Plug & Process Loads in Medical Office Buildings

December 20, 2013

By:

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Mazzetti, Inc.

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Introduction

Considerable attention has been focused on improving HVAC and lighting performance in building operation, as past research has shown these components have the most significant impact on a building's energy consumption. However, as these systems become more efficient, plug and process loads comprise an increasing proportion of total building electricity consumption. We know intuitively that plug and process loads are an important contributor to a building's electrical load, but lack current qualitative research to inform our designs and strategies for improvement.

Current design guidelines for plug and process loads are based on antiquated studies, rules of thumb, and/or previous designs with generous safety factors. As a result, power systems are typically oversized. The purpose of this study is to develop a more accurate understanding of plug and process loads in Kaiser Permanente's Medical Office Buildings (MOBs). A more accurate understanding of these loads will accomplish two key items. First, it will inform and improve our electrical design assumptions around MOBs. Second, it will uncover opportunities to reduce plug and process loads, and to right-size building power systems. This effort will ultimately contribute to a further reduction of the environmental impact of building operation – both within Kaiser's building portfolio and within the industry at large.

Methodology

Scope

The study focuses on five Kaiser Permanente facilities in the San Francisco Bay Area, chosen to represent a range of size, age, and function within the MOB class of buildings. Table 1 below lists the facilities and their key characteristics.

Table 1: Kaiser facilities included in plug & process load study

Site Name	Facility Age (Years)	Operating Hours	Building Size (sq. ft.)	Functions
Fairfield Medical Offices	28	M-F 8:30 am to 5 pm*	50,950	Adult & Family Medicine, Flu Clinic, Pediatrics, Pharmacy, Radiology/Diagnostic Imaging, Optometry, Women's Health
Oakland Broadway Medical Offices	5	M-Sat 8:30 am to 5 pm	160,883	Adult Medicine, Ambulatory Surgery, Cancer Center (Hematology, Oncology, Chemotherapy/Infusion, Radiation), Dermatology, Health Education, Laboratory, Internal Medicine Neurology, Pediatric Rehabilitation, Pharmacy Occupational and Employee Health, Therapy
San Jose Ambulatory Surgery Unit	11	M-F 6 am until the last patient leaves	21,434	Ambulatory Surgery
San Francisco 2238 Geary Medical Offices	15	M-F 6 am to 8:30 pm, Sat 7 am to 8:30pm, Sun 7 am to 6 pm	243,329	Cardiology, Dermatology, EKG, Infusion Center, Internal Medicine, Injury Center and Sports Medicine, Laboratory, Obstetrics & Gynecology Oncology, Orthopedics, Radiology/Diagnostic Imaging, Urgent Care - After Hours
San Francisco 450 Sixth Ave Medical Offices	90	M-F 8:30 am to 5 pm	43,050	Dermatology, EEG Sleep Laboratory, Head & Neck Surgery, Neurology, Orthopedic Surgery, Podiatry, Urology

*closed during lunch, 12:30 pm to 1:30 pm

Approach

Data collection aimed to identify base and peaks plug and process loads at four levels of granularity:

- Equipment level
- Room level
- Department level
- Total building level

Circuit-by-circuit level monitoring provided the greatest granularity of plug load measurement. By monitoring at the circuit level, power draw was mapped to specific rooms and departments. Circuit level monitoring utilized wireless amperage meters by Panoramic Power™. These devices easily snap onto the wires of individual circuits providing quick and nonintrusive installation (see Fig. 1). The meters communicate wirelessly to a bridge, which collects data and pushes it to an offsite server through which real time or historical data can be obtained.

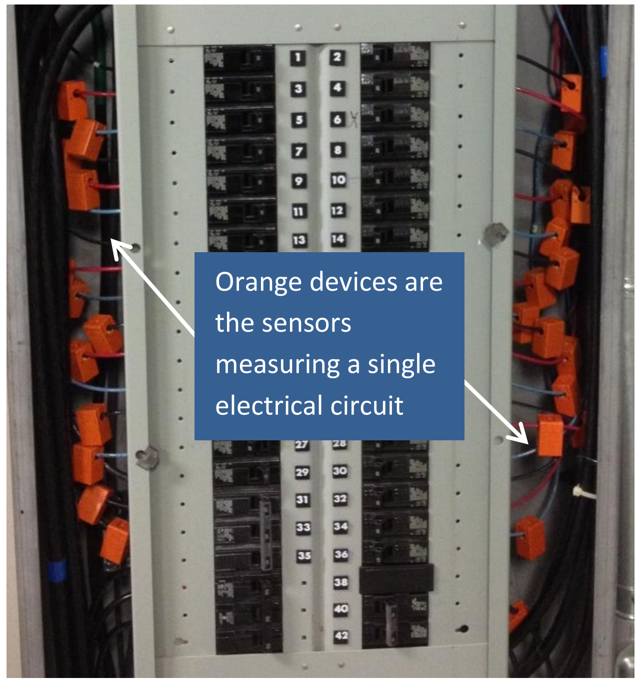

Figure 1: Panoramic Power Sensors installed in a KP facility electrical panel

The circuit level monitoring was supplemented with larger amperage meters monitoring electricity at a panel level. Meters from ACR Systems, Inc. were used at the larger facilities (Oakland, Fairfield, and SF 2238 Geary) where complete circuit level monitoring was time and cost prohibitive. Monitoring at the panel level in certain areas of the building provided detailed information on loads in specific departments, but did not enable a breakdown of plug loads at a room-by-room level.

In addition to monitoring electrical circuits and panels from the supply side, specific rooms and equipment were metered with power strips from Enmetric Systems, Inc. Often, a single circuit provides electricity to outlets in multiple rooms, so specific details on electrical consumption for individual equipment and rooms is difficult to parse. Each Enmetric power strip has four metered outlets, so equipment was rerouted through these outlets to provide real time and interval data. This allowed for individual rooms to be monitored, capturing typical room and equipment use.

In total, over 500 circuit level meters, 10 panel level meters, and 10 power strips were used over two and a half months of monitoring. Each facility was monitored for at least a week. Equipment costs were minimized by reusing monitoring equipment in each facility.

Metrics and Accuracy

Electrical power systems are designed and specified based on the expected peak load, typically allocated by space type. To compare measured consumption with design assumptions and typical sizing, the following key metrics for plug and process loads were used:

- Room and equipment watts per square foot base and peak loads
- Departmental watts per square foot base and peak loads
- Total building watts per square foot base and peak loads
- Load as a percentage of total building electricity

In order to uncover potential energy saving opportunities beyond design and system sizing, the following were also analyzed:

- Load profiles at the equipment level
- Load profiles at the room level
- Load profiles at the department level
- Load profiles at the building level

Studying load profiles at these four levels provides insight into which loads can be potentially shed during unoccupied hours.

To map individual circuits to departments and rooms, a combination of electrical single-line diagrams, power and signal drawings, and panel schedules were analyzed. As a result, the mapping of circuits is only as reliable as the information provided in drawings and panel schedules. In the older facilities, the information available was sometimes outdated or unavailable. Circuits that showed electrical usage but could not be clearly mapped to a room type were grouped into a general “other” category. In addition to these inaccuracies, the metering equipment also presents some error, especially when monitoring amperages on the low end of the meter’s rated capacity. The instrumentation equipment specification sheets can be found in Appendix A.

Study Results

Design vs. Measured Values

Table 2 below provides plug load design guidelines from the IEEE Recommended Practice for Electrical Power Systems in Commercial Buildings.

Table 2: General purpose receptacle loads from IEEE Standard 241-1990 Gray Book

Type of Occupancy	Low W/SF	High W/SF	Average W/SF
Hospitals	0.50	1.50	1.00
Hospitals, large	0.40	1.00	0.70
Office Buildings	0.50	1.50	1.00

Compare these guidelines to the measured plug and process loads summarized in Table 3 below. None of the facilities operate above the IEEE high W/SF at peak W/SF. The measured average plug load for all facilities was also lower than the design average. This result was expected, given the lack of historical data and added safety factors influencing design guidelines.

Table 3: Total building plug & process load power densities from Kaiser MOBs

Kaiser Facility	Minimum W/Sf	Peak W/sf	Average W/sf
San Jose Ambulatory Surgery Center	0.31	1.04	0.51
Fairfield Medical Office	0.21	0.50	0.28
Oakland Medical Office	0.17	0.44	0.24
San Francisco 450 6th Ave Medical Office	0.13	0.48	0.20
San Francisco 2238 Geary Medical Office	0.35	0.62	0.45

* Values extrapolated from one week of plug and process load data

** The San Jose facility does not have a dedicated utility meter that captures total building electricity

The San Jose facility sees higher average and peak loads than the other KP facilities. This facility is dedicated to ambulatory surgery and has the smallest square footage, resulting in a high density of surgical equipment and sterilization. Therefore, higher plug and process load power densities are to be expected. The San Francisco 2238 Geary facility has the next highest loads, most likely as a result of being a high use facility, and operating seven days a week. Among the other medical office buildings, the plug load densities are similar at average and peak loads.

Table 4 below breaks out plug and process loads by different room types in the facilities studied. The design values listed in Table 4 are fairly typical values used in the industry and are derived from previous Mazzetti healthcare projects. All design values are above the measured peak load, except for public/waiting areas. In general, the design guidelines at the room level are 160% higher than those measured peak loads.

Table 4: Plug & process load power densities by room type

Room Type	Design W/SF	Measured Average W/SF	Measured Peak W/SF
Breakroom/Lounge	3.91	0.48	2.92
Conference/Meeting Areas	1.85	0.19	0.41
Exam/Consultation	1.85	0.34	0.63
Imaging/Linear Accelerator	4.06	0.65	1.75
Lab/Storage	2.86	0.31	0.69
Mechanical/Electrical/Engineering/IT	4.72	0.94	1.25
Offices	1.85	0.24	0.66
Pharmacy/Retail	2.28	1.19	2.02
Prep Area, Pre-Op	5.97	2.93	4.67
Procedure/Operating Rooms/Treatment	5.07	0.29	0.92
Public/Waiting Area	0.31	0.16	0.37
Reception	4.61	0.90	2.48
Workstation/Nurse Station	4.61	1.36	2.90

Breakdown by Space Type

Figures 2 and 3 below provide a breakdown of aggregate plug and process loads by room type. The facilities compared are the San Jose Ambulatory Surgery Center and the Oakland Medical Offices. The San Jose building is a specialized facility focused on ambulatory surgery and therefore sees a large component of its plug and process loads in surgery related functions, such as pre-op, procedure/operation, and post-op. Alternatively, the more typical Oakland facility sees a larger component of plug and process loads in exam rooms, nurse stations, and offices. The other facilities studied are more typical like the Oakland facility, with a large variety of departments rather than a single specialized function. The breakdown of plug and process loads by room type for the other facilities can be found in Appendix B.

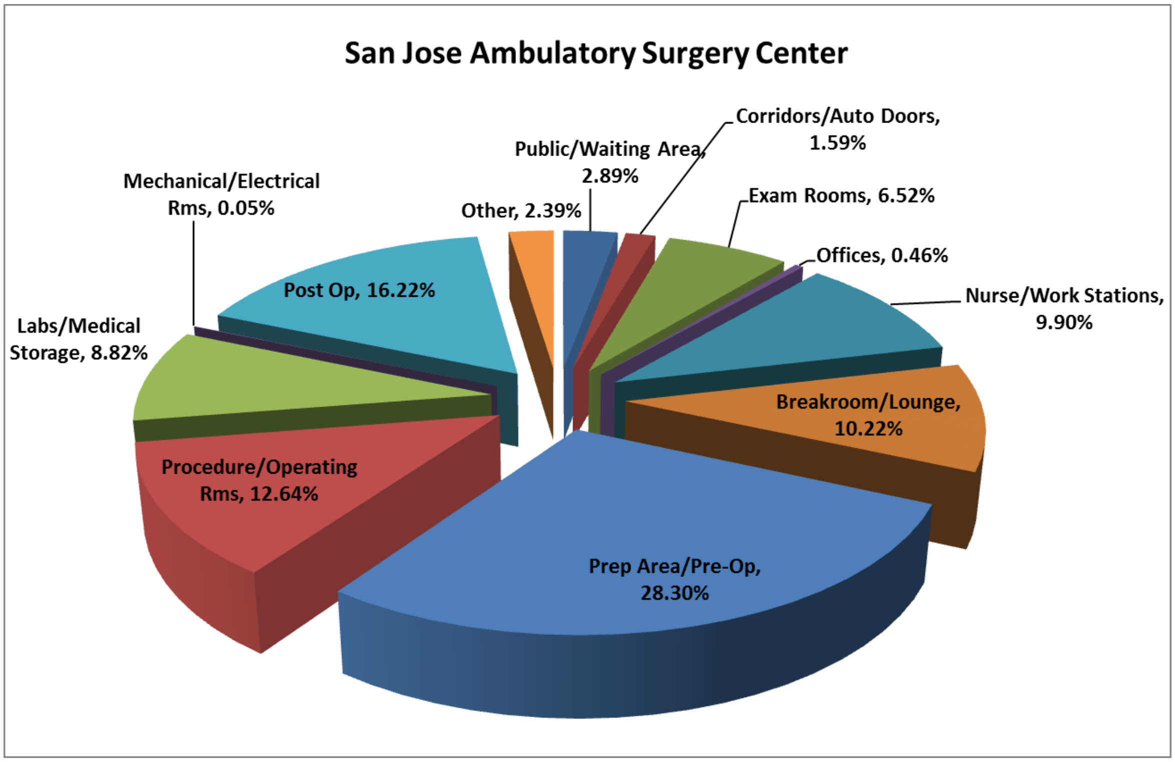

Figure 2: Plug and process load breakdown in the San Jose facility by room types

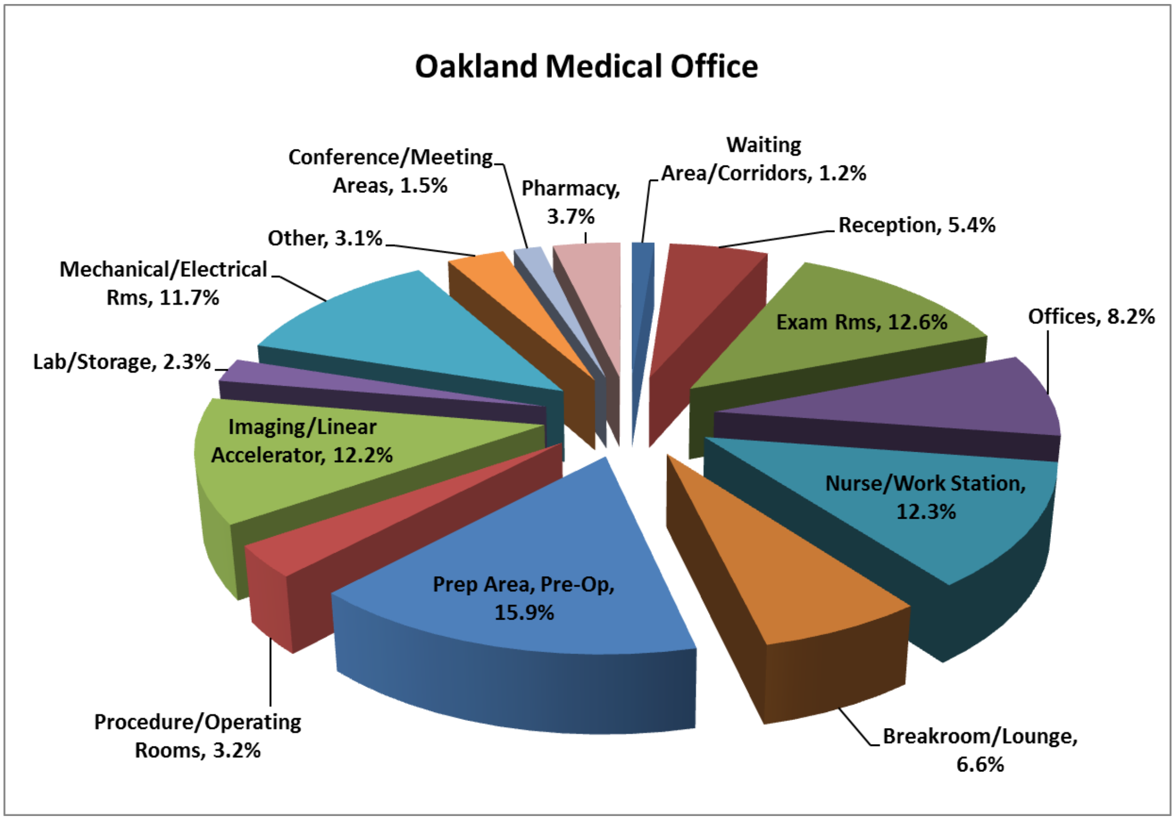

Figure 3: Plug and process load breakdown in Oakland facility by room types

Breakdown by Department

Figure 4 presents average plug and process power density by department. As to be expected, departments with large medical equipment are at the high end, such as the oncology department in Oakland with linear accelerators. In comparison, the other hemo/oncology & infusion department listed does not have linear accelerators and thus a lower power density. However, this oncology and infusion center is still on the high end because of the high use of other cancer treatment and infusion equipment. In general, departments with little equipment and high exam use have very low power densities, such as primary care, orthopedic, and podiatry departments.

Surprisingly, administration and medical staff development departments are on the high end of the scale. While these departments have no medical equipment, they do have a high density of computers, which greatly affects their average power density. See Appendix C for a full table of departmental average, peak, and kWh/sf-year plug and process loads.

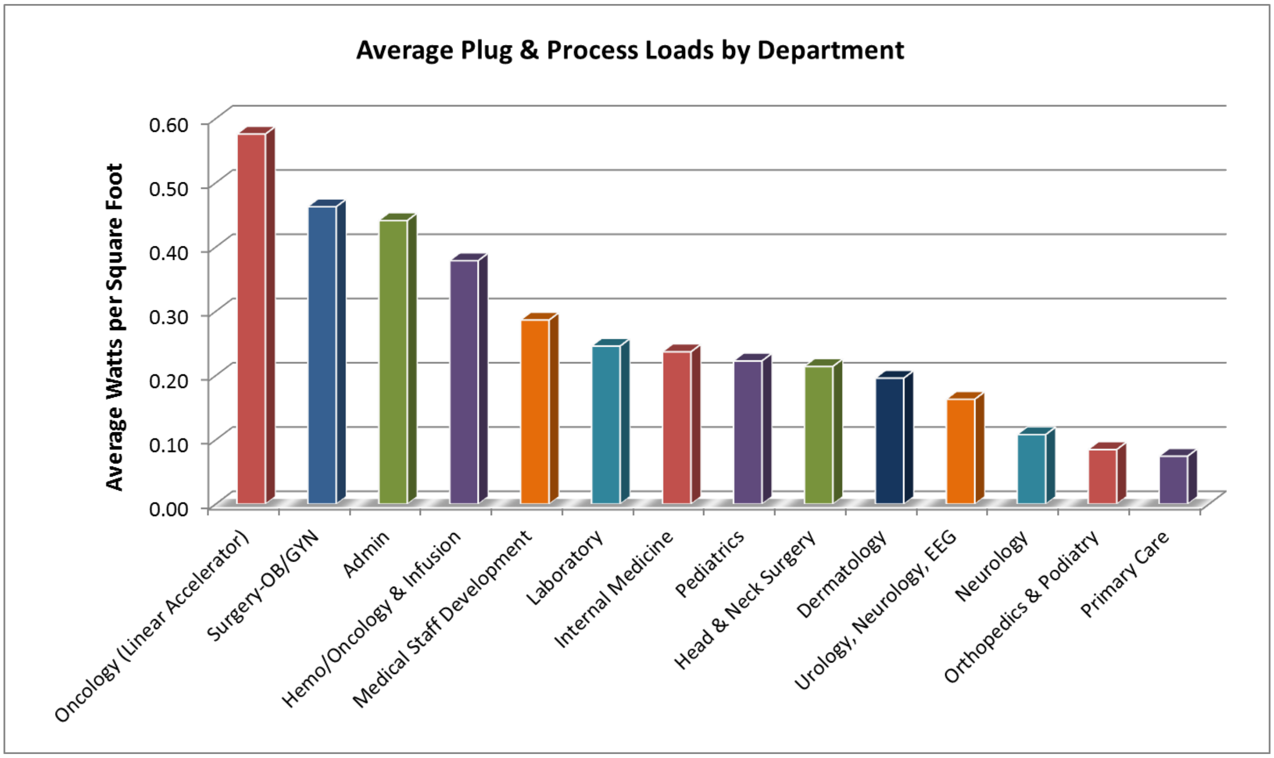

Figure 4: Plug and process load intensity by department

Load Profiles

The plug and process load profiles for both occupied and unoccupied days of operation illuminate base versus peak loading. From this information we can begin identifying potential opportunities to reduce base loading. Reduction of peak usage is difficult, because it is closely related to patient care during operating hours. However, high loads on nights and weekends indicate that equipment is being left on continuously and is a potential for energy savings. Figures 4 and 5 present the total plug and process load profiles for each of the studied facilities on an average occupied weekday and unoccupied weekend respectively. All facilities have a significant and consistent base load, suggesting the potential for energy savings by turning off equipment outside of normal operating hours.

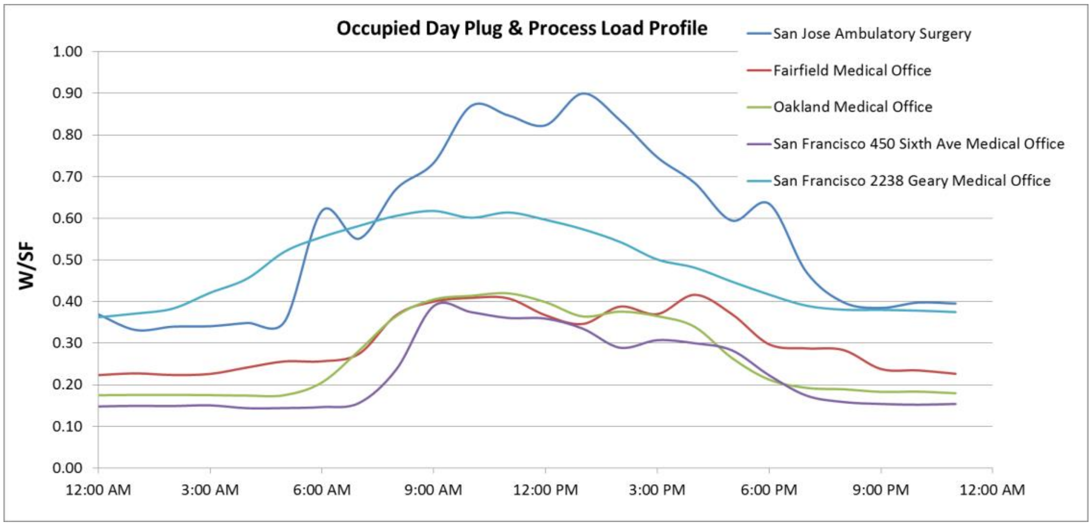

Figure 5: Average weekday plug and process load profile

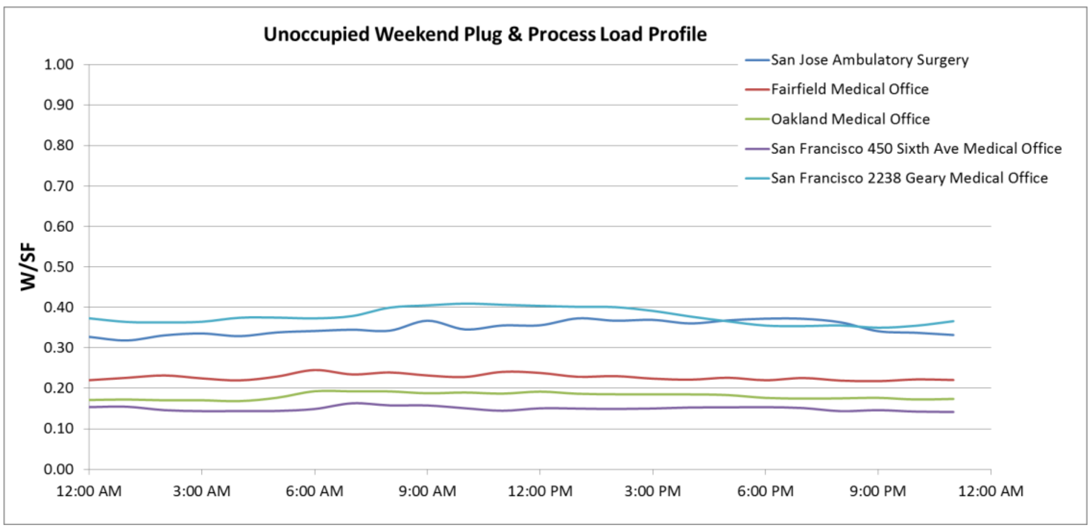

Figure 6: Average weekend plug and process load profile

The load profiles can be further broken down to a department level to identify what areas of operation are contributing to the base load. Figure 6 shows the load profile over a week of operation for the oncology and infusion center in the Oakland facility. The profile illustrates that half of the peak load remains present during unoccupied hours. This is significant and for this department 50% of total department electricity is consumed outside of normal business hours. See Appendix D for other department weekly load profiles.

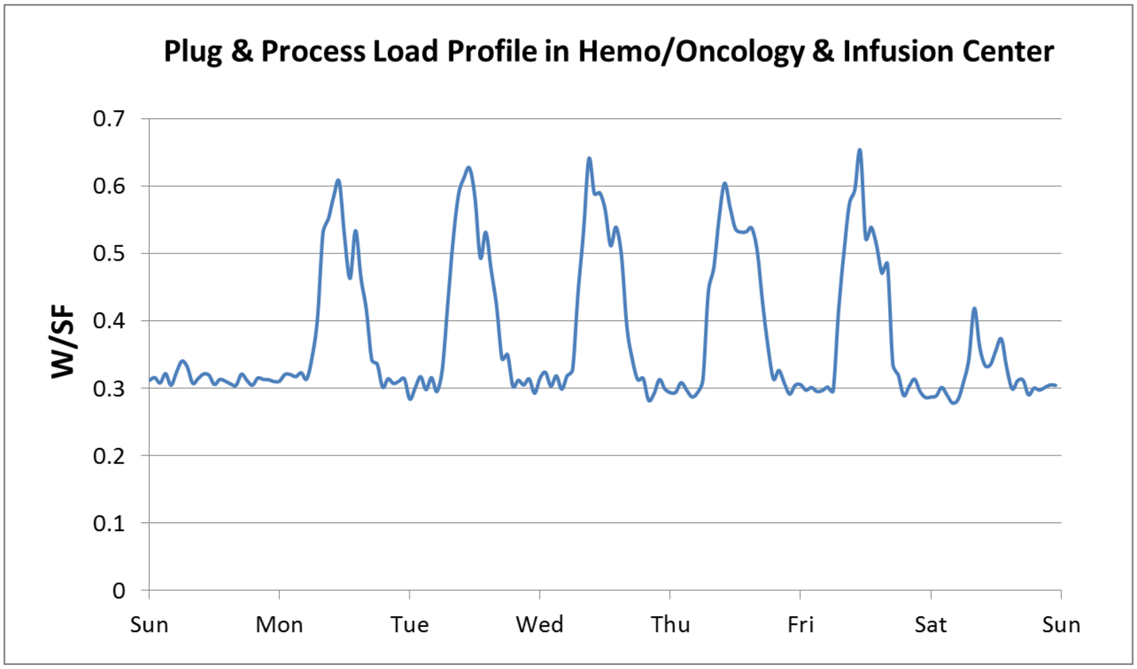

Figure 7: Plug & process load profile in Hemo/Oncology & Infusion Center department in the Oakland MOB

The load profile can be broken down again to a room and equipment level to identify equipment that remains powered on during unoccupied hours and that equipment with high standby power. Figures 7 and 8 show load profiles for two specific rooms within the oncology and infusion center. Equipment at the infusion station remains powered on and ready for use during all unoccupied hours. When the equipment is in use, power draw is only slightly higher than standby power.

Equipment within the exam room is similar. Power draw is dominated by the desktop computer which remains powered on at all hours. The other equipment sees very little use, but again has a small standby power draw. Significant savings could be seen by programming computers to enter a sleep mode or to be powered off during unoccupied hours. See Appendix E for similar load profiles for other rooms and equipment.

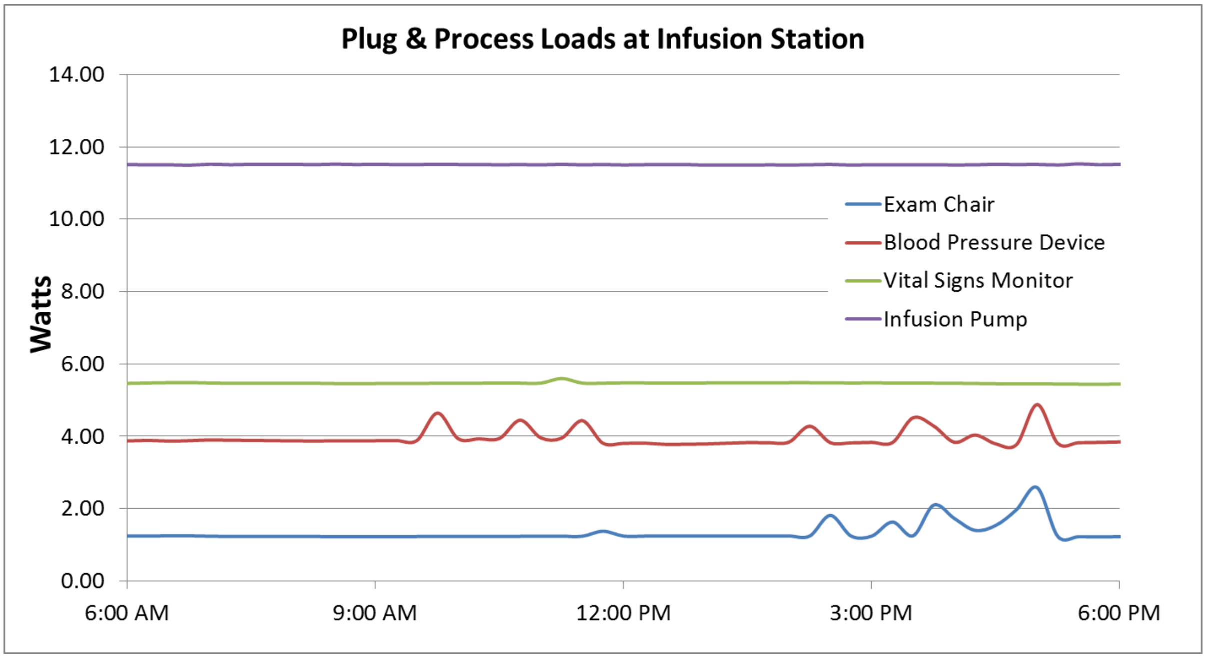

Figure 8: Plug & process Loads at a single infusion station

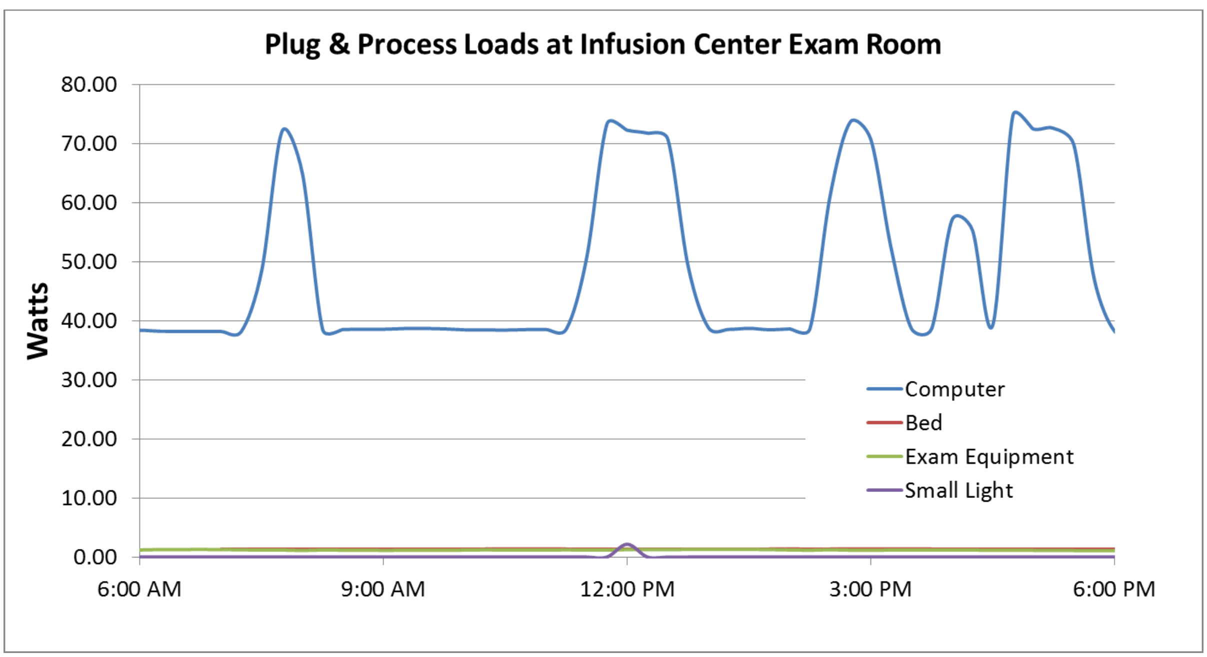

Figure 9: Plug & process loads in a single Infusion center exam room

Total Building Plug & Process Loads

Table 5 below gives measured plug and process loads compared to total building electricity. Total load can also be compared to the estimated plug and process base load. The base load calculation assumes these facilities have a constant plug and process base load which corresponds to the minimum demand observed during the week of monitoring.

The Fairfield and Oakland MOB plug and process loads both make up about 11-12% of total building electricity and have an estimated base load corresponding to 8% of total electricity. The San Francisco Geary MOB loads are much higher, representing 24% of total electricity and a base load of 18% of total electricity. The Geary MOB is a very high use facility and operates seven days a week, in contrast to the Fairfield and Oakland facilities that operate only five and six days a week with shorter business hours. These values are derived from a full week of data, therefore it would be expected for facilities with longer operating hours to have higher percentages of electricity dedicated to plug and process loads. We also see that the kWh/SF-yr usage for the Geary MOB is higher than the Fairfield and Oakland MOBs, also indicating its higher usage and longer operating hours.

All the facilities have a plug and process base load that is 60-75% of total load. Earlier analysis showed base load power being largely attributed to equipment standby power, therefore management of equipment standby power could yield large energy savings. Additionally a large percentage of this energy consumption occurs during unoccupied hours, enabling energy savings to be realized without the concern of affecting patient care.

Table 5: Total facility plug & process loads

Kaiser Facility	Estimated Base Load kWh/SF-yr	kWh/SF-yr	Estimated Plug & Process Base Load % of Total Electricity	Plug and Process Load % of Total Electricity
San Jose Ambulatory Surgery Center	2.71	4.42	N/A*	N/A*
Fairfield Medical Office	1.83	2.48	8%	11%
Oakland Medical Office	1.46	2.11	8%	12%
San Francisco 450 6th Ave Medical Office	1.17	1.77	N/A*	N/A*
San Francisco 2238 Geary Medical Office	3.04	3.95	18%	24%

* A total building electricity meter was not available to measure total facility electricity

Conclusions & Recommendations

Results from this study indicate that power systems for plug and process loads in medical office buildings are typically overdesigned. These results were expected as design guidelines have lacked significant qualitative research until this study. At a building level, IEEE peak design W/SF values were 175% higher than measured values, and IEEE average design values were 260% higher. At a room level, typical industry design values were found to be an average of 160% higher than measured peak loads.

While continued research may be needed to change IEEE standards, the results from this study can be used in energy models and design rules of thumb. Based on these results, plug load design guidelines for certain room types could be scaled back by a factor of two or even three while still leaving a margin of error for safety. Designing power systems to more closely match actual loads will save money in new construction through materials, labor, and operation.

Beyond savings from a design side, study results show medical office buildings have a significant portion of their electric consumption coming from the plug and process base load. Within medical facilities, equipment is typically powered on and ready for use at all hours, whether the building is occupied or not. This study confirmed this fact, and the electric consumption because of this is significant. Up to 75% of total plug load usage was from base load power in these buildings, corresponding to up to 18% of total building electricity. A reduction in base load power of only 10% in these five facilities would annually save about 115,000 kWh or almost $16,000.

Several low to no cost changes in building operations could reduce the plug and process base load. All computers monitored in the study did not enter a sleep mode or power down during weeknights or weekends and the computers operated at a constant standby power around 40 watts. Simply modifying computer power management settings to power off during unoccupied hours (assuming 60 hour work weeks), annual electricity savings would be about 225 kWh or $30 per computer. The savings would be significant as computers are found in a majority of exam rooms, offices, nurse stations, and reception areas.

In addition to computers remaining powered on during unoccupied hours, majority of the medical equipment monitored had a constant standby power during all hours. Informing and educating staff on powering off high energy use equipment when not in use would lead to significant savings. Replacing inefficient equipment, especially those with high standby power is also important. In new construction, extra care should be taken to specify energy efficient equipment. Kaiser Permanente could also lobby manufactures to produce more efficient equipment, possibly encouraging the implementation of power saving modes that reduce power draw during long periods of inactivity.

The last step in reducing plug and process loads are control systems that allow scheduling and remote power management. Unfortunately these systems are still very new to the industry, expensive, and difficult to implement.

This study is only the beginning in more intelligently designing electrical power systems for plug and process loads and reducing their electric consumption in medical office buildings. These study results can be used to more correctly size electrical systems, calibrate energy models, and begin working towards a reduction in plug loads. As this study found and subsequent research will support, plug and process loads contribute to significant portion of total building electricity and offer opportunities for energy savings. As other building technologies continue to become increasingly more efficient, plug and process loads are becoming an important part of building design and operation, and an important piece in creating energy-efficient buildings for the future.

Appendix A – Instrumentation Equipment

Panoramic POWER™

Panoramic Power's Wireless Sensor Family

The Panoramic Power sensor series is made up of non-invasive, self-powered, miniature wireless current sensors. The sensors clamp on the electrical outgoing wire from the circuit breaker, and powered by magnetic fields. Hundreds of sensors can be installed in a few hours with no disturbance of daily operations. Once installed, the sensors become part of the building infrastructure, never requiring maintenance, service or battery replacement.

Specifications	PAN 10	PAN 12
Physical dimensions	17 x 20 x 32 mm 0.67 x 0.79 x 1.26 inch	46.2 x 22.8 x 32.6 mm 1.82 x 0.90 x 1.28 inch
Max hot-air outer diameter (including insulation)	7 mm 0.28 inch	18.8 mm 0.74 inch
Current measurement range	0-63 A	0-225 A
Current measurement accuracy (typical, at 25^{o}C)	<2% at I>1A	<2% at I>10A
Minimum operating current	0.3 – 0.45 A	0.5 – 0.8 A
AC frequency supported	50 Hz (EU) 60 Hz (US)	50 Hz (EU) 60 Hz (US)
Transmission frequency	434 MHz (EU) 902-928 MHz (US)	434 MHz (EU) 902-928 MHz (US)
Transmission power (ERP)	0 dBm (Max)	0 dBm (Max)
Transmission interval	10 seconds	10 seconds
Safety and EMC certificates	USA & Canada Safety: UL-61010-1, CSA-C22.2 (ETL listed) EMC/Radio: FCC Part 15 subpart B, C Europe Safety: EN-61010-1 (CE) EMC: EN-ETSI 301489-3, Radio: EN-ETSI 300220-1	USA & Canada Safety: UL-61010-1, CSA-C22.2 (ETL listed) EMC/Radio: FCC Part 15 subpart B, C Europe Safety: EN-61010-1 (CE) EMC: EN-ETSI 301489-3, Radio: EN-ETSI 300220-1
Flammability rating of external enclosure	UL94 V-0	UL94 V-0
Operating temperature	0-50^{o} C	0-50^{o} C
Storage temperature	-20-65^{o} C	-20-65^{o} C

Key Features

- Non-invasive, snaps and fits on an electric hot-wire without disconnection
- No maintenance; self-powered (does not require battery)
- High accuracy
- Wireless – no wiring, unlike standard CT-based monitoring systems
- Real-time high-frequency current data transmitted every 10 seconds

Panoramic POWER™

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MAZZETTI + GBA
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TECHNICAL SPECIFICATIONS AND REQUIREMENTS

PowerPort Specifications

Data Reporting Rate:	Once per plug per second
Number of Power Outlets:	4 - Individually measured and controlled
Input Voltage:	120V 60Hz
Total Maximum Power:	1800 W
Total Maximum Current:	15 A
Maximum Current per Outlet:	15 A each. Total of 4 outlets cannot exceed 15 A.
Fuse Rating:	15 A
Dimensions:	10" x 4" x 2 "
Plug-To-Plug Distance (c-to-c):	2 3/8 " (60 mm)
Cord Length:	5 feet
Certifications:	UL 244A and UL 1363, FCC Class A+B
Wireless Communication Frequency:	2.4Ghz
Antenna Type:	Internal
Standby Power Draw:	~1 W
Vrms Resolution:	0.01V
Irms Resolution:	1mA
Power Resolution:	0.01W
Power Factor Range:	0-1.0
V and I Measurement Sampling Rate:	8192 samples per second

Bridge (Gateway) Specifications

Power Use:	1-2 W
Range of Wireless Communication:	Up to 1000 feet
PowerPorts per Bridge:	Up to 50, subject to site limitations
Certifications:	UL, FCC Class A+B
Wireless Communication Frequency:	2.4Ghz
Antenna Type:	External whip
Dimensions:	2"L x 3"W x 1"H
Mounting Options:	Mounting tabs, double-sided tape
External Ports:	RJ45 Ethernet MMC memory slot

Energy Management Software Requirements

Enmetric's web-based Plug Load Manager software requires a computer or mobile device with an internet connection and a modern web browser.

ENMETRIC SYSTEMS

5.09.13

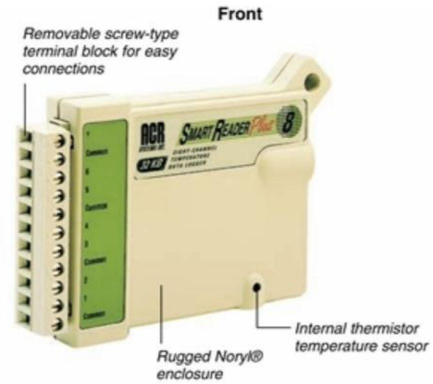
Enmetric Systems, Inc.
617 Mountain View Ave, Suite 5
Belmont, CA 94002

(650) 489-4441
sales@enmetric.com
www.enmetric.com

SmartReader Plus

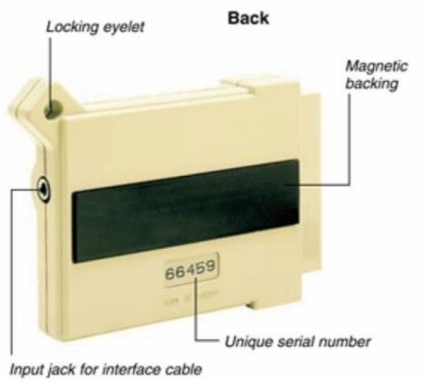
MULTI-CHANNEL ALARMING NETWORKABLE DATA LOGGERS

ACR SmartReader Plus data loggers are multi-channel, user configurable data loggers that monitor a variety of parameters and feature extended memory. The alarm feature alerts when thresholds are transgressed via phone or e-mail*. These loggers are accessible remotely by modem or device server; multiple loggers can also be linked to form a network. Durability is assured with a 3-year logger warranty and 10-year battery life. It is important to note that on competitive products if the replaceable battery comes loose or dies you will not get data - lost time and effort far outweighs any price difference. The SRP uses a 12-bit successive approximation converter for ultra-low power comsumption compared to delta sigma. When the sample interval is set longer than 8 seconds, the readings are averaged over the period giving a quantitative result. Software Packages are purchased separately as they can support more than one device.



Features

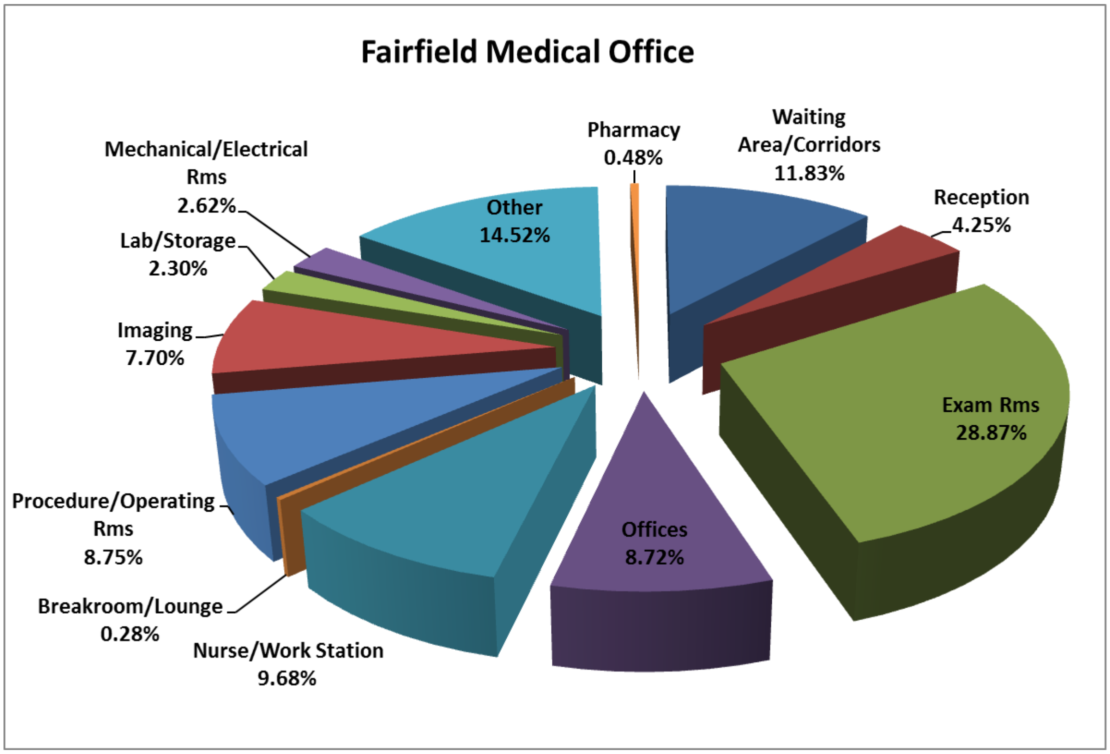
- Record: Temperature, Relative Humidity, Current, Voltage, Pressure, Process Signals, Pulse
- Better than 0.025% FS Resolution - 1 part in 4096 gives more detail for a slowly changing signal
- 32kB, 128kB or 1.5MB Memory - 21,500, 87,000 and 1,050,000 Readings repectively divided among channels
- Remote access via Modem or Ethernet - local or long distance
- Ruberdized conformal coating protects electronics from harsh environments
- 3-Year Warranty and 10-Year Battery - guarantees data is available at end of recording session.



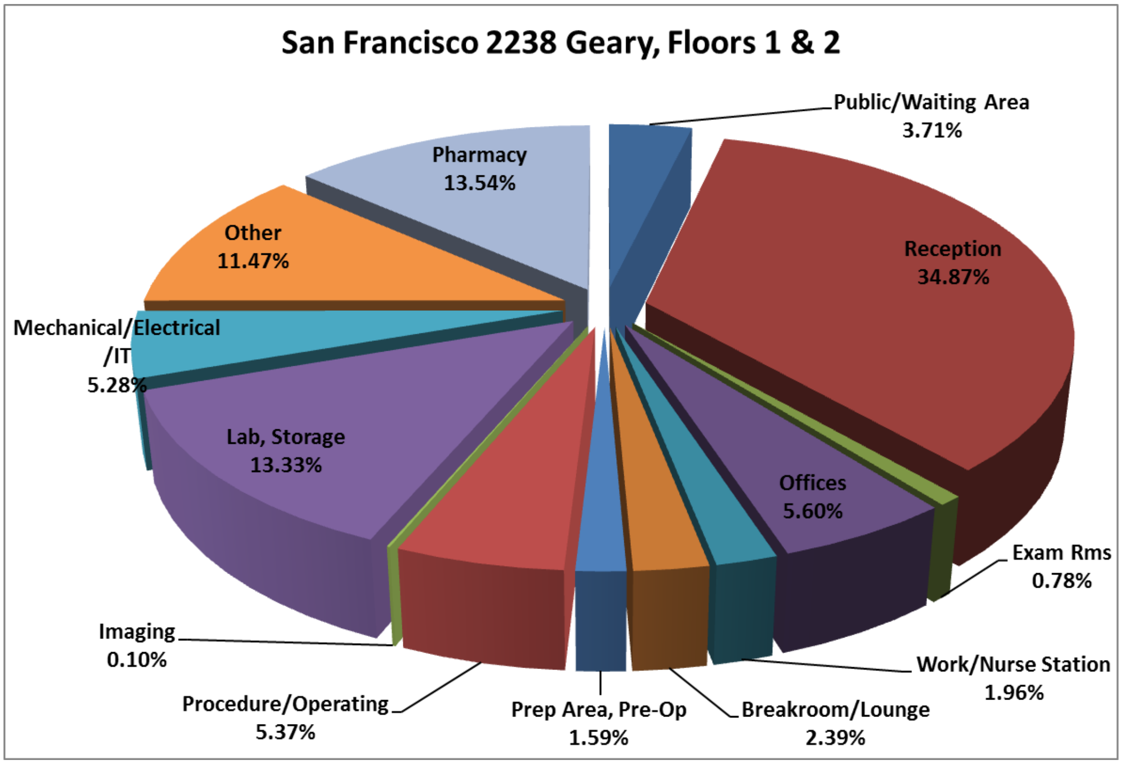
Common Specifications

Size	107 x 74 x 22mm (4.2 x 2.9 x 0.9in)
Weight	110 grams (3.75 ounces)
Case Material	Noryl® Plastic
Operating Limits	-40°C to 70°C (-40°F to 158°F) and 0 to 95% Relative Humidity (non-condensing)
Clock Accuracy	+/-2 seconds per day
Battery	3.6 volt Lithium, 1 Amp-Hour
Power Consumption	5 to 10 microamps (continuous)
Battery Life	10-year warranty (under normal use) factory replaceable
Memory Size	32 K (21,500 readings) 128 K (87,000 readings) 1.5 MB (1,000,000 readings) See specific models for availability
Sampling Method	1. Continuous (First-in, First-out); not available with sample rates faster than 8 seconds 2. Stop when full (Fill-then-stop)
Sampling Rate	User selectable rates from 25 per second to one reading every 8 hours. (BP-101 battery pack or PS-201 Power Supply required for sample rates faster than 8 seconds. See Accessories section for details.)
Resolution	12 bit (1 part in 4096)
PC Requirements	Windows PC with a least 256MB RAM, 250MB of hard drive space and one free serial or USB port
Software Requirements	TrendReader® 2 (compatible with Windows® XP, Vista, Windows 7 and Windows 8 - 32 bit or 64 bit)

Appendix B



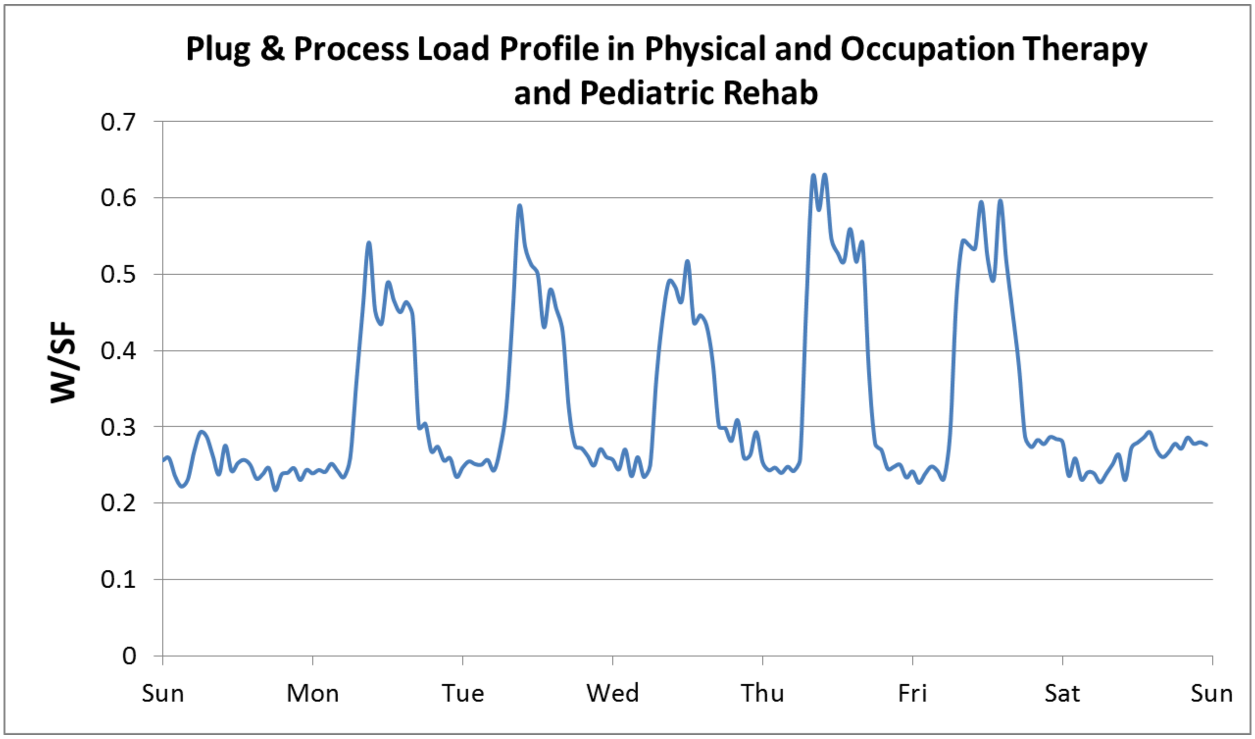
Fairfield Medical Office
Pharmacy 0.48%
Waiting Area/Corridors 11.83%
Reception 4.25%
Exam Rms 28.87%
Offices 8.72%
Nurse/Work Station 9.68%
Breakroom/Lounge 0.28%
Procedure/Operating Rms 8.75%
Imaging 7.70%
Lab/Storage 2.30%
Mechanical/Electrical Rms 2.62%
Other 14.52%


San Francisco 2238 Geary, Floors 1 & 2
Public/Waiting Area 3.71%
Reception 34.87%
Exam Rms 0.78%
Offices 5.60%
Work/Nurse Station 1.96%
Breakroom/Lounge 2.39%
Prep Area, Pre-Op 1.59%
Procedure/Operating 5.37%
Imaging 0.10%
Lab, Storage 13.33%
Mechanical/Electrical /IT 5.28%
Other 11.47%
Pharmacy 13.54%

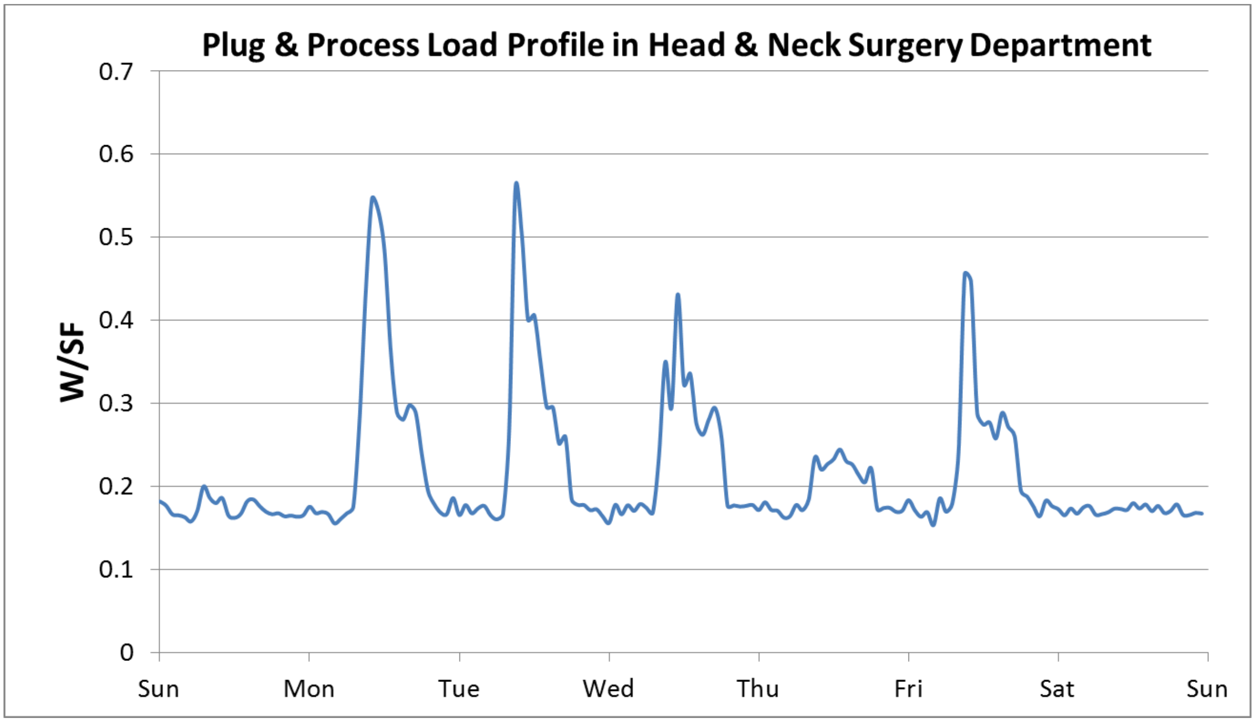
Appendix C

Department	Avg kW/SF	Peak kW/SF	kWh/SF-year
Admin	0.44	0.82	3.86
Dermatology	0.20	0.80	1.71
Head & Neck Surgery	0.21	0.56	1.87
Hemo/Oncology & Infusion	0.38	0.65	3.31
Internal Medicine	0.24	0.49	2.07
Laboratory	0.25	0.44	2.15
Medical Staff Development	0.29	0.45	2.50
Neurology	0.11	0.51	0.95
Oncology (Linear Accelerator)	0.58	0.88	5.03
Orthopedics & Podiatry	0.08	0.31	0.74
Pediatrics	0.22	0.43	1.95
Primary Care	0.07	0.18	0.65
Surgery-OB/GYN	0.46	0.78	4.04
Urology, Neurology, EEG	0.16	0.37	1.43

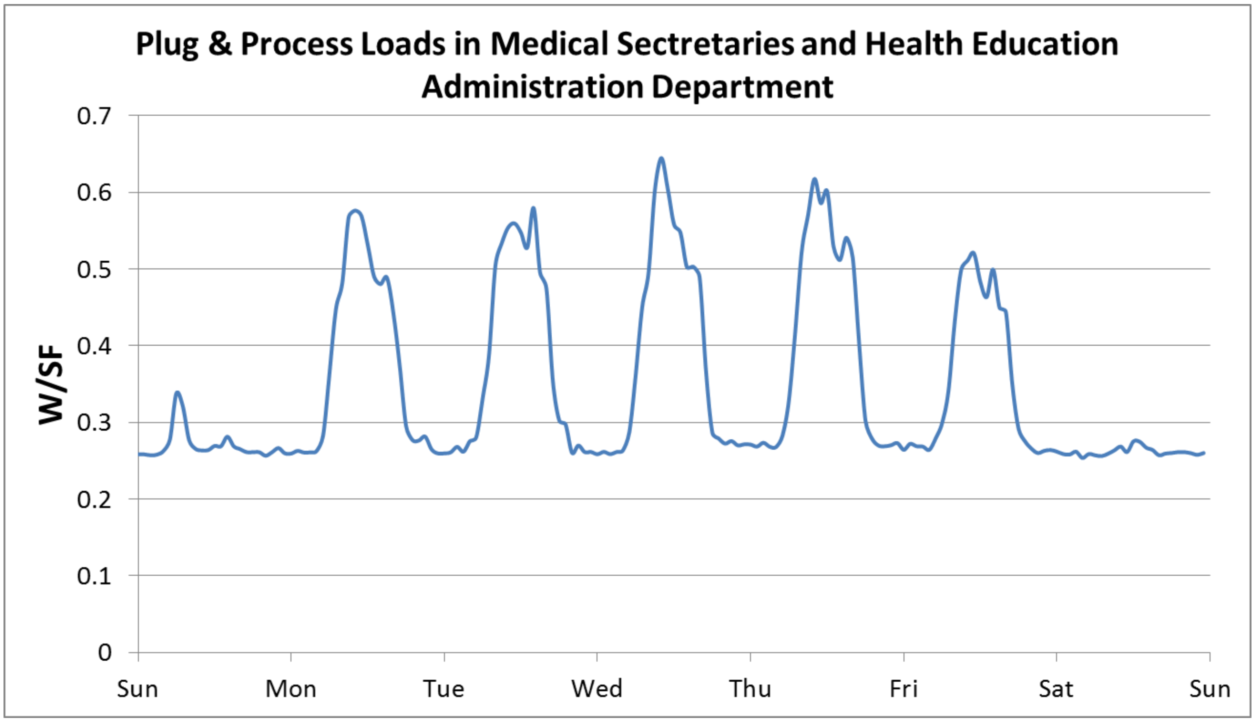
Appendix D

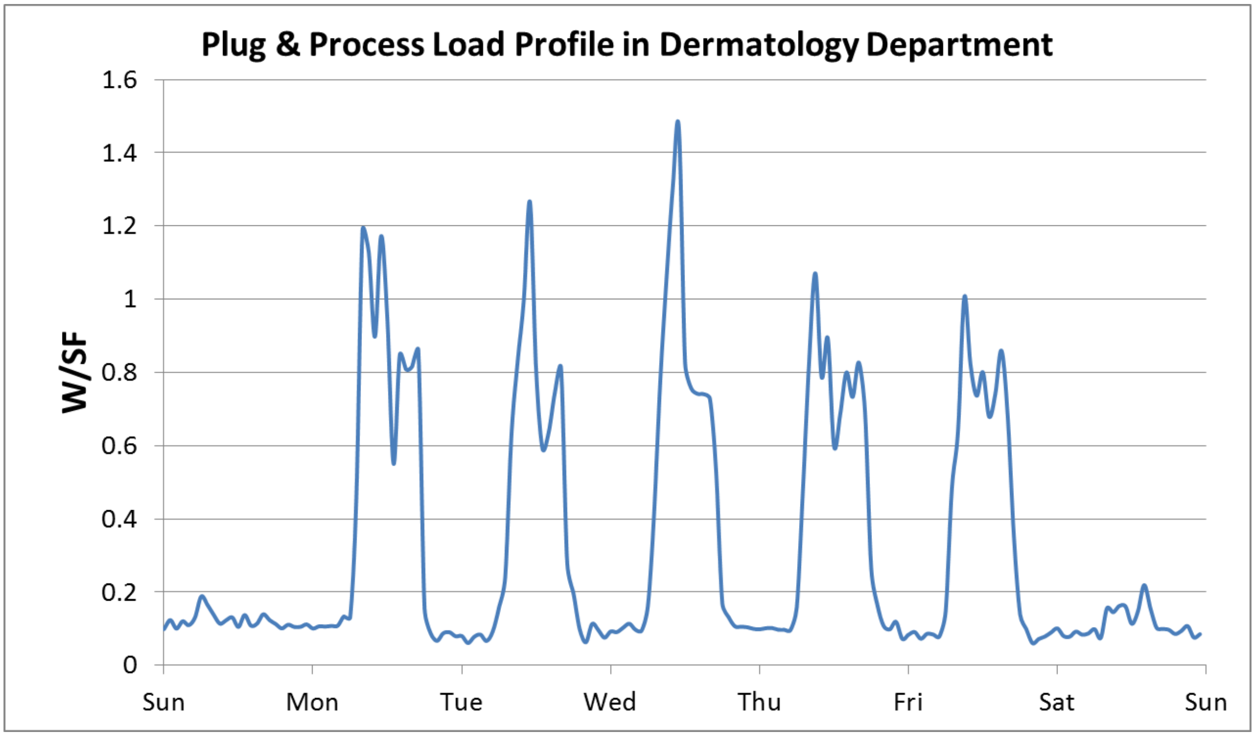


Plug & Process Load Profile in Physical and Occupation Therapy and Pediatric Rehab
W/SF
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Sun
Mon
Tue
Wed
Thu
Fri
Sat
Sun

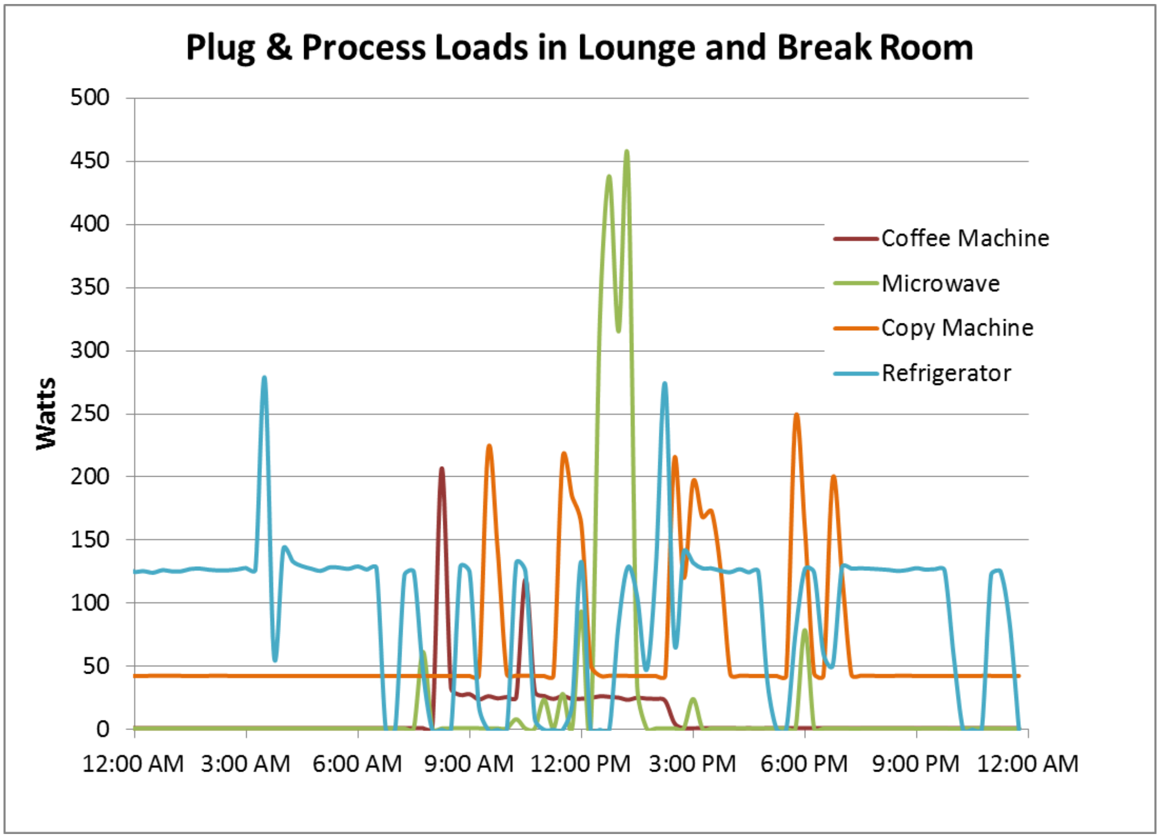


Plug & Process Load Profile in Head & Neck Surgery Department
W/SF
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Sun
Mon
Tue
Wed
Thu
Fri
Sat
Sun

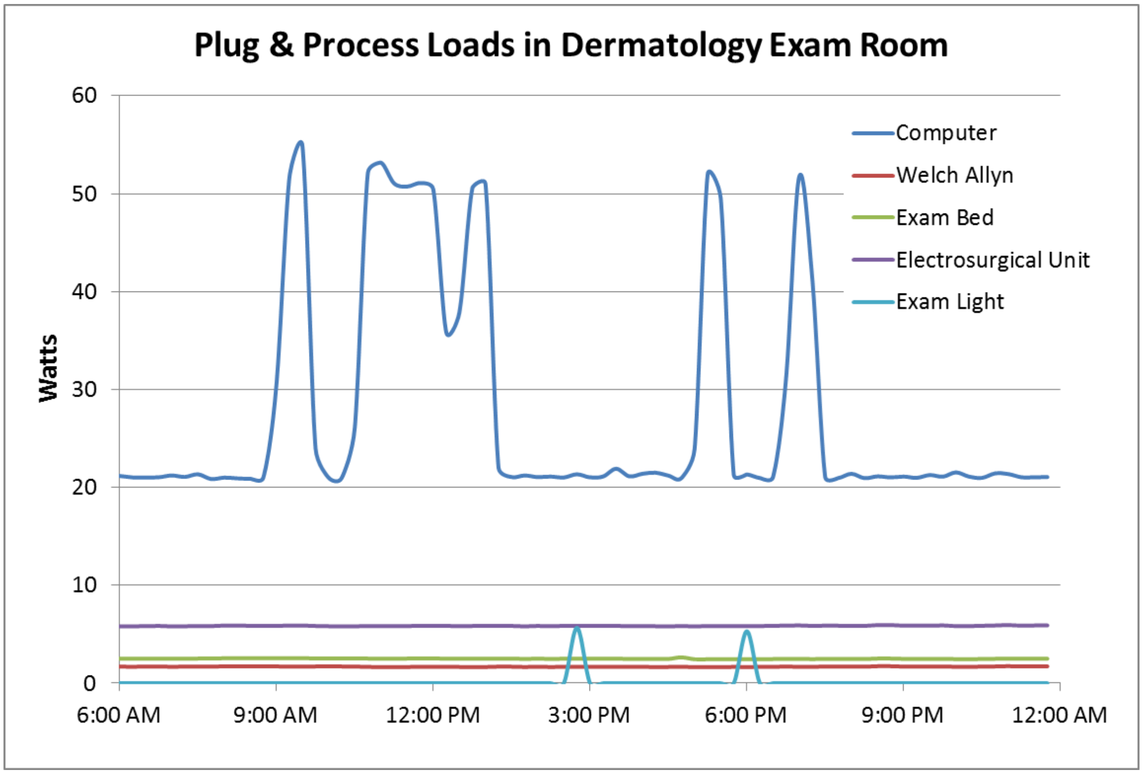

Plug & Process Loads in Medical Sectretaries and Health Education Administration Department
W/SF
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Sun
Mon
Tue
Wed
Thu
Fri
Sat
Sun


Plug & Process Load Profile in Dermatology Department
W/SF
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Sun
Mon
Tue
Wed
Thu
Fri
Sat
Sun

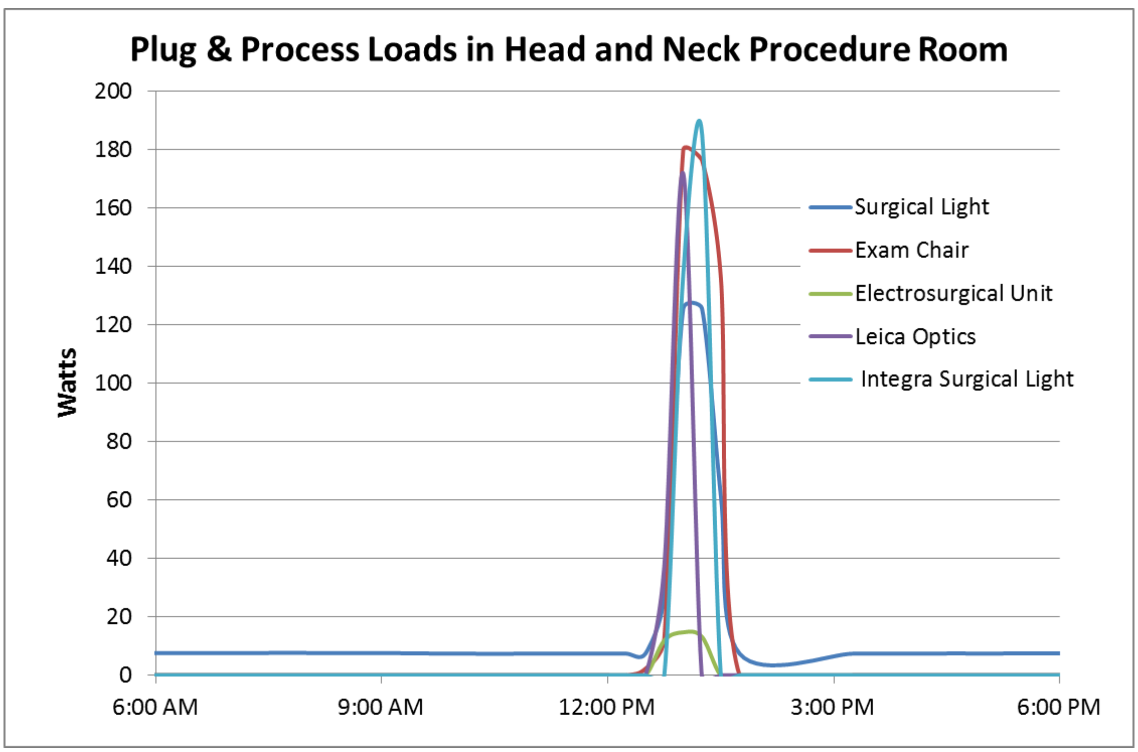
Appendix E



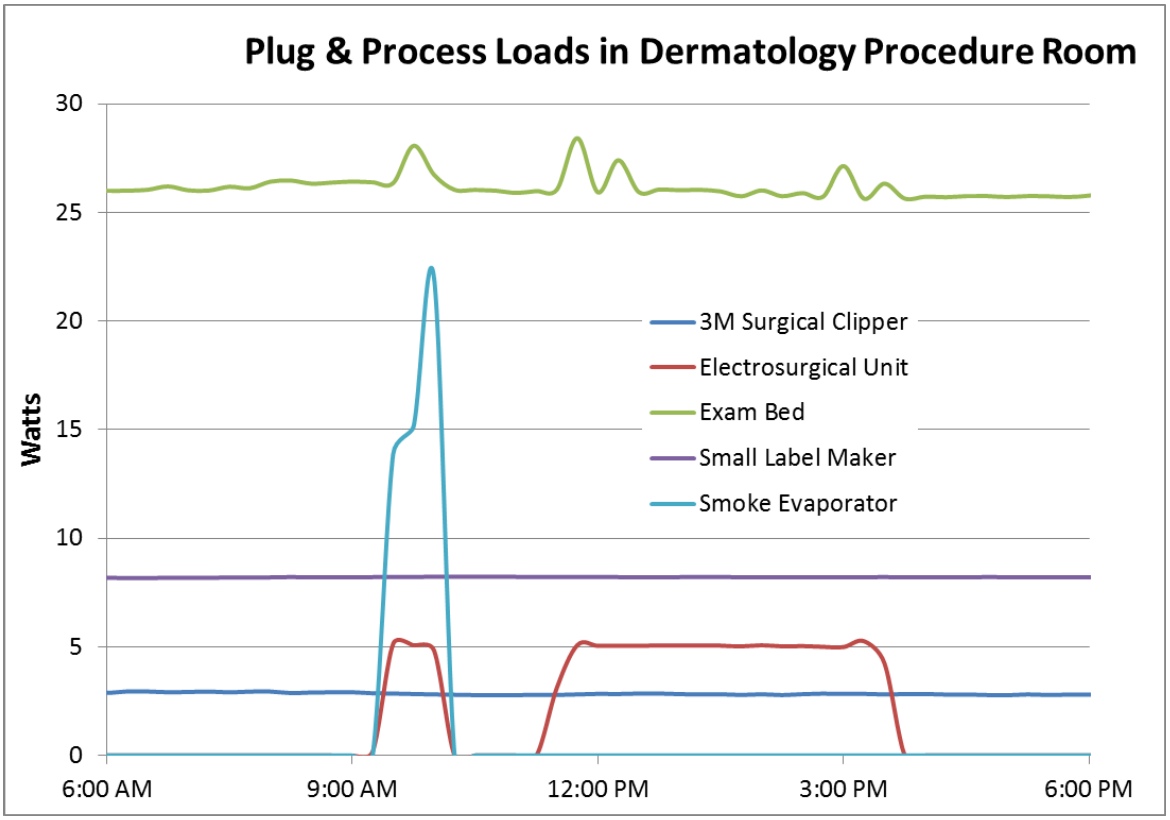
Plug & Process Loads in Lounge and Break Room
Watts
500
450
400
350
300
250
200
150
100
50
0
12:00 AM
3:00 AM
6:00 AM
9:00 AM
12:00 PM
3:00 PM
6:00 PM
9:00 PM
12:00 AM
Coffee Machine
Microwave
Copy Machine
Refrigerator



Plug & Process Loads in Dermatology Exam Room
Watts
60
50
40
30
20
10
0
6:00 AM
9:00 AM
12:00 PM
3:00 PM
6:00 PM
9:00 PM
12:00 AM
Computer
Welch Allyn
Exam Bed
Electrosurgical Unit
Exam Light



Plug & Process Loads in Head and Neck Procedure Room
Watts
200
180
160
140
120
100
80
60
40
20
0
6:00 AM
9:00 AM
12:00 PM
3:00 PM
6:00 PM
Surgical Light
Exam Chair
Electrosurgical Unit
Leica Optics
Integra Surgical Light


Plug & Process Loads in Dermatology Procedure Room
30
25
20
15
10
5
0
Watts
6:00 AM
9:00 AM
12:00 PM
3:00 PM
6:00 PM
3M Surgical Clipper
Electrosurgical Unit
Exam Bed
Small Label Maker
Smoke Evaporator