ASHRAE TC 1.4 Control Theory and Application

Sub-committee: Control Components and Applications

Meeting Agenda: Sunday 28 June 2015

Meeting: 1500-1600, Sub Committee Chair Barry Bridges

SCOPE Includes: Components (Sensors, Actuators, Controllers, OWS), Networks, Control Applications Loops, Building management reporting

Components and Control Application "brainstorming session" lets TC 1.4 members and guests talk openly about issues and hot topics without being subjected to budgets or due dates.

Introductions Around the Room: Those in attendance verbally around the room and written on the attendance form provided with Name, Business affiliation. 24 Attended.

Announcement: TC1.4 sponsored Programs at SAM15:

Mini report from Seminar 6: Campus BAS Data Analysis. The program was well attended and comments were positive.

One presentation discussed the actual use of **BAS data to analyze system performance in three different campus setting**. Day to day comfort and intermediate load performance seemed normal without critical alarms to cause operations staff to take corrective action. In each case use of data directed service intervention that improved energy use. As an example the kW/ton for chillers on average was close to the prediction by the manufacture, but when individual identical chillers were compared to each other one was far below the performance of the other two. The data mining resulted in a detailed component review to find a partially closed valve.

The other presented the findings of **RP 1633 related to building interfaces and presentation of system data (aka the dashboard project).** The engineers identified what is used and identified what could be used for data visualization. There was good information, regarding what is important (energy cost per building was most important to all disciplines) but there was **not a lot of support (18 of 83 responded to a survey** asking what visualization was most useful) to move forward. A quote attributed to Henry Ford **"if you ask folks what they want they'll tell you faster horses"** seemed to point out the lack of imagination or interest in better use of BAS data. This brings up a question if ASHRAE can **codify by reference to GPC 13 Design of BAS** the requirement for advanced presentation options. If not then will progress be made because **owners become educated and pull for better use of data, or will vendors see a benefit in pushing a product that provides these types of features?**

In a related comment an informal survey of engineers attending a controls related seminar not sponsored by ASHRAE Out of **40 in attendance only 5 used dashboard displays.** The critical alarm is more typically the means of performance presentation.

An in house developed **airport dashboard** was created by an invested maintenance administration to let operations staff sees what is happening to energy and space conditions. These individuals in **O&M could, did take action, and effected change. The project had a 3-5 month payback.** The operations staff could see how well they were doing at playing this building performance game and they won.

The **control system may be complicated** but it needs to be made **easy enough to be used by the ops and show a reward for taking action**. To be effective the data collected and its presentation involves all systems and is integrated across disciplines. It needs to be a sophisticated system that is presented simply.

Implications for control as a basis for all disciplines getting together leads to integrated building design IBD: Examples include the major equipment vendors meeting with design to decide details as a group before the final bid package is sent out for bid. Another similar method is the **Pre-bid pow-wow that must include IT or it is cancelled.** This meeting before the acceptance of bidders and have an owner run meeting to **owner proclaim "thou shalt provide this specific OPR"** It is an open discussion to determine who will adhere to owner requirements, any who can't or won't are invited to leave. A third option is a **Submittal party** where the design team, vendors commissioning and owners review the submittals and work out all the issues between what was intended and what is proposed at one time.

Seminar 17 about Guideline 13 Design of BAS. The program include a great overview presentation of network control by Bernstein. In the Q&A **it was clear participants wanted to know more and were asking about training.** The IOT is creating an interest in how to use cell phones for BAS control. 20 years ago control was only 1% of whole building construction cost now it is 4%. The importance is increasing the two things you **remember about building is color and its control.** As the cellphone link makes control more transparent this becomes more important. Is there a good framework to let architects play with philosophy of control and IT into BAS needs…the gap is the **shift from hardware for BAS into a virtual machine**.

At the Atlanta meeting yet to happen is the Wednesday at 11 AM Seminar 65: How RP1455 became GPC 36 best of practice advanced sequence of control.

Topics from 25 Jan 2015 were reviewed:

Irrigation
Control should consider all building subsystem not just energy, the integration of irrigation into BAS is an example. Control development includes monitoring moisture content and temperature of soil, air humidity and temperature to determine need for irrigation operation. Discussion of Jan 2015 Seminar 57: "Energy and Water Efficient Systems? Impossible without Controls, Wednesday, 9:45 Monroe room.
The **association for irrigation engineers** had Gaylen as speaker. T**hey need to know to integrate irrigation into BAS but find they are only working with landscape architect not part of IBD.** They are looking for **HVAC as a source of gray water** cooling tower and AHU condensate. Their sophisticated controls are not part of BAS. International CM will include a link into the use of green building code to use HVAC gray water.
In California with water shortage irrigation is a big user that BAS could be used to control the hours of irrigation and TOD when they operate. Additionally presentation of water use metrics and relations to other systems could improve owners understanding of related sustainability issues. At present this is limited to water metering use per sqft of grass. Requirements for 90.1 sub metering HVAC metering section 8 or 9 BZ whole building performance objectives are in section 12 of 90.1
Irrigation for green plants, surprisingly, is lower energy than landscaping with rocks because the rocks become a high heat reservoir and the load for AC is higher. In addition to higher electric cost there is a high water demand to make electricity.
Irrigation engineers want their systems to be integrated into BAS, but the controllers are not compatible with typical communication protocols like Modbus, BACnet, LonWorks**. Irrigation is an example of a utility and component of the building environment that has complex sensors and sequence of operation, but not part of BAS.**

NEW TOPICS From Group discussion:
Connection of **metering to DDC** and its presentation is in search of individuals who have experience beyond the physical wiring. Are **advanced revenue meters needed or can a**

standard sub-meter that only sends out pulses sufficient with appropriate software for integration and analysis. There are less expensive meters like water for smaller than 4" lines that are reliable and durable, and simple calibrated electric CT and pulse drivers. This is discussed by addendum in 2013 90.1.

Even when it is possible to reduce lab vent when the space is unocc, it may require starting equipment one hour before occupancy. If contaminants are measured in the space could react if those Unocc levels go high and allow a later restart of equipment and provide records of actual levels

Self-learning Self-healing software to modify daily strategies especially setting the temperature of the floor slab over night for radiant cooling and to predict annual GSHP bore field strategy. These strategies allow a smaller first cost chiller to provide cooling and avoid annual ground temperature creep.

Older discussion topics mentioned but not developed at this meeting.

IAQ Discussion in the CCA Subcommittee meeting

In 62.1.6.**2** the <u>prescriptive</u> path – identifies ventilation rates for the area of different space types and additional ventilation rate for occupants in that space. CO_2 is a surrogate for occupancy. and 62.1.6.**3** the <u>performance</u> path expects contaminant measurements to prove a ventilation scheme provides acceptable IAQ, This is only required once to prove the design.

Prescriptive Path Occupancy estimated without CO_2 measurement. Alternates include:
>   a camera with face recognition that counts the number of occupants
>   a security badge reader keeping track of who is in the space and who left,
>   direct status of local devices like desk computers or task lighting

What is the best mounting for a CO_2 sensor in a turbulent mixed air space? A wall at breathing zone height or hung from the ceiling 4 feet above finished floor. Would it be in a different location for displacement distribution.

Performance Path would measurement of 5-10 most likely contaminants continuously monitored represent 80% acceptance of occupants.

Magic Sensors and practical considerations

What the criteria for performance, what features are available and who are the vendors?
Air quality sensors exist to detect infection in hospital rooms. Microbial sensors provide not only instant readings of microbes in the air but through DNA analysis identify what microbe.
Technology for viral DNA analyzers is on emergency response vehicles.
Continuous particulate sensing in operating suites is a surrogate for potential infections agents.

Low microbial readings during unoccupied hours could lower required ACH from 30 to 2 ACH.

Special sensor cost is high compared to benefit for energy, but has much higher value in an OR. The cost of maintenance for energy or IEQ may be so high that benefits would never pay back.

OA is determined by all the requirements for outside air: **combustion, make up for exhaust, airside economizer, and avoid infiltration**. The volume controlled for IAQ ventilation may be a small part of required outside air. The total OA flow could never be 0 cfm. Economic benefits from advanced sensors must focus only on the OA portion that **can** be controlled for IAQ.

Preemptive control triggers

Use an enterprise "schedule object" for a list of individuals who respond to a meeting invitation as the source for BAS occupancy load calculation. Example San Jose, SERPA "Thermavote"