7. Electrical

Overview
An electrical power distribution system and lighting system review was conducted on the dates of February 9 through February 11, 2009. The review was conducted by examining floors of the building that had been determined by the owner as being typical of the various floor configurations within the building. The reviewed floors included floors 1, 2, 3, 5, 10, 12, 15, 21, and the Penthouse. All floors of the Garage structure were also reviewed. The engineering team visually assessed these floors for the requirements of the 2007 California Building Code (CBC), the 2007 California Fire Code (CFC), the 2007 California Electrical Code (CEC), Title 24 California Building Energy Efficiency Standards, and the City of Sacramento code for high rise buildings.

As-built record drawings for the electrical power distribution system and lighting system were reviewed and evaluated for general code compliance and used to facilitate the review of the building. These drawings included building core drawings prepared by Koch, Chun, Knobloch & Associates, Inc. dated November 5, 1990, and tenant improvements drawings prepared by E.M. Kado Associates dated June 22, 1992.

A. Power Distribution System Review
The Power Distribution System appears to comply with the building codes in affect at the time of construction with some exceptions. The following items were observed to not be in compliance with the 2007 codes indicated above or represent areas for improvement.

Main Electrical Room

1. The main electrical room has only one entrance. In accordance with 2007 CEC 110.26(C)(2), the main electrical room should have two entrances and because these entrances have doors, the doors should have panic hardware. The existing door does not have panic hardware installed. For spaces that house electrical equipment over 1200 Amps with less than double the minimum clearances, the code requires two personnel doors for entrance and egress. One door is required at each end of the equipment. The doors must swing outward, with panic hardware installed if the door is less than 25 feet from the edge of the working space. One outward swinging, 24 inch minimum width door with panic hardware should be installed on the south wall, as well as panic hardware installed on the existing door.

Parking Garage Electrical Room

2. In accordance with 2007 CEC 110.26(C)(2), the main electrical room should have panic hardware on the doors. The doors must swing outward, with panic hardware installed if the door is less than 25 feet from the edge of the working space. Panic hardware should be installed on the existing doors.

Separately Derived Systems Grounding

3. In accordance with 2007 CEC 250.30(A)(7), each single separately derived system shall utilize the nearest available building steel as the grounding electrode for that system. Each dry type transformer represents a separately derived system. The secondary of the dry type transformers presently utilize the ground bus bar located in each electrical room and electrical closet as a ground electrode. This ground bus bar does comply as the required ground electrode for the separately derived system. This modification should be made at each of the approximately 50 transformers throughout the building that lack this connection. A #6 AWG copper grounding connection should be added from each separately derived system at the transformer secondary to the nearest building steel.

21st Floor Electrical Room

4. The 21st floor electrical room is quite warm, apparently due to excessive heat generated by one of the transformers. Transformer T21B should be evaluated for the cause of excessive heat generation. The cause of the excessive heat should be investigated and appropriate measures taken to insure safe operation.

East / West Electrical Closets – Floors 2 through 12

5. The east/west electrical closets on the floors that were reviewed generally provide adequate clearances about the equipment and appear to be in good condition. Some electrical closets have ceiling tiles and other items stored in them that should be removed and stored elsewhere. Electrical closets should not be used for storage in accordance with 2007 CEC 110.26(B).

Generator Equipment

6. The generator controls and auxiliary equipment are beginning to show signs of disrepair. The room and equipment should be cleaned and repaired as needed, see Photo No. 5 and Photo No. 6.

Extension Cords

7. 2007 CFC 605.4 and 605.5 place limits on the use of plug strips and extension cords. There appeared to be a large number of plug strips and extension cords throughout the building. A general review of all areas should be undertaken to identify all areas not in compliance with this code. The following items were observed during the site review:
8. Break room 214 was arranged in such a manner that the refrigerator and microwave were powered through a light gauge ungrounded extension cord that does not comply with the CFC. This room should be rearranged with appliances located near available power receptacles and the number of microwaves limited to one. See Photo No. 11.
9. Makeshift break rooms have been set up in small rooms that do not have sufficient dedicated power receptacles for the appliances. The appliances have been plugged into power strips. Dedicated power circuits should be provided for coffee stations and microwaves.

10. Printer stations should be located where they have access to dedicated power circuits and receptacles. Large printers should have a dedicated circuit, while smaller printers may share a receptacle and circuit with two other small printers or fax devices. Makeshift printer stations that "borrow" power from the nearest cubicle should be removed or additional circuits/outlets provided from an electrical panel with spare capacity, see Photo No. 16.
11. A workstation area in the mail sorting room was observed to have three computers, two battery backup UPS units, a printer, and a shop vacuum plugged into a single receptacle. The shop vacuum appears to be used with regularity for a nearby printing machine process. Two additional circuits should be provided to this area, the computer equipment distributed between two circuits and the shop vacuum connected to the third. See Photo No. 12.
12. A training room on Floor 3 was observed to have three power strips chained together to one circuit to power three computer stations. See Photo No. 13.

Servery Area 133

13. A cord in the Servery Area 133 is plugged into a receptacle then disappears above the ceiling tile.

Child Care Area

14. A sink and countertop area in the child care area has non-GFCI protected receptacles installed that are not identified as GFCI protected. These receptacles should be replaced with GFCI receptacles. See Photo No. 14.

Cafeteria

15. Each vending machine should be supplied by a dedicated circuit that is located adjacent to the machine. Four machines were observed that share three outlets with two of the outlets located on the wall several feet away from the nearest machine. One additional circuit, from a panel with spare capacity, should be provided to the cafeteria vending machine area. See Photo No. 15.

B. Lighting System Review

The Lighting System appears to comply with the building codes in affect at the time of construction with some exceptions. The following items were observed to not be in compliance with the 2007 codes indicated above or represent areas for improvement.

1. The locations of the exit lighting needs to be reviewed in detail to make sure the exit lights are visible from any direction of exit travel.
2. The self luminous exit lights are at their end of their useful life. Replace self luminous exit lights.
3. A number of powered exit lights were observed to not be working. Lamps may be burned out. Re-lamp all exit lights or consider replacing all exit lights with LED type.
4. Several wall mount light fixtures in the janitor closets were damaged and should be replaced.

5. The light fixtures in the open office areas are tandem wired to allow for uniform dual level switching of the lights as required by Title 24. The wiring and switching system does not utilize the switching capabilities of the light fixtures.
6. The occupancy sensor in the restrooms is located in the entrance foyer and is partially blocked from view of the main room of the restroom. The calibrated off time delay for the occupancy sensor needs to be reviewed or an additional occupancy sensor should be added to the main room of the restroom.
7. On the first floor, in the stairwells, and in most of the core areas, T12 lamps are still being used. The T12 lamps and ballasts should be replaced with T8 lamps and electronic ballasts.
8. Lighting levels for the parking garage appeared to be low creating an unsafe environment. The existing light fixtures utilized an up-light component to provide better illumination by reflecting light off the structure. The structure is grey concrete and is not affectively reflecting this up-light component. The fixture would perform better if the garage were painted white. An alternative fixture should be considered or additional fixtures should be added to supplement the light levels.
9. The top level of the parking garage utilized short poles with non-cutoff type light fixtures. The light fixtures and poles should be replaced with taller poles and full cut-off light fixtures or with more poles and full cut-off light fixtures.

C. Methodology

Generally, all rooms of the floors indicated above were accessed and visually reviewed. Rooms that were locked by the tenant and not accessible to building maintenance personnel for security reasons were not examined. Photographs were taken and system configurations and conditions were observed. Unless otherwise mentioned, no electrical panels, ceiling panels or other enclosures, requiring tools or special equipment to open, were accessed or examined internally. No tenant furniture or equipment was moved. No testing equipment was used during this review.

Members of the building staff were interviewed during the electrical review. No problem areas related to the electrical system were identified by the building staff at that time. In addition, the Office Optimization Study dated August 8, 1997 was reviewed. This study provided options for increasing the buildings personnel capacity, or population density.

D. Power Distribution System Description

Main Electrical Room – Floor 1

1. The main ground floor electrical room contains Main Switchboard No. 1 and Main Switchboard No. 2, see Photo No. 1. Each switchboard is rated for 5,000 amps and 480/277 volts, three phase, four wire. Each switchboard is served from a SMUD transformer vault located on the east side of the building adjacent to 5th Street. Main Switchboard No. 1, distributes power to the lighting and general power loads for all floors with the exception of the 12th. Main Switchboard No. 2, distributes power to the 12th floor mechanical equipment rooms and the emergency power distribution system. The Main Electrical Room also contains the 1,600 Amp Emergency Distribution Board EDB1A. Emergency Distribution

Board EDB1A is fed by Switchboard No. 2 and the emergency generator via Automatic Transfer Switch #1. The switchboards are situated in three rows with minimum electrical code clearances provided between the equipment that is installed front to back and front to front.

Distribution Risers / Bus duct

2. The building distribution system utilizes bus duct to feed the electrical sub systems on each floor, see Photo No. 2. Main Switchboard No. 1, located in the Main Electrical Room, feeds two bus ducts rated at 2,500 Amp and 1,000Amp respectively. Power for lighting and the general 120/208 volt loads on each floor are served by these two bus ducts. The 2,500 Amp bus duct feeds the west electrical closet panels on floors two through eleven as well as the electrical room panels on floors fourteen through twenty-four. The 1,000 Amp bus duct feeds the east electrical closet panels on floors 2 through 11. Main Switchboard No. 2, located in the Main Electrical Room, feeds one bus duct rated at 3,000 amps for the12th floor mechanical equipment rooms. The bus ducts appear to be of good workmanship and in good condition.
3. Two bus ducts are fed from Emergency Distribution Board EDB1A in the Main Electrical Room. The first bus duct rated at 1,600 Amp feeds the twelfth floor Emergency Distribution Panel HVEDP12A. The second bus duct rated for 600 Amp feeds the high and low voltage emergency power panels on each floor, excluding the first and twelfth floors. The bus ducts appear to be of good workmanship and in good condition.

Electrical Distribution System to Each Floor

4. Power is distributed to the branch circuits through panelboards served as described above. Lighting is served at 277 volts from 480/277 volts, three phase, four wire panelboards. Receptacles and low voltage power is served from 120/208 volts, three phase, four wire panelboards, see Photo No. 3. These panelboards are served from three phase, dry type transformers that convert the 480 volt system to the 120/208 volt system. Each closet contains at a minimum, one 480/277 volt panelboard, one transformer, and one 120/208 volt panelboard.

East Electrical Closet – Floor 1

5. This area is adjacent to the Main Electrical Room and shares the same access door. The room appears to be adequate for the equipment installed.

East/West Electrical Closets – Floors 2 through 12

6. The east/west electrical closets on the floors that were reviewed generally provide adequate clearances about the equipment and appear to be in good condition.

Electrical Rooms – Floors 13 through 22

7. The electrical rooms surveyed provide adequate clearances about equipment and appear to be in good repair.

Penthouse Electrical Area

8. The electrical area in the penthouse is not located in a separate room. The clearances appear adequate and the area is clean and unobstructed. The equipment appears to be in good condition.

Parking Garage Electrical Room

9. The parking garage electrical room is located on the third parking level. Main Switchboard PGA, see Photo No. 4, is fed from a SMUD transformer vault on the west side of the parking garage adjacent to 4th Street. There appears to be adequate clearances for the electrical equipment in this room. There are two access doors, one at each end of the room.

Emergency Power Distribution System

Generator

10. The generator is located on the ground floor of the parking garage and is accessed from the 4th Street sidewalk. The generator provides emergency power at 277/480 volt, three phase, four wire and is standby rated at 900 kilowatts. The Generator Switchboard is located in the generator room and feeds three automatic transfer switches. One is located in the third floor garage electrical room and provides emergency power for the parking garage. The second is located in the first floor Main Electrical Room and serves Switchboard EDB1A as described above. The third is located in the Fire Pump Controller enclosure located in the generator room.

Grounding System

11. A main ground bus bar is located in the Main Electrical Room, see Photo No. 7. The main ground bus bar is identified as being connected to the Grounding Electrode System including the building steel, a Ufer ground, and a cold water pipe, as required by the CEC. The as-built record drawings indicate that the system is also connected to a gas pipe. This connection is not identified at the main bus bar but two of the connections have missing labels. The main ground bus bar appears to be the only location where the grounding system is connected to building steel.
12. The grounding system is installed with copper bus bars located in each electrical room or closet and connected by bare copper conductor from the main ground bus bar, see Photo No. 8. The ground wires are terminated with crimped lug connections bolted to the bus bars.

Isolated Grounding System

13. The 120/208 volt panels on each floor appear to have an isolated grounding bus. The isolated grounding bus within the panel is insulated from the cabinet and the equipment grounding bus. This isolated grounding bus is connected to the grounding system using a bare copper conductor to the nearest grounding bus in that electrical room or closet.

Branch Circuit Electrical Distribution

IT Server Room

14. Panel HV5C distributes power to the AC units and UPS system in the fifth floor IT Server Room. This panel is not present on the as-built record drawings.
15. Offices and conference rooms appear to have adequate placement and quantity of general convenience receptacles.

Break Rooms and Other Permanently Enclosed Areas

16. Designated break rooms are generally equipped with sufficient receptacles for one coffee maker, toaster and microwave. Each room has GFCI receptacles provided over countertops.

Furniture Workstations

17. Furniture workstation power is routed in the cellular deck. Floor boxes provide connection points.

Printers

18. Several printer stations are located on each floor of the building. Most printers appear to have a dedicated power receptacle. Several printer stations were observed that were powered through plug strips that also served furniture workstation power. Other printer stations appeared to have dedicated receptacles but the receptacle also had several printers, fax machines, etc. plugged to one power strip.

E. Electrical Utility Peak Demands

The peak electrical service demands over the last twelve months for the building's three meters were obtained from the Sacramento Municipal Utilities District (SMUD). The peak demands are as follows:

Switchboard #1	1142 Kilowatts
Switchboard #2	1277 Kilowatts
Switchboard PGA	290 Kilowatts

The percent of capacity presently being used by the electrical system can be determined by converting the kilowatts rating to kilo-volt-amps (kilowatts/0.8 power factor), dividing by 480 volts, three phase, dividing by the capacity of the switchboard, and finally multiplying by 100 to convert to a percentage. The amps of peak demand power and the percent of capacity are indicated below:

Switchboard #1	1717 Amps or 34% of 5000 Amp rating
Switchboard #2	1920 Amps or 38% of 5000 Amp rating
Switchboard PGA	340 Amps or 21% of 1600 Amp rating

F. Lighting System Description

General

1. The majority of the lighting system consists of linear fluorescent light fixtures with four feet long lamps. Labeling on the ballasts indicate that they do not contain PCB's. High Intensity Discharge (HID) lamps and compact fluorescent lamps have been used in light fixtures in the Parking Garage, the Mailing Rooms, and the lobby areas. Light fixtures with incandescent lamps appeared to be limited to areas with specific applications such as dimming requirements. The lighting is served at 277 volts with a limited number of light fixtures served at 120 volts. The 120 volts light fixtures appeared to be limited to areas with specific applications such as dimming requirements. With the exception of the stairwells, the lighting system is connected to panelboards and relay panels located on each floor. The stairwell lighting is served from the emergency power distribution system through panelboards located on the first floor. The control of the lighting is provided by a combination of local switching, occupancy sensors, low voltage switches connected to relay panels which provide time scheduling control.

Core

2. The Core area of each floor typically includes the stairwells, rest rooms, elevators and elevator lobbies, electrical/telecommunications rooms or closets, storage rooms, and the mechanical equipment rooms. The mechanical equipment rooms are limited for the most part to the 12th floor and the Penthouse. The light fixtures in the stairwells, rest rooms, electrical/telecommunications rooms and closets, storage rooms, and mechanical rooms are typically linear fluorescent type with four feet long fluorescent lamps. These types of light fixtures are appropriate for the rooms and tasks. Lighting in the rest rooms, electrical/telecommunications rooms and closets, storage rooms, and mechanical rooms is controlled by local switches or wall type occupancy sensors. The stairwell lighting is served from the emergency power distribution system and is not switched. The light fixtures in the elevator lobbies are recessed down lights with metal halide lamps and are not switched.

Tenant Areas

3. The Tenant area lighting system consists of a variety of light fixtures and lamp types based on the specific uses of the tenant. The majority of the lighting in the tenant office areas consists of two feet by four feet (2x4) light fixtures with three lamps and parabolic louvers. The record drawings indicate that these light fixtures were originally installed with T12 sized lamps but have been upgraded to T8. The 2x4 light fixtures are indicated on the record drawings as tandem wired meaning they have three two lamp ballasts for each set of two light fixtures with one of the ballasts serving one lamp in each light fixture. Typically, tandem wired light fixtures allow for three levels of switched lighting in the space, one lamp, two lamps or three lamps on. The switching in the open office areas does not utilize the available switching configurations of the tandem wiring. The switching in the open office areas is divided into the rows adjacent to the windows and the rows up to the core area or the enclosed rooms around the core

area. The switching for the open office areas includes low voltage switch stations which control the lighting through the relay panels located in the electrical rooms. Calculations for a typical area of the open office indicates light levels of approximately 60 footcandles, which is acceptable per IESNA recommendations for illuminance of an open office area.

4. Other tenant area lighting systems include two feet by two feet (2x2) light fixtures with two lamps and parabolic louvers in the corridors, HID lighting for the Mail Room areas and dimmed fluorescent and incandescent lighting for the Board Room. A portion of the 2x2 light fixtures have had specular reflectors added to them. Fluorescent lighting in strip light fixtures have been added in the Mail Rooms to provide higher levels of task lighting.
5. The installation of new lighting control devices was observed in a portion of the electrical rooms and closets. The new system appears to utilize optical isolation relays to convert a signal from the building management system to a 0-10 volt signal that is compatible with dimming ballasts. Based on the labeling on the isolation relays, it appears that dimming ballasts are to be installed on the building perimeter light fixtures with the possible intent of providing day light dimming for these light fixtures.

Parking Garage

6. The Parking Garage utilizes HID lighting mounted to the ceiling for the lower levels and pole mounted light fixtures on the upper level. Compact fluorescent wall mount light fixtures are located in the stairways. The Parking Garage level 1 lighting appears to provide the IESNA recommended lighting minimum lighting level of 0.5 foot candles, however level 2, 3 and 4 lighting levels do not meet the IESNA recommendation.

Emergency and Exit Lighting

7. The emergency lighting system appears to provide the minimum one footcandle lighting levels for the egress paths in the building as required by 2007 CBC 1006.4. Power for the emergency and exit lighting is provided by the emergency generator through the panelboards located on each floor. The light fixtures in the stairwells and a portion of the lighting in the elevator lobbies as well as the corridors on the first floor are connected to the emergency power system. In the corridor areas of the upper floors, all the light fixtures are on the emergency power system. A portion of the light fixtures in the open office areas are on the emergency power system. Calculations for a typical area of the open office indicate light levels of approximately 2 footcandles.
8. In most areas, the exit lighting appears to comply with the requirements of 2007 CBC 1011.1. The ceiling mounted exit lights contain small fluorescent lamps which require periodic replacement. Low level exit lights in the core areas and exit lights at the parking garage are self-luminous type and appear to be at the end of their 10- to 20-year life.