AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS, INC.
1791 Tullie Circle, NE Atlanta, GA 30329 404-636-8400

TC/TG/TRG MINUTES COVER SHEET

(Minutes of all meetings are to be distributed to all persons listed below within 60 days following the meeting.)

TC/TG/TRG NO. TC4.11   **DATE: June 26 , 2003**
TC/TG/TRG TITLE: Smart Building Systems
DATE OF MEETING: January 28, 2003   **LOCATION: Chicago**

Members Present	Appt	Members Absent	Appt	Ex-Officio Members and Additional Attendance
Les Norford, Chair (V)	02-03	Arthur Dexter, International member (V)	01-05	Gaylen Atkinson
Natascha Castro, Testing & Evaluation Subc, Web Master (V)	02-04	Marty Burns, CM	02-	David Bornside
Michael Kintner-Meyer, Communications and Integration Subc (V)	02-03	Jim Butler, CM	02-	Jeffrey Czarniecki
Todd Rossi, Technology Development Subc, (V)	02-03	Charles Culp, CM	00-	Theo Frutiger
Osman Ahmed (V)	02-06	Thomas Engbring, CM	99-	Mike Galler
Steve Blanc, (V)	99-03	John Mitchell , CM		Ken Gillespie
Cliff Federspiel (V)	02-06	Ron Nelson, CM	01-	Geoff Levermore
Rich Hackner, (V)	01-05	Hung Mahn Pham, CM	99-	Tor Malmstrom
Carlos Haiad, (V)	00-04	Kinga Porst, CM	01-	Mike Pouchak
Phil Haves, (V)	01-05	Barry Reardon, CM		Gene Strehlow
		Glenn Remington, CM	01-	Keith Temple
Srinivas Katipamula (V)	01-05	Pornsak Songkakul, CM	01-	
Agami Reddy (V)	02-06	James Winston, CM	02-	
John Seem, (V)	99-03	Peng Xu, CM	02-	
Corresponding Members				
John House, Vice Chair, Research Subc, CM	00-			
Mike Brambley, Secretary, CM	02-			
Carol Lomonaco, , CM Program Subc	00-			
Michael Brandemuehl, CM	99-			
Dave Branson, CM	01-			
James Braun, CM	01-			
Barry Bridges, CM	02-			
James W. Gartner, CM	02-			
David Kahn, CM	00-			
George Kelly, CM	01-			
Robert Old, CM	01-05			
Chariti Young, CM	96-			

(V) = voting member, Membership status as of 9/02

ALL COMMITTEE LIASONS AS SHOWN ON TC/TG/TRG ROSTERS:

Program: Kelly Cramm	Manager Of Technical Services : Michael Vaughn
Research: Sheila Hayter	Manager Of Research: William W. Seaton
Standards : Richard Hermans	Manager Of Standards : Claire B. Ramspeck
Journal/Insights: Harvey Sachs	Special Publications: Marilyn Listvan
TEGA: Clarles Gulledge	ALI: Alexander Boome

ADDITIONAL DISTRIBUTION: Visitors listed above

DATE: **24 July 2002**
TC NO. **TC4.11** **TC TITLE:** **Smart Building Systems**
CHAIR: **Les Norford** **VICE CHAIR:** **John House**

TC Meeting Schedule

Location, past 12 mo.	Date	Location, next 12 mo.	Date
Honolulu	6/25/02	Kansas City	6/24/03
Chicago	1/28/03	Anaheim	1/27/04

TC Subcommittees

Subcommittee	Chair
Technology Development	T. Rossi
Communications and Integration	M. Kintner-Meyer
Natascha Castro	M. Brambley
Research	J. House
Program	C. Lomonaco

Research Projects

1043-RP Fault Detection and Diagnostic Requirements and Evaluation Tools for Chillers

1139-RP Development and Comparison of On-Line Model Training Techniques for Model-Based FDD Methods Applied to Vapor Compression Equipment

Long Range Research Plan (as approved by TC 4.11 at the Cincinnati Annual Meeting)

Rank	Title	RTAR Written	RTAR Approved	W/S Written	TC Approved	To RAC ?
1	Evaluation and Assessment of Fault Detection and Diagnostic Methods for Centrifugal Chillers – Phase II	Yes	9/00	Yes	Yes	No
2	Field Performance Assessment of Package Equipment to Quantify the Need for Monitoring, FDD, and Continuous Commissioning	Yes	No	Yes (3rd draft)	No	No
3	Method of Testing FDD Tools for AHU's (was Benchmarking of FDD Tools for AHU's)	Yes	No[1]	No	No	No
4	Smart Sensor Systems for Reducing Measurement Errors in AC Systems (was Development of Fault Detection and Diagnostics for Sensor Failures)	Yes	No	Yes (1st draft)	No	No
5	Concept of Self-Configuring Control Systems	Yes	No	No	No	No
6	Prototyping and Field Testing of Utility – Consumer Information Services	Yes	No	Yes	No	No
7	Resolving Discrepancies Between Multiple, Hierarchically-Related, Fault Detection and Diagnostic Systems	Yes	No	Yes	No	No

Technical Papers from Sponsored Research
Final report for ASHRAE Research Project RP-1011, "Utility/Energy Management an d Control Systems (EMCS) Communication Protocol Requirements" is available on the TC 4.11 web site.

Results from the ASHRAE Research Project RP-1139, " Development and Comparison of On-Line Model Training Techniques for Model-Based FDD Methods Applied to Vapor Compression Equipment " have been published in the January 2001 issue of HVAC Journal.

Final report for ASHRAE Research Project RP-1043, " Fault Detection and Diagnostic Requirements and Evaluation Tools for Chillers" is available on the TC 4.11 web site.

Technical paper from 1043-RP, Comstock, M.C., Braun, J.E., and Groll, E.A., "The Sensitivity of Chiller Performance to Common Faults," International Journal of Heating, Ventilating, Air-Conditioning and Refrigerating Research, Vol. 7, No. 3, pp. 263-279, 2001.

Technical paper from 1043-RP, Comstock, M.C., Braun, J.E., and Groll, E.A., "A Survey of Common Faults for Chillers," ASHRAE Transactions, Vol. 108, Pt. 1, 2002.

TC Sponsored Symposia (past 3 years, present, planned)

Title	Date (Given or Planned)
Recent Results from Fault Detection and Diagnostic Research (Norford)	Atlanta, 1/01
HVAC Diagnostics: Development to Implementation Part 1 (House)	Atlantic City, 1/02
HVAC Diagnostics: Development to Implementation Part 2 (Dexter)	Atlantic City, 1/02
FDD in HVAC Applications (Kelly, TC 1.4 cosponsor)	Kansas City
New Variable Flow Control Strategies for Chilled Water Systems (Atkinson, TC 1.4 cosponsor)	Kansas City
Future Intelligent Control Systems (Price)	Anaheim

TC Sponsored Seminars (past 3 years, present, planned)

Title	Date (Given or Planned)
Practical Experience Using DDC Systems for HVAC Commissioning and Continuing Evaluation (Bridges; TC1.4 lead with TC1.7, TC4.11 and TC9.9 as co-sponsors	Dallas, 2/00
Deregulation for Dummies (Haiad)	Dallas, 2/00
Evaluating the Benefits of Fault Detection and Diagnostics	Dallas, 2/00
Providing for the Most Important Part of a Smart Building Control System: People (Bridges)	Minneapolis, 6/00
Control Systems Integration, What's Happening with Practical Open-Architecture Solutions (TC 4.11 co-sponsor)	Minneapolis, 6/00
Deregulation and Energy Efficiency in the State of California (Haiad)	Minneapolis, 6/00
Diagnostics from an Operations Perspective, Needs and Experiences (Rossi)	Atlanta, 1/01
Adding New Life to Old System-Control Retrofit Case Studies (TC 1.4 lead)	Atlanta, 1/01
Maximizing Facility Performance with Computerization and Controls (Gartner)	Cincinnati, 6/01
Data Modeling for Building Operations (Kintner-Meyer)	Cincinnati, 6/01
BACnet Manufacturers Association (BMA)- New role in Testing Interoperability of BACnet Systems (Newman)	Cincinnati, 6/01
Wireless DDC Systems (TC 1.4, Bridges lead)	Cincinnati, 6/01
Intelligent Agents - What They Can Do For You (Ahmed, TC 4.6 co-sponsor)	Honolulu, 6/02
Self-Configuring Control Systems: Technology and Potential Benefits (Brambley, TC 4.6 co-sponsor)	Honolulu, 6/02
Experience with Demand Responsiveness Programs (Haves, TC 4.6 co-sponsor)	Honolulu, 6/02

New Issues in State of the Art DDC Systems (Atkinson, TC 1.4 co-sponsor)	Honolulu, 6/02
Automated Functional Testing of HVAC Systems (Haves, TC 1.4 and 4.6 co-sponsors)	Chicago, 1/03
New Issues with State-of-the-Art DDC (Atkinson, TC 1.4 and 1.5 co-sponsors)	Chicago, 1/03
Wireless Sensors for HVAC Systems (Healy, TC 1.4 cosponsor)	Kansas City
Specifying LonMark DDC Systems	Anaheim
FDD from an Operator's Perspective (Rossi)	Future

TC Sponsored Forums (past 3 years, present, planned)

Title	Date (Given or Planned)
Specifying Open Lonmark DDC Systems	Atlantic City, 1/02
What Should ASHRAE's Role be in IFC and XML Standards (Gowri, GPC20 and TC 1.5 cosponsor)	Chicago 1/03
Wireless Sensors for HVAC Systems (Brambley)	Kansas City
Addressing the Need for Data Modeling Beyond Building Design- What Role Should ASHRAE Play	Future
New Sensor Technology, Other New Technologies (Kintner-Meyer)	Future

TC Sponsored Public Sessions (past 3 years, present, planned): None
Journal Publications (past 3 years, present, planned): None

Minutes summar y and activities sheet submitted by: Michael Brambley, TC 4.11 Secretary

Call to Order, Roll Call, Introductions

The meeting was called to order at 3:35 PM with Chairman Les Norford presiding. A roll call showed that a quorum was present. In attendance at the meeting were Norford, Castro, Kintner-Meyer, Rossi, Ahmed, Blanc, Federspiel, Hackner, Haiad, Haves, Reddy, Seem. Twelve of 14 voting members were present.

Norford distributed the minutes from the Honolulu meeting, and the Agenda (the call-to-meeting letter and the agenda are in Appendix A).

Approval of Minutes
The minutes of the last meeting were reviewed. Norford requested comments for minutes submitted from Atlanta meeting. Minor corrections were made to the member list.

Motion 1: Motion to accept minutes from the June 2003 meeting (Motion by Haves, 2nd by Castro)
Voice Vote, Motion passed unanimously

Announcements (Norford):

1. Handbook:
   - TC 4.11 does not have a Handbook chapter yet.
   - A 4-volume Handbook CD will become a member benefit beginning 2004.
2. ALI: TC 4.11 needs to appoint a liaison to ALI.
3. Program:
   - Use of Manuscript Central is required after the Kansas City meeting. It provides electronic means to coordinate reviews and process papers.
   - There has been a decline in symposia the last few years. Symposia reach a broader audience through the Transactions. Seminars are easier to arrange but only reach attendees of the meetings. There may be a need to do a little better in this respect.
4. Special Publications: There is always an opportunity with Special Publications. There are opportunities to join with other TCs in packaging a suitable collection of papers for a publication. We need to look at potential opportunities with other TCs.
5. Conferences coming up:
   - CIBSE/ASHRAE on building sustainability in September: Abstract deadline is February 15.
   - International Symposium on Building Systems and Facility Management in Singapore in October.
   - Les passed around brochures on the conferences.
6. ASHRAE Reorganization Proposal: TAC has developed a proposal to reorganize the technical committees to balance numbers and better group the TCs. TC 4.11 would become 7.8 in Section 7. This change would occur after the Kansas City meeting. A suggestion was made that a better name for the new section might be "Building

Operations."

Norford then asked for updates from the subcommittee chairs.

Technology Development Subcommittee (Rossi)
Rossi reported that the subcommittee met on Sunday. He reported as follows:

The work statement for the second project on chillers is in the schedule for funding, but we do not know when it will come out.

The field performance work statement is in the Testing & Evaluation subcommittee and it will be discussed in that subcommittee's report.

Self-Configuring Systems work statement: Michael Kintner-Meyer distributed copies of the work statement and provided a summary of it. Comments from the committee included:
- o Whether the budget is sufficient and possibly increasing it.
- o Dividing the project into two phases.
- o Volunteers at the subcommittee meeting to help with review and revisions: Bob Old, Maria Corsi, Glen Remington.

Wireless sensors: This topic was also discussed at the subcommittee meeting.
- o Bill Healy volunteered to lead a seminar on wireless sensors. He already has four speakers lined up.
- o Mike Brambley volunteered to moderate a forum on wireless sensors proposed to follow the seminar.
- o Both will be proposed for Kansas City. The intent of the seminar is to inform the discussion in the forum.

Draft RTAR on Real-Time Optimal Control in a Distributed Environment: Jim Braun presented a draft RTAR on this topic. Copies were distributed with Jim's highlighting for emphasis. Jim summarized these highlights. A key concept behind this RTAR is the distribution of intelligence to the controls. Discussion followed. It was recommended that this RTAR be submitted at the Kansas City meeting. The RTAR and work statement are envisioned as a joint effort with TC 4.6.

The minutes of the subcommittee meeting are in Appendix C.

Les Norford requested that the role be taken again because a number of additional attendees had joined since the meeting was convened. Mike Brambley re-took the role; the attendance listed earlier in these minutes reflects any changes. Les then read the scope for TC 4.11 for the benefit of the attendees.

Communications and Integration Subcommittee (Kintner-Meyer)

Kintner-Meyer reported that the entire subcommittee meeting was devoted to discussing the work statement on self-configuring control systems. He then asked that volunteers interested in

helping polish up this work statement contact him and emphasized that input from controls industry representatives would be valuable.

Les Norford asked Michael Kintner-Meyer to give an update on the outcome of RP-1011. Michael reported as follows. RP-1011 defined potential energy information services that might be provided by utilities and energy service providers to customers with intelligent building control systems. The project provided new data objects to facilitate communication. It recommended that the BACnet Standard be augmented accordingly. The results are now generating some interest by the Utility Interactions Committee and there is more enthusiasm for integrating the RP-1011 concepts than in the past. Marty Burns is working with the committee to accomplish this. The RP-1011 report in on the TC 4.11 web site for all interested in accessing it.

The minutes of the subcommittee meeting are in Appendix D.

Testing and Evaluation Subcommittee (Castro)

John House reported for Natascha Castro on the Testing and Evaluation Subcommittee meeting.

Work statement on Testing and Evaluation of Fault Detection and Diagnostic Systems for Air Handling Units:
    John distributed fifteen copies of the draft work statement, then provided a summary of it, explaining that additional work was needed on it. A number of others have volunteered to help refine the work statement, and John invited additional volunteers. John will email the latest draft out after this meeting and requested that comments be provided to him by mid-March. A conference call will then be held to discuss the work statement and comments. Further revisions will then be completed and the work statement distributed before the Kansas City meeting.

Field Performance Assessment of Packaged Equipment Work Statement:
    John House reported that the work statement was conditionally approved by RAC at its Fall 2002 meeting. RAC provided conditions:
    1. Need to assure cooling test methods and techniques in Task 4 are adequately described to ensure consistency and desired accuracy for statistical significance.
To meet the conditions, we must make revisions that satisfy the TC 4.11 research liaison. RAC does not need to act on it again. The work statement will then go on the list of approved work statements awaiting prioritization and funding. Norford, Rossi, and House are working on the work statement to meet this condition. Les Norford emphasized that these are simple clarifications not revisions in scope.

John reported further that at the TC 1.4 meeting yesterday, that committee was discussing problems with enthalpy-based economizer cycles. John recommended that TC 1.4 look at this work statement as a model for how to investigate this issue. TC 1.4 asked if they could piggy-back on this project as it was performed to get outdoor-air relative humidity measurements if available. This would help TC 1.4. One additional measurement and recording of two values from the unit would be required. After discussion by the committee (TC 4.11), it was

recommended that the work statement should be left as it is and TC 1.4 asked if collection of their data might be done in a follow up to this project or by asking the contractor after selected if this additional information could be collected (at least add whether each air unit is humidity controlled during characterization of the units).

John reported that there are currently four people on the PES/PMSC and asked if he could be removed for this committee. Rich Hackner volunteered to take John's place.

The minutes of the subcommittee meeting are in Appendix E.

Research Subcommittee (House)
Announcements
- o ASHRAE formed the Research Advisory Panel (RAP) to develop a research advisory plan. It is looking at how to handle high risk research. They are drafting a plan and list of high risk research at this meeting, which will be ready for review in Kansas City. They want input from the TCs on:
  - Critical research
  - Promising new technologies
  - Features of the plan that would benefit the TC.

- o Forty six RTARS were considered in the fall. From this 12 were designated as priorities and 10 were approved. Two from TC 4.11 were approved and prioritized. We need to work on those to get the m completed.

- o Considered 19 work statements at the fall meeting. Nine were approved and added to the 15 that were on hold from earlier. Eight were then put out to bid. The remaining 16 will be prioritized and top ones put out to bid in the Spring. John was not sure if that included TC 4.11's conditionally approved project. They have $500,000 to $550,000 available for new projects.

- o May 15 is the deadline for new work statements. TC 4.11 will not have anything new in this time frame.

- o Sheila Hayter, Section 4 Research Liaison, and the others are trying to better coordinate the efforts of the TCs in Section 4. They are looking for synergies of the TCs in Section 4 and better coordinate with Handbook.

- o The Handbook Committee is interested in finding how to make the Handbook more useful to members. TC 4.11 was asked to help by providing project ideas to Sheila after our meeting. Chip Barnaby has produced an RTAR for preparing a design handbook. The Handbook Committee is also wrestling with a more integrated, cohesive Handbook.

- o Sheila asked that we identify RTARS that likely would be submitted in August by the Kansas City meeting. She also asked that we attend local Chapter meetings and ask members what different they would like to see in the Handbook.

Phil Haves, John House, Mike Brandemuehl, and Les Norford are exploring having a meeting in Kansas City to kick off the new Section 7 (related to Building Operations).

After discussion, it was decided that for the next meeting of TC 4.11, the last 45 minutes will be focused on Handbook and information dissemination. The new section should possibly produce something on building operation for the ASHRAE Journal and continue providing an article every year to the journal.

Les Norford will appoint a Handbook Subcommittee Chair and split the time with research starting at the Kansas City meeting (last 45 minutes).

John distributed the list of research priorities of TC 4.11 and informed interested attendees to contract leaders on the list to volunteer to help with specific items. The list is attached along with subcommittee minutes in Appendix E.

Program Subcommittee (Lomonaco)
Carol Lomonaco reviewed the scheduled program in Chicago:
      Seminar 12: "Automated Functional Testing For HVAC Systems," chaired by Phil
      Haves, Cosponsored by TC 4.6 and TC 1.4.
      Seminar 43: "New Issues With State-of-the-Art DDC Systems," chaired by Gaylen
      Atkinson, co-sponsored by TC 1.4 and 1.5.

Carol requested that the subcommittee chairs collect presentations and get written or email approval for posting on the web from the authors.

Motion 2: Put Seminar 12 presentations on the TC 4.11 web site (Blanc moved, Gartner seconded)
Approved by unanimous voice vote.
Motion passed.

Carol asked for feedback on the Honolulu sessions. Osman Ahmed reported that the seminar during the very last session of the meeting was well attended.

Carol announced the need to use Manuscript Central.

Carol presented the proposed Program for Kansas City:
Priority 1. Symposium "FDD in Operations and Maintenance of HVAC," chaired by George Kelly, co-sponsored by TC 1.4 and seeking co-sponsorship by TC 1.7.
Priority 2: Seminar "Wireless Sensors for HVAC Applications," chaired by William Healy, co-sponsored by TC 1.4.
Priority 3: Forum "Wireless Sensors for HVAC Applications," moderated by Michael Brambley. Follow-on discussion to seminar.

Motion 3: Motion to approve the program as presented and prioritized. (Federspiel

moved, Blanc seconded)
Vote: Unanimously approved by voice vote.
Motion passed

Carol Lomonaco reviewed proposed programs for future meetings at Anaheim and beyond.

Gaylen Atkinson of TC 1.4 presented a number of sessions for Kansas City for which he was requesting co-sponsorship from TC 4.11. They included:
> Seminar: New Control Strategies for Variable Flow Chilled Water Systems
> Seminar: How Do Building Codes Affect Control Systems?
> Forum: Specifying LonMark DDC Systems
> Forum: How Should the Handbook Cover Network Technologies?

Les Norford agreed for TC 4.11 to co-sponsor.

Gaylen Atkinson also invited speakers for a seminar on State of the Art DDC, which TC 1.4 is organizing for the Anaheim meeting.

Programs as approved by ASHRAE are tabulated at the beginning of these minutes.

Handbook
No handbook meeting was held in Chicago.

Les Norford and others suggested that with the changes proposed to Sections for TCs. This is an opportune time to start talking to the other "building operations" TCs about a new handbook chapter on this topic. TC 4.6 just completed a handbook chapter on operations. That chapter may be a good place for TC 4.11 to suggest placing its topics in the future, e.g., diagnostics, controls, etc.

Jim Gartner emphasized that this is an important time to coordinate with TC 1.4, 4.6 and others.

Les Norford asked for volunteers. Jim Gartner volunteered.

Web Site (Natascha Castro)
Natascha reported that the minutes and seminar presentations from Honolulu are posted.

Presentation slides from Chicago should be submitted to Natascha Castro for posting.

The web site is on a NIST server. ASHRAE is now providing space for TCs but it is limited to 20 MB, so the committee will keep the site on the NIST server.

Motion 4: Moved to place the TC 4.11-sponsored seminar on Intelligent Agents from Honolulu on the TC 4.11 web site. (Ahmed moved; Haves seconded)
Vote: Unanimously approved by voice vote.
Motion passed.

Old Business
No old business.

New business
Roster: Les Norford reported that 5 members will be rolling off the roster at the end of this year. They will be moved to corresponding member status after the Kansas City meeting. Les then announced specific appointments.

New Voting members to be appointed: House, Brandemeuhl, Braun, and Jo n Wright as International Member

New Corresponding Members to be appointed: Price, Massey, Corsi, Pouchak, Temple, Zhou.

Officers after Kansas City:
>Chair: John House
>Vice Chair: Mike Brambley
>Secretary: Todd Rossi

Carol Lomonaco was congratulated by the Chair and by applause of the committee for her great performance as the Program Subcommittee Chair for several years. She will be going to Italy and a new Program Chair will assigned.

Announcement by Jim Gartner: BACnet is now an ISO Standard.

Adjournment

Motion : Motion to adjourn (Motion: Castro moved, Haves seconded)
Vote: Unanimous voice vote
Motion Passed

Appendices

A. Call to Meeting and Agenda
B. Scope and Organization
C. Technology Development Subcommittee Report
D. Communications and Integration Subcommittee Report
E. Testing and Evaluation Subcommittee Report
F. TC4.11 Research Subcommittee meeting/Planning Session
G. Research Plan and Activities
H. List of Subcommittee Attendees

Appendix A.
Call to Meeting and Agenda

ASHRAE American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

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1791 Tullie Circle, NE, Atlanta, Georgia 30329-2305   404-636-8400 | Fax 404-321-5478

Reply to: Les Norford
            Room 5-418
            MIT
            77 Mass. Ave.
            Cambridge, MA 02139
            lnorford@mit.edu

January 14, 2003

Dear TC 4.11 Member, International Member, or Corresponding Member: Deleted:

The **TC** on Smart Building Systems and its subcommittees will meet in the Palmer House Hilton, 17 E. Monroe Street, Chicago, according to the following schedule (the parenthetical number is the floor):

TC 4.11	Tech. Development	Sunday (1/26)	3:00-3:45p	PDR 18 (5)
TC 4.11	Comm. & Integration	Sunday (1/26)	3:45-4:30p	PDR 18 (5)
TC 4.11	Testing & Evaluation	Sunday (1/26)	4:30-5:15p	PDR 18 (5)
TC 4.11	Research	Sunday (1/26)	5:15-6:00p	PDR 18 (5)
TC 4.11	**Smart Building Systems**	**Tuesday (**1/28)	**3:30-6:00p**	**PDR 9 (3)**

A portion of the research meeting will be devoted to a discussion of dissemination of research results, as technical bulletins or within a handbook chapter.

TCs 4.11 and 4.6 are sponsoring the following program session, which will be held in the Palmer House Hilton:

Seminar 12: Automated Functional Testing of HVAC Systems
Sunday, January 26, 2003, 1:00 – 3:00 PM, Chair: Phil Haves

The room number for the seminar is not available on the ASHRAE web site. Please see the ASHRAE Program Booklet.

Attached is a draft agenda for the full TC 4.11 committee meeting and a description of the seminar. I hope to see you all in Chicago.

Les Norford
Chairman, TC 4.11

ASHRAE TC 4.11, Smart Building Systems
2001 2003 Winter Meeting
Palmer House Hilton
17 E. Monroe St., Chicago

AGENDA

Location: **Private Dining Room 9, Third Floor**
Date: **Tuesday, January 28, 2003**
Time: **3:30 - 6:00 p.m.**

Deleted: 2001

1. Roll call and introductions

2. Approval of Minutes from Honolulu

3. Announcements

4. Technology Development Subcommittee (Todd Rossi)
   - Field Performance Assessment of Package Equipment to Quantify the Benefits of Proper Service (TC-4.11 approved work statement, conditionally approved by RAC)
   - Design and Demonstration of a Self-Configuration Concept for an HVAC Control System (prioritized RTAR!)

5. Communications and Integration Subcommittee (Michael Kintner-Meyer)

6. Testing and Evaluation Subcommittee (Natascha Castro)
   - Method of Test of AHU FDD Tools (prioritized RTAR!)

7. Research (John House)

8. Program Subcommittee (Carol Lomonaco)
   - Plans for Kansas City (6/28-7/1/2003) and Anaheim (January 24-28, 2004)

9. Handbook (Les Norford)
   - Coordination with TC 4.6 on issues related to control and diagnostics
   - Establishing a handbook subcommittee

10. TC 4.11 Website (Natascha Castro)

11. Old business

12. New business

Formatted: Bullets and Numbering

13. Adjournment

Seminar 12

Automated Functional Testing of HVAC Systems
Sponsor: TC 4.11 Smart Building Systems; TC 4.6 Building Operations Dynamics
Chair: *Philip Haves, Ph.D, C.Eng., Member, LBNL*
Program Committee Liaison: *Michael R. Brambley, Ph.D., Member, PNNL*

Automation has the potential to make it easier and cheaper to perform functional testing. The fist presentation provides a background by describing currently available functional tests that could be automated. The other four presentations describe how the execution of functional tests can be automated using the building control system, either directly or as an interface to a separate tool. The design of automated test procedures and approaches to their implementation are discussed. Procedures for the automated functional testing of various air-side components are described and the results of performing some of these tests in real buildings are presented.

A Library of Commissioning Test Protocols
Kenneth L. Gillespie, Jr., Associate Member, Pacific Gas and Electric Co., San Ramon, CA.

Building Automation Systems that Go Beyond Operations
Timothy I. Salsbury, Ph.D., Member, Johnson Controls, Inc., Milwaukee, WI.

Automated Functional Testing of HVAC Secondary Systems
Peng Zu, Ph.D, P.E., Member, LBNL

Automated Proactive Commissioning of Air Handling Units
Srinivas Katipamula, Ph.D., Member, PNNL

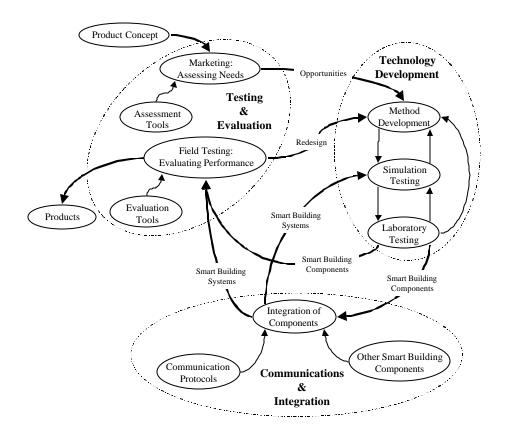**Automated Functional Testing of VAV Box Controllers**
Jim Head, Siemens Technologies Inc., Buffalo Grove, IL.

Appendix B.
TC 4.11, Smart Building Systems Scope and Organization

Revised July 1, 2001

Overall Committee Scope

The Technical Committee on Smart Building Systems (SBS), TC 4.11, is concerned with the development and evaluation of technologies that could enable the widespread application of smart building systems. "Smart" buildings should take advantage of automation, communications, and data analysis technologies in order to operate in the most cost-effective manner. This implies integration of building services such as HVAC, fire, security, and transportation; the automation of many of the operation and maintenance functions traditionally performed by humans; and the interaction with outside service providers such as utilities, energy providers, and aggregators. Currently, three subcommittees form the backbone of the TC's activities: technology development, communications and integration, and testing and evaluation. The scope and activities of these subcommittees loosely follow the product development process as depicted in following flow chart and as defined in the following sections.

Smart Building System Development Process

Technology Development Subcommittee

Scope

The Technology Development Subcommittee is concerned with research issues associated with the development of emerging smart building technologies such as (but not restricted to) automated commissioning, performance monitoring, fault detection and diagnosis, optimal maintenance scheduling, and self-configuring control. The primary outcome of research endorsed by this subcommittee is expected to be data and models that enable development of the technologies and comprehensive methods that are the basis of the technologies. An integral part of the development process is simulation and laboratory testing. Proposed designs must be tested and modified prior to field evaluation or integration with other smart building components.

Vision

The ever-increasing speed of organizational changes of the occupants in today's buildings demand greater flexibility of the building structure and the building automation system to respond to these changes. Furthermore, smart building systems offer the promise of dramatically improved building performance (e.g. comfort, reliability, and energy efficiency) and lower operating cost.

HVAC equipment automated commissioning, performance monitoring, fault detection and diagnostic, and optimal service scheduling technology directs service personnel to fix equipment problems causing poor comfort, reliability, and/or energy efficiency during different stages in building life cycles. Compared to the tools available today, these technologies are more sensitive to significant performance degradations, they are more aware of the entire building performance picture, and they help accomplish service tasks quicker.

Plug-and-play or self-configuring control systems are critical technologies needed to make buildings more flexible and to reduce the labor and expertise needed to install and maintain building automation systems. Self-configuring controllers understand their role in the building system. They are aware of the presence of other devices in the building and how they relate and interrelate with them to collectively provide building services. This high level of functionality is provided by highly skilled people at great cost today. When these people are freed for these tasks and costs are reduced, sophisticated building automation systems will become even more wide spread and the people will move on to even higher level tasks leading toward finely tuned and optimally performing buildings.

Research Agenda

To accomplish these broad goals, the subcommittee is focusing its near-term effort in the following directions:
1. Fault detection and diagnostic (FDD) technology focused on HVAC components like refrigeration cycles (including chillers, direct expansion cooling, and refrigeration) and air handing units.
2. Technologies supporting equipment FDD including smart sensor systems.
3. Self-configuring control systems

Research Projects

The sections below list ongoing (o) and planned (p) research related to the subcommittee's technology development goals. The subcommittee has no completed (c) or rejected (r) research projects. The studies are also shown on a timeline provided as a separate document.

- **o** **1043-RP Fault Detection & Diagnostic Requirements & Evaluation Tools for Chillers** – Purdue University was provided a no cost extension until the expected completion date on 6/31/01.

- **o** **1139-RP Development and Comparison of On-line Model Training Techniques for Model-Based FDD Methods Applied to Vapor Compression Equipment** – Drexel University was provided a no cost extension until the expected completion date on 8/31/01.

- **p** **Evaluation and Assessment of Fault Detection and Diagnostic Methods for Centrifugal Chillers – Phase II** - Approved in Minneapolis and will submit to RAC AFTER Phase I (1043-RP) is completed. RTAR approved 9/00.

- **p** **Smart Sensor Systems for Reducing Measurement Errors in AC Systems** - One page description exists. A two page version is being discussed and revised.

- **p** **Self-configuring Control Systems** – RTAR+ document under development for Cincinnati.

There are three phases associated with this the chiller fault detection project. The first phase is an ongoing project (1043-RP) where the important faults are being considered and the appropriate sensors will be identified. In addition, a model for simulating chiller behavior is being developed that can be used to evaluate FDD performance for the different faults. The second phase is a planned research project where the FDD methods will be developed, implemented, and evaluated through simulation. This phase will produce a comparison of alternative FDD methods and recommendations for real-time implementation. Finally, the third phase will involve the real-time implementation and evaluation of FDD methods within the laboratory and the field. It is hoped that by the end of the third phase, an algorithm will be specified for incorporation within commercial products.

<u>**Communications and Integration Subcommittee**</u>

Objective

The Communications and Integration Subcommittee is concerned with research issues associated with enabling the seamless interaction of smart building components and services within buildings, among buildings, or with an outside third party. An important aspect of this work is to identify the information that is necessary to support smart building technologies, and to identify the requirements of communication protocols to support the exchange of this information between different building services, between buildings and utilities, between multiple buildings, with outside service providers, etc. Another aspect of this work deals with the technical issues, challenges, and opportunities of integrating building systems to utilize synergies among the system components to achieve high performance building operation and highly productive work and living environments.

Addressing the Need for Innovative Building Automation Communications Systems and Services

Key to the high-performance operation and maintenance of a smart building system is the communication among various building system components that enables innovative control, monitoring and diagnostics concepts. The ever-increasing speed of organizational changes of the occupants in today's buildings demand greater flexibility of the building structure and the building automation system to respond to these changes. This will require highly flexible building automation system and a communication infrastructure to support the flexibility demanded.

Wireless sensors and control systems are emerging for building automation applications that provide a great opportunity to support and expand innovative and flexible control concepts to allow personalized and localized buildings control. As personalized and localized controls become reality, the number of sensors and control points in a building will grow significantly. This increase in sensor and control points will require a communication infrastructure that can re-configure itself to quickly establish connectivity to the added devices to the entire network. Plug-and-Play concepts are necessary for the rapid deployment of new sensors and control equipment with minimal or no set-up time.

The convergence of data and building automation networks will enable innovative remote building monitoring and control services. The need to reduce cost for the building operation will drive innovation for building remote monitoring, diagnostic, and control concepts. New building cooling, heating, and power technology and distributed power concepts will enable buildings to become zero-buyers of electricity or even net producers of electric power, whenever there is an economic incentive. To evaluate the economics of the trade-off between on-site electricity production and buying electric power from the service provider requires instant communications to the electricity markets to receive the hourly or sub-hourly changing price information. With these new technologies in place, the defining lines between the supply and demand sectors become increasingly blurred. Advanced load management strategies will seek optimal operation and dispatching of heating, cooling, and power system not only within the framework of a single building but also in a campus setting including many buildings. To engage in these new services, constant interactions among the energy consuming and producing

must be in place. This will require information protocols and standards to support these services over wide-area networks.

Addressing the Need for Integration of Building Systems

The subcommittee addresses integration issues at three levels:
1. Integration of existing building automation functions (e.g., HVAC, lighting, fire alarm, safety and security systems)
2. Integration of advanced automated fault detection and diagnostic methods and tools into existing HVAC control systems
3. Integration of different automated fault detection and diagnostic tools to enhance each other's functionality and effectiveness.

Integration of existing building automation functions: Building control system in the past have been developed and deployed independently from each other to address a specific building need. HVAC, lighting, fire alarm, and safety systems emerged in their specific industries with a set of standards and safety requirements. To fully utilize cost savings opportunities the building control systems will need to be integrated into one building automation system. Integration will support not only the use of common communication infrastructure but also seek synergetic interactions that provide enhanced functionality and value added.

Integration of advanced automated fault detection and diagnostic tools into existing HVAC controls: With the transition of automated fault detection and diagnostics tools from the research to the demonstration and deployment stage, the new tools need to be integrated into existing HVAC equipment control or building automation systems to share sensor and equipment information for the diagnosis.

Integration of different advanced fault detection and diagnostics tools into larger diagnostics systems. As more fault detection and diagnostics tools for HVAC equipment are being developed, it becomes increasingly important to harmonize the results of each diagnostic component in order to resolve discrepancies in the diagnosis and to seek internal corroboration and mutual substantiation of the same underlying problem. As the complexity of the HVAC fault detection and diagnostic system grows, it will be essential to maintain internal consistency among different diagnostic tools.

Near-Term Research Agenda of the Subcommittee:
To satisfy the science and technology needs mentioned above, the subcommittee will work on the following research topics:
1. Establish communication protocols that support automated data exchanges between service providers and buildings automation system to enhance energy efficiency, high performance of equipment operations and cost savings in buildings.
2. Promote plug-and-play and self-configuration concepts to avoid set-up problems of HVAC control systems.
3. Research the use of wireless sensors and controls for building operations and the integration into existing wired controls infrastructures.
4. Research integration opportunities to enhance the value of each single controls and

diagnostics component.

The section below lists ongoing (o), planned (p), completed (c) and rejected (r) research related to the topics above.

(c) 1011-RP Utility/EMCS Communication Protocol Requirements – completed in summer 1999. The primary objectives of research project 1011-RP were: 1) to identify potential new information services that utilities or electricity suppliers are likely to offer to their customers, 2) to determine the communication and data requirements to establish these services, and 3) to develop data object models that support interoperability for the implementation of the services.

(p) Prototyping and Field Testing of ASHRAE's Utility Consumer Interface Models (UCIM) – A work statement has been written. This research is an extension of the completed 1011-RP project. ASHRAE proposes a project for prototyping and testing a set of selected information services defined in research project 1011-RP. The project focuses on the prototyping and testing of information services under lab conditions in which the communicating parties are simulated. Co-sponsorship by SSPC 135 is sought.

(p) Resolving Discrepancies Between Multiple, Hierarchically-Related, Fault Detection and Diagnostic (FDD) Systems – A work statement has been developed. The proposed research will identify conditions in which two or more fault detection and diagnostic systems of may find disagreeing conclusions for the same underlying system faults. The research will identify solutions for resolving the discrepancies in the diagnostics provided by multiple fault detection and diagnostic systems.

(p) Self-Configuration of HVAC Control Networks – RTAR is being developed. The proposed research will describe novel self-configuration concepts used in data networking and personal computer technologies and analyze their applicability to HVAC control networks. Self-configuration methods in personal computer technologies have been proven to significantly reduce the set-up time and set-up errors. It is expected that similar advantages can be realized for when installing complex HVAC control networks in large buildings.

Testing and Evaluation Subcommittee

Objective

The Testing and Evaluation Subcommittee is concerned with research issues associated with assessing the benefits (market potential) and performance of smart building technologies such as fault detection and diagnostics, automated commissioning, self-configuring systems, etc. Research endorsed by this subcommittee is expected to result in data, metrics, methods, and tools/standards/guidelines for quantifying smart building system benefits and performance in a standardized manner, as well as findings from the actual application of these metrics, methods and tools. The sections below describe the goals of the subcommittee in more detail and list ongoing (o), planned (p), completed (c) and rejected (r) research related to these goals.

Assessing the Benefits of Smart Building Technologies

Research related to assessing the benefits of smart building technology can help define and justify research on such technology by establishing how (and by how much) the performance of existing technology can be improved. Successful studies of this nature can lay the groundwork for acceptance of new technology by end-users. To be successful and to gain support from ASHRAE, studies should be targeted at existing technology that is known to have performance problems. Furthermore, proposed studies should have a clear procedure and set of metrics (or at least such procedures and metrics should be perceivable at the start of the research) that will enable performance to be quantified in an objective manner (e.g., energy savings, time savings, etc.). In some cases a study may include demonstrations of prototype tools that can improve performance, while in other cases the study may be limited to measuring the performance of an existing technology, as new technology does not yet exist.

The status of studies related to assessing the benefits of smart building technology is summarized below. The studies are also shown on a timeline provided as a separate document.

1. **Integrated Control of Building Services** – RTAR was rejected by RAC and dropped from consideration by TC 4.11

1. **Field Performance Assessment of Packaged Equipment to Quantify the Need for Monitoring, FDD and Continuous Commissioning** – RTAR was rejected by RAC in the Fall of 2000 – a new version of the work statement is under development

Note that the second study cited above deals with field performance assessments of HVAC equipment. The outcome of this study should help establish the need for automated FDD and continuous commissioning. Studies aimed at field performance assessments of other equipment (e.g., chillers, fan coil units) may also be merited. At present, no research aimed at assessing the benefits of smart building technology have been identified for the focus areas of interconnectivity/interoperability and self-configuring systems. A proposed study in the area of integrated controls, services and facilities was rejected by RAC.

Assessing the Performance of Smart Building Technologies

Research related to assessing the performance of smart building technology is intended to produce data sets, metrics, protocols, etc. for quantifying performance, and/or to demonstrate

and test specific smart building technology in pre-commercial stages of development. Successful studies will lead to tools that can be used to test the performance of smart building technology throughout its development cycle. Demonstration studies will help establish the potential of smart building technology while also identifying possible deficiencies in the demonstrated technology.

The status of studies related to assessing the performance of smart building technology is summarized below and on the timeline of the accompanying document.

1. **Demonstration of FDD Methods in a Real Building (1020-RP)** – completed 2/00

1. **Prototyping and Field Testing of Utility – Consumer Information Services** – championed by TC 4.11 Communication and Integration Subcommittee

2. **Method of Testing FDD Tools for AHU's** – existing work statement needs revision

3. **Evaluation and Assessment of FDD for Centrifugal Chillers – Phase III** – Phase II of this work is being championed by TC4.11 Technology Development Subcommittee and has not been initiated yet.

Note that the second study listed above is being championed by the Communication and Integration Subcommittee of TC 4.11; however, the testing work is closely related to the goals of this subcommittee. At present, no research aimed at assessing the performance of smart building technology have been identified for the focus areas of integrated controls, services, and facilities and self-configuring systems.

Appendix C.
TC4.11 Technology Development Subcommittee Meeting

TC 4.11 Technology Development
January 26, 2003

Todd Rossi opened the meeting by reviewing discussions from Honolulu.

John House gave a brief summary of the status of the Phase II Chiller FDD project. It has been approved by RAC and is awaiting funding to be allocated by ASHRAE.

Rossi reviewed a project idea that was raised in Honolulu regarding self-organizing wireless sensors. Bill Healy is trying to organize a seminar on the topic. At this time it may be premature to propose a research topic, but ideas for research topics may come from the seminar. Mike Brambley and Michael Kintner-Meyer suggested a forum that would follow the seminar (at the same meeting) might be useful to get more detailed information about the needs. Rossi suggested we try to compile the topics of the seminar presentations for use in the forum. Kintner-Meyer offered to write a one-page project description for the next meeting to stimulate discussion of research in this area, if such a description would be helpful. The subcommittee supported this idea.

Rossi suggested members of this committee perform an informal literature search on the topic of self-organizing wireless sensors. This would provide background on the topic. We could also summarize the seminar presentations. This would provide the present state-of-the-art. Then we could brainstorm on new ideas, which would identify future needs. Rossi brought up this idea in the context of the broader issue of past, present, and future needs in FDD. The need for a general paper for ASHRAE in the area of FDD was brought up in Honolulu.

Brambley asked if there might be a follow-up seminar on the topic of automated functional testing. At this point, nothing specific is planned. Brambley also asked if there an opportunity to have a special publication on FDD? This might help "market" FDD to ASHRAE and make it easier to get projects approved and funded. Phil Haves suggested a special publication on building operations (FDD, commissioning, retro-commissioning, optimization etc.) on a CD. Is there enough out there to have a CD with 20 or so papers? An introductory paper suitable for the ASHRAE Journal might serve as a suitable introductory piece for the CD. Agami Reddy reminded everyone of the existence of a CRC Handbook chapter on the topic of FDD. Rossi suggested that we should use the CRC Handbook chapter as a starting point for this effort. Haves suggested the article also include a vision for future work. Rossi, House, Haves, Brambley, Srinivas Katipamula, Les Norford, Glen Remington, and Andrew Price expressed interest in helping with the article.

Rossi brought up the topic of FDD for supermarket refrigeration systems. House will check into TC 10.7 interest in this topic. Carlos Haiad noted that Southern California Edison has a test lab that would be suitable for evaluating FDD methods for such systems.

George Kelly informed the subcommittee that papers on the topics of an EMCS interface for building occupants and a maintenance advisor will be presented at a future meeting. These papers might provide new research ideas. Is this an area that we should be pursuing? The consensus was to take up this topic after the symposium.

Program for Kansas City:
Symposium: "FDD in HVAC Applications"; George Kelly, Chair
Seminar: "Self-Configuring Wireless Sensors"; Bill Healy, Chair
Forum: "Self-Configuring Wireless Sensors"; Mike Brambley, Moderator

Program Ideas for Anaheim:
Symposium: "Future Intelligent Control Systems – They are here today!"; Darrel Massie, Chair
(TC 4.6 will likely co-sponsor)

Minutes provided by John House

Appendix D.
TC4.11 Communications and Integration Subcommittee Meeting

Communication and Integration Subcommittee Minutes
January 26, 2003 – Chicago
Michael Kintner-Meyer - Chair

Michael distributed a draft work statement "Design and Testing of a Self-Configuration Concept for HVAC Control System", provided a brief summary and reviewed discussions from the previous meeting.

Brambley asks if anything meaningful can be done in this area for only $100K. Kelly and Kintner-Meyer supported that there is. Since the last meeting, the tasks have been more focused.

Kelly: Task 2 "one or more of the following 3 applications…"

There was a question about the scope of the problem. Michael described how the system has to be feasible to control. It needs to be do-able by a person with the appropriate effort. Is this going to be limited to one zone?

Maria suggested specification for a specific control configuration.

Srinivas: consider splitting into 2 phases. Norford agrees – similar to Chiller FDD.

Carlos: Things are changing fast. Do in 1 year. Adjust $ appropriately.

Michael asked for help to revise work statement. Carlos agreed to help. Example: What are the current tools that the industry is using? Help from controls manufacturer.

Chris: I have done some of this. Save the knowledge the installer know about what a sensor's function is when he puts it in. Large variety of sensors, example 2 zone temperature sensors that should be averaged. Need to have human intelligence put into the system.

Brambley: What about existing system, new BMS, old sensors. Installer does not know. Press a button on a sensor and the broader system recognizes them. Excite as much as possible remotely, may have to excite at the sensor.

Carol: Lon has "press a button". Do we reach now to have fully automated system or focus on shorter term tools that involves more human interaction, but semi-automates the process.

Maria: Literature review include artificial intelligence techniques to recognize sensors.

Are we talking about "self cleaning" existing systems or new installations? Michael: new installations. Process industry sensors exist that may help "more intelligent". Installer interface with local sensor or device with a Palm.

Software finds sensors that are available. IEEE 1451 – self-announcement "I am a temp sensor and these are my properties".

George agrees that there is a component to human info that can not be done completely automatically.

Haves: Charles Kelp's works at A&M, similar?

Michael: Need to work on WS to narrow it. Focus on analytical part (task 2)

Carol: Any program?

>Michael: Architecture of electric power delivery system". How do we provide flexible communication tool? Seminar program managers funding or contractors, Discuss research topic. What is industry going? Title: "Integration of intelligent buildings and electric power delivery infrastructure.". Carol: Anaheim or Nashville. Seminar next winter.

>Other program: Addressing need for data modeling, Forum, Kintner-Meyer, New sensor technology, plus one other – we need to resolve these pending programs by the main meeting. No resolution now.

Appendix E.
TC4.11 Testing and Evaluation Subcommittee Meeting

TC 4.11 Testing and Evaluation Subcommittee Minutes
January 26, 2003 – Chicago
Natascha Castro – Chair

John House distributed and reviewed a work statement entitled "Tools for Evaluating FDD Methods for AHUs".

George: What are main dynamics that need to be captured? May need dynamic data to test steady state detector. Examples: chiller and control faults. It needs to be spelled out. John agrees this needs to be worked through more.

Haves: (1) Need more substanial set of faults. Ask for what we want. (2) Do we know how to model faults? Useful to have a better understanding of faults and their effect on equipment. Need for project to find faults in real buildings and characterize them. Should this be done before this project.

Jonathon Wright: Based on experience in 1020RP, he is concerned about sensor uncertainty in validating models. Easier with bigger abrupt faults compared to smaller leakage faults.

Brambley: Start with big faults.

John: Dynamics, get time scale approx right to achieve steady state. Look at Phase I of chiller study. Is the SS detector working properly?

Haves: Simulation tool – Need to be able to inject test signals. John agrees.

John: Is list of faults extensive enough? Other suggestions? (1) vibration – simulation hard

Chris: NIST VCVT – John: good starting place. Different platform? Is that best tool to deliver this in?

Kelly: Simulating controllers? John: Yes. Models exist from Annex 17 & 25.

John: 4.6 dynamic cooling coil model should be included.

Haves: Broader discussion of dynamic modeling… beyond AHUs to secondary loop. VAV box and fan control FDD.

John: Who has worked with AHUs? What faults do they want to see included?

Chris: Include control system faults in addition to mechanical faults

Brambley: Will the research deliver the simulation and addition modules. What are the deliverables? If so, requirements for software. How portable? Should they be included? John: Intentionally open ended. Brambley: additional programs, software requirements. Identify folks to help. Schedule?

Haves: Specification for a simulation tool more difficult to sell for funding than simulation tool. John: There will be a simulation tool. NIST can the "test shell" be helpful to make it more sellable. User concentrate on their methods and not interfacing with simulation.

Can others help? Haves, Brambley, West, Srinivas, Jean-Christophe.

No new research ideas mentioned when Natascha asked.

Status of Rossi's work statement: Conditional approval. After changes entered during this meeting, it will be thrown into the hopper for funding with the others. Include reference to 21CR project (Hackner questio n). Done.

Program:

- George's symposium: close call
- Brambley, on table for next meeting, "resolution of conflicts between multiple hyerarchical…"

Appendix F.
TC4.11 Research Subcommittee meeting/Planning Session

TC 4.11 Research
January 26, 2003

John House opened the meeting by distributing a list of the current research projects and brought up the idea of developing new material for inclusion in TC 4.6 handbook chapter. He stated that TC 4.11 does not have a have handbook chapter and that ASHRAE is seeking to make the handbook more cohesive. ASHRAE has requested that we consider contributing to 4.6 chapter if that is appropriate.

- what is going on in other tc's
- how can we move forward with the handbook
- special publications idea could be used to develop basis for handbook chapter

Haves: overview of building operations from the perspective of TC 4.6 and TC 4.11 would be helpful, combining optimization with FDD from a practical user's perspective. He suggested beginning by identifying potential users and recruiting them for input. Adding that the handbook cycle is at the right stage to give us several years to develop the chapter.

Remington volunteered to help with the plan. Stating that a journal article would be a good marketing step. People are starting to apply simple aspects of the work being advanced by TC 4.11, making it the right time.

House raised the issue of discussing this work in more detail at the next meeting with new time set aside to discuss the content and planning. It was agreed that the winter meeting is a good time to discuss this, while at the summer meeting it would have to be combined with the task of prioritizing research projects.

Haves suggested that there is a need for greater integration.
House stated that Research chairs have been asked to go to Chapter meetings to solicit info from local members to determine what changes are needed to improve the references, to identify gaps. One idea from Chip Barnaby was to extract information useful to design and to create a separate reference for designers. Haves reiterated the need to have information in a way that is useful from a user's point of view.
Haiad showed that it would be useful to have published research reports available for dissemination.
Blanc, stated that because people want to have their material published, it is put into the handbook, which is not current and not focused to users who want good how-to information. More recent handbooks are published on cd's, it would perhaps be better to reorganize the cd's so designers can find the references better.

Haiad added that the appeal of using the old handbooks is that people are able to return to marked the reference locations.

The next discussion focused on dissemination (special publications, other means to reach people,etc.)

House highlighted that the problem of dissemination, millions of dollars spent on research funneled into handbook which is updated every 4 years. There needs to be a greater emphasis to show how the new info can be integrated into our current knowledge.
There was open discussion to come up with ideas, out of which the following suggestions were made:
- have a journal subcommittee who's focus is to write a journal article every year.
- Put hotlink to tc's website on handbook cd to highlight current research, (e.g., for the latest research on X…(link to website)
- list current research on each publication to show that the TC's are working on. It is currently done annually. (e.g., List of Major Research from ASHRAE)

House stated that ASHRAE has begun to come out of the research debt, having 550K on unmarked funds. This may be a time to bring out new ideas. House solicited new topics. No new topics were brought up at this point.

Haves proposed holding a meeting of TC's related to 4.11 to brainstorm ideas. Les suggested booking a room to host the meeting, or make dinner reservation.

Les announced that it is time to update the roster.

House closed the subcommittee meeting.

Minutes by Natascha Castro

Appendix G.
TC 4.11 Smart Building Systems
Research Plan and Activities
July 2000

Research Objectives: The long-term goal of TC 4.11 is to conduct research on topics that will lead to the development and application of "smart" building systems. "Smart" buildings of the future will take advantage of automation, communications, and data analysis technologies in order to operate in the most cost-effective manner. A smart building would most likely have fully integrated control of building services such as HVAC, fire, security, and transportation. Integrated systems would reduce initial costs and could be "supervised" so as to meet the primary objectives of comfort, safety, and performance at minimum operating cost. In addition, the integration of the hardware and software for operation and monitoring of equipment would lead to reductions in support staff needs and improved equipment reliability. Further cost reductions and reliability improvements would be possible through the integration of automated techniques for detection and diagnosis of equipment faults. Ultimately, "smart" building systems could facilitate the use of "remote" support staff that operates, monitors, and maintains a number of different buildings from a centralized location. At this higher level, a smart building might communicate and inter-operate with other smart buildings for the purpose of load aggregation and centralized control and with outside service providers, such as utilities, energy providers, aggregators, and newly developing companies providing fault detection, automated commissioning, optimization, and other innovative services. In addition to the savings in operating costs associated with "smart" buildings, other benefits include energy conservation and enhanced occupant safety and comfort.

Three subcommittees form the backbone of the TC's activities: Technology Development, Communications and Integration, and Testing and Evaluation. The Technology Development Subcommittee is concerned with research issues associated with the development of emerging smart building technologies such as automated commissioning, performance monitoring, fault detection and diagnosis, optimal maintenance scheduling, and optimal control. The primary outcome of research endorsed by this subcommittee is expected to be data and models that enable development of the technologies and comprehensive methods that are the basis of the technologies. The Communications and Integration Subcommittee is concerned with research issues associated with enabling the seamless interaction of smart building components and services. An important aspect of this work is to identify the information that is necessary to support smart building technologies, and to identify the requirements of communication protocols to support the exchange of this information between different building services, between buildings and utilities, between multiple buildings, with outside service providers, etc. The Testing and Evaluation Subcommittee is concerned with research issues associated with assessing the benefits (market potential) and performance of smart building technologies. Research endorsed by this subcommittee is expected to result in data, metrics, methods, and tools/standards/guidelines for quantifying smart building system benefits and performance in a standardized manner, as well as findings from the actual application of these metrics, methods and tools.

Current TC 4.11 research includes projects in many of these areas. The evaluation of

communication protocol requirements between utilities and energy management systems was addressed in the recently completed research project 1011-RP. Fault detection and diagnostics (FDD) is being considered for a number of different HVAC applications. Demonstration of the performance and benefits of current FDD approaches for air handling systems was performed as part of the recently completed research project 1020-RP. Tools for enabling the assessment of FDD methods for chillers are being developed in 1043-RP, while the development of on-line training techniques for model-based FDD methods is being carried out in 1139-RP for vapor compression equipment.

TC 4.11, Smart Building Systems
Research Plan and Activities
June 2002

Current Research Projects
None

2002-2003 Research Plan

Priority	Project	Contributors	Status
1	Field Performance Assessment of Package Equipment to Quantify the Need for Monitoring, FDD, and Continuous Commissioning	Todd Rossi Mark Breuker Jim Braun	RTAR rejected 9/00. Revised RTAR to be submitted by 8/01/01 as priority 1 RTAR for 2001. Revised RTAR approved 9/01. WS approved in Atlantic City 10-0-0 (CNV). WS submitted to RAC 5/15/02. Returned by RAC (Honolulu). WS approved in Honolulu subject to minor revisions
2	Tools for Evaluating FDD Methods for AHUs (Was "Method of Testing FDD Tools for AHUs")	John House Les Norford Mike Brambley Phil Haves Chariti Young Andrew Price	RTAR to be submitted by 8/01/01 as TC 4.11 priority 2 RTAR for 2001. RTAR approved 9/01. Draft WS exists. RTAR to be resubmitted 8/02 due to change in scope. Ranked priority 1 RTAR for 02-03.
3	Design and Demonstration of a Self-Configuration Concept for an HVAC Control System	Michael Kintner-Meyer	RTAR exists. Draft WS exists. RTAR to be submitted 8/02 as priority 2 RTAR for 02-03.
4	FDD for Supermarket Refrigeration	Todd Rossi	New research idea proposed in Honolulu.
5	Real-Time Optimal Control in a Distributed Environment	Jim Braun George Kelly	New research idea proposed in Honolulu.
6	Prototyping and Field Testing of Utility – Consumer Information Services	Michael Kintner-Meyer Marty Burns Chuck McParland	SSPC 135 has reviewed the WS and set up a utility/building interface working group. This group will work with TC 4.11 to identify research needs in this area.
7	Smart Sensor Systems for Reducing Bias Errors in the Measurement of Air Temperatures and Flows in Air-handling Units (Was "Development of Fault Detection and Diagnostics for Sensor Failures")	Arthur Dexter Phil Haves	Two page Issues Paper handed out by Phil Haves in Minneapolis. Revised two page write-up distributed by Arthur Dexter in Atlanta. Arthur will revise to focus on a particular application. Arthur has been asked to expand this to a WS for Atlantic City.
8	Resolving Discrepancies Between Multiple, Hierarchically-Related, Fault Detection and Diagnostic Systems	Mike Brambley Todd Rossi	Mike Brambley scaled back scope and distributed a revised WS in Atlanta. TES thought "looked good". Need to submit revised RTAR.
9	Development of Tools for Assessing the Value of Demand Response Assets	Michael Kintner-Meyer	New research idea proposed in Honolulu.
10	Whole-Building FDD	Les Norford	New research idea proposed in Honolulu.

Appendix H.
List of Subcommittee Attendees

Chicago: January 2003

	Technology Development	Communications & Integration	Testing & Evaluation	Research
Voting Members				
Les Norford, Chair (V)	X	x	x	x
John House, Vice Chair, Research Subc (V)	X	x	x	x
Michael Kintner-Meyer, Communications and Integration Subc (V)	X	X	X	
Todd Rossi, Fault Detection Diagnostics Subc, (V)	X	x	x	x
Natascha Castro, Secretary, Web Master (V)	X	X	x	x
Steve Blanc, (V)	X	x	x	x
Barry Bridges (V)				
James W. Gartner (V)				
Rich Hackner, (V)	X	x	x	x
John Seem, (V)				
Mike Brambly, Testing and Evaluation Subc, CM	X	x	x	x
Phil Haves, (V)	X	x	x	x
Agami Reddy, CM	x	X	x	x
John Mitchell , CM	x		x	x
Carlos Haiad, (V)				
Srinivas Katipamula (V)				
Arthur Dexter, International member (V)	x		x	x
Non-Voting Members				
Barry Reardon, CM				
Brian Kammers, CM				
Carol Lomonaco, , CM Program Subc				
Charles Culp, CM				
Cliff Federspiel				
Curtis Klaassen				
Dave Branson, CM				
David Kahn, CM				
David Shipley			x	
Don Aymann				
Gene Strehlow			x	
George Kelly, CM				
Glenn Remington				
Hofu Kiu	x			
Hung Mahn Pham, CM				
James Braun, CM	x			

Name	Col1	Col2	Col3	Col4
Jean Christophe Visier			X	X
Jim Butler	X	X		
Jon Douglas	X	X	X	X
Jonathan Wright	X			
Keith Temple				
Kirstin Heinemeier			X	
Marty Burns	X	X	X	X
Michael Brandemuehl, CM				
Osman Ahmed				
Par Carling	X	X	X	X
Paul Reimer				
Peng Xu	X			
Peter Armstrong	X	X	X	X
Peter Gruber				
John Seem				
Pornsak Songkakul				
Richard Kelso				X
Robert Old, CM				
Rodney Martin	X	X	X	X
Ron Nelson, CM				
Song Zhang		X		
Thomas Engbring, CM				
Tim Salsbury	X	X	X	X
Virgil Seribo		X		
Zach Obert				