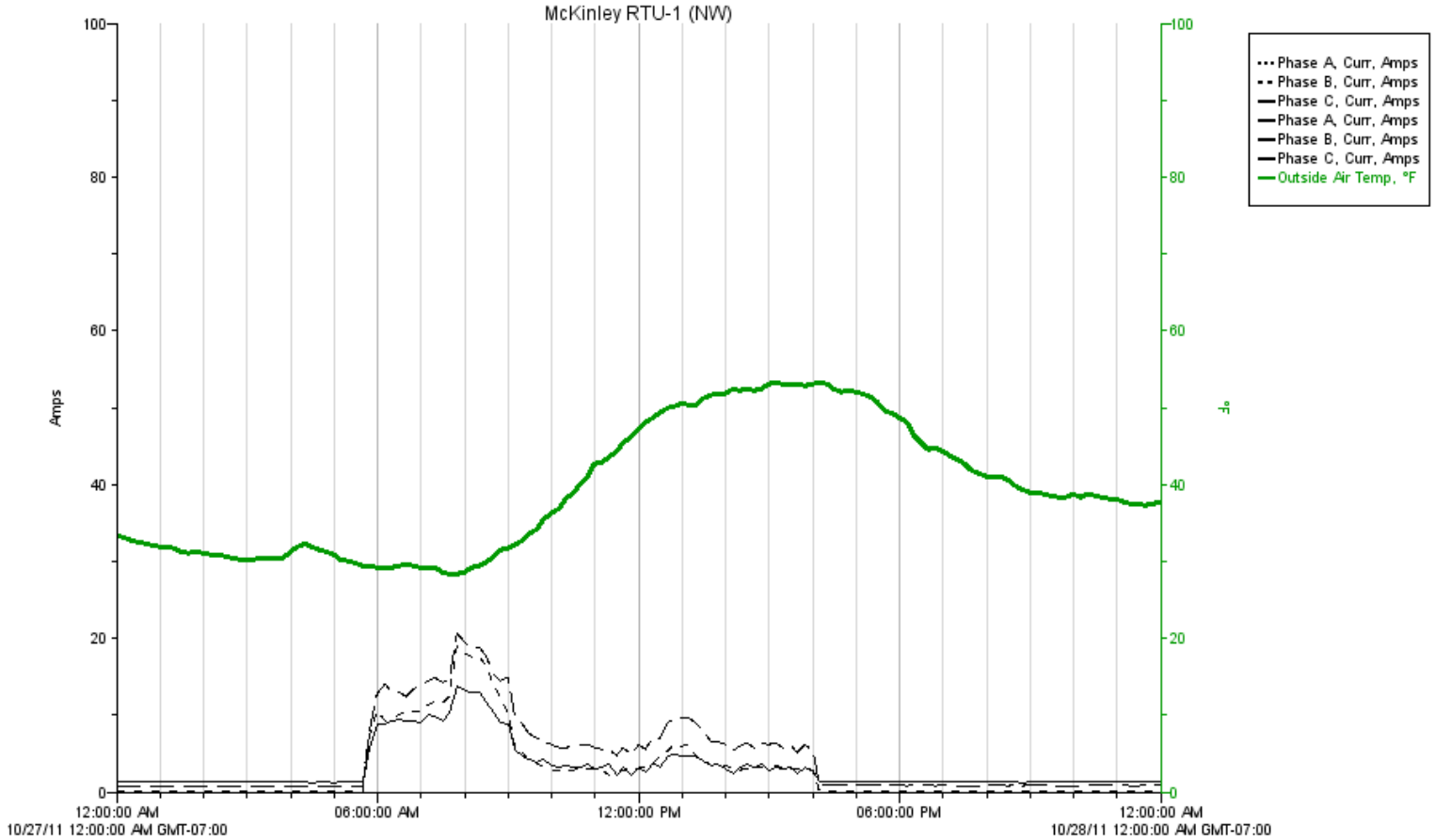
The results of these portable loggers are presented on the following pages, to document that the total power consumed by these units is operating as intended, in order to meet or exceed the guaranteed energy savings for the projects.

Amp readings graphs in the following pages include data from:

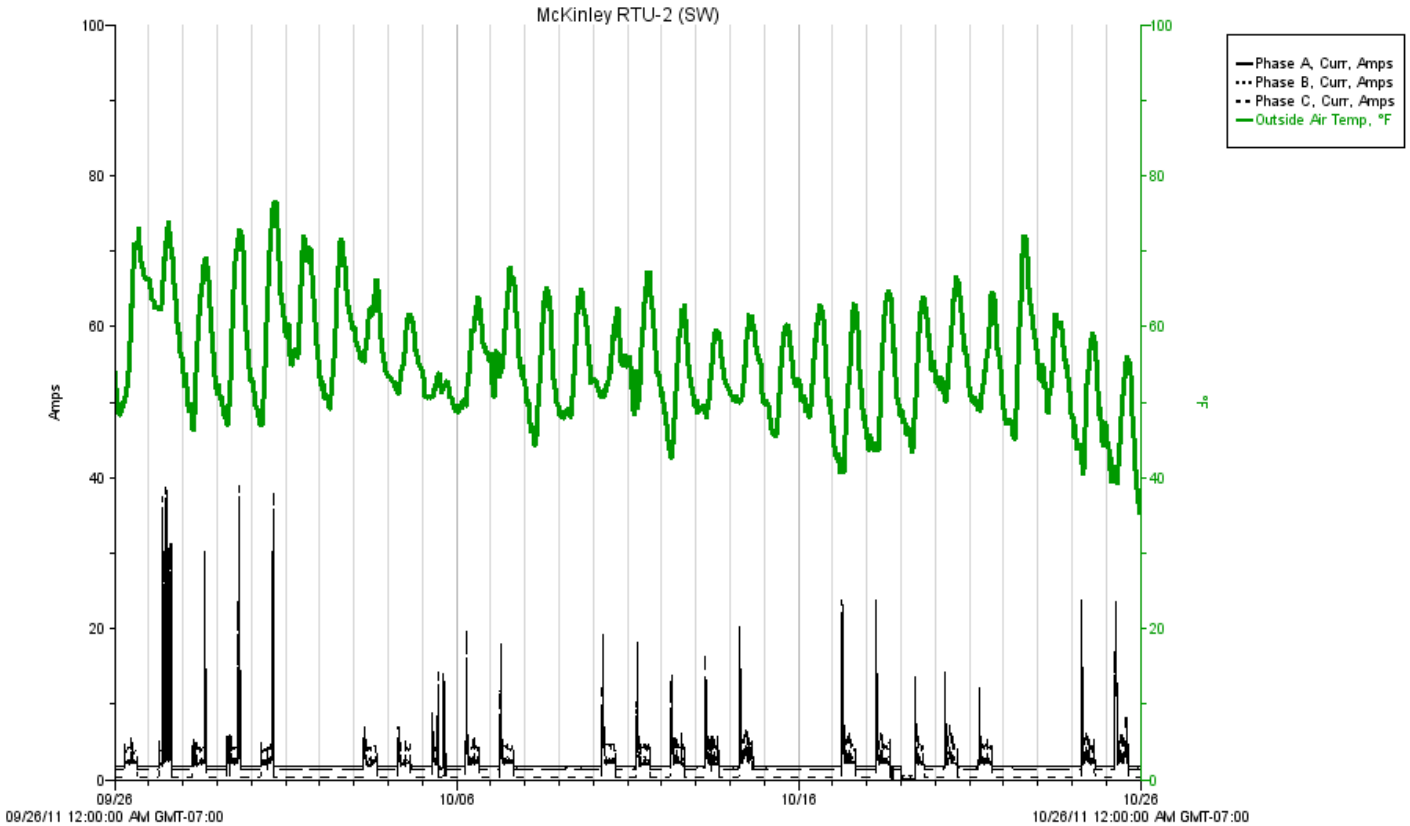
- RTU-1
- RTU-2
- RTU-3
- RTU-4



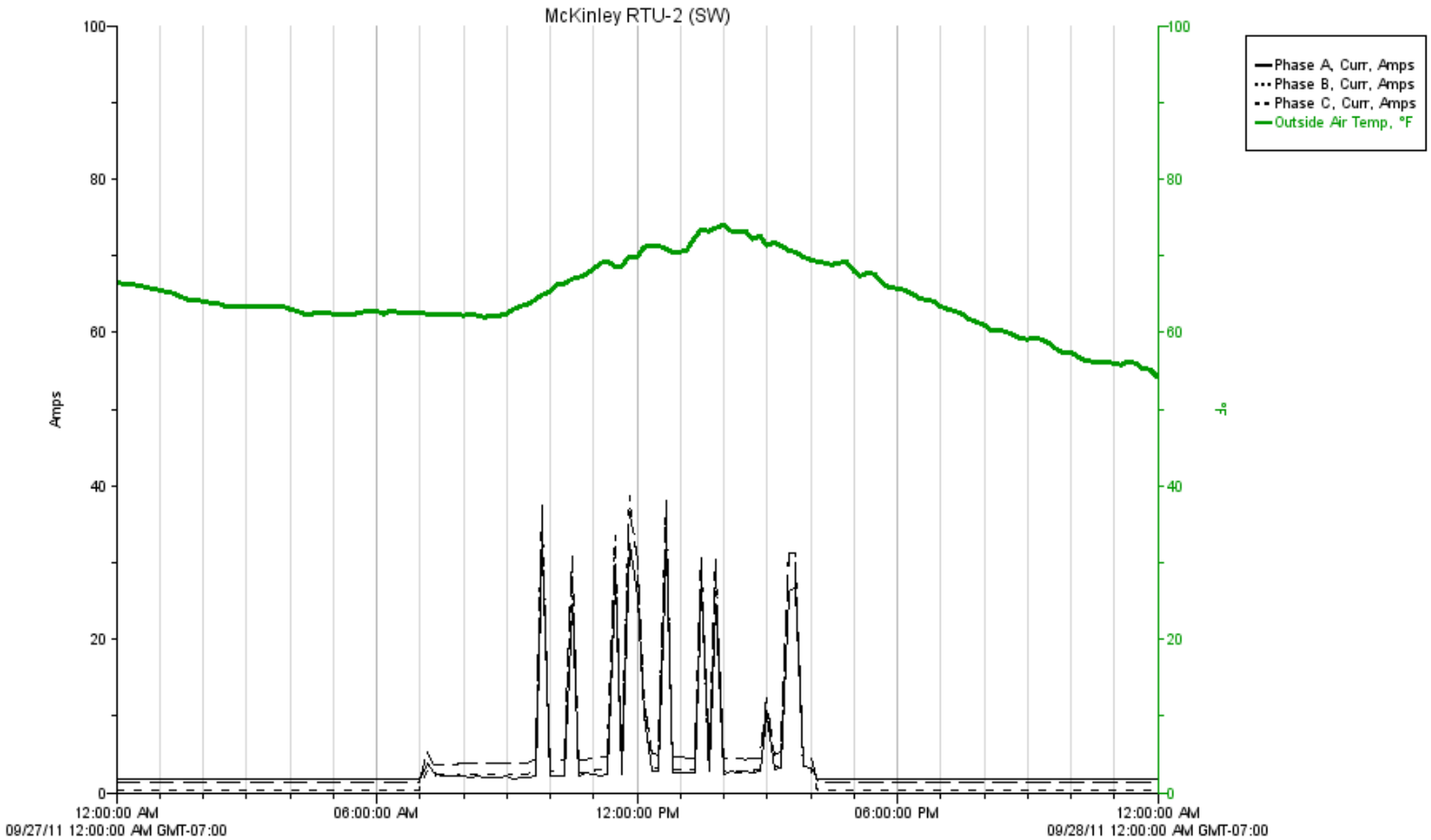
Graph shows 30 days of data for RTU-1.
Black line is the amp reading for all three phases of power coming into the Air Handler, measured inside the air handler.
Green line is the outside air temperature.
Units normally only operate M-F during scheduled hours, unless there is an after-hours over-ride event, in which case the units only operate for an hour at a time.
See following page for a typical daily usage pattern.



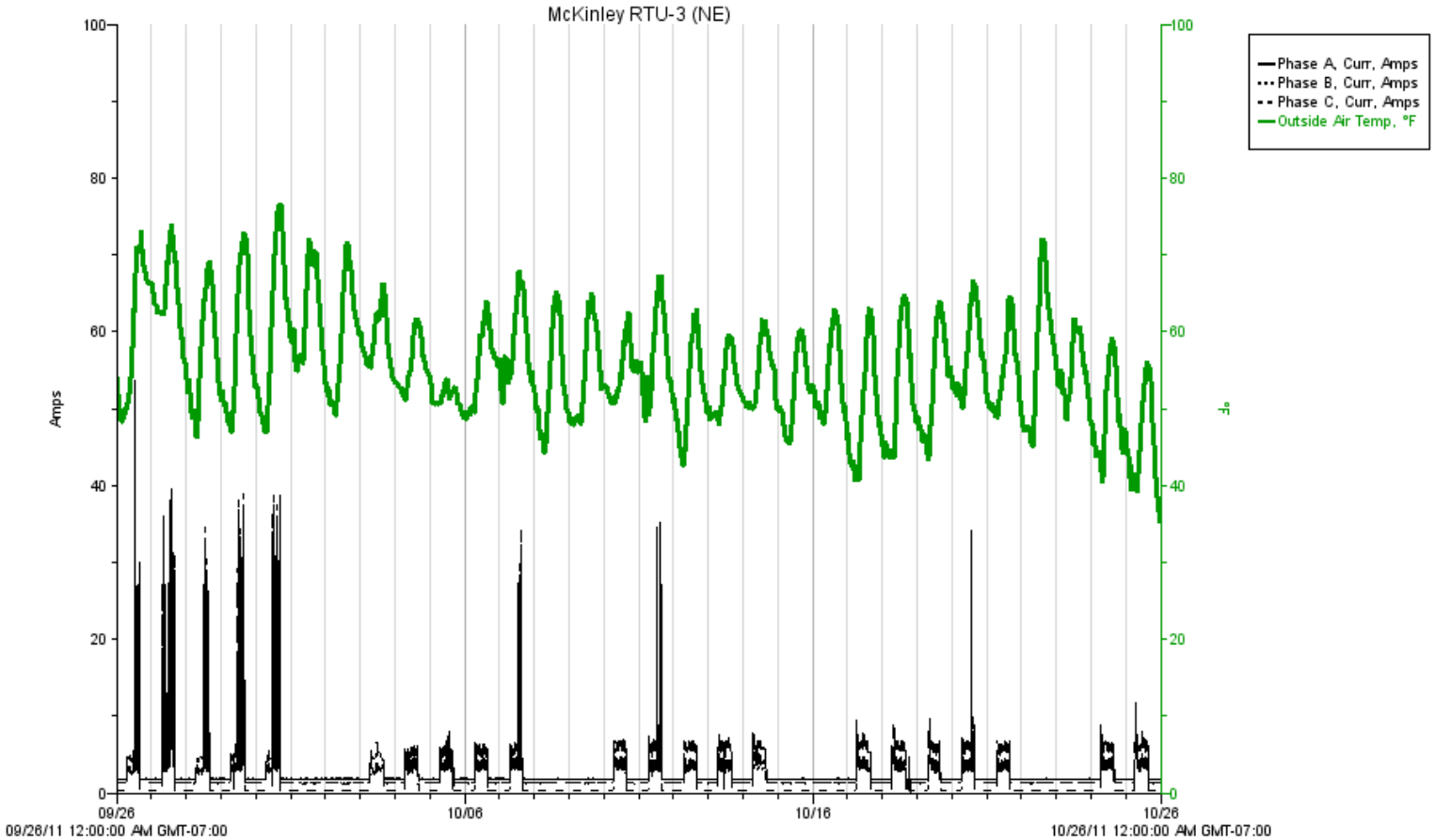
Graph shows 1 day of data for RTU-1.
Black line is the amp reading for all three phases of power coming into the Air Handler, measured inside the air handler.
Green line is the outside air temperature.
On this cold day the unit started at 6am to heat the space by 7 am. The VSD operates at high speed until the spaces are warmed, then slows down to reduced power. Unit shuts off and remains off after 4 pm.



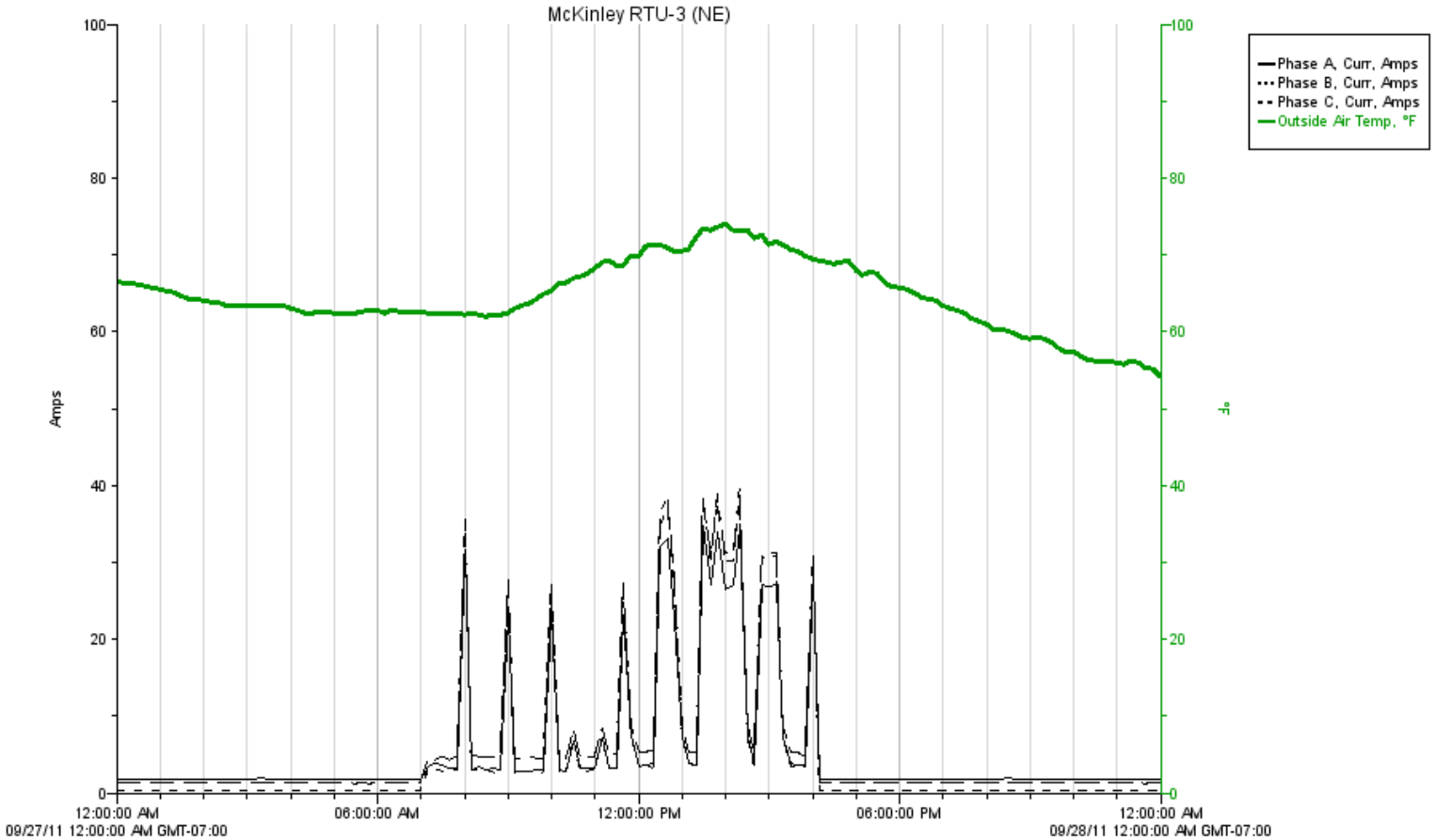
Graph shows 30 days of data for RTU-2.
Black line is the amp reading for all three phases of power coming into the Air Handler, measured inside the air handler.
Green line is the outside air temperature.
Units normally only operate M-F during scheduled hours, unless there is an after-hours over-ride event, in which case the units only operate for an hour at a time.
See following page for a typical daily usage pattern.



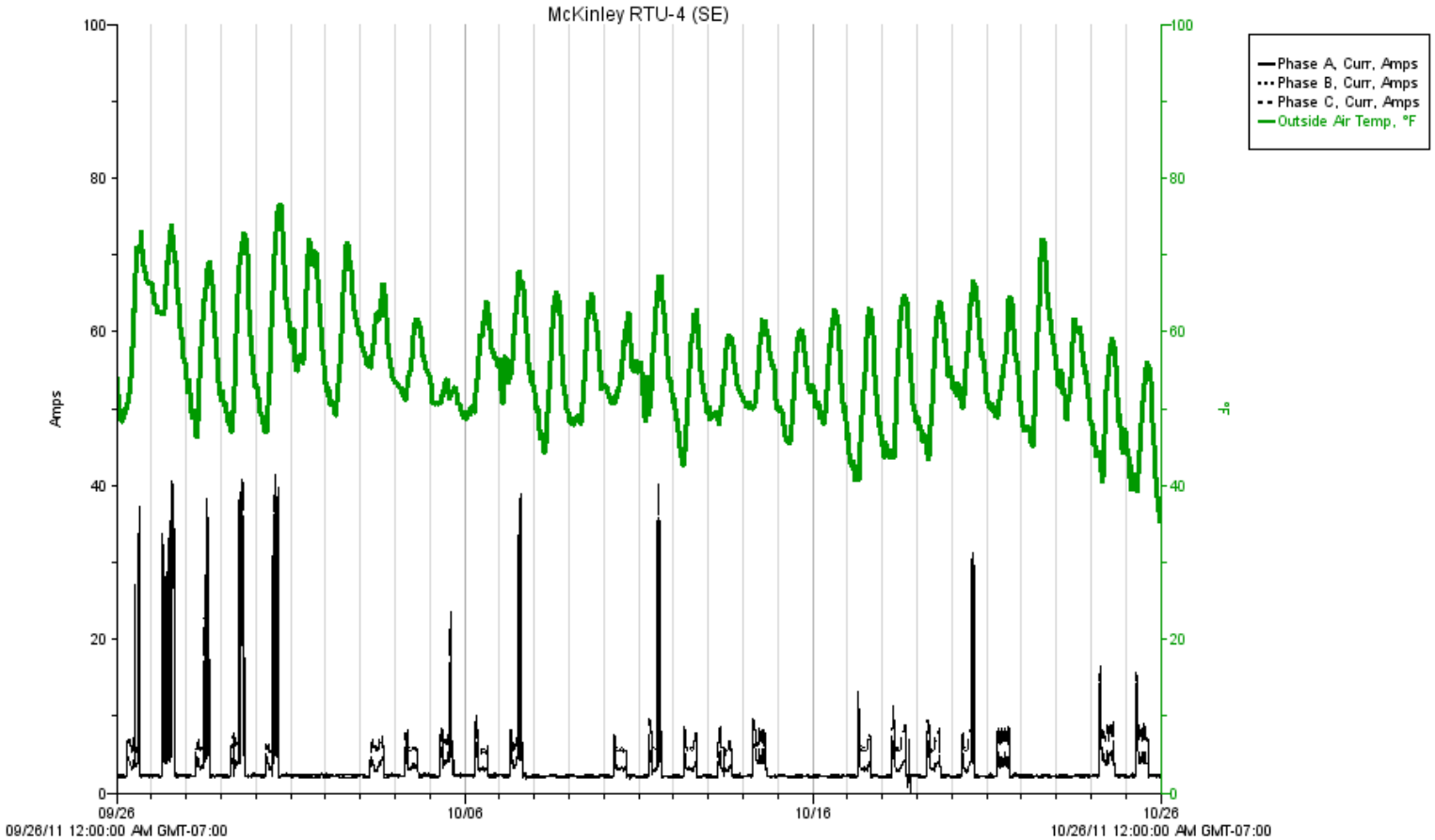
Graph shows 1 day of data for RTU-2.
Black line is the amp reading for all three phases of power coming into the Air Handler, measured inside the air handler.
Green line is the outside air temperature.
On this warm day the unit started at 7 am. The air conditioning compressor cycles on throughout the day as the temperature rises over 60 F. Unit shuts off and remains off after 4 pm.



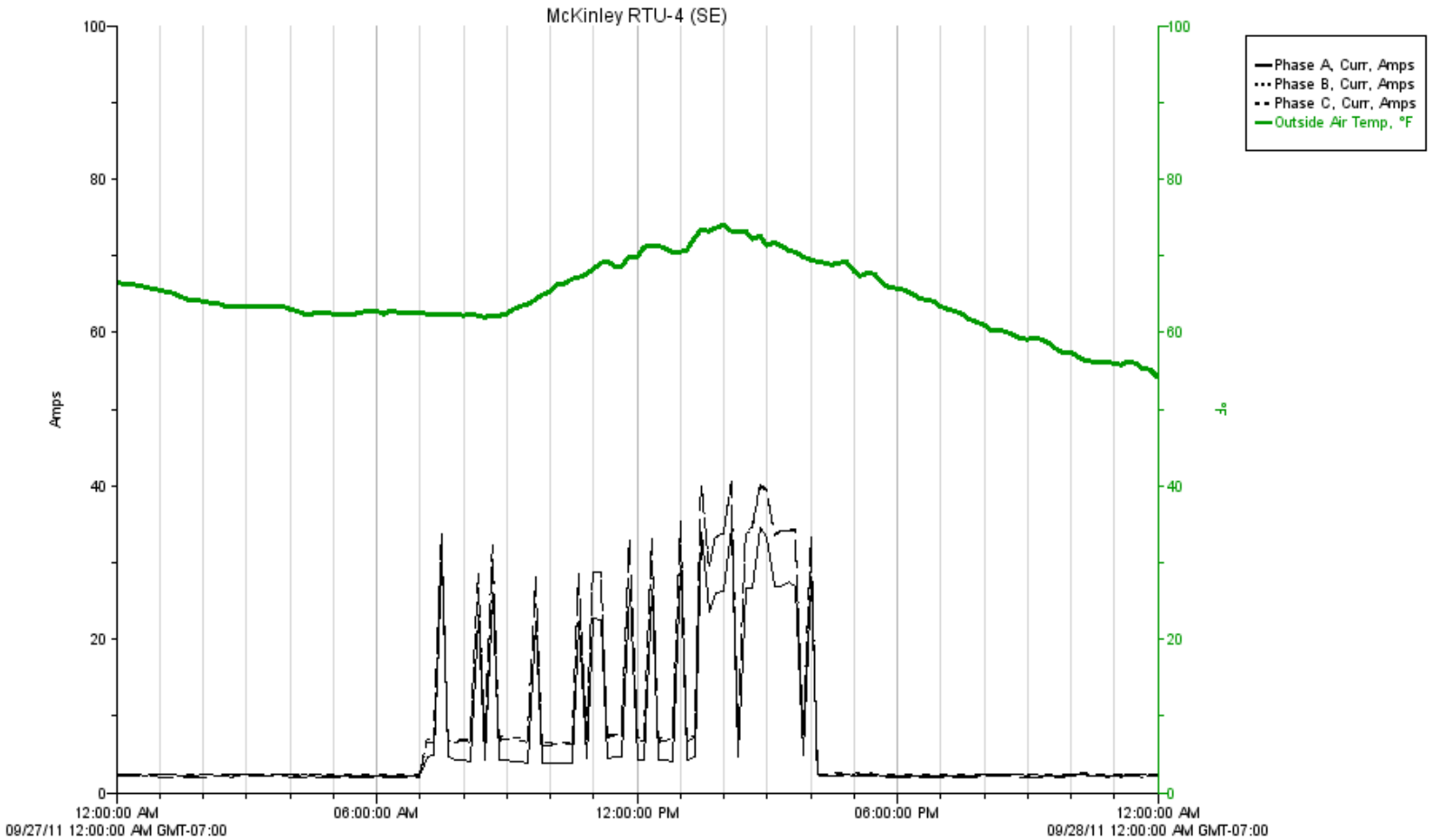
Graph shows 30 days of data for RTU-3.
Black line is the amp reading for all three phases of power coming into the Air Handler, measured inside the air handler.
Green line is the outside air temperature.
Units normally only operate M-F during scheduled hours, unless there is an after-hours over-ride event, in which case the units only operate for an hour at a time.
See following page for a typical daily usage pattern.



Graph shows 1 day of data for RTU-3.
Black line is the amp reading for all three phases of power coming into the Air Handler, measured inside the air handler.
Green line is the outside air temperature.
On this warm day the unit started at 7 am, and the air conditioning compressor cycled on as the outside air temperature was over 60 F. Unit shuts off and remains off after 4 pm.



Graph shows 30 days of data for RTU-4.
Black line is the amp reading for all three phases of power coming into the Air Handler, measured inside the air handler.
Green line is the outside air temperature.
Units normally only operate M-F during scheduled hours, unless there is an after-hours over-ride event, in which case the units only operate for an hour at a time.
See following page for a typical daily usage pattern.



Graph shows 1 day of data for RTU-4.
Black line is the amp reading for all three phases of power coming into the Air Handler, measured inside the air handler.
Green line is the outside air temperature.
On this warm day the unit started at 7 am. The air conditioning compressor cycled on throughout the day as the outside air was above 60 F. Unit shuts off and remains off after 4 pm.

MEASUREMENT OF ENERGY SAVINGS DIRECTLY FROM UTILITY BILLS

The measurement of actual energy savings used for the energy savings guarantee will be based on the actual utility bills from January 1, 2012 through December 31, 2012.

We are presenting here the baseline utility bills that are used for the existing condition, and the recent bills that were collected during the construction period.

As the 2012 utility bills arrive they will be compared to the baseline energy bills to determine the actual measured energy savings.

The energy savings will be multiplied by the utility rates used in our contract to determine the annual $ savings.

Utility Rate Assumptions

The following costs were used in our Energy Services Agreement, and they will be used to determine the annual energy cost savings. These costs will be applied to the measured energy savings to determine the measured energy cost savings.

cost per kWh	$0.048
cost per therm	$1.06

ENERGY USE AFTER UPGRADE - Measured Electric Energy Savings

Electric Savings Analysis

Baseline Energy Use				
Month	2008 kWh	2009 kWh	2010 kWh	Avg kWh BASELINE
Jan		48,048	48,270	48,159
Feb		46,920	53,975	50,448
Mar		53,880	47,491	50,686
Apr		49,427		49,427
May		53,158		53,158
Jun		63,238		63,238
Jul		49,886		49,886
Aug		57,175		57,175
Sep		71,462		71,462
Oct		57,418		57,418
Nov	48,596	53,710		51,153
Dec	57,825	49,621		53,723
TOTAL	106,421	653,943	149,736	655,932

Energy Use During Construction			
Month	2011 kWh	Saved kWh	Saved kWh
Jan			
Feb			
Mar			
Apr			
May			
Jun			
Jul	11,136	38,750	78%
Aug	26,754	30,421	53%
Sep	38,693	32,769	46%
Oct	20,331	37,087	65%
Nov	23,309	27,844	54%
Dec			
TOTAL	120,223	166,871	58%

Energy Use After Upgrade			
Month	2012 kWh	Saved kWh	Saved kWh
Jan			
Feb			
Mar			
Apr			
May			
Jun			
Jul			
Aug			
Sep			
Oct			
Nov			
Dec			
TOTAL			

Note 1: Construction of these projects started in July, 2011, and was substantially complete in the fall of 2011. The energy savings achieved during the construction period are shown here for reference only; they are not a part of the energy savings guarantee.

Note 2: The energy savings guarantee period is from January 1, 2011 through December 31, 2012.

ENERGY USE AFTER UPGRADE - Measured Natural Gas Energy Savings

Natural Gas Savings Analysis

Baseline Energy Use				
Month	2008 therms	2009 therms	2010 therms	Avg therms
Jan		5,487	4,892	5,190
Feb		4,052	3,619	3,836
Mar		3,405		3,405
Apr		1,403		1,403
May		591		591
Jun		153		153
Jul		88		88
Aug		92		92
Sep		187		187
Oct	1,317	1,233		1,275
Nov	2,879	3,477		3,178
Dec	7,211	6,471		6,841
TOTAL	11,407	26,639	8,511	26,238

Energy Use During Construction			
Month	2011 therms	Saved therms	Saved therms
Jan			
Feb			
Mar			
Apr			
May			
Jun			
Jul	47	41	47%
Aug	159	-67	-73%
Sep	235	-48	-26%
Oct	402	873	68%
Nov	1,851	1,327	42%
Dec			
TOTAL	2,694	2,126	44%

Energy Use During Construction			
Month	2012 therms	Saved therms	Saved therms
Jan			
Feb			
Mar			
Apr			
May			
Jun			
Jul			
Aug			
Sep			
Oct			
Nov			
Dec			
TOTAL			

Note 1: Construction of these projects started in July, 2011, and was substantially complete in the fall of 2011. The energy savings achieved during the construction period are shown here for reference only; they are not a part of the energy savings guarantee.

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Project Experience	Mr. Kinzer has provided ESCO project management services for Abacus from 1988 to 2005. He has completed over 40 performance contracts in excess of $50 million. Mark's expertise includes the completion of central heating/cooling plants, HVAC improvements, energy management systems, building envelope improvements, lighting improvements, water conservation, high voltage power system improvements on projects ranging in size from $100,000 up to $12 million. <u>Project History includes</u>: • Central Washington University $23M • Olympia Capitol Campus $12M • Clark College $1.2M • Oregon Employment Building $4M • Washington Correction Center Steam Plant • Clallam Bay Correction Center Prison Industries • WA State Penitentiary Steam Line Replacement • Trident Submarine Base Energy Management System • Puget Sound Naval Shipyard Energy Conservation • Malmstrom Air Force Base Energy Mgmt System • Fairchild Air Force Base Energy Management System • University of Washington Steam Plant • Wenatchee Valley College • Peninsula College • South Puget Sound Community College • Green River Community College • Renton Technical College • Seattle Central Community College • Shoreline Community College • Skagit Valley College
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Years of Industry Experience	30
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Education	University of Washington; Seattle, Washington BS in Mechanical Engineering
Years of Industry Experience	21
Professional Licenses	N/A
Certifications	EIT LEED Workshop
Affiliations	APEM ASHRAE BOMA

Rich Davis *Senior Energy Engineer* *Engineering Supervisor*	*Responsible for execution, oversight and completion of all energy analysis services provided by Abacus*
Project Experience	In his role as Engineering Supervisor for Abacus, Rich is responsible for all aspects of energy analysis delivery. His expertise is both the identification and calculation methodology of energy efficiency measures in new and existing facilities. He is responsible for directing, performing and reviewing all energy analysis work on behalf of the company. Rich has particular experience with the Oregon SB 1149 K-12 schools programs as well as the Business Energy Tax Credit. <u>Recent SB 1149 K-12 Projects include</u>: • Portland Public Schools, Portland, OR. • Beaverton School District, Beaverton, OR • Silver Falls School District, Silverton, OR • Oregon City School District, Oregon City, OR • Lincoln City School District, Lincoln City, OR • Roseburg School District, Roseburg, OR • Riddle School District, Riddle, OR • Winston Dillard School District, Winston, OR • Gresham Barlow School District, Gresham, OR • Days Creek School District, Days Creek, OR • Central Linn School District, Albany, OR • N Clackamas School District, Clackamas, OR
Education	Rochester Institute of Technology BS in Energy Engineering Technology
Years of Industry Experience	21
Professional Licenses	N/A
Certifications	Certified Energy Manager LEED Applied Professional Certified M&V Profession Certified Energy Auditor
Affiliations	APEM ASHRAE AEE

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Certifications	Several company accredited certifications, including HVAC engineering, DDC systems and Project Management
Years of Industry Experience	29
Professional Licenses	N/A
Affiliations	Member: ASHRAE and APEM

Energy Conservation Measure Data Worksheet

Yakima School District

FIFTEEN YEAR FINANCE OPTION

McKinley & Garfield Elementary Schools - Energy Retrofit

ABACUS RESOURCE MANAGEMENT COMPANY

PROGRAM SAVINGS:	Inflation	YEAR 1 2013	YEAR 2 2014	YEAR 3 2015	YEAR 4 2016	YEAR 5 2017	YEAR 6 2018	YEAR 7 2019	YEAR 8 2020	YEAR 9 2021	YEAR 10 2022	YEAR 11 2023	YEAR 12 2024	YEAR 13 2025	YEAR 14 2026	YEAR 15 2027	TOTAL
ENERGY SAVINGS																	
Demand Side Savings	3%	$57,000	$58,710	$60,471	$62,285	$64,154	$66,079	$68,061	$70,103	$72,206	$74,372	$76,603	$78,901	$81,268	$83,706	$86,218	$1,060,138
Supply Side Savings																	
Rate Change Savings		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
SUB TOTAL ENERGY SAVINGS		$57,000	$58,710	$60,471	$62,285	$64,154	$66,079	$68,061	$70,103	$72,206	$74,372	$76,603	$78,901	$81,268	$83,706	$86,218	$1,060,138
OPERATIONAL SAVINGS																	
Ops Savings 1	0%	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Ops Savings 2	0%	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Ops Savings 3	0%	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Ops Savings 4	0%	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Ops Savings 5	0%	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Ops Savings 6	0%	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Miscelleneous Savings	0%	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
SUB TOTAL OPS SAVINGS		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL SAVINGS		**$57,000**	**$58,710**	**$60,471**	**$62,285**	**$64,154**	**$66,079**	**$68,061**	**$70,103**	**$72,206**	**$74,372**	**$76,603**	**$78,901**	**$81,268**	**$83,706**	**$86,218**	**$1,060,138**

PROGRAM COSTS:		
PROJECT COST (GUARANTEED MAXIMUM PRICE)	$1,835,909	
LESS OWNER CAPITOL (NON-ENERGY PROJECT COSTS)	$300,000	
LESS ESTIMATED UTILITY INCENTIVES	$214,000	
LESS DEPARTMENT OF COMMERCE GRANT	$715,000	
NET PROJECT COST	$606,909	
LOAN FEE	$9,104	
FINANCED AMOUNT	$616,013	
PROJECTED INTEREST RATE	3.00%	
ESTIMATED LOAN PAYMENT	($51,601)	(per year)

	Inflation	YEAR 1 2013	YEAR 2 2014	YEAR 3 2015	YEAR 4 2016	YEAR 5 2017	YEAR 6 2018	YEAR 7 2019	YEAR 8 2020	YEAR 9 2021	YEAR 10 2022	YEAR 11 2023	YEAR 12 2024	YEAR 13 2025	YEAR 14 2026	YEAR 15 2027	TOTAL
Loan Payment		$51,601	$51,601	$51,601	$51,601	$51,601	$51,601	$51,601	$51,601	$51,601	$51,601	$51,601	$51,601	$51,601	$51,601	$51,601	$774,019
Monitoring & Varification (M&V)	0%	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Maintenance and Operation (M&O)	0%	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL COST		**$51,601**	**$51,601**	**$51,601**	**$51,601**	**$51,601**	**$51,601**	**$51,601**	**$51,601**	**$51,601**	**$51,601**	**$51,601**	**$51,601**	**$51,601**	**$51,601**	**$51,601**	**$774,019**
NET CASH FLOW		**$5,399**	**$7,109**	**$8,870**	**$10,684**	**$12,553**	**$14,477**	**$16,460**	**$18,502**	**$20,605**	**$22,771**	**$25,002**	**$27,300**	**$29,667**	**$32,105**	**$34,616**	**$286,119**

Net Present Value @ 1.00% = $259,116

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