U.S. DEPARTMENT OF ENERGY

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Recommended Actions to Reduce Electrical Peak Loads at the Marine Corps Air Station at Camp Pendleton, California

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Final Report

Recommended Actions to Reduce Electrical Peak Loads at the Marine Corps Air Station at Camp Pendleton, California

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May 8, 2001

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Federal Energy Management Program
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PREFACE

The mission of the U. S. Department of Energy's Federal Energy Management Program (FEMP) is to reduce the cost of government by advancing energy efficiency and water conservation, in addition to the use of solar and other renewable technologies. This mission is accomplished by creating partnerships, leveraging resources, transferring technology, providing training, and technical guidance and assistance to agencies. Each of these activities is directly related to achieving the requirements set forth in the Energy Policy Act of 1992 and the goals established in Executive Order 13123 (June 1999), as well as supporting activities that promote sound management of Federal financial and personnel resources. The Pacific Northwest National Laboratory (PNNL) supports the FEMP mission in all activity areas.

This report provides the findings and recommendations from a walk-through facility condition assessment of the Maine Corps Air Station at Camp Pendleton, California, on March 6-8, 2001. The assessment is the first of approximately 25 planned assessments to be conducted by FEMP's Assessment of Energy and Load Reduction Techniques (ALERT) Teams. FEMP formed the Teams in response to the energy supply issues arising from California's deregulation of electricity. The Teams are to help Federal sites reduce their energy use, with the primary focus of reducing summer peak electrical loads.

1 Purpose

The primary purpose of the audit was to identify actions to reduce the 15-minute summer electrical peaks at the Marine Corps Air Station (MCAS) at Camp Pendleton, California. The audit was also to identify actions that might not reduce the peaks, but could reduce energy use during other periods.

2 Summary

Pacific Northwest National Laboratory[1] (PNNL) conducted a walk-through audit of MCAS on March 6-8, 2001. The Department of Energy's (DOE) Federal Energy Management Program (FEMP) funded the audit in response to the energy supply issues arising from California's deregulation of electricity. The MCAS Public Works Department hosted the audit and made their staff and facilities available to the audit team.

The audit inspected a significant portion of MCAS and found a large number of similar energy saving opportunities across all building types. The most common opportunities are to reset heating, air conditioning, and ventilation (HVAC) controls to minimize their operating hours and to repair or replace malfunctioning HVAC equipment such as economizers that bring in outside air to cool a building. Implementing recommendations will reduce peak loads (kW) and significantly reduce consumption (kWh).

The energy savings estimate of this audit report focuses on the savings potential of three buildings that are typical of a majority of the MCAS building inventory and referred to as the "model" buildings. The models are an office building that is part of a hangar/office/shop building (Building 23170), a stand-alone office building (23123, Public Works), and a classroom training building (23195, FREST). The total 15-minute summer peak reduction potential for actions at these three buildings is 44 kW. The recommendations (a.k.a. measures) include actions that can be implemented quickly and actions that require several months or more of lead time for development and/or funding.

This report extrapolates, based on square footage, the estimated savings of the model buildings to MCAS' inventory of similar building types. This simple extrapolation finds an estimated potential reduction of 233 kW or approximately 7% of MCAS' estimated 15-minute summer peak load (kW) and a 23% reduction in annual kilowatt-hours (kWh). The estimated annual cost savings (kW and kWh) is 25% or $297K.

3 Background

3.1 Definition of Peak

This audit report uses the local utility's [San Diego Gas & Electric (SDG&E] definition of peak hours for purposes of estimating electricity cost savings to MCAS. SDG&E's summer peak season is from 11 am to 6 pm on non-holiday weekdays in May through September. SDG&E also defines a "semi-peak"

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[1] Operated for the U.S. Department of energy under Contract DE-AC06-76RLO 1830.

period with its own kWh rates. SDG&E staff indicates that Camp Pendleton's literal highest 15-minute peak (kW) occurs during the peak hours but the exact time of the use varies. The peak hour definition is important for estimating kWh savings during those hours. The highest 15-minute peak is the definition of peak as used in this report, unless otherwise specified.

At the state level, the California summer peak hours are significantly shorter than those defined by SDG&E; 2 pm to 6 pm in June through September[1]. Table 1 illustrates the SDG&E and California peak hours for a non-holiday weekday.

Table 1: SDGE Peak Time of Use (TOU) from Schedule AL-TOU of January 1, 2001

Weekdays during Summer (May through September)

	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11
On-Peak hours												■	■	■	■	■	■	■						
Semi-Peak hours									■	■	■								■	■	■	■		
Off-Peak hours	■	■	■	■	■	■	■	■															■	■

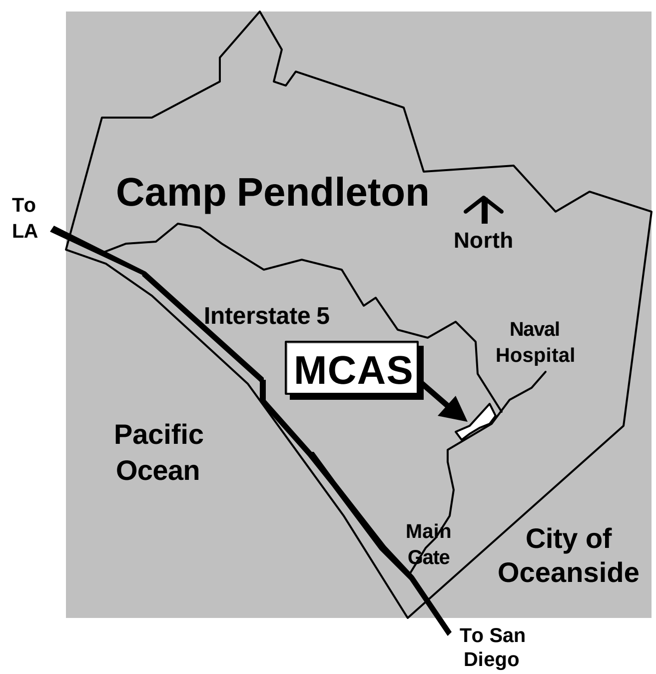
California's Summer Peak Hours (June through September)

	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11
On-Peak hours															■	■	■	■						
Off-Peak hours	■	■	■	■	■	■	■	■	■	■	■	■	■	■					■	■	■	■	■	■

3.2 Description of the Marine Corps Air Station (MCAS) at Camp Pendleton

Location

Camp Pendleton borders the Pacific Ocean and the city of Oceanside, California, is 38 miles from San Diego and 84 miles from Los Angeles (see map at right).



Mission

MCAS houses Marine Aircraft Group 39, which provides utility [maintenance] helicopter support, close-in fire support, fire support coordination, aerial reconnaissance, observation and forward air control in aerial and ground escort operations during ship-to-shore movement and subsequent operations ashore.

[1] Peak Load Reduction Program AB970, Demand Responsive HVAC and Lighting Building System Guideline, California Energy Commission, December 16, 2000.

Buildings

Table 2 shows the types and square footage (SF) of buildings based on MCAS' current building database (MCAS staff indicate, however, that the database has not kept up with recent new building construction, and the actual total area is approximately 647,000 SF). Table 2 indicates whether the buildings are heated or cooled because 1) hangar shop spaces are typically heated but not cooled and 2) high-bay hangar spaces are not heated or cooled. Table 2 also indicates the area of the buildings inspected by the audit.

Table 2: Buildings at MCAS

BldgType	SF	%	Qty	Heated	Cooled	Audited SF	Qty
Hangar	176,737	29%	9	No	No	132,561	7
Admin./Office	135,277	22%	14	Yes	Yes	78,136	8
Schools/Training	83,043	14%	6	Yes	Yes	20,495	1
Hangar Shops	72,986	12%	7	Yes	No	41,706	3
Warehouse	59,000	10%	1	Yes	Yes	59,000	1
Military Other	39,736	7%	71	TBD	TBD	5,500	2
Shops	31,690	5%	3	TBD	TBD		
Storage	12,060	2%	12	TBD	TBD		
Grand Total	**610,529**	**100%**	**123**			**337,398**	**22**

MCAS facilities also include other facilities covered by this audit, such as a lighted landing strip, aircraft aprons, well-water pumps, and wastewater treatment plants. The pumps and waste facilities serve Camp Pendleton.

Climate

The climate is mild, as illustrated in Figure 1. MCAS staff indicates that coastal fog routinely stops at the low mountains and mountain pass between MCAS and the coast and, therefore, MCAS experiences slightly higher temperatures than at the coast.

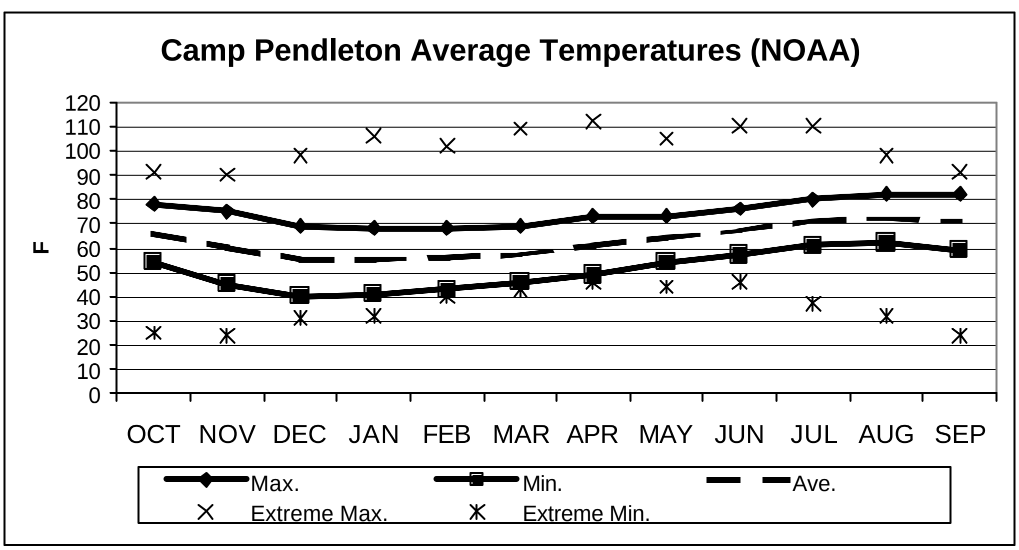


Figure 1. Camp Pendleton Average Temperatures

Energy Consumption

Figure 2 summarizes the most recent MCAS budget report (FY 00) with a full fiscal year of energy use. The figure also shows the estimated peaks. The underlying actual and estimated data is provided in Appendix A. MCAS has annual energy use and cost for several previous years; however, this report relies on FY 00, because MCAS has experienced significant growth in building square footage and occupants over the last few years.

Camp Pendleton staff read manually for kWh the three meters serving MCAS, but did not collect demand (kW) readings. Consequently, the kW measurements displayed below are estimated on the assumption that peak loads are four times the baseload. The estimate is included in Appendix B, “Estimate for Peak Load Factor”. This assumption leads to an estimated peak for MCAS of 3,453 kW (3.5 MW) as shown on Appendix A “Summer Average,” which is consistent with MCAS’ size in comparison to the Camp Pendleton peaks discussed below.

Camp Pendleton staff indicates the Camp Pendleton winter peak is 25 MW, and the summer peak is 28 MW. The winter and summer peaks for the substation serving MCAS and several other Camp Pendleton sites is 13 and 18, respectively.

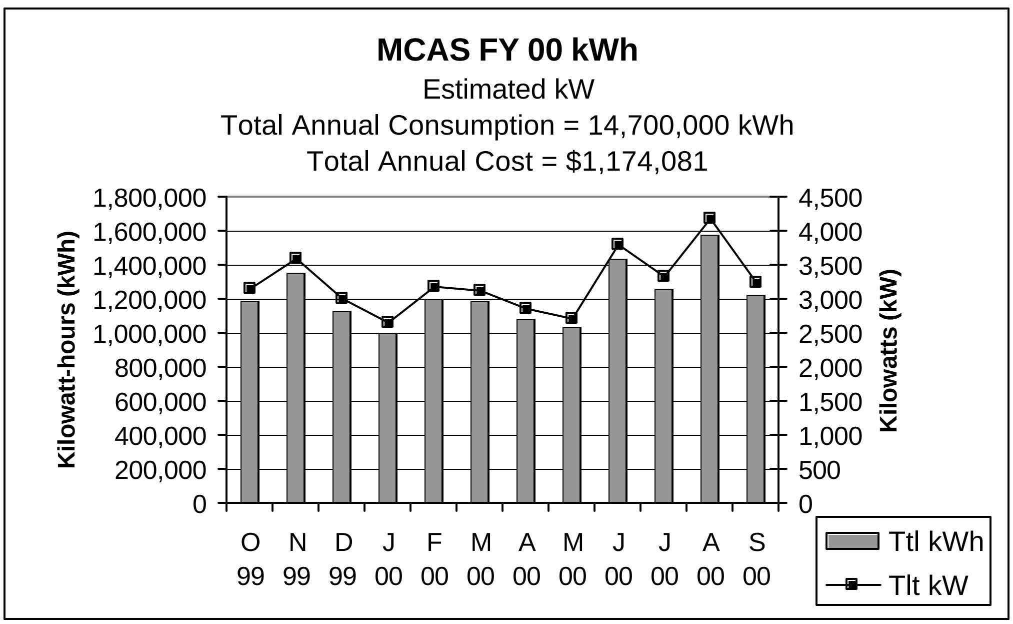


Figure 2. MCAS Energy Use

Most buildings use air-to-air cooling systems, such as chillers and packaged rooftop units. Some buildings use natural gas for heating, and most of these buildings use steam and hot water as the heat transfer medium. The normal hours of operation are 40 hours/week on a 9 to 5 schedule, but the Marines conduct special operations as needed throughout the year.

Each hangar has a natural gas generator that could be used for reducing peak demand. MCAS staff asked regional Navy engineering staff for advice on how to implement a program, given regulatory air quality limitations. The generators' capacities and serviceability information was not available for this report.

3.3 Electricity Cost

MCAS relies on SDG&E for electricity (and natural gas) provided to the "Hay Barn" secondary substation at Camp Pendleton. In FY 00, Camp Pendleton was on SDG&E's electricity Schedule AL-TOU of approximately $8/kW, 1 to 1.5 cents/kWh for transmission, plus market electricity rates. Camp Pendleton pools the total cost and allocates it to MCAS and other Camp Pendleton tenants based on their metered share of kWh. The effective FY 00 blended rate was 8 cents/kWh.

In FY 01, the rates rose significantly so that Camp Pendleton's effective rate was 28 cents/kWh, but passed on only 15 cents/kWh to its tenants, including MCAS. Camp Pendleton was going to increase the recharge rate to 28 cents/kWh starting May 1, 2001. Most recently, however, the California Legislature passed Senate Bill 43 (April 9, 2001), which capped the market electricity rates that SDG&E can charge customers at 6.5 cents/kWh. SDG&E adds their transmission and distribution charges per established schedule AL-TOU. SDG&E staff expects FY 01 actual rates will be similar to FY 00 as noted above.

The California Public Utilities Commission recently decided to allow a major rate increase across the state as of May 2001. SDG&E staff is proceeding under the understanding that Senate Bill 43's cap supercedes the Commission's increase.

The cost savings estimates presented in this report follow SDG&E's AL-TOU schedule. The true cost of electricity, including power purchases by the state will, presumably, be much closer to the blended 28 cent/kWh rate experienced by Camp Pendleton for the first half of FY 01. SDG&E staff believes the state will eventually require customers to pay for the excess market rate costs through bonds. This audit makes no estimate of effective kW and kWh cost under the bond program.

3.4 Natural Gas

MCAS uses natural gas for limited heating needs, and their FY 00 consumption was 66,000 therms, at 45 cents/therm, for a total cost of $30K. MCAS staff indicate that FY 01 rates have significantly increased, and common market forecasts are two to three times their FY 00 rate. The most recent recharge statement provided by Camp Pendleton shows a 72 cent/therm rate. Natural gas meters exist at most points where the line enters a MCAS facility, including the two aircraft washing stations. The meters are not connected to a communication line and, therefore, can only be read manually.

4 Recommendations for Peak Load Reduction Measures

This section arranges the measures into the following categories:

1. Conservation measures require actions by the operation and maintenance (O&M) program and by the project (capital & expense) programs. This category contains the largest number of individual measures and is the basis for the kW and kWh savings estimates for peak and off-peak periods.

2. Management measures require actions by management to balance mission or program needs with the need to reduce building operations during peak and off-peak hours. Actions could include curtailment of building operations and shifting staff's work hours.
3. Special load reduction measures are actions that are capital projects, such as construction of electricity generation (e.g., microturbines, photovoltaic) and thermal storage (ice or chilled water storage), or actions that are operational in nature, such as running existing generators to reduce peak loads.

4.1 Conservation Measures

4.1.1 Summary

The most common measures or actions shown in Appendix B are summarized as near-term and longer-term actions as follows. Table 3 contains electricity and costs savings summary for both categories.

Summary of Near-Term Actions (e.g., those actions that can be done within a few work weeks, labeled "Now," in Table 3.

Revise existing control schedules to run HVAC systems as needed to meet actual daily and seasonal heating/cooling loads, rather than running constantly (e.g., 24 hours/day, 7 days/week, regardless of outdoor temperatures) or running in manual mode and not, therefore, optimized for efficiency. This action is a major opportunity and the rough overall estimate of the savings from just the reduced operation of HVAC fans is $35K to $50K a year at the 8 cents/kWh rate. This dollar savings is roughly 5% of MCAS' annual electricity cost.

1. Correct, repair, or replace malfunctioning HVAC systems to reduce energy use. For an example, most of the audited economizers (fans and ductwork designed to bring in outside air to cool a building) were not working correctly. Typically, the audit found the economizers' outside air supply or exhaust dampers completely closed, thereby not allowing outside air to be drawn into the building for cooling when the outside air was, in fact, still cool enough. Consequently, the buildings' chillers were forced to operate unnecessarily. For one building (23195), the estimated 15-minute summer peak savings is 16 kW (approximately $4,000).
2. Reduce temperatures and revise the operating schedules of domestic hot water systems to meet actual varying loads. The audit found several tanks set at very high temperatures and without operational controls for night temperature setbacks.
3. Turn off all exterior lights during the day either by schedule or manual controls. Reset automatic controls to meet actual needs.
4. Establish a program to reward tenants and staff who achieve significant energy savings. Use the new metering system (e.g., the older existing meters recently connected to the central Unity/Delta system) and energy-performance software to measure achieved savings for a particular building. For buildings with tenants who have expressed a commitment to reducing energy use, contribute a portion of the measured savings to a Marine Corps Community Service fund that serves the tenants directly, such as the annual squadron events.

Focus the above actions on the model buildings noted previously to quickly achieve a significant and measurable impact and to provide staff with showcase examples. Additional information on the value of the model building strategy and the identity of the suggested buildings is in Appendix C.

One last general measure worth noting is to run the existing backup generators to reduce peak demands. However, this measure has significant issues to resolve before implementation. This measure is discussed in Section 4.1.5, Special Load Reduction Measures.

Summary of Longer-Term Actions (Two Months or Longer)

1. Recommission HVAC systems, including repairing equipment and significantly increasing the level of maintenance and operational-control of the primary systems (boilers, chillers, and packaged heat/cool rooftop units) and secondary systems (zone terminals that mix hot/cool air to achieve final temperatures, and pneumatic controls). This recommissioning will require repair and replacement of HVAC components because of their failure. Additional information on commissioning and recommissioning is in Appendix D.
2. Upgrade MCAS to a digital building control system through O&M expense funds and through planned renovation projects. Standardize on one control system manufacturer to minimize installation and operating costs and maximize staff capabilities. Minimize procurement costs by purchasing through GSA. Obtain trained MCAS staff who can operate building controls in partnership with Camp Pendleton's centralized building control organization.

The estimated savings from implementing the actions noted above across MCAS' offices (including hangar offices) and classroom/training buildings are shown in Table 3 below. The table subdivides the actions by how quickly they can be implemented. The nearer-term work is work that may be treated as expense work and, thus, can be funded by MCAS' existing O&M program. The estimate is extrapolated from the estimated savings for each model building (23170, 23123, and 23195). The model buildings are approximately 11% of MCAS' total SF. The models' building types comprise approximately 65% of MCAS' total SF.

Table 3: Total Savings for Offices and Classroom/Training Buildings

	Savings		
Time to Implement	Summer 15-Minute Peak kW	Annual kWh	Total Annual $ Savings
1. Now (Work Weeks)	102	2,544,074	$211,196
2. Soon (2-3 Months)	115	796,877	$74,585
3. Later (4+ Months)	16	98,437	$10,912
Total	233	3,439,388	$296,693

The following actions are general recommendations that are not listed in the per-building action list (Appendix E). While these actions should result in some savings, this report does not estimate the savings.

1. Implement building commissioning for all new and renovation projects. Budget for commissioning in each project; revise projects under design or construction to include commissioning. Retain an experienced commissioning agent to perform the commissioning of new facilities. Employ an agent to recommission existing HVAC systems for transfer to MCAS' new building controls staff.

2. Take practical responsibility for MCAS' building controls while allowing Camp Pendleton's centralized controls group to maintain oversight. The benefits will come in the form of additional energy and maintenance savings, because building control will be at the core of MCAS facility operations.
3. Connect the water well pumps to the new communication line for metering and building controls to track the pumps' electrical usage and system performance. Upgrade controls to monitor and diagnose efficiency improvements. Recommission the well water pumps (similar to the work noted above for HVAC systems). Pump electrical loads could be significant, and good monitoring and management could save a significant amount of kW and kWh.
4. Consider replacing large, central hot water boilers with distributed heaters to meet actual loads.
5. Seek and repair leaks in compressed air systems. Consider converting from compressed-air powered tools to electric-powered tools. Centralized air systems are often less efficient overall because of their recurring leaks, lack of maintenance, and unused capacity.
6. Make energy performance obvious to all by implementing automatic performance measurement and diagnostics such as DOE's Whole Building Diagnostician tool, a software tool that monitors and diagnoses HVAC performance. The tool is in use at Pacific Northwest National Laboratory and several smaller sites. MCAS' metering and building controls service providers (San Diego Gas & Electricity and Johnson Controls) and other vendors should have similar diagnostics in several months.
7. Obtain the services of a Resource Efficiency Manager (REM) who will evaluate project designs and ongoing O&M to achieve energy savings two to three times his cost of service. Southwest Division is actively seeking a REM who could serve MCAS. Some REM programs will fund all or part of the REM's first-year labor cost.
8. Obtain project design reviews by energy engineers focused on evaluating options. Obtain California public benefit funds and seek support from the DOE Regional Support Office in Seattle [contact Cheri Sayer, 206-553-7838].
9. Develop peer-to-peer relationships with the Public Works staff at 29 Palms and Paris Island Marine bases, because they have developed a leading-edge preventative maintenance program. MCAS' practices (especially the current effort to convert to Maximo software for O&M management) will be of interest to those sites. Also discuss programs with Assault Craft Unit 5 regarding their recent campaign to manually shut off building systems during non-work hours.
10. Incorporate alternative generation (a.k.a. distributed generation and off-grid generation) projects into MCAS' capital planning process.

4.1.2 Specific Actions for the Model Buildings

The specific recommended actions and estimated savings for each model building are shown in Table 4. The specific audit observations and recommendations for all audited building are in Appendix E. The kWh use and cost savings is much higher than the kW savings, because the peak is a very narrow window of time (e.g., only one 15-minute peak a month). The cost savings is based on SDG&E's AL-TOU rate schedule discussed previously.

Appendix B includes an "Action Matrix," showing the recommended actions for each model building mapped to the following information:

- estimated savings (i.e., kW reductions, kWh reductions, and cost savings)
- MCAS resources and timing needed to implement the actions
- the potential public benefit funds that may provide partial funding for some actions.

Table 4: Recommended Actions for Model Buildings

	Savings				
	Summer 15-Minute Peak		Annual kWh		Annual $
Specific Actions	kW	kW $	kWh	kWh $	kW + kWh
Bldg 23123	**9**	**$622**	**43,272**	**$3,322**	**$4,170**
Fix economizers	7	$467	15,467	$1,221	$1,688
Clean cooling coils	0	$14	305	$24	$38
Install HVAC override switches and fix problems noted in Observations (may be covered by warranty)	2	$140	5,248	$405	$771
Put HVAV fans onto aggressive setback schedule for non-work hours	0	$0	22,252	$1,673	$1,673
Bldg 23170 Office	**7**	**$489**	**306,767**	**$23,151**	**$24,112**
Fix or replace failed mechanical components	3	$241	15,620	$1,208	$1,682
Put the fans in automatic control and schedule equipment to turn off/on in a more aggressive manner	0	$0	240,580	$18,110	$18,110
Turn down the domestic hot water temperature and save gas energy and reduce risk to staff from scalding hot water at showers/sinks. No electricity savings	0	$0	0	$0	$0
Automate the bathroom heating/ventilation supply fans and exhaust fans such that they are interlocked to the light switches serving the bathrooms.	4	$248	50,566	$3,833	$4,320
Add automation to turn off the gas-fired hot water system (pumps) when outside air is above 65 degrees	0	$0	0	$0	$0
Bldg 23170 Hangar	**10**	**$679**	**84,002**	**$6,410**	**$7,746**
Change lighting override switches in the hangar bays to timer design, to ensure that they are not left in override	10	$679	84,002	$6,410	$7,746
Bldg 23195	**19**	**$1,317**	**236,176**	**$17,969**	**$21,751**
Fix economizers. Update controls on the three fan systems and the numerous classroom variable air volume (VAV) controllers.	16	$1,104	36,559	$2,885	$3,990
Put the three rooftop air handlers on an agressive on/off schedule using the existing controls, or add the necessary control relays via existing control panel	0	$0	180,435	$13,582	$15,636
Upgrade controls to allow the VAV zone controllers to know if the fan is in heat or cool modes. Let the VAV zone controllers drive the fan system to provide heat or cool on a demand calculation basis	3	$212	19,182	$1,502	$2,125
Grand Total	**44**	**$3,106**	**670,217**	**$50,853**	**$57,779**

4.1.3 Extrapolation of Model Buildings' Savings to MCAS

Table 5 extrapolates the model buildings' savings across the square footage for each listed building type.

Table 5: Savings Estimate for MCAS

				Savings					
				15-Minute Peak		Annual kWh		Annual $ (kW+kWh)	
Model Buildings	SF	Bldg Type	Ttl SF for Bldg Type	Audit Est.	Extrap. to Bldg Type	Audit Est.	Extrap. to Bldg Type	Audit Est.	Extrap. to Bldg Type
Bldg 23123	11,000	General office	47,839	9	38	43,272	188,190	$4,170	$18,135
Bldg 23170 office flr	17,280	Hangar office	87,438	7	35	306,767	1,552,261	$24,112	$122,010
		Office sbttl check:	135,277						
Bldg 23170 hangar	20,009	Hangar	176,737	10	85	84,002	741,982	$7,746	$68,417
Bldg 23195	20,495	Training/Classrooms	83,043	19	75	236,176	956,955	$21,751	$88,131
Column Totals	68,784		395,057	44	**233**	670,217	**3,439,388**	$57,779	**$296,693**
% of MCAS Total FY 00 Energy (actual kWh, estimated kW)					**7%**		**23%**		**25%**

4.1.4 Management Measures

MCAS may have options in shifting staff work hours and/or curtailing operations to reduce loads during peak time-of-use hours and the 15-minute peak. However, these measures require decisions by management to balance mission or program needs with the need to reduce building operations during peaks. During the audit site-visit, MCAS Public Works staff acknowledged the possibilities of shifting or curtailing operations. This report does not estimate the impact except to note that shifting or curtailing operations should have an effect similar to running the existing generators, as noted in Section 4.1.5, Special Load Reduction Measures.

The following outline illustrates several curtailment options. MCAS staff should work closely with SDG&E and Camp Pendleton utility staff to forecast the actual peak hours and 15-minute peaks.

- Turn off a major building system for 1 hour, such as a chiller or rooftop package unit. Turn off a second system before restarting the first. In this way, staff can cycle through several cooling zones to minimize disruptions to operations in any one building zone.
- Change some or all work schedules or shifts to avoid building operations during the peak hours.

Check if the above curtailment actions qualify for the demand response programs offered by the Independent System Operation (ISO)-Discretionary Load Curtailment or Demand Relief Program, and SDG&E's Voluntary Demand Response Program and the Base Interruptible Program. Program rules and guidelines vary by program, and FEMP technical assistance is available if a more detailed briefing on program opportunities is desired.

PNNL encouraged MCAS to perform its curtailment strategies as part of the California Federal Load Reduction Test on May 24, 2001. Additional information is available at http://www.eren.doe.gov/sro/loadtest.html.

4.1.5 Special Load Reduction Measures

Running Existing Generators During Peak Hours

MCAS may be able to run one or more of its natural gas backup generators to reduce peak demands. The kW reduction for the audited building (Bldg 23170: hangars, offices, shops) is not likely to exceed 199 kW. Extrapolated to all hangars, the MCAS-wide savings would then be 1,410 kW or 41% of MCAS' estimated peak demand. However, this estimate is only a very rough order of magnitude, because generator data was not available for this report. Using the generators for load reduction has significant operational issues, including air quality regulations, the rising price of natural gas, the generators' ability to run for extended periods, and the staffing required. Consequently, these savings are not included in this report's summaries for individual buildings or for MCAS as a whole.

PNNL encouraged MCAS to perform its curtailment strategies as part of the California Federal Load Reduction Test on May 24, 2001, as noted above.

MCAS should closely coordinate any of these efforts with SDG&E and Camp Pendleton staff.

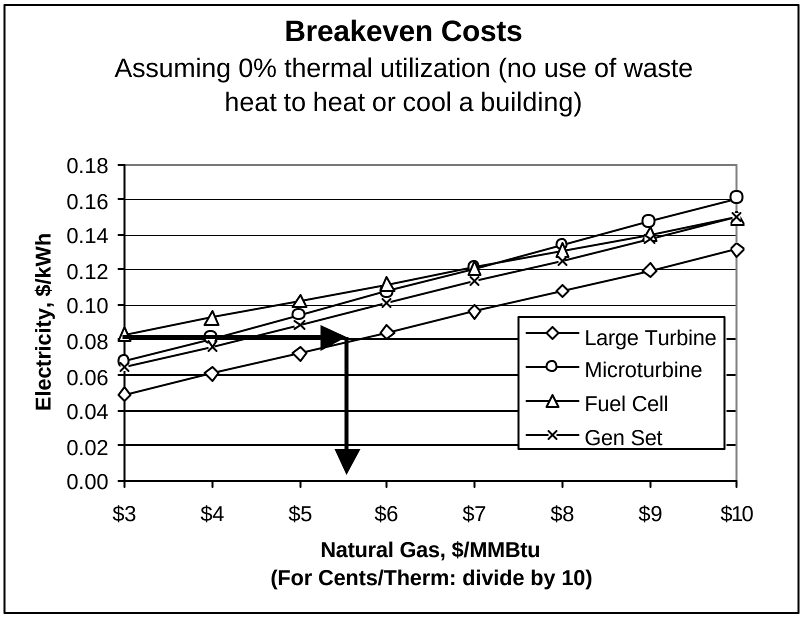
Constructing Distributed Generation (a.k.a. alternative generation and off-grid generation)

Distributed generation includes fuel cells, natural gas microturbines, photovoltaic, wind power, and standard diesel or natural gas generators to reduce the electrical load on the state and regional electricity grid systems. These generation systems require significant funding, but MCAS may be able to obtain funding or generate operating revenue from its HQ, SDG&E, California public benefit funds, or private parties, such as energy savings contractors. The cost effectiveness of any one of the generation options is a very complex evaluation, and the development of a project is a long-term effort. Consequently, this report cannot estimate the feasibility or cost effectiveness of generation projects.

However, an informal study done for other Federal sites indicates that several types of natural gas generators are **not** cost effective, given MCAS' current low electrical rates (8 cents/kWh) and higher gas rates (72 cents/therm). The study developed the implementation cost (capital construction, fuel, and operation & maintenance) for four types of natural gas-fired generators: large turbines (10 MW and above), microturbines, fuel cells, and standard generator sets. The study then related the costs to electricity and gas rates to determine the breakeven points, as shown in Figure 3, which is adapted from the study.

As indicated by the arrows in the chart, if a site's electricity rate is 8 cent/kWh, then a large turbine project may break even only when natural gas is cheaper than approximately 55 cents/therm. Similarly, microturbines and standard generator sets may break even at 40 cents/therm, and fuel cells at 30 cents/therm.

At 16 cents/kWh rate, all generators may break even when gas averages $1/therm. Before the recent legislative cap on SDG&E electricity rates, Camp Pendleton staff indicates their effective or blended



electricity rate was 28 cents/kWh. Under these higher prices, one or more generation options seem promising.

Figure 3. Generator Breakeven Costs

The generation options have more promise when a site uses the generator's waste heat to heat or cool a building. Waste heat can be used in the winter, for example, to heat water before it enters a space-heating boiler. Waste heat can also be used in the summer to drive an absorption chiller to cool a building and thereby decrease the amount of electricity to run standard building chillers. The capture and utilization of waste heat requires additional equipment that is not included in the study's estimate of capital construction. The additional capital cost would need to be balanced against the additional energy savings to determine the most cost-effective options.

Constructing Thermal Storage

Another approach to reducing peak loads is to generate large quantities of ice or chilled water during off-peak hours and store it to cool building during the peak hours. As noted above for distributed generation options, project funding may be available from several sources outside of MCAS. Thermal storage approaches require significant funding and development and consequently, this report does not estimate the feasibility or cost effectiveness. Additional information is available in a Federal Technology Alert available at http://www.eren.doe.gov/femp/prodtech/thermal-storage1.html.

4.2 Public Benefit Funds

A number of public benefit funds (PBFs) exist now and more programs are expected. Appendix F presents a very recent summary of PBFs provided by Restructuring Subcommittee of the Interagency Energy Management Task Force in May 2001. This new summary has not been integrated into this report's matrix, which maps the report's recommended actions to PBFs (the matrix is found in

Appendix B, “Action Matrix.” MCAS should investigate opportunities by contacting the PBF programs directly, or by working with SDG&E and others.

Appendix A

MCAS Actual FY00 KWh Use and Estimated KW

Appendix A

MCAS Actual FY 00 kWh Use and Estimated kW

FY 00 Actual kWh for MCAS

	Electricity							**Gas**
Meter ID :	15-296-548		CMP 23 AREA		15-357-992	Totals		CMP 23 GAS
	ELEC MASTER #1 (VAND/Bas) 1 of 3		ELEC MASTER #2/LESS MAG-46		PORK CHOP HILL/ALT ELC MASTER #2			GAS-N-GAS Masterless MAG 46
	kWh	kW Est. 0.3%	kWh	kW Est. 0.3%	kWh	kWh	kW Est. 0.3%	THRM
O 99	842,400	2,226	347,497	918	0	1,189,897	3,144	4,180
N 99	921,600	2,435	436,889	1,154	0	1,358,489	3,589	1,890
D 99	763,200	2,016	369,800	977	3,000	1,133,000	2,993	6,174
J 00	669,600	1,769	331,872	877	0	1,001,472	2,646	6,131
F 00	828,000	2,188	369,264	976	0	1,197,264	3,163	6,299
M 00	784,800	2,073	398,800	1,054	0	1,183,600	3,127	6,202
A 00	741,600	1,959	336,032	888	0	1,077,632	2,847	6,298
M 00	712,800	1,883	316,800	837	0	1,029,600	2,720	6,355
J 00	1,029,600	2,720	409,120	1,081	0	1,438,720	3,801	6,340
J 00	885,600	2,340	377,496	997	4,000	1,263,096	3,337	6,359
A 00	1,087,200	2,872	490,888	1,297	0	1,578,088	4,169	6,356
S 00	871,200	2,302	353,960	935	111,000	1,225,160	3,237	3,222
USAGE TOTALS	10,137,600	2,232	4,538,418	999	118,000	14,676,018	3,231	65,806
Summer average:							**3,453**	
SDGE "TOU-AL"	$0.080		$0.080		$0.080	$0.080		$0.450
COST TOTALS	$811,008		$363,073		$9,440	$1,174,081		$29,613

The kW estimate is the kWh times the factor developed, as shown in Appendix B, "Estimate for MCAS Peak Load Factor."

Appendix B-1

Estimate for MCAS Peak Load Factor

[NOTE: The Excel file containing most of the tables and charts for this report is available by contacting John Hail at john.hail@pnl.gov.]

Ratio of Peak to Base Load

Assumption: peak is 4 x base load

Monthly Model

SDGE Peak Time of Use (TOU)

Enter the 4:1 ratio of peak to base load

Factor to use on actual kWh to estimate peak loads.

Workday

	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	Hrs	kW	kWh	Days	Hrs	kWh	%
On Peak hours												1	1	1	1	1	1	1							7	4	28	22	154	616	47%
Semi									1	1	1								1	1	1	1			7	3	21	22	154	462	36%
Off-Peak hours	1	1	1	1	1	1	1	1															1	1	10	1	10	22	220	220	17%
																									24		59		528	1,298	100%
																													71%	86%	

Monthly Amts

If kWh qty =			
1,000,000			
Workday Share 86%	Divide by Hrs	Then kW =	Factor
857,332			
406,869	154	2,642	0.3%
		3 :MW	
		28 CP MW	
		9.4%	
		3 :MW	
		15 CP MW	
		17.6%	

NonWorkday Assume flat, base consumption

	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	Hrs	kW	kWh	Days	Hrs	kWh
On Peak hours																									0	4	0	9	0	0
Semi																									0	3	0	9	0	0
Off-Peak hours	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	24	1	24	9	216	216
																									24		24		216	216
																												Total:	744	1,514

Appendix B-2

Action Matrix

[**NOTE:** The matrix of specific recommended actions for each model building mapped to their savings (i.e., kW reductions, etc.), to MCAS' resources and timing, and to the public benefit funds that provide funding or incentives for some of the actions].

Action Matrix (actions and evaluations)

Electricity Evaluations

Highlighted columns are the 15-Minute Peaks (the focus of audit)

Enter kW Savings per Time-of-Use Periods

Actions

			Summer						**Winter**							**Annual $**
			a.m.	Mid-Day	CA's Peak	**15 Min Peak**	Eveng	Night	Office Hrs	Peak Eve	**15 Min Peak**	Late Eve	Night	kWh Annual	kWh $ Annual	kW + kWh
				SDG&E's On-Peak	SDG&E's On-Peak											
			8am - 11am	11am 2pm	2-6 pm	**varies**	6-10 pm	10pm 8am	6am - 5pm	5-8pm	**~6 pm**	8- 10pm	10pm 6am			
			SDG&E TOU Designations for On-Peak, etc.													
Bldg	Bldg Type	Item Brief (Number is from the Field Notes)	Semi	Peak	Peak	**15 Min Peak**	Sem	Off	Semi	Peak	**15 Min Peak**	Semi	Off			
Bldg 23195	Training	50. Fix economizers. Update controls on the 3 fan systems and the numerous classroom VAV controllers.	16	23	31	**16**	23	0	0	**0**	**0**	0	0	36,559	$2,885	$3,990
Bldg 23195	Training	51. Put the (3) rooftop air handlers on an agressive on/off schedule using the existing DDC controls or add the necessary control relays via existing ES-USA DDC control panel.	0	0	0	**0**	30	30	0	**30**	**30**	30	30	180,435	$13,582	$15,636
Bldg 23195	Training	52. Upgrade controls to allow the VAV zone controllers to know if the fan is in heat or cool modes. Let the VAV zone controllers drive the fan system to provide heat or cool on a demand calculation basis.	6	6	6	3	0	0	6	**6**	**6**	0	0	19,182	$1,502	$2,125
Bldg 23170 Office	Office	12. Fix or replace failed mechanical components.	3	3	**3**	**3**	1	1	3	3	3	1	1	15,620	$1,208	$1,682
Bldg 23170 Office	Office	13. Put the fans in automatic control and schedule equipment to turn off/on in a more aggressive manner.	0	0	**0**	**0**	40	40	0	40	0	40	40	240,580	$18,110	$18,110
Bldg 23170 Office	Office	14. Add automation to turn off the gas-fired hot water system (pumps), when the outside air temperature is above 65 degrees F.	0	0	**0**	**0**	0	0	0	0	0	0	0	0	$0	$0
Bldg 23170 Office	Office	15. Turn down the domestic hot water temperature and save gas energy and reduce risk to staff from scalding hot water at showers/sinks. No elect savings.	0	0	**0**	**0**	0	0	0	0	0	0	0	0	$0	$0

Action Matrix (actions and evaluations)

Electricity Evaluations

Highlighted columns are the 15-Minute Peaks (the focus of audit)

Enter kW Savings per Time-of-Use Periods

Actions

SDG&E's On-Peak

SDG&E TOU Designations for On-Peak, etc

Bldg	Bldg Type	Item Brief (Number is from the Field Notes)	Summer a.m.	Summer Mid-Day	Summer CA's Peak	Summer 15 Min Peak	Summer Eveng	Summer Night	Winter Office Hrs	Winter Peak Eve	Winter 15 Min Peak	Winter Late Eve	Winter Night	kWh Annual	kWh $ Annual	Annual $ kW + kWh
			8am - 11am	11am 2pm	2-6 pm	**varies**	6-10 pm	10pm 8am	6am - 5pm	5-8pm	**~6 pm**	8- 10pm	10pm 6am			
			Semi	Peak	Peak	**15 Min Peak**	Sem	Off	Semi	Peak	**15 Min Peak**	Semi	Off			
Bldg 23170 Office	Office	16. Automate the bathroom heating/ventilation supply fans and exhaust fans such that they are interlocked to the light switches serving the bathrooms.	4	0	**4**	**4**	7	7	4	7	**4**	7	7	50,566	$3,833	$4,320
Bldg 23170 Ofc & Hgr	Office & Hangar	17. Evaluate using the gas-fired emergency generator for peak-shaving or load reduction for significant periods of day or peak periods.			**274**	**274**								119,342	$9,551	$28,930
Bldg 23170 Hangar	Hangar	18. Change lighting override switches in the hangar bays to timer design, to ensure that they are not left in override continuously.	10	10	**10**	**10**	10	10	10	**10**	**10**	10	10	84,002	$6,410	$7,746
Bldg 23123	Office	49. Install HVAC override switches and fix problems noted in Observations (may be covered by warranty).	0	1	**3**	**2**	1	0	0	1	**3**	2	1	5,248	$405	$771
Bldg 23123	Office	48. Clean cooling coils.	0.2	0.2	**0.2**	**0.2**	0.2	0.0	0.0	0.0	**0.0**	0.0	0.0	305	$24	$38
Bldg 23123	Office	47. Put HVAV fans onto aggressive setback schedule for non-work hours.	0	0	**0**	**0**	4	4	0	0	**0**	4	4	22,252	$1,673	$1,673
Bldg 23123	Office	46. Fix economizers.	7	10	**13**	**7**	10	0	0	0	**0**	0	0	15,467	$1,221	$1,688

Action Matrix (actions and evaluations)

Implementation Evaluations

MCAS resources or programs that are needed to implement the action

Actions

					Operations & Maintenance Activities						Projects			
					Bldg Controls for Cooling, Heating, HotWater, Lighting									
Bldg	Bldg Type	Item Brief (Number is from the Field Notes)	Time to Impl. Action	General MCAS Resource	Reset bldg control schedules	Re-tune HVAC controls	Repair bldg parts, do maint.	Replace, upgrade parts (minor expense work)	Shift or curtail work hours	Run backup generators to reduce peak	Retrofit parts (lights, motors, etc)	Replace, upgrade systems (exp. & capital)	New distributed /local generation	New thermal storage, load-shift technology
Bldg 23195	Training	50. Fix economizers. Update controls on the 3 fan systems and the numerous classroom VAV controllers.	1. Now (Work Weeks)	O&M		x	x							
Bldg 23195	Training	51. Put the (3) rooftop air handlers on an agressive on/off schedule using the existing DDC controls or add the necessary control relays via existing ES-USA DDC control panel.	1. Now (Work Weeks)	O&M	x									
Bldg 23195	Training	52. Upgrade controls to allow the VAV zone controllers to know if the fan is in heat or cool modes. Let the VAV zone controllers drive the fan system to provide heat or cool on a demand calculation basis.	3. Later (4+ Months)	O&M		x					x			
Bldg 23170 Office	Office	12. Fix or replace failed mechanical components.	1. Now (Work Weeks)	O&M			x							
Bldg 23170 Office	Office	13. Put the fans in automatic control and schedule equipment to turn off/on in a more aggressive manner.	1. Now (Work Weeks)	O&M	x									
Bldg 23170 Office	Office	14. Add automation to turn off the gas-fired hot water system (pumps), when the outside air temperature is above 65 degrees F.	2. Soon (2-3 Months)	Project							x			
Bldg 23170 Office	Office	15. Turn down the domestic hot water temperature and save gas energy and reduce risk to staff from scalding hot water at showers/sinks. No elect savings.	1. Now (Work Weeks)	O&M		x								

Action Matrix (actions and evaluations)

Actions

Bldg	Bldg Type	Item Brief (Number is from the Field Notes)	Implementation Evaluations: MCAS resources or programs that are needed to implement the action — Time to Impl. Action	General MCAS Resource	Operations & Maintenance Activities — Bldg Controls for Cooling, Heating, HotWater, Lighting: Reset bldg control schedules	Re-tune HVAC controls	Repair bldg parts, do maint.	Replace, upgrade parts (minor expense work)	Shift or curtail work hours	Run backup generators to reduce peak	Projects: Retrofit parts (lights, motors, etc)	Replace, upgrade systems (exp. & capital)	New distributed /local generation	New thermal storage, load-shift technology
Bldg 23170 Office	Office	16. Automate the bathroom heating/ventilation supply fans and exhaust fans such that they are interlocked to the light switches serving the bathrooms.	2. Soon (2-3 Months)	Project							x			
Bldg 23170 Ofc & Hgr	Office & Hangar	17. Evaluate using the gas-fired emergency generator for peak-shaving or load reduction for significant periods of day or peak periods.	1. Now (Work Weeks)	O&M						x				
Bldg 23170 Hangar	Hangar	18. Change lighting override switches in the hangar bays to timer design, to ensure that they are not left in override continuously.	2. Soon (2-3 Months)	O&M				x						
Bldg 23123	Office	49. Install HVAC override switches and fix problems noted in Observations (may be covered by warranty).	2. Soon (2-3 Months)	O&M		x	x				x			
Bldg 23123	Office	48. Clean cooling coils.	1. Now (Work Weeks)	O&M			x							
Bldg 23123	Office	47. Put HVAV fans onto aggressive setback schedule for non-work hours.	1. Now (Work Weeks)	O&M	x				x	x				
Bldg 23123	Office	46. Fix economizers.	2. Soon (2-3 Months)	O&M		x	x	x						

Action Matrix (actions and evaluations)

Actions			Public Benefit Funds Evaluations								
			CA Public Benefit Programs for Energy Efficiency, Demand Response, and Distributed Generation								
			California Energy Commission				CA ISO		SDG&E		
			Demand-responsive Building Systems	Innovative Peak Load Reduction Proposals	TOU & Real Time Meters	Emerging Renewables & DG	Discretionary Load Curtailment	Demand Relief (loads w/o Backup gen)	Energy Efficiency (e.g. Express Efficiency, SPC)	Demand Response (VDRP, BIP)	Onsite Renewable, DG incentives
Bldg	Bldg Type	Item Brief (Number is from the Field Notes)	$35M	$50M	$35M	$30M	Open all year	2nd RFP is Closed			
Bldg 23170 Office	Office	16. Automate the bathroom heating/ventilation supply fans and exhaust fans such that they are interlocked to the light switches serving the bathrooms.		X					X		
Bldg 23170 Ofc & Hgr	Office & Hangar	17. Evaluate using the gas-fired emergency generator for peak-shaving or load reduction for significant periods of day or peak periods.								X, verify	
Bldg 23170 Hangar	Hangar	18. Change lighting override switches in the hangar bays to timer design, to ensure that they are not left in override continuously.		X					X		
Bldg 23123	Office	49. Install HVAC override switches and fix problems noted in Observations (may be covered by warranty).	X	X			X	X	X	X	
Bldg 23123	Office	48. Clean cooling coils.	X				X	X		X	
Bldg 23123	Office	47. Put HVAV fans onto aggressive setback schedule for non-work hours.	X				X	X		X	
Bldg 23123	Office	46. Fix economizers.	X				X	X		X	

Notes on the Public Benefit Programs Chart & Selections on the Database Tab

Courtesy of C. Goldman, Lawrence Berkeley National Laboratory, May 7, 2001

CEC

1. Source is http://www.flexyourpower.ca.gov/rebates/AB29x-SB5x_program_summary.html
2. Excluded Low Energy Usage Building materials because they are for "cool roofs" and Municipal utility programs because they are for res. A/c and appliance incentives.

CA ISO Programs

1. DRP RFP for loads WITH backup generation has been withdrawn.
2. DRP RFP for Loads without backup generation; bids are already due in 2nd RFP.

SDG&E Programs

1. Energy Efficiency -- main programs are Express Efficiency and SPC.
2. Demand Response -- main programs are Voluntary Demand Response Program and Base Interruptible Program and most military facilities are exempt from rotating outages, so OBMC program does not apply.
3. SDG&E has requested PUC approval for loads with backup generators to participate in their DR programs. A response is expected in late May or early June.
4. Only certain technologies (not diesel) will be eligible for DG incentives; see MAY newsletter.

Appendix C

Model-Building Program
A Strategy for Initiating A Range of Improvements at MCAS

Appendix C

Model-Building Program
A Strategy For Initiating A Range of Improvements at MCAS

As in any facilities organization, improvements take time to implement and resources are limited. Therefore, focus the resources on implementing a range of improvements in a few facilities in order to quickly develop a model program. The following goals for developing the model program are suggested:

- Coordinate funds and staff responsibilities across the traditional industry staffing categories of operations, maintenance, and projects to achieve an integrated program.
- Train PWD staff in continuous commissioning and building control systems.
- Encourage and reward the early adopters (tenants and PWD staff) for measured savings achievements.

The following illustrates how to develop a model program in coordination with the existing project funds for the HVAC renovation of the 2397 Building. First, include a good building control system, electricity and gas metering, and a commissioning program in the project's design and construction scope. When the project is complete, assure that maintenance staff initiate a continuous commissioning program. Encourage staff (PWD and tenants) to experiment with operational changes to further reduce energy use. Use the metering system to measure achievements. Lastly, allocate a portion of the measured savings to the tenants' Marine Corps Community Service fund.

We suggest focusing on the following model buildings (grouped by building type):

Hangar/Administration Office Buildings

Focus on the eastern wing of the 23170 Building because the Executive Officer (Major Dahl, Squadron 164) demonstrated good energy management knowledge and practice during the audit. Their hallway lights were completely off (except for emergency egress lights) and they expressed readiness to do more. The Major was conversant in energy technologies and programmatic issues at MCAS and within the state. This squadron's energy savings should be measured by the diagnostics noted above. Their achievements may be rewarded by contributing a portion of the cost savings to a Marine Corps Community Service fund, such as their annual squadron events.

As illustrated above, focus on a second hangar/administration building (2397 Building), because of the funded HVAC renovation project (approximately $1.4M), which is now in the pre-design phase. Revise the project scope to include the improvements noted above. Continue to periodically recommission the project.

Classroom/Training Building

Focus on the newest training facility, 23195 Building, because its newer HVAC system can be recommissioned to demonstrate a higher level of performance for energy and tenant satisfaction.

Administration/Office Building

Focus on the 23123 Building, because its newer HVAC system can also be recommissioned for performance improvements, as noted in this report. The inclusion of this building as one of the models will complement the occupants’ (MCAS Public Works) existing good energy management practices and provide Public Works staff with the opportunity for training and experimentation in HVAC and controls.

Appendix D

Commissioning and Recommissioning

Appendix D

Commissioning and Recommissioning

The following information explains the concept of commissioning (and recommissioning) common to the facilities management industry. Two links are provided:

1. A [Microsoft® Powerpoint®] presentation given at an Association of American Facilities Engineering conference by Don Davenport and Steve Nixon, EMC Engineers, Inc., go to:

http://www.emcengineers.com/downloads/Commissiong Presentation with Diagnostics.htm

3. FEMP's detailed guidebook on commissioning, go to:

http://www.eren.doe.gov/femp/techassist/bldgcomgd.html

Appendix E

Initial Field Notes and Calculations
Camp Pendleton MCAS Energy Audit

Appendix E

Initial Field Notes and Calculations
Camp Pendleton MCAS Energy Audit

These notes were generated as a result of walkthrough audits conducted by Ron Underhill, PNNL Building Controls Specialist, and Dave M. Brown, PNNL Facilities Mechanical Engineer during their assessment of the site.

Building 2397 Maintenance Hangar

- Lighting – T-8 lamps throughout. Sophisticated controls for the hangar lights located in electrical room, but appear to be in manual mode or not working properly.
- Pneumatic controls throughout – in very POOR condition.
- Economizer controls not working on any fans.
- AH1 (west) system has broken belt on supply fan, but motor is running anyway – not performing.
- AH1 return fan is running without the supply fan, causing poor air balance condition in the building – no outside air is being brought in – contributes to poor indoor air quality.
- AH2 system has broken pneumatic control heating valve (indicated by loud rattling noise). Pneumatic control cooling valve has broken line, resulting in inoperable cooling valve, which adds to load on air compressor.
- Hot water boiler is providing 170° F water. This should be set lower or reset from outside air or building load.
- Domestic HW system is providing 150° F water. This is too hot and may violate health codes to prevent scalding.
- Cooling tower control valves (three-way butterfly) are disconnected from actuators for both HVAC chiller towers. This may result in over-cooling of condenser water.
- Isolation control valves on each chiller are disconnected. This results in water flowing through both chillers, when only one chiller is required to meet building load demands.
- The pneumatic control for the air compressor cooling tower is set for 50° F. This may be lower than required and results in maximum cooling tower operation (maximum energy consumption).
- The mechanical and electrical rooms are unkempt and cluttered. This does not lend itself to good maintenance practices or good environment for energy-consuming equipment and controls.
- All MCC loads are in manual control. This indicates that automatic control functions are not working or are not relied upon.
- Cooling tower fans for the chillers are selected to be in manual control. Each tower has a high and low speed motor. If there are no interlocks in place, this will result in both starters being energized, which could lead to premature failure of one or both motors and excess energy consumption.
- Spray pumps are in manual control. This can result in overuse of water, adding to overcooling of the condenser water and additional water to sewer (treatment) and additional load on the water supply system.

Some indicating lights on the MCC starters appear to have failed. This results in not being able to analyze facility equipment conditions from the MCC for status and could result in mis-diagnosis of energy use.

- Two new electric meters were found to have wiring routed to new ES-USA panel. It is not known if this data is available to MCAS personnel.

Energy Efficiency Improvement Opportunities

1. Update all controls to ES-USA DDC. Savings will be significant, but hard to quantify without sophisticated modeling (same comment for all other buildings). Recommend that new upgrade project have input from PNNL, to ensure scope is sufficient to "get" more than minimum energy-saving features from a DDC system.
2. Fix or replace failed mechanical components. This should be done by new project.
3. Put the fans in automatic control and schedule equipment to turn off/on in an aggressive manner. Interface fans to existing ES-USA DDC control panel for automatic control via new control relays. Existing occupancy is 4 am until 1 am. Implement an aggressive schedule (6 am until 11 pm, Monday – Friday). For weekends, add an override switch, to directly start the fan system. The override switch should be of a 1 to 6 hour, time delay design. This will allow timed overrides, without providing continuous override (in case the occupant fails to return the override switch to a normal condition). It is estimated that hours of runtime would drop from 8760 hours per year to approximately 5500 hours per year. This equals approximately 3000 hours of reduced equipment operations. Each fan system consumes approximately 10 kW of power. There are four fan systems, so this equates to 40 kW x 3000 hours = 120,000 kWh of energy savings. This equates to $18,000 saved (@ $0.15/kWh) or over $33,000 saved (@ $0.28/kWh).
4. Add automation to turn off the gas-fired hot water system (pumps), when the outside air temperature is above 65 degrees F. If the boiler can be turned off, this will also save energy, but it is likely not possible, if the domestic hot water system must be maintained. The hot water system pumps hot water to heating coils located in the four main fan systems, as well as the four heating ventilation systems that serve the men's and women's bathrooms. If the heating coil control valves leak or are not properly controlled, they will allow hot water to enter the coil, heating the air stream, which adds significant load to the mechanical cooling system and also causes comfort problems (too hot). There should be little to no need for hot water heat, once outside air conditions exceed 65 degrees F.
5. Turn down the domestic hot water temperature and save gas energy and reduce risk to staff from scalding hot water at showers/sinks.
6. Automate the bathroom heating/ventilation supply fans and exhaust fans such that they are interlocked to the light switches serving the bathrooms. If no lights are active from any of the switches, the fans should be turned off. The fan energy load is equivalent to 2 kW per bathroom. If the bathrooms are occupied a total of 5000 hours per year (14 hours/day), this will result in a reduction of over 3500 of both lighting and fan energy. The fan energy saved per bathroom will be equivalent to 7,000 kW. There are four bathrooms, so this results in 28,000 kW saved per year. This equates to over $4,000 saved (@ $0.15/kWh), or over $8,000 saved (@ $0.28/kWh). The key is to hardwire interlock the fans to the lights (making sure that the light switches are utilized by staff or that occupancy sensors are working properly).
7. Put EF-8 back into automatic control at the MCC. This fan runs off an existing thermostat in automatic. However, in manual, it runs continuously, even if not needed. Savings is estimated to

be approximately 5000 kW/year or approximately $750/year (@ $0.15/kWh), or approximately $1,500/year (@ $0.28/kWh).

8. Evaluate a closed loop heat rejection system to preheat or heat the domestic hot water with the heat from the air compressor.
9. Evaluate using the gas-fired emergency generator for peak-shaving or load reduction for significant periods of day or peak periods.
10. Ensure that the existing pneumatic controls or new DDC controls stage the chillers and cooling towers for the load and do not activate more equipment than necessary.
11. Change override switches in the hangar bays to timer design, to ensure that they are not left in override continuously.

Building 23170 Maintenance Hangar

- Lighting – T-8 lamps throughout. Controls for the hangar lights include override switches. Outside lights are all on – may have bad photocell(s).
- New DDC (Siebe) digital controls are installed throughout. Controls are completely terminated on west side of building, but not on east side of building. This indicates that the contractor did not complete the project and that operational problems exist from inadequately completed controls. The project staff responsible for overseeing this system (new DDC controls and HVAC systems) should require that the work be completed. Future consideration should be given to updating these controls to ES-USA DDC controls or Lonwork compatible controls. This will ensure that the DDC system is used to implement efficient control strategies and can be accessed remotely.
- All MCC fan ventilation loads are in manual control. This indicates that automatic control functions are not working or are not relied upon.
- Makeup air on west side of building is deficient.
- AH-3 return air damper is not working properly on the fan economizer.
- AH-1 and AH-2 fan systems are not working. The fans are not running, except for one return air fan. This is impacting the building air balance and comfort.
- Domestic HW tanks are running at 150° F.

<u>Energy Efficiency Improvement Opportunities</u>

12. Fix or replace failed mechanical components.
13. Put the fans in automatic control and schedule equipment to turn off/on in a more aggressive manner; i.e., if current schedule for building occupancy is 4 am until 1 am Monday - Friday, consider pushing this from 6 am to 11 pm. For weekends, add an override switch input to directly start the fan system. The override switch should be of a 1 to 6 hour, time delay design. This will allow timed overrides, without providing continuous override (in case the occupant fails to return the override switch to a normal condition). It is estimated that hours of runtime would drop from 8,760 hours per year to approximately 5,500 hours per year. This equals approximately 3,000 hours of reduced equipment operations. Each fan system consumes approximately 10 kW of power. There are four fan systems, so this equates to 40 kW x 3,000 hours = 120,000 kWh of energy savings. This equates to $18,000 saved (@ $0.15/kWh) or over $33,000 saved (@ $0.28/kWh).

Add automation to turn off the gas-fired hot water system (pumps), when the outside air temperature is above 65 degrees F. If the boiler can be turned off, this will also save energy. This is not likely, if the domestic hot water system must be maintained. The hot water system pumps hot water to heating coils located in the four main fan systems, as well as the four heating ventilation systems that serve the men's and women's bathrooms. If the heating coil control valves leak or are not properly controlled, they will allow hot water to enter the coil, heating the air stream, which adds significant load to the mechanical cooling system and also causes comfort problems (too hot). There should be little to no need for hot water heat, once outside air conditions exceed 65 degrees F.

14. Turn down the domestic hot water temperature and save gas energy and reduce risk to staff from scalding hot water at showers/sinks.
15. Automate the bathroom heating/ventilation supply fans and exhaust fans such that they are interlocked to the light switches serving the bathrooms. If no lights are active from any of the switches, the fans should be turned off. The fan energy load is equivalent to 2 kW per bathroom. If the bathrooms are occupied a total of 5,000 hours per year (14 hours/day), this will result in over 3,500 hours reduction of both lighting and fan energy. The fan energy saved per bathroom will be equivalent to 7,000 kW. There are four bathrooms, so resulting in an estimated savings of 28,000 kW per year. This equates to over $4,000 saved (@ $0.15/kWh) or over $8,000 saved (@ $0.28/kWh). The key is to hardwire interlock the fans to the lights (making sure that the light switches are utilized by staff or that occupancy sensors are working properly).
16. Evaluate using the gas-fired emergency generator for peak-shaving or load reduction for significant periods of day or peak periods.
17. Change override switches in the hangar bays to timer design, to ensure that they are not left in override continuously.

Building 2387 Heating Plant

- Lighting – T-8 lamps throughout.
- Pneumatic controls throughout are in very poor condition.
- Hot water boiler is providing 170° F to 180° F water. This should be set lower or reset from outside air or building load.
- Domestic HW system is providing 165° F water. This is too hot and may violate health codes to prevent scalding.
- All MCC loads are in manual control. This indicates that automatic control functions are not working or are not relied upon.
- Pneumatic controller outside temperature reading is 40° F.

<u>Energy Efficiency Improvement Opportunities</u>

18. Fix or replace failed mechanical components.
19. Fix pneumatic controller or update controls to ES-USA DDC. [Note: The pneumatic controller is indicating an outside air temperature of 40 degrees; it was 60 degrees at the time. This may have been causing the hot water to be hotter than normal if the pneumatic controller uses a reset strategy from outside air temperature. This is a "lack-of-maintenance" issue that may be contributing to excess energy consumption issues].

Turn down the domestic hot water temperature and save gas energy and reduce risk to staff from scalding hot water at showers/sinks.

20. Add automation to turn off the gas-fired hot water system (pumps), when the outside air temperature is above 65 degrees F. If the boiler can be turned off, this will also save energy; however, this is not likely, if the domestic hot water system must be maintained. The hot water system pumps hot water to heating coils located in the four main fan systems, as well as the four heating ventilation systems that serve the men's and women's bathrooms. If the heating coil control valves leak or are not properly controlled, they will allow hot water to enter the coil, heating the air stream, which adds significant load to the mechanical cooling system and also causes comfort problems (too hot). There should be little or no need for hot water heat, once outside air conditions exceed 65° F.
21. Turn down air compressor pressure setting to keep compressor runtime lower.

Building 2386 Maintenance Hangar

- Lighting – T-8 lamps throughout. Pneumatic controls throughout are in very poor condition.
- Economizer control on MZ-2 is not working properly.
- There is not any interface from the new ES-USA digital controls to the existing pneumatic control for Building 2387 (Heating Plant) to activate the Hot Water pumps correctly. This may result in no heat.
- All fan loads are in manual control. This indicates that automatic control functions are not working or are not relied upon.

Energy Efficiency Improvement Opportunities

22. Fix or replace economizer controls on MZ-2.
23. Put the fans on automatic control and schedule equipment to turn off/on in an aggressive manner. Interface fans to existing ES-USA DDC control panel for automatic control via new control relays. Existing occupancy is 4 am to 1 am. Implement an aggressive schedule (6 am to 11 pm, Monday – Friday). For weekends, add an override switch input to directly start the fan system. The override switch should be of a 1 to 6 hour, time delay design. This will allow timed overrides, without providing continuous override (in case the occupant fails to return the override switch to a normal condition). It is estimated that hours of run time would drop from 8,760 hours per year to approximately 5,500 hours per year. This equals approximately 3,000 hours of reduced equipment operations. Each fan system consumes approximately 7 kW of power. There are two fan systems, so this equates to 14 kW x 3,000 hours = 42,000 kWh of energy savings. This equates to over $6,000 saved (@ $0.15/kWH) or over $12,000 saved (@ $0.28/kWh).
24. Change override switches in the hangar bays to timer design to ensure that they are not left in continuous override.
25. Turn down air compressor pressure setting to keep compressor runtime lower.
26. Update HVAC system design from multi-zone to VAV.

Building 2396 Maintenance Hangar

- Lighting – T-8 lamps throughout. Controls for the hangar lights include override switches. Daylighting potential exists in the hangar bays, but not being used.

ES-USA has controls to the hangar lights, but it is not clear how or if they are working and if they are, what the control strategy is supposed to be.

- Pneumatic controls throughout. Several problems identified, including mechanical cooling operating, with no free (outside air) cooling being utilized because dampers are on full recirculation.
- All MCC fan ventilation loads are in manual control. This indicates that automatic control functions are not working or are not relied upon.

<u>Energy Efficiency Improvement Opportunities</u>

27. Fix or replace failed mechanical components.
28. Fix pneumatic controllers or update controls to ES-USA DDC. Pneumatic controller for MZ-3 is indicating an outside air temperature of 70° F, while the controller for MZ-4 is indicating an outside air temperature of 45° F. It was 60° F at the time. This may have been causing the hot deck temperature for MZ-4 to be hotter than normal (indicating >120° F temperature), if the pneumatic controller uses a reset strategy from outside air temperature.
29. Determine if ES-USA lighting controls are working in the hangar. If not, execute work request to place back into working operation. Free lighting (via use of skylights and/or open bay doors) should be aggressively pursued.
30. Upgrading to DDC controls with electric actuators (similar to 2386) will eliminate the need for the pneumatic compressor. Estimated savings is approximately 1,000 kWh/year, from not having a compressor running. This equates to $150 saved (@ $0.15/kWh), or over $250 saved (@ $0.28/kWh).
31. Update HVAC system design from multi-zone to VAV.
32. Interface fans to new ES-USA DDC control panel for automatic control via new control relays. Existing occupancy is 4 am until 1 am. Implement an aggressive schedule (6 am to 11 pm, Monday through Friday). For weekends, add an override switch input, to directly start the fan system. The override switch should be of a 1 to 6 hour, time delay design. This will allow timed overrides, without providing continuous override (in case the occupant fails to return the override switch to a normal condition). It is estimated that hours of runtime would drop from 8,760 hours per year to approximately 5,500 hours per year. This equals approximately 3,000 hours of reduced equipment operations. Each fan system consumes approximately 7 kW of power. There are two fan systems, so this equates to 14 kW x 3,000 hours = 42,000 kWh of energy savings. This equates to over $6,000 saved (@ $0.15/kWh) or over $12,000 saved (@ $0.28/kWh).

Building 23122 Warehouse

- Lighting – T-8 lamps throughout. Several skylights exist, which could be used for daylight, to turn off selected banks of lights.
- Pneumatic controls throughout. Several controls are disconnected, or do not appear to be working correctly, including the economizer controls, chilled water controls and static pressure controls.
- All MCC fan ventilation loads are in manual control. This indicates that automatic control functions are not working or are not relied upon.
- Domestic HW tank has no temperature indication gauge, but appears (from touch) to be running very hot.

- Heating hot water boiler is running at 170° F.
- Chiller is set for 44° F water temperature.

Energy Efficiency Improvement Opportunities

33. Fix or replace failed mechanical components.
34. Upgrade from pneumatic to DDC controls.
35. Put the fans in automatic control and schedule equipment to turn off/on in an aggressive manner. Interface fans to existing ES-USA DDC control panel for automatic control via new control relays. Existing occupancy is 24 hours per day/7 days per week operations. Implement an aggressive schedule (6 am to 6 pm, Monday through Friday). For weekends, add an override switch input, to directly start the fan system. The override switch should be of a 1 to 6 hour, time delay design. This will allow timed overrides, without providing continuous override (in case the occupant fails to return the override switch to a normal condition). It is estimated that hours of runtime would drop from 8,760 hours per year to approximately 4,200 hours per year. This equals approximately 4,500 hours of reduced equipment operations. The fan system consumes approximately 10 kW of power. This equates to 10 kW x 4,500 hours = 45,000 kWh of energy savings. This equates to over $6,000 saved (@ $0.15/kWh) or over $12,000 saved (@ $0.28/kWh).
36. Turn off the gas-fired hot water system (pumps), when the outside air temperature is above 65° F. If the boiler can be turned off, this will also save energy, but it is not likely, if the domestic hot water system must be maintained. The hot water system pumps hot water to zone reheat coils. If the heating coil control valves leak or are not properly controlled, they will allow hot water to enter the coil, heating the air stream, which adds significant load to the mechanical cooling system and also causes comfort problems (too hot). There should be little to no need for hot water heat, once outside air conditions exceed 65 degrees F.
37. Turn down the domestic hot water temperature and save gas energy and reduce risk to staff from scalding hot water at showers/sinks.

Building 2378 Maintenance Hangar

- Lighting – T-8 lamps throughout. Pneumatic controls throughout are in very poor condition.
- Economizer controls on two rooftop units are not working – shot! AC-2 static pressure control of inlet vanes is disconnected. Inlet vanes were placed in wide open position on supply fan, causing excessive noise on supply fan.
- Both chilled water pumps are running, but the chiller is not on. The chilled water automatic air vent for AC-2 is continually leaking.
- All fan loads run continuously because there is no manual control. This indicates that automatic control functions are not working or are not relied upon.
- Strong smell of fumes/solvents exists in east stairwell!
- Exhaust fan 7 on east roof is off at disconnect and on/off switch.
- New heat pump above shop has very dirty coils and evaporator line is iced up all the way back from heat pump unit to the evaporator coil. Room being served (machine shop) has thermostat setting adjusted down to 55° F, but it is over 75° F.
- AH-1 in shop area is in manual control and economizer does not appear to be working.

Domestic hot water tank is set for 150° F.

- Heating hot water boiler is running at 170° F.

<u>Energy Efficiency Improvement Opportunities</u>

38. Fix or replace economizer controls on AC-2, AC-6 and AH-1.
39. Put the fans in automatic control by adding hand-off-auto switches to all fan and pump starters and schedule equipment to turn off/on in a more aggressive manner. Interface fans to new ES-USA DDC control panel via new control relays. Existing occupancy is 4 am until 1 am, Monday through Friday. Consider modifying this schedule to be 6 am to 11 pm, Monday through Friday. For weekends, add an override switch input to directly start the fan system. The override switch should be of a 1 to 6 hour, time delay design. This will allow timed overrides, without providing continuous override (in case the occupant fails to return the override switch to a normal condition). It is estimated that hours of runtime would drop from 8,760 hours per year to approximately 5,500 hours per year. This equals approximately 3,000 hours of reduced equipment operations. Each fan system consumes approximately 7.5 kW of power. There are two fan systems, so this equates to 15 kW x 3,000 hours = 45,000 kWh of energy savings. This equates to over $7,000 saved (@ $0.15/kWh), or over $13,000 saved (@ $0.28/kWh)..
40. Change override switches in the hangar bays to timer design, to ensure that they are not left in override continuously.
41. Turn off chilled water pumps at disconnect, or hand-off-auto switch, during the winter season to save energy. The pumps consume approximately 2 kW of power. If the winter season runs from November 1 until February 28, this represents an opportunity to save 120 days of pump power, or approximately 5,000 kWh of power. This equates to $750 savings (@ $0.15/kWh), or over $1,300 saved (@ $0.28/kWh).
42. Fix pneumatic controllers or update controls to ES-USA DDC.
43. Update HVAC system design from multi-zone to VAV for the two roof multi-zone units.

Building 23123 MCAS Station Headquarters

- Lighting – T-8 lamps throughout. Occupancy sensors throughout offices – not in bathrooms.
- Multi-zone fan serves main office and runs continuously, but could be programmed to have daily schedule with weekends off. This indicates that ownership has not yet filtered down to MCAS staff.
- Multi-zone fan has two cooling coils. One is located in outside air intake stream and is full of dirt/debris. Economizer controls are not working or integrated to ES-USA DDC system.
- Multi-zone serves nine zones with gas-fired reheat. Controls for reheat are standalone and not integrated to ES-USA DDC.
- ES-USA DDC controls have enabled both heating and cooling. This contradicts the sequence of operations statement that either heating or cooling will be enabled. Simultaneous heating and cooling is not efficient.
- Sequence of operations on ES-USA drawings indicates that the ventilation systems will be on a schedule. They do not appear to be turning off at night.
- ES-USA drawings show return air sensor, but field walkthrough identified it as being in the outside air intake. The local energy management workstation connected to 23123 DDC system shows the

outside air temperature reading of 45° F. This indicates that either the system was not programmed correctly, the sensor is not wired correctly, or is located in the wrong location.

Energy Efficiency Improvement Opportunities

44. Fix or replace economizer controls on the main office multi-zone system. The ES-USA DDC controller has spare analog output capability that could be used to drive a compatible damper actuator. The economizer controls should be set up to take advantage of the free cooling, versus use of electrical mechanical cooling.
45. Put the fans on a schedule using the existing ES-USA DDC controls and ensure that the schedule is aggressive (6 am to 6 pm, Monday through Friday). For weekends, add an override switch input to directly start the fan system. The override switch should be of a 1 tp 6 hour, time delay design. This will allow timed overrides, without providing continuous override (in case the occupant fails to return the override switch to a normal condition). It is estimated that hours of runtime would drop from 8,760 hours per year to approximately 4,200 hours per year. This equals approximately 4,500 hours of reduced equipment operations. The fan system consumes approximately 4 kW of power. This equates to 4 kW x 4,500 hours = 18,000 kWh of energy savings. This equates to over $2,500 saved (@ $0.15/kWh), or over $5,000 saved (@ $0.28/kWh).
46. Clean cooling coils and dust stops because they are full of debris and causing significant fan energy loss and cooling inefficiency, leading to additional energy required to cool the spaces.
47. Fix the noted discrepancies above for the DDC instrumentation. If this is under warranty, this should be a no-cost improvement.

Building 23195 FREST Training

- Lighting – T-8 lamps throughout. Occupancy sensors – not in the bathrooms.
- Three rooftop carrier VAV fan air handlers serve the main office and run continuously. Air handlers have Toshiba inverter variable frequency drives; they work in a standalone mode with local pressure sensors inputting to the drives.
- The economizer controls are not intelligent and are not taking advantage of free outside air cooling because the dampers are all closed while building is warm and calling for mechanical cooling. Also, the windows on several rooms and several floors for both sides of the building are open, indicating that spaces are not properly controlled.
- Zone controls are Siebe VAV controllers.
- There does not appear to be any interface from the zone controllers to the air handler controllers.
- Rooftop unit has gas-fired heaters, which requires maximum flow during heat mode; however, it is not clear if the fans are" intelligent."
- One fan apparently was in heat mode, as the combustion blower was running.
- Controls for first floor electrical room are not wired to activate exhaust fan.

Energy Efficiency Improvement Opportunities

48. Update controls on the three fan systems and the numerous classroom VAV controllers to interface to existing ES-USA DDC Lonworks protocol so this building can be remotely controlled and monitored. Update with intelligent controls for the three rooftop air handlers, for mechanical

cooling, economizer controls, supply static pressure and return fan/building static pressure controls. The economizer controls should be set up to take advantage of the free cooling as they currently are not operating correctly (re-circulating air, when 100% outside air should be utilized).

49. The three rooftop air handlers currently are on 24 hours per day/7 days per week operation. Put the fans on a schedule using the existing DDC controls, or add the necessary control relays via existing ES-USA DDC control panel located in the second floor electrical room. Ensure that the schedule is aggressive (6 am to 6 pm, Monday through Friday only). For weekends, add an override switch input to directly start the fan system. The override switch should be of a 1 to 6 hour, time delay design. This will allow timed overrides without providing continuous override (in case the occupant fails to return the override switch to a normal condition). It is estimated that hours of runtime would drop from 8,760 hours per year to approximately 4,200 hours per year. This equals approximately 4,500 hours of reduced equipment operations. Each fan system consumes approximately 10 kW of power. There are three fan systems, so this equates to 30 kW x 4,500 hours = 135,000 kWh of energy savings. This equates to over $20,000 saved (@ $0.15/kWh), or over $40,000 saved (@ $0.28/kWh).
50. The controls need to be improved to allow the VAV zone controllers to know if the fan is in heat or cool mode, or vice-versa (have the VAV zone controllers drive the fan system to provide heat or cooling on a demand calculation basis).

Building 23169 Military Police Bldg

- Lighting – Three tube/four-foot T-8 Lamps
- Honeywell Thermostat Set for 70° F heat/72° F cool

<u>Energy Efficiency Improvement Opportunities</u>

Replace the existing thermostat with a programmable thermostat for night setback options and wider dead-band between heat/cool.

General ideas for MCAS

- Segregate MCAS DDC from main base UNITY system. This will require a MCAS strategic DDC plan to outline technical staff resource(s) and training of those resources. A paradigm shift must take place to embrace the DDC system as a tool that needs to be utilized, maintained, and developed to the fullest extent possible. The payback will come in energy and maintenance savings, if ownership of the DDC in each building is at the heart of MCAS facility operations policy. Otherwise, efforts will be wasted.
- Implement solar technology. The new emerging projects (2397 Building, etc.) should incorporate solar heating for domestic hot water. This helps isolate gas-fired HVAC heating from domestic loads.
- Implement fuel-cell technology. Considering the amount and extent of gas piping to all the buildings, these types of projects should also be considered in new or existing facility upgrades. The high cost of power and relatively easy access to natural gas makes fuel-cells a prime candidate for consideration.
- Emergency power generators. Recommend using more proactively, if they are designed to run for significant lengths of time. This will help offset summer peak demands.

- Actively pursue gas metering. All the buildings have gas meters with analog display for totalized consumption. These can be read weekly or monthly and entered into the MCAS metered database (along with water, etc.). This database can be used by the software tool, Facility Resources and Energy Data (FRED), or a similar process to alert staff to excess gas usage, which would be indicative of maintenance issues (failed heating valves, leaking valves, coils, etc.) and the potential for contributing to other excess energy waste in the buildings. Several gas meters already have pulse output capability and should be incorporated into the MCAS metering project being funded by SDGE, with JCI/ES-USA performing the work.
- Recommend that the SDGE project to upgrade the water/well pumping monitoring and controls include pump status for each of the well pumps on MCAS. This should also include totalized run time on each well pump. This would allow for extrapolating kWh consumption, based upon the hours of run time and measured well pump amperage draw. This is not 100% accurate for metering, but is much better than no metering and is very quick and easy to implement (no/low cost).
- Implement better use of free daylight, especially in the hangar high bays and warehouse areas, where skylights and large door openings exist.

Appendix F

California Public Benefits Programs

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California Public Benefits Programs

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May 2001

California Survival Strategies: Taking Advantage of Programs that Promote Energy Efficiency and Peak Demand Savings

The State of California is responding to the continuing electricity crisis with an increasing array of programs designed to encourage electricity end users to improve the energy efficiency of their operations, shift load away from peak periods, and expand the use of onsite (or distributed) generation. A number of new programs have been announced; this article updates the April 2001 newsletter and focuses on those new opportunities that are most applicable to Federal agencies.

California 20/20 Rebate Program

The California 20/20 Rebate program was initiated by the Governor's office through Executive Order D-30-01 and will be administered by PG&E, SCE, and SDG&E. In Resolution E-3773, the CPUC directs PG&E, SCE, and SDG&E to file tariffs by May 8, 2001 implementing the final design and implementation proposed by the state Department of Water Resources; parties will have only eight days to comment. As proposed by DWR and the utilities, the program will offer rebates to bundled service customers of PG&E, SCE, and SDG&E that reduce their electricity consumption each month during the period June 1 – September 30, 2001 by a minimum of 20% as compared to the same month last year. For customers on time of use rate schedules (mainly customers with peak demand greater than 500 kW), their consumption during the summer peak period hours (e.g., typically noon to 6 P.M. during weekdays) will only be considered. For all other customers, their total consumption will be considered. Those customers who are able to achieve the required reductions will receive a 20% rebate on their electric bills, on top of the normal reductions associated with the reduced consumption. For customers on time of use schedules, they will receive a rebate equal to 20% of their Peak Energy and Peak Demand Charges. As the program is currently designed, no partial credit is available and there will be no greater benefits for reductions above 20%. Unlike some programs that do not allow participants to benefit from other programs, participation in the 20/20 program will not expressly limit participation in any of the other programs described in this article.

In addition to the 20/20 program, Federal customers (and all end users) in California are confronted by an array of demand side programs that can be divided into three major categories: (1) energy efficiency programs, (2) demand response/load management programs, and (3) distributed generation programs.

Figure 1 presents a map of the prevailing landscape of programs and program administrators.

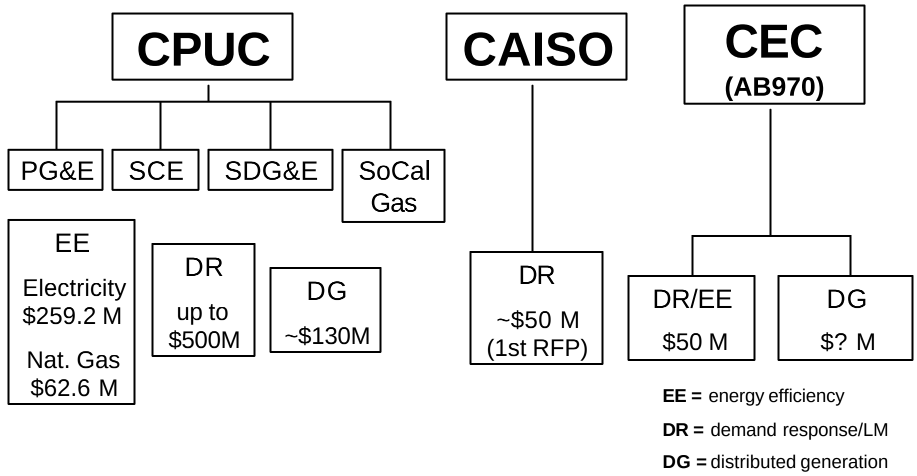

Figure 1: California's Demand-Side Programs: Administration & Funding

As shown in this figure, the California Independent System Operator (CAISO) and the California Energy Commission (CEC) both administer programs directly. The California Public Utilities Commission (CPUC) oversees the four investor-owned utilities (IOUs) who each administer a variety of programs. In addition, each of the municipal utilities in the state has public benefits programs of their own design and administration (not shown).

Energy Efficiency Programs

Table 1 includes summary information on California's energy efficiency programs. Programs that may be of particular interest to Federal customers include the statewide Standard Performance Contract, the Express Efficiency program, the Savings By Design program, and various "third party initiatives". See the April 2001 article for details.

Load Management/Demand Response Programs

Table 2 includes summary information on California's load management and demand response programs. The California ISO has developed several demand response programs in order to minimize the need for involuntary rotating blackouts. The Discretionary Load Curtailment Program (DLCP) offers $0.35/kWh payments for reduced consumption that is scheduled with the ISO on a day-ahead or same-day basis. The program is available all year to December 31, 2001. The Demand Relief program for loads without back-up generation (DRP-LOAD) is currently closed to new bids. Region 9 of the General Services Administration participated in this program by signing a contract for ~1.2 MW of savings through innovative demand limiting strategies at four GSA buildings. Bids for a second Request For Bids for this program were due on May 1, 2001. An RFP for Demand Relief utilizing Back-Up Generation (DR-BUG) was issued on 3 April, but then withdrawn on 5 April. Critical air quality issues have not yet been resolved with the state and Air Quality Management Districts. Details on all these programs can be found at: http://www.caiso.com/clientserv/load/.

Following a CPUC order, California IOUs are offering the following DR programs: the Voluntary Demand Response Program (VDRP), a set of curtailable/interruptible programs, including non-firm rates, the Base Interruptible Program (BIP) and the Optional Binding Mandatory Curtailment program (OBMC), and Direct Load Control programs. The VDRP will function as follows; the utility solicits bids from customers when the ISO notifies the utility of the need for demand relief. The customer offers kW (minimum 100kW) reductions for specified hours (2 hr min, 4 hr max). Within several hours, the utility either accepts or rejects the bid. If accepted, the customer is paid for performance at $0.35/kWh demand reduced, when compared to a baseline of the average hourly usage during the immediate 10 similar days (non-event). New participants receive interval meters and communication equipment without charge, provided they stay in the program for a minimum of 1 year, and respond to 10 events.

The Base Interruptible Program offers customers an incentive of $7 per kW-month credit on their bill if they can commit to curtail 15% of their load, with a minimum drop of 100 kW per event when called by the utility. In this program, the utility agrees to limit requests for demand curtailment to one four-hour event per day, ten events per month, and 120 hours per year. If customer fails to curtail, they will face a penalty of $6/kWh for all energy consumption in excess of their Firm Service Level.

The Optional Binding Mandatory Curtailment (OBMC) program exempts participating customers from Stage 3 rotating outages if the customer, or group of customers, reduce the absolute CIRCUIT load by 15% during system firm load reductions (i.e., concurrent with rotating outages) The load reductions are requested in 5% increments. The utilities will facilitate circuit aggregation. Program participants must pay for their own equipment, and receive no payments. The penalty for failure to reduce as requested is $6.00/kWh for energy use in excess of the baseline.

In AB970, the California Energy Commission (CEC) was authorized to administer a $50 million grant program to reduce electricity peak load. The program includes six elements and $49.0M has been awarded as of April 2001. Region 9 of the General Services Administration received a grant for $305,000 in the Demand-responsive HVAC and Lighting program area. In April 2001, with the passage of SBX5 and AB29X, the CEC received an additional $315 million of new funding. Program eligibility guidelines and timelines are currently under development. Federal customers are urged to consider applying in program elements where they are likely to be eligible: Demand-Responsive HVAC and Lighting Systems, Innovative Energy Efficiency and Renewables proposals, and Time of Use and Real-Time Metering. Program details can be found at: http://www.energy.ca.gov/peakload/index.html

Distributed Generation Programs

Table 3 below summarizes the key distributed generation programs. As can be seen, both the CEC and the CPUC have rebate programs available. The CPUC program is intended to be a companion program to the CEC program. So, for example, while the CEC might provide a subsidy of $3/watt for the installation of new photovoltaic (PV) systems, the CPUC would provide an additional $1.50/watt to a total of $4.50/watt or a maximum of 50% of total system costs. Given current IOU tariff structures, PV systems eligible for the full $4.50/watt support may be cost-effective energy supply options in certain applications, particularly for facilities located in San Diego. In addition, if reliability is of high value at a particular facility, some of the other technologies eligible for support under these programs may also be cost effective.

FEMP plans to continue to monitor and summarize the rapidly changing situation in California. Information on energy efficiency and demand response program opportunities available to Federal customers can be found on the FEMP restructuring web site (www.femp-restructuring.org) as well as special newsletters/articles on the California situation which will be distributed via email and at FUPWG meetings.

Table 1: California's 2001 Energy Efficiency Programs

Program Type	Key Programs of Interest	Administrator	Source of Funds	2001 Program Budget
Electric energy efficiency programs	- Standard Performance Contract (incentives for calculated/measured savings) - Express Efficiency (rebates, not available to large C/I customers in SDGE territory) - Savings By Design (new construction, incentives for designed efficiency in excess of Title 24) - Third Party Initiatives (respond to RFP)	Investor-owned utilities (IOUs) - PG&E, SCE, and SDG&E	Ratepayers via public benefits fund surcharge (~1.3 mills/kWh)	Total: $259.2M PGE: $156M SCE: $90M SDGE: $32.6M
Natural gas energy efficiency programs	- Standard Performance Contract (incentives for delivered savings) - Express Efficiency (rebates) - Savings By Design (new construction) - Third Party Initiatives (respond to RFP)	Investor-owned utilities (IOUs) - PG&E, SoCal Gas, and SDG&E	Bundled gas rates, set in rate case	Total: $62.6 M PGE: $20.9 SDGE: $8.9 SoCalGas: $32.6M
Energy efficiency programs	Programs vary by utility LADWP: Lighting = $400/peak kW reduced & $4 credit per 50kWh reduced from last year SMUD: Low-interest financing	Municipal utilities (e.g., SMUD, LADWP, many other small utilities)	Bundled in rates; funding floor level set by restructuring legislation	~100M*

Note: Municipal utilities have discretion to spend public benefits funds on energy efficiency, low-income programs, or renewables.

Table 2: California's 2001 Demand Response Programs

Key Programs of Interest	Administrator	Payment Scheme
Demand Response Programs (DRP) - Discretionary Load Curtailment Program (DLCP) - Demand Relief Program w/o Back-Up Generation (DR-LOAD) – closed - Demand Relief w/ Back-Up Generation (DR-BUG) – not yet approved	California Independent System Operator (ISO)	- $0.35/kWh - $20,000 per MW-month; and - $0.50/kWh
Voluntary Demand Response Program (VDRP)	IOUs	- $0.35/kWh
Utility Curtailable/ Interruptible Programs - Existing Non-Firm Rates - Base Interruptible Program (BIP) - Optional Binding Mandatory Curtailment (OBMC)	IOUs	- ~15% rate discount - $7 per kW-month credit on bill - No payments
Direct Load Control	IOUs	- varies by utility
Peak Load Efficiency Grant Program - Demand responsive HVAC and Lighting Systems - Innovative Proposals - Time of Use and Real Time Metering - Cool Communities and Cool Roofs	CEC	New funding (SBX5) - $35 M - $50 M - $50M - $35M

Table 3: California's 2001 Distributed Generation Programs

Key Technologies	4.3 Administrator	Program Budget	Payment Scheme
PV, Solar Thermal, Wind (< 10kW), Fuel Cell	**5 CEC**	$20M/yr x 4yrs	$3.00/W, not to exceed 50% of project cost
Tier 1: PV, Wind (30kW- 1MW), Fuel Cells (renewable fuel) Tier 2: Fuel Cells (any fuel + heat recovery)<1MW Tier 3: Microturbines, IC engines (both with heat recovery) <1MW	IOUs- (PG&E, SoCal Gas, and SDG&E)	$125 M/yr x 4yr	Tier 1: $4.50/W, not to exceed 50% of project cost Tier 2: $2.50/W not to exceed 40% of project cost Tier 3: $1.00/W not to exceed 30% of project cost
PV	LADWP SMUD	NA NA	LADWP: Up to $5.00/W for systems manufactured in LA, $3.00/W for systems from outside LA SMUD:

NOTE: = Not Available