ACHIEVE MULTI-BENEFITS USING THE COMMISSIONING PROCESS FOR RETRO-COMMISSIONING OF BUILDINGS

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Owners and Others are Evaluating Existing Building

- Objective is to reduce energy cost, identify maintenance and repair needs, sometimes fire/life safety, or to determine potential for rehab.
- Why not use the same quality evaluation approach used for new buildings?

Owners and Others are Evaluating Existing Building

- The commissioning process: Identifies energy opportunities, use change or upgrade opportunities, maintenance and other needs of the building.
- Provides information on all economic benefits.
- Plus it has maximum input from all stakeholders at a low cost.
- Plus it leaves the same quality documentation in the form of an effective systems manual.

Using Guideline 0-2005

- Broadens the scope and benefits of retro-commissioning
- Allows formal format for all projects
- Usually identifies more energy and maintenance opportunities than traditional approaches of (retro-commissioning)
- Provides engineering, operations, and maintenance information in a usable Systems Manual

Key Differences

- Does not assume the original design intent and basis of design was correct for the current usage of the building or facility
- Uses a Team vs. an Expert
- Allows the use of many quality tools for identification and optimization

Table 1

- This is the comparison of using the commissioning process steps in Guideline 0-2005 as an approach for improving existing buildings and facilities.
- This is typically referred to as retro-commissioning in US

Table 1

- However, traditional retro-commissioning was energy cost reduction orientated, without looking at the functional use of the facility
- A discussion of the comparison of the two retro-commissioning approaches is not included in this paper

hase	The Commissioning Process	Retro-Commissioning
re-Design	Develop the OPR, CxPlan with CxP team lead by the CxA and develop the programming document.	Develop facility needs, potential changes, and energy/IAQ/EOM opportunities with a team, lead by the CxA. The retro-commissioni plan includes OPR for the facility.
esign	Verifies that the design meets the OPR and assist with developing construction phase requirements in the documents that will allow effective commissioning process activities in the construction phase, turnover, and during occupancy Finalize Design	Develop data to determine the benefit of changes, including maintenance, repair, tuning, and modifications to the building asse or systems. During this phase many opportunities will be identified can be immediately implemented without budgeting or expending a funds. Develop the retro-commissioning implementation document
onstruction	Construct the building or facilities	Implement the retro-commissioning document requirements (this m be done over a number of years, as some items may require capital budgeting that have a long term payback or low, but effective productivity benefits to the users)
urnover	Commissioning activities to verify that all construction is complete and functional tests are performed with results satisfactory to meet the OPR	A verification and acceptance procedures are developed, using statistical sampling for all retro-commissioning items or opportuniti from owner's staff tuning to construction projects. Construction projects may use the commissioning process, with some streamlinin especially where the retro-commissioning is done through a performance contract
ccupancy	Develop procedures to continuously maintain and operate at the level of current and future needs. First year specific tasks will be verified by the CxTeam, including lessons learned and what is required for the on-going commissioning of the building's assemblies and systems for the life of the building	Implement procedures to assure the benefits of the retro-commissioning process are continuously maintained. Do a lessons learned workshop and report to assist with improving all other retro commissioning projects. Since retro-commissioning implementatio may be achieved through several delivery means (owner, service contract, contract, or performance contract) there will be several separate construction and occupancy phase RCxP documents and plans.

The Commissioning Process

- It is not “startup commissioning”
- It is an owner’s quality process for evaluating existing buildings and verify needs are achieved.

The Commissioning Process

- It is a formal approach to delivering quality buildings at a reduced cost and improved users satisfaction
- It uses a team and provides benefits to all stakeholders: owner, architects, engineers, contractors, vendors, service, operations.

Case Studies

- Executive Office AHU
- Identified Opportunities
  - 3-way to 2-way valve control
  - Disable the duty cycling
- Benefits
  - Energy
  - Operations and Maintenance
  - Productivity

AHU

- Typical 40 year old AHU
- Operations modified by a number of different O&M staff

Benefits of Disabling Duty Cycling

- Energy
  - Duty Cycling:

(1000L/s*870Pa t.p.)/(1.023* 10^6*0.85 fan eff.)* 0.5 operating ratio = 0.5 kW/1000 L/s (0.236kW/1000 cfm)

  - Continuous Run, at 50% of airflow:

0.5 kW/1000 L/s * 2 (double operating time) * 0.25 average power ratio reduction = 0.25kW/1000 L/s (0.12kW/1000cfm)

Energy Savings

- Do to existing turndown of thermostats, it is estimated the net savings are: 0.6kW/3840L/s (0.6kW/8200cfm)

- Operating Hours per Year: 3000

Net Saving:0.6kW*3000*0.12 ~ $200

Productivity Savings

- Operations and Maintenance
  - Reduced service calls (comfort complaints)
  - 60 or more per year

60 calls/year * 65/call = $3,900/year

Productivity Benefits

- Based upon informal feedback, it appears that the temperature discomfort was a daily occurrence and lead to daily “stop work” discussions or even leaving the office for extra breaks
- There is also some direct lost related to distraction at the work station or desk
- There may have been some lost of customers, as this was an executive office for the organization

Productivity Benefit

- A conservative estimate is that 5% productivity loss was related to the selected Duty Cycling control strategy
- At least everyone is more satisfied, and few complaint calls, and usually related to other issues

40 Associates*$1,600/year = $64,000/year

Summary

Energy Benefit = $ 200/year

Operations Benefit = $ 3,900/year

Office Productivity = $64,000/year

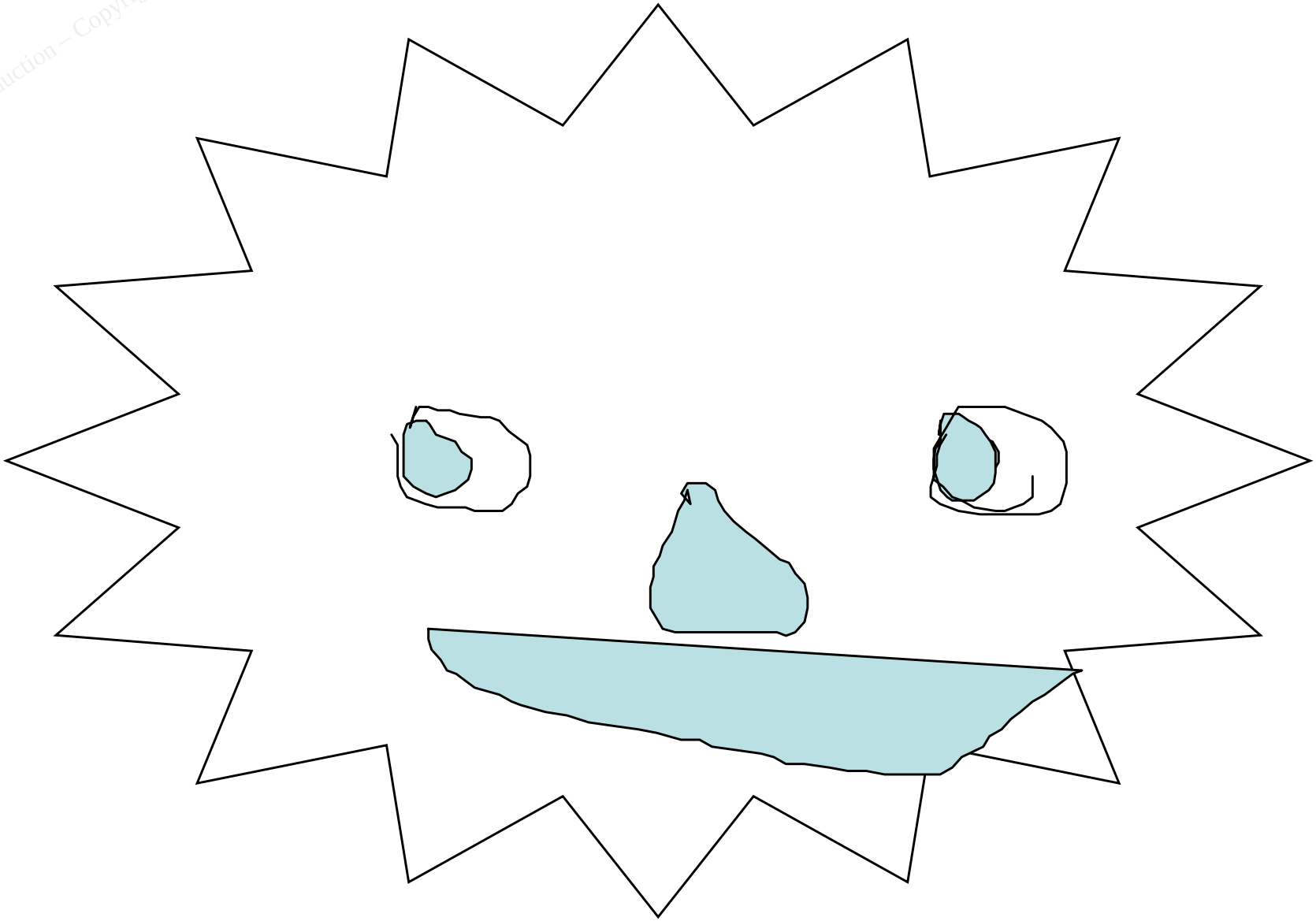
Even if Productivity is only 1%, it is still the major benefit, and it is often 10-15%, large dollars.

Conclusion

- Using the team and proven methods of the commissioning process for doing retro-commissioning provides more benefits to the owner, and provides the documentation to make evaluations beyond just energy dollar savings.

Finished

- Questions



Total Facility Energy Reduction

- Large Resort Hotel in California
  - Estimated energy opportunities by traditional expert lead approach, was about 10%, based on experience at other similar hotels
  - The retro-commissioning approach identified 27% energy reduction opportunities

Total Facility Energy Reduction

- Large Resort Hotel in California
  - Plus, it identified operation and maintenance opportunities
  - In addition, it lead to well trained staff that could perform a large majority of the energy conservation (cost saving) opportunities (ECOs)

Total Facility Energy Reduction

- Large Resort Hotel in California
  - It concentrated on documentation that required revision and organization
  - Discovered that one BAS was no longer supported by the manufacturer and would not be able to be reprogrammed to meet some energy opportunities, until it was upgraded or replaced

Lighting

- Watts Reduction
- Dimming
- Reduced Time On
- Daylighting (really watts reduction)
- Reduced maintenance and cost of lamps

em	Description	Demand kW	Usage kWh	Maintenance	Annual Energy Cost Reduction	Cost to implement	SPB
candescent ghts	126 incandescent lamps installed, of which 366 are non-dimming and should be replaced with compact fluorescent fixtures, saving 48 watts per lamp	36kW	52,980	Reduced annual reduction, related to long life of lamps, not included in initial cost benefits. Can be as much as energy cost savings, especially with group replacement	$5,828	$3,276	0.56

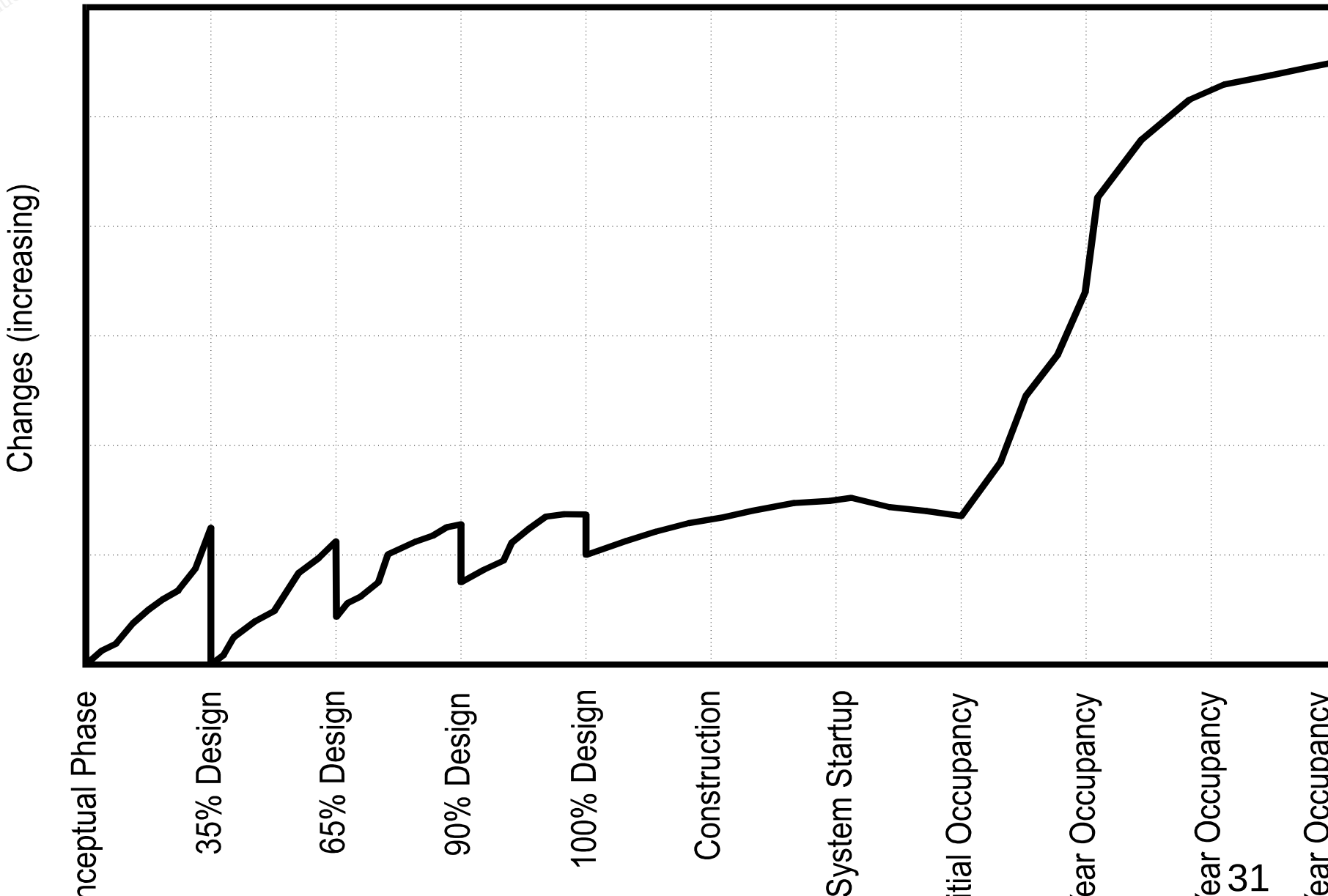
Vacuum Cleaning

- Improved IAQ
- Use best HEPA filter vacuum
- Vacuum most areas weekly, high traffic daily
- Vacuum walls once a month (tricky)
- Save energy, labor, and improve IAQ

Savings from Vacuum Program

- Approximately 50% of current Janitorial cost, which results in $0.23/sf/year or $23,000 per 100,000 sf

Why Should New Buildings (1-3 yrs) Be Recommissioned?



Other Opportunities

Develop Project Intent/Project Requirements

- First step is to determine the facility needs
  - BR (building requirements)
  - OFR (owner's facility requirements)
- This leads to developing the retro-commissioning project intent or project requirements.

Develop Retro-Cx Project Intent

- This has not usually been documented for the existing building, however there may be a programming document that is of some use
- Our goal is to details current requirements of building systems and maybe some building assemblies (example windows and roofs)
- Need to make sure the PI Workshop or Process does not focus on existing problems
- Must focus on building or facility needs

Project Intent Workshop Questions

- What are functional needs of this building
- List conditions important to your comfort in an ideal building.
- What activities generate pollutants in this building (school and community)?
- What functions must the heating and air conditioning system perform?
- What problems with heating and air conditioning systems have you experienced in other school buildings that you would like to avoid?

Project Intent Workshop Questions

- If you become uncomfortable in the building, what do you do to solve the problem?
- List your top five concerns/criteria from the entire discussion today.
- What is required for a maintainable system?
- What efficiency/quality benchmarks must the system meet?
- What must your manuals provide/accomplish?

Project Intent Workshop Questions

If energy conservation is a key or primary reason for the retro-Cx

- What are operation and maintenance level energy opportunities
- What are low cost energy opportunities (simple payback in 2 yrs)
- What are capital level opportunities
- How does this building waste energy?

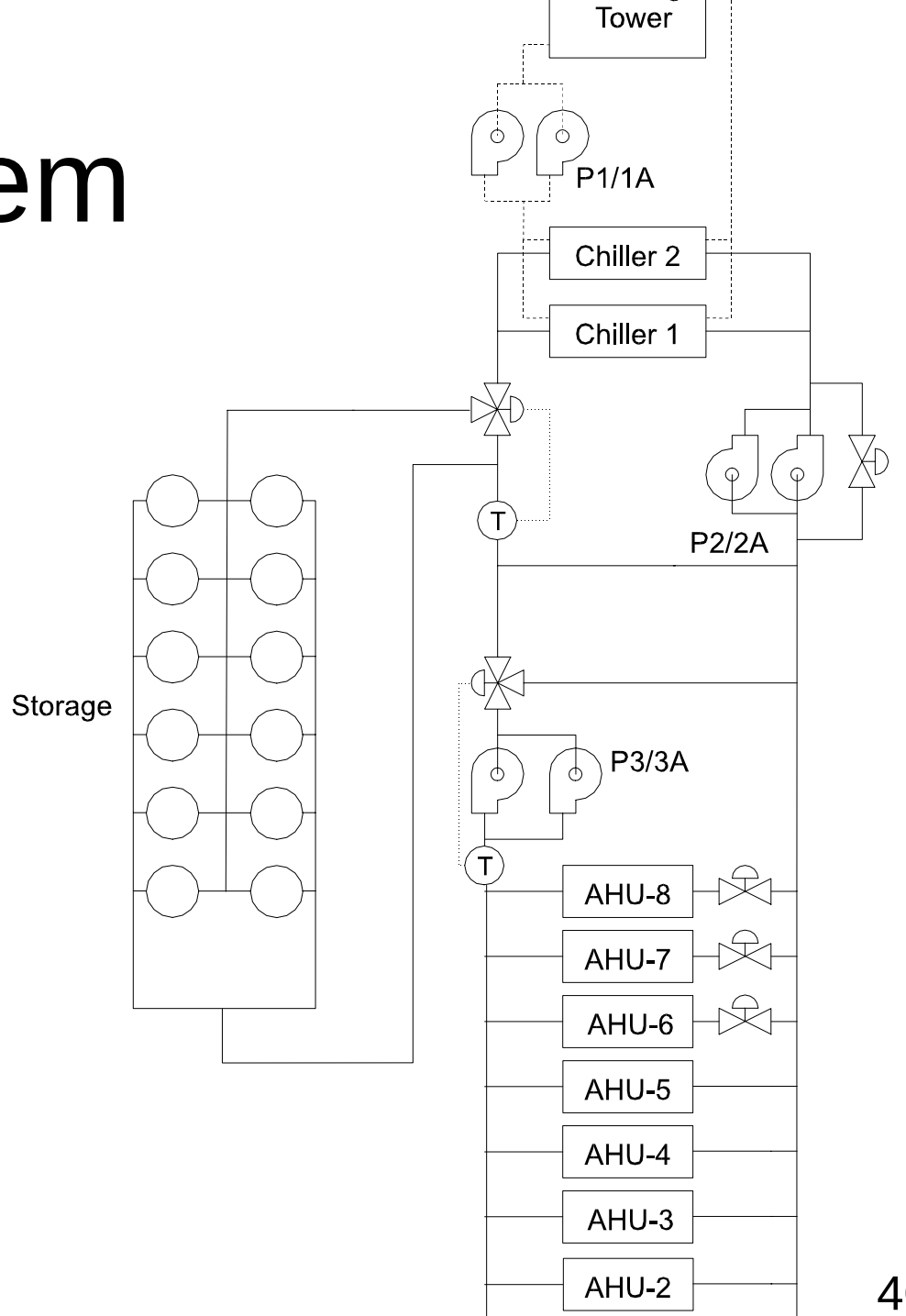
Case Studies

- Thermal energy storage (TES) system
- Medical facility

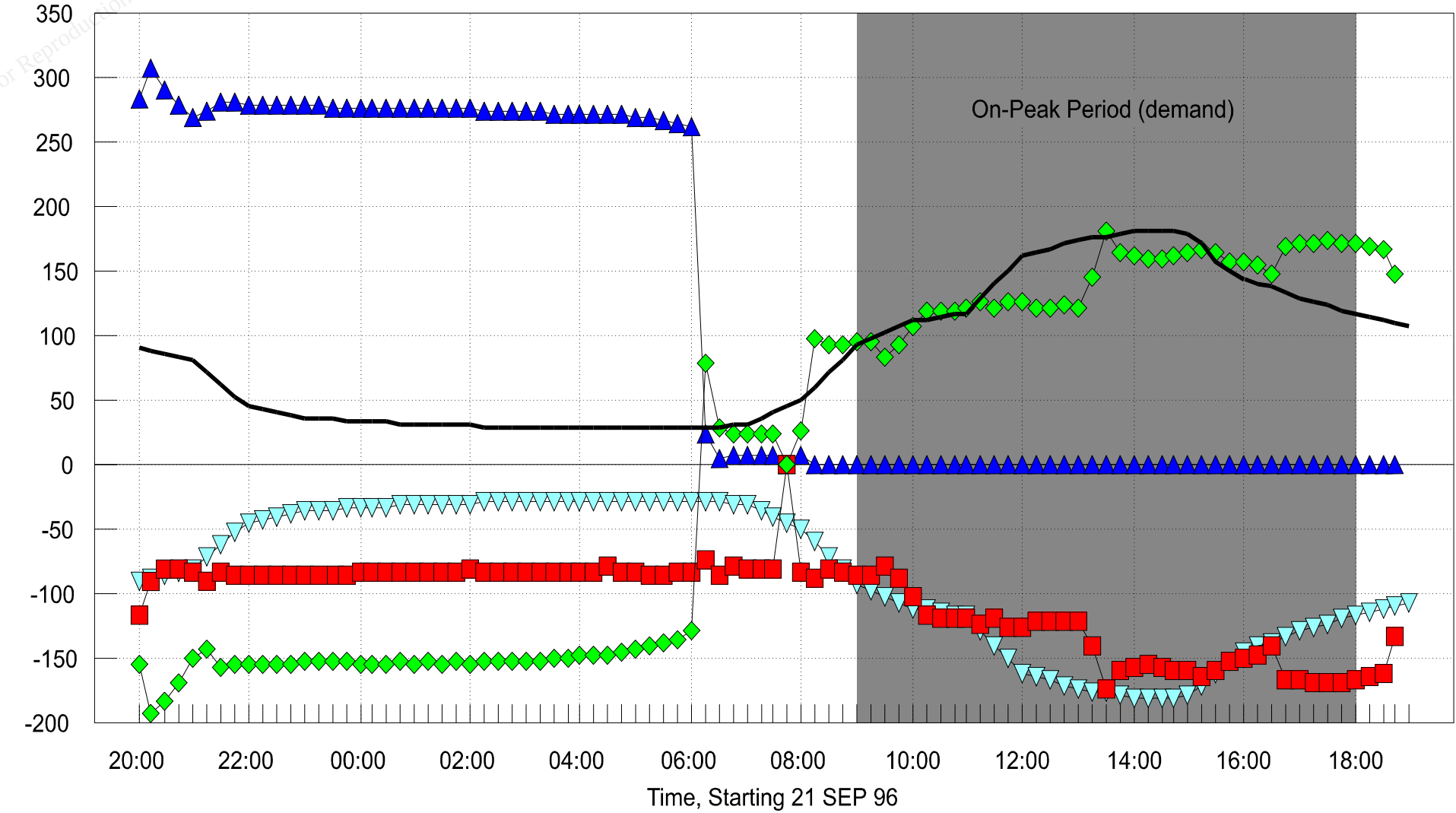
Why Commissioning Initiated

- TES was installed with the last addition to the studio
- However, energy cost were much higher than projected

TES System Layout



Verification Test



TES System - Opportunities Identified

- TES differential temperature increase
  - Install VSD on secondary pumps and control valves on air handling units
  - $20,400/year savings at a cost of $17,500
- Control system adjustments
  - Adjust set points and control outdoor air
  - $2,400/yr. savings with in-house labor

TES System - Opportunities Identified

- TES tank piping insulation/repair
  - Insulate branch piping to tank
  - Install larger band clamps on branch piping
  - $800/year savings at a cost of $500
- Overall system improvements
  - Modify operating sequence
  - Add discriminator control (minimize reheat)
  - $10,050/year savings at a cost of $14,600

TES System - Results of Recommissioning

- Increased storage capacity by approximately 40%
- Reduction in energy use by approximately 20% (reheat)
- Verified operation of system through field test
- Developed useful Systems Manual

Other Benefits

- Staff re-trained and given systems manual to operate all systems
- Implement control sequence to quickly cool large studio, plus increased cooling capacity with 47 F supply air to this studio
- Eliminated an additional chiller that was part of a new studio addition under construction
- Satisfied a demanding producer, who did bring in a large revenue source to the studio.

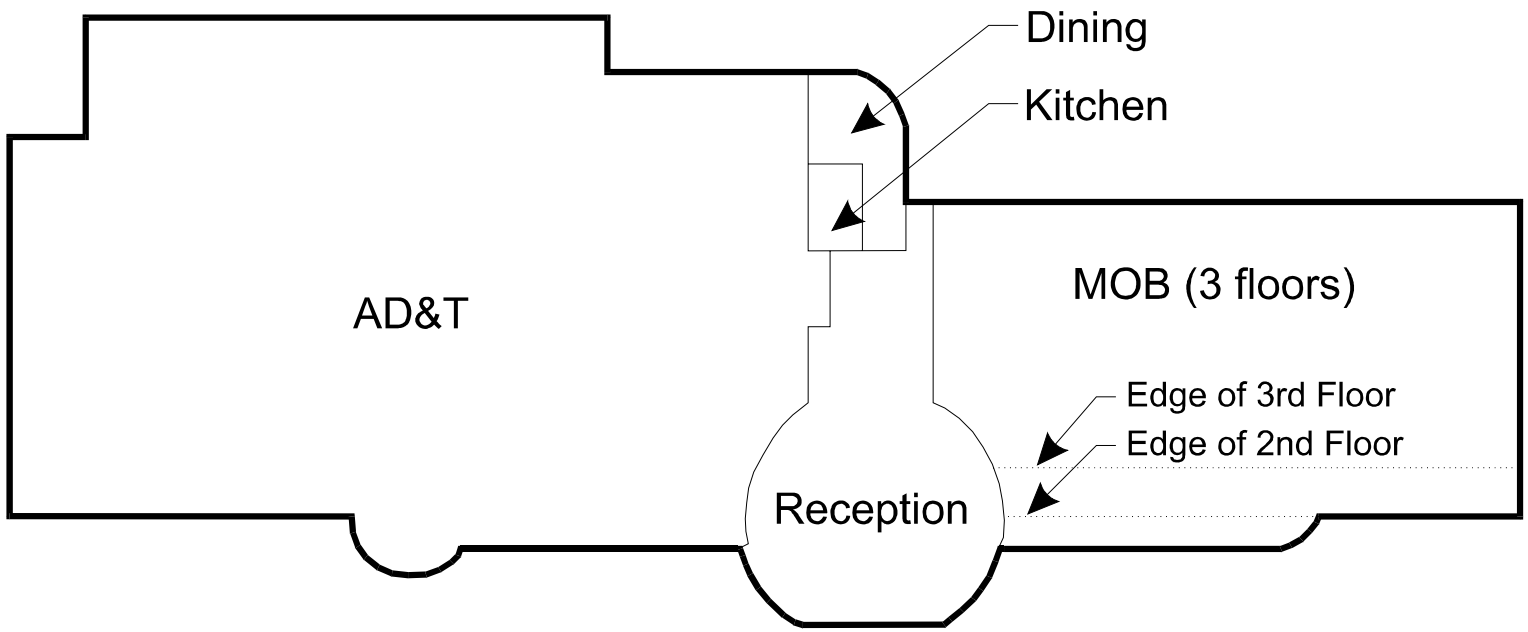
Medical Center - Background

- New medical center with out-patient surgery and offices
- Construction completion was two years after design was finished
- All new people hired to operate facility
- 60% occupied after two years
- Building was recommissioned at two year point

Initial Purpose that lead to Cx

- High steam usage was the problem identified by the hospital
- However, we convinced them to use the retro-commissioning process

Medical Center - Layout



AD&T = Ambulatory Diagnostic and Treatment
MOB = Medical Office Building

Medical Center - Opportunities Identified

- Modify steam system to match usage (5.7 year payback)
- Modify AHU control (1.4 year payback)
- Install active pressure control on surgery suites
- Install easy to read temperature in surgery
- Modify lobby airflow pattern
- Implement commissioning procedures on tenant fit-out

Medical Center - Opportunities Identified

- Install computer interface with existing Trane Tracer system
- Modify hot water freeze protection procedures
- Implement smoking area policy/system

Medical Center - Results of Recommissioning

- Most opportunities improved the space conditions and were not energy related
- Provided system documentation which was previously unavailable

Results

- If only energy issues addressed, then many facility issues would not be achieved and we would not be developing the systems manual for effective operations and maintenance of the facility
- For the TES case we would have only fixed the TES, which did not need fixing
- For the Hospital we would have only concluded that the steam use required a new smaller steam boiler

Energy Retro-Cx Examples

Small building: 100,000 s.f. office or school, 270kW demand

Cost for Retro-Commissioning (which includes verifying energy opportunities are being operated and maintained as required and provide continuous assistance to the operational staff or service contractor during the first year after implementation): $ 4.1K

Expected Savings for O&M and less than 3-year Simple Payback: $ 119K

Annual Electrical Energy Cost Reduction: $ 52K

Annual Gas Energy Cost Reduction: $ 10K

Demand Reduction: 38 kW

Energy Retro-Cx Examples

Medium Size Hotel: 300,000 s.f., 760 kW Demand

Cost for Retro-Commissioning (which includes verifying and assistance to the operational staff or service contractor during the first year after implementation): $ 28.7 K

Estimated cost to implement Savings for O&M and less than 5-year Simple Payback: $ 399 K

Annual Electrical Energy Cost Reduction: $ 142 K

Demand Reduction: 228 kW