

Building Re-Commissioning

Presented By

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Introduction

- Re-Commissioning is commissioning of existing buildings that were originally commissioned when built
- Retro-Commissioning is commissioning of existing buildings that have never been commissioned before
- The process is the same for both, but for ease we call it Re-Commissioning
- We may start to call it EB-Cx



- Experience tells how well / poorly the building has performed
 - Bench mark the building in terms of energy cost
 - *This is now easier for 7x24 facilities w/ PEU defined*
- Performance probably has degraded over time for many reasons
 - Change in personnel
 - Change in building purpose
 - Lack of support and training for the BAS
- Most problems start with a control system that was not completed to begin with



- Original system performance data may not exist anymore
- Building function / usage may have changed
- Original construction documentation may / may not exist



- Re-Commissioning focuses on known trouble spots or performance problems / less on equipment that appears to function properly or has not been problematic over the years
- Also, the control system should be thoroughly reviewed for potential improvements for energy efficiency & comfort
- ***Re-Cx does not mean you have to return it to its original state!!***



Who is the Re-Cx Team?

- Re-Cx provider is the team leader
- Building owner or representative for owner
 - *There must be a Re-Cx champion on staff!*
- Building O&M staff
- Utility Account Manager
- System specialists:
 - BAS contractor
 - TAB
 - Service contractors
 - Manufacturer's representatives



Re-Commissioning

- Rule #1 – Don't put it back to where it was on day one *(this is also the most common mistake)*
- Typically focuses on:
 - HVAC Systems & Controls (mostly)
 - Lighting Controls
 - Can include other problematic systems
- It is important to check with your utility for Re-Cx rebates – locally Xcel Energy, Platte River Power Authority & Colorado Springs offer rebates
- Evaluates systems operating characteristics and optimizes the operation and performance to meet current operational needs.



Benchmarking the Facility

- Establish your facility's energy consumption & cost in relation to the area average, taking into account size, type of facility & systems, age of facility & level of automation – ***this is very difficult the more unique a facility is.***
- Re-Cx provider can provide insight here along with a preliminary interview with staff concerning facility operation practices
- *Remember – being in the average is NOT the goal. There are too many poorly operated buildings that bring the average costs UP!!!*



EMS/BAS is large part of Re-Cx

- EMS/BAS is the biggest tool to use for Re-Cx
 - Trending and program analysis are most important
- Without EMS/BAS, data loggers and observation can be very helpful
- Make sure the EMS/BAS info is correct before relying totally on it (pressure, CO₂ & flows are generally a calibration problem)
- EMS/BAS support group being cooperative is essential



- 6 phases of Re-Commissioning include:
 - Phase I – Discovery
 - Phase II – Repair and Tuning
 - Phase III – Renovation Planning & Budgeting
 - Phase IV – Renovation Design & Construction
 - Phase V – Final Test & Tune
 - Phase VI – Training



Case Studies

- 1972 Office Building (CBD 520K) \$32K saved/\$6K cost
- 1984 Office Building (CBD 600K) \$58K saved/\$16K cost
- Gov't Building (Boulder) \$23K saved/\$32K cost
- Major Hospital (Denver Area) \$66K saved/ \$30K cost
- 1954 Office Building (CBD 450K) \$13K saved/\$12K cost
- 1978 Office Towers (Aurora 290K) \$31K saved/\$10K cost
- 1984 Office Building (CBD 1.2M) \$54K saved/ \$23K cost
- 1998 Office Building (DTC 275K) \$93K saved/\$77K cost
- 2003 Office Building (CBD 450K) \$56K saved/\$27K cost
- Average payback of 39 Re-Cx projects is 0.7 yrs



Re-Cx Examples of Measures

- Corrupted BAS programming for garage EF's
- CHW valve control not connected to SF status
- Garage temperature control setpoint up at night
- Return fans inlet vanes not hooked up
- Reduce minimum outdoor air for actual population
- CWSP of 65° won't allow CRAC economizers to operate
- ***Every building will offer different opportunities***



“Top 10” Typical Re-Cx Opportunities

10. Improve boiler efficiency/controls
9. Reset supply air static pressure set-points
8. Terminal unit tune-ups – dampers & valves
7. Not having optimal start function enabled
6. Lower condenser water temps/improve chiller sequencing
5. Calibrate sensors and instrumentation
4. System level test & balance (over air, over pumping)
3. Optimize/restore economizer operation
2. Eliminate simultaneous heating and cooling
1. Turn off equipment when not needed (Scheduled S/S)





BAS Upgrades or Retrofits

7X24 Exchange

Colorado Springs

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AGENDA

- **Overview**
- **Functional Software Requirements**
- **Technical Considerations**
- **Control Software**
- **Commissioning**
- **System Training**



In an Ideal World the owner wants:

- Fair pricing
- Great service
- One product
- A BAS that actually works and lasts longer than 5 years
- ***But how do we achieve this “HOLY GRAIL”?***



- Defining the BAS Design Criteria with the owner & the owner's operating staff is the first step to providing a quality, long-lasting building automation system. This process will help decide items of importance before the design and specifications are "set in stone".

- ***What is the "Mission" of the facility?***

BAS have impact on

- Occupant comfort
- Indoor environmental quality
- Life safety
- Energy efficiency
- Maintenance costs
- Occupant Productivity
- Facility value
- Bottom line \$\$\$\$\$



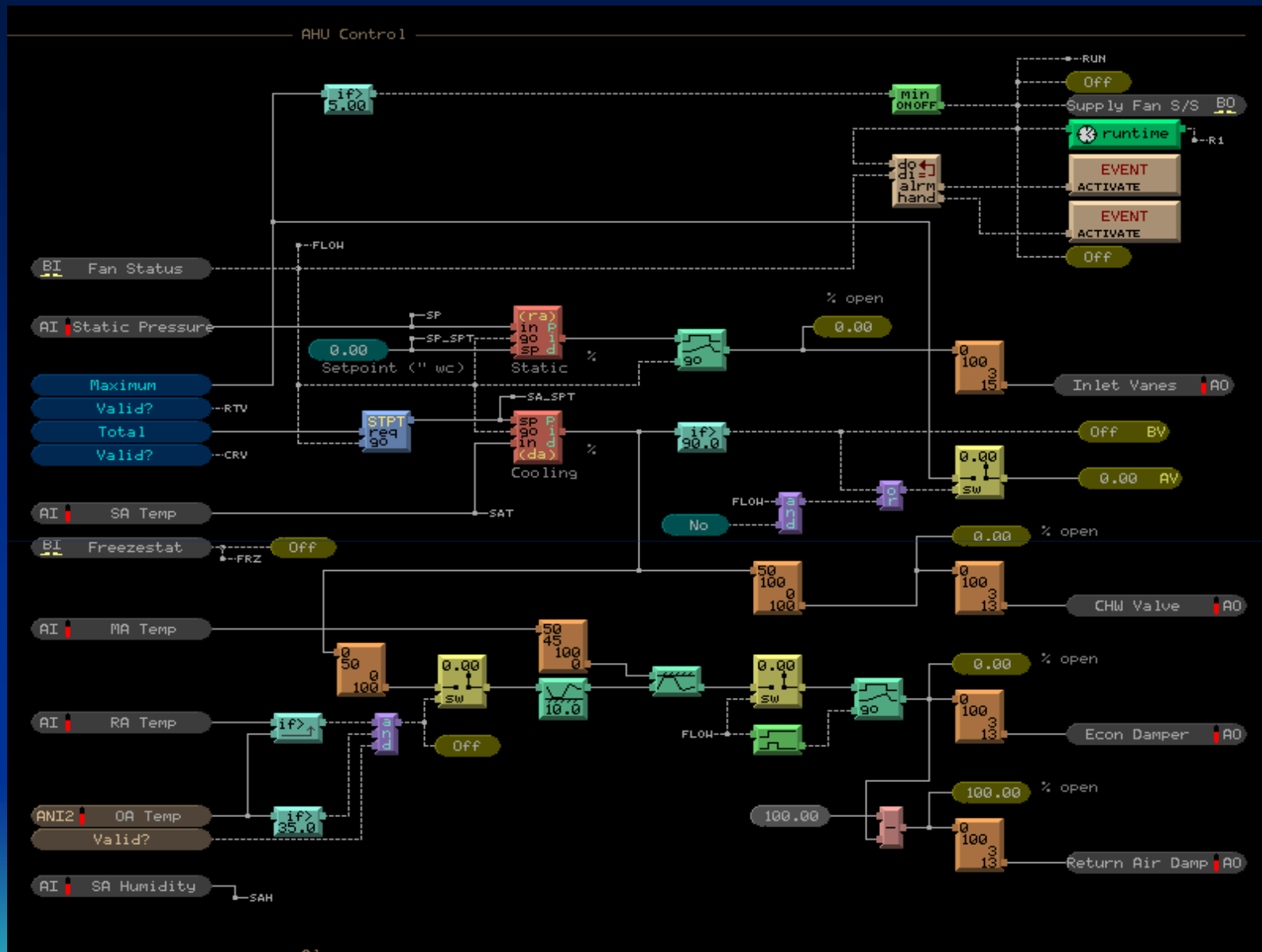
Open Book Pricing Plan

- This will help ensure a ***long-term financial arrangement*** beneficial to owner & vendor
- The plan should include the following
 - List price of DDC equipment & software with price multiplier
 - Markup (overhead & profit) for any parts not included in the manufacturers price list
 - Labor rates for various types of labor
 - Typical hours (or hour range) for typical tasks
 - "Open Book Pricing" plan duration plus any inflation factors proposed
 - Expect to sign a "non-disclosure" agreement

Functional Software Requirements

- Graphical user interface (GUI) is required.
- Fully programmable with an easy to use programming language.
- Programming simulation (ability to fully test program off-line prior to loading into controller).
- Live view of programming in operation & on-line parameter adjustment tools.





Functional Software Requirements

- ***Color graphics*** for all systems dynamically displayed upon request.
- ***Intuitive links*** will be provided on graphic screens to access other related areas, equipment or information.
- ***Alarm*** notification – through workstation, pager, cell phones and email.
- ***Trending*** ability for ALL points (inputs, outputs and virtual points)



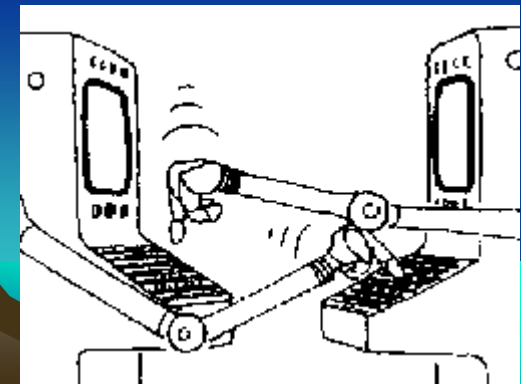
Technical Considerations

- ***Web based*** front-end software is required. All features will be accessible through a standard browser or wireless (cell phone, PDA)



Technical Considerations

- ***Interoperability*** with other building systems (fire, security, power, chillers, boilers, etc) is a must in today's world. Open systems make this easier
- Level of BACnet within BAS (BACnet PICS & BIBBS) to be submitted for approval
- Multiple ***OS's and databases*** should be available for use with the BAS



Technical Considerations

- The BAS should be *IT friendly* - adherence to IT/IP standards and minimal bandwidth demand
- BAS should support XML, SOAP, WSDL or RESTful for *Web Services & Enterprise* software integration.
- BAS should utilize “*open standards*” – top to bottom. Controllers (field and terminal) should allow for free-form programming - no “application specific controllers”



Control Software

- The primary principle for Sequences of Operation is the “**KISS**” principle.
- Program functionality to reside at the controller level for true ***stand alone operation***. No control sequences will be allowed at the system front-end or in routers/gateways.
- Any ***critical values*** common to the entire system (outdoor air temperature, humidity, life safety points) will duplicated on separate field controllers.

Control Software

- Each AHU and Central Plant system will have field controllers able to handle the larger point counts required
- All *manifolded* equipment that are to be controlled and sequenced together must be controlled from a *single controller*. Or does this conflict with redundant controller needs.



Control Software

- Optimization routines for major equipment operation based on the summation of loads (or maximum/minimum values) at the terminal unit level, then to the air handling unit level and finally to the central plant equipment. This is sometimes referred to as ***“load based control”***.



Control Software

- The contractor should be prepared to make *adjustments in the sequence of operation* at the time of commissioning. Systems seldom perform as intended and final configurations are seldom as designed initially.



Commissioning

- The contractor is expected to ***completely commission*** the building automation system
- The contractor will ***submit*** the commissioning procedure and blank log book for approval prior to starting commissioning work.

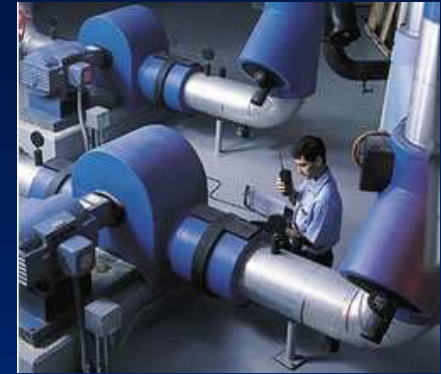


Commissioning



- Start with *verification* of the control inputs and outputs
- Each analog input and output will be properly *calibrated*. This means utilizing an independent certified temperature, pressure, etc. measurement device and performing at least a three point calibration.

Commissioning



- The ***sequences of operation*** will be tested in all normal modes and verified back to the final contract documents (***program simulation***)
- ***Loop tuning*** will be performed for all analog outputs under operating conditions. The P, I and D constants will be logged and noted which ones were utilized. “D” can be valuable.
- The alarms, safeties, failure and system re-start modes will then be tested.

System Training



- ***Adequate training***
- Training should take place ***over a one-year period.***
- The training will include both ***generic system and site specific*** training
- On-line and DVD based interactive training programs should be available for customer refresher training

Other Thoughts

- Occupant/Tenant Portals
- Wireless “mesh networks”
- Real Time Utility Pricing
- CMMS interface
- Real Time Energy Analysis



**Thank you for the opportunity to
present our views of these important topics**

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