DESIGNING AN ENVIRONMENTAL SHOWCASE: THE SAN FRANCISCO PRESIDIO*

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SYNOPSIS

The San Francisco Presidio is a major demonstration of innovative technological and financial strategies for energy efficiency and environmental sustainability.

ABSTRACT

The San Francisco Presidio is one of the most exciting environmental showcase projects in the U.S. today. However, shrinking government funding support and conflicting priorities across the various players makes it one of the most challenging as well. The Presidio is literally a city within a city, with buildings built before the Civil War located adjacent to modern laboratory facilities. Despite these challenges, the U.S. Department of Energy and the National Park Service are currently converting this former army base into a showcase of sustainable design. Our work to date has focused on both the technical and the financial aspects. On the technical side we have conducted energy audits, reviewed retrofit design strategies and renovation plans and recommended numerous strategies for energy-efficiency improvements, keeping within the constraints of historic preservation and often modest budgets. On the financial side we have successfully negotiated a ten-year pay-for-measured-performance contract with the local utility's DSM program. Towards this goal we have been working to set up an energy savings performance contract that will create partnerships with the private sector in project implementation. The importance of the Presidio project is that it not only will be a large scale model for other public and private sector activities, but it will also have high-visibility, with over eight million visitors per year.

BACKGROUND: WHY MAKE THE PRESIDIO AN ENVIRONMENTAL SHOWCASE?

On October 1, 1994, the Presidio of San Francisco transferred from the U.S. Army to the National Park Service (NPS). In addition to becoming one of the nation's most spectacular parklands (Figure 1), the Presidio will be a global environmental center. With 800 buildings, including research facilities, offices, conference facilities and 1,200 units of housing, the Presidio will be a working laboratory, showcasing principles of sustainability in building renovation and operation. More than 8 million visitors to the Presidio are anticipated each year, enabling information transfer on energy efficiency and environmental sustainability on an unprecedented scale. Moreover, the efficient re-use of this former military installation can serve as a model for "greening" other federal facilities.

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[Figure 1 goes here]

The greening of the Presidio embraces a wide range of environmental issues, including efficient use of water, waste management and transportation and community development. In this report we focus on the energy aspects of the buildings, specifically the technical and educational opportunities for renewable energy and energy efficiency and the financial strategies to implement them.

Description of the Presidio and the major energy challenges

All federal facilities are required by Executive Order 12902 to implement efficiency measures with payback periods of less than 10 years, and to reduce energy consumption by 30% or more. Fully occupied, the baseline energy cost at the Presidio is approximately $8 million per year. Based on preliminary analysis, potential savings of 40% or more in building energy use is considered feasible for this stock, so the Presidio represents a major opportunity for energy savings.

History and players

A grant from the Energy Foundation to the NPS in 1993 launched the development of an ambitious energy plan for the Presidio--a plan which not only supports the overall goals of sustainability for the park, but which will produce substantial cost savings to the federal government and tenant organizations. Early accomplishments included 1) the development of a long-range energy vision for the Presidio encompassing energy management, education, and research, development and demonstration efforts, and 2) the successful negotiation of a *Power Savings* contract with the local utility Pacific Gas & Electric (PG&E), through which the Park Service will receive up to $11 million over 10 years for measured energy savings.

In September 1994, a joint resolution calling for the *Greening of the Presidio* was signed by the U.S. Department of Energy (DOE) and the Department of the Interior (DOI), the parent department for the National Park Service. The two parties agreed to work together to establish the Presidio as a showcase of energy efficiency. The resolution specifically called on the DOE's Federal Energy Management Program (FEMP) to apply the technical resources from the national energy laboratories, and to collaborate to develop information and education materials. Further, FEMP has provided direct technical and financial assistance to help the Presidio achieve energy savings goals.

The primary objective of this joint effort has been to focus on the implementation of energy efficiency measures sufficient to meet the requirements of the utility demand side management (DSM) contract--a savings in non-residential buildings of 1.7 megawatts, 8 million kilowatt hours, and 800,000 therms per year. This contract will involve retrofitting fewer than half the existing buildings, thus the energy-saving measures for each targeted building will be extensive. Other objectives include the demonstrations of advanced technologies, and the development of a strong interpretive program to document the Greening of the Presidio.

Design Charrettes

Working in conjunction with the Greater Bay Area Chapter of the Association of Energy Engineers and historic preservation experts, the Presidio hosted a two-day Energy Efficiency Design Charrette in the Spring of 1994. Approximately fifty design professionals participated in this exercise. The objective of the charrette was to study approaches to maximizing energy sustainability while preserving historic integrity and improving the work environment. The focus of the design charrette was Building 102, a stately, 4000 m^2 (40,000 ft^2) brick building, currently used by the National Park Service as the park headquarters (Figure 2).

[Figure 2 goes here]

This regional event teamed people who do not typically work together, with each professional discipline learning from the others. Separate teams investigated the envelope, mechanical, control, and lighting options, however, integration of systems and disciplines was an important goal. Each team included industry leaders to provide vision and direction. In addition to the discipline-oriented teams, modeling, measurement, and presentation teams provided overall project support. In preparation for this project, Building 102 was instrumented by Lawrence Berkeley National Laboratory (LBNL) staff to collect and analyze energy consumption at an end-use level. All the participants in this event donated their effort.

A second charrette, focusing on environmental aspects beyond the energy issues of the first charrette was sponsored by FEMP and NPS and took place in October 1995. This effort was designed to develop sustainable practices for the Presidio and to present them as learning experiences (Figure 3). Six teams were formed to address the following areas: 1) Overall Site, 2) Waste Management/Source Reduction, 3) Residential/Historic Building, 4) Natural Habitat, 5) Non-residential/Historic Building, and 6) Transportation.

[Figure 3 goes here]

TECHNICAL ASSISTANCE ACTIVITIES

To achieve the DSM savings involves the completion of several technical assistance activities, including audits, working directly with the new tenant organizations and financing for the new energy improvements.

Audits

The high voltage distribution system at the Presidio was surveyed to determine where the most power was consumed and an assessment of the occupancy schedule was made for the individual buildings. Based on these prioritization surveys, an assessment was made to confirm the feasibility of meeting the goals of the DSM contract. Walk-through surveys were conducted of the highest priority buildings to develop opportunity matrices for establishing minimum tenant requirements.

More detailed facility audits were conducted for inclusion in the implementation plans submitted to PG&E. These submissions included plans for performance measurement and verification (M&V), as required for each project under the PG&E DSM contract. The audits will also serve as the basis for ESPC scopes of work.

Monitoring was installed on the GGNRA headquarters at Fort Mason for a two week period to establish baseline electricity usage. The comprehensive audit performed on this building revealed typical opportunities found at the Presidio:

1. Lighting fixture conversions to T8 lamps and electronic ballasts
2. Incandescent lighting fixture conversions to compact fluorescent and LED exit signs
3. Improved control or conversion to hot water radiators for the electric baseboard heating systems found in approximately 1/2 the building
4. Addition of attic and floor insulation
5. Replacement of windows with high efficiency windows
6. Repair of ventilation system
7. Lighting controls including occupancy sensors and photocell controls
8. Heating plant control upgrades
9. Boiler retrofits or replacements

The technical support for this work was provided by LBL, through FEMP, with assistance from a private consulting firm, Newcomb Anderson Associates, which had primary responsibility for the audits.

Design assistance activities

FEMP Design Assistance provides direct technical assistance services to federal projects to improve energy efficiency and incorporate renewable energy and water conservation elements into these projects. FEMP's goal for design assistance services is to cause new construction and major rehabilitation of Federal buildings to incorporate all cost effective energy efficient, water efficient and renewable technologies and design techniques at the earliest stages by influencing decisions during conceptual design and throughout the project. The Presidio's goal is that the retrofits of the historic buildings will combine energy efficiency and conservation while maintaining historic integrity (Figure 4).

[Figure 4 goes here]

Design Assistance has focused on the Letterman complex (including the Thoreau Center for Sustainability) and the main Post including the Golden Gate Club. These buildings either have large energy savings opportunities that will contribute to the DSM contract, or will serve as models for the rest of the retrofits at the Presidio.

The Letterman complex was the first area for NPS to receive leasing authority. The complex includes the Letterman Army Institute of Research (LAIR), the most energy intensive building at the Presidio, and the focus of the DSM contract. The complex is served by a central steam plant with a deteriorated distribution system, offering significant gas and maintenance savings opportunities. Replacement of the central plant with distributed boilers is the first major Presidio energy project. An indoor swimming pool in the Letterman complex offers a great opportunity to showcase fuel cells or other advanced micro-cogeneration technologies.

The historic Old Letterman Hospital will be the new home for the Thoreau Center for Sustainability, a “model” tenant for the Presidio, committed to demonstrating sustainable design

principles. The NPS will assure that energy efficiency is integrated with other projects and use the Letterman complex as a model throughout the Presidio.

Climate Specific Design. Technical assistance has included substantial input for a tenant information sheet regarding the climate and implications for energy systems design. Anyone living or working along the northern California coast is aware of the natural "air conditioning" built into the climate. The summer design temperatures on the Northern California coastline are extraordinarily low, falling into the free-cooling or ventilative cooling range (i.e., outdoor design temperatures significantly lower than comfortable space temperature)[1].

A sustainable facility would take advantage of these unique conditions, using natural ventilation as the sole cooling source in many applications, using forced ventilation to the greatest extent possible elsewhere, and considering other available "freecooling" sources for higher heat loads and more difficult design situations. Widely applicable ventilative cooling strategies taking advantage of the cool summer design conditions can have both low first cost and low operating cost.

Renewable energy opportunity assessment for the Presidio

The Presidio of San Francisco is replete with opportunities to create a model of sustainability by utilizing renewable energy. Historic examples of renewable energy at the Presidio include:

- buildings illuminated naturally by daylight through the numerous tall windows.
- natural ventilation provided by operable transom windows above doors and clerestory windows.
- transportation by foot, by bicycle, or by horse-drawn carriage
- ships powered by the wind.

Now, a new set of renewable energy and energy efficiency opportunities are available to the Presidio and the key players are keen on their deployment:

- The National Park Service has identified sustainable design, and renewable energy in particular, as consistent with the mission of conserving the country's natural resources.
- Much of the aged infrastructure of the energy consuming systems at the Presidio is in need of replacement, so the current conversion is a perfect time to make life-cycle cost-based decisions on what those replacements should be.
- Major tenants at the Presidio have sustainable design and renewable energy as their mission, and desire to "practice what they preach" by having renewable energy technologies demonstrated in the buildings which they inhabit.

In order to assess the potential for using renewable sources of energy at the Presidio, staff from the National Renewable Energy Laboratory (NREL) conducted an assessment of renewables for the entire complex as well as detailed recommendations at the Thoreau Center for Sustainability (Building 1016). This building was chosen because it has the high profile required to showcase renewable energy and energy efficiency measures to the public and to other Presidio tenants.

Renewable energy measures were assessed using the Federal Renewable Energy Screening Assistant Software (FREScA). Renewable energy applications considered during the audit were biomass, wind, photovoltaics, daylighting, hydroelectric and solar water heating. As an example

of the audit approach we summarize three of the potential applications below. Not all of these applications have cost benefit ratios favorable under today's economic conditions. But as part of the Presidio's mission to promote educational aspects they are being considered as demonstration projects.

Solar water heating. As an office building, hot water use in Building 1016 (part of the Thoreau Center) is expected to be small. However, plans for the renovation include the provision of hot water, and a flat roof located directly above the restrooms on all three floors provides a perfect setting for solar water heating.

Photovoltaics. There are several cost-effective applications of photovoltaics (PV) at the Presidio in small, independent applications such as path lighting. A larger, more visible PV system on Building 1016 would be primarily for demonstrating building-integrated photovoltaics. In this application, the photovoltaic devices will be integrated into the roof over the enclosed front entrance, which is scheduled to be replaced. This roof is a good site for the demonstration of building-integrated photovoltaics because it is unshaded on the south side of the building and because 200,000 people per year are expected to pass through the entryway, providing an excellent opportunity for public contact. The installation is not cost effective with current non-mature market PV system costs, but it will be a visible demonstration of sustainable design.

Another application of photovoltaics near Building 1016 is for charging electric vehicles (Figure 5). The photovoltaics would be mounted in front of the building on the south side of the north-facing parking barrier. The panels would be high enough to allow grass trimming underneath, but low enough so that the upper edge of the PV array did not rise above the hood of parked cars.

[Figure 5 goes here]

Daylighting. As an historic building, Building 1016 was constructed with large windows and high ceilings to let light in and to distribute it in open plan offices. Indeed, daylight coming in the windows was the main source of light in the building in its early years. Only after the widespread use of electric lighting systems and cheap energy was the space divided into private offices, each cut off by partitions from natural light. In restoring the historic conditions, there was an opportunity to, once again, use daylight as the primary light source. In order to realize energy savings however, the artificial light sources should be automatically controlled to dim the lights (or turn off circuits) when the daylight is available. *FREScA* estimates that such controls would add $23,500 to the cost of building rehabilitation and would save 34,904 kWh per year. The resulting savings-to-investment ratio would be 2.2 and the discounted payback period would be 11 years.

The Showcase Building at the Presidio

FEMP's *Showcase Program* falls under Section 307 of Executive Order 12902, which details energy efficiency and water conservation in federal facilities. Each federal agency is charged with designating at least one building to be a showcase to highlight energy or water efficiency. Criteria for selection include buildings with high levels of nonfederal visitors, historic significance and a likelihood that visitors will learn from displays and implement similar projects. The Golden Gate Club is targeted as a showcase building. This building will serve as

one of the primary conference and workshop centers at the Presidio and will therefore be highly visible to an international audience.

The first step for any building design, including this showcase building, is a careful analysis of the specific climate of the Presidio. At the entrance of the Golden Gate, the climate is substantially cooler even than that of downtown San Francisco[2].

Climate analysis was coupled with more specific programmatic design requirements including specification by the NPS of a 5% exceedence level for cooling design. Commonly available design weather data corresponds to exceedence levels of 1%, 2.5 %, or 5%[3]. Design data is established with a range of exceedence levels to "...enable the engineer to match the risk level desired for the problem at hand" (ASHRAE 1993). This is in recognition of the impracticality of providing HVAC systems which are capable of meeting all loads under all weather conditions that could be encountered over their lifetime (ASHRAE 1995).

The NPS chose this criteria for a number of reasons including overall conservation, the preponderance of high mass structures with slower thermal swings[4], and an overall desire to have the occupants more in tune with the building and the outdoors. Careful analysis here has established design parameters that greatly reduce the tendency for over design.

The Golden Gate Club provided the opportunity for improvement in the performance of the envelope since the roof diaphragm required additional seismic sheathing. Our analysis determined the most cost-effective insulation upgrade to be rigid insulation on top of the roof decking. This measure also preserved the existing finished wood decking at the ceiling.

The largest energy efficiency savings were in the mechanical systems. The existing hot water baseboard heat system will be reconditioned and new piping, boilers, and energy management controls are being installed. These measures will allow the NPS to control the heating to match the highly variable occupancy of the conference center. Basement breakout rooms required the only compression-cycle air-conditioning, with small two-ton units serving each room. Careful evaluation of peak design conditions and loading reduced the size (and first cost) of these units considerably from initial design.

Natural ventilation was enhanced in the main ballroom through supply of outside ventilation air along the baseboard of the south wall. Existing high louver windows along the north wall will be opened, allowing ventilation air to be supplied low and exhausted high, across the ballroom.

Elevators, particularly electric motor, hydraulic piston driven elevators, can be a major peak electrical load. With implementation of accessibility requirements for the structures at the Presidio, the NPS conducted an in-depth evaluation of elevator technologies. New roped hydraulic technology will be far more energy efficient and will eliminate elevator pits containing up to 200 gallons of hydraulic fluid in the ground. The NPS anticipates application of this technology in forthcoming projects, although it is not ready for use at the Golden Gate Club.

Lighting rehab implemented current best practices. In addition, historic fixtures will be reconstructed to incorporate compact fluorescent lamps--thereby preserving the important character-defining feature of these fixtures while saving 75% of the energy consumed.

To guide architects and tenants in their design work for the Golden Gate Club and other buildings, the NPS developed the *Guidelines for Rehabilitating Buildings at the Presidio of San Francisco* (NPS 1995). This document illustrates how concerns for historic preservation can be synergistic with sustainable energy performance. For example, natural ventilation and cooling through operable windows is considered to be part of the inherent historical character of the spaces.

With construction started in October of 1995 and scheduled to be complete in June of 1996, this project will be a timely, highly visible example of sustainable, energy-efficient building rehabilitation.

New Technologies Demonstrations

FEMP's *New Technology Demonstration Program* evaluates new, cost effective, energy efficient, U.S.-manufactured technologies and shares results with federal design and procurement communities. The Presidio has the potential to serve as a federal site for new technology demonstrations through the program. In addition, the Presidio may serve as a site for other technology demonstrations identified by FEMP, but carried out by others, such as industry participants.

To date, LBL and NREL have evaluated and provided support relative to several potential technology demonstrations, including:

1. Ultra-low ambient lighting with high-efficiency task lights.
2. A photovoltaic (solar) electric vehicle charging station.
3. Architecturally integrated solar electric canopy.
4. Advanced daylighting techniques incorporating historic preservation needs.

Working with the new tenants of the Presidio

One of the major transitions at the Presidio is the change from a single tenant to multiple new tenants. In order to ensure that the new tenants are meeting energy-efficiency objectives, minimum tenant improvement requirements and implementation procedures are being established for the tenant-occupied spaces at the Presidio (the majority of the buildings). Specific language on energy issues is being developed for leases and other applicable contractual mechanisms to establish roles and responsibilities between NPS and tenants.

FINANCIAL ASSISTANCE ACTIVITIES

Several financial strategies are being pursued to provide funding for the energy and environmental changes to the Presidio. The principle financial strategies include the utility DSM program, the Federal Energy Efficiency Fund (FEEF), direct funding (NPS or tenant), and Energy Savings Performance Contracts. In addition, technical assistance is helping to lower up-front redevelopment costs together with operating costs through improved energy system design. Each of these activities involves a different set of players and activities that need to be coordinated with the other activities currently underway at the Presidio.

Demand-Side Management funding

With financial assistance from the Energy Foundation, NPS successfully competed for, and negotiated a demand side management (DSM) contract with the local utility (PG&E). Under this innovative partnership, PG&E will pay NPS for measured energy savings over a ten-year period.

This program, known as the *Power Saving Partnership*, was initiated through the California Collaborative process and was California's first endeavor to have utility companies procure conservation (or DSM) through a competitive-bidding process. The *Power Saving Partnership* program will test the hypothesis that reliable and measurable demand side management (savings) can be procured at lower cost than supply side options. The maximum payments for energy savings under this program are based on the marginal cost of new capacity over the ten-year contract period. This innovative partnership with PG&E was designed to overcome barriers to conservation in the federal sector, as well as the lack of energy efficiency incentives in non-owner occupied property.

To meet the requirements of the DSM contract, all measures must be installed by October 1, 1997 (although the buildings need not be occupied). The level of investment required indicates that an Energy Savings Performance Contract (ESPC), which will leverage federal dollars with private financing, is the best option for installing these measures. The ESPC will extend beyond the ten-year period of the DSM contract and provide a vehicle for further savings for NPS.

Successful implementation of the *Power Saving Partnership* will reduce the Presidio's non-residential energy consumption by 20%. The contracted power savings is for 1,700 kW, with electricity savings of 8,000,000 kWh/year and gas savings of 790,251 therms/year. The contract allows payment up to 130% of these targets. Payments are tiered, based on annual performance. Under the DSM contract, the payments for power savings steadily increase through the ten-year contract period, with the starting and ending values for power set at $40 to $80 per kW, $0.04 to $0.12 per kWh and $0.28 to $0.60 per therm.

The project will involve the retrofit of approximately one half of the building area, so that the savings will be significant, e.g., 40% and average payback will exceed five years. Typical measures include lighting fixture upgrades, lighting controls, HVAC upgrades and building automation.

The estimated work is split evenly between the lighting and non-lighting retrofits. Over half of the lighting cost will be for fixture retrofits including T-8 conversions, solid state ballasts, exit sign upgrades, and HID and fluorescent conversions. The remaining lighting retrofits will involve controls such as occupancy sensors and photocells. The combination of fixture and control retrofits will assure deep cuts, on the order of 60%. Non-lighting retrofits will focus on controls including energy monitoring and control systems (EMCS), adjustable-speed drives, conversion from constant to variable-air-volume (VAV) systems and conversion of central plant heating systems to distributed systems in individual buildings. The estimated cost for measurement and verification (M&V) is approximately 10% of the implementation cost. We believe that M&V can be a cost-effective component of a comprehensive energy management program--not just the satisfaction of a regulatory requirement.

Federal Energy Efficiency Fund

The Federal Energy Efficiency Fund (FEEF) provided grants to federal agencies to help them meet the energy efficiency and water conservation requirements of the National Energy Conservation Policy Act (NECPA). It was anticipated that the majority of direct FEMP support for the Greening of the Presidio would come through the Fund, however, budget limitations have restricted funding to one Presidio project. This project was designed to significantly leverage federal funding through the development of an energy savings performance contract (see below). This project received a $175K grant at the end of 1995.

Direct funding

Direct funded projects will be financed by the NPS and Presidio tenants. This option yields the greatest life-cycle cost value, and can be the fastest to implement, however, funding is limited. Direct funding in 1995 of energy-efficiency related projects totaled close to $2 million (primarily in the Letterman complex).

Energy Savings Performance Contract (ESPC)

Private sector energy service companies (ESCOs) can provide financing for energy efficiency projects in exchange for a negotiated share of the savings. Contract development and contract administration responsibilities remain with the government. An ESPC requires a strong agency champion and cooperation from the procurement staff.

A request for proposals (RFP) is issued by the government to prospective energy service companies (ESCOs). The ESCOs respond with proposals covering their technical approach, experience, pricing, and financing. One or more ESCOs can be selected for negotiations. The negotiations can focus on specific buildings or on "unit pricing" under an indefinite quantities contract. The ESCO is then tasked to develop specific retrofit proposals for specific government selected facilities. Each project involves some level of negotiations (scope, schedule, and pricing). The government is not obligated to accept project proposals.

Once a project proposal is accepted, the ESCO implements the project subject to further design and construction review by the government. Payments are made to the ESCO from utility and related maintenance savings. Financing terms can extend up to 25 years, but are often less. In the case of the Presidio, the ESCO will be required, as a minimum, to meet the requirements of the PG&E DSM contract. Further, obligations under the contract (i.e., for payment) may be transferred to the tenants. The contract(s) should allow for the buyout of individual projects if the government or tenant choose to fund the project(s) directly. In some cases, the ESCO may propose projects pending the leasing of a building and the approval by the new tenant, or in some cases improvements may be made prior to leasing. This type of "fast tracking" may be needed to meet the schedule requirements of the DSM contract (and may make the buildings more attractive to potential tenants).

Baseline development (the basis on which savings are calculated and payments are made) is a major issue, especially at the Presidio, where comprehensive retrofits are desired, and building use is changing. The performance measurement and verification protocols set forth in the DSM contract must be incorporated into the ESPC requirements. Under an ESPC, the ESCO is

responsible for technical performance, however, the baseline is generally adjusted for changes beyond the ESCOs control.

FEMP (including LBL and NREL) is actively working with NPS to help achieve an innovative indefinite quantities ESPC. FEMP has provided briefings to NPS management and real estate personnel, and more comprehensive training to technical and contracting personnel. Technical assistance is being provided on all aspects of the contract.

FUTURE WORK AT THE PRESIDIO

Work at the Presidio is progressing on several fronts. In addition to the continued technical support for audits and retrofits, measurement and verification will play an important role in the implementation of the DSM contract, as well as to establish baselines and measure energy savings performance under the anticipated ESPC. The Presidio will be also be used as a testing and demonstration site for the new National M&V Standards.

A key component of the Presidio's role as an environmental showcase will be the energy education, training, and technology transfer activities that will increase in importance with the increase in sustainable activities at the Presidio. In partnership with tenants and local groups, the Presidio will become an international showplace and learning center for sustainable design.

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ENDNOTES

1) With the exception of the Northern California coastline, such "freecooling" conditions are not common anywhere near sea level and at low latitudes (less than 43 degrees).

2) The region around the San Francisco Bay Area has been described as having the largest temperature ranges across a given geographical distance of any location in the world. A 17^{o} F difference for the 2.5% summer design condition exists between two sites only 18 miles apart, the Presidio and the Oakland Navy/Veterans Hospital. In this case, an armed forces engineering design reference (Air Force, Army and Navy 1978) provides more specific and applicable location designations than commonly used design data references (ASHRAE 1982, ASHRAE 1993). Similar issues arise in the use of climate zone data for energy use modeling.

3) In practice, if the design loads are all concurrent, the indoor thermal environmental design requirements may not be met during a number of hours equivalent to the design weather data exceedence percentage representing excursions from the design conditions (ASHRAE 1995). In

this case, the percentages are based on a four-month period from June to September, with 2.5% corresponding to 73 hours.

4) The effect of the additional thermal mass will not otherwise be accounted for in common HVAC design calculations.

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FIGURES

Figure 1. View of the San Francisco Presidio from the Golden Gate Bridge

Figure 2. Building 102

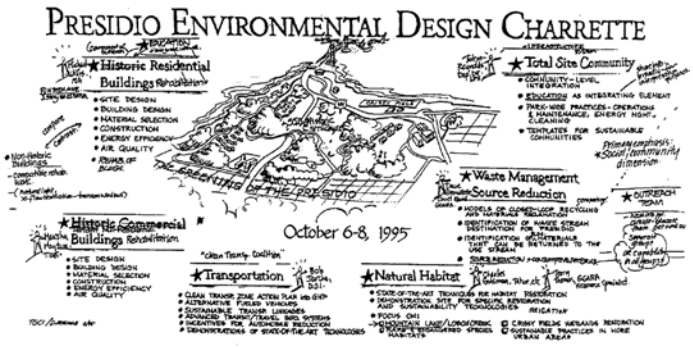

Figure 3. Notes from the Environmental Charrette

Figure 4. The Presidio has several thousand units of housing, including many historic structures.

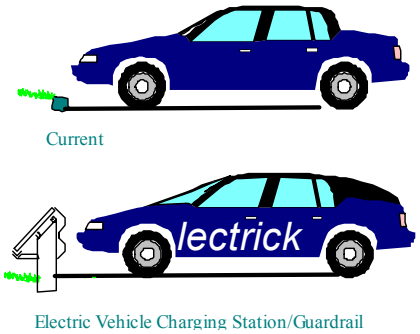

Figure 5. Presidio electric vehicle charging station low-profile guardrail concept