AMERICAN SOCIETY OF HEATING, REFRIGERATION 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. TC 4.7 DATE: May 5, 2011

TC/TG/TRG TITLE: Energy Calculations

DATE OF MEETING: Feb. 1, 2011 LOCATION: Las Vegas

MEMBERS PRESENT	YEAR APPTD	MEMBERS ABSENT	YEAR APPTD	EX-OFFICIO MEMBERS & ADD'L ATTENDANCE
Jeff Haberl (CHAIR)	2010	Jan Hensen (Int'l)	2008	See attendance list for
Tim McDowell (V CHAIR)	2010	Russ Taylor	2010	additional attendees.
Joe Huang (SEC)	2010			
Chip Barnaby (HDBKSC CHR)	2010			
Chris Balbach (PRGM SC CHR)	2010			
Joel Neymark (STDS SC CHR)	2007			
Iain Macdonald (SCM SC CHR)	2009			
Klaus Sommer (Int'l)	2007			
Dru Crawley	2008			
Moncef Krarti	2007			
Robert Sonderegger	2008			

Total attendance of voting members: 11 present, 2 absent.

DISTRIBUTION

ALL MEMBERS OF THE TC/TG/TRG

TAC CHAIR	Chuck Wilkin
TAC SECTION HEAD	Walter Grondzik
SPECIAL PUBLICATIONS LIAISON	John Clark
STANDARDS LIAISON	James Tauby
HANDBOOK LIAISON	Peter Simmonds
RAC RESEARCH LIAISON	Agami Reddy
PROF DEV COMM LIAISON	Filiza Walters
CHAP TECH TRANSFER LIAISON	Andrew Cochrane
STAFF LIAISON (RESEARCH)	Michael Vaughn
STAFF LIAISON (TECH SERVICES)	Michael Vaughn
STAFF LIAISON (STANDARDS)	Stephanie Reiniche

These draft minutes have not been approved and are not the official, approved record until approved by this committee.

ASHRAE TC 4.7 Energy Calculations

LAS VEGAS MEETING

MOTIONS AND ACTION ITEMS

MOTION: "Approval of the minutes from the meeting in Albuquerque" Neymark/Balbach (9-0-0 CNV)

MOTION: "Four-month No Cost Extension (NCX) to August 2011 for RP-1416 " McDowell/Crawley (10-0-0 CNV)

MOTION: "Approval of program plan for Montreal proposed by Program Subcommittee Chair" Sonderegger/Barnaby (10-0-0 CNV)

ACTION ITEM: Secretary (Huang) and Webmaster (Kinney) to canvas the TC on the use of Google Groups.

ACTION ITEM: Huang to present WS for Phase Two of 1456-RP at Montreal

ACTION ITEM: Huang to respond to RAC questions on 1588-RP by May

ACTION ITEM: Wetter to develop RTAR on Modelica for presentation at Montreal

ACTION ITEM: Research SC Chair (Abushakra) will follow-up with Agami Reddy to update the list of papers maintained by the TC, and put the list on the TC web site.

ACTION ITEM: A COMNET Working Group is set up with Huang, Neymark, Gardner, Haddad, Reilly, Cho, and Balbach.

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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. TC 4.7 DATE: May 10, 2011

TC/TG/TRG TITLE: Energy Calculations

DATE OF MEETING: Feb. 1, 2011 LOCATION: Las Vegas

TC/TG/TRG MEETING SCHEDULE

LOCATION – past 12 months	**DATE**	**LOCATION - planned next 12 months**	**DATE**
Albuquerque	June 29, 2010	Montreal	June 28, 2011
Orlando	January 26, 2009	Chicago	January 24, 2012

TC/TG/TRG SUBCOMMITTEES

Function	**Chair**
Program	Chris Balbach
Research	Bass Abushakra
Handbook	Chip Barnaby

RESEARCH PROJECTS – Current		**Monitoring**	**Report Mode**
Project Title	**Contractor**	**Comm.Chm.**	**At Meeting**
Appendix 1			

LONG RANGE RESEARCH PLAN

Rank	Title	W/S Written	Approved	To R & T
	Appendix 2			

HANDBOOK RESPONSIBILITIES

Year & Volume	Chapter Title	**No.**	Deadline	**Handbook Subcom. Chair/Liaison**
2009 Fundamentals	Energy Estimating Methods	19	June 2011	Barnaby/Simmonds

STANDARDS ACTIVITIES - List and Describe Subjects

SPC 140 Standard Method of Test for Building Energy Software – Joel Neymark
SPC 205 Data Exchange Protocols for Energy Simulation of HVAC&R Equipment Performance - Chip Barnaby

TECHNICAL PAPERS from Sponsored Research - Title, when presented (past 3 yrs. present & planned)

Appendix 3

TC/TC/TRG Sponsored Symposia - Title, when presented (past 3 yrs. present & planned)

Appendix 4

TC/TG/TRG Sponsored Seminars - Title, when presented (past 3 yrs. present & planned)

Appendix 5

TC/TG/TRG Sponsored Forums - Title, when presented (past 3 yrs. present & planned)

Appendix 6

JOURNAL PUBLICATIONS - Title, when published (past 3 yrs. present & planned)

None

Attendance

Below is a complete listing of attendees at this and the prior three meetings. It includes the voting members of the committee listed on the first page.

Present at Meeting				Last Name	First Name	Affiliation	Status 1/30
Las Vegas Jan 2011	Albu querque Jun 2010	Orlando Jan 2010	Louisville Jun 2009				VM Voting CM Corres. V Visitor
X	X	X	X	Abushakra	Bass	Milwaukee School of Eng.	CM
X	X	X	X	Balbach	Chris	Performance Systems Develop.	VM
X	X	X	X	Barnaby	Chip	Wrightsoft	VM
X				Bosworth	David	Cornell	V
X				Boyd	Matthew	NIST	V
X	X			Brandemuehl	Mike	Univ. of Colorado	CM
X	X	X	X	Carpenter	J Patrick	Facility Performance Engineer	CM
X				Cho	Heejin	PNNL	V
X		X		Cho	Soolyeon	Catholic Univ. of America	V
		X	X	Claridge	David	TAMU	CM
X				Cockerham	Keith	DLB Associates	V
X				Cook	Malcolm	Loughborough Univ (UK)	V
X	X	X	X	Cornick	Steve	Nat'l Research Council Canada	V
X	X	X	X	Crawley	Dru	Bentley Systems	VM
X				Cumali	Zulfi	Energy Systems Consultant	CM
	X	X	X	Degelman	Larry	TAMU	CM
X				DeGraw	Jason	Penn State	V
X				Djunaedy	Ery	Univ. of Idaho	V
X				Dong	Bing	UTRC	V
X	X	X		Eldridge	David	Grumman/Butlas Associ.	V
X				Feng	Jingjuan	UC Berkeley	V
X	X		X	Fisher	Dan	Oklahoma State Univ	CM
X				Gardner	Carol	Cobalt Engineering	CM
				Grondzik	Walter	Ball State University	TAC Sec Hd
X	X	X	X	Haberl	Jeff	TAMU	VM
X		X	X	Haddad	Kamel	NR Canada	V
X				Harleman	Sean	KW Engineering	V
X	X	X	X	Haves	Philip	LBNL	CM
X			X	Hong	Tianzhen	LBNL	V
X	X	X	X	Huang	Joe	White Box Technologies	VM
X				Im	Piljae	ORNL	V
	X	X	X	Judkoff	Ron	NREL	CM
X		X		Kennedy	Mike	Mike D Kennedy, Inc.	V
X				Kim	Hyojin	TAMU	V
X	X	X		Kolderup	Erik	Kolderup Consulting	V
		X	X	Kosny	Jan	Fraunhofer Inst	CM
X		X	X	Krarti	Moncef	University of Colorado	VM

Attendance (continued)

Present at Meeting				Last Name	First Name	Affiliation	Status
Las Vegas Jan 2011	Albu querque Jun 2010	Orlando Jan 2010	Louisville Jun 2009				VM Voting CM Corres. V Visitor
X	X			Kruis	Neal	NREL	V
X	X			Laouadi	Aziz	NRC Canada	V
X	X			Lee	Kwang Ho	UC Berkeley	V
			X	Liesen	Richard	ERDC	CM
X				Lin	Hongwen	LBNL	V
X				Liu	Xiaobing	ORNL	V
X	X			MacDonald	Iain	NRC	VM
X	X	X	X	McDowell	Tim	TESS	VM
X				Mendez	Charlene	ASU	V
X	X	X	X	Neymark	Joel	J. Neymark & Assoc	VM
X				Novoselac	Atila	Univ. of Texas at Austin	V
X		X		O'Neill	Zheng	UTRC	V
X	X			Pang	Xiufeng	LBNL	V
X				Pappas	Aleka	Group 14 Eng.	V
X				Paulus	Mitch	Milwaukee School of Eng.	V
X	X	X	X	Pedersen	Curtis	Univ. of Illinois	CM
X				Peeters	Leen	Univ. of Brussels (VUB)	V
X	X	X		Pegues	Jim	Carrier	V
X				Reddy	T. Agami	Arizona State Univ	CM
X	X		X	Rees	Simon	DMU	CM
X				Reilly	Sue	Group 14 Eng.	CM
X				Ruch	Jennifer	PG&E	V
X				Settlemyre	Kevin	LBNL	V
X	X	X		Shirey	Don	UCF/FSEC	V
X				Sleiti	Ahmad	UNC Charlotte	V
X	X		X	Som	Shrestha	ORNL	V
X		X	X	Sommer	Klaus	Koln Univ of Applied Sciences	VM (Int'l)
X		X	X	Sonderegger	Robert	Itron, Inc.	VM
X				Stafford	Stanton	Newcomb&Boyd	V
			X	Taylor	Russell	UTRC/UTC	VM
X				Veronica	Dan	NIST	V
X				Wang	Lei	TAMU	V
X				Wang	Liping	LBNL	V
X	X	X	X	Wetter	Michael	LBNL	CM
			X	Wray	Craig	LBNL	CM
X			X	Wright	Jonathan	Loughborough Univ (UK)	CM
X	X			Zuo	Wangda	LBNL	CM

Appendix 1
TC 4.7 RESEARCH PROJECTS STATUS

ASHRAE
Technical Committee 4.7 Energy Calculations
(Feb. 1, 2011)

Active projects

#	Title	Joint TC	Cog SC/ Contractor	PMSC	Dates / status
1416-RP	Development of Internal Surface Convection Correlations for Energy and Load Calculations	4.1	Sim/Comp, Univ of Texas	Dan Fisher (Chair), Steve Bruning, Jan Kosny	4-month NCX to August 2011 approved by Full Committee in Las Vegas
1456-RP	Assess and Implement Natural and Hybrid Ventilation Models in Whole-building Energy Simulations	4.10	Sim/Comp, Univ of Colo	Joe Huang (Chair) Philip Haves, Jan Hensen, R.Banks, C Scrutton, S.Szymurski	Final report approved by Full Committee letter ballot on Jan 12, 2011. Final paperwork to be submitted to RAC Mar 2011 (see following page for status of Phase Two effort)
1404-RP	Modeling, Analysis, and Reporting Protocols for Predicting Annual Energy Performance from Short-Term Building Energy Monitoring		DDM, Milwaukee School of Engineering	R. Sonderegger (Chair) J. Haberl, V. Smith	In Progress

Appendix 2
RESEARCH PLAN

ASHRAE
Technical Committee 4.7 Energy Calculations
2011 Research Plan (Feb 1, 2011)

Title	Society status	TC 4.7 Status	Actors or TC 4.7 Prime Contact	Subcom-mittee*
Active projects				
1416-RP Development of Internal Surface Convection Correlations for Energy and Load Calculations	project underway	Fifth PMS meeting held in Las Vegas Jan '11 (NCX granted thru Aug 2011)	Contractor: UTexas PMS: Dan Fisher (chair), Steve Bruning, Jan Kosny	SCM
1404-RP Modeling, analysis, and reporting protocols for predicting annual energy performance from short-term building energy monitoring	project underway	Second PMS meeting held in Las Vegas Jan'11	Contractor: UMilwaukee PMS: Robert Sonderegger (chair), Jeff Haberl, Vern Smith	DDM
WSs approved by TC				
1588-WS Procedure to create hypothetical layer-by-layer fenestration descriptions when only the bulk properties such as U-factor and SHGC have been defined	WS returned to committee Jun'10	WS authors to respond to RAC by May'11	Joe Huang (WS author), proposed PES Jeff Haberl (chair), Chip Barnaby, Tim McDowell, + TC4.5 rep to be determined	A
WS under development				
1456-RP Assess and Implement Natural and Hybrid Ventilation Models in Whole-building Energy Simulations (Phase Two)	RTAR unnecessary for Phase Two	WS under development	Joe Huang , Simon Rees, Eric Kolderup, Malcolm Cook, Iain Macdonald	SCM
co-sponsored WS led by other TC				
WS-1413 Developing standard procedures for filing missing weather data (TC 4.2 lead)	RFP released by RAC Mar 15, 2011; proposals due May 16,2011	Co-sponsorship approved by full committee Jun'08	Joe Huang (TC 4.7 contact)	DDM

Appendix 3
TECHNICAL PAPERS FROM SPONSORED RESEARCH

RP	Title	Contractor	Approved	Paper
1051	Procedures for Reconciling Computer-calculated Results with Measured Energy Data	Drexel	Chicago January 2006	Reddy, T.A., 2006. "Literature Review on Calibration of Building Energy Simulation Programs: Uses, Problems, Procedures, Uncertainty and Tools", ASHRAE Transactions, vol 112(1).
1051	Procedures for Reconciling Computer-calculated Results with Measured Energy Data	Drexel	Chicago January 2006	Sun J. and Reddy T.A., 2006, "Calibration of Building Energy Simulation Programs Using the Analytic Optimization Approach (RP-1051)", Int. J HVAC&R Research 12(1) 177-196.
1051	Procedures for Reconciling Computer-calculated Results with Measured Energy Data	Drexel	Chicago January 2006	Reddy, T.A., I. Maor and C. Ponjapornpon, 2006, "Calibrating Detailed Building Energy Simulation Programs with Measured Data- Part I: General Methodology", accepted for publication in Int. J HVAC&R Research.
1051	Procedures for Reconciling Computer-calculated Results with Measured Energy Data	Drexel	Chicago January 2006	Reddy, T.A., I. Maor and C. Ponjapornpon, 2006, "Calibrating Detailed Building Energy Simulation Programs with Measured Data- Part II: Application to Three Case Study Office Buildings", accepted for publication in Int. J HVAC&R Research.
865	Accuracy Tests for Simulations of VAV Dual Duct, Single Zone, Four Pipe Fan Coil and Four Pipe Induction Air Handling Systems (4796)	Univ Nebraska, Texas A&M	July 2002	Yuill, G., Haberl, J. 2006. “Accuracy Tests for Simulations of VAV Dual Duct, Single Zone, Four Pipe Fan Coil and Four Pipe Induction Air Handling Systems (4796),” ASHRAE Transactions-Research, Vol. 112, Pt. 1 (January).
865	Accuracy Tests for Simulations of Constant Volume, Dual Duct and Variable Volume Air Handling Systems (4796).	Univ. Nebraska, Texas A&M	July 2002	Yuill, G., Haberl, J., Caldwell, J. S. 2005. “Accuracy Tests for Simulations of Constant Volume, Dual Duct and Variable Volume Air Handling Systems (4796, RP-865),” ASHRAE Transactions-Research, Vol. 111, Pt. 2, No. 4796, pp. 137 – 153 (June).

Appendix 3
TECHNICAL PAPERS FROM SPONSORED RESEARCH (continued)

1050	Development of an Inverse Model Toolkit	Univ. of Dayton, Texas A&M	December 2001	Kissock, K., Haberl, J., Claridge, D. 2003. "Inverse Model Toolkit (1050-RP): Numerical Algorithms for Best-Fit Variable-Base Degree-Day and Change-Point Models," ASHRAE Transactions-Research, Vol. 109, Pt. 2, pp. 425 – 434.
1050	Development of an Inverse Model Toolkit	Univ. of Dayton, Texas A&M	December 2001	Haberl, J., Claridge, D., Kissock, K. 2003. "Inverse Model Toolkit (1050-RP): Application and Testing," ASHRAE Transactions-Research, Vol. 109, Pt. 2, pp. 435 – 448.
1093	Diversity Factors and Schedules for Energy and Cooling Load Calculations	Texas A&M	June 2000	Abushakra, B., Haberl, J., Claridge, D. 2004. "Overview of Literature on Diversity Factors and Schedules for Energy and Cooling Load Calculations (1093-RP)," ASHRAE Transactions-Research, Vol. 110, Pt. 1 (February), pp. 164 – 176.
1093	Diversity Factors and Schedules for Energy and Cooling Load Calculations	Texas A&M	June 2000	Claridge, D., Abushakra, B., Haberl, J. 2003. "Electricity Diversity Profiles for Energy Simulation of Office Buildings (1093-RP)," ASHRAE Transactions-Research, Vol. 110, Pt. 1, pp. 365 – 377 (February).

Appendix 4
TC/TG/TRG SPONSORED TRANSACTIONS SESSIONS

Current as of January 2011

PRESENT:

PLANNED:

PAST:

Louisville, June 20-24, 2009

Transaction "Improving Load Calculations for Fenestrations with Shading Devices"

Chicago, January 24-28, 2009

HVAC&R Research Seminar "Synthesis of Optimum HVAC System Configurations"

New York City/January 2008

How Low Can You Go?

Recent Advances in Energy Simulation (Chair: Dan Fisher)

How Low Can You Go? Low-Energy Buildings Through Integrated Design (Chair: Dru Crawley)

Application of Inverse Models (Chair: Jeff Haberl)

Appendix 5
TC/TG/TRG SPONSORED SEMINARS

Current as of February 2011

PRESENT:

Las Vegas, Jan 29-Feb 2, 2011

"Building Energy Simulation 102"
Track: HVAC Fundamentals and Applications
Chair: Keith Cockerham

"Energy Modeling of Existing Buildings"
Track: Low Energy Design
Chair: Sue Reilly

PLANNED:

Montreal, June 25-29, 2011

"Modeling Protocols for Building Energy Simulations for Code Compliance and Other Regulatory Programs"
Chair: Joe Huang
Speakers: Charles Eley, Jason Glazer, Aleka Pappas

"Operation Oriented Flexible Building Systems Modeling"
Chair: Wangda Zuo
Potential Speakers - Michael Wetter, Zheng Oneil, Wangda Zuo

"Building Simulation 103: Inverse Modeling Techniques"
Chair: Chris Balbach
Potential speakers: Jump/Koran, Bass Abushakra, John Shonder

"Quality Assurance in Modeling"
Chair - Carol Gardner
Potential Speakers – Joel Neymark, Maria Karpman, Nick Long

PAST:

Albuquerque, June 26-30, 2010

Building Energy Simulation 101 (Chair: Tim McDowell)
Simulation of HVAC/R equipment and systems using the limited data published by manufacturer (Chair: Michael Wetter)

Orlando, January 23-27, 2010

Web-based Programs for Calculating Energy Code-Compliance (Chair: Larry Degelman)
How to Assess the Performance of Sustainable Buildings (Chair: Moncef Krarti)

Louisville, June 20-24, 2009

Energy modeling of large buildings systems

Appendix 5
TC/TG/TRG SPONSORED SEMINARS (continued)

Salt Lake City June 21-25, 2008

Use of Equation Solvers for Simulation (Chair: Michael Wetter)

New York City/January 2008

How to model nothing – Energy Modeling for Zero Net Energy Buildings: Parts 1 & 2 (Chair: Jan Kosny)

Long Beach/June 2007

Simulation Support for the 2007 Solar Decathlon (Chair: Kamel Haddad)

Dallas/January 2007

Use of Equation Solvers for Simulation (Chairs: Jean Lebrun/Mike Wetter)
Applications of Computer Simulation in High Performance Buildings (Chair: Martha Brook)

Québec City/June 2006

None

Chicago/January 2006

How and Why to Calibrate a Simulation to Measured Data (Chair: Robert Sonderegger)
Application and Experiences with the New Simulation Software (Chair: Dan Fisher)

Denver/June 2005

Neglected Topics in Building Simulation (Chair: Ian Beausoleil-Morrison).

Orlando/January 2005

What to do When Data Misbehave (Chair: Agami Reddy)

Appendix 6
TC/TG/TRG SPONSORED FORUMS

Current as of January 2011

PRESENT:

Jan 29-Feb 2, 2011 - Las Vegas, NV

None

PLANNED (w/priorities):

June 26-30, 2011 – Montreal, PQ

"Should ASHRAE/LEED/etc. require certification for Building Energy Modeling?"

"The value of certification for Building Energy Modeling"

PAST:

Chicago, January 24-28, 2009

"Limitation of Energy Simulations for NZEB" (Chair: Tim McDowell)

Chicago/January 2006

"What Controls Modeling Capabilities are Needed for Energy Simulations?" (Chair: Philip Haves)

ASHRAE TC 4.7 Energy Calculations
Tuesday, February 1, 2011, 6:00-8:30 p.m.
Las Vegas

Minutes of 4.7 Full meeting

1. Meeting was called to order by Chair Haberl 6:08

2. Introductions 6:25

3. Roll call (Huang)

4. Minutes (MOTION: Neymark moved to approve the minutes, Balbach seconded, motion passed 9/0/0 CNV)

5. Announcements (Haberl):

* Drafts of the Advanced Energy Design Guide (50% and etc. energy savings) for schools will be available Feb. 2.

* ASHRAE now records badges for attendance at sessions. This is helpful for those who may need to show evidence of their attendance.

* For San Antonio, ASHRAE will be dropping themes and having tracks (8 tracks, e.g., alternative energy, building modeling, etc.)

* CEC is trying to work closer with program chairs to improve the quality of abstracts.

* Request from ASHRAE for TC's to be more welcoming to visitors.

* There is more information on the ASHRAE web site on TC activities; ASHRAE also wishes to help TCs in improving their web sites.

* There will be new special projects, with mechanisms to help them develop, on topics including BIM and performance metrics; However, these meetings are separate from the TC meetings, e.g., the BIM meetings are on Saturday.

* ASHRAE encourages use of Google groups, but the Chair feels this opens us up to ads (*such as for Viagra? comment by Abushakra*). The ASHRAE web page is more plain, Google Groups is flashier, but comes with ads, etc.

ACTION ITEM: Secretary and Webmaster to canvas the TC on the use of Google Groups.

* ASHRAE wants to facilitate the use of conference calls to spur TC activity between meetings. The TC has not used the ASHRAE conference call facilities to date.

* ASHRAE wants the TC to be aware of the following conferences and workshops:

1. *ASHRAE Building Modeling Workshop* in Atlanta, April 4-6. Space is limited to around 120 participants, so those interested should register early at the web address *www.ashrae.org/energymodeling*. The content of the web site is still fairly limited, but is likely to be improved over time (Haves).

2. *10th IEA Heat Pump Conference* May 10 in Tokyo (an ASHRAE-affiliated workshop)

3. *Latest Technologies in Refrigeration and Air Conditioning Conference*, June 10-11 Milan Italy.

4. *ECOS 2011 (24th Intl Conference on Efficiency, Cost, Organization, Simulation & Environmental Impact of Energy Systems*), July 4-7th, Novi Sad, Serbia

5. For the next ASHRAE Conference in Montreal, ASHRAE wants to remind everyone to bring their passport.

* The ASHRAE web page has a Help Wanted section for TCs. Mike Vaughn can help in answering questions.

* For the TC Membership, Chair Haberl still needs to update the roster for July. Crawley, Neymark, Krarti, and Sommer will be rolling off. Wetter , Fisher, and Abushakra will be rolling on.

Subcommittee Reports:

Applications (Huang)

The SC met on Tuesday afternoon 3:30-5:00, and spent a great deal of time discussing COMNET, which the SC felt was an important topic. Many suggestions were tossed around, but in the end the SC recommended the following two actions: (1) establish a working group on COMNET[1] , (2) organize a seminar for Montreal on "Modeling Protocols for Building Energy Simulations for Code Compliance and Other Regulatory Programs". The SC also discussed 1588-WS on "Procedure to create hypothetical layer-by-layer fenestration descriptions when only the bulk properties such as U-factor and SHGC have been defined". This WS was returned from RAC last July requesting additional clarification. The SC thought the questions were relatively minor and that the WS author (Huang) should respond.

Data-driven Modeling (Abushakra)

The SC met on Monday evening 7:30-9:00. The SC is planning to write 2 RTARs, one relating Smart Grid data to Data-Driven Modeling for which Sonderegger agreed to help, and another on In-situ procedures for actual performance LEED-certified buildings being led by Keith Cockerham. The SC is also preparing a seminar for Montreal on data-driven models as well as revisiting artificial neural network methods. and has three potential speakers.

Simulation and Component Models (MacDonald)

The SC met on Monday evening 6:00-7:30. There was high attendance. The discussion revolved around Modelica, and updates on ongoing projects on natural ventilation, and internal convection coefficients. The SC hopes to have RTARs and WS for the next meeting.

Research (Abushakra)

There are the following announcements about ASHRAE research:

a. Grants-in-aid of around $10K in size are available from ASHRAE

b. A new research avenue for large multi-disciplinary projects, e.g. a 1.5M project recently form NIST.

c. RAC will accept up to one cross-cutting research proposal a year, as well as high-risk research projects of around 100K.

d. At the Research SC chair breakfast, there was discussion on getting more RTARs.

e. 18 WSs will be coming out in the Spring for bidding. None from 4.7, 1 from 4.2, and 1 from 4.10.

f. Approached by RAC to form a PES for a 1637-URP, "Development of an Energy and Exergy-Based Model of Data Center HVAC Systems", with 3 TC4.7 and 2 TC 9.9 members; will aim for a recommendation before the RAC meets in May.

Report on on-going projects:

1404-RP "Modeling, analysis, and reporting protocols for predicting annual energy performance from short-term building energy monitoring" (Sonderegger) The project is fairly advanced. The objective is to determine the minimum time period necessary to monitor a building to determine its performance. This depends on the type of project and time of year. This is a fairly scholarly work with practical use. The PMS is pleased with the work, but will likely ask for a 6-month no-cost extension.

1416-RP "Development of internal surface convection correlations for energy and load calculations" (Fisher) The contractor (UTexas/Austin) has done a fabulous job. He was asked to run 48 cases, but has

[1] the same recommendation was made at the Albuquerque meeting, but there was no follow-up *(secretary's note).*

instead ran over 500 cases, and produced a large amount of data. The project is now in the last stage of completion, with the results to be included in the ASHRAE Toolkit. A 4-months' No-Cost Extension (NCX) is requested to get the project past Montreal. MOTION: McDowell moved that a NCX be granted to Aug 1 2011, seconded by Crawley. Motion is approved 10-0-0-1 CNV.

1456-RP "Assess and implement natural and hybrid ventilation models in whole-building energy simulations" (Huang) The Phase One project was finished in early 2010. The TS full committee voted to accept the final report in Albuquerque, but because the voting membership failed to reach quorum, RAC requested that the vote be repeated. A letter ballot was held Jan. 12 2011 that passed 10-0-3 CNV. According to Michael Vaughn, Phase Two does not need a new RTAR and can proceed directly to WS (Work Statement). Simon Ress and Eric Kolderup have agreed to help with Huang on finishing the WS to be presented at the Montreal conference. At the SCM SC meeting, Malcolm Cook and Macdonald had also expressed interest in helping.

1588-RP "Procedure to create hypothetical layer-by-layer fenestration descriptions when only the bulk properties such as U-factor and SHGC have been defined" (Huang). This WS was approved by the TC in Orlando and forward to RAC, who returned it to the TC in Albuquerque requesting additional clarification. The WS author (Huang) will respond to RAC's questions in time for the RAC meeting in May.

ACTION ITEMS:

1. Huang to present a WS for Phase Two of 1456-RP at Montreal.

2. Huang to respond on 1588-RP before RAC meeting in May.

3. Wetter to develop a RTAR on Modelica at Montreal.

Agami Reddy (RAC Research Liaison) noted that the TC 4.7 Research Plan still includes 1413-WS, which should be removed.

There are no requests for co-sponsorship of WS or RTARs (Haberl)

ASHRAE encourages the formation of Multidisciplinary Task Groups (MTGs) (Haberl). This is more like a grant, rather than a contract. Respond to an open solicitation, very little oversight, only requirement being writing a paper (Reddy).

Handbook (Barnaby)

The SC met just a few moments ago. The schedule has been defined, with a draft to be done by Chicago for review, maybe by San Antonio if later. Review of chapter came up with more information on use of programs rather than documentation of models, because that task is impossible to achieve anyway. There is a need to more clearly identify the audience for the chapter. Handbook chapter will be circulated for review; Barnaby requests review and comments back to SC, and invites anyone interested to join the SC.

Reddy said that all the research produced by the TC should be included in the chapter, It's good that the TC maintains the list of papers produced by the TC.

ACTION ITEM: Research SC Chair Abushakhra will follow-up with Reddy to update the list of papers maintained by the TC, and put it on the TC web site.

Program (Balbach)

SC Chair Chris Balbach thanks the chairpersons for the two programs at this conference, which were both very well attended.

Michael Wetter made the following announcements related to IPBSA-USA

* information on the *SimBuild 2011 Conference* is available on the ibpsa.org web site. The deadline for abstracts has been extended by one week to Feb. 8th.

* IBPSA-USA will be holding building energy training workshops every 6 weeks throughout the country. Information is also available on the IBPSA-USA web site.
* the book *Building Performance Simulation for Design and Operation* is now available.
* there will be a workshop chaired by GHenze on "Model Predictive Control in Buildings" in Montreal on Friday and Saturday just prior to the ASHRAE conference.
* 109 people are now certified as BEMs.

Balbach explained the requirements for ASHRAE technical papers published in the Transactions, conference papers (8 pages, single blind review), seminars and forums.

The proposed program plan for Montreal include:

(1) seminar on "Modeling Protocols for Building Energy Simulations for Code Compliance and other Regulatory Programs", to be chaired by Sue Reilly or Huang.

(2) seminar on "Application for Model-based Simulations", to be chaired by Wangda Zuo, with three confirmed speakers (Wetter, ONeil, and Zuo)

(3) seminar on inverse modeling toolkit, to be chaired by Balbach, with three likely speakers to be confirmed.

(4) seminar on "Quality Assurance in Modeling", to be chaired by Carol Gardner, with two speakers identified so far (Nick Long, and Maria Karpman on model inputs/outputs).

MOTION: Sonderegger moved that the program plan for 2011 be approved, seconded by Barnaby, motion passed 10-0-0-1 CNV.

Standards

SSPC 140 (Neymark). ANSI/ASHRAE Standard 140 is the "Standard Method of Test (SMOT) for the Evaluation of Building Energy Analysis Computer Programs". 140-2007 is listed with ASHRAE's 10 most popular standards and guidelines. It is 8th on the list of 111 Standards and 18 Guidelines. It is being cited by an increasing number of organizations, such as ASHRAE (Standards 90.1 and 189.1), International Energy Conservation Code, International Green Construction Code, COMNET, ASHRAE BEQ. Residential Energy Services Network plans to cite 140-2011 when it is published. Forthcoming addenda to 140-2011 (after that is published) include test suites for ground heat transfer modeling, multi-zone modeling not including airflow, and simulation test for air-side HVAC equipment (originally from RP-865). HVAC equipment modeling tests are undergoing simulation trials within SSPC 140 with test spec revisions to be out in March 2011. A new development is that NREL published in Fall 2010 a BESTEST for Existing Homes (BESTEST-EX). See Attachment G for Chair's meeting summary notes and meeting agenda.

SPC 205 (Barnaby). This is the newly approved SPC on "Data Exchange Protocols for Energy Simulation of HVAC&R Equipment Performance". The committee was formed and the first meeting held today. The goal is to automate the transmission of equipment data through BIM. There was an interesting interaction between the simulation and equipment people; looking for a "quick win", can be a big deal. Those interested are invited to get involved.

SPGP 20 (also Barnaby). They have already contacted 4.1 for real use cases. Eventually information will be on a web site for software developers.

TC Web Site

Webmaster Kris Kinney was not here. Haberl has communicated with Kinney; the Web site is relatively up to date. Those interested should get in touch with Chair (Haberl).

Related Activities

TC 1.5 "Computer Applications" (Barnaby) Ongoing research project RP-1468 on translating BIM to thermal. The contractor is Haberl, and the work focuses primarily on the building envelope.

TC 4.1 "Load Calculation Data and Procedures" (Curt Pedersen) (1) SPC 203 just got started on a method of test for determining heat gain from office equipment. Instead of having ASHRAE do the measurements, the objective is to establish a MOT for the manufacturers instead. The SPC needs suggestions on how to get in touch with the producers of office equipment. (2) Bill Bahnfleth, who used to be in TC 4.7, was just named ASHRAE secretary, to be in line to be ASHRAE president eventually.

TC 4.2 "Climatic Information" (Steve Cornick) The TC has selected the contractor to update the HOF climatic tables. It is a good time to submit requests and comments on what data to be include in the tables.

TC 4.3 "Ventilation Requirements and Infiltration" (Macdonald) The TC is coming out with a lot of data on infiltration on multistory residential buildings. Some buildings need a lot of CFMs just to raise the pressure in tests.

TC 4.5 "Fenestration" (Barnaby) Results of previous TC 4.5/4.7 project on multi-layer fenestration (contractor John Wright and Barnaby) is now being used in California's residential analysis tool. Kamel Haddad mentions that he is a member of the PMS of a project on tubular skylights.

TC 4.10 "Indoor Environmental Modeling" (Zuo) described a project that may eventually link CFD to thermal simulation; they are also developing boundary conditions for simulations.

TC 6.5 "Radiant Heating and Cooling" (Pedersen) described a project in which the calculation of thermal comfort is needed.

TC 7.5 "Smart Building Systems" (Moncef Krarti) There are four ongoing projects, as well as a RTAR under development on reducing simultaneous heating and cooling in commercial buildings that TC 4.7 might be interested in co-sponsoring.

TC 7.6 "Systems Energy Utilization" (Haberl) This TC is now renamed, "Building Energy Performance". There is a lot of work going on for Guideline 14, but not a whole lot on simulations, except for calibrated simulations.

BuildingSMART (formerly IAI) (Haves) They are working on a national BIM standard. GSA is now testing this standard and will require it in all federal projects.

IBPSA-USA (Wetter) There was an IBPSA dinner on Saturday, after which Malcolm Cox gave a great talk (Haberl).

IBPSA-Canada (MacDonald) *eSim 2010* was a great success. The next *eSim* conference will be held May 2012 in Halifax.

No Old Business

New Business (Haberl)

TC 4.7 is not good on nominating people for awards. Haberl and Pedersen will work together to look more into those who have made contributions for nominations for awards.

ACTION ITEM: A Working Group is set up on COMNET; volunteers include Huang, Neymark, Gardner, Haddad, Reilly, Heejin Cho, and Balbach.

Attachments

A. Agenda
B. Simulations and Component Models Subcommittee Agenda and Minutes
C. Data-Driven Models Subcommittee Agenda
D. Applications Agenda and Minutes
E. Handbook Subcommittee Minutes
F. Program Plan
G. SSPC 140 Agenda and Minutes

Attachment A

Agenda
ASHRAE TC 4.7 Energy Calculations

Tuesday, Feb 1, 2011, 6:00-8:30 p.m.
Hilton Hotel, Pavilion 3

1. Roll call and introductions	Huang
2. Accept agenda & approve minutes of Orlando meeting	Haberl
3. Announcements/Liaisons	Haberl
4. Membership	Haberl
5. Subcommittee reports	
5.1 Applications	Huang
5.2 Data-Driven Modeling	Abushakra
5.3 Simulation and Component Models	MacDonald
5.4 Research	Abushakra
• *Status:* 1404-RP Modeling, analysis, and reporting protocols for predicting annual energy performance from short-term building energy monitoring (Milwaukee School of Engineering)	
• *Status:* 1416-RP Development of Internal Surface Convection Correlations for Energy and Load Calculations (TC 4.1/4.7 Univ. of Texas at Austin)	
• *Status:* 1588-WS Procedure to create hypothetical layer-by-layer fenestration descriptions when only the bulk properties such as U-factor and SHGC have been defined	
• RTARs and Work statements for consideration	
• Requests for co-sponsorship	
• Multidisciplinary Task Groups (MTGs)	
• Cross-Cutting high risk, exploratory research	
5.2 Handbook	Barnaby
5.3 Program	Balbach
5.4 Standards	Neymark/Barnaby
• SSPC 140 SMOT for Eval Bldg Energy Analysis Computer Programs	
• IEA Annex 34/43 Test and Validation of Bldg Energy Sim Tools	
• SPC 205 – Data Exchange Protocols for Energy Simulation of HVAC&R Equipment Performance	
• SGPC 20 Documenting HVAC&R Work Process and Data Exchange Requirements	
5.5 Web Site	Kinney
6. Related activities reports	
TC 2.8 Building Environmental Impacts and Sustainability	
TC 4.1 Load Calculation Data and Procedures	Petersen
TC 4.2 Climate Information	Degelman
TC 4.5 Fenestration	Barnaby
TC 6.5 Radiant Heating and Cooling	Sommer
TC 7.5 Smart Building Systems (now includes TC 7.4)	Wetter
TC 7.6 Systems Energy Utilization	Abushakra
BuildingSMART (formerly IAI International Alliance for Interoperability)	Haves
IBPSA: USA, SimBuild 2008; Canada, eSim 2006; IBPSA, BS 2009	Wetter, Hensen
7. Old Business	Haberl
9. New business	Haberl
9.1 Appoint TC 4.7 Subcommittee for Awards Nominees	
• ASHRAE Distinguished Service, Exceptional Service	
• ASHRAE Fellow	
• Service to ASHRAE Research	
• ASHRAE New Investigator Award	
• ASHRAE Homer Adams Award	
10. Adjourn	Haberl

Attachment B

TC 4.07 Simulation and Component Models Subcommittee
Agenda
Monday, January 31, 2011
6:00-7:30pm (H) Pavilion 4

1) Introductions and Agenda Review (5 minutes)
2) Program (15 minutes)
    a. 2011 Winter (Las Vegas)
    Seminars:
    Building Simulation 102 (chair Keith Cockerham) presenters: ??
    Modeling of Existing Buildings (chair Sue Reilly) presenters: Haberl, Judkoff, Reilly.
    b. 2011 Summer (Montreal)
    Seminars:
    Solar Decathlon (chair Kamel Haddad) presenters: ??
    You don't know what you've got 'till it's checked! The importance of QA in benchmarking energy analysis results (chair Chris Balbach) presenters: ??
    c. 2012 Winter (Chicago)
    d. 2012 Summer (San Antonio)
3) Research (45 minutes)
    a. Work Statements
    xxxx Develop comprehensive performance rating procedure for unitary equipment (co-sponsor request from TC 8.1; ???)
    b. RTARS
    1629 *Testing and Modeling Energy Performance of Active Chilled Beam Systems* (co-sponsor request from TC 5.3; Iain Macdonald) 5.3 submitting RTAR may ask for co-sponsorship after 2011 winter meeting.
    c. Research Plan/New ideas
    Natural Ventilation (follow-on to RP1456) (???)
    Modelica for simulation (???)
    Validation Issues (model algorithms) (???)
4) AOCB (5 minutes)

Attachment B (continued)

TC 4.07 Simulation and Component Models Subcommittee
Draft Minutes
Monday, January 31, 2011
6:00-7:30pm (H) Pavilion 4

1) Introductions and Agenda Review
   a. 47 attendees
   b. No minutes to approve from the Albuquerque meeting as there was no SCM meeting.
2) Program
   a. Chris Balbach informed participants about items from this meeting
3) Research

Topic	Champion(s)/Liaison(s)	Status
Develop comprehensive performance rating procedure for unitary equipment	Chip Barnaby	co-sponsor request from TC 8.1 Not discussed as Barnaby not present.
Exploring Modelica for solving the thermal model	Jeff Habrel, Michael Wetter, Tim McDowell	Discussed rational and purpose of using Modelica. ACTION: McDowell to contact Wetter and draft RTAR
Natural Ventilation	Joe Huang, Malcolm Cook, Iain Macdonald	RP 1456 complete, discussed follow on work. ACTIONS: Abushakra to check if we can write phase 2 as a WS (i.e. skip RTAR stage).[2] Macdonald will investigate creating a MTG with membership from 4.3, 4.7 and 4.10[3] Cook to draft RTAR
Underprediction of heating energy consumption	Phil Haves, Charlie Curcija	In discussion of validation issues building heating energy is reported as dominating by USDOE EIA
Cloud computing	Ahmed Sleiti	Is there a role for cloud computing. Overlap with TC 1.5.
Internal convection	Dan Fisher	RP 1416 looking for a no cost extension. Need more work in this area.
1629 Testing and Modeling Energy Performance of Active Chilled Beam Systems	Iain Macdonald	Co-sponsor request from TC 5.3. No update.

4) AOCB
   a. URP on "Development of an energy and exergy model for HVAC systems" received. (Also sent to TC 9.9). Volunteers for the PES: Haddad, Zhang and Zuo.

[2] Joe checked with Mike Vaughn, who said we can go straight to an WS; therefore, chase Joe.
[3] MTGs are cross section (Dru) so this will not fly on that ticket.

Attachment C

TC4.7 Data-Driven Modeling Subcommittee
January 31, 2011, Monday 7:30-9:00 PM
Hilton, Pavilion 4
Las Vegas

Chair: Bass Abushakra

AGENDA

1. Introductions

2. Approval of the minutes from the Albuquerque meeting, June, 2010 *(check the Full TC4. 7 Meeting Minutes, since there were no separate subcommittees meetings)*

3. Discussion of Program

    a. Annual Meeting 2011 (Montreal)
    b. Winter Meeting 2012 (Chicago)
    c. Beyond

4. Discussion of WS and RTAR's
    d. Existing WS and RTAR's
    e. Ideas for new RTAR's
    RTAR's need to be aligned with the ASHRAE Research Strategic plan for 2010-2015 (attached).
        1. AI for data-driven modeling
        2. In-situ procedures for energy savings from renewable projects
        3. In-situ procedures for actual energy savings in LEED-Certified projects
        4. Electricity demand savings
        5. Water use in a facility
        6. Smart-grid data in DDM
        7. Standardized M&V for savings from operational changes
        8. Other ideas

5. Current RP's

6. Discussion on:
    a. Better ways to digest past research
    b. Disseminate research results
    c. Coordinate research and results with allied TC and SC
    d. Participate in newly-formed "Multi-disciplinary Task Groups (MTG's)
    e. Maintain expertise within SC even when membership changes.

7. Old Business

8. New Business

9. Adjourn

Some Background Information:

Review of ASHRAE Strategic Plan for Research:

- Research themes include: 1) Energy and Resources, 2) Indoor Air Quality, 3) Tools and Applications, and, 4) Equipment, Components and Materials
- Weighted criteria: 1) Supports strategic plan 45%, 2) co-funding support 10%, 3) anticipated application 10%,, 5)RAC vote 20%, 6) Tech Council Preview Feedback 5%
- RAC will review RTARs at all meetings: 3/yr —need 45 days advance — May 15, Aug 15, Dec 15
- Limited time for RTARs in Implementation Plan (4 meeting shelf life); intended to minimize delays in initiating research projects

Attachment D
ASHRAE TC 4.7 Energy Calculations
Applications Subcommittee
Tuesday, February 1, 2011
3:30-5:00pm (H) Pavilion 3
Las Vegas, NV

Agenda

5) Introductions and Agenda Review (5 minutes)
6) Program (15 minutes)
    a. 2011 Winter (Las Vegas)
    Seminars:
    "Energy Modeling of Existing Buildings" (Seminar 14, Sunday 11:00-12:30, chair Sue Reilly)
    "Building Energy Simulations 102" (Seminar 7, Sunday 11:00-12:30, chair Keith Cockerham)
    b. 2011 Summer (Montreal)
    Forum:
    COMNET (chair Sue Reilly?) presenters: ??
    c. 2012 Winter (Chicago)
    d. 2012 Summer (San Antonio)
7) Research (45 minutes)
    a. Work Statements
        - 1588-WS Representative Layer-by-Layer Descriptions for Fenestration Systems with Specified Bulk Properties such as U-Factor and SHGC (co-sponsored by TC 4.5)
        - 1413-WS Developing standard procedures for filing missing weather data (TC 4.2 lead)
    b. RTARS
    c. Research Plan/New ideas
        - Working Group to review the rules extracted from COMNET for use in BuildingEQ and report to ASHRAE within 30 days" (motion passed in Albuquerque)
        - COMNET/Building energy simulations for standards, labels green building certification, CDM
        - Reconciling simulated and measured performance

Minutes

Present: Chris Balbach, Juan-Carlos Baltazar, Matt Biesferveld, David Bosworth, Heejin Cho, Soolyeon Cho, Charlie Curcija, Jeff Haberl, Anthony Hardman, Philip Haves, Erik Kolderup, Kwang Ho Lee, Tim McDowell, Joshua New, Joel Neymark, Aleka Pappas, Simon Rees, Sue Reilly, Theresa Stovall, Michael Wetter, Wangda Zuo

Introductions and Agenda Review

Joe Huang explains the scope of the subcommittee as "the use and applications of simulation program."

Program

Two seminars were presented at Las Vegas "Energy Modeling of Existing Buildings" and "Building Energy Simulations 102".

If the seminar speaker is rated by 3.5 or lower for three times, then the speaker may not be scheduled anymore.

Attachment D (continued)

Chris Balbach announces the ASHRAE Energy Modeling Conference. See web site for details.

Joe Huang and Sue Reilly proposes a forum about COMNET. Possible title is "What would ASHRAE members like to see in next versions of COMNET." A working group may be a better mechanism, as there is a concern that a Forum does not bring together the right, informed audience for a constructive discussion. Haves suggest considering a 90 minute forum that starts with short series of presentations. For general membership, a seminar series is well suited. This may be followed by a forum, or a closed discussion about possible more controversial issues.

The TC may want to consider establishing a (standing) working group about COMNET.

A seminar may also include rules for tax credit, and a discussion where rules are applicable, and where they may cause problems for innovative systems that bring us towards NZEB.

McDowell make a motion to organize a seminar about to role of modeling rules. Haves make an amendment to follow up with a forum. Suggest title "Energy modeling rules for standards, credits and labeling."

Haberl mentions that a problem with COMNET is that it may exclude non-DOE-2 based systems, and that the range of systems is limited. There is no official ASHRAE group that reviews COMNET, and yet COMNET is the basis of the labeling program.

The subcommittee considers establishing a working group about rules for energy modeling. This could be a MTG across the society.

Balbach announces the NREL releases data sets that were used for design guides. Nick Long from NREL likes to organize a seminar about this activity. There is also a speaker that addresses quality assurance in modeling. Balbach can chair the seminar.

Wangda Zuo proposes a seminar about model-based design and applications. Wetter could give an introduction about Modelica, Zuo could present chilled water plants, other speakers could be Jim Braun (Purdue) and maybe from Johnson Controls. Working title is "Application of model-based design." Chair: Wangda Zuo

Research

Huang describes 1588-WS. WS was returned by RAC. The TC needs to respond to the comments. The WS has to revoted by the full committee after the respond is crafted. Charlie Curcija considers the WS an impossible task as the computation of layer-by-layer properties from SHGC and UA value is too ambiguous. Huang thinks if all data that is available is taken into account, then the layer-by-layer reconstruction is still better than just using the SHGC and UA value. Curcija questions whether a look-up in a database, while valuable, represents research that ASHRAE should sponsor. Haves thinks the response of RAC should be addressed, and the WS resubmitted as it got approved previously by the TC.

1413-WS "Developing standard procedures for filing missing weather data" is lead by TC 4.2, and now out for bid, with proposals due May 16.

New Ideas

Huang presents ideas of COMNET.
Other ideas include reconciling simulated and measured performance. Haves suggest this could be done within a MTG. They will be discussed at the next meeting.

Attachment E
ASHRAE TC 4.7 Energy Calculations
Handbook Subcommittee
Tuesday, Feb. 1, 2011, 5 – 6 PM
Hilton Pavilion 3, Las Vegas, NV

Attendance

Who	Affiliation	eMail
Iain MacDonald	NRC-IRC	Iain.macdonald@nrc.ca
Tim McDowell	TESS	mcdowell@tess-inc.com
Carol Gardner	Cobalt Engineering	cmg750@gmail.com
Joel Neymark	JNA	neymarkj@msn.com
Klaus Sommer	University of Applied Science, Cologne, Germany	Klaus.sommer@fh-koeln.de
Erik Kolderup	Kolderup Consulting	erik@kolderupconsulting.com
Chip Barnaby	Wrightsoft	cbarnaby@wrightsoft.com
Bass Abushakra	MSOE	abushakr@msoe.edu

Minutes

The approved, revised chapter manuscript must be delivered to ASHRAE by June 16, 2012 – this is before the SA meeting. This will require a complete review plan by Montreal with assigned tasks. Mark-up reviews will be collected by the chair in a couple months to collate by the Montreal meeting.

General schedule –

- Revised outline and writing assignment: June, 2011 (Montreal)
- Section writing / intermediate deadlines as needed: June, 2011 – January, 2012
- Draft chapter: January, 2012 (Chicago)
- Revisions January – May, 2012
- TC approval (eMail ballot) – approx June 1, 2012
- Submission to Handbook and ASHRAE – before June 16, 2012.

The group concentrated on brainstorming on changes of chapter focus and organization.

Kolderup reviewed the current chapter from the view of a practitioner. Suggests new section on how to apply energy modeling. This section should include advice on choosing software based on the limits of the software and the requirements of the building and systems being modeled. This is especially true of low-energy buildings.

Add UFAD topics, displacement ventilation, natural ventilation, coupled thermal and air flow, daylighting.

Do we want to go into exergy and/or emissions modeling?

BIM and interoperability should be covered.

Is chapter a useful reference source for the BEMP exam?

Fan modeling should be improved.

Possibly reduce the number of components discussed. Chillers are discussed in multiple locations, maybe we could thoroughly discuss one component.

Attachment E (continued)

Rework ground coupling.

How is the best way of introducing energy modeling in a chapter? Do you start with the building and add the envelope, then the internal, then the systems? Or is this load calculation?

What is the purpose of the chapter? Should we write some use cases for the chapter?

Include quality control approaches and procedures.

Take the outline and review how many pages are spent on each topic.

Possible target audiences – 1) students 2) newbies 3) BEMP takers 4) clients

Perhaps change the chapter into more of a guidebook to modeling and where to find more information.

References to TC sponsored research project should be included. RAC uses Handbook references as part of evaluation of impact of research.

Action Items

Who	Affiliation	When
Erik Kolderup	Draft and circulate use cases for chapter	Feb. 14, 2011
Carol Gardner	List sections with page counts; recommend increase / decrease	Feb. 14, 2011
All	Review chapter, circulate comments	ASAP
Chip Barnaby	Reminder to committee; organize outline development	March 14, 2011

Attachment F
TC 4.7 Program Plan
ASHRAE Meeting
2/1/11

January 29-February 2, 2011, Las Vegas, NV **Theme: Zero Energy Design – A Safe Bet**

SUNDAY, SEMINAR 7: Building Energy Simulation 102
SUNDAY, SEMINAR 14: Energy Modeling of Existing Buildings

Specialty Conference: Energy Modeling : Tools for Designing High Performance Buildings Conference
April 4-6 ASHRAE Headquarters Registration opens soon. www.ashrae.org/energymodeling

2011 Annual Conference Date / Location: June 25 – 29, 2011 / Montreal, Canada Theme: Net Zero Buildings

Track 1 Refrigeration / Track Chair: Dan Dettmers / Email: dettmers@cae.wisc.edu
Track 2 HVAC Systems / Track Chair: Charlie Henck / Email: chenck@wrallp.com
Track 3 HVAC Fundamentals and Applications / Track Chair: Wade Conlan / Email: wconlan@x-nth.com
Track 4 Net Zero Energy Buildings / Track Chair: Bill Dean / Email: bill.dean@nrc.ca
Track 5 Professional Skills / Track Chair: David Zimmerman / Email: david.zimmerman@rji-sales.com
Track 6 Engineering Tools / Co-Track Chairs: Dunstan Macauley dmacauley@encongroup.com, Mike McDermott mmcdermott@esdesign.com
Track 7 Commissioning / Track Chair: Sarah Maston / Email: smaston@rdkengineers.com
Track 8 Alternative Technologies / Track Chair: Keith Newcomer / Email: keith.newcomer@piedmontng.com

Key Dates: (WEBSITE CURRENTLY OPEN FOR SUBMISSION OF SEMINAR AND FORUM PROPOSALS)

02/14/2011: SEMINAR AND FORUM PROPOSALS DUE
02/21/2011: CONFERENCE PAPER ACCEPT / REJECT NOTIFICATIONS
03/07/2011: FINAL TECHNICAL PAPERS AND CONFERENCE PAPERS DUE
03/18/2011: NOTIFICATION OF SEMINAR / FORUM / TPS / CPS PAPER ACCEPT/REJECT DISTRIBUTED
05/06/2011: UPLOAD OF SEMINAR AND CONFERENCE PAPER TPS BEGINS
06/06/2011: ALL SEMINAR AND CONFERENCE PAPER .PPT UPLOADS COMPLETE
3/2/2009 Notification of acceptance of Transactions Sessions; 5/1/2009 Papers Due ***

Ideas for Montreal

Building Energy Simulation 103 – Leveraging Inverse Modeling Tools – what are they and what kind of information can be extracted for a given data set: Chair: Chris Balbach Potential Speakers: K Kissock, D Jump (Neural Networks)

Improving Simulation Predictions - Quality Assurance Issues: Practical Methods for improving the reliability of simulation results w/ Feedback? Chair : ? Potential Speakers – Karpman, Long, ? OpenEI/Vibe, NYSERDA, NJSmartStart QA/QC methods

Risk or Reward – using simulation techniques to evaluating Investment Risk (General topic is managing uncertainty)
Chair: ? Potential Speakers (Shonder – Guideline 14 Uncertainty), Jerry Jackson (EBAR

Forum: Should ASHRAE/LEED/etc. require certification for "Building Energy Modeling"

Forum: The value of certification for "Building Energy Modeling"

Program Ideas from Previous meetings

Seminar "Web-based Programs for Calculating Energy Code-Compliance" Not Scheduled
Organized by: TC 4.7 (Applications)
Chair: Larry Degelmann
Status: Moved from Dallas. (Jeff Haberl, Eric Richmond, Paul Mathew).

Seminar "How to Assess the Performance of Sustainable Buildings" Not Scheduled
Organized by: TC 4.7 (Data Driven Models)
Chair: Moncef Krarti
Status: 4 speakers (B. Koran, Bass Abushakra, David Claridge)

Seminar "Supporting Performance Feedback Via Community Energy Benchmarking - Lessons learned" Not scheduled
Organized by: TC 4.7 (Data Driven Models)
Chair: Chris Balbach
Status: Since 1/09. (Candace Damon, Kim Lenihan, Chris Balbach)

Seminar "Computer Simulation of Supermarkets" Not scheduled
Organized by: TC 10.7 (co-sponsored by 4.7)
Chair: Van D. Baxter, ORNL
Status: Since 7/09. Has 4 speakers

Attachment F (continued)

Tracks: What Is Sustainable Anyway? - **Energy Facts and Simulation** - Ventilation Systems - Refrigeration for the Future - Central Plant Systems - BIM/CAD/Paper and Pencils - Energy Conservation vs. New Generation - Living with HVAC&R Systems - High Efficiency HVAC Systems - Professional Skills - Data Center and High Density Cooling

Transaction "Use of 'equation solvers' for Simulation"
Organized by: TC 4.7 (Data Driven Models)
Co-Chair: Jean Lebrun/Michael Wetter
Status: Have 1 paper (Lebrun), need one more paper.

Forum "Should ASHRAE Develop a Standard for Simulation Aided Design of High Performance Buildings"
Track: Sustainability/LEED
Organized by: TC 4.7 (Applications)
Chair: Jason Glazer
Status: Since 6/08

Conference Paper "Use of Building Energy Simulation in Energy Code and Policy Analysis"
Organized by: TC 4.7
Chair: Russ Taylor
Status: Since 1/09. 3 speakers (R. Taylor, R. Brahme, K. Otto)

Seminar "Simulation Support for the Solar Decathlon"
Track: Applications
Organized by: TC 4.7 (Applications)
Chair: Kamel Haddad
Status: Since 6/07. Has speakers.

Seminar "Shoot-out of Code Compliance Simulation for Residential Buildings"
Organized by TC 4.7 (Applications)
Chair: Jeff Haberl
Status: Since 1/07

Seminar "Experience with Simulation of Standard 90.1 Code-compliant Buildings"
Organized by TC 4.7 (Applications)
Chair: Carol Gardner
Status: Since 1/07

Seminar "Applying Performance Assessment Tools to mitigate Climate Change"
Organized by TC 4.7 (Applications)
Chair: Carol Gardner
Status: Since 1/08. May get 4 speakers, but none confirmed.

Seminar "Advanced Inverse Modeling Techniques using Interval Data"
Organized by: TC 4.7 (Data Driven Models)
Chair: Jeff Haberl
Status: Since 1/08.

Seminar "Methods of Carbon Credit Certification from Energy Efficiency and Renewable Energy"
Organized by: TC 4.7 (Data Driven Models)
Chair: Kris Subbarao
Status: Since 6/07. Confident to get 3 speakers.

Seminar "Modeling of High Performance Buildings"
Track: Energy Conservation and Alternative Energy Sources
Organized by: TC 4.7 (Simulation and Component Models)
Chair: Tim McDowell
Status: Since 6/08.

Seminar "Simulation of HVAC/R equipment and systems using the limited data published by manufacturer"
Track: Systems and Equipment
Organized by: TC 4.7 (Simulation and Component Models)
Chair: Michael Wetter
Status: Since 6/08. Joel Neymark, Vincent Lemort, Stephane Bertagnolio & Jean Lebrun, Craig Wray.

Seminar "You don't know what you've got 'till it's checked! The importance of QA in benchmarking energy analysis results"
Organized by: TC 4.7 (Simulation and Component Models)
Chair: Russ Taylor
Status: Since 1/08. Had two speakers (summer 09).

Attachment G

AGENDA – SSPC 140
STANDARD MOT FOR THE EVALUATION OF BUILDING ENERGY ANALYSIS COMPUTER PROGRAMS
Monday, January 31, 2011; Las Vegas

Time: 2:15P – 6:15P
Location: room N213 (Convention Center)
Chair: Ron Judkoff

1. Introductions

2. Chair Announcements/Communications since last meeting *[Judkoff, 5 min.]*
   - **ANSI/ASHRAE Standard 140-2007 listed with ASHRAE's 10 Most Popular Standards and Guidelines.** It is 8th on the list. See http://www.techstreet.com/lists/ashrae_standards.tmpl
   - **Standard 140-2011 Continuous Maintenance Revision** letter ballot for SSPC 140 Publication/Public Review approval. The public review is needed because the CM revision incorporates language changes to normative sections to comply with ICC language requirements. The changes are intended to be editorial (non-substantive), but the nature of the changes requires public review. Std 140-2011 will add the following to the current material of Std 140-2007:
     - 140-2007 Addendum A (updated modeler reports to match content and format of those used for posting Standard 140 results on the DOE Tools Directory web site)
     - 140-2007 Addendum B (HERS BESTEST)
     - Errata related to Section 5.4 (Furnace tests), including update to informative DOE-2 input files, and editorial revisions to relevant normative and informative sections.
   - **Current IRS rules** (IRS notice 2008-40, published Apr 2008) relating to the deduction for energy efficient commercial buildings require software used for assessing tax credits be tested to Standard 140-2007. Currently **9** programs have satisfied the new requirements; since June 2010, two of those programs satisfied the requirements for updated versions. **Direct new submittals to brent.griffith@nrel.gov**
   - **Standard 140-2011, Proposed Addendum A** (BESTEST In-Depth Ground-Coupling adaptation by NREL/JNA) was approved by SSPC 140 for publication/public review via letter ballot closed Apr 22, 2010, and completed Public Review with no comments during Fall 2010. Publication is on hold pending revisions to comply with ICC language requirements.
   - **Standard 140-2011, Proposed Addendum B** (BESTEST Multi-Zone Non-Airflow adaptation by NREL/JNA) was submitted to SSPC 140 for initial review Feb 27, 2010. It will be redistributed to the PC after revisions to comply with ICC language requirements.
   - **Standard 140-2011, Proposed Addendum C** (ASHRAE RP-865 Airside-Mechanical Equipment tests adaptation) simulation trials have been on hold, pending completion of the 140-2011CM revision. The initial simulation trial test spec will be distributed in the near future.

3. Membership *[Judkoff, 5 min.]*
   - Crawley status changed from PCVM-General Interest to PCVM-Producer for 4-year term ending June 30, 2014
   - Fairey rolling off June 2011; to re-up for 4-year term through June 2015.

4. Acceptance of Previous Minutes *[Judkoff, 5 min.]*

5. Adjustments to Agenda *[Judkoff, 5 min.]*

6. 140-2011 Continuous Maintenance Revision *[Neymark/Kennedy, 20 minutes]*
   - Letter ballot
   - See meeting handout summarizing updates in addition to those listed above with (see Chair announcements)

7. 140-2011-A: Adaptation of NREL/IEA-34/43 Ground Coupling Tests *[Neymark, 20 minutes]*

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- PC approved for Public Review April 2010; Public Review with no comments Fall 2010.
- Public reviewed version did not have ICC language improvements.
- See meeting handout for example proposed changes
- Consider withholding current addendum pending new public review for "ICC'd" version.

8. 140-2011-B: Adaptation of NREL/IEA 34/43 Multi-Zone Tests *[Neymark, 5 min.]*
   - Requires ICC language edits before re-distribution to PC for initial comments.

9. 140-2011-C: Adaptation of ASHRAE/RP-865 (air-side mechanical equipment): Modifications and Simulation Trials *[Neymark/Kennedy 15 min]*

10. Errata for Sections 5.4.1.9.3 and B17.2.3 (for Furnace cases) *[Kennedy 20 min]*
    - Consider as an addendum (for public review)

11. References to Standard 140 in Standard 90.1 *[Pegues, 10 min – hold until 4:15P for JP]*
    - After publication of 140-2011, recommend to SSPC 90.1 to specifically cite the Class I test procedures (Section 5 of Std 140) for 90.1-2013. *Publication of 140-2011 expected Aug 2011, keep on agenda as continuing reminder.*
    - If GC and MZ addenda (coming after 140-2011 CM) are part of 5.2 (as 5.2.4 and 5.2.5), is that ok for future (2016?) referencing by 90.1 and others?

12. Ad-Hoc Data Format Subcommittee Report *[Pegues/Witte, 15 min.]*
    - Data Format SubC did not meet in Albuquerque
    - Consider renaming subcommittee as "Results Maintenance SubC" with the following topics to address: how to update example results, development of example pass/fail criteria for test suites that do not have them, other.

13. Adaptation of BESTEST-EX, residential calibrated energy savings test cases *[Judkoff/Neymark, 60 min]*

14. Comments by P. Sahlin on Case CE410 (Economizer with non-integrated compressor – i.e., economizer only operates when it can satisfy the entire cooling load by itself). *[Kennedy 15 min.]*

15. Adaptation of RESNET test cases *[Judkoff/Neymark, 15 min]*

16. COMNET and ASHRAE Building Energy Quotient (EQ) Referencing of Standard 140 *[Haberl/Fairey 10 min]*
17. Simulation Requirements, Federal Tax Deductions in Energy-Efficient Commercial Buildings *[Judkoff, 10 min.]*
18. Other Updates *[Fairey 10 min.]*
    - RESNET, Tax Credits/Supplemental Cases, IECC Section 404, Homestar Gold
19. Additional Future Test Suites that could be adopted *[Judkoff, 5 min.]*
    - Other IEA-34/43: Shading/Daylighting/Load Interaction by Switz. (empirical), Hydronic Equipment by Germany, Airflow by Japan (final report still in progress), Double-Skin Façade empirical by Denmark.
    - IEA ECBCS Annex 42: Comparative Testing and Empirical Validation of Annex 42 Models for Residential Cogeneration Devices
    - Other Existing Test Suites
    - New Research
20. Investigate possibility of ASHRAE funding research projects for Std 140 *[McDowell, 5min.]*.
    - Has anyone written RTARs?

21. New business

22. Adjourn

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SSPC 140 Meeting Summary –1/31/11 (submitted 2/1/11)

Standard Method of Test for the Evaluation of Building Energy Analysis Computer Programs.

ANSI/ASHRAE Standard 140-2007 listed with ASHRAE's 10 Most Popular Standards and Guidelines. It is 8th on the list of 111 Standards and 18 Guidelines. See http://www.techstreet.com/lists/ashrae_standards.tmpl

Standard 140-2007 Addendum C incorporates *ICC Mandatory Language revision and other user and PC requested improvements and clarifications.* The changes are intended to be editorial (non-substantive), but the nature of the changes requires public review. ICC's restrictions on the use of non-mandatory language within normative sections are stricter than what ASHRAE's requirements were when Standard 140 was initially developed. As the issue with non-mandatory language relates to other ASHRAE standards, we have been working closely with ASHRAE Staff and ASHRAE StdsC. The language improvements allow continued referencing by IGCC (Intl. Green Construction Code) and IECC (Intl. Energy Conservation Code). A letter ballot for SSPC 140 Publication/Public Review approval is in progress.

Standard 140-2011 will add the following to the current material of Std 140-2007:

- 140-2007 Addendum A (updated modeler reports to match content and format of those used for posting Standard 140 results on the DOE Tools Directory web site)
- 140-2007 Addendum B (HERS BESTEST); includes an *informative* (non-mandatory) example procedures for developing acceptance range criteria adapted from HERS BESTEST
- 140-2007 Addendum C (ICC language changes)
- Errata (Dec 2008) related to Section 5.4 (Furnace tests), including update to informative DOE-2 input files, and editorial revisions to relevant normative and informative sections.
- Also, example results as electronic only w/ better xls/chart automation
- Other improvements and clarifications requested by users and the PC since 2007.

Standard 140-2011, Proposed Addendum A (BESTEST In-Depth Slab-On-Grade Ground-Coupling adaptation by NREL/JNA) was approved by SSPC 140 for publication/public review via letter ballot closed Apr 22, 2010, and completed Public Review with no comments during Fall 2010. Publication is on hold pending revisions to comply with ICC language requirements; those revs will have to be public reviewed (as we did for 140-2007-C).

Standard 140-2011, Proposed Addendum B (BESTEST Multi-Zone Non-Airflow adaptation by NREL/JNA) initial draft was submitted to SSPC 140 for initial review Feb 27, 2010. It will be redistributed to the PC after revisions to comply with ICC language requirements. Content includes:

- Analytical verification conduction test
- Comparative tests of
  - The effect of shading on a window, where a shading device is affixed to the window of a neighboring zone
  - The effect of shading on a window by a neighboring zone of the building
  - Internal windows

Standard 140-2011, Proposed Addendum C (ASHRAE RP-865 Airside-Mechanical Equipment tests adaptation): **NREL is proceeding with** adaptation for Standard 140 of ASHRAE RP 865 (by Yuill and Haberl) – air-side mechanical equipment analytical verification test cases. RP 865 includes 78 test cases over 7 air-distribution systems with similarly varied loads, set points and economizer controls. The tested systems are: four pipe fan coil (FC), single-zone air conditioner (SZ), constant volume terminal reheat, VAV, single fan constant volume dual duct, dual fan VAV dual duct, four pipe induction. **The initial draft spec includes 10 total test cases for FC and SZ systems.** The adaptation will include full NREL/IEA-type simulation trials with SSPC 140 (and others invited to participate). **The spec will be revised as indicated by the simulation trials.** Distribution of an initial Std 140-adapted test specification with a very limited set of test cases to address fundamental modeling issues is planned for

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March 2011. **Several rounds of simulation trials are expected, with incremental expansion of the test specification. Completion of the work is planned for 2012. After that the test suite will be submitted to SSPC 140 for publication/public review recommendation.**

SSPC 140 is developing a new erratum for the Furnace cases developed by NRCan. This is to correct a minor discrepancy with developing equivalent base case furnace loads for programs that cannot directly input specified surface coefficients.

Current IRS rules (IRS notice 2008-40, published Apr 2008) relating to the deduction for energy efficient commercial buildings require software used for assessing tax credits be tested to Standard 140-2007. Currently **9** programs have satisfied the new requirements; since June 2010, two of those programs satisfied the requirements for updated versions. **Direct new submittals to brent.griffith@nrel.gov**

References to Standard 140 in Standard 90.1. Jim Pegues is working with Jason Glazer (90.1 ECB SubC Chair) to indicate that with respect to 140-2011 (forthcoming CM revision), future references by 90.1 must be specific to Section 5 (Class I) test procedures, which are more appropriate for testing detailed models used with 90.1 modeling. The newly added Section 7 (Class II) test procedures are more appropriate for testing simplified models commonly used for low-rise residential modeling. Standard 90.1 will not be able to reference 140-2011 until after 140-2011 is published. 90.1's referencing of 140-2011 can be via an addendum to 90.1-2010. The next CM revision of 90.1 that can reference 140-2011 is 90.1-2013.

References to Standard 140. Standard 140 is referenced by:

- Listed above: IRS, Standard 90.1
- Standard 189 (High Performance Green Building Design) Appendix D
- IECC, IGCC
- The newly developing COMNet (BPI, Energy Foundation et al) User's Manual.
- Implicitly referenced for ASHRAE Building Energy Quotient IF that is based on the COMNet User's Manual;
- RESNET plans to reference Section 7 tests after they are published (in 140-2011).

BESTEST-EX UPDATE

This is a **new comparative test suite (published Aug 2010) for testing the ability of software used for modeling residential retrofits to predict energy savings**. Part of the test process also tests the ability to initially calibrate the model of the existing building (pre-retrofit). The soon-to-be-published **Phase-1 Test Procedure** includes a set of **building physics tests** with **calibrated energy savings test versions of the physics tests**. The test cases are **based on HERS BESTEST, but with improvements** including to equivalent constant surface coefficients (lower values based on recent advancements in the modeling state of the art) and Sherman-Grimsrud infiltration modeling. Test case **parametric variations** include the following retrofits**: air sealing, attic insulation (blown cellulose), wall insulation (blown cellulose), thermostat setback, low-e windows, exterior shading, cool roof, and all retrofits combined**. There are also a number of **targeted calibration scenarios** including targeted high and low space heating energy consumption base case scenarios, and fully random selection base case scenarios. Future test cases would be developed for BESTEST-EX to address furnace and space cooling system retrofits, duct leakage, and domestic hot water modeling. Additionally, other building physics test cases for BESTEST-EX could be cross-referenced from HERS BESTEST. **SSPC 140 is beginning discussions of adapting BESTEST-EX (B-EX) for Std 140, Section 7. Incorporation of the B-EX physics test cases and reference results is ok. SSPC 140 identified discussion issues related to adapting the calibrated energy savings test cases, including:**

- Reference results for the calibrated savings test are blind (3rd party review is required)
- If manual calibration is allowed then is the user being tested? And do the calibration test cases then fall outside 140's scope (which is testing programs)?

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- Is automated calibration within the scope of Std 140 ("These standard procedures apply to building energy computer programs that calculate the thermal performance of a building and its mechanical systems.")?

Listing of test suites either included in Std 140 or listed in Annex B18 (of Std 140) is included below. (Included per Jan 2010 request by TC 4.7 Chair; a more comprehensive listing requires a literature survey.)

Analytical Verification Tests and Comparative Tests already in Standard 140 (or with addenda in progress)

- NREL/IEA 12/21 "IEA BESTEST" (building thermal envelope fabric load tests
- NREL/IEA 22 "HVAC BESTEST Volume 1" (analytical verification tests)
- NREL/IEA 22 "HVAC BESTEST Volume 2" (comparative tests)
- NRCan/IEA 22 "Furnace BESTEST" (analytical verification and comparative)
- NREL/HERS Council "HERS BESTEST" (comparative tests, simplified residential)
- NREL/IEA-34/43 "Ground-Coupled Slab-On-Grade In-Depth Tests" (analytical verification)
- NREL/IEA-34/43 "Multi-Zone Non-Airflow" (analytical verification and comparative)
- ASHRAE RP-865 "Air-Side Mechanical Equipment Analytical Verification Tests"

Other Analytical Verification and Comparative Tests

- NREL "BESTEST-EX" (comparative physics and calibration tests, existing homes)
- ASHRAE RP-1052 "Development of an Analytical Verification Test Suite for Whole Building Energy Simulation Programs – Building Thermal Fabric
- "RADTEST Radiant Heating and Cooling Test Cases"
- IEA-34/43 Airflow Tests by Japan (final report still in progress)

Empirical Validation Tests

- IEA-34/43: "Empirical Validations of Shading/Daylighting/Load Interactions in Building Energy Simulation Tools (EMPA, Switzerland)
- IEA-34/43 "Chilled Water and Hot Water Mechanical Equipment and Control Comparative and Empirical Validaiton Tests (empirical and comparative, TUD, Germany)
- IEA-34/43 "Double-Skin Façade Empirical Validation Tests" (Aalborg U., Denmark).
- IEA 22 "Daylighting/HVAC Interaction Tests for the Empirical Validation of Building Energy Analysis Tools (Iowa ERS, US)
- IEA 22 Economizer Control Tests for the Empirical Validation of Building Energy Analysis Tools (Iowa ERS, US and Spain)
- "ETNA BESTEST Empirical Validation Test Specification (NREL and Electricite de France)
- IEA ECBCS Annex 42: Comparative Testing and Empirical Validation of Annex 42 Models for Residential Cogeneration Devices (NRCan)
    - http://cogen-sim.net/index.php?pg=&download=Annex_42_ST_B_Final_report_on_comparative_testing_and_empirical_validation.pdf
- New Research: There is a possibility of developing a test facility for empirical validation of software used to model retrofits of existing building (i.e., software that is currently the subject of the BESTEST-EX test suite). Such a test facility would be expensive relative to developing comparative and analytical verification tests, but such expense would be well justified if U.S. energy policy moves towards supporting energy efficiency retrofits of energy-inefficient houses that comprise a large portion of the current U.S. housing stock.

Full SSPC 140 meeting notes are available from the Chair on request.

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