A TECHNOLOGY DEMONSTRATION AND VALIDATION PROJECT FOR INTELLIDYNE ENERGY SAVING CONTROLS

FINAL REPORT

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ABSTRACT

The objective of this project is to validate the energy savings and pollution reduction caused as a direct result of using the Intellidyne control technology on heating and cooling systems.

Whenever performing a comparative analysis, it is important to eliminate as many variables as possible and to establish a sound base-line for comparison. Testing performed during this project utilized an alternating-day method which allows for a comparative analysis to be performed (days "with" and days "without" the Intellidyne Controls) without the need for historical data that may or may not be accurate or indicative of the test site during the time of testing. The alternating day methodology also has the benefit of reducing the effects of changes in ambient weather conditions, and any day-of-week or time-of-day sensitivities that would have a bearing on energy usage.

Results have demonstrated that the Intellidyne controls do indeed reduce the energy consumption and pollution of heating and cooling systems. The Intellidyne controls are an after-market add-on (retrofit) type of control that targets demand type heating and cooling systems for residential and commercial end-users. The Intellidyne technology takes advantage of an inherent design flaw that requires the heating or cooling system to be sized for the worst-case scenario which occurs infrequently throughout the life-cycle of the system. These controls achieve energy savings by dynamically adjusting the dead-band of the operating-control of the energy system in accordance with the system's energy load. Pollution reduction is a byproduct of the reduction of burner cycling caused by the Intellidyne controls.

It is important to remember that these controls are add-on (retrofit) devices and are not meant to correct control deficiencies. The data provided demonstrates that the Intellidyne controls do not cause any appreciable change in user comfort or control levels while achieving savings at low cost relative to other measures that would net the same results.

It is recognized and acknowledged by Intellidyne that prudent maintenance of systems and controls can and will result in energy reductions. However in the real world this is seldom done.

KEY WORDS: energy saving, energy reduction, energy efficiency, fuel saving, fuel reduction, electric saving, pollution reduction, pollution saving, retrofit control, economizer.

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SUMMARY

Introduction

The patented IntelliCon control concept, invented and manufactured by Intellidyne LLC, is a retrofit product developed to reduce the energy consumption of oil and gas-fired boilers, and refrigeration and air conditioning equipment. The control uses measurements of system temperatures to estimate overall heating or cooling load and in response varies the operating "deadband" of the primary control with resultant reductions of energy consumption and cycling.

For boiler applications the control can have an added benefit in reducing air pollutant emissions. During startup and shutdown there are elevated levels of emissions associated with incomplete combustion including smoke, CO, and hydrocarbons. Reducing burner cycling rates will reduce the total amount of these emissions.

Objectives

1. To quantify, under realistic field conditions, the impact that the IntelliCon control has on cycling rates and energy use in boiler, air conditioning, and refrigeration applications.
2. In the case of oil-fired boilers a further objective is to evaluate the impact on air pollutant emissions during typical cyclic operation.

Test Procedures

The work included two key parts: The instrumented field studies of boiler, air conditioning, and refrigeration applications and measurements in the laboratory to allow estimates to be made of the impact of the control on boiler air pollutant emissions.

At field test sites short-term validation analysis can only be performed properly by the elimination and reduction of as many variables as possible, and through the analysis of some of the data on a purely mathematical basis, and some of the data on a statistical basis. After many years of testing by Intellidyne, it was determined that the best way of evaluating these types of controls was to alternate the days that the controls were "in" and "out" of the circuit and to be able to time-stamp and log the required data in such a fashion that it could be segregated into the two different modes of operation (in-circuit and out-of-circuit). Alternating the days that the Intellidyne control is "in" and "out" of the circuit has the major advantage of generating base-line data (on out-of-circuit days) without having to depend upon historical data from the site that may or may not be relevant or accurate for the test period. Other advantages are: The minimization of variations due to time-of-day sensitivity, day-of-week sensitivity, degree-day effects, solar effects, etc.

Intellidyne installed control equipment at each site to implement the day-on (in-circuit), day-off (out-of-circuit) control scheme. Instrumentation was installed to record each compressor or burner "on" and "off" event with a resolution of 0.5 seconds. Total run time of the burner or compressor was used to prepare comparisons of the energy use during day-on and day-off days. For the purpose of this project, this approach required that all burners be of the fixed firing rate or "on/off" type, i.e. not modulating. Local outdoor air temperature measurements were made to allow run times to be compensated for estimated heating and cooling loads.

Space temperatures in the tested buildings were monitored for both heating and air conditioning applications. In refrigeration applications the temperature of the refrigerated space was monitored. In all cases this was done to ensure that the use of the control did not adversely impact the desired end result – comfort or temperature control.

Measurements were also made at the test site of the solar load to enable possible evaluation of the impact of cloud cover on the heating or cooling loads. These were considered for information only and not used in the analysis of energy use reductions only because of the uncertainty associated with correcting for this factor.

In work done at Brookhaven National Laboratory (BNL) – the impact of the control on cycling rates was measured using typical residential heating equipment. An analysis was then done of the impact of the control on air pollutant emissions including CO, NOx, hydrocarbons, and filterable particulates. This analysis was based on prior studies that have been done of steady state and cyclic air pollutants from small oil-fired boilers.

BNL also provided some support and oversight of the field studies, particularly those involving heating boilers. At several sites BNL installed temperature loggers to monitor both boiler cycling patterns and supply and return water temperatures. These measurements were used to confirm Intellidyne data on burner start and stop times, cycling patterns and total run times. At one site BNL examined in detail the correlation between daily burner run time and outdoor weather conditions based on local airport data.

Test Sites

Sites were selected to provide a broad range of applications typical of the potential market for the IntelliCon control. These were all commercial sector buildings including schools, libraries, office, hotel, and other applications. Table 1 below, provides a summary of the field sites and equipment types included in this evaluation.

Table 1. Field Sites Included in Project

Site		Application Type		
Name	Location	Boiler	Air Cond.	Refrigeration
Beech Street School	Islip, N.Y.	X		
Esteé Lauder	Melville, N.Y.	X[1]	X	X
Freeport Electric	Freeport, N.Y.	X		
Lynbrook Library	Lynbrook, N.Y.		X	
Marriott Hotel	Tarrytown, N.Y.	X	X	
Rohm and Hass	Freeport, N.Y.		X	
Quinnipiac Club	New Haven, Ct.	X		
Krinos Foods	Long Island City, N.Y.			X

1 Results from this location are not verifiable due to heating system and data logging equipment problems.

Results

For all of the sites tested an analysis of energy savings was completed using the standard format for presentation used by Intellidyne. Results are provided in Table 2, below and indicate energy savings, based on run time reductions, in the 10-20 % range.

Results of the BNL analysis of the run time / degree day correlation at one specific site, the Beech Street School are shown below in Figure 1 for cycling rate and Figure 2 for burner run time. This shows that the control is most effective under cold weather conditions, where the load is higher and this could be expected. Under mild conditions the burner will cycle only periodically when a heat call does occur.

Table 2. Energy Savings Summary with Return On Investment (ROI)

Test Site	Application	System Size (input)	Raw Savings	Degree-Day Adjusted Savings	Estimated Project Cost[7]	ROI[1]
Beech Street	Hydronic Heating	9.6 mmbtu	11.73%	12.6%	$7800	2.0[2]
Esteé Lauder	Air Conditioning	60 Ton	11.46%	10.6%	$1150	3.3[4]
Esteé Lauder	Refrigeration	15 HP	12.06%	12.06	$550	6.8[4]
Esteé Lauder[8]	Hydronic Heating	1.2 mmbtu	10.71%[8]	13.7%[8]	$4500	7.4[3]
Freeport Electric	Steam Heating	2.9 mmbtu	9.64%	10.08%	$4900	7.0[2]
Lynbrook Library (AC-1)	Air Conditioning	25 Ton	9.90%	11.53%	$1150	5.8[4]
Lynbrook Library (AC-2)	Air Conditioning	25 Ton	11.78%	13.37%	$1150	7.9[4]
Marriot Hotel	Dom. Hot-Water	2.4/1.2 mmbtu	8.28%	8.28%	$7800	9.7[3,5]
Marriot Hotel	Air Conditioning	50 Ton	10.30%	19.02%	$2000	1.2[4,6]
Marriot Hotel	Air Conditioning	10 Ton	10.44%	19.15%	$1150	19.4[4]
Rohm and Hass	Air Conditioning	7.5 Ton	12.05%	12.84%	$575	4.2[4]
Quinnipiac Club	Steam Heating	3.5 mmbtu	11.04%	14.68%	$9400	8.0[2,3]
Krinos Foods	Refrigeration	10 HP	10.27%	10.27	$550	11.7[4]

1 Operational Months (Approximate)
2 Assume 1 gallon #2 Oil = $2.00
3 Assume 1 Therm Natural Gas = $1.45
4 Assume 1 KWH = $0.15 (including all charges), Power Factor = 0.9
5 ROI calculation based on 1.2MMBTU input
6 ROI was calculated based on RAW savings and individual compressor run-times because of the different compressor sizes within the unit. Actual calculated savings for the test period was $1,713.
7 Assumes IntelliCon Controls installed on all units, even though some Boilers or Air Conditioners are only used as Standby systems. Project cost could be reduced by not installing controls on Standby systems.
8 Results from this location are not verifiable due to heating system and data logging equipment problems.

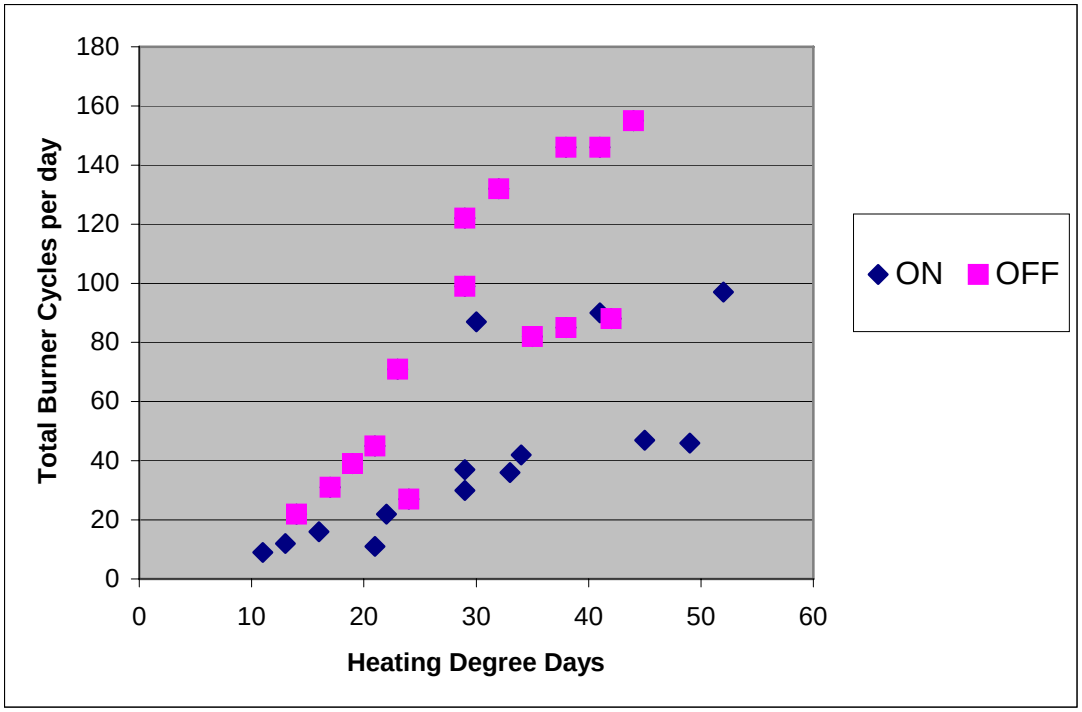

Figure 1. Impact of the control on burner cycling rates at the Beech Street School.

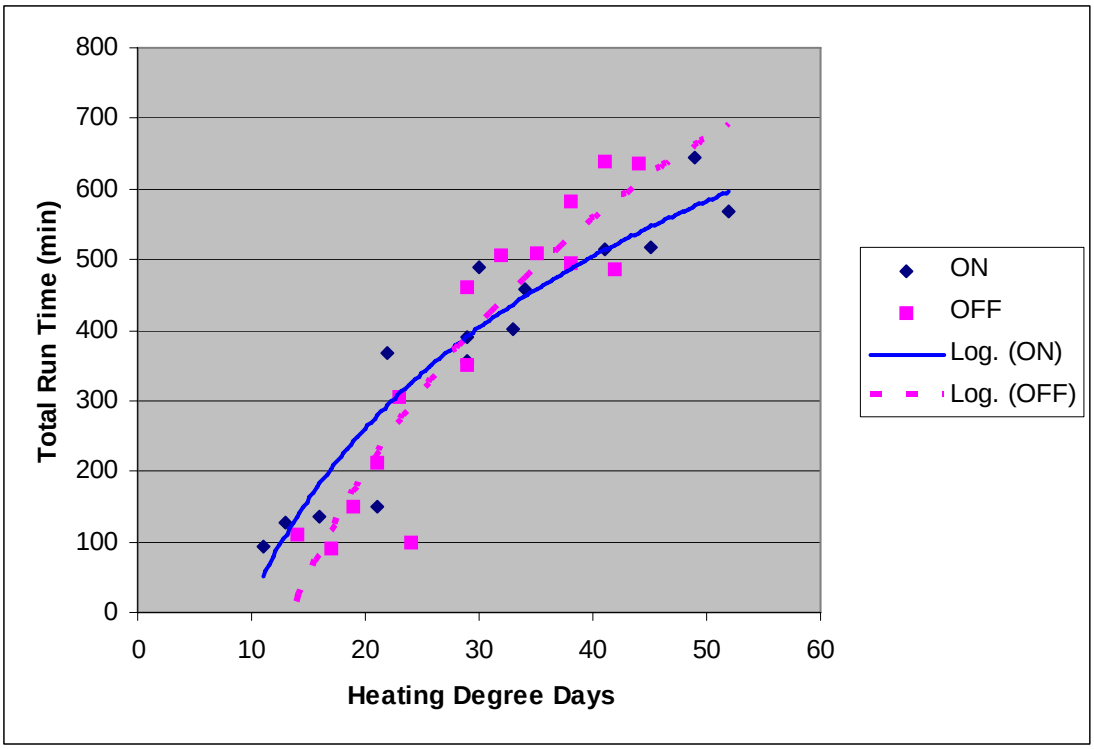

Figure 2. Correlation between total burner run time (both boilers combined) and heating degree days for the West Islip Beech Street School.

Results of the BNL analysis of emissions impact showed that pollutants related to incomplete combustion (CO, HC, and filterable particulates are decreased with lower cycling rates. Emissions of NOx, however, are increased as the burner operates longer in a fully hot condition. Results of one analysis, done for a simulated year, are shown in Table 3, below.

Table 3. Results of estimates of annual impact on number of cycles and emissions.

		Cycles per hour		Reduction due to control	
Parameter	units	3.2	1.2	total amount	%
cycles	total/year	15162	5686	9476	62.5
Particulates[1]	gms/year	117.7	70.1	47.6	40.4
HC	gms/year	28.7	19.7	9	31.4
CO	gms/year	2568	1355	1213	47.2
NO_x	gms/year	7079	7785	-706	-10

1. Particulates in this table are measured using a heated filter in accordance with the EPA-5 method.

Pollution Reduction Conclusion

Extrapolating from the above data, it appears that by outfitting 1 million homes with an annual fuel consumption of 1000 gallons of # 2 heating oil would reduce the amount of filterable particulates and hydro-carbons going into the atmosphere by between 1000 – 2000 Tons.

BNL Project Report on IntelliCon Operating Control

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December 8, 2006

Objective – Under sponsorship from New York State Energy Research and Development Authority (NYSERDA) Intellidyne is conducting field studies to evaluate performance of their IntelliCon operating control. The objective of the work done by Brookhaven National Laboratory (BNL) under this project, as described in this report, has been to provide technical support and verification on this evaluation.

Background – The IntelliCon control is of the general type that has been loosely termed as a "duty cycler", however the control does not directly turn the equipment "on" or "off" while trying to maintain any predetermined or preprogrammed setpoint. It can be used in heating or cooling (air conditioning and refrigeration) applications. In heating applications, the burner operation is controlled to better match the load. During a continuous call for hydronic heating the burner normally cycles on and off under control of the standard aquastat control with a fixed differential. The IntelliCon control senses the magnitude of the heating load (through a time analysis of discharge water temperature) and adjusts the lower temperature at which the burner fires during such a continuous call for heat. At low loads the water temperature at which the burner will fire again is reduced. In cooling applications, compressor operation is controlled in response to a temperature / load analysis, which is determined by analyzing the way that the primary control is cycling the compressor, and then modifying the compressor cycling pattern to better match the cooling load.

BNL Tasks – Under this project, BNL has completed two specific tasks: 1) laboratory evaluation of the impact of the IntelliCon control on cycling rates and air pollutant emissions associated with startup and shutdown transients and 2) support for field tests conducted by Intellidyne. This report provides a summary of the BNL work in both of these areas.

Impact of the IntelliCon Control on Cyclic Emissions.

Several comprehensive studies have been done on air pollutant emissions from oil-fired heating systems and these have focused on startup and shutdown transient emissions. During startup there is a peak in the emissions of unburned hydrocarbons, CO, and smoke. Several factors contribute to this including poor atomization during a brief period while fuel pressure is building up to its steady state value, a time delay

between the start of fuel injection and ignition, and a pressure pulse in the combustion chamber that leads to a momentary shift in air/fuel ratio to the rich side. A field study by Battelle Columbus Laboratories (BCL) in 1973 [1] evaluated this for both residential and commercial boilers. These startup emissions are always present but vary considerably from unit to unit. This field study was followed by a lab study in which the transient and steady state emissions were compared in more detail [2]. Table 4, below provides a summary from that report of steady state and transient emissions.

A report by Brookhaven National Laboratory (BNL) in 1986 [3] focused on the basic mechanisms of these transient emissions and the impact that selected burner improvements could have.

In 1990, BNL completed a comprehensive study of the emission factors of CO, hydrocarbons, smoke number, NOx, and particulates from 7 modern burner units in both steady state and cyclic operation [4]. In this case particulates were measured using an EPA-5 train method which involves hot filtering of undiluted flue gas. This is an important point because more recently focus has shifted towards use of a dilution system and filtering of cooled flue gas. The purpose of the dilution is to reproduce phenomena which occur when the flue gas leaves the chimney top and is cooled by ambient air. Under these conditions some species, such as sulfuric acid, condense and contribute significantly to the total measured particulates. Later studies with dilution systems are discussed further below.

Table 4. Summary of lab investigations of oil burner emissions [2]

Pollutant	units	Steady State	Cyclic
HC	lb/million Btu	.0006	.004
CO	lb/million Btu	.017	.025
particulates	lb/million Btu	.003	.003

Figure 3 shows, for example, typical emission transients observed with a conventional retention-head oil burner. These measurements were made at BNL as part of the study completed in 1990. For four retention-head oil burners which represent a typical sample of modern burners, Table 5 provides a summary comparison of steady state and cyclic emissions.

There is clearly considerable difference between results with different units. This is perhaps most notable in the case of NOx. NOx is lower in cyclic operation because of lower average combustion chamber temperature and this is most significant in cases where the appliance has a heavy refractory combustion chamber liner which may take a long time to heat up to steady state. Some of this available data is with older units which tended to have heavier refractory liners than modern equipment. In modern equipment, fairly small differences between steady state and cyclic NOx can be expected.

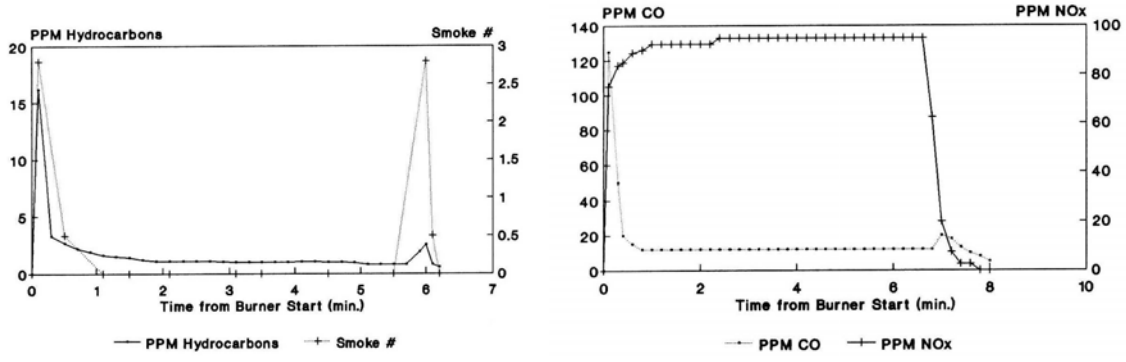


Figure 3. Typical emission transients measured with a retention head burner. [Ref. 4]

Table 5. Summary comparison of steady state and cyclic emissions for four typical retention Head Burners [3].

Pollutant	Units[1]	Steady State	Cyclic[2]
Burner 1. at 0.5 gallons per hour firing rate			
Particulates	lb/1000 gallons of fuel	.10	.41
HC	ppm	.31	1.94
CO	ppm	15.0	15.4
NOx	ppm	92.5	90.2
Burner 2. at 0.5 gallons per hour firing rate			
Particulates	lb/1000 gallons of fuel	.13	.38
HC	ppm	.91	---
CO	ppm	15.0	19.3
NOx	ppm	115.0	90.3
Burner 2 at 1.0 gallons per hour firing rate			
Particulates	lb/1000 gallons of fuel	.08	.28
HC	ppm	.69	.55
CO	ppm	15.0	14.7
NOx	ppm	172.5	119.7
Burner 3 at 0.5 gallons per hour firing rate			
Particulate	lb/1000 gallons of fuel	.14	.43
HC	ppm	.79	1.59
CO	ppm	15.0	33.7
NOx	ppm	83.5	80.0

1. Values in ppm are averaged over the firing period
2. Burner operating pattern fixed at 5 minutes on and 15 minutes off

To estimate the emissions reduction benefit associated with reduced cycling an approach is taken here in which the emissions are divided into two parts: 1) steady state and 2) those due only to the start/stop transients. For this, and based on the results presented in Table 5, average values are suggested in Table 6, below.

Table 6. Suggested Average Values for Cyclic and Steady State Emissions

Pollutant		Steady State	Cyclic	Ratio
Filterable Particulates	lb/1000 gallons	0.113	0.375	3.32
HC	ppm	0.60	1.36	2.28
CO	ppm	15.0	20.88	1.39
NO_x	ppm	115.9	95.1	0.82

Based upon a typical firing rate during the tests the values in Table 6 are converted to an emissions index (grams of pollutant per gram of fuel fired) in Table 7.

Table 7. Average Emission Levels from Table 6 Converted into an Emissions Index, EI=gms/kg fuel

Pollutant	EIs = Steady State Emissions Index	EIc = Cyclic Emissions Index
Filterable Particulates	.0157	.0521
HC	.00540	.0123
CO	.237	.330
NOx	3.01	2.47

Next, a new parameter EIt is defined as the emissions, in grams of pollutant, produced during each startup/shutdown cycle. This is the emission due only to the transient. Using this, the emissions during a single cycle can be calculated using:

Total emission during cycle = emission during steady state period + emission during transients

or

$$EIc \bullet \tau_{on} \bullet fr = EI_s \bullet \tau_{on} \bullet fr + EIt \qquad (1)$$

where:

EIc = Cyclic Emissions Index from Table 4 (gms/kg fuel)

EIs = Steady State Emission Index from Table 4 (gms/kg fuel)

EIt = Emissions Index Transient (gms/start-stop cycle, transient emission only)

τ_{on} = burner total firing time (hours)

fr = firing rate (kg/hour)

Applying this to the 5 minute on / 15 minute off- cycle used for the results in Tables 5, 6, and 7, and using an average firing rate of 0.5 gallons per hour, values for EIt for each pollutant can be calculated. Results are shown in Table 8.

Table 8. Emission index for start-stop transients, EIt, in grams per cycle

Pollutant	EIt
Filterable Particulates	$5.02 * 10^{-3}$
HC	$9.52 * 10^{-4}$
CO	$1.28 * 10^{-1}$
NOx	$-7.45 * 10^{-2}$

This parameter can be combined with EIs to allow calculation of the total emissions during a period which includes both steady operating periods and start-stop cycles using:

$$Etotal = EIs \bullet \tau_{total} \bullet FOT \bullet fr + CPH \bullet \tau_{total} \bullet EIt \qquad (2)$$

where:

$Etotal$ = total pollutant emissions during time period τ_{total} (grams)

τ_{total} = total time period (hours)

FOT = burner fractional on time during time period

other variables as defined above.

The specific emissions reductions that can be realized will, of course, depend very much upon the site and system details. Figure 4 shows for example data taken in the lab using a steel boiler fired at 0.75 gph with the IntelliCon control on and off. The aquastat in this case was adjusted for a differential of 5 ºF and clearly the control has a large impact on the cycling pattern. Average cycling frequency with the control off is 3.2 cycles per hour and on is 1.2 cycles per hour. Using this and assuming a FOT value of .1 with the control both on and off (providing equal input), the emissions over 10 hours of operating time can be calculated from the equation above and results are shown in Table 9, below.

Table 9 clearly shows strong reductions in the emission of pollutants that are associated with incomplete combustion but an increase in NOx which is primarily temperature driven. For the results in Table 6 and assumed burner fractional on-time of 0.1 was assumed. The effect of the control will clearly depend on this. If the burner on time is very high, than the effect of steady state emissions would be expected to be more

important that the start-stop emissions. To illustrate this, the results above have been recalculated for a value of FOT = 0.5 and this is presented in Table 10.

Table 9. Calculated Total Pollutant Emissions for Example 10 hour period with the IntelliCon Control both on and off. FOT = 0.1

Pollutant	Total emissions with a cycling rate of 3.2 per hour (grams)	Total emissions with a cycling rate of 1.2 per hour (grams)	% change from 3.2 to 1.2 cycles per hour
Filterable Particulates	.197	0.097	-50.8
HC	.043	0.024	-44.2
CO	4.65	2.085	-55.1
NOx	4.59	6.084	+32.4

Table 10. Calculated Total Pollutant Emissions for Example 10 hour period with the IntelliCon Control both on and off. FOT = 0.5

Pollutant	Total emissions with a cycling rate of 3.2 per hour (grams)	Total emissions with a cycling rate of 1.2 per hour (grams)	% change from 3.2 to 1.2 cycles per hour
Filterable Particulates	.343	.242	-29.4
HC	.093	.074	-20.4
CO	6.84	4.283	-37.4
NOx	32.51	33.998	+ 4.6

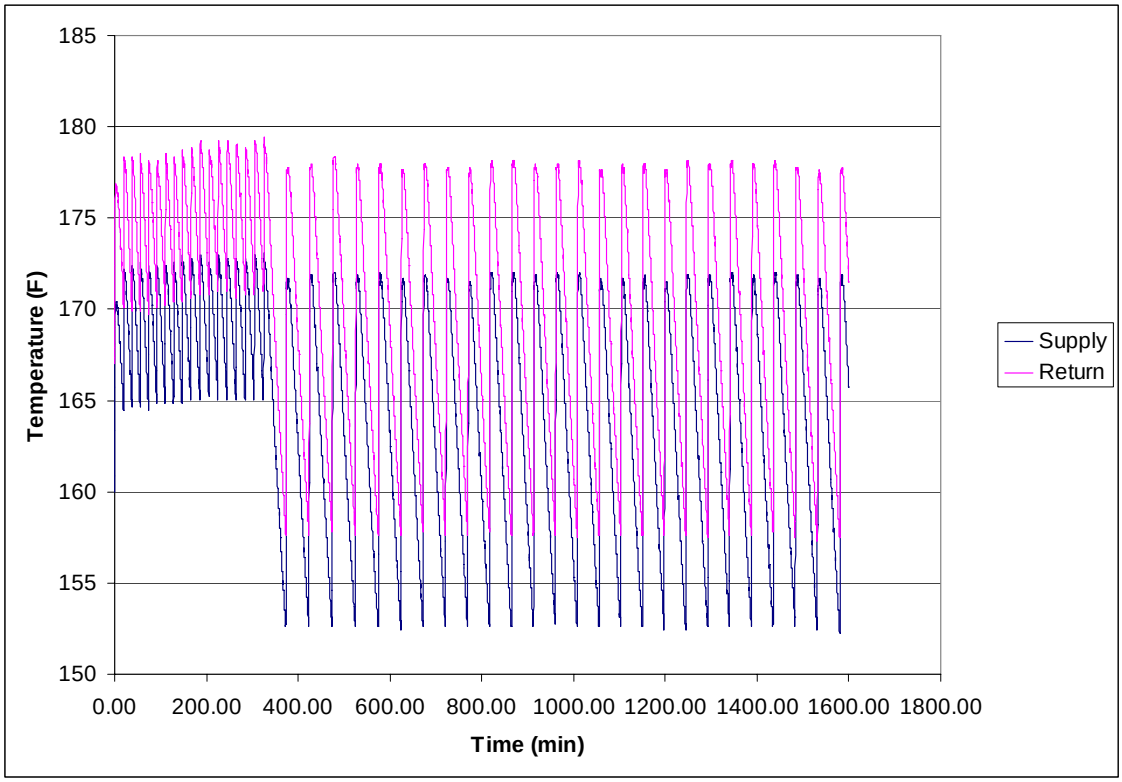


Figure 4. Cycling test of a steel boiler in the BNL lab. The IntelliCon control was turned "on" at the 300 minute point.

It can be noted from Figure 4, that the actual operating differential with the control off is higher than the setpoint differential of 5 ºF. During the course of this project several field tests were done and this is consistent with these observations i.e. the actual variation in supply water temperature during a response to a heat call is higher than the nominal differential. It is assumed that key contributing factors for this in residential systems include thermal mass and associated response time and non-uniformity of water temperature within the boiler. Also – the higher the nominal value for the operating differential the smaller the effects of a control concept of this type would be.

In this report the particulate measurements that have been reported are "filterable" particulates measured using an EPA-5 sampling train with undiluted flue gas and a heated filter. BNL has more recently been involved with measurements of PM-2.5, i.e. particulates smaller that 2.5 microns measured with diluted exhaust and an unheated filter. In the later case the measured particulates are very heavily dominated by sulfates which are not captured with high efficiency in the EPA-5 sampling train. With PM 2.5 measurements at BNL have not indicated a significant difference between steady state and cyclic emission factors (likely because of the sulfate influence, which is not related to incomplete combustion) and so a control like the IntelliCon would not be expected to have a significant influence.

Estimate of Annual Emissions Impact per Household

The results presented above can be used to prepare an estimate of the annual emissions impact that might be realized per household using the IntelliCon control. This is presented here for a winter heating load only (domestic hot water summer load not considered).

For this, the following assumptions for a typical household are used:

Average winter outdoor temperature = 42 ºF
Winter design temperature = 5 ºF
Annual oil consumption = 800 gallons
Firing rate = 0.75 gph
Oversize factor = 1.7

At the design temperature the burner fractional on-time, FOT_{design}, can be simply calculated as:

$$FOT_{design} = \frac{1}{1.7} = 0.59 \quad (3)$$

At the average outdoor winter temperature the burner fractional on-time, $FOT_{average}$, can be calculated by assuming the heating load is directly proportional to the difference between the balance point temperature, 65 ºF, and the outdoor temperature:

$$FOT_{average} = \frac{(65-42)}{(65-5)} \bullet 0.59 = 0.23 \quad (4)$$

The assumed annual oil consumption, firing rate, and $FOT_{average}$ lead to a heating season total hours of 4738.

To complete the emissions impact estimate it is further assumed that the average winter cycling rate with the control off is 3.2 cycles per hour and with the control on is 1.2 cycles per hour. Total winter emissions with the control on and off can then be calculated using equation 2, above. Results are presented along with impact on total cycles in Table 11.

Table 11. Results of estimates of annual impact on number of cycles and emissions.

		Cycles per hour		Reduction due to control	
Parameter	units	3.2	1.2	total amount	%
cycles	total/year	15162	5686	9476	62.5
particulates	gms/year	117.7	70.1	47.6	40.4
HC	gms/year	28.7	19.7	9	31.4
CO	gms/year	2568	1355	1213	47.2
NO_x	gms/year	7079	7785	-706	-10

Field Tests

BNL supported the field tests by reviewing the equipment installation and data reduction. At some of the sites, where boilers were tested BNL installed instrumentation to monitor the supply and return temperatures as well as the flue gas temperatures which were then used as a measure of run times and cycling rates. The most detailed measurements were made at the West Islip Beech Street Middle School which is described in more detail in the main body of the Intellidyne report.

The West Islip site has two oil-fired boilers with a firing rate of 35 gallons per hour. Because these burners operate with a fixed input rate the total run time of the burner can be used to estimate changes in the fuel use with the IntelliCon control.

Figure 5 shows a portion of the flue gas temperature data recorded by BNL and illustrates the marked difference in the cycling rates observed between alternating days when the IntelliCon control was on and off.

Using the recorded flue gas temperatures, BNL reviewed the Intellidyne analysis of specific burner start and stop times and essentially confirmed that the Intellidyne analysis correctly determined total burner run times. In the Intellidyne analysis local weather conditions were used to evaluate the energy savings associated with the IntelliCon control. BNL completed a review of the energy savings with the control using a somewhat different approach. Examining the run times of both boilers on a range of specific days over the entire test period BNL examined the correlation between total run time and heating degree days based on local airport hourly weather data (Islip, New York). This analysis was done only for non-holiday periods and only mid-week days (Tu, We, Th). The time period covered was January 14, 2005 to April 13, 2005.

Figure 6 shows the results for total number of burner cycles per day vs. heating degree days and clearly demonstrates a strong reduction in cycling. Figure 7 shows total burner run time per day. The effects of the control are certainly greater during cold weather when the load is greatest and this could be expected. Under warm weather when the heating load is very low the burner cycling might be dictated more by the response time of the building. Under very cold conditions, where there is essentially constant heat demand on the boilers the burner cycles under aquastat control constantly.

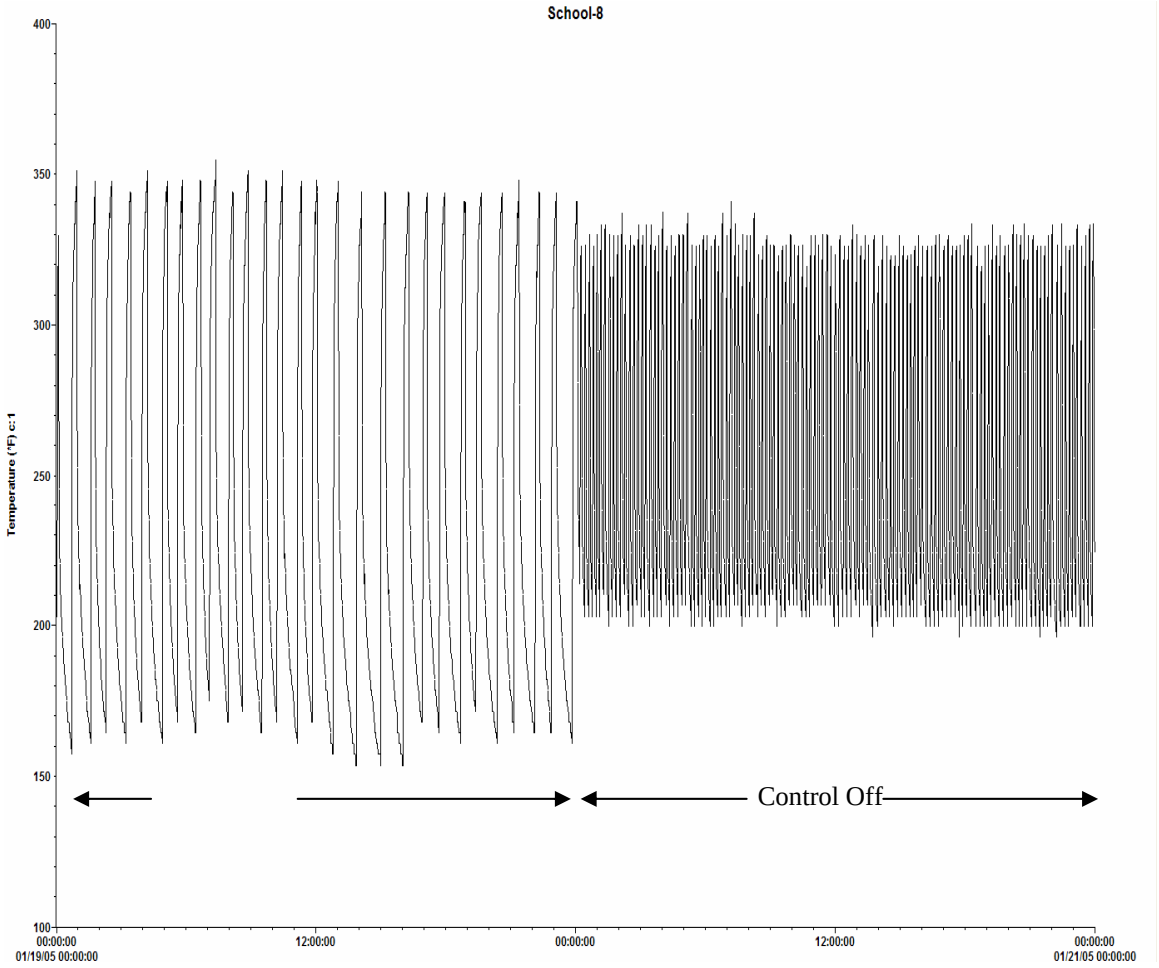


Figure 5. Example BNL flue gas temperature data recorded at the Beech Street School building over two days illustrating strong effect of the IntelliCon control on cycling rates.

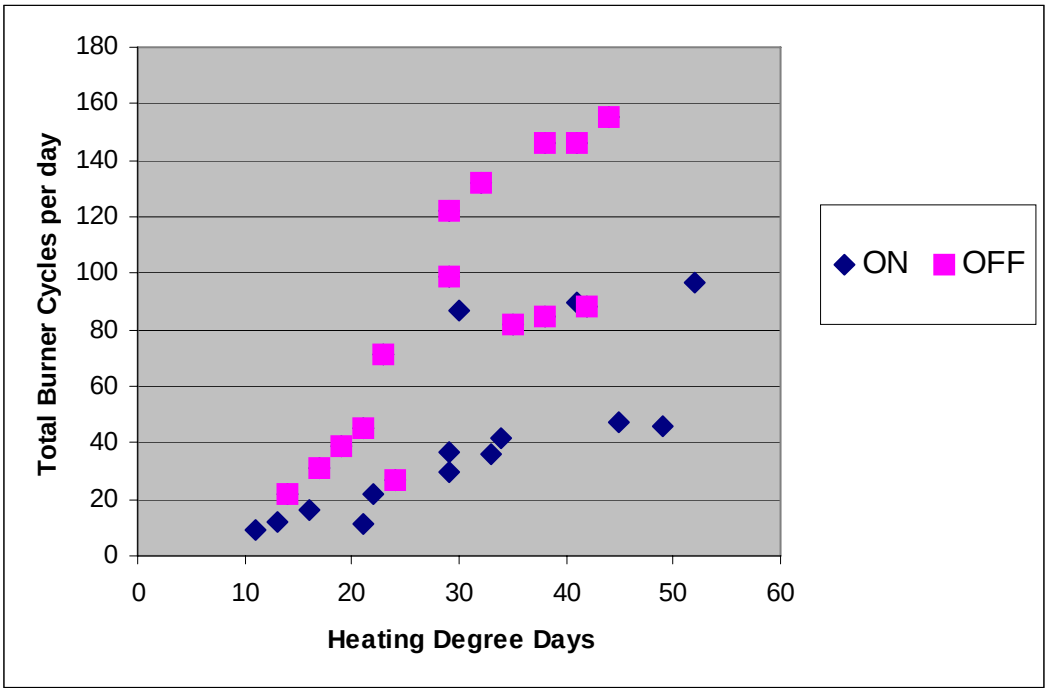


Figure 6. Test results at the West Islip Beech Street School. Impact of the control on burner cycling rates.

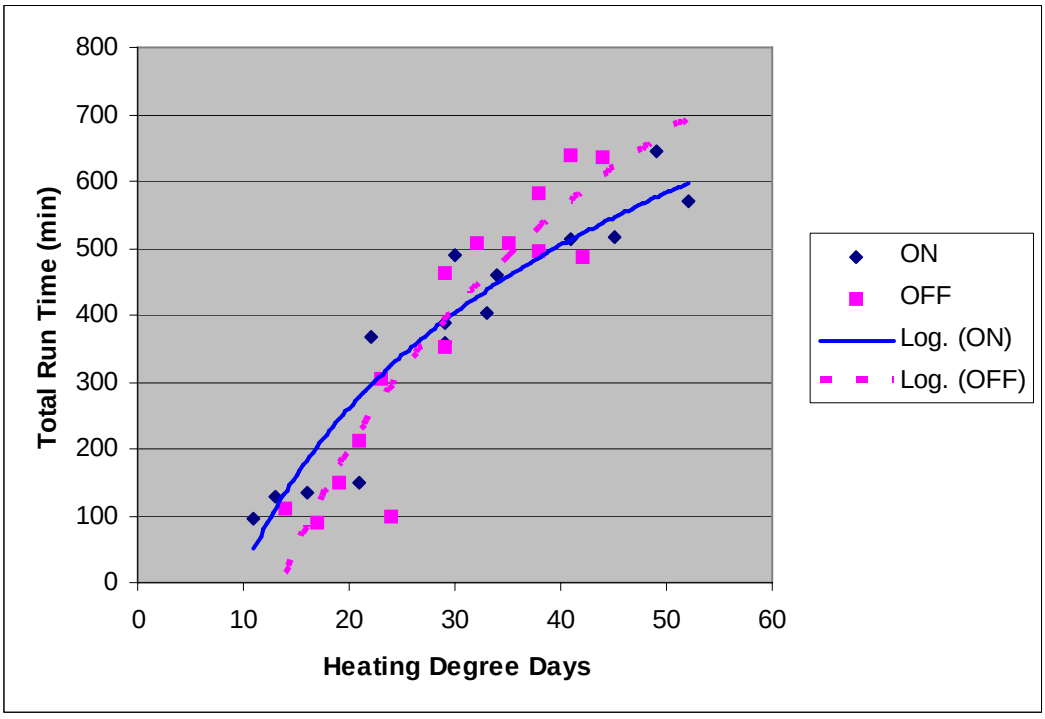


Figure 7. Correlation between total burner run time (both boilers combined) and heating degree days for the West Islip Beech Street School.

BNL Report References

1. Barrett, R.E., Miller, S.E., and Locklin, D.W., Field Investigation of Emissions from Combustion Equipment for Space Heating, Report EPA-R2-73-084a submitted to the U.S. EPA, 1973.
2. Barrett, R.E., Locklin, D.W. and Miller, S.E., Investigation of particulate emissions from oil-fired residential heating units, EPA-650/2-74-026, March 1974.
3. Butcher, T., McNeill, F., Celebi, Y., and Wegrzyn, J. Impact of Burner Design Features on Sooting in Residential Oil-Fired Systems, BNL Report 52102, November, 1986.4. Krajewski, R., Celebi, Y., Coughlan, R., Butcher, T., and McDonald, R. Emissions Characteristics of Modern Oil Heating Equipment, BNL Report 52249, July, 1990.

TECHNOLOGY OVERVIEW

The Intellidyne line of controls consists of add-on (retrofit) units that provide intelligent microprocessor control logic for commercial refrigeration compressors, residential and commercial air-conditioning compressors and residential and commercial steam and hydronic heating boilers. These control devices achieve energy savings by dynamically adjusting the dead-band of the operating-control of the energy system in accordance with the system's energy load. That load is deduced from measurements made by the control units.

The dead-band's cut-in point is dynamically adjusted in response to the load changes calculated by the controller. This allows the energy output of the controlled device to more closely match the energy requirements of the system, thereby minimizing overshoots in the temperature of the controlled space. The energy load on the system is deduced from continuous time history data measured by the control device itself. This control strategy is in distinction to most current electromechanical controls such as thermostats, aquastats, pressure controls etc. where the control decision is based only on an instantaneous measurement. By matching the operating cycle of the energy system more closely to the actual load requirements, energy savings of 10-20% can be achieved for almost all applicable installations. Higher savings are possible and have been documented in previous field tests.

While the patented technology used in the Intellidyne control line is both new and different from most energy savings control devices currently on the market, the technical basis for the energy savings is very similar to the application of "outdoor air reset controls" used on heating systems. There, extensive physical modification of the heating plant (e.g. - boiler bypass or variable speed pumps) to vary the system energy output, along with an installed outdoor air sensor and a site-specific "reset program" (to estimate the load) are combined to modify the average system energy output in response to load variations, attempting to match the output of the energy system to the required load.

By comparison a normal boiler with an aquastat or pressure control as the sole burner control always develops the same energy output (near maximum and determined by the average value of the aquastat or pressure control deadband). Since the system energy output is almost always significantly above the energy required by the controlled space, significant space temperature overshooting and boiler cycling occurs. The excess heat during the temperature overshoot is lost due to normal air exchange in the heated space while the excessive boiler cycling reduces boiler thermal efficiency during the transient portion of the cycle. This is why actual system thermal efficiencies are always much lower than the rated boiler steady-state thermal efficiencies

Outdoor reset control systems, although relatively expensive to install, have resulted in savings of 10-15% when the reset program has been carefully matched to the local site. These savings are obtained by adjusting the average output of the heating system to attempt to match the actual load. Since the outdoor air temperature sensor controls the changes in system output, the time scale for any control system changes is on the order of hours.

By comparison, the Intellidyne controls achieve better savings without requiring physical modification of the plant (other than electrical connection to the energy unit) or any outdoor sensor. They can be installed easily in 30 – 90 minutes and the installed costs of the device are typically one quarter or less that of outdoor air reset systems. Since the Intellidyne controls are dynamic controls, they self adjust to the site. With the Intellidyne control the energy load is obtained from a heating system by monitoring the output side of the boiler over an on- off cycle. Thus the time scale for the control to act is reduced to minutes.

While the discussion above is specific to heating systems, the principle of operation is the same for the air conditioning and refrigeration controls. The control continually monitors the system to detect load changes. In cases where the load is less than the system maximum output the control delays the start of the system to lower the energy output to match the reduced load. This process is varied dynamically from cycle to cycle.

Three issued US Patents protect the Intellidyne controls. The products are all market ready and currently being sold commercially. They have been extensively shown at major energy shows and featured in local newspapers. We are unaware of any similar products being currently marketed for air conditioning and commercial refrigeration. There is only one similar product for heating systems. It is only for larger commercial hydronic systems and inferior in energy savings. Typical payback periods for the Intellidyne controls are 1-3 years based on the installed costs of these devices. Paybacks of less than one year have been documented in many cases.

TESTING METHODOLOGY

Preface

The very nature of the Intellidyne line of products makes them difficult to analyze under laboratory conditions.

The IntelliCon products are adaptive to change and actually depend upon the normal load fluctuations that occur in real-world use of heating and cooling systems, to achieve savings.

Laboratory analysis under steady-state conditions will actually hamper the results obtained and is not the preferred method for determining savings for the Intellidyne product line due to the fact that the products reduce consumption by reducing the run-time of the energy consuming device. When the Intellidyne control allows the Burner to fire, or the Compressor to run, they operate the same as if the IntelliCon was installed or not. The Intellidyne controls depend upon the changing loads and using the "Total heat delivered or removed" methodology under varying load simulation conditions is not an accurate method for determining savings because under varying load conditions, it is not necessary to deliver or extract the same amount of heat [to maintain the temperature within the controlled environment].

In normal operating conditions, the heating or cooling system is relatively over-sized for the load imposed for all but the periods that it was designed for. Optimally that occurs when the demand on the system is equal to the capacity of the system. At this moment the system is operating at its highest level of efficiency whereby the only way to reduce energy consumption [at that time] would be to turn the unit off or to allow the temperature maintenance to vary more than the norm.

METHODOLOGY

Short-term validation analysis can only be performed properly by the elimination and reduction of as many variables as possible, and through the analysis of some of the data on a purely mathematical basis and some of the data on a statistical basis. After many years of testing it was determined that the best way of testing these types of products was to alternate the days that the controls were "in" and "out" of the circuit and to be able to time-stamp and log the required data in such a fashion that it could be segregated into the two different modes of operation. Alternating the days that the Intellidyne control is "in" circuit and "out" of circuit has the advantage of minimizing the variations due to time-of-day sensitivity, day-of-week sensitivity, degree-day effects, etc. The data logging equipment selected, and as described below, was optimally selected to yield the accuracy, reliability, and reproducibility necessary.

The sampling times for temperatures and solar intensity level logging was selected based upon the time constants usually seen in HVAC&R systems. It was therefore determined that the sampling rates would be on a fifteen (15) minute interval basis. Burner and compressor start and stop times are individually time-date stamped of their occurrence with an accuracy of ± 0.5 seconds. Run-time is determined by subtracting the stop-time stamp from the start-time stamp, and is an aggregate of the segregated data for in-circuit and out-of-circuit days.

Degree-day data for a given day is the average temperature for that day (96 samples) compared to the balance point (point where heating or cooling is generated). For the most part sixty-five degrees Fahrenheit (65˚F) was used (an industry standard) except where indicated differently.

Solar loading is a function of the data logger and is in units of Lumens per square-foot (Lum/ft²). It is integrated over a 15 minute sample interval (not an instantaneous value taken at the sample interval). This data is totalized and illustrated in histograms and probability curves for reference purposes only, since there is very little if any agreement on the proper way to apply such data. Therefore it was decided not to compensate for solar-loading, but to present the data for informational purposes.

Graphical histograms and probability charts have been generated and included for Outdoor Air Temperature, Solar Load, and Space/Process temperatures. The Space/Process temperature charts are included to demonstrate that the temperature maintenance of the space, or process, is virtually unaffected by the Intellidyne controls.

In order to properly evaluate the data, the following must be determined:

1. A baseline must be established. Baseline consumption data is the “use” or consumption information that is unaffected by the Intellidyne control (“out” of circuit). This may be derived during the pilot (which is what is done here) or from historical records. The advantage of deriving the base-line during the test process is that site specific degree-day and solar data may be determined as opposed to weather-service data that may or may not be indicative of the test site. Also, changes in the physical facility or the way that it is used, may not be reflected in historical data which would lead to wrong conclusions.

2. In order to properly compare the two consumption cases (Intellidyne control “in” and “out” of circuit), and determine the savings, it is necessary to adjust (or “normalize”) the data collected during the “in” circuit phase. The consumption data collected when the Intellidyne control was “in” circuit is “normalized” by compensating for the effects of the degree-day influences that occurred during the same phase of the test. This is accomplished mathematically by reducing the

segregated aggregate run-time data to a run-time per degree-day value for both cases and comparing these values; the resultant being the degree-day compensated savings value in percent.

Equipment Used For Validation Purposes

Specific timing and data logging devices are used to gather detailed information about the unit(s) being evaluated. Each device has been carefully selected for its reliability, capability and function. The individual devices INTELLIDYNE uses are explained below.

1. TIME CLOCK:
   Manufacturer: Tork Model: 8007V-0

   Used to switch the IntelliCon® product in and out of the circuit. This is done on a 24 hour basis. The result is that the IntelliCon® product is in control ("in" the circuit) one day and not in control ("out" of circuit) the next day. A 14 day time clock was selected so that a complete alternation of days that the Intellidyne unit is in control would result.

2. CURRENT SWITCH:
   Manufacturer: Veris Industries Model: Hawkeye 608/908
   or
   Functional Devices Inc. Model: RIBXGF

   The current switch is used to monitor when current is being drawn by the cooling/refrigeration compressor or heating burner. When current is sensed it is "On" when no-current is sensed it is off "OFF". The current switch is used in conjunction with the "Change-of-State" data logger.

3. "CHANGE–OF–STATE" DATA LOGGER:
   Manufacturer: Onset Computer Corp. Model: H06-001-02
   or
   Model: U11-001

   This device monitors and logs the "change-of-states" (the on / off status) of the unit being tested. It is used in conjunction with the CURRENT SWITCH, above, and time and date-stamps (logs) each change of status. By processing the logged data, the durations for each cycle can be determined.

4. “LIGHT INTENSITY” & OUTDOOR AIR TEMP DATA LOGGER:

   Manufacturer: Onset Computer Corp. Model: HLI
   or
   Model: UA-002-64

   This data logger is used to monitor and log Light Intensity and is used to determine the solar-load influence on the facility.

5. “T/Rh ” DATA LOGGER

   Manufacturer: Onset Computer Corp. Model: H08-003-02
   or
   Model: U10-003

   This data logger is used to monitor and log the temperature and relative humidity in the conditioned space.

6. “TEMPERATURE” DATA LOGGER

   Manufacturer: Onset Computer Corp. Model: H08-001-02
   or
   Model: U10-001

   This data logger is used to monitor and log the outdoor air temperature, and is used to determine the degree-day influence on the facility

TEST SITES LOCATIONS, DESCRIPTIONS, AND RESULTS

The information that follows in this section is comprised of the following:

1. A brief description of the facility, equipment and application.
2. A Summary of the savings results obtained.
3. Support documents that detail the specific run-times of the equipment and also data histograms and probability charts. These charts illustrate the ambient conditions which have been derived at the actual test site, and they also document the temperature maintenance of the system under test.

It is important to remember that these controls are add-on (retrofit) devices and are not intended to correct control deficiencies. The data provided demonstrates that the Intellidyne controls do not cause any appreciable change in user comfort or control levels while achieving savings at low cost relative to other measures that would net the same results.

Beech Street Middle School - West Islip, NY

Facility Size: ~110,000 Ft^2

Boiler Manufacturer: 2 each - Horizontal Steel Boilers with Iron Fireman burners.

Model: Not Available (Tags removed from boilers)

Capacity: 70 gallons per hour

Fuel Type: #2 Heating Oil

Application: Hydronic heating through convectors and base-board radiators, and domestic hot-water generation through heat-exchangers feeding two (2) 864 gallon storage tanks.

Area Served: Entire Facility

Savings Results: 11.73% Savings (RAW), 12.6% Savings Degree-Day adjusted

90 Pratt Oval
Glen Cove, NY 11542
Phone:516-676-0777
Fax: 516-676-2640

Test Report

Report No. 12153-1

Date: 11/01/06

Customer:
NYSERDA

Test Site Location:
Beach Street Middle School
7 Beach Street
West Islip, NY, 11795

Test Type: ☑ HEATING ☐ AIR CONDITIONING ☐ REFRIGERATION ☐ OTHER:

Product Tested: ☐ HW ☐ LCH ☐ LCS ☑ CHW ☐ CHS ☐ AC ☐ CAC ☐ RU ☐ OTHER:

Type of Equipment:

Manufacturer:	Horizontal steel boiler with an Iron Fireman burner
Model:	Not Available
Capacity / SetPt:	70GPH
Fuel Type:	#2 Fuel Oil
Application:	Hydronic Heat / Domestic Hot Water
Area Served:	Entire school
Misc.	Pre-Purge=60 sec., Post-PURGE=15 sec.

Test Start Date: 01/14/05

Test End Date: 04/13/05

No. of Days in Test: 90

BURNER RUN-TIME: ☑ in HRS. ☐ in MIN.

IntelliCon **ON-DAYS:** 296:58:06

IntelliCon **OFF-DAYS:** 336:25:50

RUN-TIME was reduced by: 11.73%

BURNER USAGE FACTOR:

IntelliCon **On-Days:** 27%

IntelliCon **Off-Days:** 31%

HEATING DEGREE-DAYS (FOR TEST PERIOD)

IntelliCon ON-DAYS: 1356

IntelliCon OFF-DAYS: 1343

Total Degree-Days: 2699

It was 1.0% **Colder on the On-Days.**

USAGE PER DEGREE-DAY

ON-DAYS: 0:13:08

OFF-DAYS: 0:15:02

SOLAR LOAD COMPENSATION: (Lumens/Sq. Ft.)

IntelliCon ON-DAYS: 14862

IntelliCon OFF-DAYS: 14597

It was 1.82% **Sunnier on the On-Days.**

BURNER CYCLING REDUCTION:

IntelliCon ON-DAYS: 1842

IntelliCon OFF-DAYS: 4728

Cycling was reduced by: 61.0%

Individual Runtimes

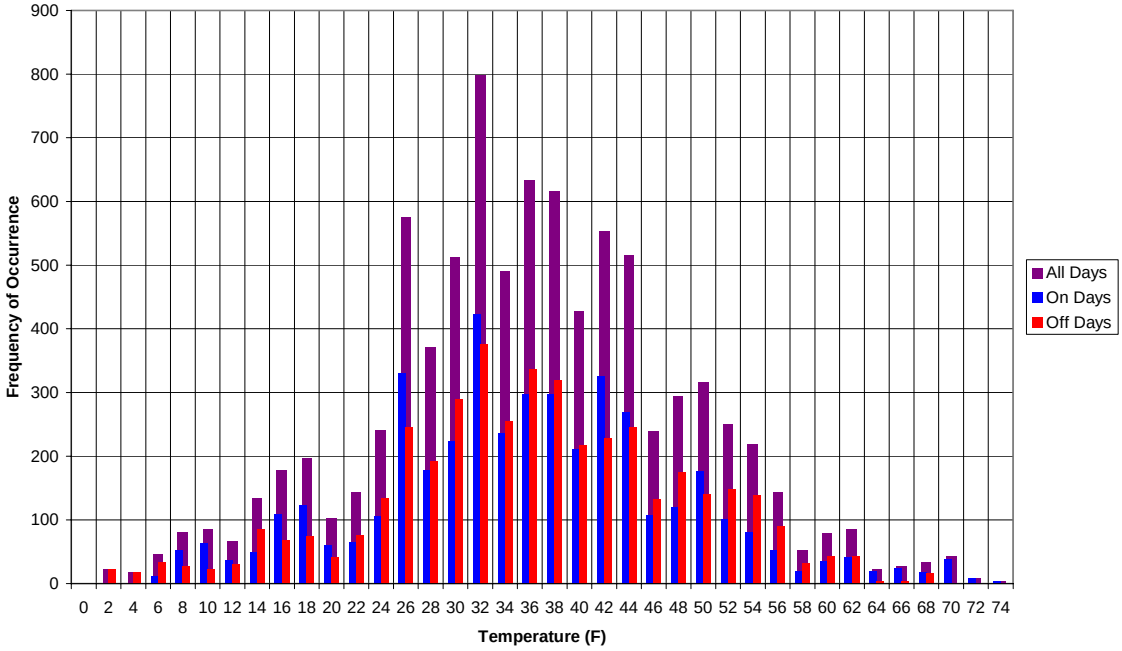
ON-Day	Boiler #1	Boiler #2
Runtime	211:36:52	85:21:13
Cycles	1335	507

OFF-Day	Boiler #1	Boiler #2
Runtime	289:36:40	46:49:10
Cycles	4251	477

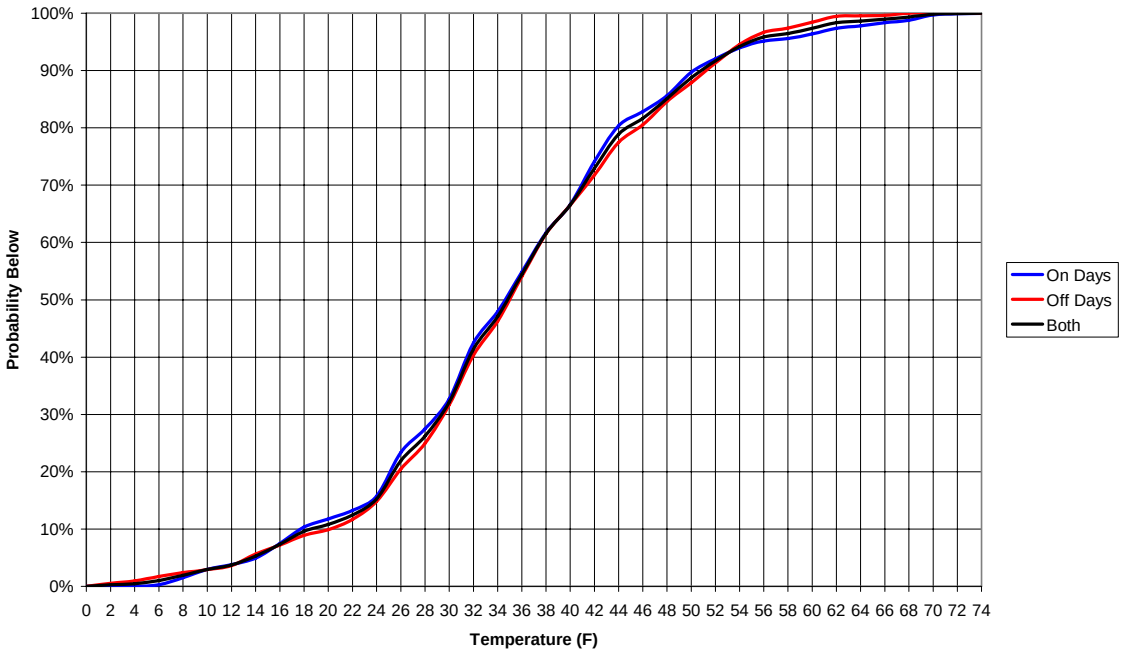
Adj. Savings = 12.60%

COMMENTS: Burner Run-Times are minus Pre & Post Purge cycle times (60 second Pre + 15 second Post = 75 seconds total per cycle).

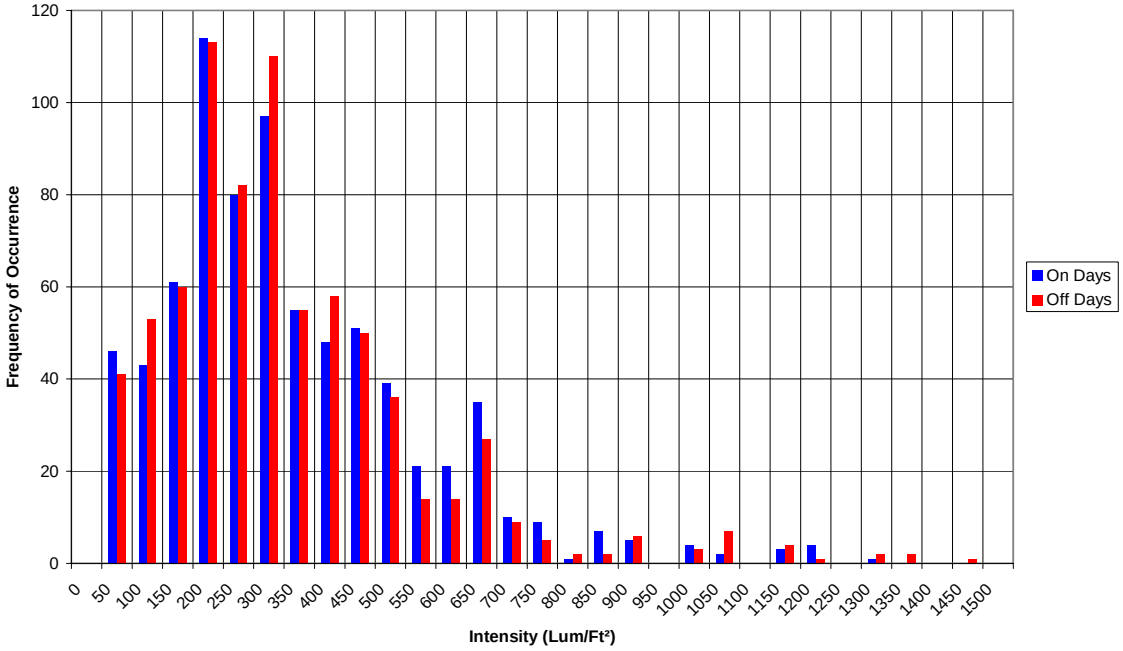
NYSERDA TEST - Beech Street School
Outside Air Temperature Histogram (01/14/05--04/13/05)



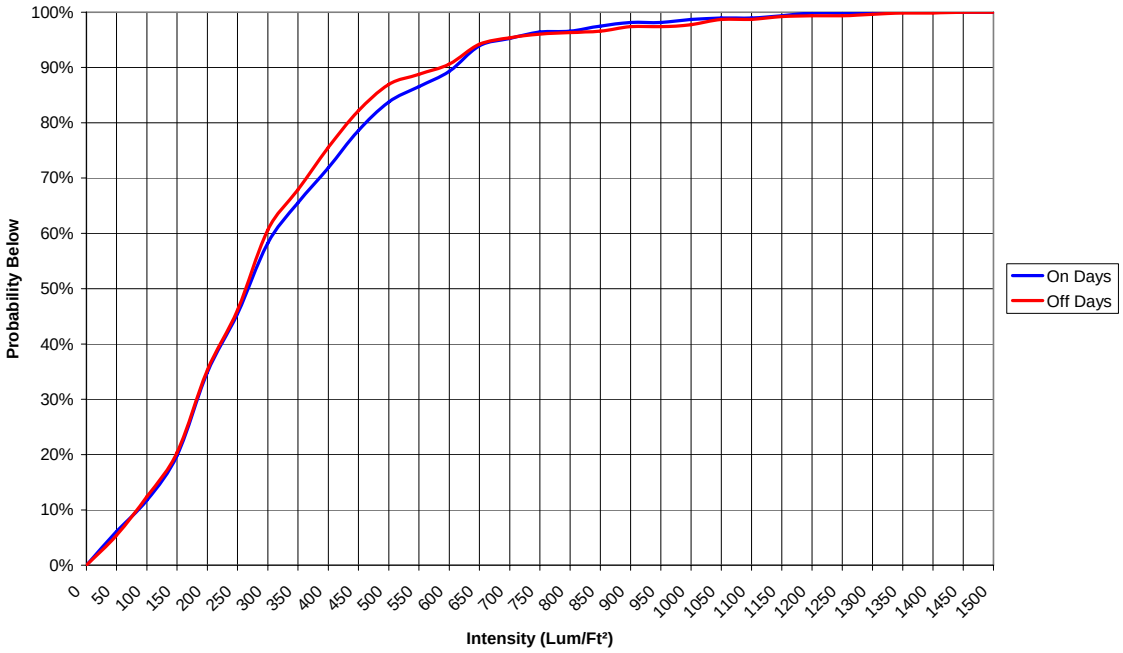
NYSERDA TEST - Beech Street School
Outside Air Temperature Probabilities (01/14/05--04/13/05)



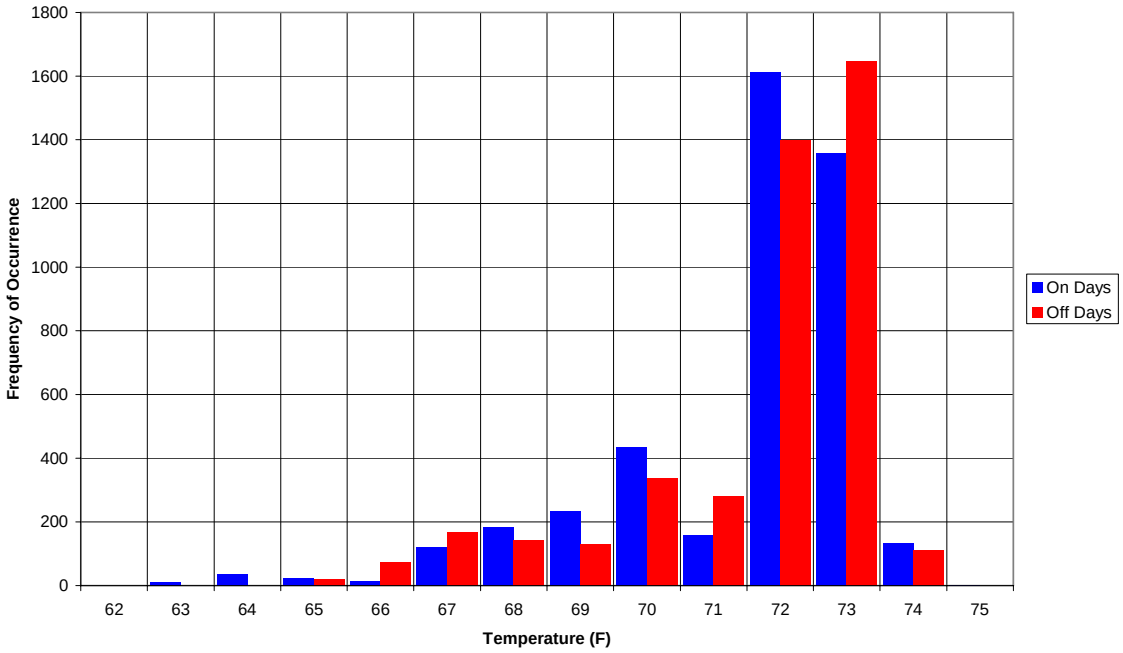
NYSERDA TEST - Beech Street School
Solar Load Histogram 7:00 am - 5:00 pm (01/14/05--04/13/05)



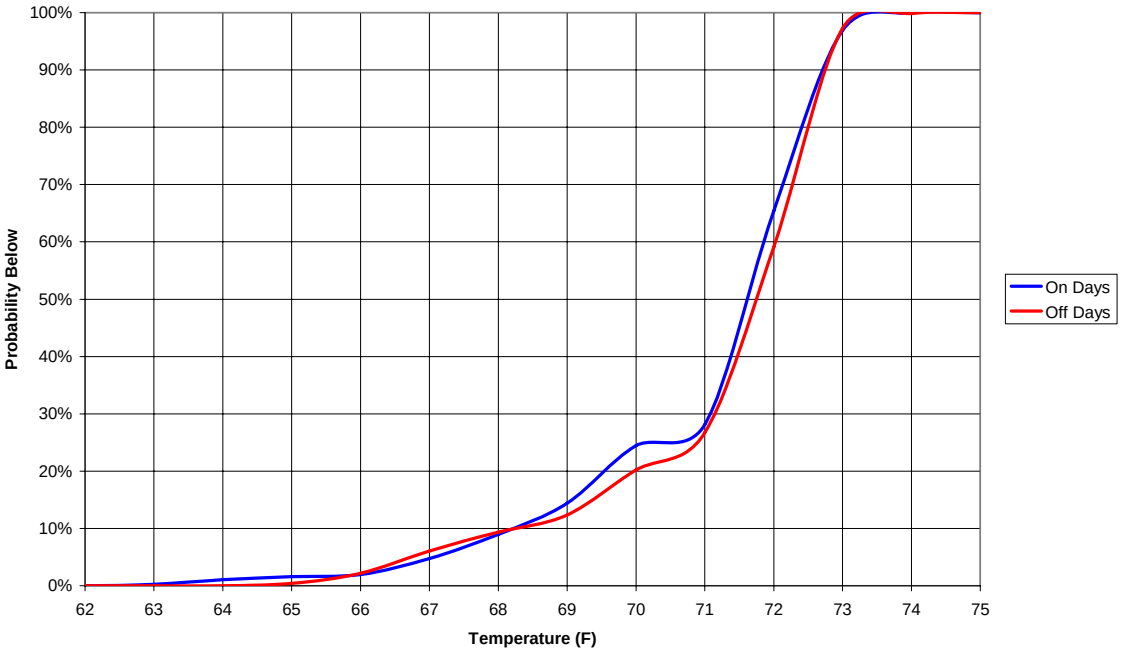
NYSERDA TEST - Beech Street School
Solar Load Probabilities 7:00 am - 5:00 pm (01/14/05--04/13/05)



NYSERDA TEST - Beech Street School
Space Temperature Histogram (01/14/05--04/13/05)



NYSERDA TEST - Beech Street School
Space Temperature Probabilities (01/14/05--04/13/05)



Esteé Lauder Cosmetics – JHL Building, Melville, NY

Facility Size: 58,000 s.f.

Boiler Manufacturer: 3 each – Weil McLain

Model: Not Available (Tags removed from boilers)

Capacity: ~1.2MMBTU (3 x 390,000 BTU/hr (input))

Fuel Type: Natural Gas

Application: Hydronic heating through base-board radiators.

Area Served: Entire Facility

Savings Results: 10.71% Savings (RAW), 13.7% Savings Degree-Day adjusted

IMPORTANT NOTE

DUE TO HEATING SYSTEM AND DATA LOGGING EQUIPMENT MALFUNCTIONS THAT OCCURRED DURING THE TEST PERIOD, THE SAVINGS RESULTS ARE NOT VERIFIABLE AND SHOULD NOT BE CONSIDERED ACCURATE.

Intellidyne
90 Pratt Oval
Glen Cove, NY 11542
Phone:516-676-0777
Fax: 516-676-2640

Test Report

Report No. 12153-4

Date: 11/01/06

Customer:
NYSERDA

Test Site Location:
Estee Lauder
JHL Building
7 Corporate Center drive

Test Type: ☑ HEATING ☐ AIR CONDITIONING ☐ REFRIGERATION ☐ OTHER:

Product Tested: ☐ HW ☑ LCH ☐ LCS ☐ CHW ☐ CHS ☐ AC ☐ CAC ☐ RU ☐ OTHER:

Type of Equipment:

Manufacturer:	Weil McLain
Model:	
Capacity / SetPt:	390,000 Btu each boiler X 3
Fuel Type:	Nat. Gas
Application:	Hydronic Heating
Area Served:	Entire Building
Misc.	

Test Start Date: 03/24/05
Test End Date: 04/16/05
No. of Days in Test: 24

BURNER RUN-TIME: ☑ in HRS. ☐ in MIN.

IntelliCon **ON-DAYS:** 280:33:12
IntelliCon **OFF-DAYS:** 314:11:19
RUN-TIME was reduced by: 10.71%

BURNER USAGE FACTOR:
IntelliCon **On-Days:** 32%
IntelliCon **Off-Days:** 36%

HEATING DEGREE-DAYS (FOR TEST PERIOD)

IntelliCon ON-DAYS: 229
IntelliCon OFF-DAYS: 221
Total Degree-Days: 450
It was 3.5% **Colder on the On-Days.**

USAGE PER DEGREE-DAY
ON-DAYS: 1:13:32
OFF-DAYS: 1:25:12

SOLAR LOAD COMPENSATION: (Lumens/Sq. Ft.)

IntelliCon ON-DAYS: 1777
IntelliCon OFF-DAYS: 2040
It was 12.91% **Sunnier on the OFF-Days.**

BURNER CYCLING REDUCTION:

IntelliCon ON-DAYS: 717
IntelliCon OFF-DAYS: 2858
Cycling was reduced by: 74.9%

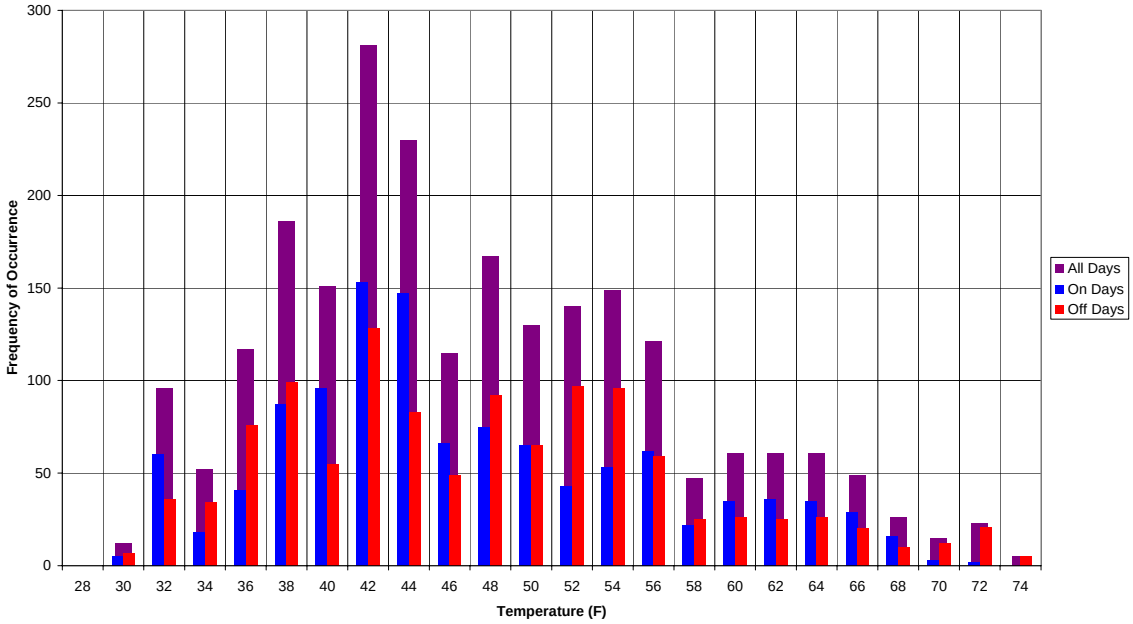
Individual Boiler Data

	ON-DAY	OFF-DAY
Boiler #1		
RT:	170:38:56	176:03:19
CYCLES:	214	881
Boiler #2		
RT:	32:05:06	41:41:26
CYCLES:	260	1074
Boiler #3		
RT:	77:49:10	96:26:34
CYCLES:	243	903

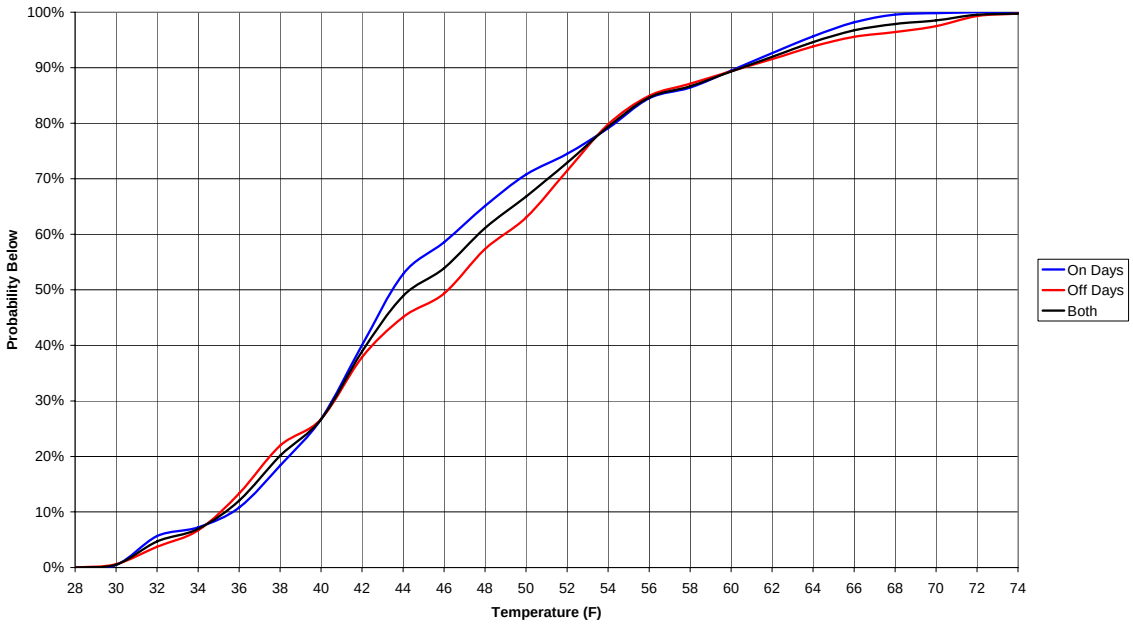
Adj. Savings = 13.70%

COMMENTS: All Three (3) Boilers were the same Make and Model. An LCH control was installed on each boiler.

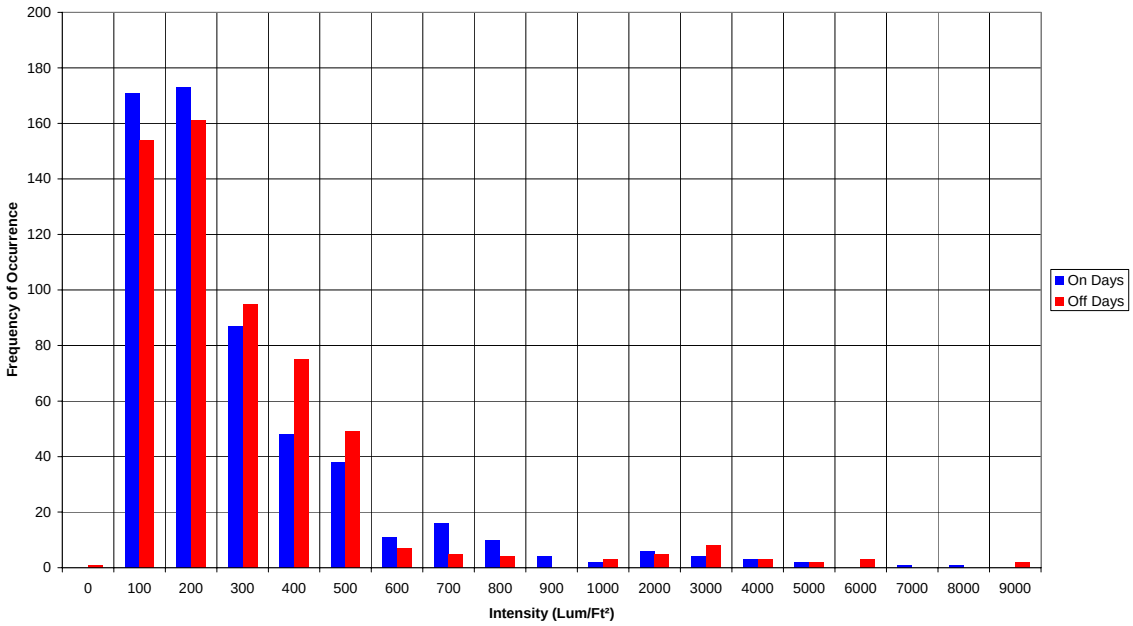
NYSERDA TEST - Estée Lauder JHL Bldg.
Outside Air Temperature Histogram (03/24/05--04/16/05)



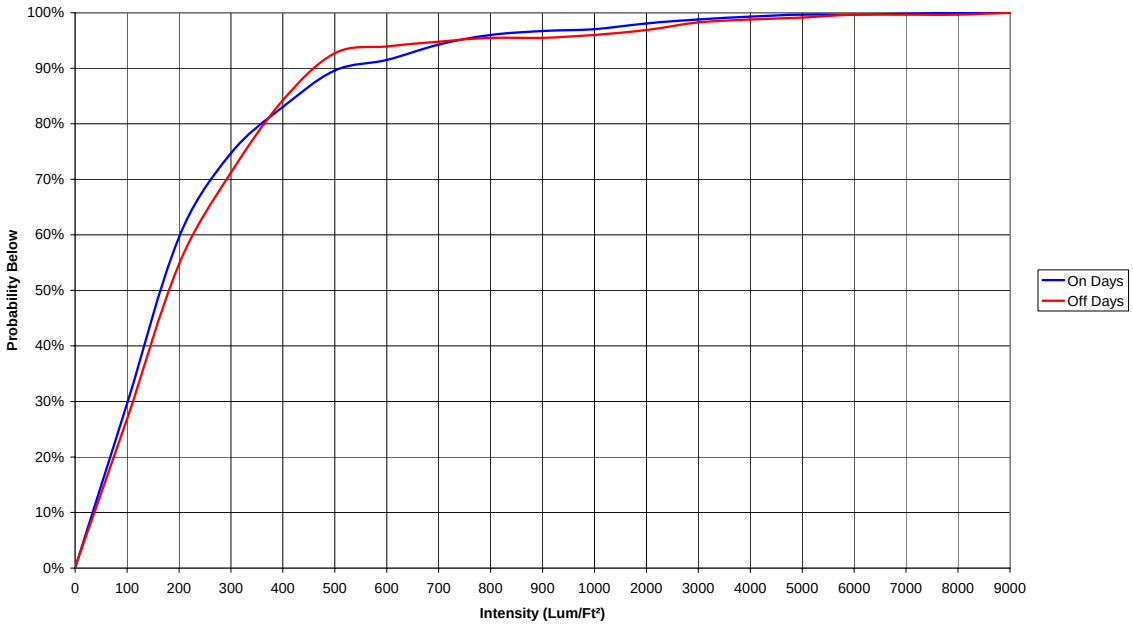
NYSERDA TEST - Estée Lauder JHL Bldg.
Outside Air Temperature Probabilities (03/24/05--04/16/05)



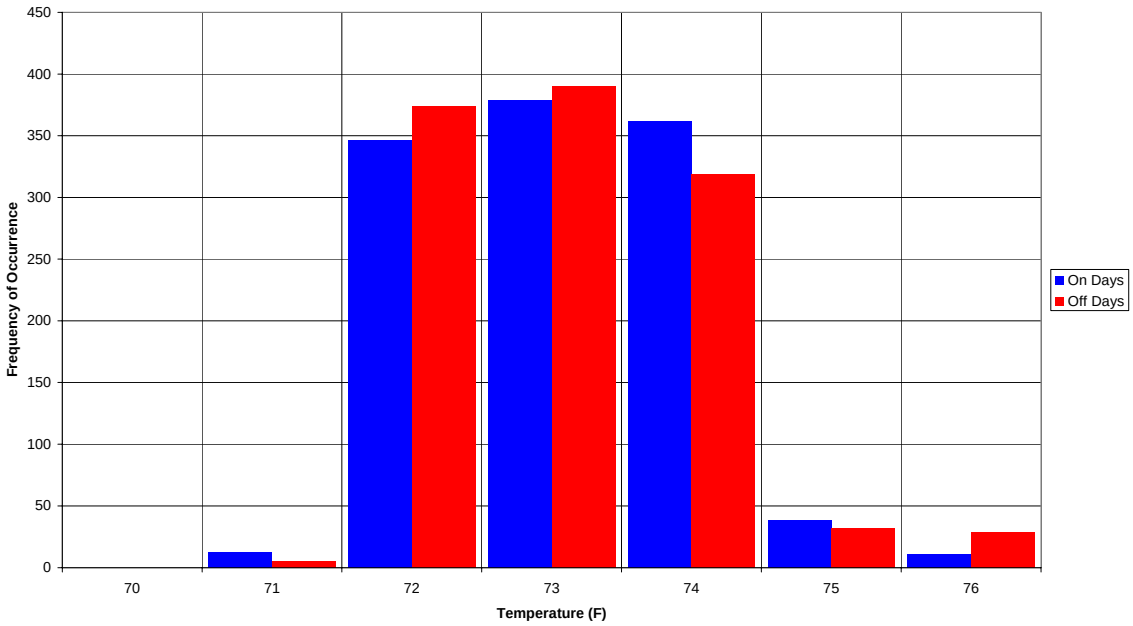
NYSERDA TEST - Estée Lauder JHL Bldg.
Solar Load Histogram 6:00 am - 6:00 pm (03/24/05--04/16/05)



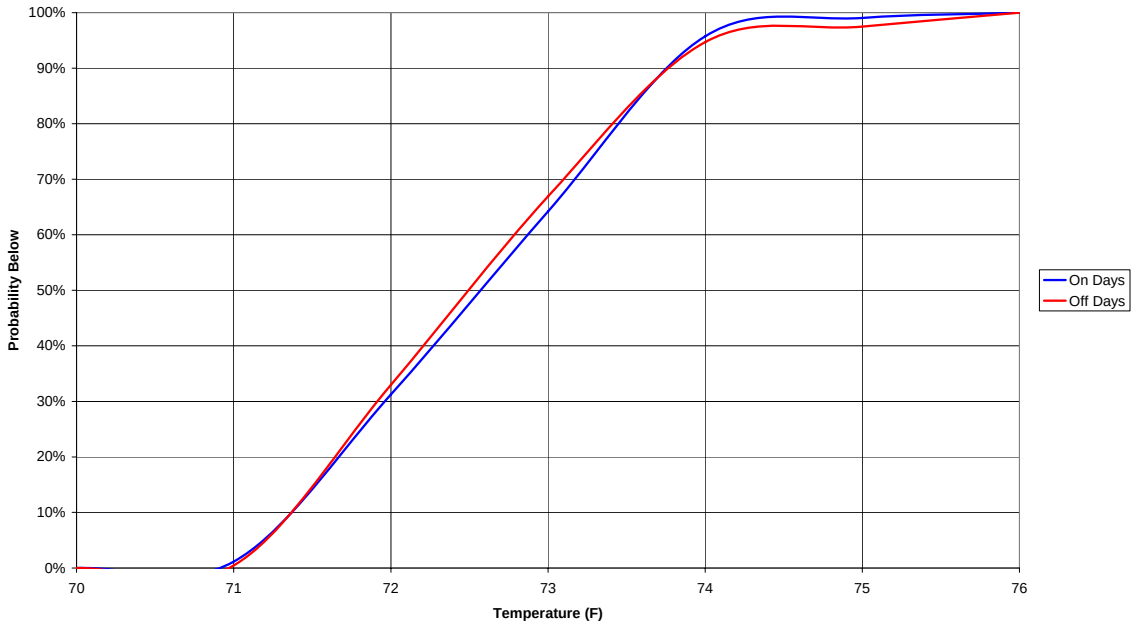
NYSERDA TEST - Estée Lauder JHL Bldg.
Solar Load Probabilities 6:00 am - 6:00 pm (03/24/05--04/16/05)



NYSERDA TEST - Estée Lauder JHL Bldg.
Space Temperature Histogram (03/24/05--04/16/05)



NYSERDA TEST - Estée Lauder JHL Bldg.
Space Temperature Probabilities (03/24/05--04/16/05)



Esteé Lauder Cosmetics – 350 South Service Rd., Melville, NY

Air Conditioner Manufacturer: Carrier

Model: 38AE064 610 (Roof Top Unit)

Capacity: 50 Tons (2 x 25 Ton Compressors)

Fuel Type: Electric

Application: Space Cooling for ~4800 Ft^2 Area

Area Served: Cafeteria / Dining Area

Savings Results: 11.47% Savings (RAW), 10.6% Savings Degree-Day adjusted

90 Pratt Oval
Glen Cove, NY 11542
Phone:516-676-0777
Fax: 516-676-2640

Test Report

Report No. 12153-2

Date: 11/01/06

Customer:
NYSERDA

Test Site Location:
Estee Lauder
350 South Service Road
Melville, NY 11747

Test Type: ☐ HEATING ☑ AIR CONDITIONING ☐ REFRIGERATION ☐ OTHER:

Product Tested: ☐ HW ☐ LCH ☐ LCS ☐ CHW ☐ CHS ☐ AC ☑ CAC ☐ RU ☐ OTHER:

Type of Equipment:

Manufacturer:	Carrier
Model:	38AE064 610
Capacity / SetPt:	50 Ton (2 x 25 Ton Compressors) / 74 Deg. F.
Fuel Type:	
Application:	Area Cooling
Area Served:	Dining Area
Misc.	

Test Start Date: 08/06/05

Test End Date: 08/27/05

No. of Days in Test: 22

COMPRESSOR RUN-TIME: ☑ in HRS. ☐ in MIN.

***IntelliCon* ON-DAYS:** 230:28:11

***IntelliCon* OFF-DAYS:** 260:18:57

RUN-TIME was reduced by: 11.47%

COMPRESSOR USAGE FACTOR

***IntelliCon* On-Days:** 87%

***IntelliCon* Off-Days:** 99%

COOLING DEGREE-DAYS (FOR TEST PERIOD)

IntelliCon ON-DAYS: 78.5

IntelliCon OFF-DAYS: 79.3

Total Degree-Days: 157.8

It was 1.0% **Cooler on the ON-Days.**

USAGE PER DEGREE-DAY

ON-DAYS: 2:56:08

OFF-DAYS: 3:17:01

SOLAR LOAD COMPENSATION: (Lumens/Sq. Ft.)

IntelliCon ON-DAYS: 48481

IntelliCon OFF-DAYS: 44808

It was 8.20% **Sunnier on the On-Days.**

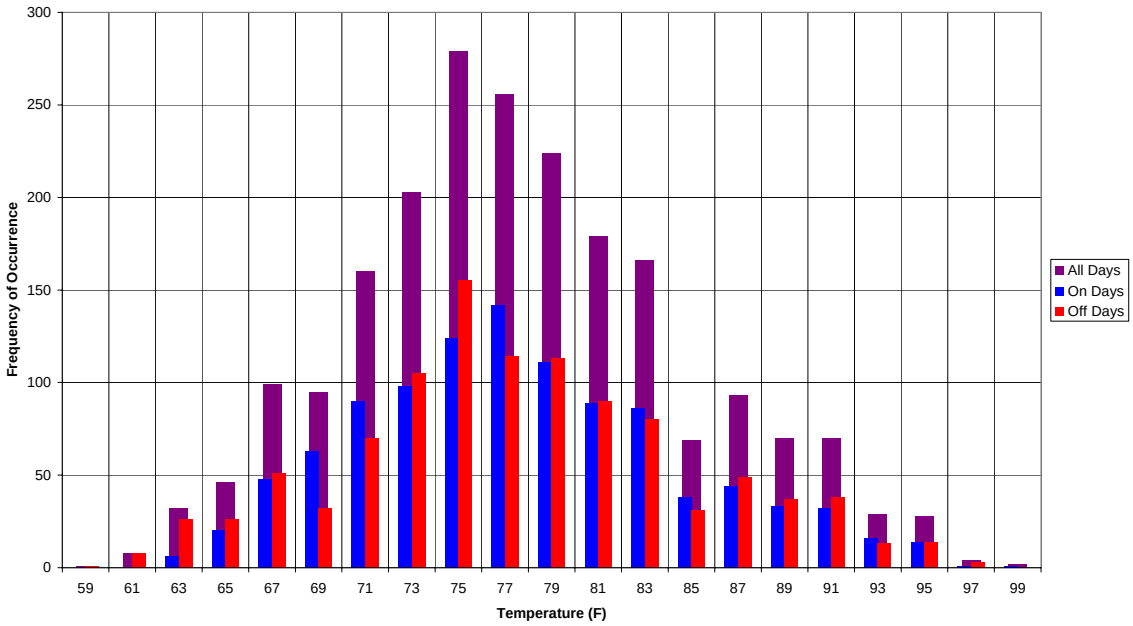
Individual Compressor Data

	ON-DAY	OFF-DAY
Comp. #1 RT:	117:00:11	135:52:23
Comp.#2 RT:	113:28:00	124:26:34

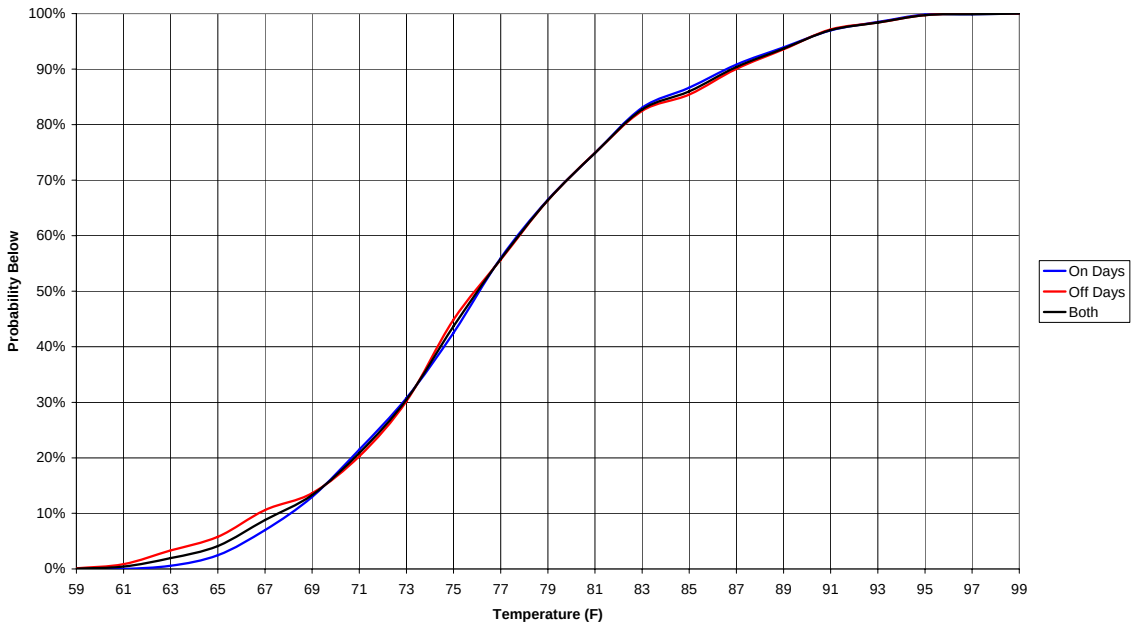
Adj. Savings = 10.60%

COMMENTS:

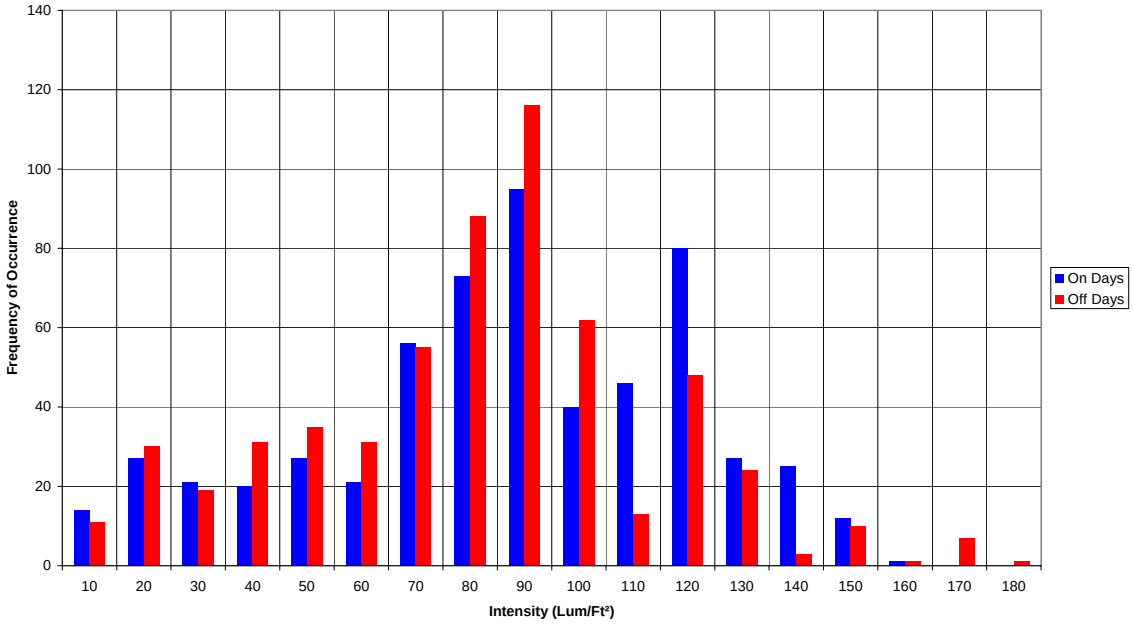
NYSERDA TEST - Estée Lauder JHL Bldg.
Outside Air Temperature Histogram (08/06/05--08/27/05)



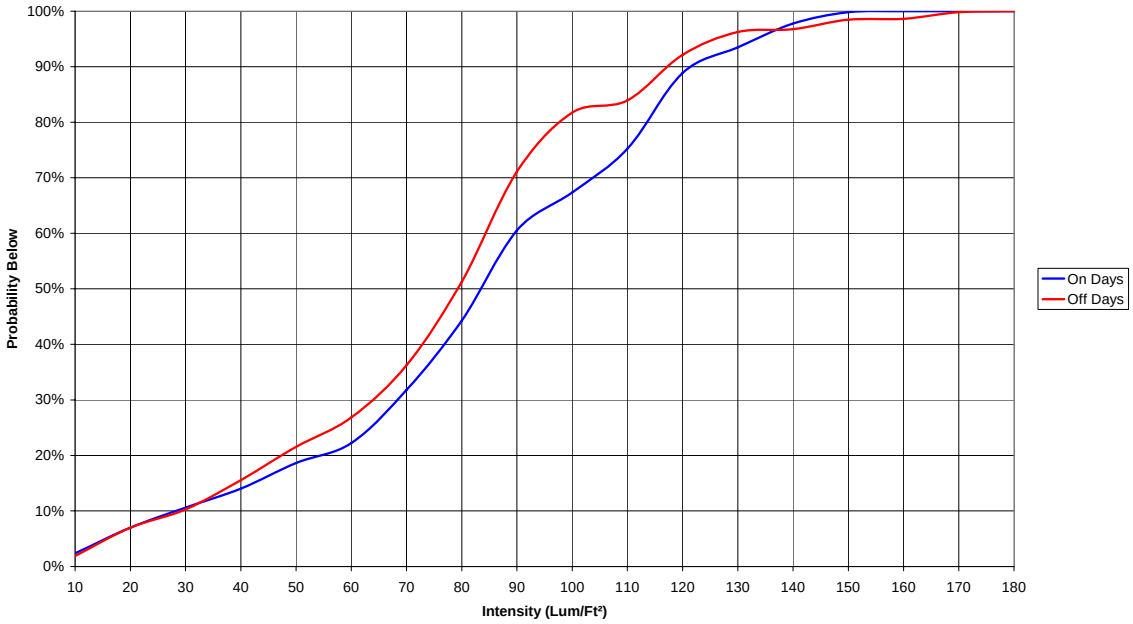
NYSERDA TEST - Estée Lauder JHL Bldg.
Outside Air Temperature Probabilities (08/06/05--08/27/05)



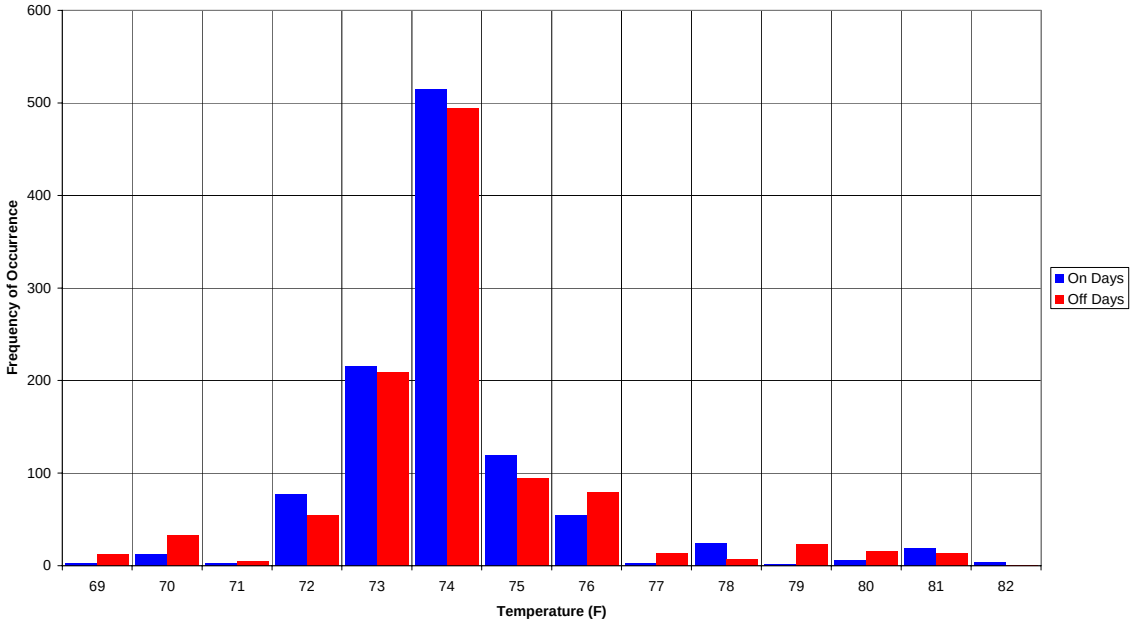
NYSERDA TEST - Estée Lauder JHL Bldg.
Solar Load Histogram 6:00 am - 8:00 pm (08/06/05--08/27/05)



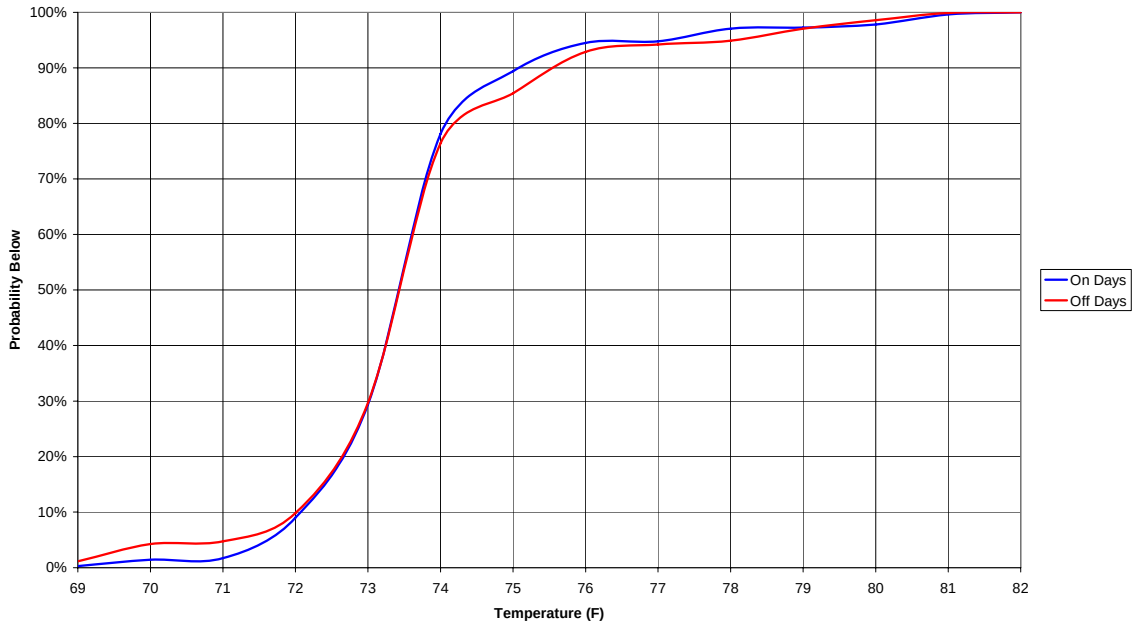
NYSERDA TEST - Estée Lauder JHL Bldg.
Solar Load Probabilities 6:00 am - 8:00 pm (03/24/05--04/16/05)



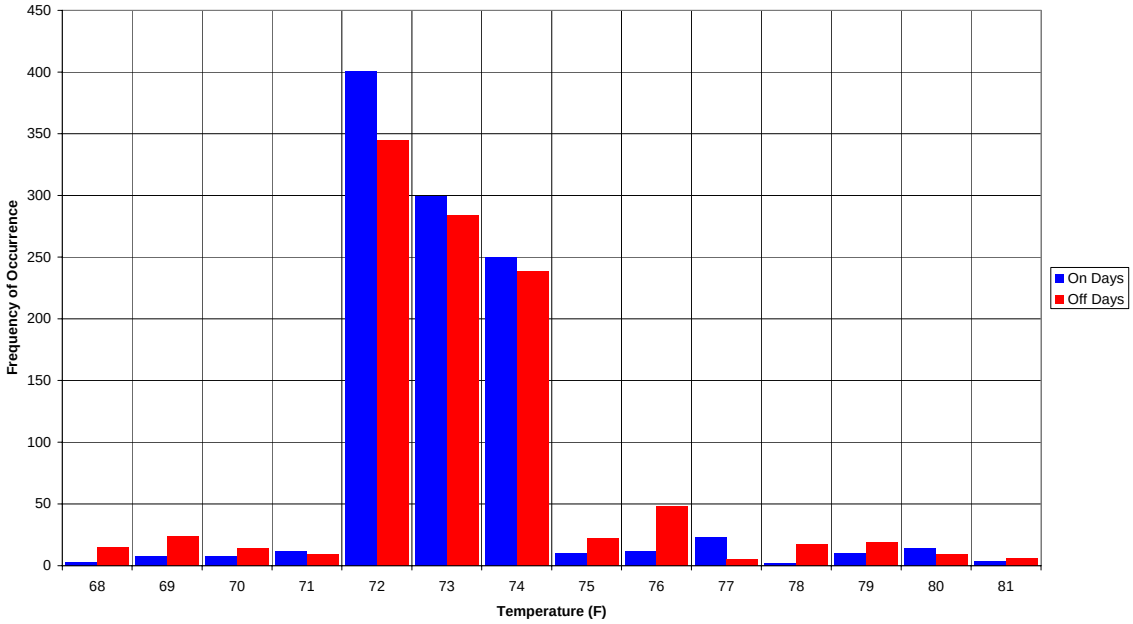
NYSERDA TEST - Estée Lauder JHL Bldg.
Cafeteria East Side Space Temperature Histogram (08/06/05--08/27/05)



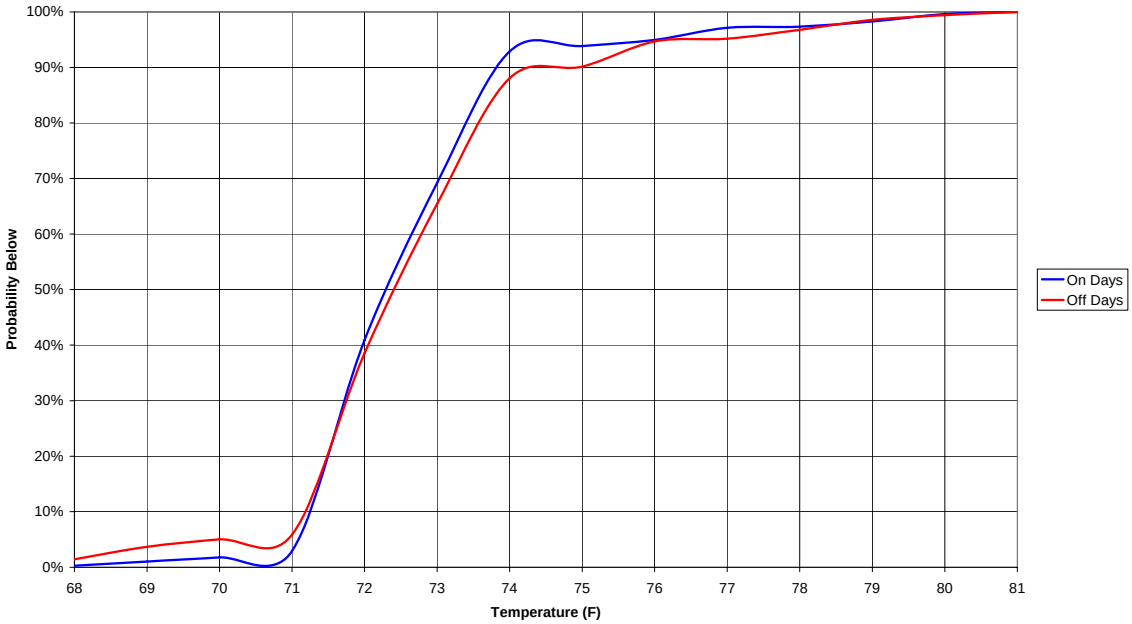
NYSERDA TEST - Estée Lauder JHL Bldg.
Cafeteria East Side Space Temperature Probabilities (08/06/05--08/27/05)



NYSERDA TEST - Estée Lauder JHL Bldg.
Cafeteria West Side Space Temperature Histogram (08/06/05--08/27/05)



NYSERDA TEST - Estée Lauder JHL Bldg.
Cafeteria West Side Space Temperature Probabilities (08/06/05--08/27/05)



Esteé Lauder Cosmetics – 350 South Service Rd., Melville, NY

Refrigeration Unit Manufacturer: Climate Control (Snyder General)

Model: SC-1500-H2D WTFO 1922 (Box Mounted)

Capacity: 15 HP

Fuel Type: Electric

Application: Walk-in Refrigerator (~ 1000 s.f.)

Area Served: Raw Materials Room

Savings Results: 12.06% Savings (refrigeration systems are NOT degree-day compensated).

Intellidyne
90 Pratt Oval
Glen Cove, NY 11542
Phone:516-676-0777
Fax: 516-676-2640

Test Report

Report No. 12153-3

Date: 11/01/06

Customer:
NYSERDA

Test Site Location:
Estee Lauder
350 South Service Road
Melville, NY 11747

Test Type: ☐ HEATING ☐ AIR CONDITIONING ☑ REFRIGERATION ☐ OTHER:

Product Tested: ☐ HW ☐ LCH ☐ LCS ☐ CHW ☐ CHS ☐ AC ☐ CAC ☑ RU ☐ OTHER:

Type of Equipment:

Manufacturer:	Climate control (Snyder General)
Model:	SC-1500-H2D WTFO 1922
Capacity / SetPt:	15 hp / 43.5Deg. F.
Fuel Type:	Electric
Application:	Walk-in Refrigerator Box
Area Served:	Raw Products
Misc.	

Test Start Date: 08/06/05

Test End Date: 08/27/05

No. of Days in Test: 22

COMPRESSOR RUN-TIME: ☑ in HRS. ☐ in MIN.

***IntelliCon* ON-DAYS:** 92:50:34

***IntelliCon* OFF-DAYS:** 105:34:50

RUN-TIME was reduced by: 12.06%

COMPRESSOR USAGE FACTOR

***IntelliCon* On-Days:** 35%

***IntelliCon* Off-Days:** 40%

COOLING DEGREE-DAYS (FOR TEST PERIOD)

IntelliCon ON-DAYS: 78.5

IntelliCon OFF-DAYS: 79.3

Total Degree-Days: 157.8

It was 1.0% **Cooler on the ON-Days.**

SOLAR LOAD COMPENSATION: (Lumens/Sq. Ft.)

IntelliCon ON-DAYS: 48481

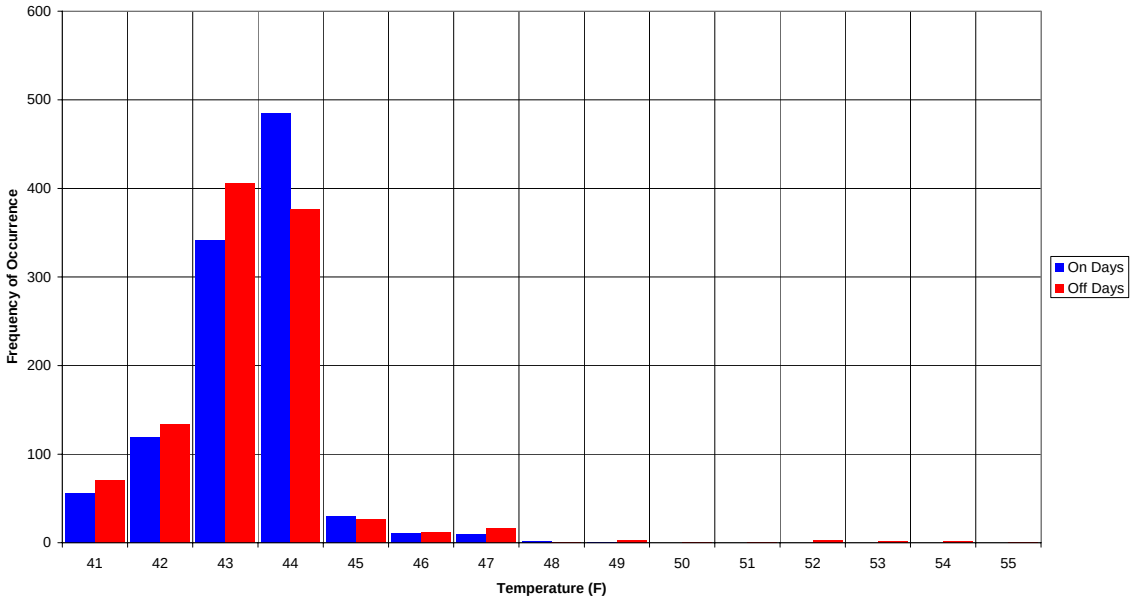
IntelliCon OFF-DAYS: 44808

It was 8.20% **Sunnier on the On-Days.**

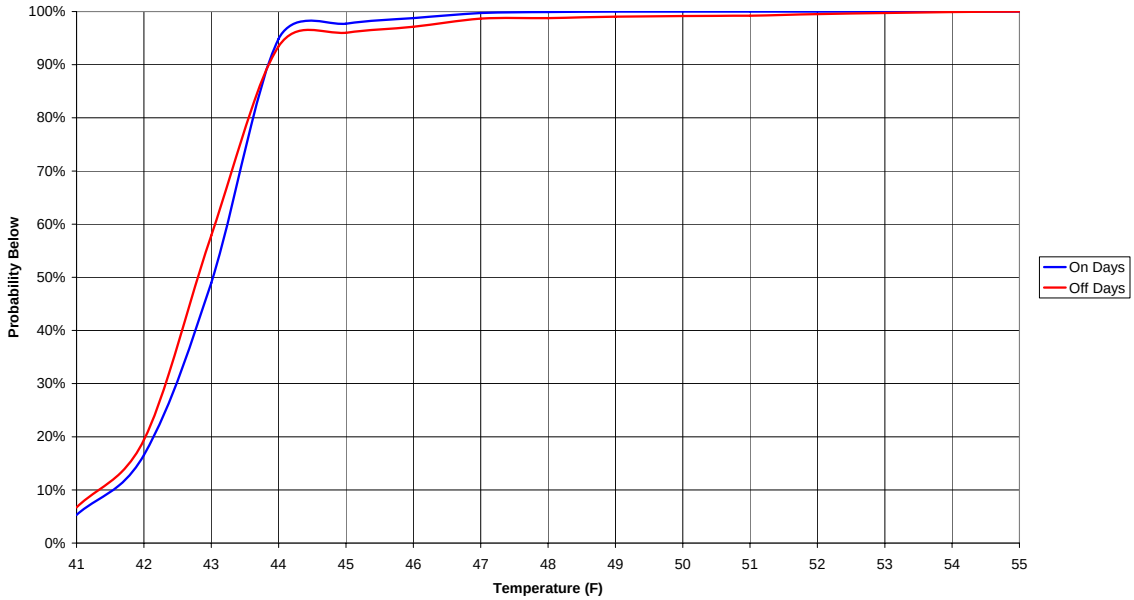
Savings = 12.06%

COMMENTS:

NYSERDA TEST - Estée Lauder JHL Bldg.
Walk-in Box
Temperature Histogram (08/06/05--08/27/05)



NYSERDA TEST - Estée Lauder JHL Bldg.
Walk-in Box
Space Temperature Probabilities (08/06/05--08/27/05)



Freeport Electric – Freeport, NY

Boiler Manufacturer: Orr and Sembower

Model: PF-1H

Capacity: 2.8 MMBTU/hr. (input)

Fuel Type: #2 Heating Oil

Application: Steam Boiler used to maintain water jacket (through heat-exchanger) temperature of a Generator (Generator jacket temperature maintained at approximately 140˚F) and also provides steam to unit heaters used to temper air temperature in huge open space.

Area Served: Generator water-jacket and Generator room (~ 30,000Ft^2.).

Savings Results: 9.64% Savings (RAW), 10.08% Savings Degree-Day adjusted

90 Pratt Oval
Glen Cove, NY 11542
Phone:516-676-0777
Fax: 516-676-2640

Test Report

Report No. 12153-5

Date: 11/01/06

Customer:
NYSERDA

Test Site Location:
Freeport Electric
220 Sunrise Hwy
Freeport, NY 11520

Test Type: ☑ HEATING ☐ AIR CONDITIONING ☐ REFRIGERATION ☐ OTHER:

Product Tested: ☐ HW ☐ LCH ☐ LCS ☐ CHW ☑ CHS ☐ AC ☐ CAC ☐ RU ☑ OTHER: High Pressure

Type of Equipment:

Manufacturer:	Orr and Sembower (O&S)
Model:	PF-1H
Capacity / SetPt:	2,891,700 BTU/hr., 44 psi off, 35 psi on
Fuel Type:	Nat. Gas / #2 Oil
Application:	Steam to warm Generator's water-jacket + Heating
Area Served:	
Misc.	Pre-Purge = 90 Seconds, Post-Purge = 15 Seconds

Test Start Date: 03/17/05
Test End Date: 04/23/05
No. of Days in Test: 38

BURNER RUN-TIME: ☑ in HRS. ☐ in MIN.

IntelliCon **ON-DAYS:** 188:06:54
IntelliCon **OFF-DAYS:** 208:11:27
RUN-TIME was reduced by: 9.64%

BURNER USAGE FACTOR:

IntelliCon **On-Days:** 41%
IntelliCon **Off-Days:** 46%

HEATING DEGREE-DAYS (FOR TEST PERIOD)

IntelliCon ON-DAYS: 1630
IntelliCon OFF-DAYS: 1622
Total Degree-Days: 3252
It was 0.5% **Colder on the On-Days.**

USAGE PER DEGREE-DAY

ON-DAYS: 0:06:55
OFF-DAYS: 0:07:42

SOLAR LOAD COMPENSATION: (Avg. Lumens/Ft²)

IntelliCon ON-DAYS: 3426
IntelliCon OFF-DAYS: 3615
It was 5.23% **Sunnier on the OFF-Days.**

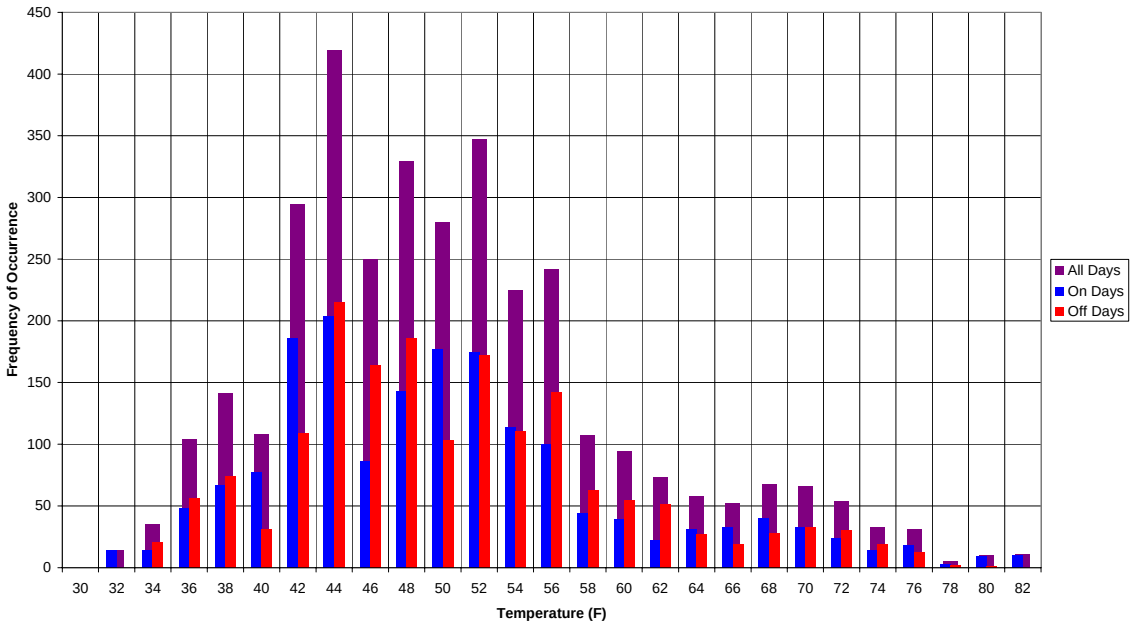
BURNER CYCLING REDUCTION:

IntelliCon ON-DAYS: 1569
IntelliCon OFF-DAYS: 1979
Cycling was reduced by: 20.7%

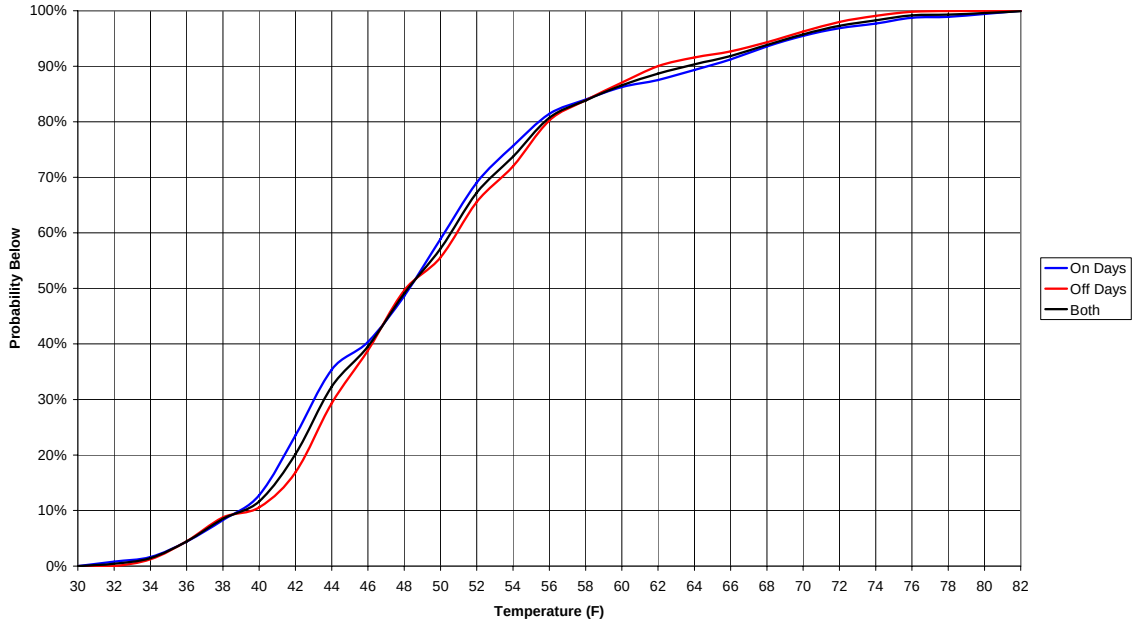
Adj. Savings = 10.08%

COMMENTS: Burner Run-Times are minus Pre & Post Purge cycle times (90 second Pre + 15 second Post = 105 seconds total per cycle). Since the boiler is used to generate steam to maintain the generator jacket temperature at 140? F, 140? F was used as the "Balance Point" for Heating Degree-Day calculations.

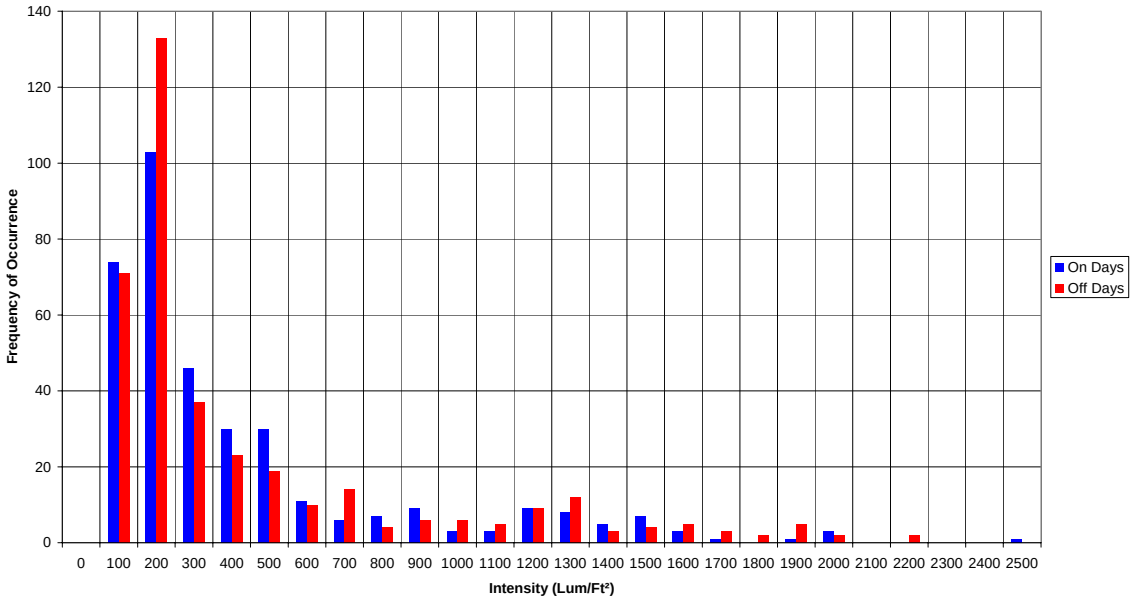
NYSERDA TEST - Freeport Electric
Outside Air Temperature Histogram (03/17/05--04/23/05)



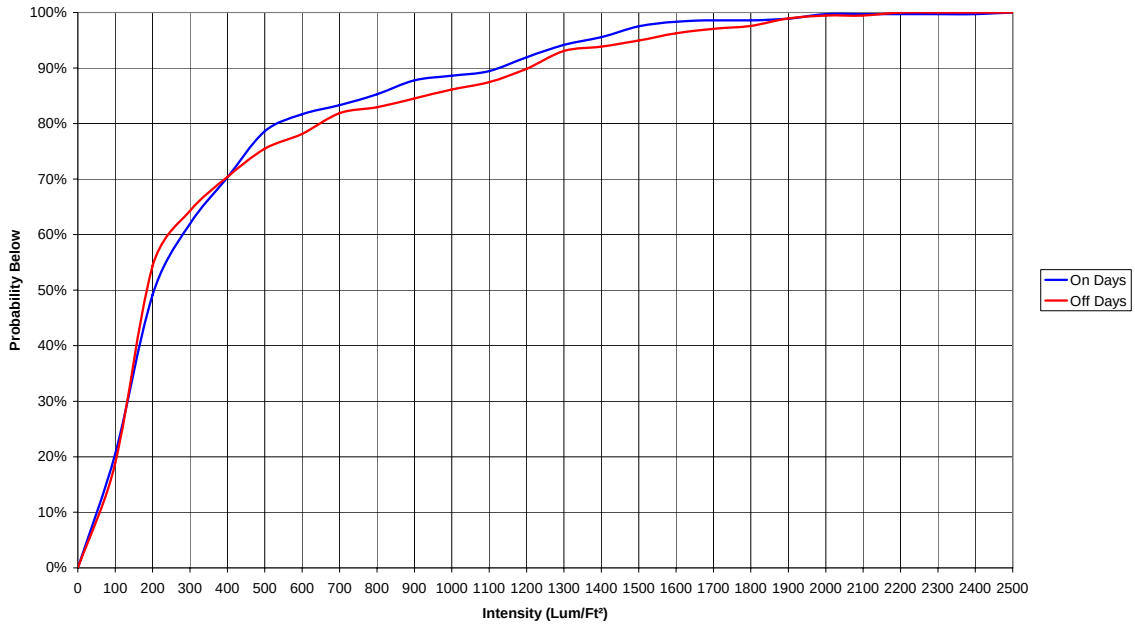
NYSERDA TEST - Freeport Electric
Outside Air Temperature Probabilities (03/17/05--04/23/05)



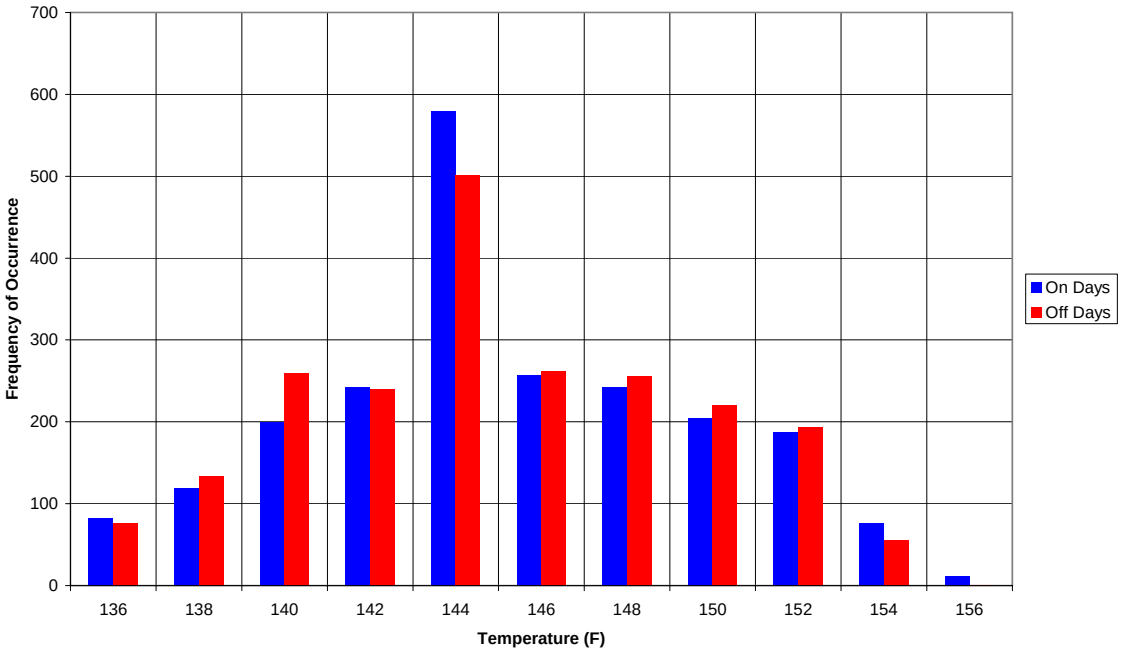
NYSERDA TEST - Freeport Electric
Solar Load Histogram (03/17/05--04/23/05)



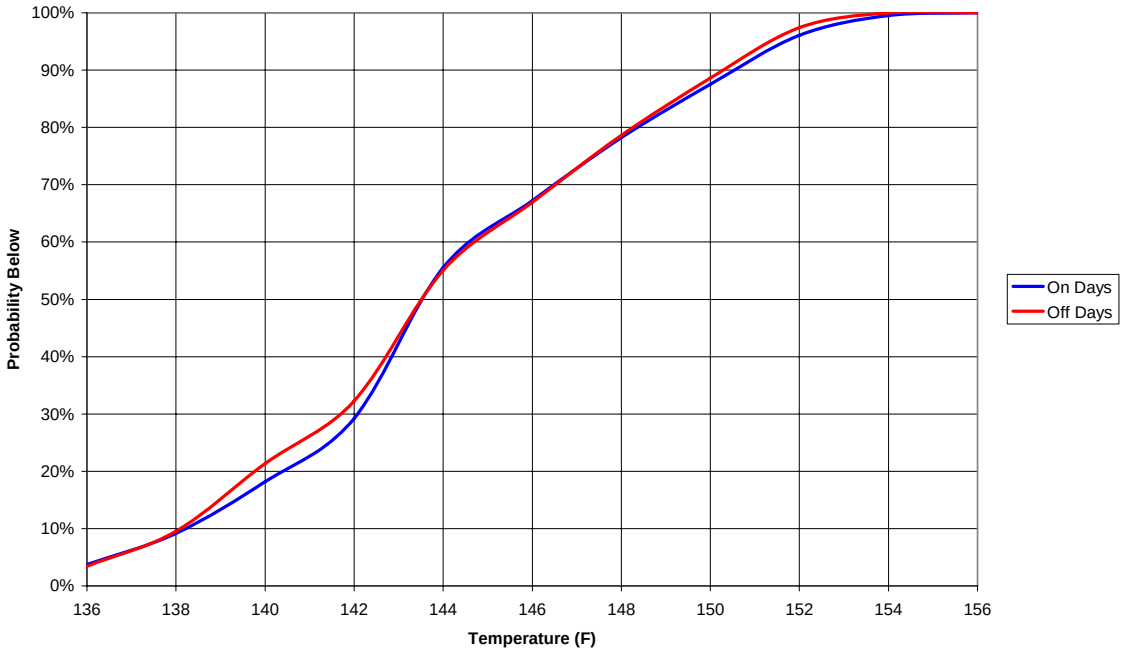
NYSERDA TEST - Freeport Electric
Solar Load Probabilities (03/17/05--04/23/05)



NYSERDA TEST - Freeport Electric
Generator Water-Jacket Temperature Histogram (03/17/05--04/23/05)



NYSERDA TEST - Freeport Electric
Generator Water-Jacket Temperature Probabilities (03/17/05--04/23/05)



Lynbrook Library – Lynbrook, NY

Air Conditioner Manufacturer: Carrier

Model: 48DJE030 Series 500 AB (Packaged Type Units)

Capacity: 25 Tons each

Fuel Type: Electric

Application: Space Cooling

Area Served: Main Book Repository (main Floor) ~ 7600 s.f.

Note: Unit designated as AC-1 served west side of book repository, AC-2 served the east side. Each air conditioner contained 2 – 12.5 Ton, semi-hermetic compressors with mechanical un-loaders (4 stages of cooling each AC unit). Each AC unit had two (2) IntelliCon-CAC controllers installed. There was a considerable amount of Glass used in this facility (for the south wall, west wall, and ceiling). As such, solar loading imposed a significant load upon the systems serving the controlled space.

Savings Results AC-1: 9.9% Savings (RAW), 11.53% Savings Degree-Day adjusted.

Savings Results AC-2: 11.78% Savings (RAW), 13.37% Savings Degree-Day adjusted.

Comments: There was a considerable amount of sky-light and wall glass used in the construction of this facility. The impact of Solar load is much greater than with other types of construction, and should be considered when evaluating the results. Normalization of the results was calculated only using the Cooling Degree-Days, thus the savings would have been greater had solar loading been compensated for. VAV box thermostats were normally set at minimum by the customer to compensate for the solar loading.

90 Pratt Oval
Glen Cove, NY 11542
Phone:516-676-0777
Fax: 516-676-2640

Test Report

Report No. 12153-6

Date: 11/01/06

Customer:
NYSERDA

Test Site Location:
Lynbrook Library
56 Eldert St.
Lynbrook, NY 11563

Test Type: ☐ HEATING ☑ AIR CONDITIONING ☐ REFRIGERATION ☐ OTHER:

Product Tested: ☐ HW ☐ LCH ☐ LCS ☐ CHW ☐ CHS ☐ AC ☑ CAC ☐ RU ☐ OTHER:

Type of Equipment:

Manufacturer:	Carrier
Model:	48DJE030 Series 500 AB (Unit Designated AC-1)
Capacity / SetPt:	25 Ton
Fuel Type:	
Application:	Area Cooling
Area Served:	West Side of Main Book Area
Misc.	Unit contained 2 X semi-hermetic compressors with 1 unloader each.

Test Start Date: 07/23/05

Test End Date: 08/27/05

No. of Days in Test: 36

COMPRESSOR RUN-TIME: ☑ in HRS. ☐ in MIN.

***IntelliCon* ON-DAYS:** 504:58:12

***IntelliCon* OFF-DAYS:** 560:27:21

RUN-TIME was reduced by: 9.90%

COMPRESSOR USAGE FACTOR

***IntelliCon* On-Days:** 58%

***IntelliCon* Off-Days:** 65%

COOLING DEGREE-DAYS (FOR TEST PERIOD)

IntelliCon ON-DAYS: 323.9

IntelliCon OFF-DAYS: 318.0

Total Degree-Days: 641.9

It was 1.8% **Warmer on the On-Days.**

USAGE PER DEGREE-DAY

ON-DAYS: 1:33:33

OFF-DAYS: 1:45:45

SOLAR LOAD COMPENSATION: (Lumens/Sq. Ft.)

IntelliCon ON-DAYS: 106168

IntelliCon OFF-DAYS: 103735

It was 2.35% **Sunnier on the On-Days.**

Individual Compressor Data

	ON-DAY	OFF-DAY
Comp. #1 RT:	387:15:52	401:40:17
Comp.#2 RT:	117:42:20	158:47:03

Adj. Savings = 11.53%

COMMENTS: There is a considerable amount of sky-light and wall glass used in the construction of this facility. The impact of Solar load is much greater than with other types of construction, and should be considered when evauating the results. Normalization of the results was calculated only using the Cooling Degree-Days, thus the savings would have been greater had solar loading been compensated for. VAV box thermostats were normally set at minimum by the customer to compensate for the solar loading.

90 Pratt Oval
Glen Cove, NY 11542
Phone:516-676-0777
Fax: 516-676-2640

Test Report

Report No. 12153-7

Date: 11/01/06

Customer:
NYSERDA

Test Site Location:
Lynbrook Library
56 Eldert St.
Lynbrook, NY 11563

Test Type: ☐ HEATING ☑ AIR CONDITIONING ☐ REFRIGERATION ☐ OTHER:

Product Tested: ☐ HW ☐ LCH ☐ LCS ☐ CHW ☐ CHS ☐ AC ☑ CAC ☐ RU ☐ OTHER:

Type of Equipment:

Manufacturer:	Carrier
Model:	48DJE030 Series 500 AB (Unit Designated AC-2)
Capacity / SetPt:	25 Ton / 72 Deg. F.
Fuel Type:	
Application:	Area Cooling
Area Served:	East Side of Main Book Area
Misc.	Unit contained 2 X semi-hermetic compressors with 1 unloader each.

Test Start Date: 07/23/05

Test End Date: 08/27/05

No. of Days in Test: 36

COMPRESSOR RUN-TIME: ☑ in HRS. ☐ in MIN.

***IntelliCon* ON-DAYS:** 313:57:16

***IntelliCon* OFF-DAYS:** 355:52:35

RUN-TIME was reduced by: 11.78%

COOLING DEGREE-DAYS (FOR TEST PERIOD)

IntelliCon ON-DAYS: 323.9 **It was** 1.8% **Warmer on the On-Days.**

IntelliCon OFF-DAYS: 318.0

Total Degree-Days: 641.9

USAGE PER DEGREE-DAY

ON-DAYS: 0:58:10

OFF-DAYS: 1:07:09

SOLAR LOAD COMPENSATION: (Lumens/Sq. Ft.)

IntelliCon ON-DAYS: 106168

IntelliCon OFF-DAYS: 103735 **It was** 2.35% **Sunnier on the On-Days.**

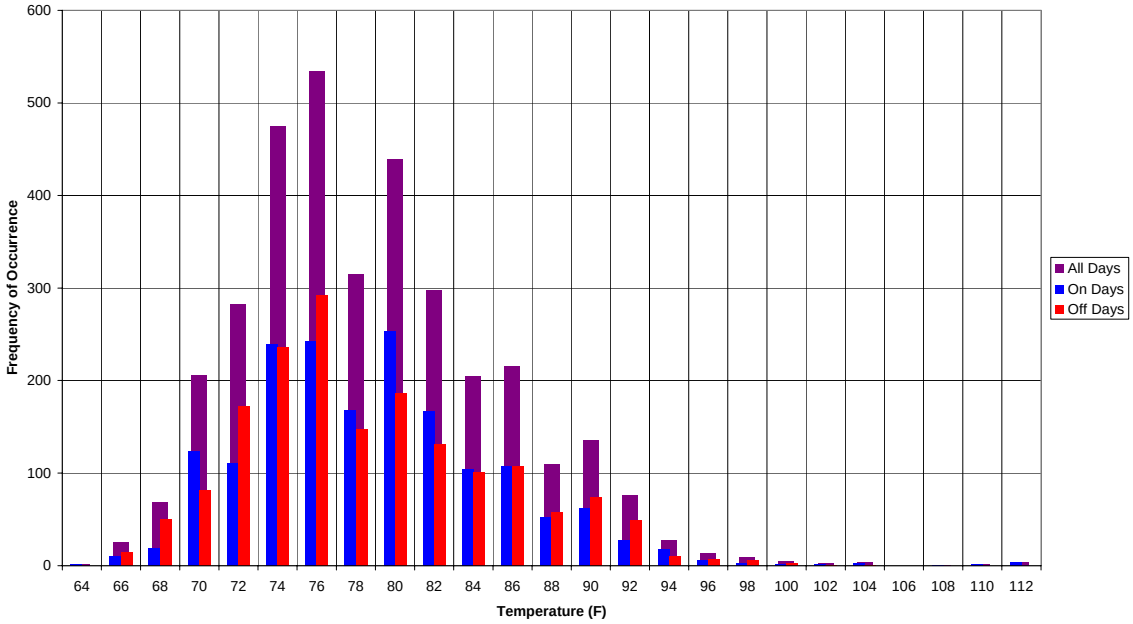
Individual Compressor Data

	ON-DAY	OFF-DAY
Comp. #1 RT:	159:10:15	175:53:28
Comp.#2 RT:	154:47:01	179:59:06

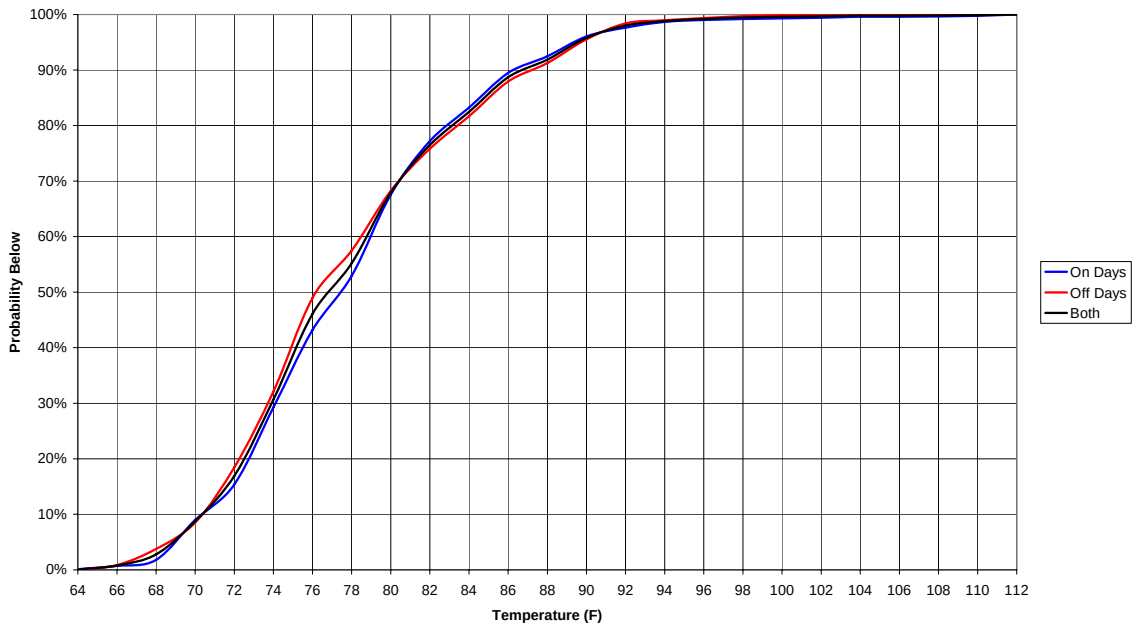
Adj. Savings = 13.37%

COMMENTS: There is a considerable amount of sky-light and wall glass used in the construction of this facility. The impact of Solar load is much greater than with other types of construction, and should be considered when evaluating the results. Normalization of the results was calculated only using the Cooling Degree-Days, thus the savings would have been greater had solar loading been compensated for. VAV box thermostats were normally set at minimum by the customer to compensate for the solar loading.

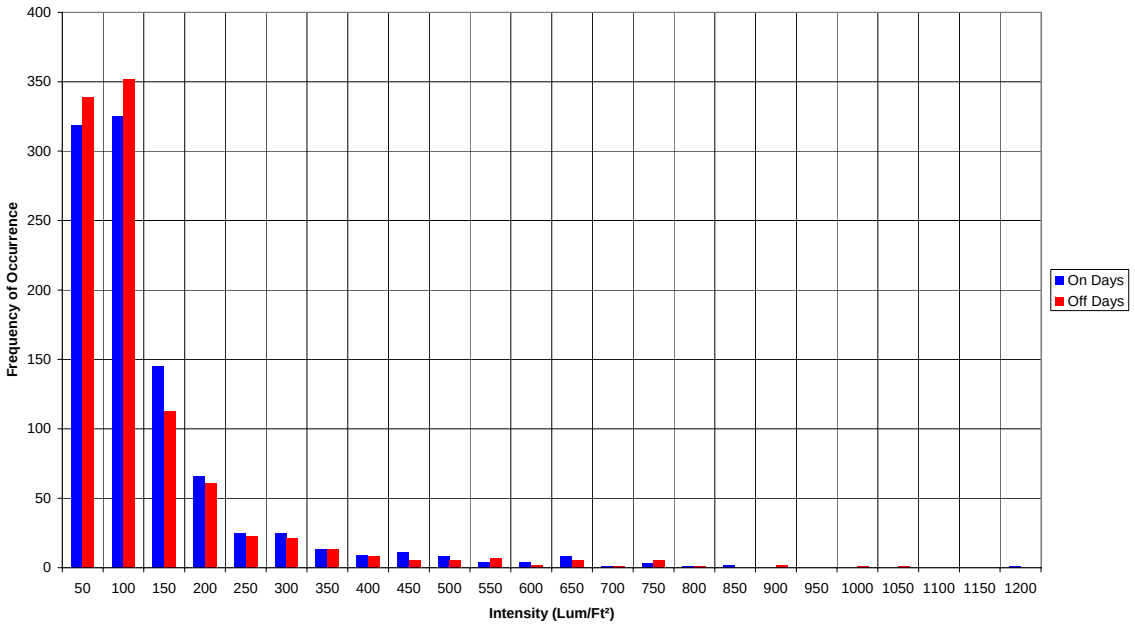
NYSERDA TEST - Lynbrook Library
Outside Air Temp Histogram (07/23/05--08/27/05)



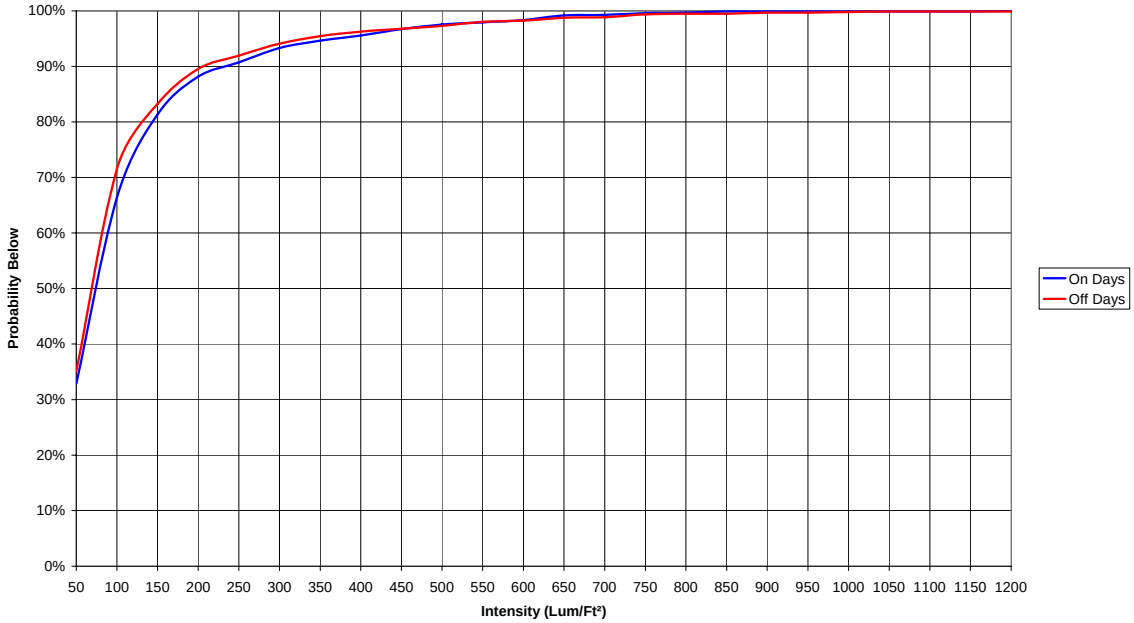
NYSERDA TEST - Lynbrook Library
Outside Air Temperature Probabilities (07/23/05--08/27/05)



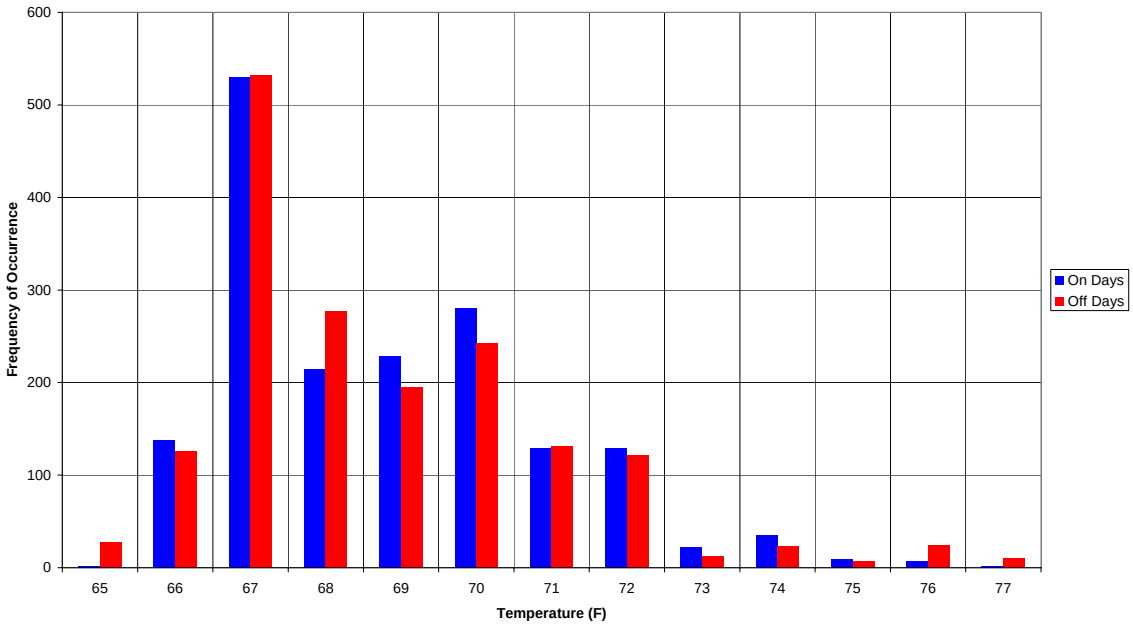
NYSERDA TEST - Lynbrook Library
Solar Load Histogram (07/23/05--08/27/05)



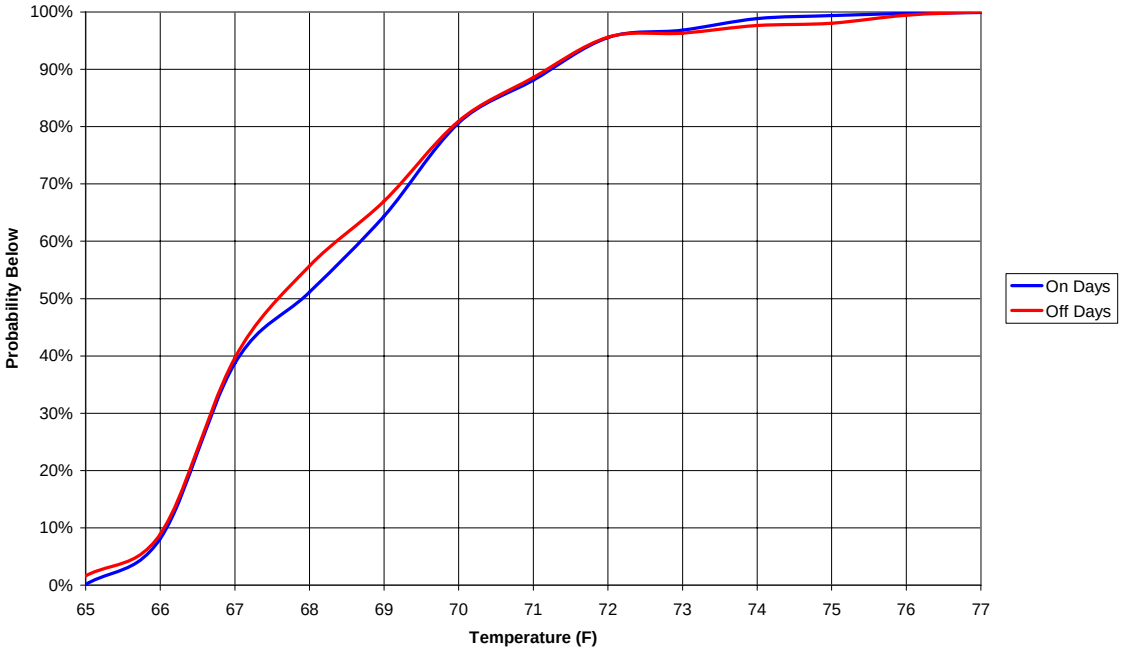
NYSERDA TEST - Lynbrook Library
Solar Load Probabilities (07/23/05--08/27/05)



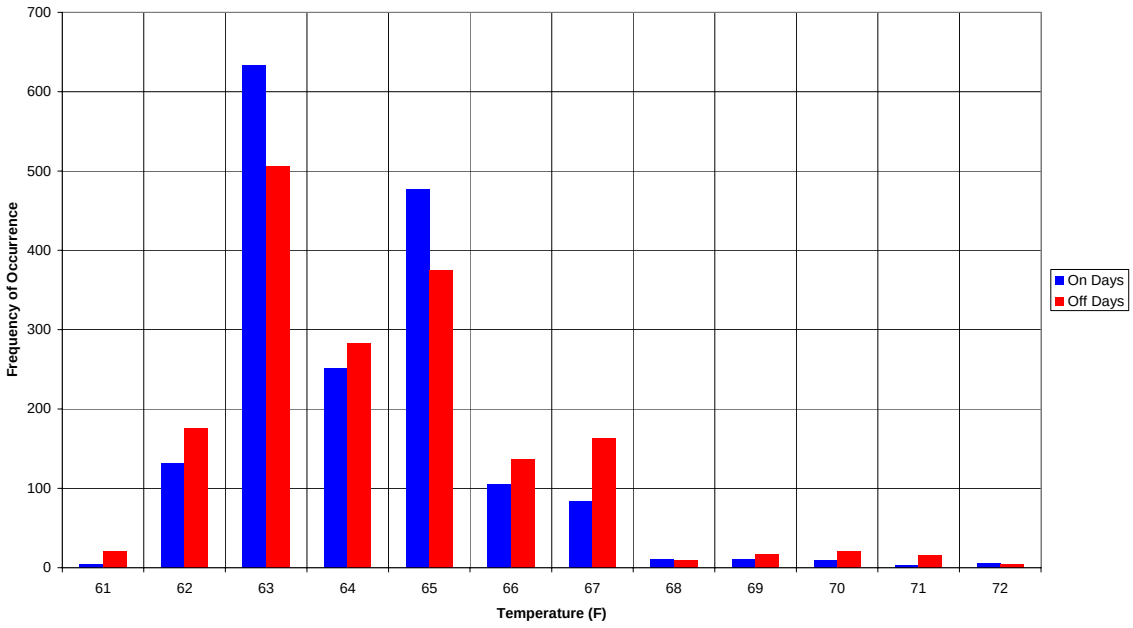
NYSERDA TEST - Lynbrook Library
West Side Space Temperature Probabilities (07/23/05--08/27/05)



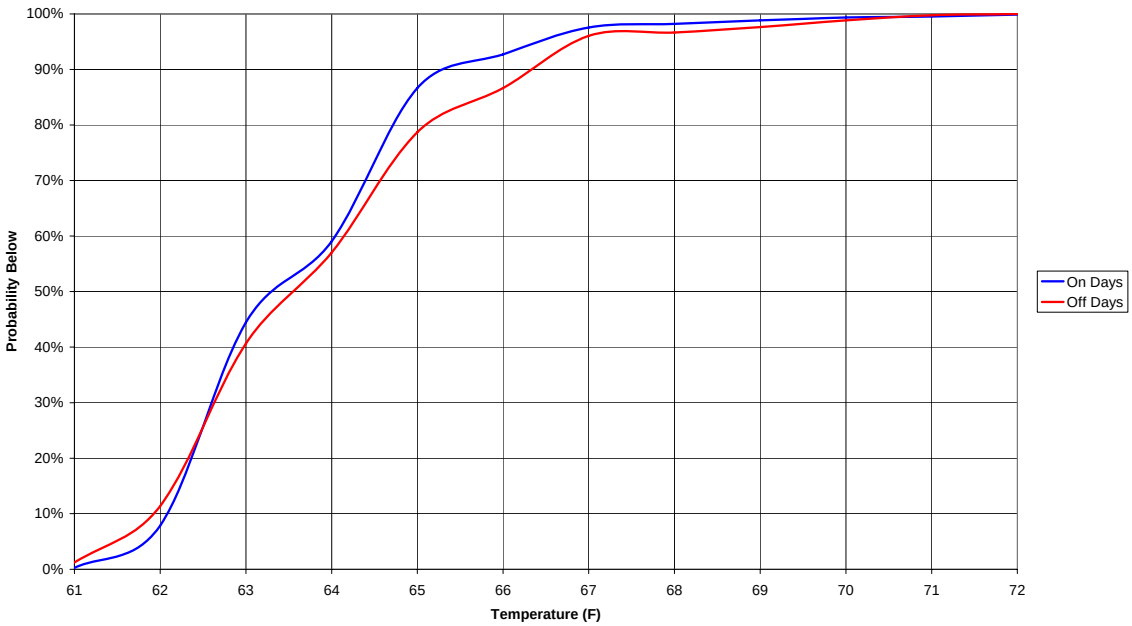
NYSERDA TEST - Lynbrook Library
West Side Space Temperature Probabilities (07/23/05--08/27/05)



NYSERDA TEST - Lynbrook Library
East Side Space Temperature Probabilities (07/23/05--08/27/05)



NYSERDA TEST - Lynbrook Library
East Side Space Temperature Probabilities (07/23/05--08/27/05)



Westchester Marriott Hotel – Tarrytown, NY

Facility Size: 10 Floors, 19 Banquet/Meeting Rooms, 450 Rooms

Boiler Manufacturer: Bryan

Model: CLM240 WT-G1

Capacity: 2400/1200 MBTU/hr. (input)

Fuel Type: Natural Gas

Application: Domestic Hot-Water Generation and Swimming Pool Heating through heat-exchanger in return line to Boiler.

Area Served: Entire Facility (Domestic Hot-water), Swimming Pool

Note: Domestic water usage in this type of facility is largely dependant upon occupancy but is not influenced by outside temperatures. Data provided to Intellidyne by the Hotel showed that the occupancy during the test period varied by less than 1% (average daily occupancy was 68%). As such the savings results were not normalized for occupancy or heating degree-days.

Savings Results: 8.28% Savings (Domestic Water Systems are NOT degree-day compensated).

Comments: Occupancy for the test period was gathered directly from Hotel records. The data showed that the occupancy level was 0.5% higher on the days when the IntelliCon was out of the circuit. This percentage is inconsequential to the usage and is not compensated for. Temperature data gathered both before and after the domestic water mixing valve (pre-mix and post-mix) demonstrates virtually no change in domestic water generation. Due to the fact that the primary load on the system was domestic hot-water generation, degree-day compensation was NOT calculated, since domestic water usage is usually not influenced by outside air temperatures.

Intellidyne
90 Pratt Oval
Glen Cove, NY 11542
Phone:516-676-0777
Fax: 516-676-2640

Test Report

Report No. 12153-8

Date: 11/01/06

Customer:
NYSERDA

Test Site Location:
Westchester Marriott
670 White Plains Road
Tarrytown, NY, 01590

Test Type: ☑ HEATING ☐ AIR CONDITIONING ☐ REFRIGERATION ☐ OTHER:

Product Tested: ☐ HW ☐ LCH ☐ LCS ☑ CHW ☐ CHS ☐ AC ☐ CAC ☐ RU ☐ OTHER:

Type of Equipment:

Manufacturer:	Bryan
Model:	CLM240 WT-G1 (Same for Boiler #1 & #2)
Capacity / SetPt:	2400/1200 MBH / # 1 = 210? F., #2 = 195? F.
Fuel Type:	Natural Gas
Application:	Domestic Hot Water
Area Served:	Entire Hotel
Misc.	

Test Start Date: 03/03/05
Test End Date: 04/17/05
No. of Days in Test: 46

BURNER RUN-TIME: ☑ in HRS. ☐ in MIN.

IntelliCon **ON-DAYS:** 390:52:46
IntelliCon **OFF-DAYS:** 426:09:10
RUN-TIME was reduced by: 8.28%

BURNER USAGE FACTOR:
IntelliCon **On-Days:** 35%
IntelliCon **Off-Days:** 39%

HEATING DEGREE-DAYS (FOR TEST PERIOD)
IntelliCon ON-DAYS: 396
IntelliCon OFF-DAYS: 383
Total Degree-Days: 778
It was 3.4% **Colder on the On-Days.**

USAGE PER DEGREE-DAY
ON-DAYS: 0:59:18
OFF-DAYS: 1:06:50

Percent Occupancy for Test Period
IntelliCon ON-DAYS: 1570
IntelliCon OFF-DAYS: 1579
It was < 1% **more on the OFF-Days.**

Individual Runtimes

ON-Day Runtime	Boiler #1	Boiler #2
Cycles	256:44:29	134:08:16
	187	2201

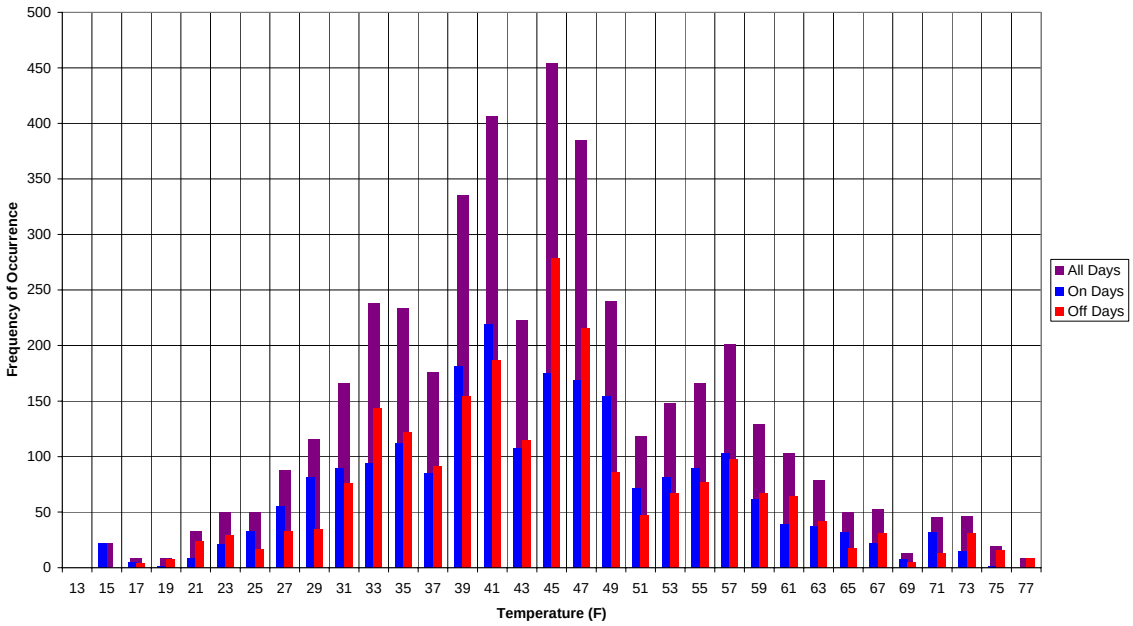
OFF-Day Runtime	Boiler #1	Boiler #2
Cycles	271:48:16	154:20:54
	193	3017

BURNER CYCLING REDUCTION:
IntelliCon ON-DAYS: 2388
IntelliCon OFF-DAYS: 3210
Cycling was reduced by: 25.6%

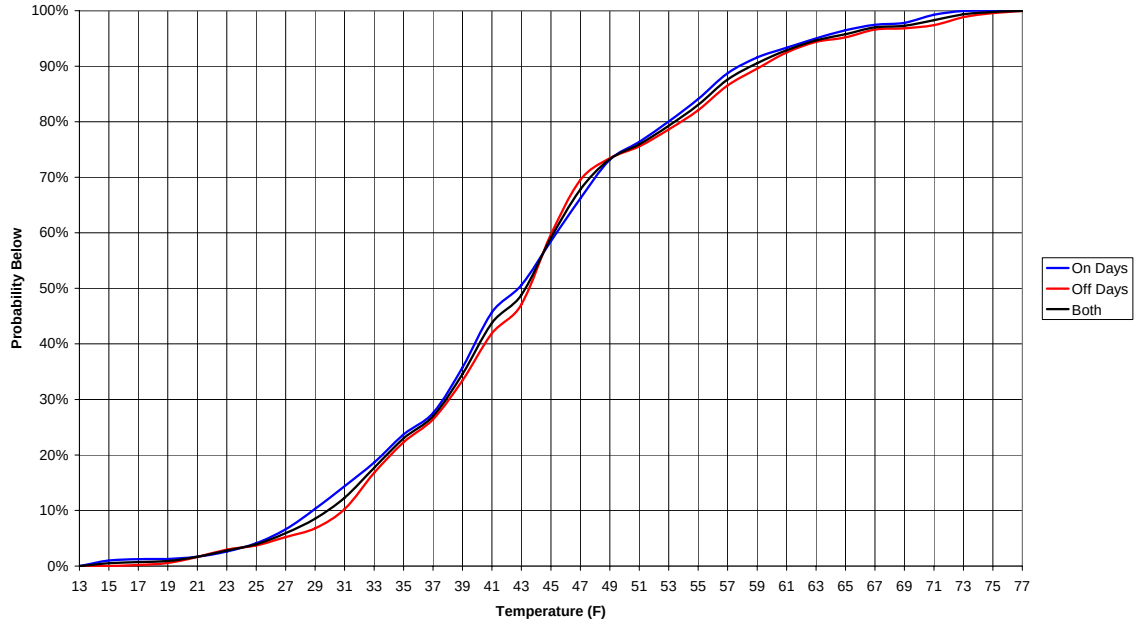
Savings = 8.28%

COMMENTS: Occupancy for the test period was gathered directly from Hotel records. The data showed that the occupancy level was 0.5% higher on the days when the IntelliCon was out of the circuit. This percentage is inconsequential to the usage and is not compensated for. Temperature data gathered both before and after the domestic water mixing valve (pre-mix and post-mix) demonstrates virtually no change in domestic water generation. Due to the fact that the primary load on the system was domestic hot-water generation, degree-day compensation was NOT calculated, since domestic water usage is usually not influenced by outside air temperatures.

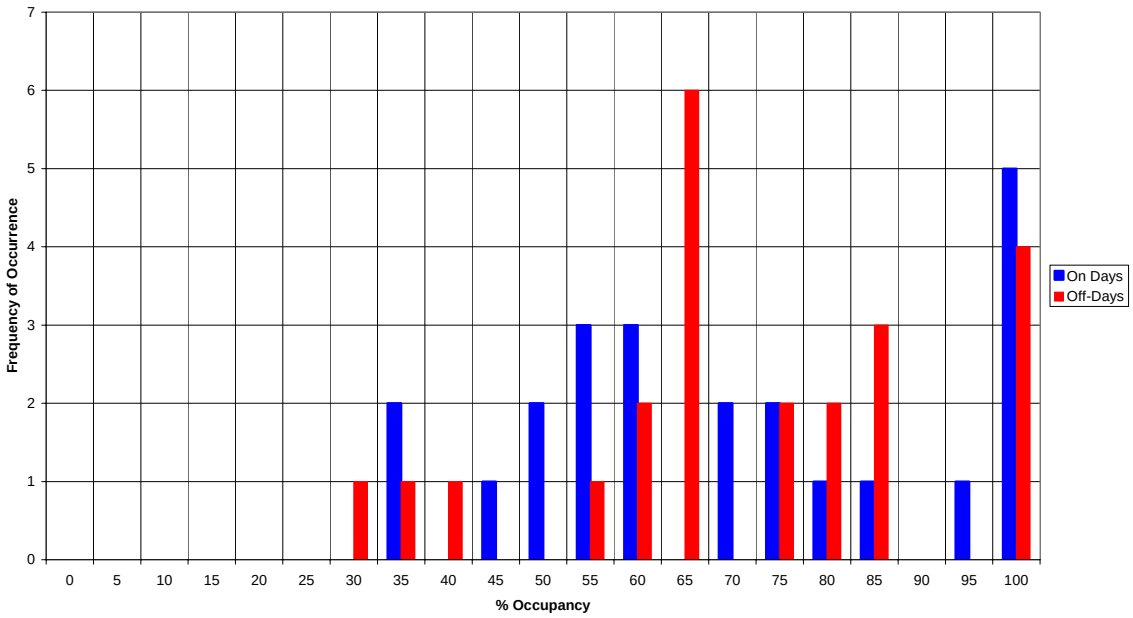
NYSERDA TEST - Marriot Hotel
Outside Air Temperature Histogram (03/03/05--04/17/05)



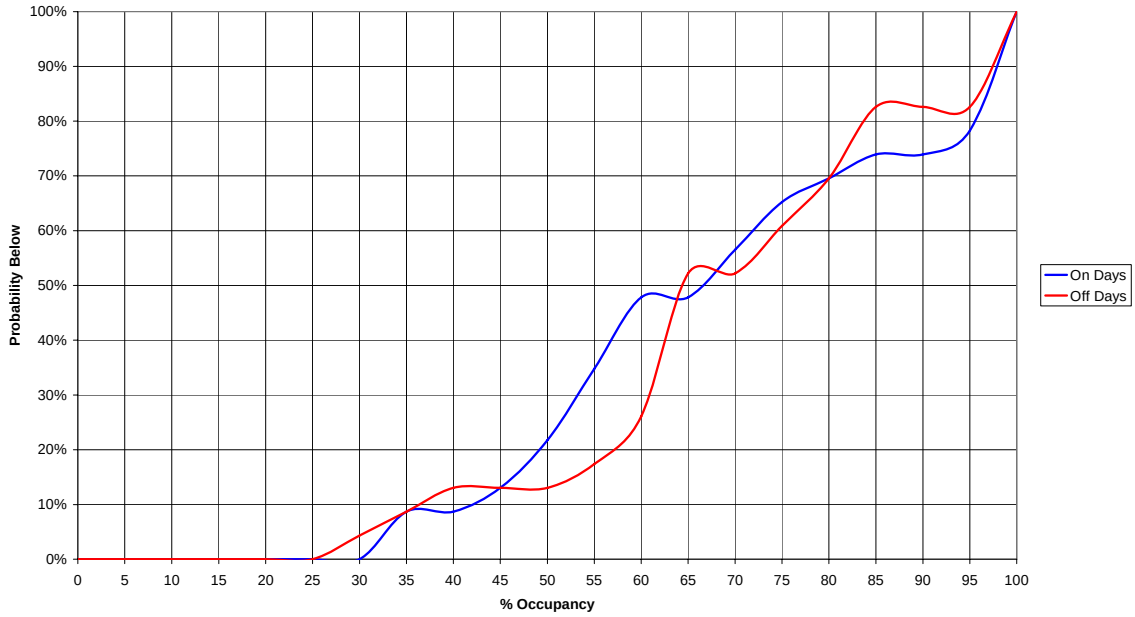
NYSERDA TEST - Marriot Hotel
Outside Air Temperature Probabilities (03/03/05--04/17/05)



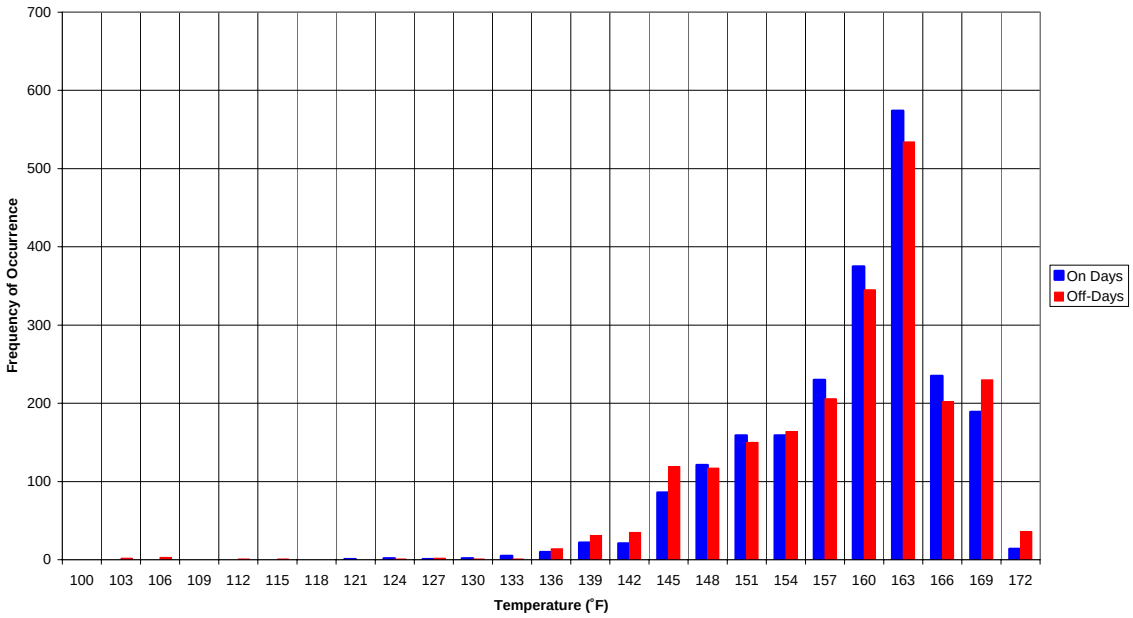
NYSERDA TEST - Marriot Hotel
% OCCUPANCY Histogram (03/03/05--04/17/05)



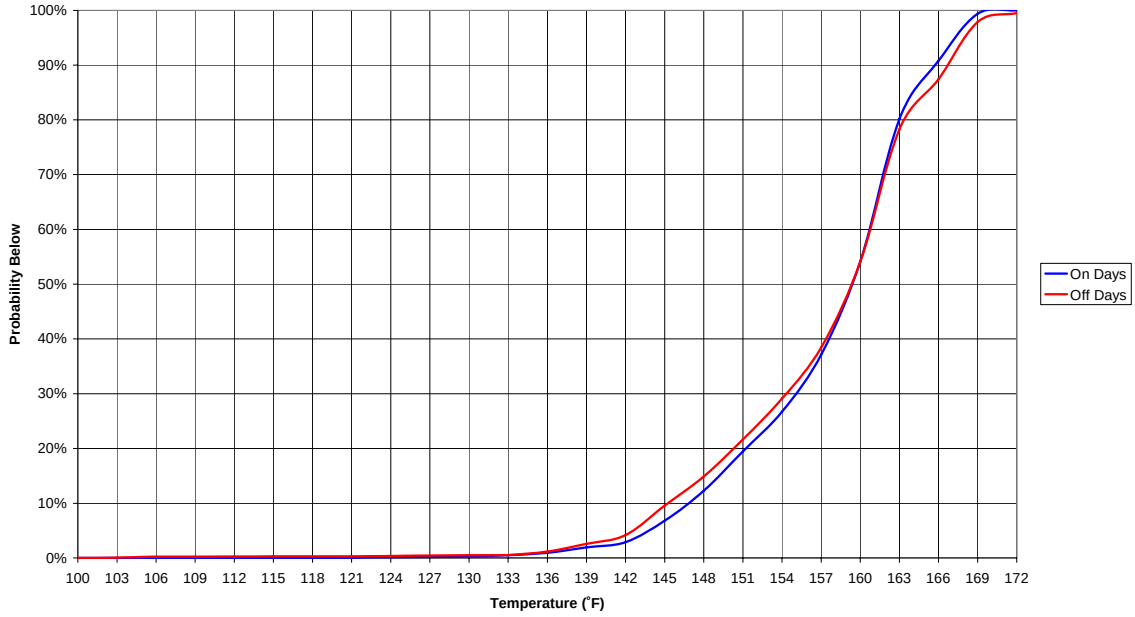
NYSERDA TEST - Marriot Hotel
% OCCUPANCY Probabilities (03/03/05--04/17/05)



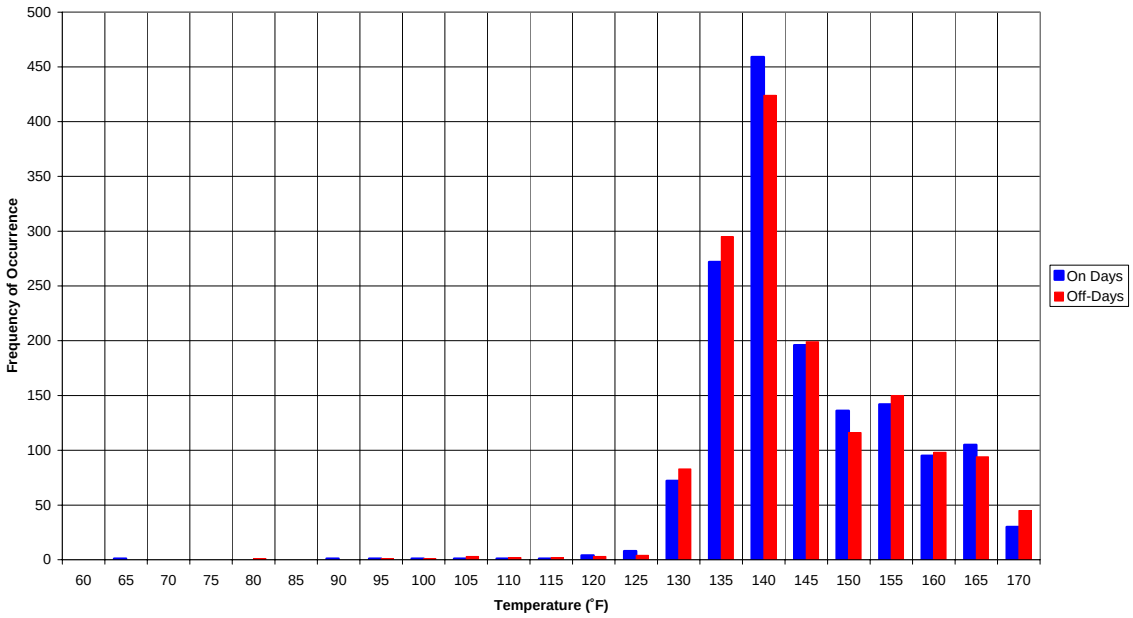
NYSERDA TEST - Marriot Hotel
Pre-Mix Temperature Histogram (03/03/05--04/17/05)



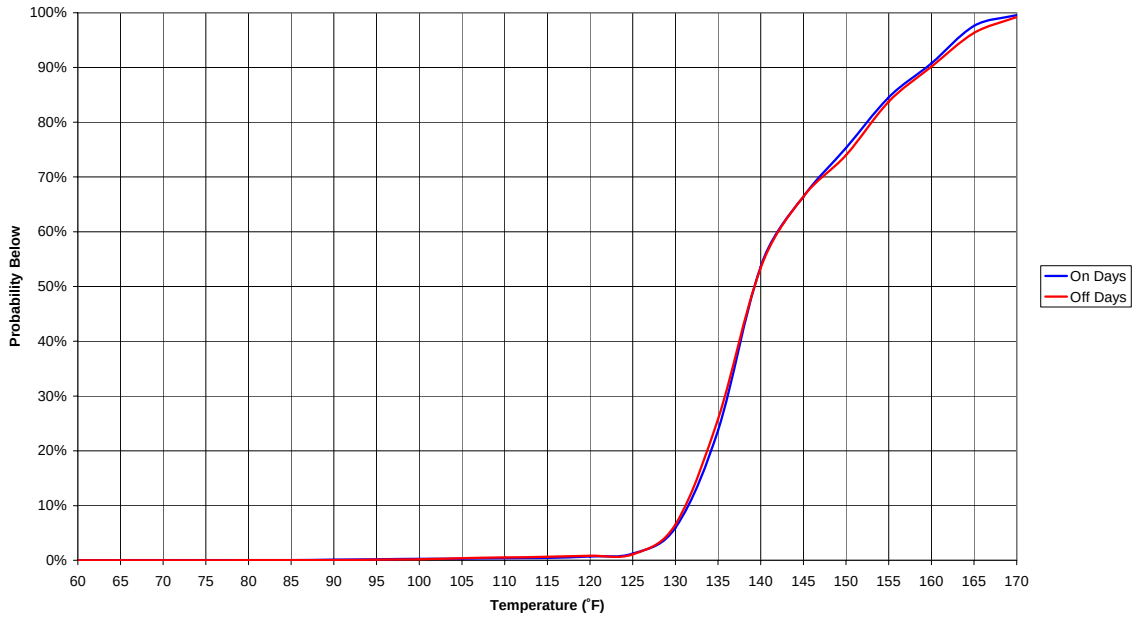
NYSERDA TEST - Marriot Hotel
Pre-Mix Temperature Probabilities (03/03/05--04/17/05)



NYSERDA TEST - Marriot Hotel
Post-Mix Temperature Histogram (03/03/05--04/17/05)



NYSERDA TEST - Marriot Hotel
Post-Mix Temperature Probabilities (03/03/05--04/17/05)



Westchester Marriott Hotel – Tarrytown, NY

Facility Size: 10 Floors, 19 Banquet/Meeting Rooms, 450 Rooms

Air Conditioner Manufacturer: Trane

Model: Intellipack SF HFC50

Capacity: 50 Ton

Fuel Type: Electric

Application: Space Cooling

Area Served: Kitchen

Note: This system has a high percentage of make-up air due to code requirements and exhaust fans.

Savings Results: 10.37% Savings (RAW), 19.02% Savings Degree-Day adjusted

90 Pratt Oval
Glen Cove, NY 11542
Phone:516-676-0777
Fax: 516-676-2640

Test Report

Report No. 12153-12

Date: 11/01/06

Customer:
NYSERDA

Test Site Location:
Westchester Marriott
670 White Plains Road
Tarrytown, NY

Test Type: ☐ HEATING ☑ AIR CONDITIONING ☐ REFRIGERATION ☐ OTHER:

Product Tested: ☐ HW ☐ LCH ☐ LCS ☐ CHW ☐ CHS ☐ AC ☑ CAC ☐ RU ☐ OTHER:

Type of Equipment:

Manufacturer:	TRANE
Model:	INTELLIPACK SFHFC50
Capacity / SetPt:	50 TON - 4 Comp.
Fuel Type:	Electric
Application:	Space Cooling
Area Served:	Kitchen
Misc.	

Test Start Date: 08/26/05
Test End Date: 10/02/05
No. of Days in Test: 38

COMPRESSOR RUN-TIME: ☑ in HRS. ☐ in MIN.

***IntelliCon* ON-DAYS:** 859:12:49
***IntelliCon* OFF-DAYS:** 957:50:23
RUN-TIME was reduced by: 10.30%

COMPRESSOR USAGE FACTOR

***IntelliCon* On-Days:** 47%
***IntelliCon* Off-Days:** 53%

COOLING DEGREE-DAYS (FOR TEST PERIOD)

IntelliCon ON-DAYS: 160.8
IntelliCon OFF-DAYS: 145.1
Total Degree-Days: 305.9
It was 10.8% Warmer on the On-Days.

USAGE PER DEGREE-DAY

ON-DAYS: 5:20:42
OFF-DAYS: 6:36:01

SOLAR LOAD COMPENSATION: (Lumens/Sq. Ft.)

IntelliCon ON-DAYS: 4142422
IntelliCon OFF-DAYS: 3524070
It was 17.55% Sunnier on the On-Days.

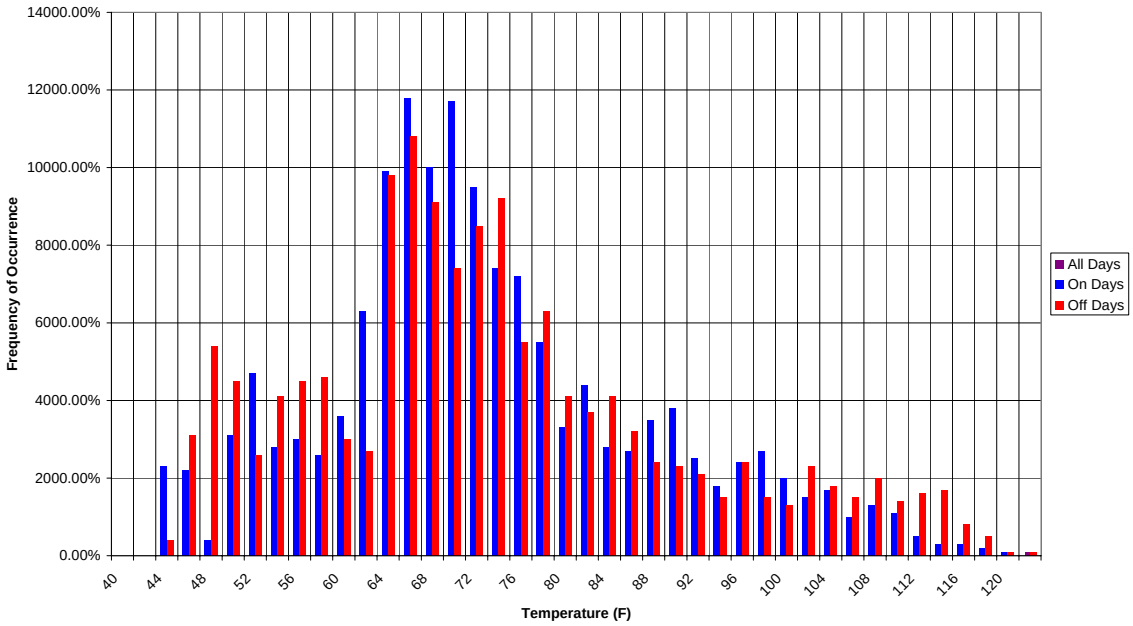
Individual Compressor Data

	ON-DAY	OFF-DAY
Comp. #1 RT:	195:54:14	252:13:34
Comp.#2 RT:	245:00:41	269:36:48
Comp. #1 RT:	184:31:25	194:26:21
Comp.#2 RT:	233:46:29	241:33:40

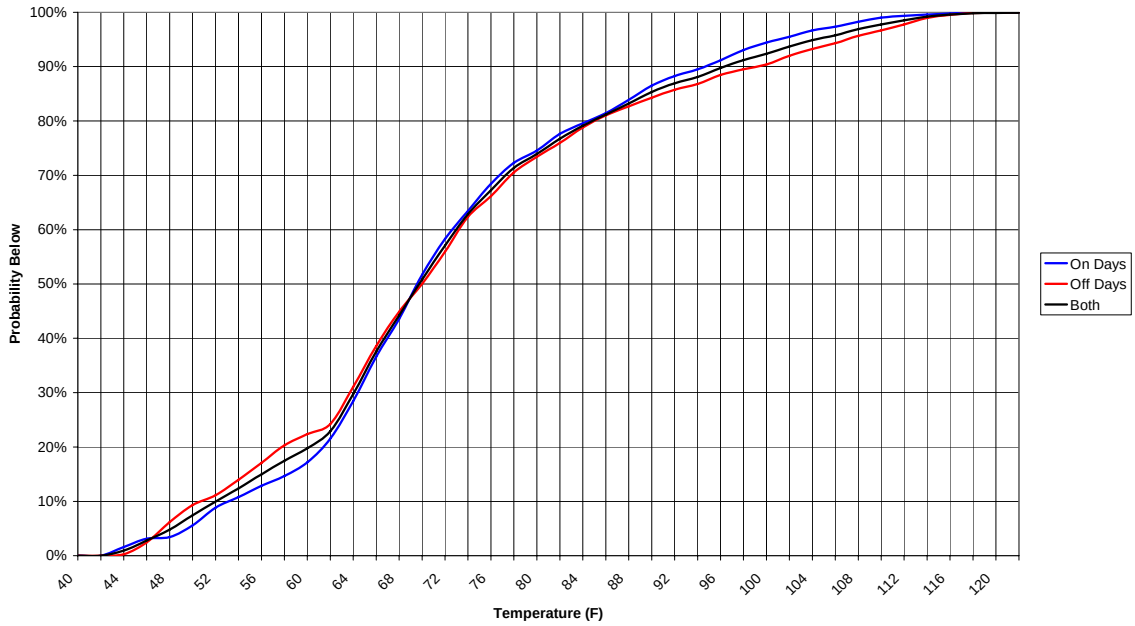
Adj. Savings = 19.02%

COMMENTS:

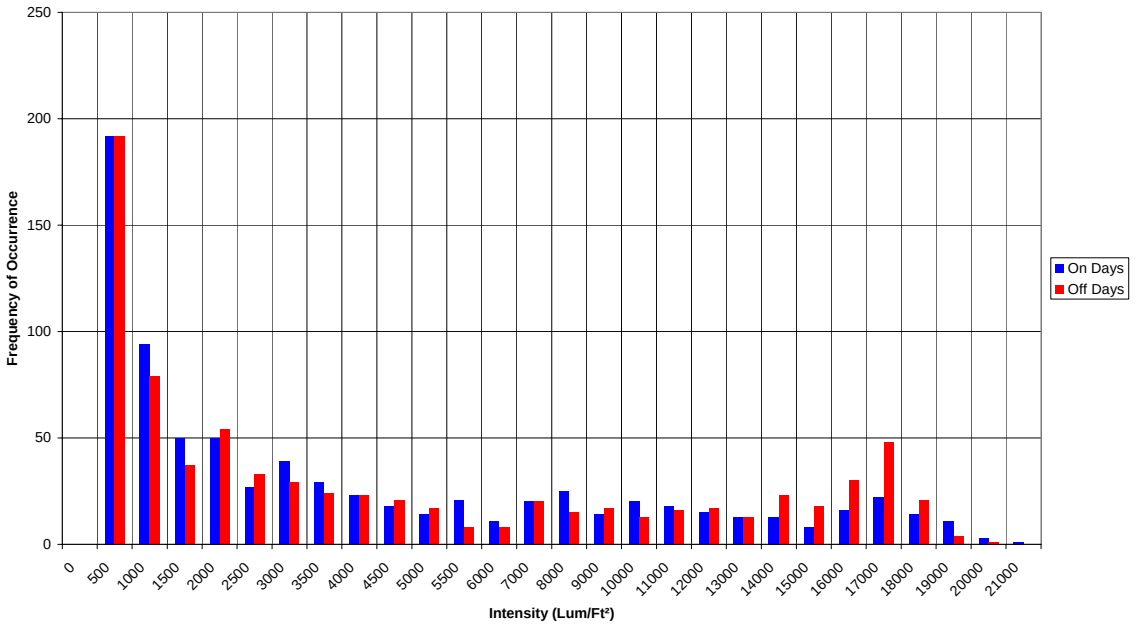
NYSERDA TEST - Marriott Hotel
Outside Air Temperature Histogram (08/17/05--10/03/05)



NYSERDA TEST - Marriott Hotel
Outside Air Temperature Probabilities (08/17/05--10/03/05)



NYSERDA TEST - Marriott Hotel
Solar Load Histogram 6:00 am - 8:00 pm (08/17/05--10/03/05)



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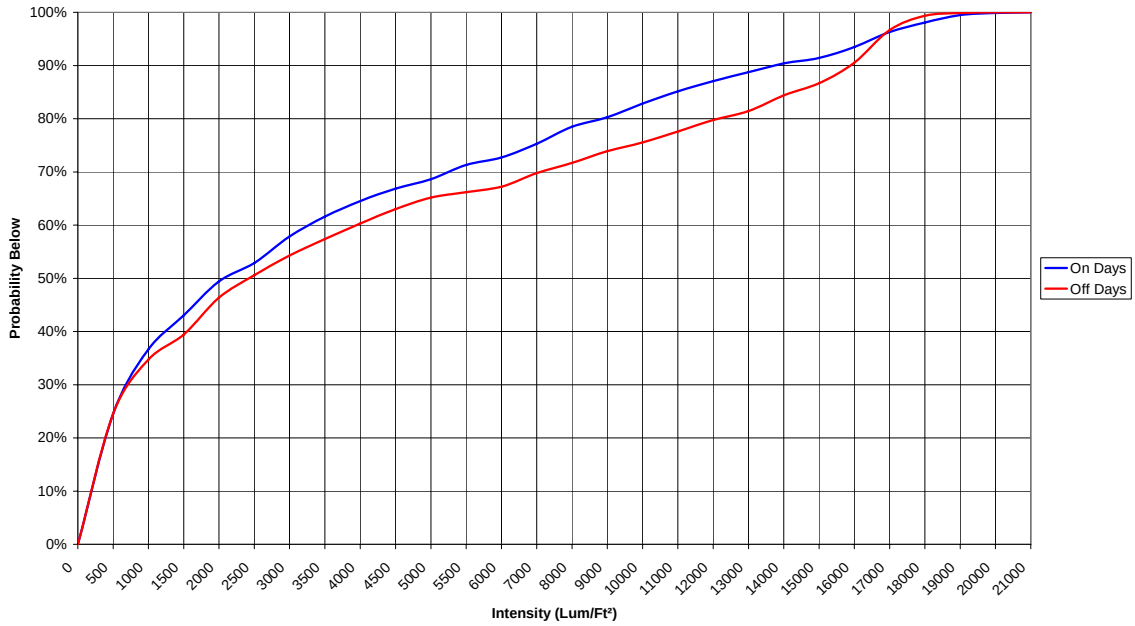
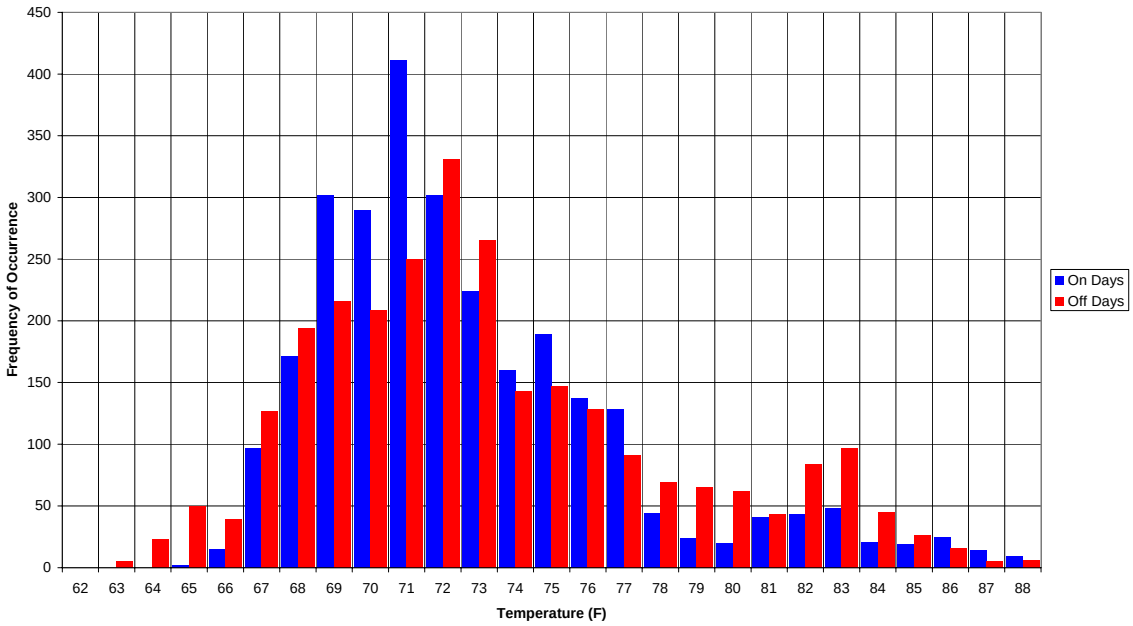
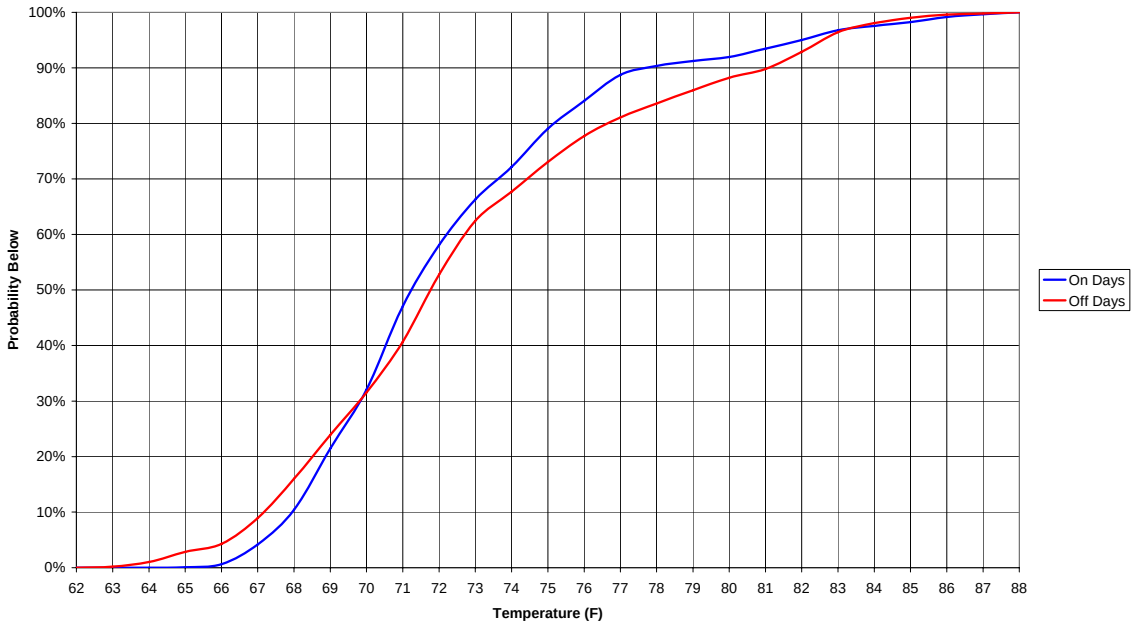


NYSERDA TEST - Marriott Hotel
Kitchen Area Space Temperature Histogram (08/26/05--10/02/05)



NYSERDA TEST - Krino's Foods
Kitchen Area Space Temperature Probabilities (08/26/05--10/02/05)



Westchester Marriott Hotel – Tarrytown, NY

Facility Size: 10 Floors, 19 Banquet/Meeting Rooms, 450 Rooms

Air Conditioner Manufacturer: YORK

Model: DL10N24

Capacity: 10 Ton

Fuel Type: Electric

Application: Space Cooling

Area Served: Pub / Restaurant

Savings Results: 10.44% Savings (RAW), 19.15% Savings Degree-Day adjusted

Intellidyne
90 Pratt Oval
Glen Cove, NY 11542
Phone:516-676-0777
Fax: 516-676-2640

Test Report

Report No. 12153-13

Date: 11/01/06

Customer:
NYSERDA

Test Site Location:
Westchester Marriott
670 White Plains Road
Tarrytown, NY

Test Type: ☐ HEATING ☑ AIR CONDITIONING ☐ REFRIGERATION ☐ OTHER:

Product Tested: ☐ HW ☐ LCH ☐ LCS ☐ CHW ☐ CHS ☐ AC ☑ CAC ☐ RU ☐ OTHER:

Type of Equipment:

Manufacturer:	YORK
Model:	DL10N24
Capacity / SetPt:	10 TON - 2 Comp.
Fuel Type:	Electric
Application:	Space Cooling
Area Served:	PUB
Misc.	

Test Start Date: 08/17/05
Test End Date: 10/03/05
No. of Days in Test: 48

COMPRESSOR RUN-TIME: ☑ in HRS. ☐ in MIN.

IntelliCon **ON-DAYS:** 440:52:14
IntelliCon **OFF-DAYS:** 492:14:40
RUN-TIME was reduced by: 10.44%

COMPRESSOR USAGE FACTOR

IntelliCon **On-Days:** 38%
IntelliCon **Off-Days:** 43%

COOLING DEGREE-DAYS (FOR TEST PERIOD)

IntelliCon ON-DAYS: 160.8
IntelliCon OFF-DAYS: 145.1
Total Degree-Days: 305.9
It was 10.8% **Warmer on the On-Days.**

USAGE PER DEGREE-DAY

ON-DAYS: 2:44:33
OFF-DAYS: 3:23:31

SOLAR LOAD COMPENSATION: (Lumens/Sq. Ft.)

IntelliCon ON-DAYS: 4142422
IntelliCon OFF-DAYS: 3524070
It was 17.55% **Sunnier on the On-Days.**

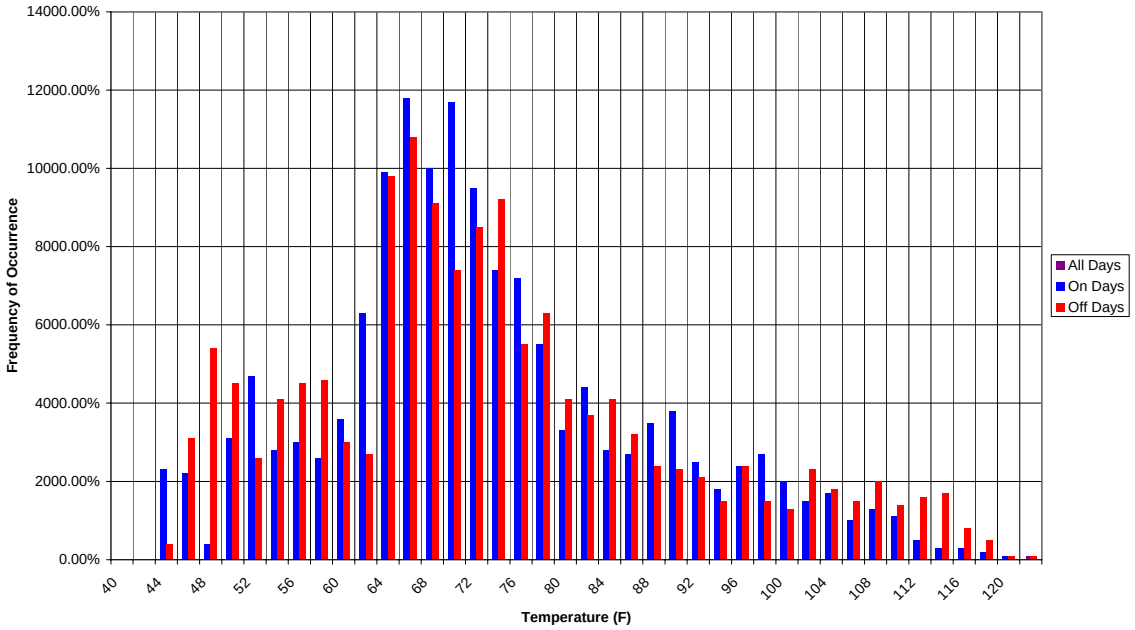
Individual Compressor Data

	ON-DAY	OFF-DAY
Comp. #1 RT:	294:36:19	343:42:10
Comp.#2 RT:	146:15:55	148:32:30

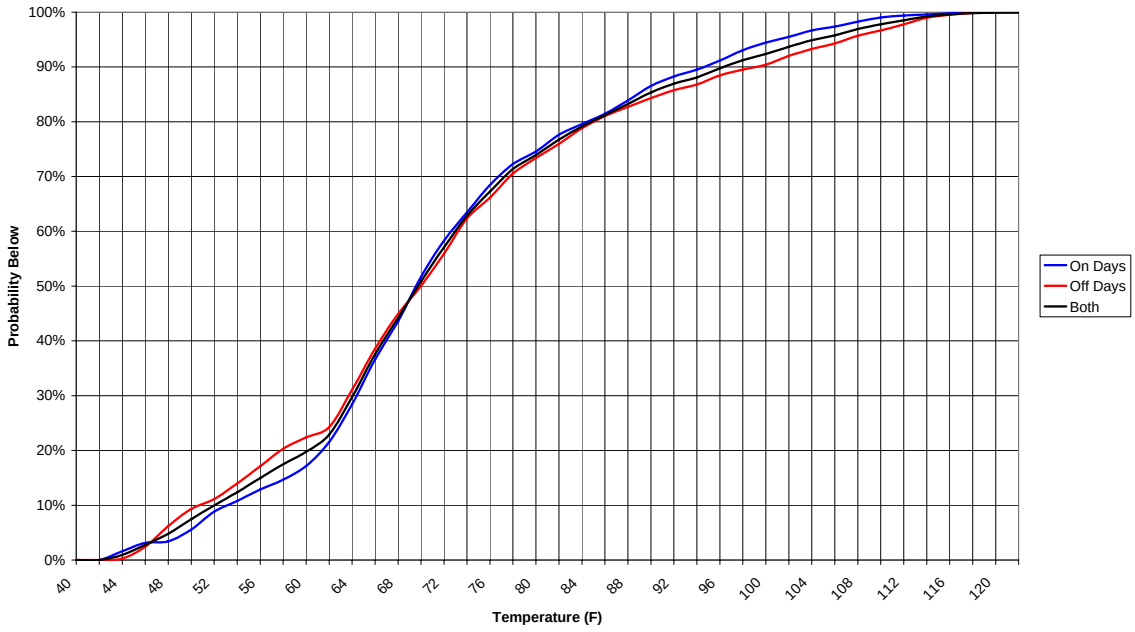
Adj. Savings = 19.15%

COMMENTS:

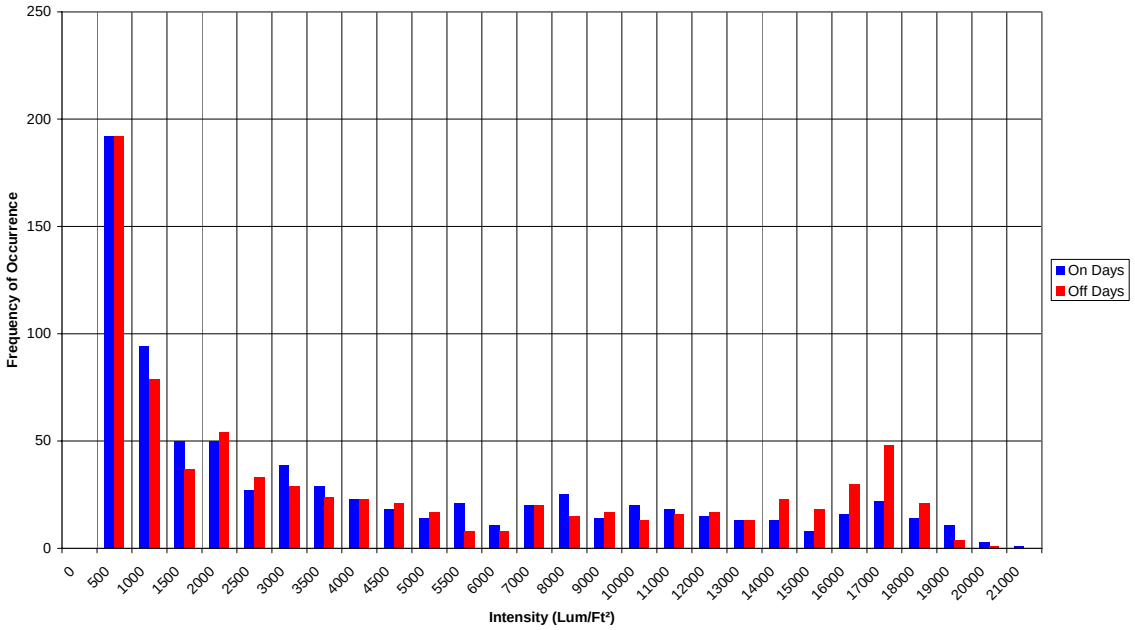
NYSERDA TEST - Marriott Hotel
Outside Air Temperature Histogram (08/17/05--10/03/05)



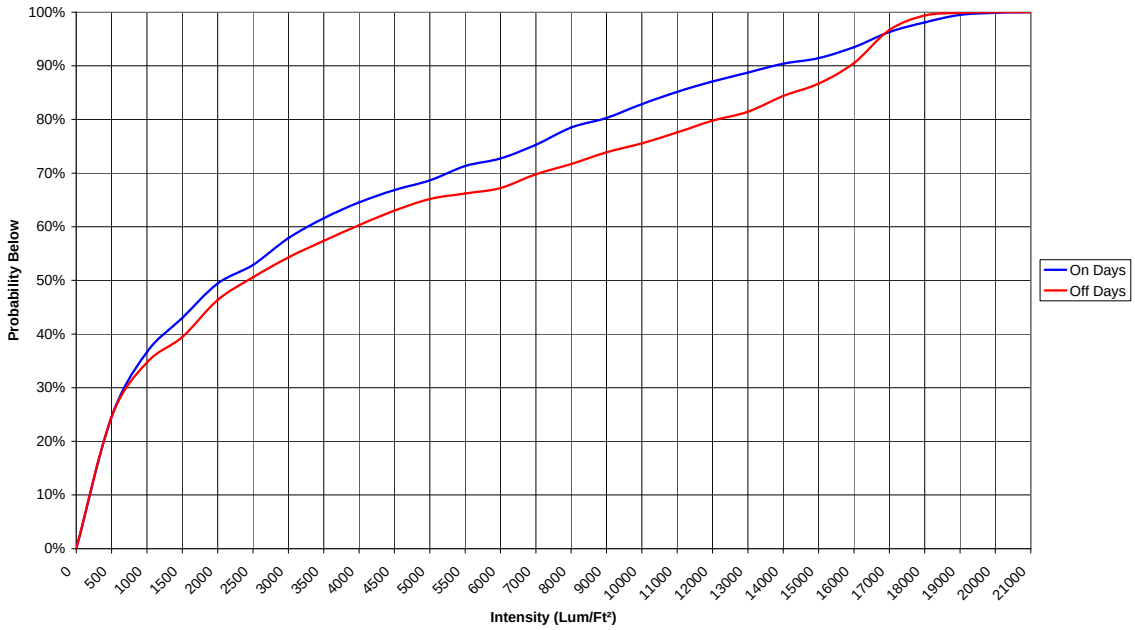
NYSERDA TEST - Marriott Hotel
Outside Air Temperature Probabilities (08/17/05--10/03/05)



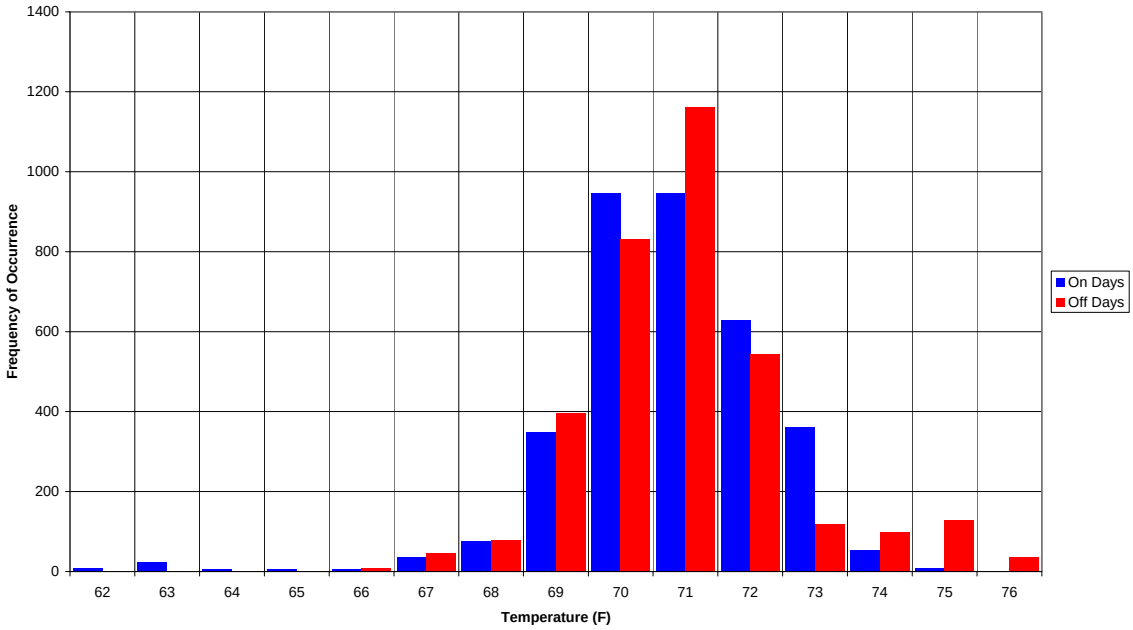
NYSERDA TEST - Marriott Hotel
Solar Load Histogram 6:00 am - 8:00 pm (08/17/05--10/03/05)



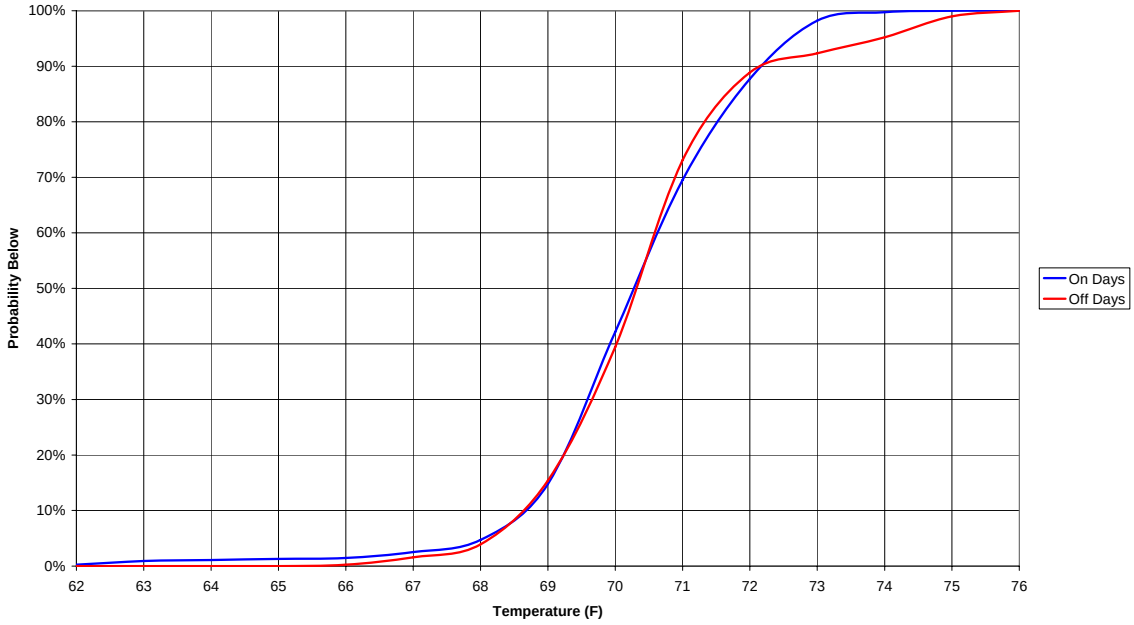
NYSERDA TEST - Marriott Hotel
Solar Load Probabilities 6:00 am - 8:00 pm (08/17/05--10/03/05)



NYSERDA TEST - Marriott Hotel
Pub Area Space Temperature Histogram (08/17/05--10/03/05)



NYSERDA TEST - Marriott Hotel
Pub Area Space Temperature Probabilities (08/17/05--10/03/05)



Rohm and Hass Electronic Materials– Freeport, NY

Air Conditioner Manufacturer: Carrier

Model: 48TFE008-601

Capacity: 7.5 Tons

Fuel Type: Electric

Application: Space Cooling for ~ 2000Ft^2. Area

Area Served: Rear Chemical Lab

Savings Results: 12.05% Savings (RAW), 12.84% Savings Degree-Day adjusted

Intellidyne
90 Pratt Oval
Glen Cove, NY 11542
Phone:516-676-0777
Fax: 516-676-2640

Test Report

Report No. 12153-9

Date: 11/01/06

Customer:
NYSERDA

Test Site Location:
Rohm And Hass
272 Buffalo Ave.
Freeport, NY 11520

Test Type: ☐ HEATING ☑ AIR CONDITIONING ☐ REFRIGERATION ☐ OTHER:

Product Tested: ☐ HW ☐ LCH ☐ LCS ☐ CHW ☐ CHS ☐ AC ☑ CAC ☐ RU ☐ OTHER:

Type of Equipment:

Manufacturer:	Carrier
Model:	48TFE008---601--
Capacity / SetPt:	7.5 Ton / 72 Deg. F.
Fuel Type:	
Application:	Area Cooling
Area Served:	Rear Chemical Lab
Misc.	

Test Start Date: 07/21/05

Test End Date: 08/27/05

No. of Days in Test: 38

COMPRESSOR RUN-TIME: ☑ in HRS. ☐ in MIN.

***IntelliCon* ON-DAYS:** 142:21:16

***IntelliCon* OFF-DAYS:** 161:51:59

RUN-TIME was reduced by: 12.05%

COMPRESSOR USAGE FACTOR

***IntelliCon* On-Days:** 31%

***IntelliCon* Off-Days:** 35%

COOLING DEGREE-DAYS (FOR TEST PERIOD)

IntelliCon ON-DAYS: 253.8

IntelliCon OFF-DAYS: 251.6

Total Degree-Days: 505.4

It was 0.9% **Warmer on the On-Days.**

USAGE PER DEGREE-DAY

ON-DAYS: 0:33:39

OFF-DAYS: 0:38:36

SOLAR LOAD COMPENSATION: (Lumens/Sq. Ft.)

IntelliCon ON-DAYS: 61773

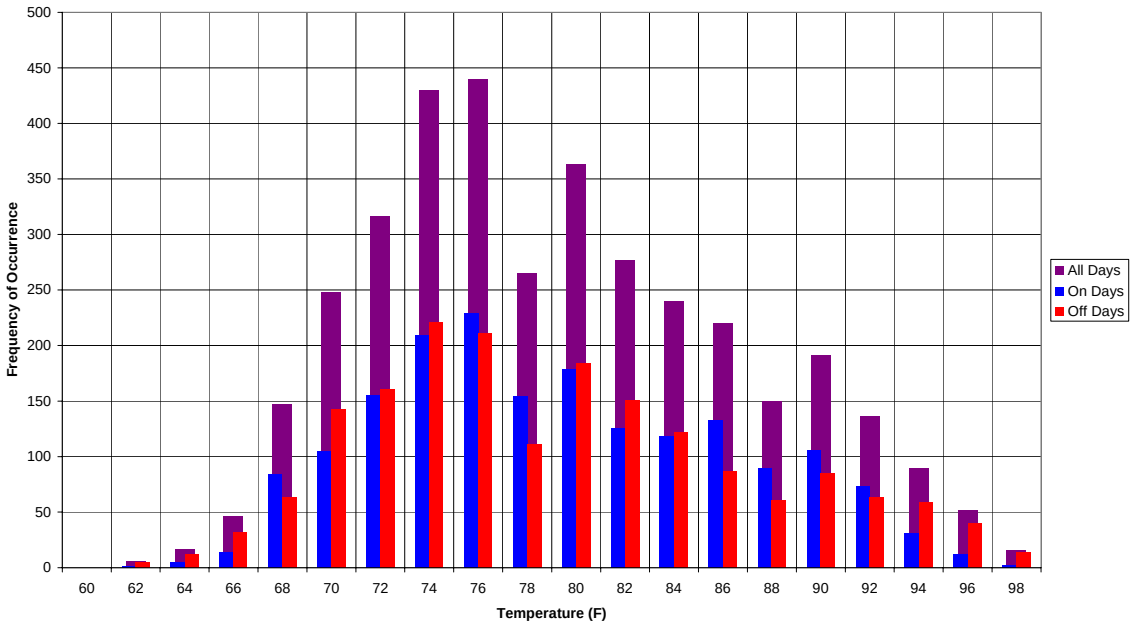
IntelliCon OFF-DAYS: 59191

It was 4.36% **Sunnier on the On-Days.**

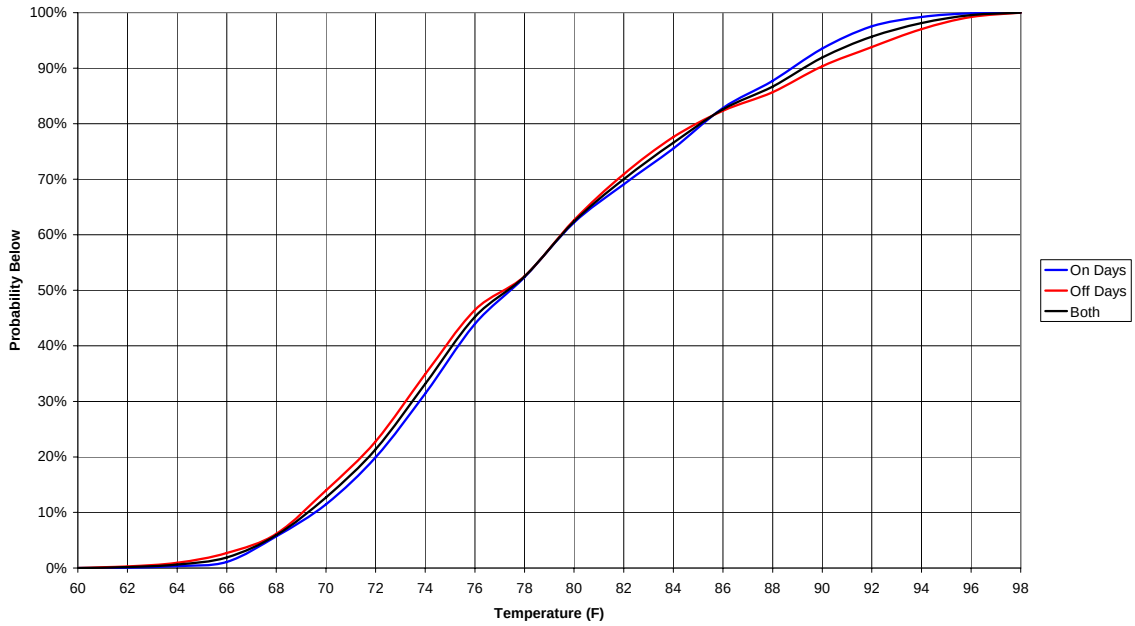
Adj. Savings = 12.84%

COMMENTS:

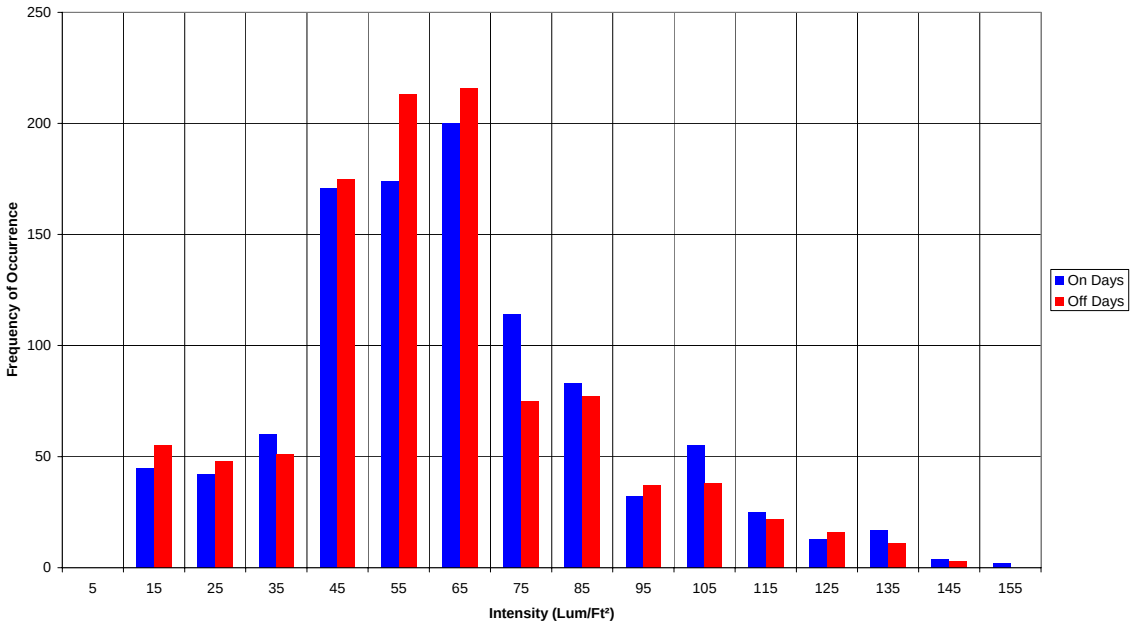
NYSERDA TEST - Rohm and Hass
Outside Air Temperature Histogram (7/21/05--08/29/05)



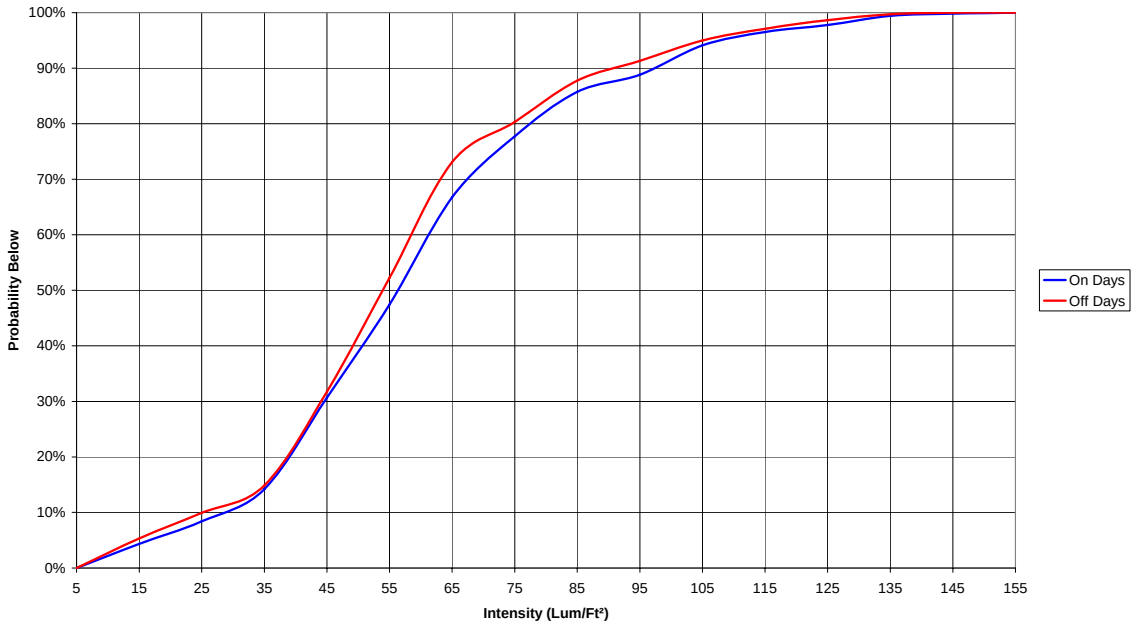
NYSERDA TEST - Rohm and Hass
Outside Air Temperature Probabilities (7/21/05--08/29/05)



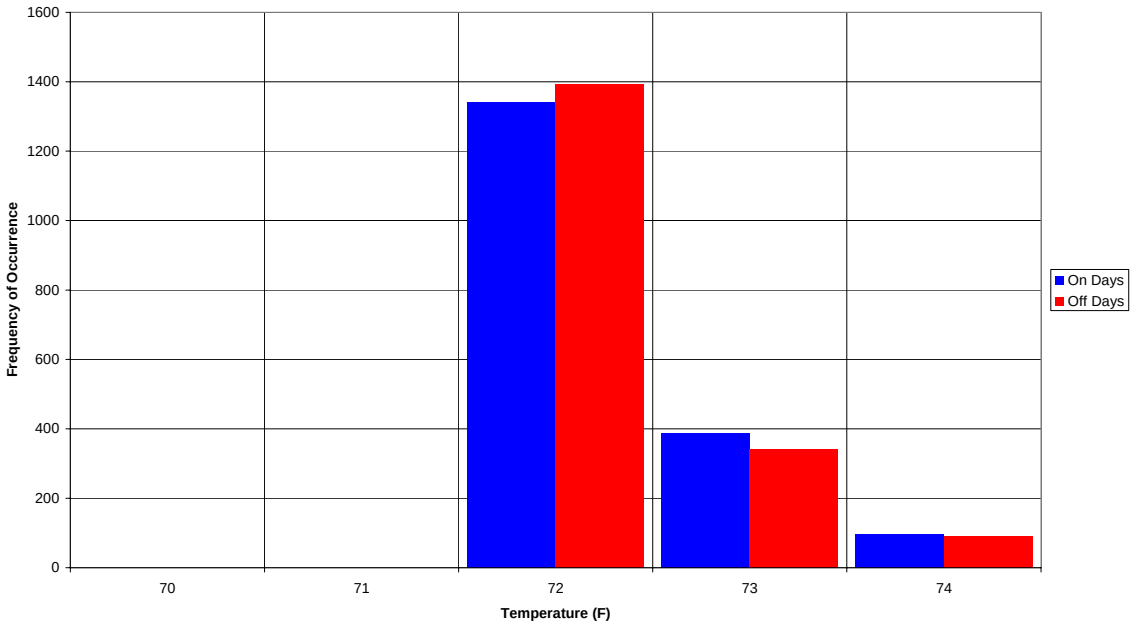
NYSERDA TEST - Rohm and Hass
Solar Load Histogram 6:00 am - 8:00 pm (7/21/05--08/29/05)



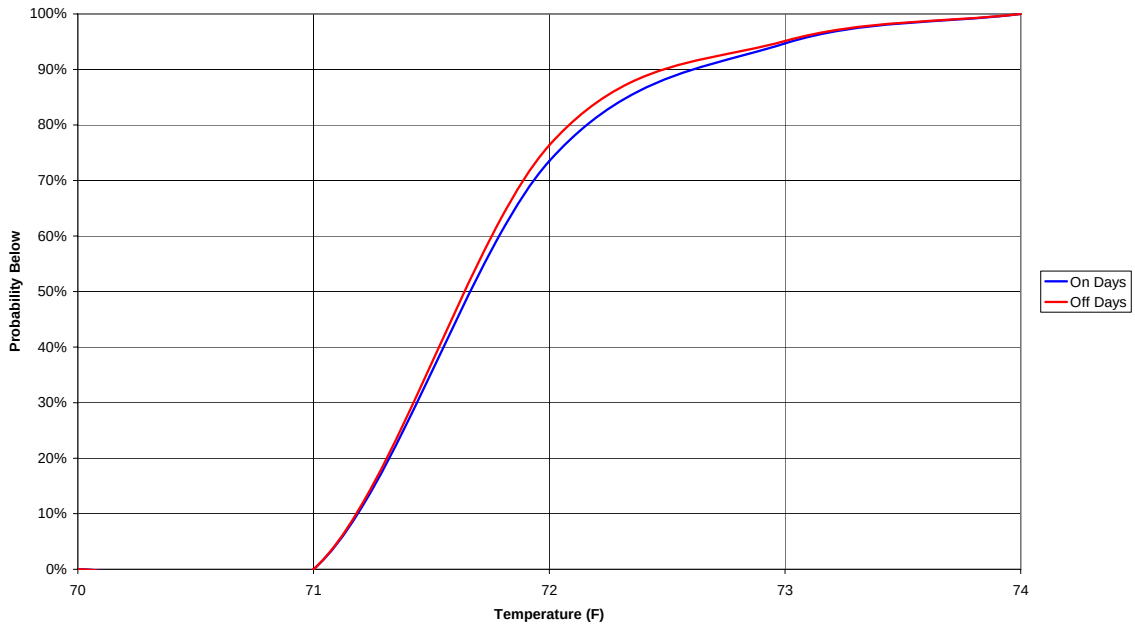
NYSERDA TEST - Rohm and Hass
Solar Load Probabilities 6:00 am - 8:00 pm (7/21/05--08/29/05)



NYSERDA TEST - Rohm and Hass
Space Temperature Histogram (7/21/05--08/29/05)



NYSERDA TEST - Rohm and Hass
Space Temperature Probabilities (7/21/05--08/29/05)



Quinnipiac Club – New Haven, CT

Facility Size: ~50,000 s.f. , 19 Guest Rooms

Boiler Manufacturer: HB Smith with Iron Fireman Burner

Model: 450 Mills / HP GO-4-4.5

Capacity: 3.5 MMBTU/hr. (25 GPH #2 oil, 35 Therms/hr. Nat. Gas)

Fuel Type: Natural Gas / #2 Oil

Application: Steam Space Heating through free-standing cast-iron radiators.

Area Served: Club House and Inn

Note: This building was built in 1933 and is a historical landmark.

Savings Results: 11.04% Savings (RAW), 14.68% Savings Degree-Day adjusted

Comments: Burner Run-Times are minus Pre & Post Purge cycle times (60 second Pre + 15 second Post = 75 seconds total per cycle). Usage factors are low which is indicative of either an oversized system or a system that is not under a normal load. Logged data provided from the test site indicates that the system was not in the heating mode for approximately 50% of the time, due to elevated outdoor temperatures. However, Domestic Hot-Water generation continued. Savings results would be higher under normal loading conditions (during winter months)... Boiler # 2 did not run at all during the test period.

INTELLIDYNE
"Smart ways to save energy"

90 Pratt Oval
Glen Cove, NY 11542
Phone:516-676-0777
Fax: 516-676-2640

Test Report

Report No. 12153-10

Date: 11/01/06

Customer:
NYSERDA

Test Site Location:
Quinnipiac Club
221 Church St.
New Haven, CT 06510

Test Type: ☑ HEATING ☐ AIR CONDITIONING ☐ REFRIGERATION ☐ OTHER:

Product Tested: ☐ HW ☐ LCH ☐ LCS ☐ CHW ☑ CHS ☐ AC ☐ CAC ☐ RU ☐ OTHER:

Type of Equipment:
Manuf.: HB Smith / Burner is An Iron Fireman
Model: 450 Mills / HP GO-4-4.5
Capacity / SetPt: 3.5 MMBTU
Fuel Type: #2 Oil, 25 GPH

Application: Heating & DHW
Area Served: Entire Building

Test Start Date: 03/18/05
Test End Date: 04/16/05
No. of Days in Test: 30

BURNER RUN-TIME: ☑ in HRS. ☐ in MIN.

IntelliCon **ON-DAYS:** 73:48:47
IntelliCon **OFF-DAYS:** 82:58:12
RUN-TIME was reduced by: 11.04%

BURNER USAGE FACTOR:
IntelliCon **On-Days:** 21%
IntelliCon **Off-Days:** 23%

HEATING DEGREE-DAYS (FOR TEST PERIOD)
IntelliCon ON-DAYS: 296
IntelliCon OFF-DAYS: 284
Total Degree-Days: 580
It was 4.3% **Colder on the On-Days.**

USAGE PER DEGREE-DAY
ON-DAYS: 0:14:57
OFF-DAYS: 0:17:31

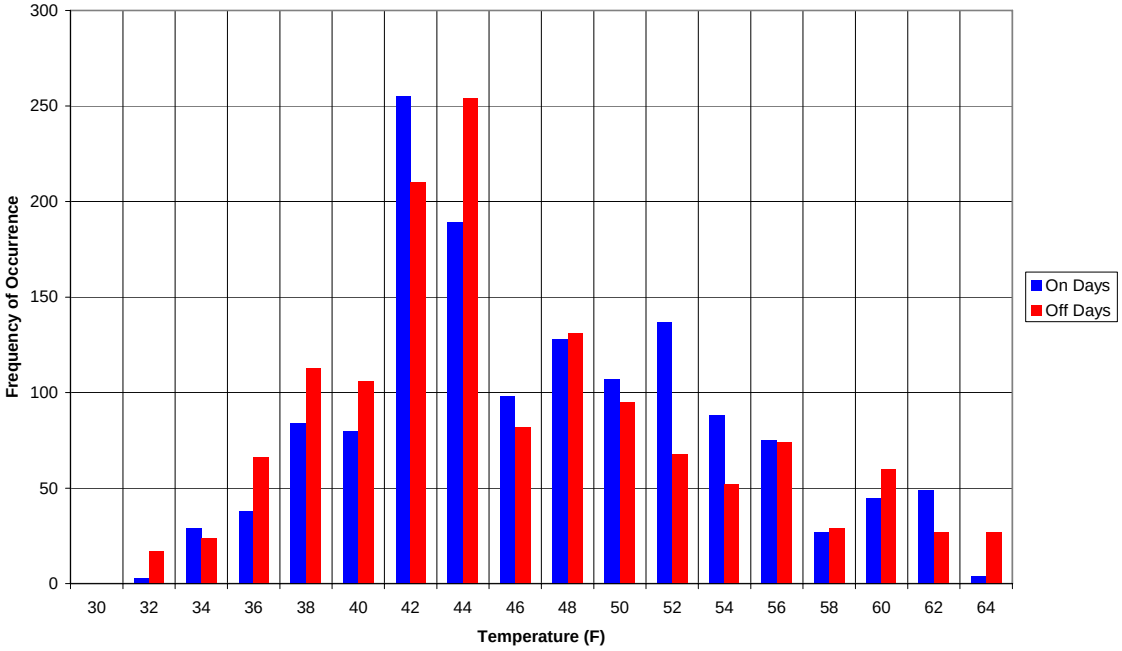
SOLAR LOAD COMPENSATION: (Lumens/Sq. Ft.)
IntelliCon ON-DAYS: 173101
IntelliCon OFF-DAYS: 171471
It was < 1% **Sunnier on the On-Days.**

BURNER CYCLING REDUCTION:
IntelliCon ON-DAYS: 1617
IntelliCon OFF-DAYS: 2066
Cycling was reduced by: 21.7%

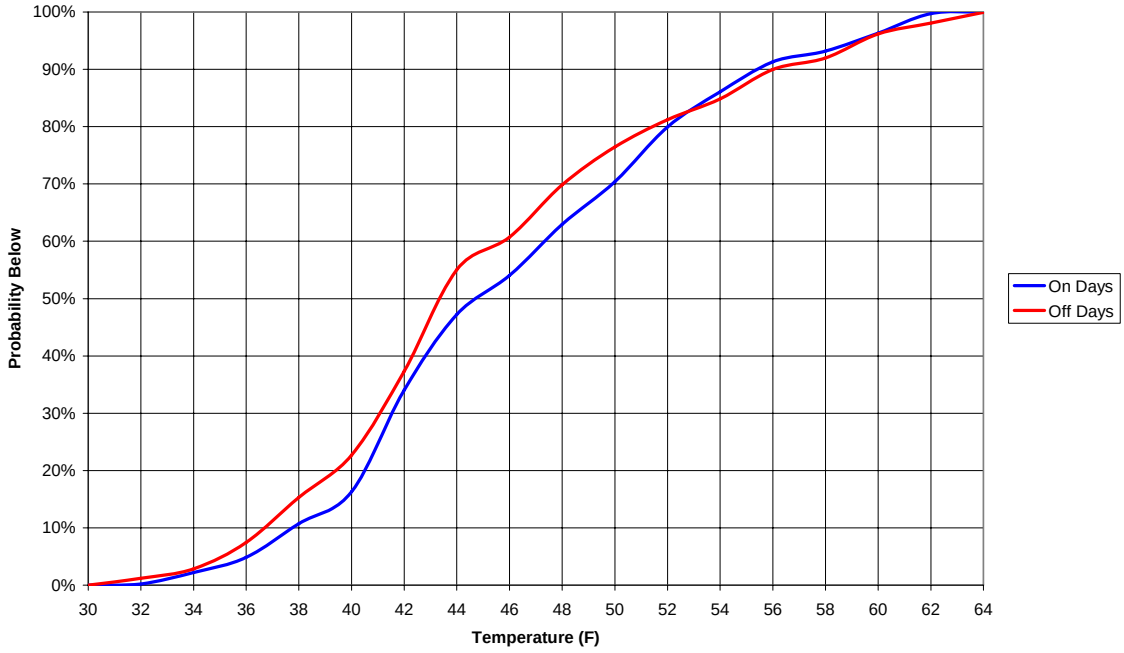
Adj. Savings = 14.68%

COMMENTS: Burner Run-Times are minus Pre & Post Purge cycle times (60 second Pre + 15 second Post = 75 seconds total per cycle). Usage factors are low which is indicative of either an oversized system or a system that is not under a normal load. Log data provided from the test site indicates that the system was not in the heating mode for opproximately 50% of the time, due to elevated outdoor temperatures. However, Domestic Hot-Water generation continured. Savings results would be higher under normal loading conditions (during winter months)... Boiler # 2 did not run at all during the test period.

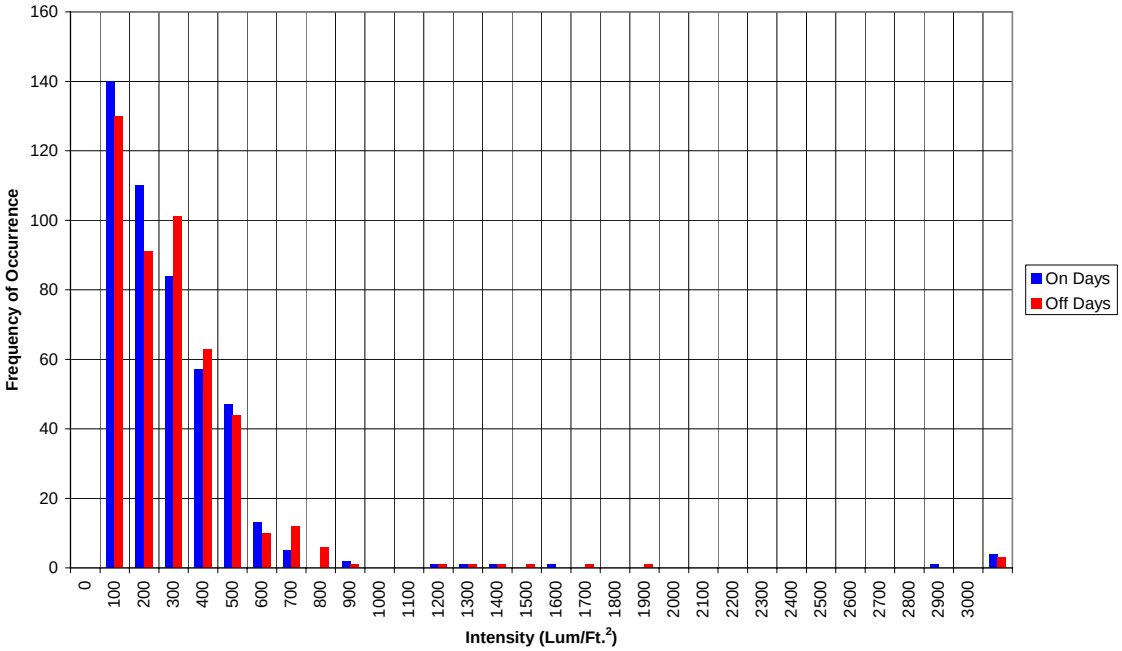
NYSERDA Test - Quinnipiac Club
Outside Air Temperature Histogram (3/18/05 --4/16/05)



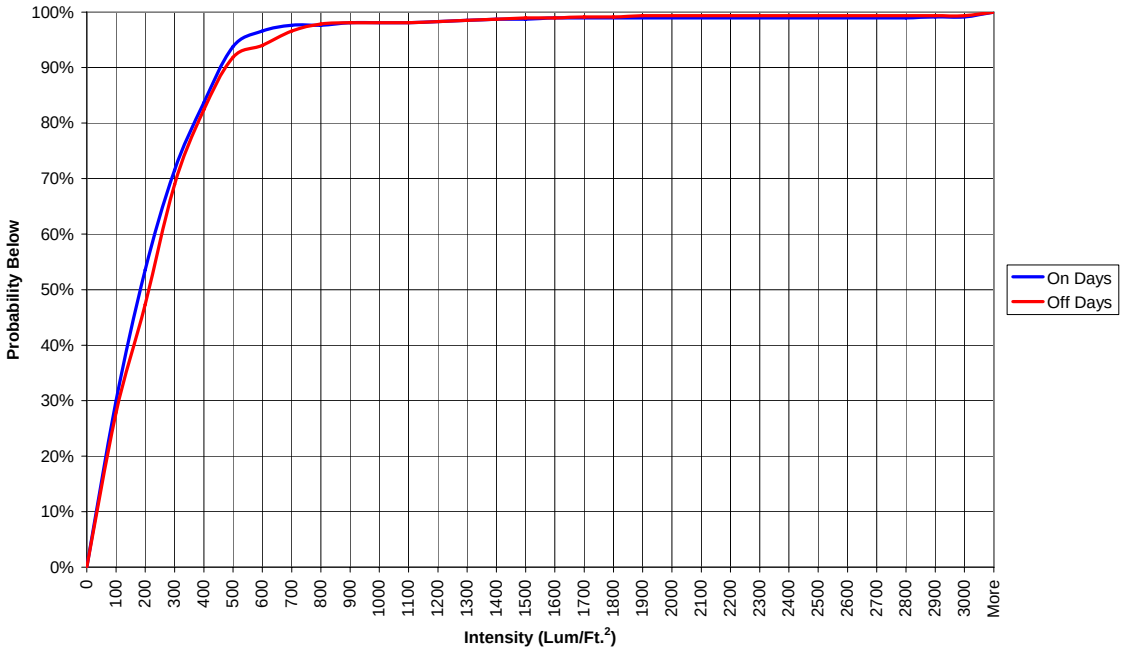
NYSERDA Test - Quinnipiac Club
Outside-Air Temperature Probabilities (3/18/05 --4/16/05)



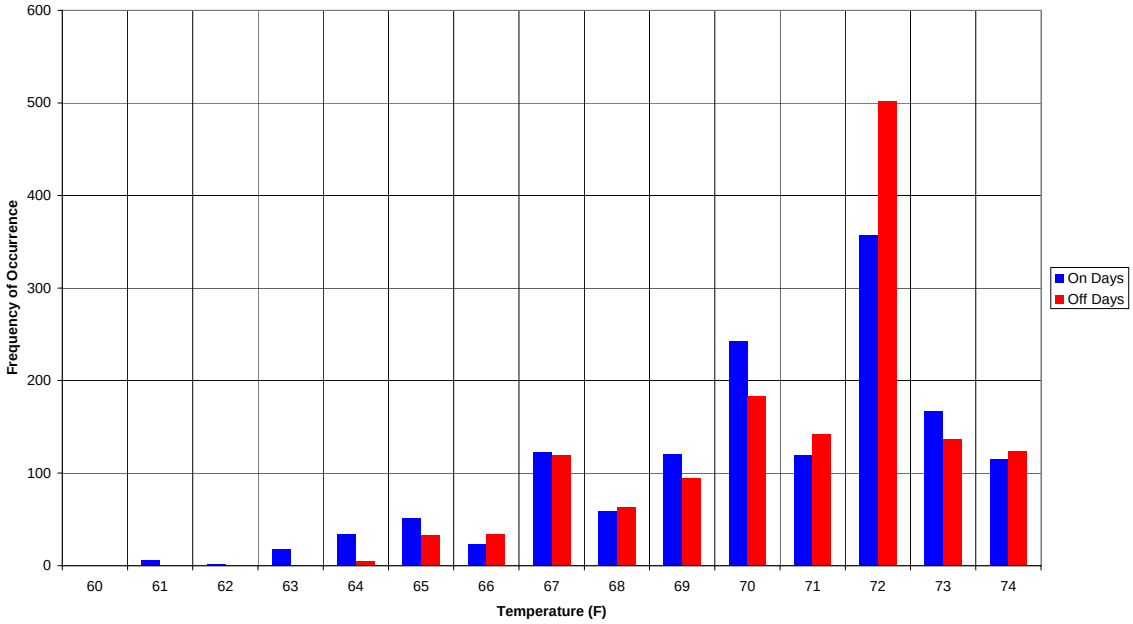
NYSERDA Test - Quinnipiac Club
Solar Load Probabilities (3/18/05 --4/16/05)



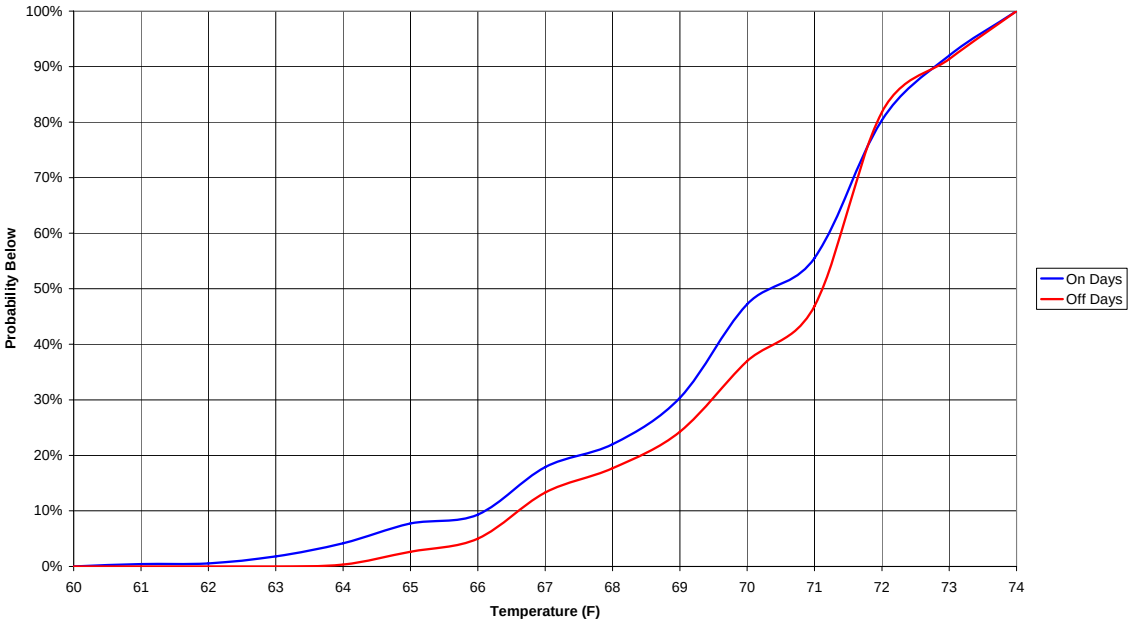
NYSERDA Test - Quinnipiac Club
Solar Load Probabilities (3/18/05 --4/16/05)



NYSERDA Test - Quinnipiac Club
Space Temperature Histogram (3/18/05 --4/16/05)



NYSERDA Test - Quinnipiac Club
Space Temperature Probabilities (3/18/05 --4/16/05)



Krinos Foods – Long Island City, NY

Facility Size:

Refrigeration Unit Manufacturer: Krack

Model: KCU100-KH1

Capacity: 10 HP

Fuel Type: Electric

Application: Walk-In Refrigerator ~ ??? Ft^2. Area

Area Served: Club House and Inn

Savings Results: 10.27% Savings (Refrigeration systems are NOT degree-day compensated).

90 Pratt Oval
Glen Cove, NY 11542
Phone:516-676-0777
Fax: 516-676-2640

Test Report

Report No. 12153-11

Date: 11/01/06

Customer:
NYSERDA

Test Site Location:
Krinos Foods
47-00 Northern Blvd.
Long Island City, NY

Test Type: ☐ HEATING ☐ AIR CONDITIONING ☑ REFRIGERATION ☐ OTHER:

Product Tested: ☐ HW ☐ LCH ☐ LCS ☐ CHW ☐ CHS ☐ AC ☐ CAC ☑ RU ☐ OTHER:

Type of Equipment:

Manufacturer:	KRACK Corp.
Model:	KCU100-KH1
Capacity / SetPt:	10HP
Fuel Type:	Electric
Application:	Walk-In Refrigerator
Area Served:	
Misc.	

Test Start Date: 08/16/05

Test End Date: 10/12/05

No. of Days in Test: 58

COMPRESSOR RUN-TIME: ☑ in HRS. ☐ in MIN.

***IntelliCon* ON-DAYS:** 453:25:08

***IntelliCon* OFF-DAYS:** 505:19:20

RUN-TIME was reduced by: 10.27%

COMPRESSOR USAGE FACTOR

***IntelliCon* On-Days:** 65%

***IntelliCon* Off-Days:** 73%

COOLING DEGREE-DAYS (FOR TEST PERIOD)

IntelliCon ON-DAYS: 397.9

IntelliCon OFF-DAYS: 399.3

Total Degree-Days: 797.2

It was < 1% **Cooler on the ON-Days.**

USAGE PER DEGREE-DAY

ON-DAYS: 1:08:22

OFF-DAYS: 1:15:56

SOLAR LOAD COMPENSATION: (Lumens/Sq. Ft.)

IntelliCon ON-DAYS: 57460

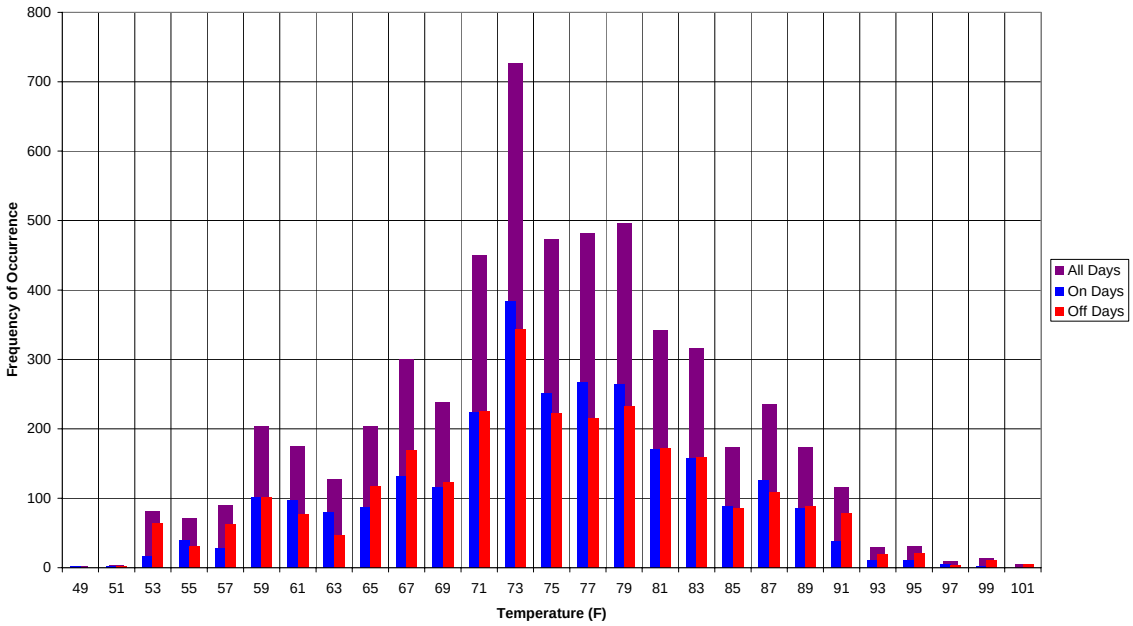
IntelliCon OFF-DAYS: 53547

It was 7.31% **Sunnier on the On-Days.**

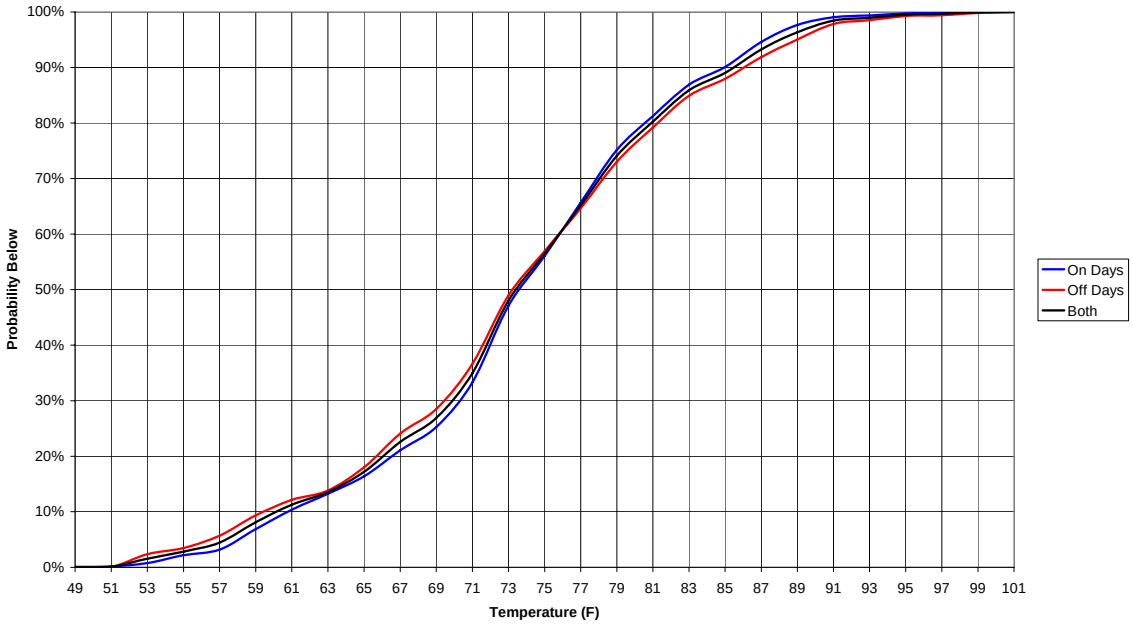
Adj. Savings = 10.27%

COMMENTS: Note: Refrigeration Boxes are environments within environments. As such they are not subject to ambient influences. Thus degree-day or solar load compensation is not necessary.

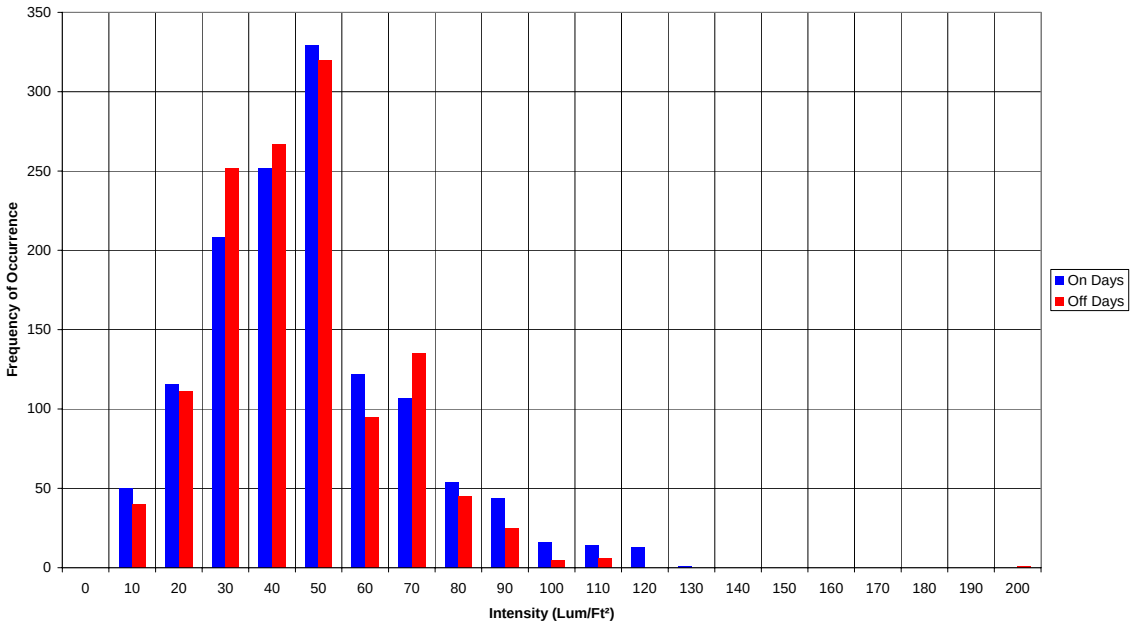
NYSERDA TEST - Krino's Foods
Outside Air Temperature Histogram (08/16/05--10/12/05)



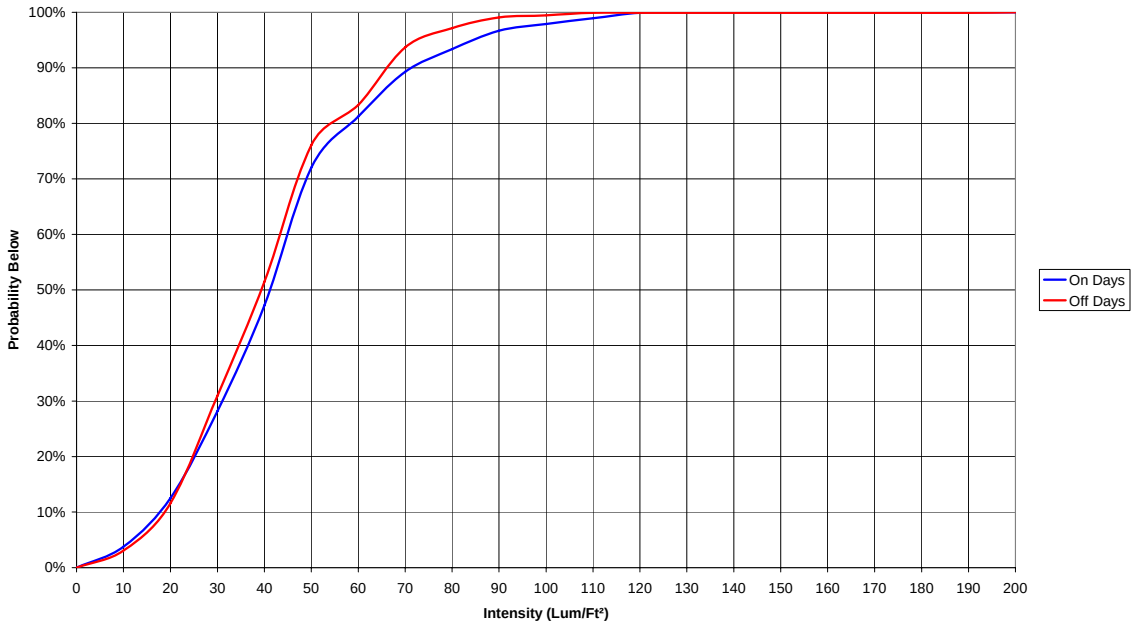
NYSERDA TEST - Krino's Foods
Outside Air Temperature Probabilities (08/16/05--10/12/05)



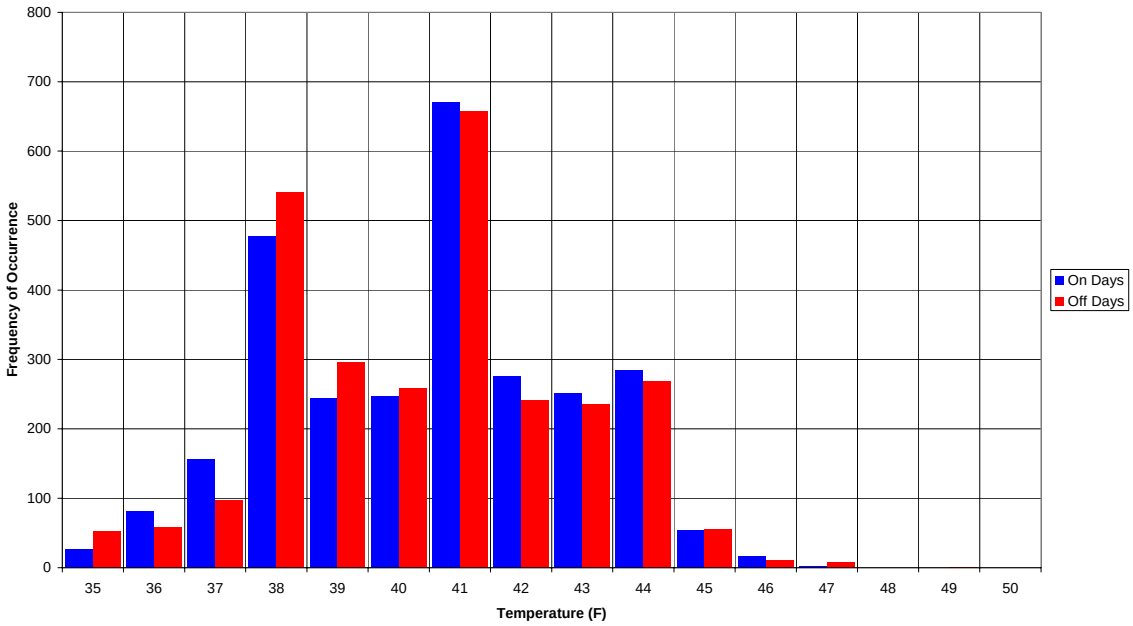
NYSERDA TEST - Krino's Foods
Solar Load Histogram 6:00 am - 8:00 pm (08/16/05--10/12/05)



NYSERDA TEST - Krino's Foods
Solar Load Probabilities 6:00 am - 8:00 pm (08/16/05--10/12/05)



NYSERDA TEST - Krino's Foods
Walk-in Box Temperature Histogram (08/16/05--10/12/05)



NYSERDA TEST - Krino's Foods
Walk-in Box Space Temperature Probabilities (08/16/05--10/12/05)