



An Energy Efficiency Workshop & Exposition
Palm Springs, California

How Well Do You Know Your Building?

Energy 101 – Session 5

DOE/FEMP ALERT Program

History, Process, & Lessons Learned

Ab Ream DOE, 202-586-7230, Ab.Ream@ee.doe.gov

Sara Farrar-Nagy NREL, 303-384-7514, Sara_Farrar-Nagy@nrel.gov

John Hail PNNL, 503-472-4799, John.Hail@pnl.gov



Agenda

- I. Overview**
- II. Origins & Initial Results
- III. Process
- IV. Protocols
 - Lessons Learned
 - Questions & Answers



Overview of ALERT Program

- ALERT: Assessment of Load and Energy Reduction Techniques to identify low-cost O&M improvements to:
 - Reduce energy use and cost
 - Reduce vulnerability to volatile prices and supply

June 2 -5, 2002

www.energy2002.ee.doe.gov

3



Examples of O&M Improvements

- Revise operation schedule for central cooling systems and fans
- Reset chilled water setpoint
- Repair/replace motors, dampers, sensors and gauges
- Clean heat exchanger coils
- Cycle air handler units
- Balance air systems

June 2 -5, 2002

www.energy2002.ee.doe.gov

4



FY01 Results

- Assessed 25 federal sites in California ... estimated potential savings:
 - Demand - 9.1%
 - Consumption - 11%
 - Cost - 9.9%
- Several sites are implementing ALERT recommendations



ALERT Objectives

- Contain cost of energy use
- Manage peak load for reliability
- Identify FEMP services & projects
- Assist with public benefits funding
- Assess on-site generation



Goal of ALERT Protocols

- Goal of Protocols (a.k.a. checklists):
 - Guide qualified ALERT team members to rapidly and effectively capture large energy savings opportunities and reduce exposure to energy price volatility.
- Objectives of Protocol:
 - Focus on high impact low-cost/no-cost measures for the facility operation, rather than equipment replacements.
 - Provide flexible guidelines applicable for all US regions.

June 2 -5, 2002

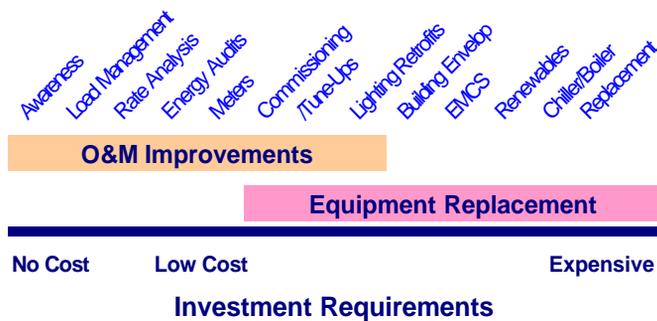
www.energy2002.ee.doe.gov

7



The Bigger Picture

The Energy Management Continuum



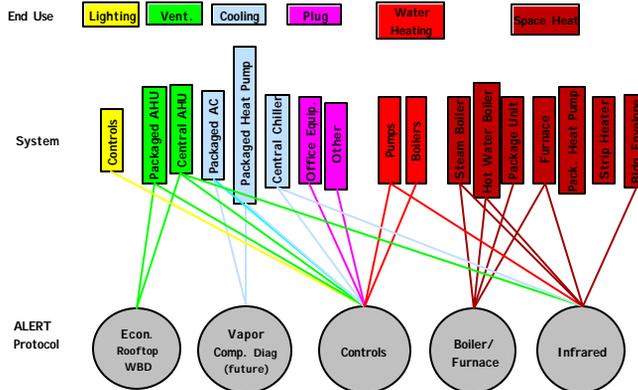
June 2 -5, 2002

www.energy2002.ee.doe.gov

8



Targeted Protocol Candidates



June 2 -5, 2002

www.energy2002.ee.doe.gov

9



Protocol Candidates (1 of 3)

- Facility controls
 - Preferably perform on EMCS
 - Scheduling
 - Set points
 - Check sensors calibration
- Outdoor air economizer
 - Proper functioning of outdoor air intake during heating and cooling

June 2 -5, 2002

www.energy2002.ee.doe.gov

10



Protocol Candidates (2 of 3)

- Boiler/furnace checks
 - Heating plants and domestic hot water
 - Combustion efficiency
 - Overall plant thermal efficiency
 - O&M high impact items

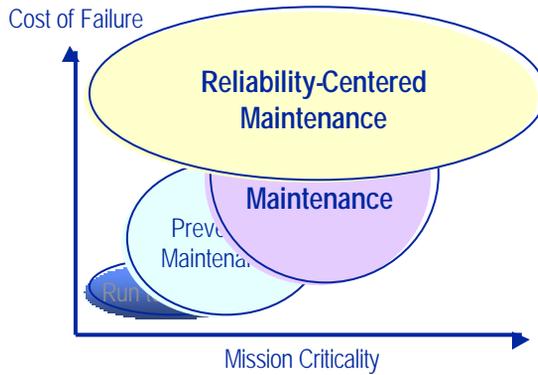


Protocol Candidates (3 of 3)

- Vapor compression diagnostics (future)
 - Refrigerant charge
 - Several checklists
- IR scanning
 - Electrical circuits
 - Steam traps
 - Envelope



What O&M level do you need?



June 2 -5, 2002

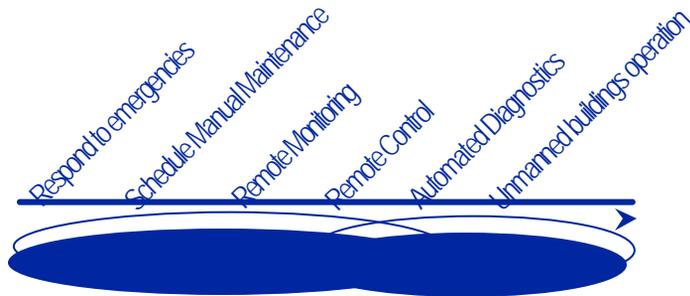
www.energy2002.ee.doe.gov

13



Migration Path

From Manual Checking to Advanced Diagnostics



June 2 -5, 2002

www.energy2002.ee.doe.gov

14



Agenda

- I. Overview
- II. Origins & Initial Results**
- III. Process
- IV. Protocols
 - Lessons Learned
 - Questions & Answers



Origins

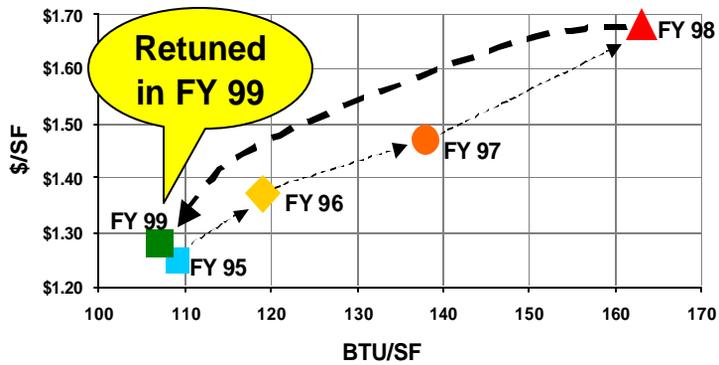
- Origins of the ALERT strategy
 - Corporate experience in DOE facilities helped FEMP define an ALERT process
 - California's energy price volatility and shortages drove FEMP to implement the ALERT process
- Many federal agencies and sites already have similar experience with retuning successes and energy cost problems



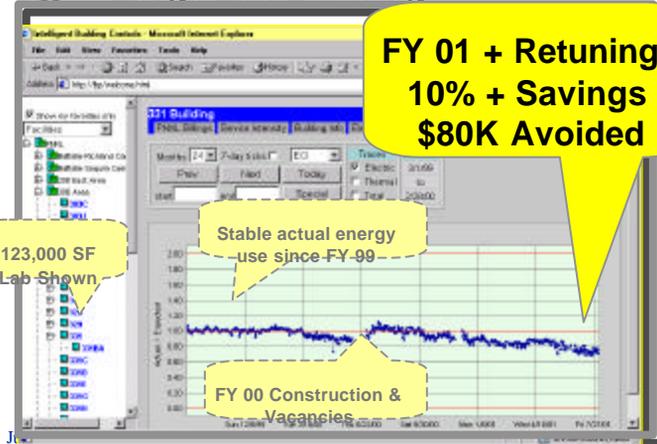
Corporate Experience: Large Office Building

Results of HVAC Retuning in a Large Office Building

100,000 SF "ETB" Building, Pacific Northwest National Laboratory



Corporate Experience: Large Lab Building





ALERT Test Confirms Potential

HVAC Problems Encountered	Qty of Bids	Peak Impact?	kWh Impact?
Schedule runs HVAC after office hours	5	-	x
Temperature sensors are out of calibration	3	x	x
Control programming is installed but not activated	3	x	x
Control programming lacks key manual inputs	3	x	x
Economizers failing	2	x	x
Unneeded outside air is drawn into building	2	x	x
Demand-controlled operation	1	x	x
System functions are redundant	1	x	x
Chiller water resets not used	1	-	x
Heat transfer surfaces dirty	1	x	x
Insufficient outdoor-air temperature sensors	1	x	x
Heat/Cool temperature deadbands too narrow	1	-	x
Leaking heating/cooling valves	1	x	x

June 2 -5, 2002

www.energy2002.ee.doe.gov

19



Test Finds Potential Savings

Building	SF	Age	Estimated Potential Savings		
			% kW	% kWh	% \$
University library	212,000	6	14%	17%	19%
GSA/DOE office	360,000	38	1%	1%	1%
BPA office	381,000	40	3%	1%	1%
GSA/Courthouse	201,000	67	5%	1%	2%
GSA/Courthouse	565,000	4	7%	8%	6%

June 2 -5, 2002

www.energy2002.ee.doe.gov

20



Retuning: Feasible & Affordable

- O&M departments have the discretion, flexibility, and opportunity to redirect some of their work to HVAC retuning
- Some building systems can be scaled down without disrupting occupants
 - Thermostats have a range of settings
 - In contrast, lights typically either on or off
- O&M departments sometimes directly reap the energy cost savings

June 2 -5, 2002

www.energy2002.ee.doe.gov

21



Cost/Benefit Concept Chart



June 2 -5, 2002

www.energy2002.ee.doe.gov

22



California Energy Crises

- Management's objective: quickly address electricity reliability issues ... be part of the solution:
 - help prevent power outages
 - help contain rapidly rising energy costs
- The FEMP team evaluated the situation and the quick response options ...

June 2 -5, 2002

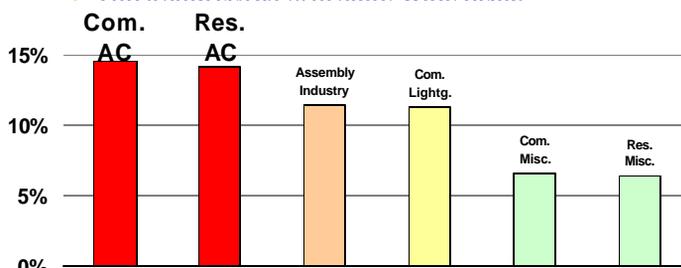
www.energy2002.ee.doe.gov

23



California Major Peak Loads

- CEC's 2001 peak load forecast by source
 - 56,000 megawatt total peak demand state-wide
 - 33 sources
 - Top 6 sources as % of state-wide peak:



June 2 -5, 2002

www.energy2002.ee.doe.gov

24



FEMP Response To CA's Crises

- Developed protocols for building systems and components to assess in the field
- Created spreadsheet templates for estimating Time Of Use energy & cost savings
- Mapped utility incentives for the sites
- Selected 25 sites and performed the ALERT site assessments

June 2 -5, 2002

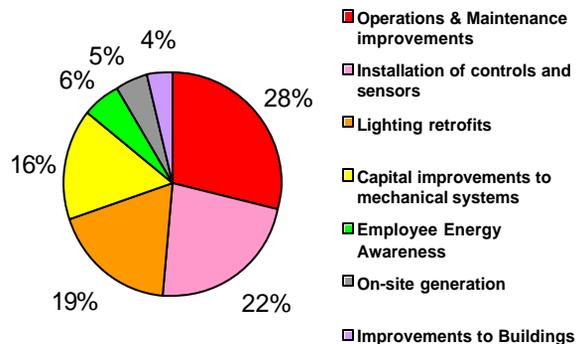
www.energy2002.ee.doe.gov

25



California Recommendations

Frequency of Recommendations for the 25 Sites





Sample O&M Recommendations

- Revise operation schedule for central cooling systems and fans
- Reset chilled water setpoint
- Repair/replace motors, dampers, sensors and gauges
- Clean heat exchanger coils
- Cycle air handler units
- Balance air systems

June 2 -5, 2002

www.energy2002.ee.doe.gov

27



California Estimated Savings

Average estimated potential savings for the 25 sites:

- Demand (kW)– 9.1%
- Consumption (kWh)– 11%
- Cost – 9.9%

June 2 -5, 2002

www.energy2002.ee.doe.gov

28



Some of the California Results

- USDA, Albany, CA
 - Achieved a 20% reduction last summer and received a 20% rebate on their bill.
- MCAS Pendleton, Oceanside, CA
 - Obtained grant for \$18K for HID lighting/sensors
- IRS Service Center, Fresno, CA
 - 6%-18% reduction in energy during summer of 2001 compared to summer 2000



ALERT FY 02 Vision

- More emphasis on heating efficiency
- Continued emphasis on controls
- Greater use of portable metering
- Deployment to any location in US
- Training agency staff to do ALERT



Agenda

- I. Overview
- II. Origins & Initial Results
- III. Process**
- IV. Protocols
 - Lessons Learned
 - Questions & Answers

June 2 -5, 2002

www.energy2002.ee.doe.gov

31



III. ALERT Process

FEMP's Overall Steps:

1. Market to Agencies/Sites
 2. Request & Screen Sites
 3. Select & Assign Sites
 4. Prepare for Site Visit
 - 5. Visit/Assess Site**
 6. Document
 7. Issue Final Report
 8. Identify Opportunities
 9. Follow Up
- Discuss with staff:
 - Bldg condition issues
 - Control systems
 - Energy supply & cost
 - O&M and projects
 - Building area priorities
 - Assess building(s)
 - Apply checklists
 - 1-3 person -days
 - Debrief with staff

July 1-4, 2002

www.energy2002.ee.doe.gov

32



Prepare

- Collect data to be prepared for site visit
- Determine authority/responsibility for facility operations
- Establish Expectations



Site Interview Record

- Part I: Informational Interview
 - Conducted by the Regional Office
 - Screening site
- Part II: Team Leader Interview
 - Conducted by the Team Leader
 - Setting expectations with the site
- Part III: Building Information
 - Conducted by the ALERT Team
 - Gathering the details (incl. Attachments 1 & 2)



Site Interview - Review

- Affirm goals:
 - Energy cost containment
 - Peak load management
 - On-site generation
 - O&M practices and costs
- What are the trouble areas?
 - Rising costs
 - Power reliability
 - Comfort complaints



Prepare (continued)

- Establish Plan
 - Adapt checklists to site conditions
 - Organize protocols
- Schedule Site Visit and Team
 - Facility, O&M and energy managers
 - Site mechanical engineer
 - HVAC controls expert & equipment operator
- Pack the toolbox



Sample Instruments

- Infrared (IR) Gun
 - surface temperature measurement
- Watt Meter
 - simple power demand and consumption measurement
- Ballast Detector
 - magnetic or electronic
- Light Meter
 - light level readings
- Window Coating Detector
 - indicates low-e coating on which surface



June 2 -5, 2002

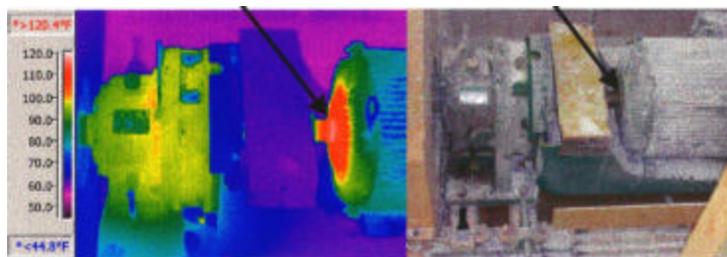
www.energy2002.ee.doe.gov

37



Infrared Camera/Video

Warm inboard motor bearing:



June 2 -5, 2002

www.energy2002.ee.doe.gov

38



Visit Site & Conduct Protocols

- Kick-off meeting with site staff
- Tour facility
- Review operation and occupancy schedules
- Site Interview Record
 - Review Parts I and II
 - Complete Part III: Building Information
 - Complete Attachments 1 & 2

June 2 -5, 2002

www.energy2002.ee.doe.gov

39



Site Interview – Sample of Data

- Building occupancy & work schedules
- Operation staff
- Buildings: HVAC, condition, inventory
- Building controls: what is automated?
- Largest and critical end-uses
- Energy cost recharge method
- On-site generation
- Facility projects – past and current

June 2 -5, 2002

www.energy2002.ee.doe.gov

40



Conduct Protocols

- Identify potential measures
- Target areas for data collection
- Apply protocols
 - Centralized building controls
 - Economizers
 - Infrared Thermography
 - Boilers



Conduct Protocols (continued)

Seek other no-cost/low-cost measures:

- Lighting
 - Reduce number of lamps in over-lit areas
 - Refine schedules for indoor and outdoor fixtures
 - Identify non energy-efficient equipment
- Timers on electric appliances
 - Battery chargers, water heaters, water coolers, and vending machines
- Equipment Repairs
 - Dampers
 - Sensors



Site Visit (continued)

- Check other scheduling opportunities
 - Alternate work schedules, additional shifts
- Identify longer-term projects
 - Distributed generation
 - Equipment replacement
 - Building envelop measures
- Debriefing meeting with site staff



Identify Opportunities

- Implementation
 - Facilitate negotiation with O&M contractor
 - Utility & Public Benefit Fund grant applications
- Project Development Opportunities
 - Connect with other FEMP services
 - Design assistance
 - Alternative finance projects
 - Awareness campaign materials



Funding Opportunities

- **Utility & Public Benefits Funding**
 - Energy Efficiency Rebate Programs
(lighting, mechanical equipment)
 - Demand Response Programs
(standby generators, real time pricing)
- **Program Information Sources**
 - FEMP Energy Management Website
(State-by-State description of programs)
<http://pnnl-utilityrestructuring.pnl.gov/energymanagement/energymanagement.htm>



Agenda

- I. Overview
- II. Origins & Initial Results
- III. Process
- IV. Protocols**
 - Lessons Learned
 - Questions & Answers



Protocols

- Checklist Protocols:
 - HVAC including chillers and economizers
 - Boilers
- Software Protocols:
 - Pacific Gas & Electric's Excel template for economizers
 - Whole Building Diagnostician application for buildings/components, and for economizers

June 2 -5, 2002

www.energy2002.ee.doe.gov

47



HVAC Checklist

Screen shot of section for economizers:

	<input type="checkbox"/> Check to see that the economizer system is running at minimum fresh air settings. Decrease RAS to minimum. ODA. 1. Decrease ODA temp to high value. 2. Decrease ODA temp to mid/low. 3. Look at damper position in RAS to see if it closes. 4. If dampers may stick and at what apparent position they may be.	If economizer active during warm-up, it should be off or closed during morning warm-up before staff arrives to work.
Econo- meter	<input type="checkbox"/> Take following Air Temp to verify minimum mod air. Check mixed air ducts by using temperatures of return, mixed and ODA. Fraction = Mix Rwy/ODA-Frn. If above 10% getting too much ODA. Lower minimum position. Note mixed air temperature set point does not play a part at this mode of operation so would not need to be checked unless mixed air temperature is below 40 degree. Then heating may be in effect.	Return air temp = _____ Mixed air temp = _____ Outdoor air temp = _____ OAF = _____ = _____%
	<input type="checkbox"/> If ODA temperature is below 45 to economize running in economizer mode. Check to see if dampers are modulating or stuck or leaving at set points or stuck.	Damper modulating or stuck: _____ If economizer active when building is unoccupied?

June 2 -5, 2002

www.energy2002.ee.doe.gov

48



Economizer Protocol Options

- ALERT HVAC checklist: temperature spot checks and simple calculation
- Data loggers and spreadsheet analysis
 - Use site's existing controls system or HOBOS
 - Input into PG&E's Excel template
- Integrated, portable logger & analysis
 - Rooftop A.C. Packaged Unit Diagnostician device
- Permanent, automatic, and complex-wide monitoring and diagnostics
 - Install Whole Building Diagnostician software

June 2 -5, 2002

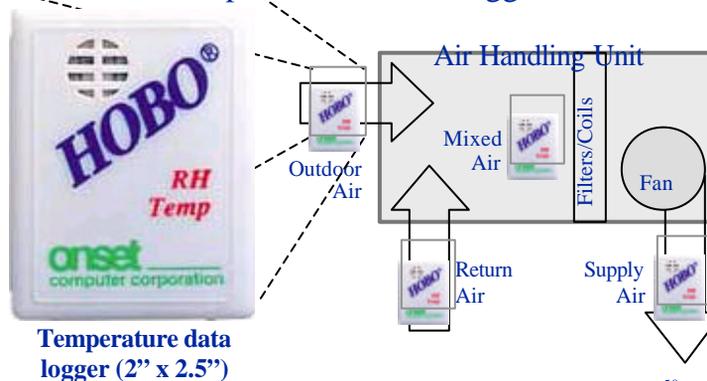
www.energy2002.ce.doe.gov

49



PG&E Protocol – Get Data

- Place 4 temperature sensors/loggers:



50



PG&E Protocol – Evaluate Data

- Put data in PG&E's Excel template to evaluate economizer performance

Input some more information

See the results

Project Data		Results	
Project Name	Your Project	Hours in Monitoring Period	
Minimum OA Percentage	20%	Total	360
System CFM	10,000	Total Occupied	150 42% of total hours
Supply Air Setpoint	70°F	Total OK	142 95% of occupied hours
Start of Day	8:00 AM	Too little OSA	111 74% of occupied hours
End of Day	5:00 PM	Too much OSA	3 2% of occupied hours
Weekends?	<input type="radio"/> Yes <input checked="" type="radio"/> No		

- Future: add tab to estimate cost-impacts

June 2 -5, 2002

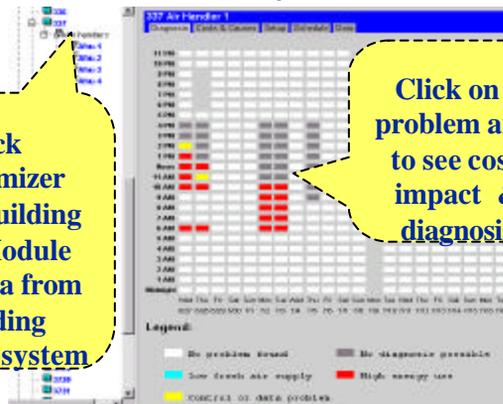
www.energy2002.ee.doe.gov

51



Whole Building Diagnostician - Economizer Performance

Pick economizer from building list. Module gets data from building control system



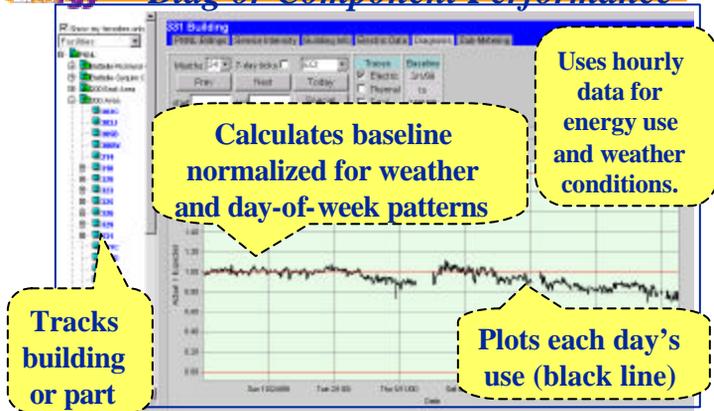
June 2 -5, 2002

www.energy2002.ee.doe.gov

52



Whole Building Diagnostician – Bldg or Component Performance



June 2 -5, 2002

www.energy2002.ee.doe.gov

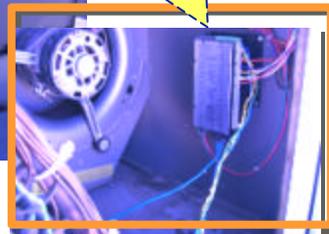
53



Rooftop Diagnostician Device



Rooftop-Unit AC Diagnostician installed in unit



June 2 -5, 2002

www.energy2002.ee.doe.gov

54

Diagnostician Report Via Web

Each device has own IP address

Click tabs for data

Diagnostic performance note

Click on image areas to see data pop-up

Unit ID	Status	Checked
2400 stevens/air handler 31	Low outdoor air is being supplied	Thu Jul 12 08:18:01 PM 2001

55

Agenda

- I. Overview
- II. Origins & Initial Results
- III. Process
- IV. Protocols
- **Lessons Learned**
- Closing Info and Questions

June 2 -5, 2002 www.energy2002.ee.doe.gov 56



Lessons: Ideal ALERT Building

- Is 5-10 years old:
 - Automated & integrated controls for most of building
 - But not implemented or used well
- Has large spaces: large air conditioning systems (e.g. chillers, not window units)
- Has a facility manager with funds, authority, and will to make changes



Lessons: Team Members

- Include a HVAC controls expert
 - Makes control changes now and/or advise site staff on what to do
 - Trains staff to do more retuning
 - Advises staff on advanced monitoring and diagnostics
- Site/Field staff are key team members
 - help them and make them look good
 - Key for site visit & follow-up



Lessons: Process

- Stay focused on lower-cost measures with high impact
- Implement ALERT recommendations during site visit
 - or help staff do ASAP after visit
- Get good energy and building data
 - Measure building performance before tuning, after retuning, and for long term
 - Get blueprints, control diagrams, bills



Lessons: Last Interesting Points

- Myth: “New buildings run better”
 - We only presume they run better
- Don’t believe everything you are told
 - e.g. HVAC schedules rarely match people
- Organizational barriers are common
 - Leases, O&M service contracts, and internal subdivisions between O&M and utility departments and their budgets
- ALERT strategy can quickly save costs
 - Savings like projects - but cheaper, faster



Agenda

- I. Overview
- II. Origins & Initial Results
- III. Process
- IV. Protocols
 - Lessons Learned
 - **Closing Info and Questions**



Information Resources

- Websites
 - http://groups.yahoo.com/group/alert_fy02
 - <http://www.eren.doe.gov/femp/techassist/>
- Program Documents
 - Report findings
 - Protocols/Checklists and tool information
 - Energy and cost templates
 - Utility incentive summaries



How to Get an ALERT Study?

- FY 02: Still a few openings for a site to get an ALERT assessment
 - Contact your DOE Regional Office
 - Complete the screening questionnaire
- FY 03: Watch for FEMP's FY 03 call for project requests
 - ALERT will be included under "O&M"

June 2 -5, 2002

www.energy2002.ee.doe.gov

63



Questions and Comments?

- Technical Assistance
- Design Assistance
- ESPC
- ALERT



Central:	Randy Jones	303-275-4814
Mid-Atlantic:	Claudia Marchione	215-656-6967
Midwest:	Sharon Gill	312-886-8573
Northeast:	Paul King	617-565-9712
Southeast:	Doug Culbreth	919-782-5238
Western:	Cheri Sayer	206-553-7838
National:	Ab Ream	202-586-7230

June 2 -5, 2002

www.energy2002.ee.doe.gov

64