Example
Design Intent for an Existing Building:
Current Facilities Requirements

12/04/2003

IMPORTANT NOTICE
This sample document is provided for instructional purposes only. CCC is not rendering advice concerning any commission project or practices. This document is neither approved nor intended to serve as a standard form. The user of these documents should confer with qualified advisors with respect to its commissioning and other documentation.

ACKNOWLEDGEMENTS
This document is based upon work from the Corporate Real Estate Department of the Pacific Gas and Electric Company.

LEGAL NOTICE
This document was originally prepared by Pacific Gas and Electric Company for exclusive use by its employees and agents. Neither Pacific Gas and Electric Company nor any of its employees:
(1) makes any written or oral warranty, expressed or implied, including, but not limited to those concerning merchantability or fitness for a particular purpose;
(2) assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, process, method, or policy contained herein; or
(3) represents that its use would not infringe any privately owned rights, including, but not limited to, patents, trademarks, or copyrights.

© 2003 by Pacific Gas and Electric Company. All rights reserved.
(Company / Department)  
(City)  
Current Facility Requirements  
(Prepared prior to the start of a HVAC controls project)  
Current as of (date)  

Location & Directions  
(insert description of facility location and directions to location from major roadways)  
(insert map of facility)  

History  
The facility was built by (Company) and first occupied in 1971 to replace its predecessor, the (Name). The original Main Building included a standards lab, a chemistry lab, an electrical lab, a rock and soils test lab, a mechanical test high bay area, which contained both horizontal and vertical axis tensile testing equipment, and office space for approximately 110 people.  

The facility has undergone numerous changes and additions over the last 30 plus years. The Metallurgy Building, a two-story building to the north of the main building was added in 1982-3. It included a weld and NDE test high-bay area, a NDE inspection lab, a metal metallurgy test laboratory and a metallography lab with a scanning electron microscope and darkroom. Office space and parking was provided for approximately 30. A corrosion laboratory was added later and office space restacked.  

During 1987 and 1988 a large expansion project designed by (Architect) was undertaken in phases. Projects included:  
- Three laboratories were added to the rear (north) of the main building, a new electrical test lab, an environmental engineering lab and a vibration test lab  
- Existing space in the Chemistry Lab was upgraded to a full service PCB lab.  
- A second story office space was added to a portion of the mechanical test high-bay area.  
- A cafeteria was added to the front of the main building and the existing kitchen remodeled.  
- All office trailers and cargo boxes used for storage where removed from the site.  
- New storage space was added to the exterior of the warehouse with roll-up access doors.  
- The south end of the warehouse was also remodeled to provide office space for facilities staff up to 6.  

A security system with access gates was also installed about this time.  

Numerous minor upgrades and space restacks have taken place over the years. The most significant restack took place as part of the expansion project in 1987. Over the years, additional office and laboratory space has been obtained in adjacent independently owned complexes.
Objectives
Our current objective is to provide a full range of testing, analytical, and environmental services at its 14-acre site, as well as in field locations throughout the company for both internal and external clients in conjunction with meeting corporate needs. The current facility goal is to meet occupant needs while optimizing energy efficiency.

Functional Uses/Operational Capabilities
(Department) has over 150 engineers, scientists, and technicians who work in various areas providing specialized testing, analytical and environmental services essential for safe, reliable and cost effective utility generation, transmission and delivery. These include aquatic & terrestrial biology, air quality & acoustics, chemistry services, civil & mechanical engineering services, electrical testing, analysis & design, instrument calibration & repair, land & water quality management, metallurgy, corrosion & coatings, meteorology, non-destructive examinations, performance testing & analysis, radiation, and welding services.

In regard to technology evaluation, capabilities currently exist for additional testing related to:

1. Chemical concentrations
2. Corrosion
3. Efficiency
4. EMF
5. Emissions
6. Indoor Air Quality
7. Noise
8. Vibration
9. Alignment

Space requirements
Dedicated office and laboratory space, field equipment set-up spaces, and general meeting rooms dominate building space requirements. Space in the facility is also provided for a small cafeteria for 60 and kitchen; restrooms; telecommunications phone switches and network severs; records, equipment and materials storage; waste management; and shipping and receiving. Parking spaces surround the facility on three sides.

Special requirements
Special requirements include (examples):
- an accredited full service standards laboratory,
- a full service air quality and chemistry lab,
- a full service soils and rock test lab with an environmental chamber to store soils and rock samples,
- 2 darkrooms,
- a scanning electron microscope,
- a waste disposal storage locker,
- an electric vehicle charging station
- and a machine lathe.
Two dedicated compressed air systems, one in the basement and the other on the east end of the main building, serve most main building labs.

Emergency response
Portions of this facility are used as an emergency command center.

Indoor Environmental Quality Requirements
Provide optimum thermal comfort and indoor air, visual and sound quality in response to the varying facility activities while limiting occupant complaints and to maintain laboratory environmental conditions within required tolerances. Occupied conditioned spaces are to be stable year round and hot and cold drafts minimized. HVAC generated noise must not interfere with office or meeting room function. The number of comfort complaints from building users needs to be less than 1 per month. The HVAC control system must function properly, providing easily understood graphical information that allows staff to ascertain the status of comfort and systems in the facility. An HVAC caused failure to provide cooling must not occur. Office lights are to be off when rooms or building are unoccupied.

Temperature
The HVAC system is to maintain thermal comfort at all hours of occupancy. When occupied conditioned spaces should have a setpoint of between 69°F and 75°F year round to maintain a comfortable atmosphere for occupants and visitors. Office space must be comfortable at the time of morning occupancy. The Telecommunications Equipment Room must be kept below 70°F year around.

Lighting
Lighting must be energy efficient, consistent from space to space and standardized to limit inventory but versatile enough to enhance space functionality, which is impacted by varying space use and day and nighttime conditions. Local lighting controls must be easy to operate and occupancy sensors provided where applicable to minimize unnecessary lighting use. Lighting controls must eliminate the current need to turn off the numerous local circuit breakers as a manual lighting sweep.

IAQ
The use of outdoor air for cooling and ventilation should be maximized. Internally generated pollutants including odors from fume hoods, the kitchen, break rooms and restrooms, should be exhausted to the out of doors and not returned via the HVAC outdoor air inlets. In high density occupancy spaces CO₂ control should be used to improve energy efficiency.

Special Environmental Conditions
Standards Laboratory.
Physical: The floor space of the Standards Lab is about 1250 sq. ft. The ceiling height is about 8 ft. The ceiling is false and separates the room from an attic plenum, which is about 6 ft high, yielding an effective height of 14 ft. The volume of the air handler and ducting of the HVAC system is estimated at not more than 230 cu ft which calculates out
to a total volume of 17500 cu ft, which at 22 °C and 45% RH, holds 1300 lbs of dry air and 9 lbs of water.

Temperature Setpoint and Range: Maintain the temperature of the room @ 22 ± 2°C (68 °F to 75°F) 24 hours a day, seven days a week.

Humidity Setpoint and Range: The humidity of the room is currently maintained to 45% ± 10% RH, although special calibrations require work at less than 50% RH. A more preferred setpoint and range is 45% (+ 5% to - 10%) RH, 24 hours a day, seven days a week.

Homogeneity: The existing system has varied in temperature and humidity from the north end of the room to the south end (the long dimension) by up to 0.5 °C and 2% RH. The new system should not be any worse. Most of the work is carried out at a fairly uniform height; typically on bench tops 3 to 4 feet above the floor. To date, vertical stratification has not been a significant problem. We should avoid increasing any existing stratification.

Stability: Temperature should not change by more than ±0.1°C every 8 hours. Humidity should not change by more than ±1% RH every 8 hours.

Thermal Load: While 6 people normally work here, the design load is 8 plus a computer and an average of two instruments per person. An instrument furnace (with an average heating capacity of 1500 watts) along with a vent in the room is used for certain types of temperature calibration work. When it is operational, the furnace has not impacted temperature stability. The vent is a system leak of the conditioned air to the exterior of the building. It has been the cause of losing critical water vapor to the outside on extremely dry days. In those cases, we have resorted to sealing it temporarily with plastic film. A permanent solution to this leak is desired.

Turbulence and Air Flow: The work done in the Standards Lab is the calibration and repair of instruments. Airflow has not been cited as a significant problem to date, although above unspecified levels it would become one (for example, if papers started to move, or electric connection leads started to sway or mechanical vibrations were introduced into the measurement systems).

Fresh Air Make-up: The air available for fresh air make up comes from the electric lab area and does not appear to differ from the lab temperature and humidity requirements by very much throughout the year except for extremely dry periods (which often happens in winter). Fresh air make-up needs to meet OSHA/ASHRAE requirements of 15 cfm per person.

Static Pressure: We believe that a slightly positive pressure in the room over the static air pressure in the rest of the building improves the performance of an environmental system.
Down Time: We realize that a system, which meets the performance specifications 100% of the time, would be unacceptably expensive. A target performance of two weeks downtime per year with no more than one week of downtime in any month is desired.

Filtration: Clean room specifications are not required, but sufficient filtration to ensure that visual particulate matter is not emitted from the ducts.

Inspection: Provide easy access to air filters to facilitate their inspection and replacement every six months.

Monitoring: Lab personnel currently monitor lab conditions with 2 temperature and humidity sensors located in opposite corners of the lab. Data from these sensors is acquired by a local data acquisition system and fed into the local area network for review and data storage. This equipment is required for lab accreditation and is maintained by lab personnel.

Air Quality/Chemical Laboratory.
Standard comfort conditions of 72°F ±3°F are adequate. Only a minor heat load stems from operating equipment. Room pressurization must be maintained to allow fume hoods to work properly.

Rock and Soils Lab Environmental Chamber.
There are two chambers, one required to maintain 100% RH and the other 50% RH ± 2% RH. Each chamber is to be kept at 73 °F ± 2 °F.

Metallurgy Building Labs.
The Metallography and Corrosion Lab and Dark Room are on a separate HVAC system and controls (Met AC1). These rooms do not require 24/7 operation of the HVAC system, but occasionally need to operate on weekends, and on rare occasions there is a need to operate it 24/7 for an indeterminate period while specific tests are being conducted in the rooms. Local access to A/C schedule is desired when special operating periods are required.

The Mechanical Metallurgy Lab has its own HVAC system and control (Met AC2). It has an economizer and the system shuts down at night and on weekends. It does not require 24/7 operation of the HVAC system, but occasionally it needs to operate on weekends, and on rare occasions 24/7 while specific tests are being conducted in the room. Time clocks must be changed manually to accommodate this. Local access to A/C schedule is desired when special operating periods are required.

The Optical Microscope Lab and the SEM Lab must have the HVAC system operating 24/7. These two rooms required a separate HVAC system and controls (Met AC5). The SEM Lab has a significant heat load from electronic equipment that is always on. The Optical Microscope Lab has virtually no equipment heat load. Both rooms have a Halon fire extinguishing system that requires that they not be connected to the rest of the building ventilation so that the Halon is confined to these two rooms when it is
discharged in a fire.

All labs have problems with dust. The ability to monitor ventilation filtration is desired.

**Utility Cost / Energy Savings Goals**

Take full advantage of economizer function by maximizing the use of outdoor air for cooling and to limit A/C function during unoccupied hours, except where needed. The goal is to reduce the $/sq. ft. cost over time.

**Level of System Control**

(Remember, this is a wish list, as we may not know what the budget or the various HVAC systems will allow.)

The HVAC automated controls system must reliably and efficiently control the systems and equipment under its control. Distribution fans and pumps must be controlled off and valves closed when the building is unoccupied. Control system caused failures to provide cooling or heating are unacceptable. Facility personnel must be able to easily ascertain the status of comfort and systems and to make adjustments in setpoints and schedules using the control system graphical interface via onsite or remote terminals or PC’s. Web access is preferred to modems. Local-override is necessary for off-hour unscheduled use. High-level alarms should generate an alarm message to facility management staff that may be off-site.

Systems controls must be tuned and able to maintain a stable setpoint. The HVAC control system must be able to respond to a change in load or system upset in a timely fashion. The control system must have the capability to implement a system wide demand response program if implemented. The capability of monitoring of critical spaces such as the Standards Lab and the Telecommunications Equipment Room along with facility energy use and demand during utility billing periods and thermal cooling load and chiller performance is preferred. DDC network nodes are needed in the Main Building, the Metallurgy Building, and the Warehouse. Obtaining full DDC control, down to the zone level, of all heating and cooling systems and equipment including schedules and setpoints as well is interface with dedicated lighting controls is our goal.

**Training Needs**

The building supervisor, facility management staff, and department representatives must be trained in accessing DDC HVAC control system information, making adjustments to setpoints and schedule, responding to and adjusting alarms, adding new trends as needed and diagnosing minor system upsets using trend reports.

**Systems Summary**

**HVAC Systems**

**Main Building (Main):** Five air-handling units serve this building. The two main units, Main AC1 & Main AC2, are located in the main building penthouse fan room and are variable-air-volume systems with hot water reheat, each with variable speed drives. Main AC3 is a constant volume single-zone unit with chilled and hot water coils that serve the High Voltage Test Facility control room. Main AC4 is a constant volume single-zone unit with chilled and hot water coils that serves the Standards Laboratory. A fifth unit, called Main
AC5 here, serves the north end labs expansion area.

Central heating equipment for the building includes a Kewanee, low-pressure steam boiler, which is rated at 200 boiler horsepower (approximately 6,694,000 Btu/hr), a steam-to-water heat exchanger, and two PACO heating water pumps along with conventional accessories for the heating systems. The hot water heat exchanger was designed to provide 3,000,000 Btu/hr of heating capacity with 200 GPM of hot water.

A York, Model YTB, electrically driven centrifugal water chiller, which has a rated capacity of 195 Tons to cool 468 GPM from 54 °F to 44 °F, provides chilled water. This chiller was also installed ca. 1989 to replace the original steam-fired absorption chiller. A Marley, Series 220, cooling tower, located in the utility yard on the north side of the building, cools the chiller condenser water. This cooling tower was installed in 1989 to replace the original tower and is rated to cool 600 GPM from 92 °F to 82 °F, at 71 °F wet bulb temperature.

The chiller and boiler are located in separate mechanical rooms in the basement. They provide chilled and hot water to Main AC1, 2, 3 and 5 and hot water to Main AC4 on a back-up basis.

A separate cooling and heating system that includes a Trane air handling unit (Main AC4), and a separate Raypak gas-fired boiler and Trane air-cooled water chiller that are located on the roof above the Electrical Test area serves the Standards Lab, Room 143. The air handler has a chilled-water cooling coil and hot-water heating coil. The unit is suspended above the ceiling in the Gallery Corridor outside the Lab. Chilled water and heating water are normally supplied to the air handling unit from the boiler and chiller on the roof, but piping is arranged with interconnections and valves that allow the air handler to also be supplied from the main building chilled and heating water systems to provide redundancy. Humidification for the lab is being provided by a Nortec, electric steam humidifier that is located on a wall in the Electrical Test area, near the air-handling unit. Temperature and humidity are required to be maintained continuously in the Standards Lab.

Main AC5 is a McQuay air-handling unit that is located in a louvered penthouse structure on the roof of the addition. It is a variable-volume system that originally included variable inlet vanes on the supply fan to control the supply air volume, but has been converted to utilize a variable speed drive to control the speed of the fan motor for more efficient operation. The system includes dampers and controls to provide 100% outdoor air “economizer” cooling but does not include a return fan, or exhaust fan, to relieve building pressure when it is operating with 100% outdoor air.

Two Carrier commercial quality, gas-fired, rooftop AC units serve the Cafeteria (Main AC7) and the Kitchen (Main AC8). Temperature controls for these units are electric. The Kitchen also includes a commercial exhaust hood above the cooking equipment with a conventional roof mounted up-blast type grease exhaust fan, and a make-up air supply fan that provides filtered, but otherwise untreated, make-up air to the Kitchen when the hood exhaust fan is activated.
A small independent A/C unit (Main AC6), which is water-cooled with a dedicated cooling tower, serves the Rock and Soils Lab environmental chamber. The chamber and A/C unit is due to be replaced as part of an ongoing structural upgrade project.

A combination of two, ductless split-system cooling units, and four through-the-wall residential type AC units that take their condenser air from the adjacent storage room independently cool the Telecommunications Equipment Room in the basement.

Small, independent AC units also serve the Computer Room and Count Room.

There are nine fume hoods with dedicated exhaust fans and local control serving the various labs. Fume hoods are located in Standard’s Pressure Lab, Environmental Engineering Lab, 2 in the Health Physics Lab, 2 in the Air Quality/Chemistry Lab and 3 in the PCB Lab. Most have variable-air-volume controls. Staff checks each fume hood regularly for operational effectiveness.

Exhaust Fans with local controls are located in the Kitchen, Standards Lab, Performance Test & Analysis Lab, the Rotating Machinery Annex Room and in the Rock and Soils Lab.

Zone temperature control is accomplished throughout mot of the building with duct mounted hot water reheat coils, and Titus VAV control boxes for each zone in the variable-volume systems. Temperature controls and actuators are generally pneumatic, with the exception of those for the rooftop package units serving the Cafeteria-Kitchen, and other small rooms that are served by small individual unitary equipment and split-systems.

Metallurgy Building (Met): Five packaged air conditioning units serve this building. Four units are rooftop packaged-units with gas furnace heating sections. Met AC1 serves the Metallography and Corrosion Lab and the Dark Room. Met AC3 serves the entire second floor and has pneumatic controls. Met AC4 serves first floor offices. Met AC5 serves the Optical Microscope Lab and the SEM Lab.

Met AC2 is a small packaged water-cooled unit with a dedicated rooftop cooling-tower, which serves the Mechanical Metallurgy Lab.

All five units are on time clocks.

The Welding and NDE high bay has gas heating units and exhaust ventilation but not A/C.

Two fume hoods are located in the Metallography and Corrosion Lab. Exhaust fans are in the 2 darkrooms and in the welding area portion of the high bay.

Warehouse: Two small A/C packaged units serve the front facilities area and the shipping receiving office area to the rear. Two natural gas heaters provide heat to the main warehouse.

HVAC Controls: The existing control systems are electric and pneumatic, but primarily pneumatic. (Contractor) completed a major pneumatic system upgrade in the Main Building
in 1989. Mechanical time clocks and local thermostats currently control Met Building A/C units. Local thermostats control Warehouse A/C units.

**Current Operating Schedules**

The facility is typically occupied from 6:00AM to 6:00PM. Facility Management staff typically arrive earlier. Staff may arrive earlier; work later, or on weekends, but they have limited means for changing a schedule; which must be done manually. The HVAC equipment operating schedules, as they currently exist follows.
<table>
<thead>
<tr>
<th>UNIT / LOCATION</th>
<th>MON. – FRI. TIME ON</th>
<th>MON. – FRI. TIME OFF</th>
<th>SAT. / SUN. TIME’S</th>
<th>AREA SERVED</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main AC1 / Main penthouse</td>
<td>06:00</td>
<td>18:00</td>
<td>Chiller not on</td>
<td>West end of main building</td>
<td>AH Unit on 24 hrs. 7 days</td>
</tr>
<tr>
<td>Main AC2 / Main penthouse</td>
<td>06:00</td>
<td>18:00</td>
<td>Chiller not on</td>
<td>East end of main building</td>
<td>AH Unit on 24 hrs. 7 days</td>
</tr>
<tr>
<td>Main AC3 / Dome basement</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>HVT Control Room</td>
<td>Uses timer to operate on an as needed basis</td>
</tr>
<tr>
<td>Main AC4 / Roof</td>
<td>Unit on 24 hrs. 7 days</td>
<td></td>
<td></td>
<td>Standards Lab</td>
<td>Unit on 24 hrs. 7 days</td>
</tr>
<tr>
<td>Main AC5 / Addition penthouse</td>
<td>06:00</td>
<td>18:00</td>
<td>Chiller not on</td>
<td>Main building north end labs</td>
<td></td>
</tr>
<tr>
<td>Main AC7 / Cafeteria Roof</td>
<td>06:00</td>
<td>18:00</td>
<td>Not on</td>
<td>Main cafeteria</td>
<td>Local smart stat control</td>
</tr>
<tr>
<td>Main AC8 Kitchen Roof</td>
<td>06:00</td>
<td>18:00</td>
<td>Not on</td>
<td>Main kitchen</td>
<td>Local smart stat control</td>
</tr>
<tr>
<td>Met AC1 / Roof</td>
<td>06:00</td>
<td>18:00</td>
<td>Not on</td>
<td>Met Lab &amp; Darkroom</td>
<td>Time clock &amp; stat control</td>
</tr>
<tr>
<td>Met AC2 / Roof</td>
<td>06:00</td>
<td>18:00</td>
<td>Not on</td>
<td>Mech Met Lab</td>
<td>Time clock &amp; stat control</td>
</tr>
<tr>
<td>Met AC3 / Roof</td>
<td>06:00</td>
<td>18:00</td>
<td>Not on</td>
<td>Met offices Second floor</td>
<td>Time clock &amp; stat control</td>
</tr>
<tr>
<td>Met AC4 / Roof</td>
<td>06:00</td>
<td>18:00</td>
<td>Not on</td>
<td>Met offices First floor</td>
<td>Time clock &amp; stat control</td>
</tr>
<tr>
<td>Met AC5 / Roof</td>
<td>06:00</td>
<td>18:00</td>
<td>Not on</td>
<td>Optical Microscope Lab &amp; SEM Lab</td>
<td>Time clock &amp; stat control</td>
</tr>
<tr>
<td>Warehouse AC1 / Warehouse Mezzanine South</td>
<td>04:45</td>
<td>17:00</td>
<td>Not on</td>
<td>Facilities Offices</td>
<td>Stat only</td>
</tr>
<tr>
<td>Warehouse AC2 / Warehouse Mezzanine North</td>
<td>05:00</td>
<td>17:00</td>
<td>Not on</td>
<td>Shipping &amp; Receiving office area</td>
<td>Stat only</td>
</tr>
</tbody>
</table>