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# Sandia National Laboratories Site Energy Program Christopher Evans, LEED AP, CEM Energy Management Team Leader

# Overview

- **Locations**
  - Kirtland Air Force Base, Albuquerque, NM
  - Livermore, CA
  - Tonopah, NV
  - Kauai, HI
- **Workforce: 11,000**
- **Major buildings: 225**
- **Space: 7.4 million GSF**

# Energy Consumption 2009

- **Electric:** 311,000,000 kWh
- **Natural gas:** 446,267,000 SCF
- **Total utility costs:** over \$25M

# Challenges

- **Over 7 million GSF of space**

- Office
- Laboratory
- Warehouse
- High-performance computing



- **Energy costs:** increased by 50% with new electric utility contract
- **Regulations**
- **Corporate culture**

# Going Greener

## Approach

- Standards
  - Design Manual
  - Standard specifications
  - Campus Design Guidelines
- Building Automated Control (BAC)
- Metering
- Auditing
- Retrocommissioning

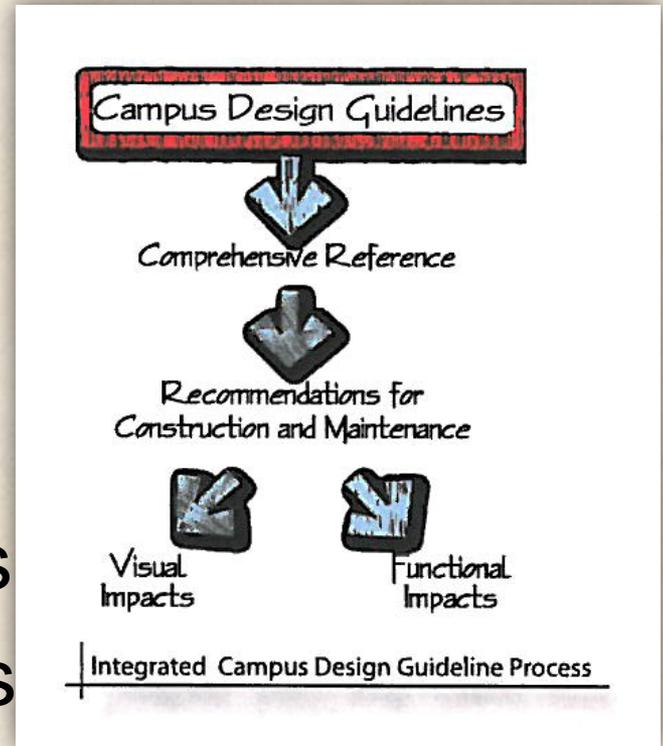


# Going Greener

## Design Standards

### 2001 – FEMP Funding

- Create greener standards
  - Design Manual
  - Construction Specifications
  - Campus Design Guidelines
- Ensure that all projects meet standards



# Going Greener

## Design Standards

### Requirements

- Lighting control systems
- Meters for electric and natural gas
- Energy Conservation Report
- Variable frequency drives (VFDs)
  - For variable loads over 5 hp
  - Required to communicate with BAC system



# Going Greener

## Design Manual

### Requirements (continued)

- Efficient lighting
  - F32T8
  - 3500K
  - Rapid start
- BAC for buildings over 10,000 SF
- LEED Gold for new construction
- 30% more efficient than ASHRAE 90.1
- Commissioning



*PV Lighting*

# *Going Greener*

## **Standard Specifications**

**Based on EPA Energy Star and Guiding Principles**

### **01350. LEED Requirements (Sandia Master Spec)**

02232. Aggregate Base Course (ABC),  
Recycled Asphalt Base Course (RABC),  
Crushed Concrete Base Course (CCBC)

03300. Cast-in-Place Concrete

03351. Exposed Aggregate Concrete

05120. Structural Steel

07531. Single-Ply Roofing – PVC

07532. Single-Ply Roofing – CSPE

07533. Single-Ply Roofing – TPO

08800. Glazing

09511. Acoustical Lay-In Ceilings

09651. Resilient Tile Flooring

09680. Carpet Tile

09682. Broadloom Carpet

09900. Painting

10160. Metal Toilet Compartments

12700. Systems Furniture

12701. Free-Standing Modular Furniture

# Going Greener

## Standard Specifications

### Example: 09900. Painting

#### 2.01 MATERIALS

##### 1. Prohibited organic compounds

- a. Methylene chloride
- b. 1,1,1-Trichloroethane
- c. Benzene
- d. Toluene (methylbenzene)
- e. Ethylbenzene
- f. Vinyl chloride
- g. Naphthalene
- h. 1,2-Dichlorobenzene
- i. Di (2-ethylhexyl) phthalate
- j. Butyl benzyl phthalate
- k. Di-n-butyl phthalate
- l. Di-noctyl phthalate
- m. Diethyl phthalate
- n. Dimethyl phthalate
- o. Isophorone
- p. Formaldehyde
- q. Methyl ethyl ketone
- r. Methyl isobutyl ketone
- s. Acrolein
- t. Acrylonitrile

##### 2. Prohibited metals (including their oxides)

- a. Antimony
- b. Cadmium
- c. Hexavalent chromium
- d. Lead
- e. Mercury

# Electric Metering

## Objectives

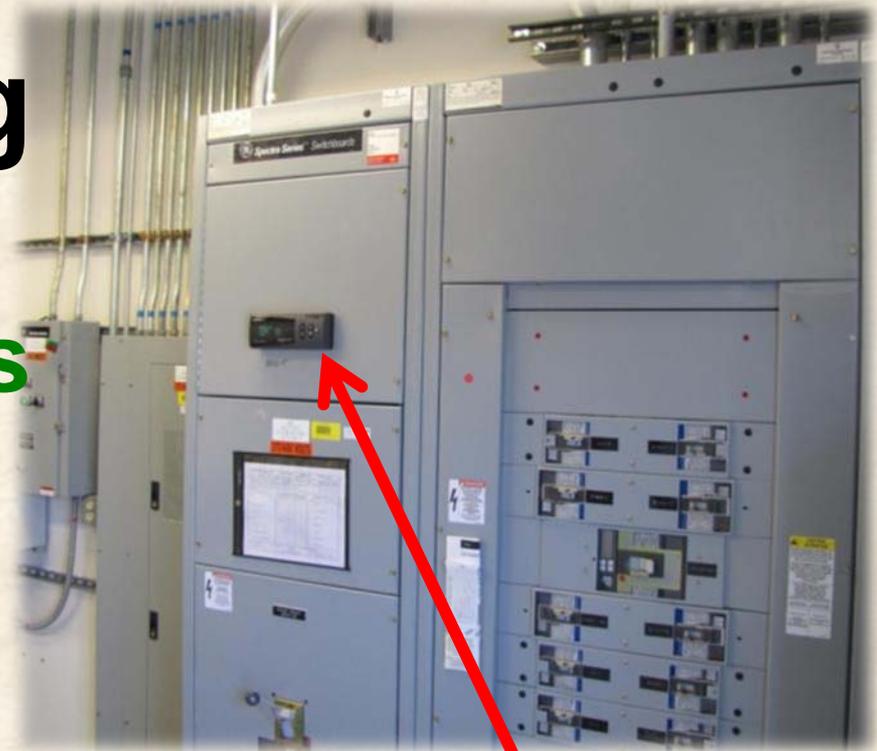
- Identify & monitor “energy hogs”
- Benchmark energy consumption
- Track effectiveness of Energy Conservation Management (ECM) program
- Report to DOE



# Electric Metering

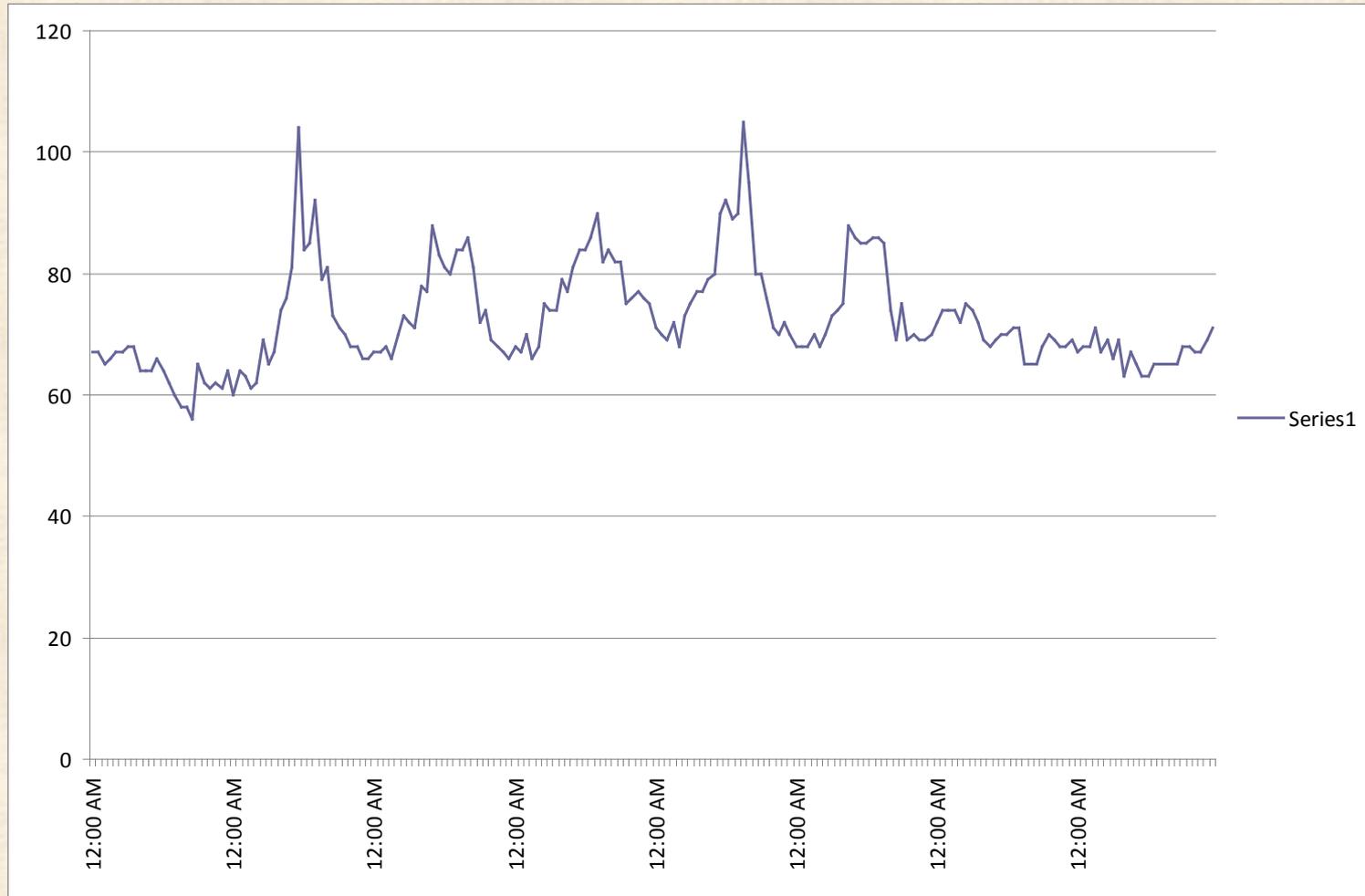
## Reasons for Success

- One manufacturer
- One owner
- Advanced metering
- Continuous monitoring of data



# Typical Load Profile

kW



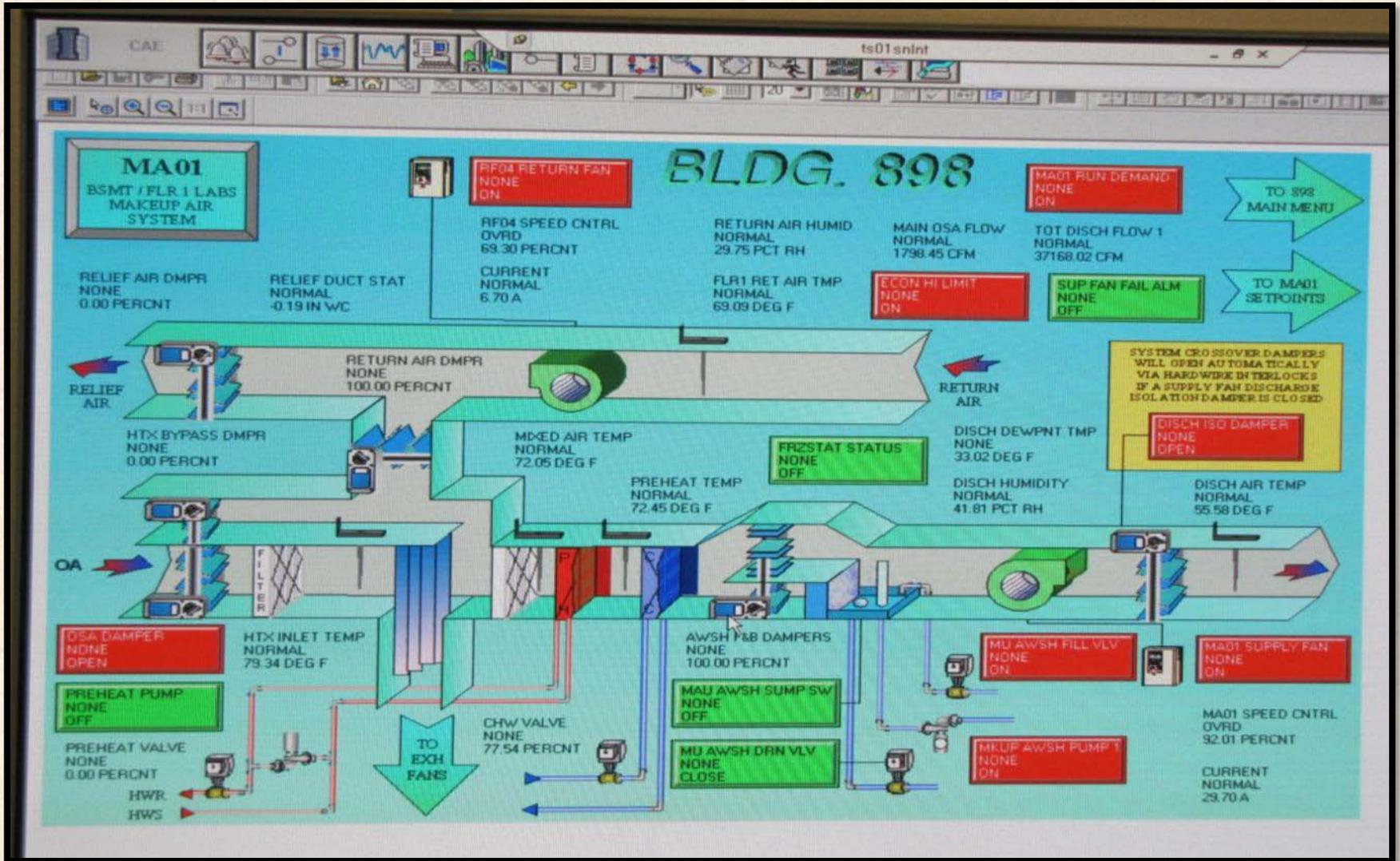
**Example: 12:00 A.M. on 8 days**

# BAC System

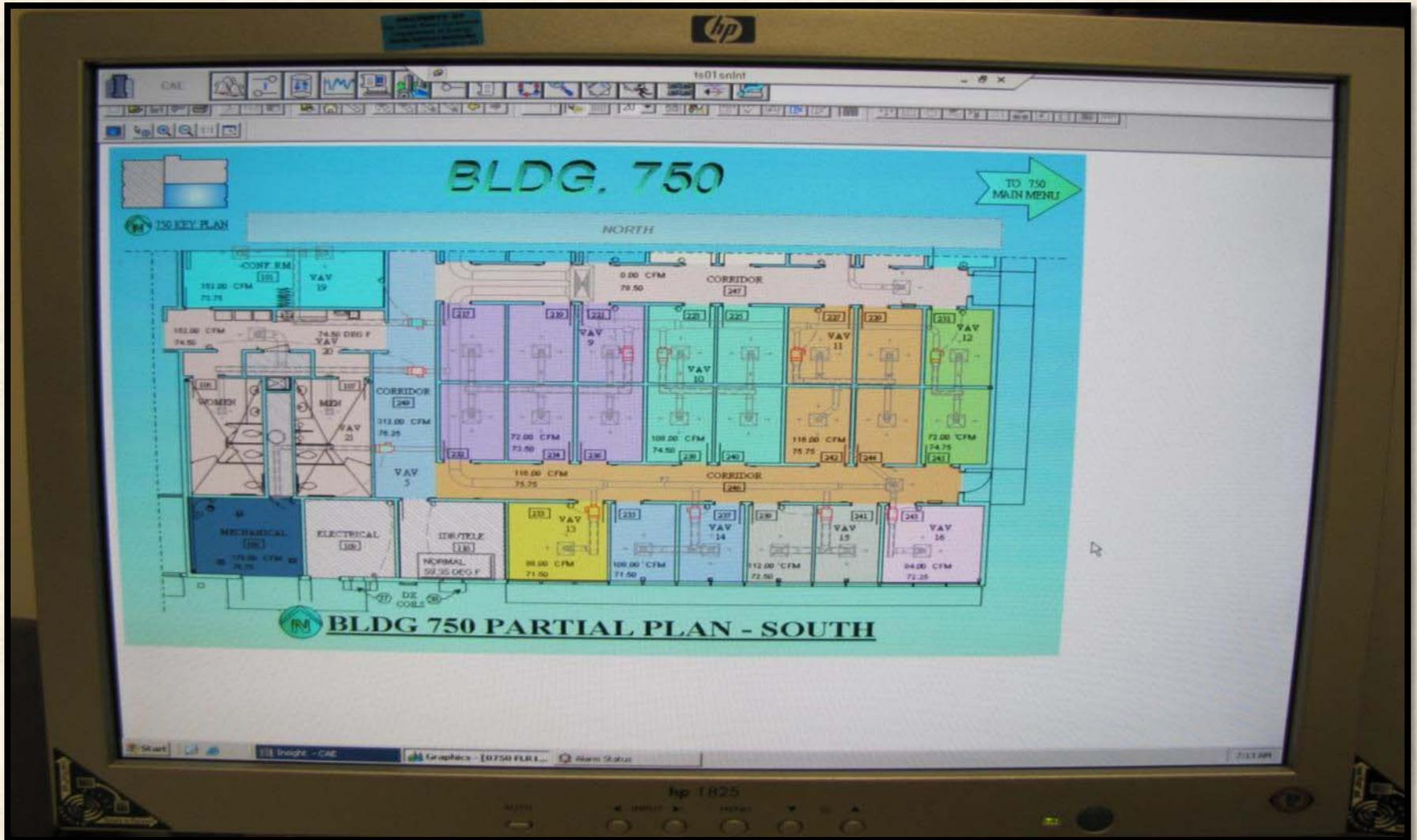
## Contributions to ECM Program

- Monitors operations
- Uses demand-based programming
- Identifies zones
- Tracks consumption

# BAC System



# BAC System



# BAC System

## Reasons for Success

- One system
- One group programs, operates, & maintains
- Required in all new construction
- Valued by Sandia's funding organization

# Auditing & Retrocommissioning 2005 – Phase I

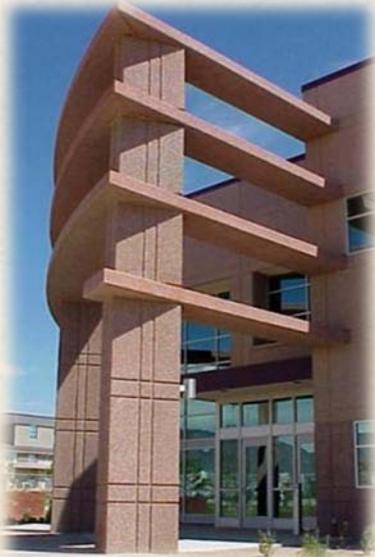


## FEMP funding for 100,000 SF Facility

- Outside firm performed work
- Mixed results:
  - Reduced energy costs by about \$30K/year
  - Increased complaints
  - Required ongoing in-house support



# Auditing & Retrocommissioning 2007 – Phase II



## Multistep process

1. Converted-warehouse data center
  - Upgraded air handlers
  - Used in-house workforce
2. Office/light lab facility: Optimized fume-exhaust system



# Auditing & Retrocommissioning 2009 – Phase II

## EM strategy

- Meet the Guiding Principles
- Identify new EM opportunities
- Complete 25% of site GSF annually
- Energy/Water Audit Checklist



*Lighting Sensor*

**Results:** Energy savings from 10% to 40%

*Significant!*

# Classic ECM Problems

- 24/7 operation
- Demand based
- Excessive reheat
- Simultaneous heating/cooling
- Outside air dampers – broken
- VAV linkages – broken or not aligned
- Economizer cycle optimization
- Insufficient lighting controls
- VFDs in hand

# Classic ECM Problems

## Workforce “culture”

- Insufficiently informed on energy issues
- Lack operational understanding
- Manually adjust equipment
- Sometimes resist change
- Existing “creative solutions”



# “To Do” List

1. Install occupancy sensors
2. Expand and upgrade BAC system
3. Expand program to shut down computers during nonpeak hours
4. Improve on initial commissioning
5. Use Guiding Principles
6. Achieve “net-zero-energy-use”