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 person listed below within 60 days following the meeting.)

TC/TG/TRG No. _____ TC 4.7 _____ DATE: _____ February 10, 2002 _____

TC/TG/TRG TITLE: ___ Energy Calculations _____

DATE OF MEETING: January 28, 2003 _____ LOCATION: ___ Chicago _____

MEMBERS PRESENT	YEAR APPTD	MEMBERS ABSENT	YEAR APPTD	EX-OFFICIO MEMBERS & ADDIT'L ATTENDANCE
Dru Crawley (CHM)	2000			
Les Norford (VC)	2000			
Dan Fisher (SEC)	2002			
Vern Smith (RES)	2000			
Jeff Haberl (PROG)	2002			
Ian Beausoleil-Morrison	2000			
Jim Willson (APP)	2000			
Agami Reddy (IM)	1999			
Joel Neymark (SC)	2000			
Klaus Sommer (INTL)	1999			
Jan Hensen (INTL)	2000			
Chip Barnaby	1999			
Phil Haves	2000			
Moncef Krarti	1999			
Tim McDowell	2002			
Rick Strand	2001			
Robert Sonderegger	2002			
Gren Yuill	2000			

DISTRIBUTION

ALL MEMBERS OF THE TC/TG/TRG

TAC CHAIR William E. Murphy
TAC SECTION HEAD Eckhard Achim Groll
SPECIAL PUBLICATIONS LIAISON Marily A Listvan
JOURNAL/INSIGHTS LIAISON Harvey Sachs
STANDARDS LIAISON Richard D. Hermans
HANDBOOK LIAISON William S. Fleming
PROGRAM LIAISON Kelley Cramm
RAC RESEARCH LIAISON Sheila Hayter
ALI LIAISON Alexander J Boone
TEGA LIAISON Charles E. Gulledge III
STAFF LIAISON (RESEARCH) Michael R. Vaughn
STAFF LIAISON (TECH SERVICES) Michael R. Vaughn
STAFF LIAISON (STANDARDS) Claire Ramspeck

ASHRAE TC 4.7 Energy Calculations

CHICAGO MEETING

ACTION ITEMS

1. Approve minutes from Honolulu . (Motion: Sonderegger/Barnaby. Approved by voice vote)

2. Accept final report for RP1050, *Development of a Toolkit for Calculating Linear, Change-point Linear, and Multiple Linear Inverse Building Energy Analysis Models* (Motion: Reddy/Haves. Approved 13-1-1, chair not voting; contractor abstaining)

3. Accept the following prioritization of the Kansas City program. (Motion: Haberl/Willson. Approved 14-0-1, chair not voting)
    1. seminar: Successful application for energy simulation in building design
    2. symposium: Inverse Methods for calculating savings from energy conservation retrofits
    3. forum: Thermal Energy Storage Simulation Models
    4. symposium: Integrating air flow modeling into energy analysis programs

4. Executive session recommended contractor for 1051-TRP *"Procedure for Reconciling Computed-calculated Results with Measured Energy Data."* (Motion: Sonderegger/Smith. Approved 11-0-4, chair not voting; 3 members excused from executive session and not voting.)

5. Appoint PMSC for 1051-RP Robert Sonderegger, Ron Judkoff, Vernon Smith and Marlin Addison.

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TC/TG/TRG MEETING SCHEDULE			
LOCATION – **past 12 months**	**DATE**	**LOCATION - planned next 12 months**	**DATE**
Honolulu	June 25, 2002	Kansas City	July 1, 2003
Chicago	January 28, 2003	Anaheim	January 27, 2004
TC/TG/TRG SUBCOMMITTEES			
Function		**Chair**	
Simulation and Component Models		Ian Beausoliel-Morrison	
Applications		Jim Willson	
Data-Driven Modeling		Agami Reddy	
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**
2005 Fundamentals	Energy Estimating Methods	31		Strand/Fleming

STANDARDS ACTIVITIES - List and Describe Subjects
SSPC 140 Standard Method of Test for Building Energy Software – Joel Neymark
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)
none
JOURNAL PUBLICATIONS - Title, when published (past 3 yrs. present & planned)
none

<u>Attendance</u>

This 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. Email addresses are listed for those who have explicitly authorized their inclusion in the minutes, which are posted on the TC's web site.

Present at TC 4.7 meeting?					Last name	First name	Email
Add to email list	Chicago January 2003	Honolulu June 2002	Atlantic City Jan 2002	Cincinnati June 2001			
X	X				Abushakra	Bass	abushadr@msoe.edu
				X	Anderson	J R	jrhazel@bellsouth.net
		X			Armstrong	Peter	parmstr@mit.edu
	X	X	X		Bahnfleth	Bill	wbahnfleth@psu.edu
	X	X	X	X	Barnaby	Chip	CBarnaby@wrightsoft.com
		X			Bauman	Fred	fbauman@uclink.berkeley.edu
X	X	X	X	X	Beausoleil-Morrison	Ian	IBeausol@nrcan.gc.ca
		X			Black	Al	ablack@mcclureeng.com
		X			Bojic	Milorad	bojic@knez.uis.ac.yu
X	X				Bradley	Brian	bbradley@nrcan.gc.ca
	X	X	X		Brandemuehl	Mike	michael.brandemuehl@colorado.edu
X	X				Braun	Jim	jbraun@ecn.purdue.edu
	X	X	X		Carpenter	J Patrick	pcarpenter@kling.us
			X		Chantrasrisalai	Chanvit	chanvit@okstate.edu
	X		X	X	Claridge	David	Claridge@esl.tamu.edu
	X	X	X	X	Crawley	Dru	Drury.Crawley@ee.doe.gov
				X	Dougherty	Brian	
			X		Deng	Zheng	zhengd@okstate.edu
				X	Domanski	Piotr	
				X	Dubrous	Francois	
		X	X	X	Fisher	Dan	DFisher@okstate.edu
	X		X		Fleming	Bill	flemg@aol.com
		X			Gowri	Krishnan	k_gowri@pnl.gov
X	X				Guan	Don	yzguan@ksu.edu
	X		X	X	Haberl	Jeff	JHaberl@esl.tamu.edu
			X		Haddad	Kamel	khaddad@nrcan.gc.ca
	X	X	X	X	Haves	Philip	PHaves@lbl.gov
	X	X		X	Hensen	Jan	j.hensen@tue.nl
	X	X	X		Huang	Joe	YJHuang@lbl.gov
			X		Iu	Ipseng	iip@okstate.edu
			X		Jin	Hui	jinh@okstate.edu
	X	X	X		Judkoff	Ron	ron_judkoff@nrel.gov
				X	Klaassen	Curtis	
				X	Klein	Sandy	

Present at TC 4.7 meeting?					Last name	First name	Email
Add to email list	Chicago January 2003	Honolulu June 2002	Atlantic City Jan 2002	Cincinnati June 2001			
				X	Knappmiller	Kevin	
			X		Kong	Weixiu	weixiu@okstate.edu
	X		X	X	Kosny	Jan	kyo@ornl.gov
			X		Krarti	Moncef	krarti@colorado.edu
X	X				Kreider	Jan	
		X			Lawrence	Tom	lawrenct@ecn.purdue.edu
	X				Lawrie	Linda	Linda@lawrie.com
	X	X			Liesen	Richard	r-liesen@uiuc.edu
				X	Logee	Terry	
	X		X	X	McDowell	Tim	Mcdowell@tess-inc.com
				X	Mottillo	Maria	
	X	X	X	X	Neymark	Joel	neymarkj@msn.com
				X	Nichols	Laurier	
	X	X	X	X	Norford	Les	lnorford@mit.edu
				X	Nguyen	Phuong	
	X		X		Parson	Jim	parsons@me.msstate.edu
X	X				Phillips	Duncan	Duncan@cedarmere.ca
	X	X	X	X	Pedersen	Curt	cpederse@uiuc.edu
	X	X	X	X	Reddy	T. Agami	reddyta@drexel.edu
	X	X	X	X	Rees	Simon	SJRees@okstate.edu
			X		Riemer	Paul	paulr@twgi.com
X	X				Rode	Carsten	car@byg.dtu.dk
X	X				Scheatzle	David	scheatzle@asu.edu
				X	Schwarz	Walter	
	X	X	X	X	Smith	Vernon	VSmith@archenergy.com
		X	X	X	Sommer	Klaus	Klaus.Sommer@vt.fh-koeln.de
	X	X	X		Sonderegger	Robert	rsonder@siliconenergy.com
	X	X	X	X	Spitler	Jeffrey	Spitler@okstate.edu
	X	X		X	Strand	Rick	R-Strand@uiuc.edu
	X	X	X	X	Walton	George	GWalton@nist.gov
		X	X		Wassmer	Mike	wassmer@colorado.edu
	X	X	X	X	Willson	Jim	jimwill@indy.net
				X	Witte	Mike	MJWitte@gard.com
	X	X	X	X	Wray	Craig	CPWray@lbl.gov
		X		X	Wright	Jonathan	J.A.Wright@lboro.ac.uk
			X		Xiao	Dongyi	xdongyi@okstate.edu
	X	X		X	Yuill	Gren	yuill@unomaha.edu
			X		Zhang	Yi	y.zhang@lboro.ac.uk
X	X				Zhu	Daming	zdmhvac@yahoo.com

Appendix 1

RESEARCH PROJECTS

TC 4.7 RESEARCH PROJECTS STATUS

Active projects

#	Title	Joint TC	Cognizant Subcommittee/ Contractor	PMSC	Dates / status
1049-RP	Building System Synthesis and Design	1.5	Sim/Comp Loughborough University Jonathan Wright	Curt Pedersen (chair), Ed Sowell, Dave Knebel, Ron Nelson (TC 1.5), Mike Brandemuehl (TC 4.6), Jan Hensen	WS: 1-20-98 (SF) Rec: 6-22-99 (Seattle) NCE: 7-31-03 (6-25-02)
1050-RP	Development of a Toolkit for Calculating Linear, Change-point Linear, and Multiple Linear Inverse Building Energy Analysis Models		Inv U. of Dayton Kelly Kissock	Jan Krieder (chair), Robert Sonderegger, Moncef Krarti, Agami Reddy	WS: 7-1-98 (Boston) Rec: 6-23-98 (Toronto) NCE: 3-31-01 (6-27-00) NCE: 10-1-01 (1-30-01) Accept report : 1-28-03
1197-RP	Updated Energy Calculation Models for Residential HVAC Equipment	7.6	Sim/Comp U Colorado Michael Brandemuehl	Chip Barnaby (chair), Craig Wray, Brian Dougherty (TC 7.6)	WS: 2-8-00 (Dallas) Start: 1-02

Appendix 2

RESEARCH PLAN

Technical Committee 4.7 Energy Calculations
2003-2004 Research Plan
1 August 2002

Title	TC Priority 2003-2004	Prior TC priority	Society status	TC Status	Sub-com
Procedures for Reconciling Computer-Calculated Results With Measured Energy Data (1051-TRP)	0	3 (1998-1999)	Work statement approved, awaiting funding		IM
Development of Comparative Test Cases for Evaluating Simulation Models of Slab, Crawl Space and Basement Heat Transfer Through Adjacent Ground	0	2 (2001-2002)	RTAR, accepted	Hold, IEA work underway	SCM
Inverse Bin Procedures for Analyzing Energy Savings	0	3 (2001-2002)	RTAR, accepted		IM
Procedures and Data for High-Performance Residential Design	0	1 (2002-2003)	RTAR, accepted	Draft WS	A
Development of a Procedure for Base-lining Energy Use at Large Central Plants	0	2 (2002-2003)	RTAR, prioritized	Draft WS	IM
Technical and Usability Enhancements to the Energy Calculation Toolkits	1			RTAR	SCM
Improving Load Calculations for Fenestrations with Shading Devices	Co-sponsor			TC 4.1 RTAR	

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Appendix 3

TECHNICAL PAPERS FROM SPONSORED RESEARCH

RP	Title	Contractor	Approved	Paper
987	Loads Toolkit	UIUC, Pedersen	Atlanta, January 2001	Pedersen, C.O., D.E. Fisher, R.J. Liesen, and R.K. Strand. 2003. "ASHRAE Toolkit for Building Load Calculations." ASHRAE Transactions 109(1). To be presented in Chicago, January 29, 2003
1052	Verification Test Suite	OSU, Spitler	Atlanta, January 2001	Rees, S.J., D. Xiao, and J.D. Spitler. 2002. "An Analytical Verification Test Suite for Building Fabric Models in Whole Building Energy Simulation Programs." ASHRAE Transactions. 108(1):30-41.
1145	Two- and Three-Dimensional Heat Transfer	Enermodal	Atlanta, January 2001	Carpenter, S.C., J. Kosny, and E. Kossecka. 2003. "Modeling Transient Performance of 2 and 3-D Building Assemblies: ASHRAE 1145-RP." ASHRAE Transactions 109(1). To be presented in Chicago, January 29, 2003
1093	Diversity Factors	TAMU, Haberl	Cincinnati, June 2001	Abushakra, B., D.E. Claridge and J.S. Haberl. "Electricity Diversity Profiles for Energy Simulation of Office Buildings;' "Electricity Diversity Profiles for Peak Cooling Load Determination in Office Buildings;" and "Overview of Literature on Diversity Factors and Schedules for Energy and Coolling Load Calculations." Submitted to ASHRAE December 27, 2001.
865	Accuracy Tests	UNO, TAMU	Honolulu, June 2002	Yuill, G.K. and J.S. Haberl. "Development of Accuracy Tests for Mechanical System Simulations." Submitted to ASHRAE July 29, 2002.
1222	Nodal Models	MIT, Chen	Honolulu, June 2002	Two papers submitted to Int. J. of HVAC&R Research

Appendix 4

TC/TG/TRG SPONSORED SYMPOSIA

Current as of November 19, 2002

PLANNED:

Kansas City, June-July 2003

Integrating Airflow Modeling into Energy Analysis Programs (Chair: Jelena Srebric)

PRESENT:
Chicago, January 2003

Recent Advances in Energy Simulation: Building Loads (Co-sponsored by TC4.1/Chair: Jan Hensen)

PAST:
Honolulu, June 2002

Recent Advances in the Thermal Simulation of HVAC Equipment
 (Co-sponsored by TC4.1/Chair: Ian Beausoleil-Morrison)

Atlantic City, January 2002

Tools and Techniques for Calibration of Component Models
(TC1.5 sponsor; TC4.7 co-sponsor/Chair: Agami Reddy)

Cincinnati, June 2001

Better Inputs for Better Outputs (TC9.6 co-sponsor/Chair: Jim Willson)

Atlanta, January 2001

Analysis Tools for the Design of Low-Energy Cooling Systems (Chair: Joe Huang)

Minneapolis, June 2000

International Experience with Weather Data for Simulation and Design, Part 1: Simulation, Ventilation and Daylighting (TC 4.2 co-sponsor/Chair: Dru Crawley)

International Experience with Weather Data for Simulation and Design, Part 2: Simulation (TC 4.2 co-sponsor/Chair: Dru Crawley)

Seattle, June 1999

*Applications of Heat and Mass Balance Methods to Energy and Thermal Load Calculations
(*Chair: Chip Barnaby)

*Accuracy tests for simulation models (*Chair: Mike Witte)

Appendix 5

TC/TG/TRG SPONSORED SEMINARS

Current as of November 19, 2002

PLANNED:

Anaheim, January 2004

Validation of Building Simulation Programs (Chair: Joel Neymark)

Successful Applications of Energy Simulation in Building Design (Chair: Ian Beausoleil-Morrison)

Kansas City, June-July 2003

Automated Baseline Procedures Using Inverse Methods (Chair: Jeff Haberl)

Inverse Methods in Support of Building Commissioning (Chair: Jean Lebrun)

PRESENT:

Chicago, January 2003

Getting started in Building Simulation (Chair: Chip Barnaby)

Using Monitored Data for Solving Engineering Problems (Chair: Agami Reddy)

PAST:

Atlantic City, June 2001

Commercial Use of Building Energy Simulation Software (Chair: Kamel Haddad)

Cincinnati, June 2001

A Review of State of the Art in Building Simulation Programs (Chair: Dru Crawley)

Atlanta, January 2001

Low-Energy Cooling Case Studies (Chair: Phil Haves)

Dallas - January 2000

ASHRAE's Software Toolkits for Energy Calculations (Chair: Dru Crawley)

<div align="center">

ASHRAE TC 4.7 Energy Calculations
Tuesday, January 28, 2003, 6:00-8:30 p.m.
PDR 17, 5th floor, Palmer House Hilton, Chicago, IL

</div>

1. Roll call and introductions.
The meeting was called to order by Chair Crawley 6:06 pm. Introductions were made and Secretary Fisher called the role. Present were: Crawley, Fisher, Smith, Haberl, Beausoleil-Morrison, Willson, Reddy, Neymark, Hensen, Barnaby, Haves, McDowell, Strand, Sonderegger, Yuill.

2. Accept agenda (Attachment A) & approve minutes of Atlantic City meeting.
Sonderegger moved (Barnaby second) that the minutes of the Honolulu meeting be approved. The motion passed by voice vote.

3. Announcements.
- The program committee wants sponsored presentations on the web site.
- Manuscript central is up and running.
- ASHRAE is concerned with decline in symposia—also looking for qualified reviewers.
- Papers for CIBSE/ASHRAE meeting being accepted on manuscript central
- Jim Wolfe's listening tour has finally been compiled (after two years).
- Tech. bulletin was distributed to the committee. It's on the ASHRAE web site as an FAQ

4. Membership.
Changes after June 2003 meeting
- Rolling off: Reddy, Barnaby, Krarti, Sommer
- Rolling on: Walton, Carpenter, Bahnfleth, Brandemuehl
- Rolling on as international member: Wright
- Subcommittee chairs unchanged

5. Subcommittee reports.
5.1 Applications Subcommittee (*Attachment B: Meeting Minutes*).
Jim Willson summarized the highlights of the meeting as follows:
- There is a need in industry for energy simulation manuals—similar to what is available at the ARTI web site.
- The energy simulation short course by Gren Yuill will be available soon.
- The seminar, "Getting Started with Building Simulation" chaired by Barnaby was well received (standing room only). Some of the program material will be made available to ASHRAE chapters in cooperation with IBPSA.
- Judkoff will spearhead the effort to write a Journal article on SPC 140.

5.2 Inverse Methods (*Attachment C: Meeting Minutes*).
Agami Reddy summarized the meeting highlights as follows:
- Subcommittee name will be changed to "Data Driven Modeling Subcommittee" The committees scope will now emphasize developing physically plausible modeling methodologies.
- Four RTAR's and one workstatement will be ready for KC
- **1050-RP Inverse Toolkit (U Dayton)**.Jan Kreider reported from the PMSC that the project was complete. The final report has been accepted by the subcommittee and two tech papers have been submitted for Kansas City. Reddy made a motion to accept final report of RP 1050 (Haves second). Approved 13-1-1, chair not voting.

5.3 Simulation & Component Models (*Attachment D: Meeting Minutes*).
Ian Beausoliel-Morrison reported on the subcommittee meeting:
- Symposium, *Integrating Airflow Modeling into Energy Analysis Programs* (Chair: Jelena Srebric) on track for KC—3 papers in hand; 3 more promised.
- Research 'wish list' is on the TC 4.7 web site.
- **1049-RP Building System Design Synthesis (Loughborough U.).** Pedersen reporting. Met with Jon Wright—demonstration. Project moving well. Est. time of completion May 1. On schedule should be complete by KC
- **1197-RP Updated Energy Calc. Models for Res. Equip. (UC-Boulder).** Barnaby reporting. Brandemuehl PI—8 months into project—concentrating on Steady state models. Proceding to part load performance issues. They expect to be nearly complete by KC.

5.4 Research (*Attachment E: Meeting Minutes*).
Vern Smith reporting:
- Barnaby presented the development of an ASHRAE procedures CD—which would put procedures on a CD not in the handbook—as a possible research topic.
- Smith noted that theTC4.7 long range plan due Feb. 1. New ideas for the plan were offered as follows:
  - Haves—Large Scale Optimization
  - Haberl—Building Simulation in Support of Emission Reduction
  - Fleming—Identification of chemical and biological materials in HVAC distribution systems.

5.5 Handbook (A*ttachment F: Meeting Minutes*).
- Chair Strand reported on the meeting:
- Updated section based on Honolulu comments was received and will be posted on the web site
- Spring 2004 is the deadline for chpt. 31.
- TC 4.7 part of pilot program to look at electronic applications for the handbook.

5.6 Program (*Attachment G: Meeting Minutes*).
Jeff Haberl reported on TC 4.7 program activities. The extended program plan was submitted and reviewed.

5.7 Standards (SSPC-140 SMOT) (*Attachment H: Meeting Minutes*).
Ron Judkoff reported:
- first addendum for public review has been written and approved by SSPC.
- SPLS will approve by letter ballot and put out for public review within six months.
- Std 90.1 energy cost budget subcommittee voted to reference SSPC 140
- RP865 and RP1052 have both produced very good test suites, but they're not ready to plug into a standard. There is no mechanism to fund implementation in the standard.
- Standard will get increased visibility in the area of tax credits as well.
- IEA task is coming to an end. Proposed a continuation of IEA support.

Crawley: Task definition workshop last thursday and friday of march
Gren proposed round of applause for Ron Judkoff and his committee for completing the task
5.8 Web Site
Simon Rees, TC 4.7 webmaster, resported that the web site is moving (with a few glitches) toward Standard ASHRAE format. Send conference announcements; call for papers, etc in pdf format to sjrees@okstate.edu.

6. Reports on related activities.
GPC 20 Definitions of HVAC&R
Phil Haves reported:

- The main goal of the gpc is to enable interoperability in HVAC domain.
- The definitions will include catalog information from manufacturers.
- Main deliverable of the committee will be a written guideline describing the schemas as well as the XML schemas—which will be continuously updated and freely available on an ASHRAE website.
- Next step is to prepare a second use case.
- The major source of information is IFC data model.

Chip Barnaby added that domain knowledge about components is at the heart of the project. Grappling with means of gathering the information that is diffusely scattered around society.

IBPSA

Les Norford reported that IBPSA-USA is ready to select contractor to develop two hour long presentations for ASHRAE chapters.

Jeff Spitler and Jan Hensen reported that the IBPSA sponsored Eindhoven conference is on track

- excellent conf. facilities
- excellent location
- expecting 220 papers with 300 in attendance.

Ian Beausoliel-Morrison reported on the IBPSA-Canada sponsored ESIM 2002 conference:

- Excellent turnout with lots of enthusiasm.
- Web site is growing.
- Next ESIM conf. in 2004 in Vancouver or Halifax.

IAI International Alliance for Interoperability

Phil Haves reported:

- Developing data model for interoperability.
- Recently extended part of model that deals with HVAC equipment.
- Next release is scheduled for May 2003.
- Also looking at new data models to handle time series (weather data).
- Developing a virtual data model to support commissioning and other activities.

TC 4.1 Load Calculations

Chip Barnaby reported:

- RP1117, Validation of cooling load procedures, has been completed. Generally speaking very good match between experimental measurements and predicted data.
- Spitler and Barnaby presented update on their research project to update the residential cooling load calculation procedure.
- A work statement to evaluate fenestration with interior shading in progress.

TC 4.2 Weather Information

Dru Crawley reported:

- Committee voted to change name to 'Climatic Information'.
- Recommended contractor to update the handbook and include more data. The new chapter will include techniques to formulate data for TC 4.1 cooling load calculation procedures.

TC 4.5 Fenestration

Curt Pedersen reported that the committee is developing a joint workstatement with TC4.1 on interior fenestration devices. Joe Klems (4.5), Barnaby and Pedersen working out the details

TC 4.6 Building Operation Dynamics

Mike Brandemuehl reported that current research topicsinclude dynamic cooling coil models and environments that will allow building operators to explore alternate operating strategies.

TC 4.11 Smart Building Systems

Les Norford reported:
- Chiller fault detection in the pipeline.
- Working on tools for fault detection.
- Control agents concepts on the drawing board.
- Very interested in data driven models.
- Looking at mixed mode (natural) ventilation systems

TC 9.6 Systems Energy Utilization
Agami Reddy reported that the contractor seclected by TC was turned down by RAC.

TC 9.10
Patrick Carpenter reported that TC 9.10 is proposing a seminar on energy analysis of laboratory facilities.
He will post the announcement to the TC4.7 list serve

7. Old Business.

8. New business.
Dru Crawley reported that TAC has proposed change to TC structure.
- A number of section 4 TCs have been moved to section 7.
- Section 7 is totally different.
- Section 9 is being revamped.
- TAC wanted to know if we had objections about the location of our subcommittee in the stucture.
- "Load calculations and Energy Requirements" will include TC4.1, 4.2, 4.3, 4.4, 4.5, 4.7 and 4.10
- Haves noted that the move sharply separates design from operations. Doesn't want committee to lose sight of this association.
- Crawley noted that research chairs may be interested in a combined section 4/section 7 research chair meeting.
- Haberl wondered if inverse methods would fit within the new scope.
- Crawley noted that scope includes energy requirements which is broader than design.

Crawley announced that GRI published real time weather information until two years ago. DOE will now fund continuation of this data acquisition and dissemination effort. Will be provided in IWEC format. will move to list serve.

9. Executive Session.
The committee moved to executive session to consider RP1051-TRP
The executive session recommended a contractor to RAC

Attachments

  A. Agenda
  B. Applications Subcommittee Minutes
  C. Inverse Methods Subcommittee Minutes
  D. Simulation and Component Models Subcommittee Minutes
  E. Research Subcommittee Minutes
  F. Handbook Subcommittee Minutes
  G. Program
  H. SSPC 140 Minutes

ASHRAE TC 4.7 Agenda
Tuesday, January 28, 2003, 6:00-8:30 p.m.
PDR 17, 5th floor
Palmer House Hilton, Chicago, Illinois

1. Roll call and introductions   Fisher

2. Accept agenda & approve minutes of Honolulu meeting   Crawley

3. Announcements   Crawley

4. Membership   Crawley

5. Subcommittee reports
   5.1 Applications   Willson
   5.2 Inverse Methods   Reddy
     1050-RP Inverse Toolkit (Univ Dayton)   Kreider
     1051-TRP *see item 9. Executive Session   Sonderegger
   5.3 Simulation & Component Models   Beausoleil-
                                                                                             Morrison
     1049-RP Building System Design Synthesis (Loughborough Univ)   Pedersen
     1197-RP Updated Energy Calc Models for Residential Equip. (UC-Boulder)   Barnaby
   5.4 Research   Smith
     Section 4 Research Subcommittee Chairs Ad Hoc   Smith
   5.5 Handbook   Strand
   5.6 Program   Program
   5.7 Standards   Neymark
     SSPC 140 SMOT for Eval of Building Energy Analysis Computer Programs   Judkoff
     New IEA Annex on Validation Methods   Judkoff
   5.8 Web Site   Rees

6. Reports on related activities
   GPC 20 Definitions for HVAC&R (XML Subcommittee)   Haves
   TC 4.1 Load Calculations   Barnaby
   TC 4.2 Weather Information   Crawley
   TC 4.5 Fenestration   Pedersen
   TC 4.6 Building Operation Dynamics   Brandemuehl
   TC 4.11 Smart Building Systems   Norford
   TC 9.6 Systems Energy Utilization   Reddy
   IBPSA   Barnaby
   IAI International Alliance for Interoperability   Haves

7. Old Business

8. New business

9. Executive Session
     1051-TRP Proc. for Reconciling Comp.-Calc. Results With Meas. Energy Data   Sonderegger

10. Adjourn

TC 4.7 Applications Subcommittee
Meeting Minutes - Chicago
28 January, 2003

Attending:

Jim Willson	jimwill@indy.net
Ian Beausoleil-Morrison	IBeausol@nrcan.gc.ca
Gren Yuill	yuill@unomaha.edu
Vern Smith	vsmith@archenergy.com
Brian Bradley	bbradley@nrcan.gc.ca
Tom Squillo	tsquillo@owpp.com
Joe Huang	YJHuang@lbl.gov
Hofu Wu	hwu@csupomona.edu
Brennan Downes	bdowne1@uic.edu
Daming Zhu	zdmhvac@yahoo.com
George Walton	GWalton@nist.gov
Jeff Haberl	JHaberl@esl.tamu.edu
Tim McDowell	mcdowell@tess-inc.com
David Scheatzle	scheatzle@asu.edu
Dru Crawley	Drury.Crawley@ee.doe.gov
Joel Neymark	neymarkj@msn.com

Subcommittee Chair Jim Willson called the meeting to order at 3: 35 p.m.

Self introductions were made by those attending.

Willson stated that the purpose of this Subcommittee is to look for opportunities to get results to practitioners. In particular, programs for national meetings as well as local chapter meetings are good ways to provide practitioners with energy calculation methods and tools. He commented that Seminar 36 (held this morning) was very well attended with 120 seats filled and about 30 attendees standing at the back of the room.

There were no additions to agenda.

Review of minutes of Honolulu. Haberl: Comment on minutes – have them reflect <u>action items.</u>
Moved to approve: by Yuill, second by Haberl – approved by voice vote.

Short Course Development and Local Chapter Meeting Programs

Yuill had volunteered at the last meeting to chair a professional development seminar committee on "Use of Building Energy Analysis Computer Programs." He reported that ASHRAE's course development committee is discouraging development of new professional development seminars because they are not making money on them. They include a PowerPoint presentation, speaker notes, and handouts. A short course is based on a PowerPoint presentation, but does not necessarily include hand out material.

At the IBPSA meeting on Saturday evening, Les Norford had announced that proposals to develop two sets of materials for a speaker's program were being reviewed. Yuill will finish up his work on a short course (½ day course) that could also be offered as a chapter course using a local, experienced simulations user. But this Subcommittee may want to wait to see what IBPSA has developed. Jeff Haberl is willing to deliver the course at locations within 100 miles of TAMU in Texas.

<u>**Action Item:**</u> **Yuill** will call Les Norford and find out details regarding the proposed IBPSA speaker materials and feasibility of coordinating his short course development with the IBPSA efforts. He will report back on his findings and progress.

Willson pointed out that there are two excellent published manuals regarding energy simulations: (1) Building Energy and Environmental Modeling, Applications Manual AM11, 1998, published by CIBSE.
(2) State-of-the-Art Review Whole Building, Building Envelope, and HVAC Component and System Simulation and Design Tools, ARTI-21CR-605-30010-30020-01, Feb 2002, published by Air-Conditioning and Refrigeration Technology Institute.

This Subcommittee also prepared a Technical Bulletin titled "Estimating Building Energy Usage". It covers:
1. Available energy estimating software packages and whether any are recommended by ASHRAE.
2. The readily available sources of applicable hourly, daily, and monthly weather data for a given location.
3. The readily available sources of bin weather data for a given location.

TC 4.7 Web Site
Haberl: We could take older presentations from past seminars and symposiums, and post them on the TC 4.7 web site.

Walton: Another way to get information to users is to place links on TC-4.7 web site. [Editor's note: there is a links page on the web site, but at the moment it only has a link back to the main ASHRAE URL.]

Handbook
There is no applications subsection in the current TC-4.7 chapter. Is there a need?

Haberl: Recent handbook directives seem to say more procedural material should be in the HB, but there is no consensus on approach.

Crawley: There is a discussion in the current chapter on simulation applications. In particular, there is a long discussion on inverse methods.
Haberl: But should we consider putting together a half page or whole page on applications?

Action Item: **Willson** agreed to work with Handbook Subcommittee chair on what should be done and then make assignments. Haberl suggested that this be done soon so that we don't miss the review cycle.
Smith and Walton volunteered to look at the Handbook chapter sections with direction from Willson.

Programs
Program Subcommittee Chair Haberl distributed a TC 4.7 program plan for review.
April 1st is the deadline to register symposia for the Anaheim meeting.
August 8th is deadline to have fully reviewed and accepted papers submitted to ASHRAE HQ.

Anaheim:
Symposium "Validation of Building Simulation Programs"
Neymark has four papers lined up. He would like to be replaced as symposium chair so that he can present a paper. Judkoff suggested that it would be useful to have Standard 140 referenced in the symposium title.
Haberl noted that there may be up to six papers in this area. It may be possible to have two symposia, one more focused on Standard 140 and the other covering other validation papers. Curt Pedersen may have been volunteered for a paper, need to check with him.

Action Item: **Willson** agreed to chair the symposium.

Crawley mentioned that when registering a new symposium on the on-line system, a technical paper that will be included should be listed as the first item. This will alert ASHRAE staff to include the paper in the symposium and not in a general technical session.

Beausoleil-Morrison stated that he will not be attending the meeting in Anaheim and will not be able to chair the planned seminar titled "Successful Applications of Energy Simulation in Building Design". There are five speakers lined-up. After some discussion, it was agreed to move this seminar to Kansas City.

Action Items: **Smith** agreed to chair the seminar. **Beausoleil-Morrison** will forward contact information for the speakers to Smith.

Nashville:
Two symposia are planned. Dan Fisher is chairing one on "Recent Advances in Simulation". Haberl has proposed one titled "Predictor Shootout III: Energy Simulation for Residential Code Support".

Journal Articles

Action Item: **Willson** will contact Alan Daley to ask if he would consider preparing an article based on his seminar this morning.

Judkoff noted that it is time to publish a Journal article on Standard 140 since it will be used and cited by codes.

Action Item: **Willson** will send an e-mail to Judkoff to remind him to write the article.

Survey on Website
Willson mentioned that it may be possible to have a link from the main ASHRAE web site to a survey on practitioner's needs regarding energy calculations. No suggestions were forthcoming at the meeting. Email Jim Willson with any ideas.

Increasing General Use of Simulations
The agenda has two general areas that need to be addressed: (1) increase use of simulations by design engineers, and (2) promote better enforcement of energy simulation requirements in codes by code officials. There was a brief discussion about web-based simulations with acceptable defaults to reduce the amount of effort to work through a simulation. There were concerns expressed about the accuracy and viability of this approach. No conclusions were reached.

Research

There are three draft RTARs listed on the agenda.

1.   "Procedures and Data for High Performance Residential Design" The draft was originally prepared by Mike Witte, who requested that someone else take up further development. Smith noted that he had apparently volunteered to do so (as noted in TC 4.7 Main Committee meeting Honolulu minutes), but did not notice it in the Honolulu minutes until shortly before this meeting. He has made no progress yet.

2.   "Methodology to Define Bounds of Variability in Building Energy Use Predictions Using Detailed Simulation Models and How it can be Incorporated in the Design Process" Haddad and Wyndham-Wheeler are noted as authors. No one present could report on progress.

3.   "Defining Performance Factors for Primary and Secondary Equipment Simulation Inputs for Commercial Buildings" LeBrun and Nall are noted as authors. No one present could report on progress.

Haberl suggested that we need more time for research topics on applications subcommittee agenda. There was a brief discussion on research topics and the relationship between the Applications Subcommittee and the Inverse Methods Subcommittee.

Action Item: **Willson** will coordinate with Agami Reddy about research ideas and relationship with Inverse Methods committee.

Judkoff observed that there is an ASHRAE research "valley of death" – we do the research and then it dies – there is no recognition of getting the research results out and made usable. There are test methods available that have not been made into standards or otherwise used. More recent research projects are available for download from the main ASHRAE web site for $25, but we need to consider how to promote use of the research.

New Business

David Scheatzle, as a liaison from TC 6.5, Radiant Space Heating and Cooling, stated that TC 6.5 was interested in working with TC 4.7 to develop new, or identify existing, radiant heating and cooling modeling tools. TC 6.5 has identified a need to promote reliable models to practitioner to encourage appropriate applications of radiant space heating and cooling.

Adjourned at 5:05 p.m.

TC 4.7 SUBCOMMITTEE ON INVERSE METHODS

Monday, 27th January, 2003,7:30 to 9:00 p.m.
Montrose 1, 7th Floor, Chicago

Chair: Agami Reddy

AGENDA

1. Introductions

2. Discussion of the minutes from the Honolulu meeting, June 2002 - **attached**

3. Discussion on modifying the title of SC

4. Rethink scope of SC

5. Discussion of Work Statements

- WS "Development of a procedure for baselining energy use at large central plants." (Haberl/ Krarti) **draft attached**

6. Long Range Research Plan (Research Topic Acceptance Request)

- Use case studies- **draft attached**

7. Program

- Forum for June 2003 meeting (Kansas City): Reddy/Haberl:
  - Short Course on Inverse Modeling/Analysis of Data
- Symposium for June 2003 meeting (Kansas City): Kreider
  - SYM "Inverse methods for calculating savings from energy conservation retrofits"
    PAPER "RP1050 Inverse methods" (Kissock et al.)
    PAPER "SMTP Method" (Abushakra)
    PAPER "Neural Network Savings Calculation Method" (Krarti)
- January 2004 meeting (Anaheim)

8. Old Business

9. New Business

10. Adjourn

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1) Meeting called to order by subcommittee (SC) chair Reddy at 7:35 pm. Introductions.

2) Agenda and Honolulu minutes circulated to all attendees. Minutes approved by all present.

3) A certain amount of time spent on discussing items (3) and (4) of the agenda. After some lively discussion, it was felt that "**Data-driven modeling**" was more descriptive of the function of the SC than did "Inverse modeling".

Action Item: Seek approval of the full TC membership to make this change to SC name.

1. Scope of the TC: To develop physically plausible modeling methodologies and models using monitored data. These models should be applicable to base-casting energy use, secondary and primary equipment, systems and whole building energy use, and should be easy to use and suitable for automation.

2. The WS entitled: Development of a procedure for baselining energy use at large central plants, was discussed. Reddy stated that the RTAR was accepted and prioritized by the TC, but that the WS still needed to be improved.

Action Item: Reddy to work on this WS, and have a final draft completed for discussion by June 2003.

3. A document which assembled numerous use cases proposed by Sonderegger, Reddy and Claridge was discussed. It was felt that all topics were salinet, and that four RTARs should be prepared:
   - Sonderegger – Use cases 1-3 which need to be assembled into one.
   - Use Case (4) to be shelved for the time being
   - Use case (5)- to be expanded by Bass Abushakara
   - Use cases (6) and (7) – to be expanded by David Claridge

Action Items: Reddy to follow up with Sonderegger, Abushakara and Claridge on getting the RTARs completed by June.

4. Program was discussed. Haberl reminded attendees of the Seminar chaired by Reddy scheduled for Wednesday at 10:15 entitled: "Using Monitored Data to Solve Engineering problems". Scheduled speakers are: Sonderegger, Smith (energy analysis), Claridge (CC), Braun (building thermal mass to shave peak), Norford (FDD).

   Other program items to be included in HAberl's report.

- Meeting adjourned at 9:05 pm.

ATTENDEES

NAME	EMAIL
Jeff Haberl	jhaberl@esl.tamu.edu
Les Norford	lnorford@mit.edu
Jon Wright	j.a.wright@lboro.ac.uk
Geoff Levermore	Geoff.levermore@umist.ac.uk
Robert Sonderegger	rsonder@siliconenergy.com

Vernon Smith	vsmith@archenergy.com
David Eldridge	dancingDAvidE@hotmail.com
Bass Abushakara	Abushakr@msoe.edu
Jean Lebrun	j.lebrun@ulg.ac.be

RESEARCH TOPIC ACCEPTANCE REQUEST (RTAR)

Title:

DEVELOPMENT OF A PROCEDURE FOR BASELINING ENERGY USE AT LARGE CENTRAL PLANTS

TC/TC:

TC 4.7 Energy Calculations

Research Category:

O&M Tools

Estimated Cost:

Basic and Applied

Background/State-of-theArt:

The commercial sector accounts for approximately 15% of the total US energy consumption. Half of the commercial sector energy use is attributed to multi-building facilities. Several of these multi-building facilities are served by large central plants that produce energy forms directly used in the buildings (such as steam, hot water, chilled water, and electricity) from primary fuel sources (including natural gas, fuel oil, and potable water). Colleges and universities are examples of multi-building facilities with a central plant. It is estimated that 83% of college and university floor-space is located in a multi-facility served by a central plant.

The potential to reduce energy use in multi-building facilities is significant. For instance, energy

conservation programs sponsored by some state universities have been able to achieve 30% reduction

in energy consumption. If this reduction is extrapolated to all the US college and university facilities, it

would provide about $1.3 billion in reduced energy bills or about 10% of total budget of US

Department of Education allocated to post-secondary education.

One important element that ensures the effectiveness and the success of energy conservation programs is a procedure to assess and quantify the energy and/or cost savings attributed to implemented retrofit

measures. Recently, several procedures and guidelines for measuring and verifying energy savings for individual buildings have been developed. Among the methods proposed for the measurement of energy savings are those proposed by ASHRAE Guideline 14P, the National Association of Energy Service Companies (NAESCO), the Federal Energy management Program (FEMP), the American Society of Heating Refrigeration and Air Conditioning Engineers (ASHRAE), the Texas LoanSTAR program, and the North American Energy Measurement and Verification Protocol (NEMVP) sponsored by DOE and later updated and renamed the International Performance Measurement and Verification Protocol (IPMVP).

However, None of the existing base-lining procedures are applicable to large central plants serving multiple buildings. One of the main features of large central plants is that they include the relatively complex energy interaction between several equipment used central plants such as boilers, chillers, turbines, pumps, and heat exchangers. In a typical central plant, primary fuel sources (such as natural gas, fuel oil, potable water, and purchased electricity) are used by a utility plant to produce various energy demands (such as steam, hot water, chilled water, and generated electricity) supplied to the buildings. The conversion of the primary fuels to energy demands is accomplished through numerous energy conversion processes performed within the utility plant. Any base-lining procedure for central plants should be capable to account for the various thermal interactions between the multiple equipment commonly used in the plant.

Justification and Need/Advancement to State-of-the-Art:

In order to improve the energy performance of large central plants, a simplified base-lining procedure is needed to measure the energy savings from retrofits of multi-building facilities. This procedure should have the ability to identify various system effects such as those due to equipment replacement, operational strategies change, weather variation, addition or subtraction of building stock, or equipment degradation. The base-lining procedure would facilitate the comparison of energy savings retrofits between multi-building facilities.

It is expected that the development of an accepted procedure for base-lining energy use at large central plants will complement and widen the applicability of the existing guidelines and standards for measuring savings from energy retrofits in commercial buildings including multi-building facilities (such as ASHRAE 14 GPC-14P and IPMVP). The procedures outlined in this work statement will result in an ASHRAE publication that can be widely distributed to ASHRAE members. ASHRAE has already developed and is distributing software toolkits that contain computer-modeling routines of primary (HVAC01) and secondary (HVAC02) systems. Therefore, the final result of this work is intended to be a guide, complete with algorithms, presentation formats, and quantitative references, of how to reconcile the results of simulation programs developed with such toolkits with actual data.

The project will benefit the following:

1. ASHRAE to buttress the credibility of the use of baseline procedures based on ASHRAE methods by the energy engineering community.
2. Software code developers and users to develop standard baseline procedures fit measured data from actual buildings.

3. ASHRAE members as a guide for more effective baseline procedures for use in their day-to-day practice.
4. ASHRAE Guideline 14p to strengthen its use in large central plants.
5. Performance contractors and energy service companies with a consensus calibration method for baselining large central plants.

Objective:

The main objective of this research project is to develop and document a procedure to baseline energy use at large central plants that serve multiple buildings. The procedure would account for different plant component efficiencies, operational strategies, variable weather conditions, and addition or elimination of building stock and/or plant equipment. As an application, the developed procedure would be demonstrated to measure savings from retrofits to equipment in the central plant for a multi-building facility.

Contributors:

Jeff Haberl
Moncef Krarti

TC 4.7- Inverse Sub-Committee

USE CASES

<u>What are Use Cases?</u> *(contributed by Robert Sonderegger)*

Before launching into the description of specific examples, let me briefly re-iterate the purpose of use cases. Use cases are a recitation of a problem with a possible engineering solution, from the perspective of a "protagonist". At its simplest, a use case is a brief story with a protagonist whose problem at hand is described, possibly with some hints as to what the protagonist would like to be able to do but can not currently do.

While perusing such use cases, a TC 4.7 engineer should ask himself the following questions:

a) what methods are available today that would solve at least some of the protagonist's problems or shortcomings described in the use case; if there are, why are they not in use here;

b) would the use case protagonist be able or willing to apply these methods; if not, what can we do to make them more user-friendly;

c) where a real gap exists in available or usable methods, what would be the most useful method look like to fill these gaps?

Future TC 4.7 efforts would flow from all three points above:

(a) better publication of what we have in hand;
(b) simplifying the use of, and modernizing the packaging of existing methods;
(c) focus our research efforts to develop what is needed by the protagonist.

Use Case (1): How to measure load curtailment initiated by building owner

A building owner wants to better manager her energy costs. Her energy manager's first impulse is to turn off chillers and dim unnecessary lighting at peak times, using the building control system or the two-way capability of a recently acquired web-based energy information system. The hard part is figuring out whether the savings were worth the inconvenience and lost productivity.

Ideally, the energy manager needs a real-time baseline against which he can compare real-time energy use, especially around peak demand times; meanwhile, the building owner needs a periodic report where week-to-date or month-to-date figures for actual and baseline are shown in financial terms.

Discussion:

The challenge, for TC 4.7, is to suggest ways to calculate a baseline in real time that reflects the effects of weather and building operation on energy use, so as to permit both energy manager and building owner to accurately assess the quantitative impact of their energy management. Above all, such baseline calculation methods must be easy to use or to automate, and sufficiently plausible to be accepted by all. There already are numerous baseline calculation methods in the literature. This is a case where better publication and packaging of what already exists would go a long way to address this use case.

Use Case (2): Load curtailment settlement in the context of a utility demand reduction program

Strapped for summer-time capacity, some utilities have been contracting with their major industrial and commercial users for on-call load reductions at times of power emergency, in return for more favorable tariff terms. In one type of program the utility will contact all signed-up customers and offer a given price (e.g., $250/MW) for customer-initiated demand reduction, to be effected anywhere between 1 hour and 24 hours in the future.

The customers whose lost production is less valuable than the utility payment will follow the call and commit to certain reductions in MW. Some of these programs have been effective in avoiding blackouts at a fraction of the cost of permanently increasing capacity.

The problem arises when the time comes for utility and customer to settle on what actual demand reduction has been achieved. Armed with 15-minute resolution charts and graphs, the customer will show the visible drop in power usage. What is usually missing is a mutually acceptable estimate of what the power usage *would* have been, had the customer done nothing.

Discussion:

This is analogous to the problem faced by performance contractors trying to prove the magnitude of energy savings to their customers. Similar baseline calculation methods as in Use Case (1) come into play, with the difference being that they need not be calculated in real time, which opens new possibilities of what is usable.

Use Case (3): What specific measures to implement to reduce demand in a building by a pre-specified amount".

A commercial utility customer has signed up to a utility load curtailment program, whereby the owner agrees to cut power usage by an amount and on a schedule provided on short notice by the utility, in return for more favorable rate tariffs.

When the time comes to "shed 250 kW of power starting 30 minutes from now", the owner must have a quick way to estimate power reductions from different actions, so as to make a judgment as to which choices are least detrimental and costly to him.

Discussion:

In engineering terms, this boils down to developing a catalog of operational actions sorted by their estimated power reductions, with regards given to time-of-day of the reduction and likely weather conditions.

Other actions could involve temporary over-usage of energy, for example to pre-cool the building, followed by total shut-off of the cooling plant during the curtailment period.

While such power reductions are calculable in principle, few of the methods available are suitable in terms of simplicity and speed, to be useful to a building owner.

Moreover, many of TC 4.7's methods are geared to model the effects of
permanent structural or mechanical changes -- relatively little is available in the way of operational (short term) changes.

Use Case (4): Procedure to develop performance models of HVAC&R equipment from Published Manufacturer data *(contributed by T. Agami Reddy)*

Different HVAC&R equipment manufacturers publish or provide performance data of their equipment in different ways. Further, this format has been changing in recent years. For example, chiller manufacturers no longer provide the extensive catalog data of their chillers at different sets of operating conditions as did previously.

The objective of this research would be to:
  (i)   classify the various HVAC&R equipment (must include secondary (AHU, fans,…) and primary equipment (pumps, chillers, boilers, prime movers (diesel gen sets, gas turbines,…))
  (ii)   identify the different types of energy models suitable to the above classes (usually steady-state, either lumped or component)- distinguish between energy models, versus FDD or models suitable for dynamic control of equipment
  (iii)   evaluate whether manufacturer data is adequate for proper model identification
  (iv)   provide recommendations if found wanting

This research is appropriate not only for the Inverse SC but the Component Simulation and Application SCs of TC4.7 as well. For example, component models used for simulation invariably use some sort of manufacturer data.

Use Case (5): Characterizing Building Cooling Thermal Loads over a Year from Short-Term Monitoring *(contributed by T. Agami Reddy)*

Build on past work done in RP 827, RP 1004

Use Case (6): Procedures for Adjusting Baseline Models for M&V Projects *(contributed by David Claridge)*

Should account for factors such as electric creep, changes in occupancy, changes in equipment, retrofits and renovations,….)

Use Case (7): Rehabilitation of Missing Data *(contributed by David Claridge)*

TC 4.7 Simulation and Component Models Subcommittee
Chicago Meeting Minutes
Monday, January 27 2003, 18h00 to 19h30
Palmer House Montrose 1

Introductions / Additions to agenda
Meeting called to order at 18h05. No additions to the agenda. There were 39 attendees as shown in attachment 1.

Program
Chicago (January 2003)
- We have a symposium on *Recent Advances in Energy Simulation: Building Loads* which is chaired by Jan Hensen. This will be held on Wednesday morning at 8h00.

Kansas City (June 2003)
- A symposium on *Integrating Air Flow Modelling into Energy Analysis Programs* is under preparation. This is chaired by Jelena Srebric. Eight abstracts were submitted: seven were accepted. Six papers were produced and all have been reviewed. One of these has been fully accepted while two others have been submitted for the second round of review (only minor comments). The remaining three papers are still to be submitted for the second review. Therefore, there should be five to six papers in the end. Jelena feels confident that the package will be ready for February 7 and that the symposium can happen in Kansas City.
- A forum on the modelling of thermal storage was proposed for Anaheim. Mark MacCracken volunteered to organize this. The forum should address not only the shortcomings of some current simulation programs, but also address the successes.

Anaheim (January 2004)
- A moisture absorption/desorption modelling seminar was proposed for Nashville. Jan Kosny volunteered to organize this.

Future
- Jeff Spitler volunteered examine the feasibility of organizing a seminar on fenestration heat transfer and energy calculations. This would bring together TC 4.5 and TC 4.7.
- Dan Fisher volunteered to continue the "Recent Advances" symposium theme. Dan will do a call for abstracts in the near future. There will likely be a paper or two from 1049-RP that could fit this symposium.

Research Projects in Progress
1049-RP Design Synthesis
The PES is chaired by Curt Pedersen Chair. The PI is Jonathen Wright. As the PES chair was not in the room, Ian Beausoleil-Morrison provided an overview of the project's current status, with additional comments provided by the PI.

The PES met on Sunday. The research is progressing well with programming of the main component, the ACG, almost complete. A couple of examples were used to demonstrate the performance of the ACG. These were on single-zone examples. A more complex example will be used next to test the ACG.

An outline of the final report was presented by the PI and discussed by the PMS. There was general agreement on the structure of the final report. The PI is planning to deliver a draft final report to the PMS in May so that the PMS can be prepared to vote on its acceptance at the June meeting.

1197-RP Updated Energy Calculation Models for Residential HVAC Equipment
The PES is chaired by Chip Barnaby. The PI is Mike Brandemuehl. The PES' meeting time was changed from Sunday to Tuesday. As such, Chip Barnaby provided an overview of the project's current state based upon this last correspondence with the PI.

The project has considered A/C units so far, but not yet HPs. Five models are currently being evaluated: two DOE-2 based models, two Secondary Toolkit based models, and a component-based model.

It is unknown at this time whether the progress of the research is on schedule. A more detailed report can be given following Tuesday's PMS meeting.

Research Wish List
Copies of the July 19, 2002 research "wish list" were circulated (attachment 2). Ian Beausoleil-Morrison summarised its history. The wish list was started at Atlantic City. Input at that meeting and responses from the posting on the TC 4.7 web site resulted in an expanded list that was tabled in Honolulu. The list was further fleshed out in Honolulu and those present cast ballots on their top seven research priorities. The priorities reflected in the July 19, 2002 wish list reflects these votes. The wish list is to be used to guide the subcommittee on the development of new RTARs/WSs. It is not a static document, but rather something that should be continuously updated.

There was some general discussion on the wish list and the placement of some items. Jeff Spitler suggested a research project to examine the importance of some of the "exterior boundary" items, such as items 11 (shading by external objects) and 29 (deep-sky temperature). There was general agreement that this was a good approach to gauge the significance of these items. As an outcome of this research, these items may be re-ordered in the list or eliminated from the list. Tim McDowell and Jan Hensen agreed to work with Jeff Spitler to turn this into an RTAR by Kansas City.

There was a good discussion on the fifth item on the list "Moisture absoprtion/desorption by building materials and furnishing (necessary to accurately model night ventilation)". It was agreed that although some work has been done in this area, further research is required. Rich Liesen and Jan Kosny will flesh this out into an RTAR for discussion in Kansas City. Mike Brandemuhl will send them notes from a forum that was held on a similar topic a number of years ago.

A comment was made that research projects should not be EnergyPlus-centric. Many other simulation programs are in use and ASHRAE research should be usable by other tool authors.

Work Statements in Progress
Technical and Usability Enhancements to the Energy Calculation Toolkits
- RTAR 2004-19 approved by RAC but not priorized.
- This was voted in the "lower" category on the wish list, but this voting occurred after TC 4.7 sent it up. What to do?
- Dan Fisher authored RTAR. As he had to leave the meeting before this point on the agenda, this was not discussed.

Improving Load Calculations for Fenestration with Shading Devices
- RTAR 2004-12 accepted by RAC and priorized.
- TC 4.1 took lead on RTAR. TC 4.7 and TC 4.5 co-sponsored RTAR.
- Chip Barnaby was involved in the RTAR and has fleshed this into a WS.
- Sheila Hayter recommended that rather than having three TC's co-sponsor the WS, the chair of TC 4.7 should write a letter of support for a TC 4.1 lead.
- Chip handed out copies of the WS. Goal is to finalize this by May 15. All volunteers to send Chip comments within the next two months. Chip is especially looking for references to previous and current work in this area.

Energy Performance Simulation Model for Refrigerated Warehouses
- This was discussed in Honolulu. It was agreed that Dan Fisher would talk to section 10 about this WS.
- Joe Huang reported there was has been no progress on this WS.
- Dan Fisher had some communication from TC 10.8 on this. They might be interested in contributing or assuming this WS.
- Jan Kosny will talk to Dan Fisher to discuss the way forward.

Models for Natural and Hybrid Ventilation
- Carrilho Graca Guilmerme circulated a two-pager that he and Paul Linden drafted. Comments on this two-pager have been provided by Mona Ahmed Fanny.
- This item was voted our highest priority on the wish list.
- The general feeling was that this was headed in the right direction.
- Dru Crawley mentioned that TC 4.2 had a discussion about the inapplicability of wind data from weather files for the modelling of building air flow. This should be considered in the WS.
- Joseph Deringer stated that ventilation shafts with cross-ventilation should be considered in this WS.
- A literature review is required to pull in related work.
- Joe Huang and George Walton volunteered to assist Linden, Guilmerme, and Fanny with this WS.
- The goal is to have a fleshed out document to discuss at Kansas City.

Create algorithms to allow mapping of manufacturer's or available data to simulation inputs
- A two-pager drafted by Milorad Bojic was circulated but there was no time to discuss this.
- The current draft is too EnergyPlus-centric: this needs to be generalised.
- Mike Brandemuhl volunteered to work with Bojic and Bruce Billedeaux on this.

Assess impact of explicit modelling of radiant heating (in-floor, wall panels, gas fireplaces, etc.) and radiant cooling and devise appropriate modelling strategies
- A two-pager drafted by Milorad Bojic was circulated but there was no time to discuss this.
- The current draft is too EnergyPlus-centric: this needs to be generalised.
- Jan Hensen and Rick Strand work with Bojic on this.

New Business
No new business.

Adjourn
The meeting was adjourned at 19h30.

Attachment 1

Chicago	Honolulu	Atl. City	Last Name	First Name	E-Mail
X	X		Barnaby	Chip	cbarnaby@wrightsoft.com
X			Bass	Abushakra	abushak@msoe.edu
X	X	X	Beausoleil-Morrison	Ian	ibeausol@nrcan.gc.ca
X			Berinato	Reed	rrb144@psu.edu
X			Bernier	Michel	michel.bernier@polymtl.ca
	X		Bojic	Milorad	bojic@knez.uis.ac.yu
X			Bradley	David	bradley@tess-inc.com
X	X	X	Brandemuehl	Mike	michael.brandemuehl@colorado.edu
X			Cane	Doug	caneta@compuserve.com
X			Carrilho Graca	Guilherme	gcg@ucsd.edu
X	X	X	Crawley	Dru	drury.crawley@ee.doe.gov
		X	Chanvit	Chantrasrisalai	chanvit@okstate.edu
	X		Curcija	Charlie	curcija@ceere.org
		X	Deng	Zheng	zhengd@okstate.edu
X		X	Deringer	Joseph	jderinger@deringergroup.com
		X	Deru	Michael	michael_deru@nrel.gov
X			Eldridge	David	dancingdavide@hotmail.com
X	X		Fisher	Dan	d-fisher@uiuc.edu
X		X	Gardner	Carol	gems@teleport.com
X		X	Griffith	Brent	griffith@mit.edu
X			Haberl	Jeff	jhaberl@tamu.edu
		X	Haddad	Kamel	Khaddad@nrcan.gc.ca
	X	X	Haves	Philip	phaves@lbl.gov
X	X		Hensen	Jan	j.hensen@tue.nl
X			Hofu	Kiu	hwu@csupomona.edu
X	X	X	Huang	Joe	YJHuang@lbl.gov
		X	Iu	Calvin	iip@okstate.edu
	X	X	Judkoff	R.	Ron_judkoff@nrel.gov
		X	Jin	Hui	jinh@okstate.edu
		X	Kong	Weixiu	weixiu@okstate.edu
X		X	Kosny	Jan	kyo@ornl.gov
		X	Krarti	Moncef	krarti@colorado.edu
X	X		Liesen	Richard	r-liesen@uiuc.edu
		X	Lawrence	Tom	lawrenct@ecn.purdue.edu
X		X	Lebrun	Jean	j.lebrun@ulg.ac.be
X			Levermore	Geoff	geoff.levermore@umist.ac.uk
		X	Liu	Xiaobing	xiaobin@okstate.edu
X			MacCracken	Mark	mmaccracken@calmac.com
		X	Mangini	Jim	jim.mangini@carrier.utc.com

Chicago	Honolulu	Atl. City	Last Name	First Name	E-Mail
X		X	McDowell	Tim	mcdowell@tess-inc.com
X			Morrison	Andrew	caneta@compuserve.com
X	X	X	Neymark	Joel	neymarkj@sni.net
	X	X	Norford	Les	lnorford@mit.edu
X			Novoselac	Atila	aqn102@psu.edu
X			Olsen	Erik	eolsen@owpp.com
	X	X	Parsons	Jim	parsons@me.msstate.edu
	X	X	Pedersen	Curt	cpederse@uiuc.edu
X	X		Reddy	T. Agami	Reddyta@drexel.edu
X	X	X	Rees	Simon	SJRees@okstate.edu
		X	Shirey	Don	Shirey@fsec.ucf.edu
X	X	X	Smith	Vernon	vsmith@archenergy.com
X			Smith	Sean	sean_smith@waterfurnace.com
		X	Sommer	Klaus	klaus.sommer@vt.fh-koeln.de, Sommer.Roycroft@T-online.De
X	X	X	Sonderegger	Robert	rsonder@siliconenergy.com
X	X	X	Spitler	Jeffrey	spitler@okstate.edu
X			Srebric	Jelena	jsrebric@psu.edu
	X	X	Strand	Rick	r-strand@uiuc.edu
	X		Theios	Jason	jason-theios@guardian.com
X			Thornton	David	thornton@tess-inc.com
	X	X	Walton	George	gwalton@nist.gov
		X	Wassner	Mike	wassner@colorado.edu
		X	Witte	Mike	mjwitte@gard.com
X	X		Wright	Jonathan	J.A.Wright@lboro.ac.uk
		X	Xiao	Dongyi	xdongji@okstate.edu
X		X	Xu	Peng	pxu@lbl.gov
		X	Zhang	Peter	peter@deringergroup.com

Attachment 2

TC 4.7 Simulation Subcommittee Research "Wish List"
July 19, 2002

Purpose
This document is a work in progress. Its purpose is to allow TC 4.7's Simulation subcommittee to establish a "wish list" of research priorities for the future. The intention is for the subcommittee to focus the development of new RTARs/work statements on the priorities developed from this exercise.

The items that have been identified to date as worthy of further research by TC 4.7's Simulation subcommittee are listed below. The research items are listed in decreasing order of priority and grouped into four categories. The priority rankings were determined from votes which were cast at the Honolulu (June 2002) subcommittee meeting.

HIGHEST PRIORITY

1) Models for natural and hybrid ventilation, e.g. solar chimneys, raised floor and displacement ventilation distribution systems, controls, wind-driven air flow.
2) Create algorithms to allow mapping of manufacturer's or available data to simulation inputs.
3) More detailed modelling of internal surface convection and stratification within rooms.
4) Assess impact of explicit modelling of radiant heating (in-floor, wall panels, gas fireplaces, etc.) and radiant cooling and devise appropriate modelling strategies.
5) Moisture absoprtion/desorption by building materials and furnishing (necessary to accurately model night ventilation).

HIGH PRIORITY

6) Development of pragmatic strategies for using integrated network air flow models for simulating infiltration and inter-zone air flow.
7) Integration of dynamic thermal comfort models with spatial distribution.
8) Integration of intra-zone air flow models.
9) Duct models to consider air leakage and thermal losses.
10) HVAC-integrated fuel cells.
11) Shading and reflection by external objects: buildings, trees (including impact of seasonal leaf cover).
12) Impact of internal shading devices associated with windows on room heat transfer.
13) Modelling of micro-climate effects (e.g. courtyards, heat islands, city wind, local landscape).
14) Integration of electric power flow modelling.
15) Integration of IAQ modelling.

MEDIUM PRIORITY

16) Building-integrated photovoltaics and wind turbines.
17) Improved models for exhaust-air heat recovery, including moisture exchanger and defrost cycles (residential).
18) Model that gives ground reflectivity as function of current and time-history of weather data (snow cover, snow age) and ground temperatures.
19) Formal treatment for quantifying impact of uncertainty in input data (experimental design and analysis of results).
20) Stochastic modelling of occupant behaviour (operating schedules, occupancy patterns, lighting usage, window openings, etc).
21) Development of models to simulate window air conditioners in residential buildings, including the effects of partially conditioned buildings and inter-zone air movement.
22) More accurate models to determine heat transfer from lighting equipment: radiant/convective split, heat transfer to plenums.
23) Integration of illumination simulation (daylighting and artificial lighting).
24) Development of techniques to use simulation to assist in design synthesis.
25) Building-level cogeneration equipment (e.g. micro-turbines, Stirling cycle) other than fuel cells.
26) Accurate characterization of occupant-driven electric demand profiles in residential buildings. Necessary for accurate simulation of cogeneration equipment.
27) Models to simulate domestic hot water loads, rather than treating as user-input.
28) Geothermal heat pumps (model for ground field).
29) More accurate models for predicting deep-sky temperature for night-time radiation from external surfaces of envelope (important for modelling "cool roofs").
30) Models to simulate the effect of rain and snow on the building envelope.
31) Development of validation tests for SPC 140 that cover all significant building-load and HVAC processes: ground heat transfer, heating equipment, cooling equipment, ventilation equipment, calculating infiltration rates, etc.
32) Development of techniques to predict GHG emissions, embodied energy, capital and maintenance costs, primary energy requirements, and life-cycle costing.

LOWER PRIORITY

33) Buried ducts for pre-heating or pre-cooling ventilation air.
34) Modelling the control of hybrid HVAC systems wherein multiple systems condition a space.
35) Modelling HVAC systems at different levels of resolution.
36) Under-floor air distribution systems, including the thermal coupling with the ground.
37) Impact of shading upon surrounding surface temperatures which are in radiant contact with the external envelope.
38) Model for moisture sources within housing (cooking, cleaning, from ground).
39) Ventilated double facades.

40) Modelling the effect of carpets on the room energy balance (unexpected results from RP 1117).
41) Package primary systems, secondary systems, and loads toolkits as VBA so that they can be invoked from spreadsheet programs.
42) Update primary systems and secondary systems toolkits and package all toolkits in a single CD.
43) Models for air- and water-based thermal solar systems.
44) Determine impact of surrounding vegetation on infiltration.
45) Modelling the impact of vegetation (e.g. green roofs, vines on walls) upon evaporative heat transfer and solar gains.

ASHRAE
Technical Committee 4.7 Energy Calculations
2003-2004 Research Plan
1 August 2002

Title	TC Priority 2003-2004	Prior TC priority	Society status	TC Status	Sub-com
Procedures for Reconciling Computer-Calculated Results With Measured Energy Data (1051-TRP)	0	3 (1998-1999)	Work statement approved, awaiting funding		IM
Development of Comparative Test Cases for Evaluating Simulation Models of Slab, Crawl Space and Basement Heat Transfer Through Adjacent Ground	0	2 (2001-2002)	RTAR, accepted	Hold, IEA work underway	SCM
Inverse Bin Procedures for Analyzing Energy Savings	0	3 (2001-2002)	RTAR, accepted		IM
Procedures and Data for High-Performance Residential Design	0	1 (2002-2003)	RTAR, accepted	Draft WS	A
Development of a Procedure for Base-lining Energy Use at Large Central Plants	0	2 (2002-2003)	RTAR, prioritized	Draft WS	IM
Technical and Usability Enhancements to the Energy Calculation Toolkits	1			RTAR	SCM
Improving Load Calculations for Fenestrations with Shading Devices	Co-sponsor			TC 4.1 RTAR	

Additional Work TC 4.7 Work Statements in Process – status as of 1 August 2002

Title	TC Priority 2002-2003	Prior TC priority	Society status	Status	Sub-com
Development of a Toolkit of HVAC Models (Algorithms) for Refrigerated Warehouses					SCM
Development of Standardized Computer Simulation Input Files for Describing Typical Residential Homes and Common Energy Conservation Retrofits					A
Methodology to Define Bounds of Variability in Building Energy Use Predictions Using Detailed Simulation Models and How it can be Incorporated in the Design Process					A
Define Performance Factors for Primary and Secondary Equipment Simulation Inputs for Commercial Buildings		2 (2000 – 2001)		No progress	A
Analysis and Testing of the Energy Cost Budget Method in ASHRAE 90.1					A
Use of Evolutionary Computation for Inverse Problems					IM
Characterization of Building Secondary Thermal Loads from Chiller Electric Use Data					IM
Extend and Develop Methodology of 827-RP to Include Models for Air-Conditioners and Heat Pumps					IM
Standard Operating Conditions in North American Residential Buildings (1163-TRP)				Cancelled by Tech Council	A
Development of Detailed Descriptions of HVAC Systems (Templates) for Energy Simulation Programs (1198-WS)		3 (2000 – 2001)		Rejected 3/00	SCM

TC4.7 Handbook Subcommittee Minutes
Monday, January 27, 2003, 5:00-6:00PM
Chicago Palmer House Montrose 1 (7th Floor)

The meeting was called to order at approximately 5:20pm, Rick Strand, TC4.7 Handbook Subcommittee Chair presiding. An attendance list is provided at the end of this document. The attendance list reflects those in attendance for a significant portion of the discussion.

Overview of Electronic Handbook Additions: The meeting began with a visit from one of our liaisons, Brian Krafthefer, who discussed the nomination of TC4.7 to be one of a select number of technical committees who enhance the handbook with electronic elements (eBook only). There was a discussion of the types of items that might be included in the eBook. Rick Strand noted that in past meeting the TC4.7 handbook subcommittee had come up with several ideas for implementation in the Chapter 31 (such as: Toolkit to VBA in Excel spreadsheet, color image of a "calibration tool", psychrometric chart visualizations, and other simpler additions such as color pictures, spreadsheets, etc.). *(ACTION ITEM)* As per discussion with our handbook liaison Bill Fleming prior to the start of this meeting, Rick Strand will summarize some of the ideas and forward them to Bill so that he can see if ASHRAE is amenable to such additions. Concerns were expressed about spreadsheets and proprietary programs such as Excel. Brain Krafthefer will begin querying the ASHRAE handbook committee as to whether spreadsheets and source code from Toolkits are acceptable. Jeff Haberl noted that there was some concern about the speed at which changes are being made. He cited as an example RP-1017 which was a demonstration project on how the chiller section of the eBook could be enhanced. The research has been completed for some time and yet it does not appear in the eBook. The chair noted that ASHRAE seems to indicate that we must push forward with electronic additions but that the actual incorporation of such items seems to be slow. ASHRAE does not expect overnight, wholesale changes but wishes to move forward in a timely manner (this is a multi-year effort).

Program Issues: Jeff Haberl noted that he was soliciting ideas for Programs from all of the TC4.7 subcommittees. While it does not appear that handbook might have something that could be turned into a program, Jeff noted that information in the handbook could provide the good basis for a forum or even a seminar (such as the Chicago seminar that discussed load calculations). The subcommittee will keep this in mind in the future and will contact Jeff if we come up with any potential ideas.

New Validation Section: Rick Strand noted that Ron Judkoff and Joel Neymark have created a new section on validation for inclusion in Chapter 31. A draft was presented at the Honolulu meeting and was modified as a result of comments they received from the subcommittee members. It was noted that Standard 140 was presented to the 90.1 committee and approved. This needs to be reflected in this addition to Chapter 31. *(ACTION ITEM)* Rick Strand will arrange for this final edit and to have this document posted on the TC4.7 web site so that committee members can review this document. We will seek approval of this addition at the full committee meeting in Kansas City.

What is the Handbook/Handbook Worshop: Agami Reddy noted that there was a sense from many that the actual purpose and exact audience of the handbook series is not well understood. Rick Strand replied that this was partially discussed in a handbook workshop that ASHRAE had held the previous day for TC chairs and handbook subcommittee chairs. He mentioned that ASHRAE does have an official "ASHRAE Handbook Author and Reviser Guide" that is available on the ASHRAE web site. He quoted from a condensed version of this document:

"Typical users include consulting engineers, design engineers, plant engineers, contractors, and engineering students."

"Fundamental chapters provide concise descriptions for the basic engineering principles used in the HVACR industry. Lengthy derivations are not found here. Fundamental chapters may also provide basic data used in HVACR calculations and processes. Tables and graphs are available for the design engineer. These chapters address current design information useful to the practicing engineer. They address principles of operation and the effect of design parameter changes."

Bill Fleming expanded on these definitions and ideas. Jim Willson felt that there was a need to define our expectations and provide reference materials that will be useful to practicing engineers (example: infiltration rates). Bill Fleming stated that it might be good to have a "checklist" on design calculations/considerations with references to other sections and that we should not assume that everyone knows what we are talking about. Jim Willson mentioned that one bad example of this in the handbook is the loads calculation chapter that has theory but no procedures/examples. Bill Fleming agreed and said that step-by-step procedures were in the works for that chapter. Jeff Spitler reminded the committee that there really have not been any complaints from ASHRAE membership about Chapter 31 but perhaps ours was somewhat different from the loads calculation chapter. Nevertheless, he felt that we should at least try to provide more examples in our chapter.

Other pertinent information that was obtained by the handbook chair at the handbook workshop:
- ASHRAE Handbook Author and Reviser Guide is available at the ASHRAE web site and should be read be all members involved in revising the handbook chapters. This publication contains information on the difference between the content intent of each volume and other information that will help authors craft sections and revisions.
- Chapters should contain basic but comprehensive technical information and guides for "good practice". A non-expert should be able to figure out a chapter and use its information. Thus, it might be helpful to have a "non-expert" be part of the review team to give the committee and idea of what the typical user might go through when trying to use a chapter.
- Fundamental chapters (2005 Handbook of Fundamentals) will be due sometime in the Spring of 2004—approximately one year from now. Thus, our committee should present a modified version of the chapter to the full TC in Anaheim for a vote.
- Electronic versions of the handbook series will be published yearly, and revisions (after this year) will be due on February 1.

Other Discussion Topics:

- Print vs. Electronic: Rick Strand reminded the group that ASHRAE now considers the eBook as the official version of the handbook series with the print version available. Thus, the electronic version will contain everything in the handbook while the printed version may be a subset of that.

- Concerns about timing and moving forward: Jeff Haberl noted that the deadlines for the next version of the fundamentals is rapidly approaching and there might be some concern that our subcommittee was "spinning its wheels" a bit. Rick Strand acknowledged that this was a concern and assured those in attendance that he would make an effort to jump start things for the last push. Jeff Haberl suggested conference calls between now and Kansas City. *(ACTION ITEM)* Rick Strand will get the discussions started over email using the TC4.7 list server once feedback is received from Bill Fleming about the

type of changes that ASHRAE will approve for the handbook. The first goal will be to produce some examples for additions rather than trying to modify the entire chapter. We hope to have examples for analysis at Kansas City. *(ACTION ITEM)* Subcommittee members will assist in producing examples of electronic additions for inclusion in Chapter 31.

- Applications Subcommittee Input: Jeff Spitler noted that it would be helpful if the Applications Subcommittee got involved in the handbook process to provide some examples, etc.

- First round of reviews of Chapter 31: At the last meeting in Honolulu at the full TC meeting, Rick Strand obtained volunteers to review various sections of the handbook and provide updates references and/or ideas on how to improve the chapter. While this was not discussed in detail at this meeting, below is a summary of the feedback obtained from those volunteers. Feedback is still anticipated for other sections of the chapter and will be posted on the list server or web site when available. This could serve as a roadmap for modifying the chapter over the next year or so. *(ACTION ITEM)* Rick Strand will contact volunteers from whom feedback was not received in hopes of getting their comments on the chapter. *(ACTION ITEM)* Volunteers from Honolulu who have not reviewed their sections need to do so. Feedback received to date (many thanks to those who have and will contribute):

  2b Ground Heat Transfer (Bill Bahnfleth)
  The literature cited in the existing Ground Heat Transfer section is very limited. The primary reason for this is that the section is almost exclusively devoted to grinding through the details of a simplified method developed by Krarti and Chuangchid that has been validated against Krarti's ITPE method. There is no discussion of the capabilities and shortcomings of ground heat transfer models in commonly used programs and no discussion of recent detailed models by others, including models that model the effects of precipitation and moisture movement. In defense of the current section, its content may have been driven by the current crusade to make the handbook useful for design. Whether, and to what extent, the section needs revision depends on what ASHRAE wants the handbook to be in the future.

  2d Primary System Components (Agami Reddy)
  1)There is very little treatment of boilers and cooling towers, while recip chillers are unduly elaborated- I would have focused more on centrifugals.
  2)Second, the chapter deals with energy methods- so why go into description of various components and such. Such topics are better covered in other ASHRAE Handbook chapters (which has to go over to avoid duplication). From energy estimation viewpoint, forward and inverse chiller models are not that different. They can be treated together.But this requires reorganizing the chapter.
  3)I always find it hard to distinguish between material more appropriate to a textbook vs a handbook chapter.

  3d Simulating Primary/Secondary Systems (Craig Wray)
  I have quickly reviewed the sections with my name attached below. Overall, they seem fine as summaries of modeling techniques. However, I doubt they would help a novice figure out how to model such systems (e.g., understand the important issues to focus on when modeling secondary systems, comprehend load and system interactions).
  One particular problem not mentioned in the sections that I reviewed (and generally elsewhere in the chapter) is how to model system deficiencies with forward techniques (e.g., duct leakage, low refrigerant charge). These are important and real issues that affect many buildings. Given that perfect buildings do not exist, I think there needs to be some discussion in the chapter about commissioning and modeling imperfect systems.

I have no time now to draft text to address the issues raised above. This however is not the immediate problem. I think we first need to define what it is that handbook users want. Does such info exist yet (I suspect not)? Is this on the agenda for the Handbook Subcommittee meeting in Chicago?

3a-c Overall, DD/Bin, Correlation (Joe Huang)

I did not find anything glaringly wrong or outdated about it, although I could see room for improvement in the descriptions and particularly, examples, of the variable-based degree-day and bin calculations. I see now from rereading your e-mail below that I should have given more attention to whether the references are up-to-date. I'll do that before the Chicago meeting, but I doubt I'll have time to work on the text.

- Correction to current Chapter 31: Request for clarification/correction submitted to ASHRAE regarding Chapter 31, Equation 36

$$W_{in} = W_{in, FL} + \left(1 - \frac{N_c}{N_{c, FL}}\right) W_{pump} \qquad (36)$$

HVAC1 Toolkit uses W_s in place of $W_{in,FL}$ in this equation. This change was summarized briefly by Rick Strand. *(ACTION ITEM)* Rick Strand will contact Mark Owen and request that this change be made (changing $W_{in,FL}$ to W_s).

- Addition of a Loads Toolkit Reference: This was not discussed but an addition will likely occur during the review of the current chapter.

The meeting was adjourned at 6:00pm. *(ACTION ITEM)* Rick Strand will submit meeting notes to TC4.7 Secretary Dan Fisher for inclusion in the TC notes and to our handbook liaison, Bill Fleming.

Attendance List:

Name	Affiliation	email
Rick Strand	University of Illinois	r-strand@uiuc.edu
Jim Willson	Honeywell	jimwill@indy.net
Agami Reddy	Drexel University	reddyta@drexel.edu
Jeff Haberl	Texas A&M	jhaberl@esl.tamu.edu
Bill Fleming	Handbook Liaison	flemg@aol.com
Anthony Radspieler	LBL	aradspieler@lbl.gov
Fred Bauman	UC Berkeley	fbauman@uclink.berkeley.edu
Jeff Spitler	Oklahoma State University	spitler@okstate.edu
Dan Fisher	Oklahoma State University	fisher@okstate.edu
Ian Beausoleil-Morrison	CETC/NRCan	ibeausol@nrcan.gc.ca
Joel Neymark	J. Neymark & Associates	neymarkj@msn.com

TC 4.7 Program Plan
Chicago ASHRAE Meeting
January 28th, 2003

CHICAGO / JANUARY 2003

Seminar 36

"Getting started with building simulation"

Organized by TC 4.7 (Applications)

Chaired by Chip Barnaby

Symposium CH-03-09

"Recent advances in building energy simulation: Loads"

Organized by TC 4.7 (Sim and comp models); co-sponsored by TC 4.1

Chaired by Jan Hensen

Seminar 52

"Using monitored data for solving engineering problems"

Organized by TC 4.7 (Inverse methods)

Chaired by Agami Reddy

KANSAS CITY / JUNE & JULY 2003 (DUE FEB 7TH)

#1 Seminar

"Successful applications of energy simulation in building design"

Organized by TC 4.7 (Applications)

Chaired by Jim Willson

Status: 5 people lined up to speak

#2 Symposium

"Inverse methods for calculating savings from energy conservation retrofits"

Organized by TC 4.7 (Inverse methods)

Chaired by Jan Kreider

Status: Three papers (two from 1050-RP, Nelson) have been accepted for publication

#3 Forum

"Thermal Energy Storage Simulation Models: Do existing tools do the job?"

Organized by TC 4.7 (Sim and Comp models)

Chaired by Mark MacCracken

Status: Promised for Kansas City

#4 Symposium

"Integrating air flow modelling into energy analysis programs"

Organized by TC 4.7 (Sim and comp models) and TC 4.10

Chaired by Jelena Srebric

Status: 7 abstracts submitted, 5 under review, 1 accepted for publication

ANAHEIM / JANUARY 2004 (DUE AUG 8TH)

Symposium

"Applications and Tools for Enhanced Building Energy Simulation"

Organized by TC 4.7 (Inverse & Applications)

Chaired by Vern Smith

Status: 2 papers (1093RP-Abushakra, Hydeman), 1 paper needed or merge

Symposium

"Knowledge-based Tools for Building Design Simulation"

Organized by TC 4.7 (Applications), possible co-sponsor by TC 1.5

Chaired by (needs chair?)

Status: Two papers on KBS for HVAC conceptual Design (Reddy et al.) have been reviewed and accepted for publication, needs (1) more paper

Symposium

"Validation of building simulation programs thru ASHRAE Standard 140"

Organized by TC 4.7 (Applications)

Chaired by Joel Neymark

Status: 5 papers (865RP, Overview, HVAC Besttest, Iowa Empirical Tests, Curt Peterson, Jelena Srebric)

Seminar

"Modeling Moisture Sorption/Desorption by Building Materials"

Organized by TC 4.7 (Sim and Comp Models)

Chaired by Jan Kosny

Status: New

Seminar

"Applications of HVAC-01 Primary and Secondary Toolkit"

Organized by TC 4.7 (Applications)

Chaired by Jean Lebrun

Status: New

NASHVILLE/JUNE 2004

Symposium
        "Recent Advances in Simulation"
        Organized by TC 4.7 (Sim and Comp Models)

Chaired by Dan Fischer

Status: New

Symposium
        "Predictor Shootout III: Energy Simulation for Residential Code Support"
        Organized by TC 4.7 (Applications)

Chaired by Jeff Haberl/Charles Culp

Status: New

ORLANDO/FEBRUARY 2005

MINUTES
SSPC-140 SMOT FOR BUILDING ENERGY SOFTWARE
Chicago, January 27, 2002
Chair: R. Judkoff; Vice Chair: J. Neymark

ATTACHMENTS
    A. Agenda for January 27, 2003 meeting
    B. Minutes from January 10, 2003 Conference Call

ADDITIONAL DOCUMENTS AVAILABLE UPON REQUEST
(contact Joel neymark at neymarkj@msn.com)
    A. SSPC 140 Meeting handouts
- A1. Responses to SSPC Comments-012403.doc
- A2. AnnexB18.doc
- A3. Foreword-012303.doc

    B. Materials distributed for Compliance SubC (unofficial SubC) from Conference Call, 10 January 2003
- B1. detailed spreadsheet pages and PDF graphs available upon request
- B2. Previous Minutes from Compliance SubC in Honolulu.
- B3. Compliance SubC Address list

    C. Compliance SubC / 90.1 ECB liaison report, Chicago, January 26, 2003
    D. Previous SSPC 140 minutes
    E. SSPC 140 Address List

CORRESPONDANCE SINCE LAST MEETING
Proposed revisions to Std 140 to incorporate HVAC BESTEST were sent out to the voting members in October 2002; changes to informational sections B18 and the Foreword were sent out to voting members during January 2003. Emails and conference calls regarding referencing of Standard 140 by Standard 90.1 ECB chapter occurred during December 2002 and January 2003 (see section containing Compliance SubC January 10, 2003, conference call minutes).

DIAGNOSTIC TESTS
The primary purpose of the meeting was to address comments on Standard 140 regarding revisions to incorporate HVAC BESTEST into the standard, and to finalize the proposed revisions so that they can be recommended for public review.

ATTENDEES (see mailing list for full names, etc)

Voting Members	Walton	Other
Beausoleil-Morrison	Wilcox (arrived late [4:00P])	Bradley
Crawley	Witte	Shirey
Fairey		Thornton
Judkoff (chair)	Non-Voting Members	
Rees	Neymark (vice chair)	

		Wilcox (was absent for all votes at meeting)
Absent Voting Members		Witte
Winkelmann		

GENERAL
Roster changes effective October 2002:
    D. Knebel to VM (User)
    J. Haberl to NVM

CHAIR'S ANNOUNCEMENTS
1. SSPC 90.1 approved the following language (in Std 90.1) be submitted for public review:
2. *Add the following to Section 11.2.1* "11.2.1.4 The simulation program shall be tested according to ANSI/ASHRAE Standard 140 and the results shall be furnished by the ['software provider' or 'program sponsor']."
3. *Add the following to Section 12* "ANSI/ASHRAE 140-2001 Standard Method of Test for Evaluation of Building Energy Analysis Computer Programs"
4. Handbook section on validation to go into Chp. 31 is being posted on TC 4.7 website for comments.
5. Chair adjusted the agenda to move items 8 and 9 up to just after 3 (i.e. as 3a and 3b).

COMMITTEE DISCUSSION

A. **Approval of Prior Minutes**
    Motion (Fairey): Accept Minutes of June 2002 Honolulu minutes [See attachment E].
    2nd (Walton): Vote: Yes = 7, No = 0Absent = Knebel, Winkelmann, WilcoxMotion = passed.

B. **Discussion of Comments regarding revisions to Std 140 to incorporate HVACBESTEST**
    1. Change definition of "Analytical Solution" read as follows: "**analytical solution:** mathematical solution of a model of reality that has a deterministic result for a given set of parameters and boundary conditions."
    2. Include new term definition as follows: "**quasi-analytical solution:** mathematical solution of a model of reality for a given set of parameters and boundary conditions; such a result may be computed by generally accepted numerical methods, where such calculations occur outside of the environment of whole-building energy simulation programs and can be scrutinized."
    3. Search the text throughout on "analytical solution" and include "quasi-analytical solution" along with "analytical solution" where appropriate.
    4. **Motion (Walton): Accept definitions "analytical solution" and "quasi-analytical" solution, and include the term "quasi-analytical solution" as appropriate throughout the text.**
    5. Second (Fairey):Vote: Yes = 7, No = 0; Absent = Knebel, Winkelmann, Wilcox; Motion = passed.
    6. It was noted that dew point temperature is defined in ASHRAE Terminology, and does not also need to be defined in Standard 140.
    7. **Motion (Fairey): Delete "Dew Point Temperature" from the definitions.** Second (Crawley):Vote: Yes = 7, No = 0; Absent = Knebel, Winkelmann, Wilcox; Motion = passed.
    8. Email comments by Knebel regarding using other terms in place of "bypass factor" and "apparatus dew point" were discussed. The committee decided that these are appropriate terms.
    9. **Motion (Rees): Retain "Bypass Factor" as is, and do not include the term "effectiveness"**; Second (Walton): Vote: Yes = 7, No = 0; Absent = Knebel, Winkelmann, Wilcox; Motion = passed.
    10. **Motion (Crawley): Retain "Apparatus Dew Point" as is, and do not include the term "coil effective temperature".** Second (Fairey): Vote: Yes = 7, No = 0; Absent = Knebel, Winkelmann, Wilcox; Motion = passed.
    11. **Motion (Witte): Accept to include "6.1.1.5 All heating and cooling loads listed in 6.1.1.1 through 6.1.1.4 shall be entered into the appropriate standard output report (see Annex A2)**

as positive values (μ 0).” Second (Crawley): Vote: Yes = 7, No = 0; Absent = Knebel, Winkelmann, Wilcox; Motion = passed.

12. Proposed changes to informational Annex B18 (circulated to SSPC 140 Voting Members last week) were discussed.

13. **Motion (Crawley): Accept the informational Annex B18 as presented and allow the Chair to make minor editorial changes and consider incorporating material regarding advantages and disadvantages of comparative, analytical verification, and empirical validation tests from HVAC BESTEST in place of only giving the current reference.** Second (Fairey):Vote: Yes = 7, No = 0; Absent = Knebel, Winkelmann, Wilcox; Motion = passed.

14. **Motion (Fairey): Recommend SPLS Public Review Approval of proposed revisions to ASHRAE Standard 140-2001, "Standard Method of Test for the Evaluation of Building Energy Analysis Computer Programs", working draft 03-1 dated January 24, 2003, including changes agreed to at the January 27, 2003, meeting of SSPC-140 (see motions passed above); and to authorize the Chair of SSPC-140 to make minor editorial changes as needed to satisfy the requirements of ASHRAE editorial review.** Second (Walton): Vote: Yes = 7, No = 0; Absent = Knebel, Winkelmann, Wilcox; Motion = passed.

15. Based on comments at the meeting, SSPC 140 expects to receive one or two formal requests for interpretation of current language within Standard 140-2001 in the near future.

C. Tax Credits and IECC Chp 4. Update

1. Fairey reported on tax credit legislation. Progress is better on the Senate side than on the House side.

2. 2003 IECC chapter 4 is the standard of comparison for all tax credit legislation proposed to date, there is no evidence that will change during this federal legislative session. Current language bases software qualification on 2001 Calfornia ACM. Recommendation of RESNET cognizant committee (responsible for comparing ACM, HERS BESTEST and any other test) is that software qualification should be more like Standard 140 or HERS BESTEST, rather than prescribing algorithms as is done in ACM.

3. Over last 3 months within DOE (and PNNL) there has been movement to strip performance approach out of IECC. This is being fought by many groups. Motiviation for removal is that builders and code officials don't like it.

4. Related Research Activities (updates and intentions regarding inclusion in Std 140)

5. HERS BESTEST: Fairey reports no progress regarding converting to code language. He still plans to work on this. Fairey still feels it is important to include HERS BESTEST in Standard 140.

6. RP-865 Air-Side HVAC Analytical Verification Tests: Walton reported that the RP-865 final report has been submitted to ASHRAE. Nothing has been done to bring this into 140. Funding needs to be provided from somewhere for 865 (or RP-1052 Envelope Analytical Verification Tests) to be made compatible with incorporating into a standard.

7. Furnace Tests: The fuel-fired furnace test cases final report has been approved by the Task 22 experts, and IEA Solar Heating and Cooling Programme ExCo approval is expected in the near future. NRCan is prepared to make the effort to convert this into code language for use with 140.

D. IEA Task 22 Related Research Activities Updates

1. RADTEST: These are tests of the ability of software to model floor embedded radiant systems. This work is in the final reporting phase. The test specification is not as "tight" as the furnace tests.
2. New HVAC BESTEST cases: These are expansion of HVAC BESTEST cases that includes more dynamic loading and weather, air-mixing, thermostat setup, undersized equipment, and various economizer controls. Fairey noted we need to add duct leakage modeling.
3. Ground Coupling Tests: This is a series of tests for comparing programs to the results of advanced ground-coupling models. So far we have results for HOT3000, SUNREL, and EnergyPlus. FSEC may be interested in participating. Simulation capability has gotten to the point that detailed ground modeling is feasible for whole-building simulations.
4. ETNA Empirical Tests: This is a series of empirical tests based on the BESTEST methodology. Includes conduction, solar gains, various heater types, insulated floor (mass test). Much of the data is just to empirically characterize the test cell UA and capacitance. All data has been collected. Spec writing is in progress. EDF needs to put data in public domain before IEA can use it.
5. ERS Empirical Tests: These are daylighting and economizer empirical tests. Final reports will be completed this year.
6. IEA New Task update: IEA Task 22 is coming to an end. Looking begin a new task to follow IEA Task 22.
7. CEN Standards Related to Simulation Software: We met with Jean-Robert Millet in Fontainebleau. In CEN lowest common denominator model is used for testing for qualification. After model is tested "crippled" it must be used crippled. Problem is e.g. angle-dependent optical properties are not allowed. Millet may be interested in being involved in new IEA task.

Meeting Adjourned.

References

ANSI/ASHRAE Standard 90.1-2001, *Energy Efficient Design of New Buildings*. ASHRAE, Atlanta, GA.

ANSI/ASHRAE Standard 140-2001, *Method of Test for the Evaluation of Building Energy Analysis Computer Programs*. ASHRAE, Atlanta, GA.

Attachment A
AGENDA – SSPC 140   27 January 2003

Time: 14:15 to 18:15 on Monday, January 27
Location: Parlor E (Palmer House, possibly on the 6th floor)
Chair: Ron Judkoff

Topics
1. Introductions and Roster Changes *[Judkoff]*
2. Acceptance of Previous Minutes *[Judkoff]*
3. Adjustments to Agenda *[Judkoff]*
4. Tax Credits and IECC Chp 4. Update *[Fairey, 10 minutes]*
5. Related Research Activities (updates and intentions regarding inclusion in Std 140)
6. HERS BESTEST *[Fairey, 2 minutes]*
7. RP-865 Air-Side HVAC Analytical Verification Tests *[Walton, 2 minutes]*
8. RP-1052 Envelope Analytical Verification Tests *[Rees, 2 minutes]*
9. Furnace Tests *[Beausoleil-Morrison, 5 minutes]*
10. IEA Task 22 Related Research Activities Updates (optional, if we may be short on time later)
11. RADTEST *[Judkoff/Neymark, 1 minute]*
12. New HVAC BESTEST cases *[Neymark 1 minute]*
13. Ground Coupling Tests *[Judkoff, 2 minutes]*
14. ETNA Empirical Tests *[Neymark, 2 minutes]*
15. ERS Empirical Tests *[Judkoff, 2 minutes]*
16. CEN Standards Related to Simulation Software *[Judkoff, 2 minutes]*
17. IEA New Task update *[Judkoff, 2 minutes]*
18. Standard 90.1 Software Compliance Criteria based on results using Std 140 *[Neymark, 10 minutes]*
19. Discussion of Comments regarding revisions to Std 140 to incorporate HVAC BESTEST *[Judkoff/Neymark, 1 – 2 hours]*
20. Recommendation for revisions to Std 140 to be approved by SPLS to enter public review (if all comments in item 8 are resolved) *[Judkoff, 15 minutes]*
21. Revisions to Std 140 to incorporate HERS BESTEST *[Fairey, ? minutes]*

New business, if any *[Judkoff]*
Adjourn *[Judkoff]*

Attachment B – Minutes of SSPC 140 Compliance SubC
MINUTES
Conference Call, January 10, 2003 8:30A – 10:30A MST

CORRESPONDANCE SINCE LAST MEETING
Various email correspondence regarding development of pass/fail ranges. See Neymark for email record.

AGENDA
Objectives:
- Finalize software compliance requirements proposed to be added to 90.1 ECB chapter
- Indicate informal consensus support for these new requirements

Discussion:
1. Agenda ok?
2. Give comments on proposed referencing language *[10 minutes]*
3. Table of range values
   - Ok for modified rule base: max + range*20%, min – range*20%; where range = (maximum program result) – (minimum program result); no absolute results < 0; no illogical sensitivities *[10 minutes]*
   - Ok to delete 910-610, 920-620, and 930-630? (900-600 seems enough)   *[10 minutes]*
   - Ok for inclusion of new E+ and 2.1E (395-430, 800) results (new BLAST [395-430, 800] results have only minor effect on ranges)? See ResultsChanges010803.doc *[10 minutes]*
   - Ok with resolutions of ranges spanning 0 (opposite sensitivities)? (in general spanning 0 is allowed for small values unless there is very clear reason not to allow it, in many cases the software results span 0 for small sensitivities, analysis of each opposite sensitivity range is included with A5c of PassingRanges011003.doc, pp. 5-6) *[10 minutes]*
4. Informal vote of acceptance now (with minor mods), or email ballot next week? *[10 minutes]*
5. Comments regarding possible responses to possible concerns of 90.1 ECB SubC or full 90.1 *[20 minutes]*
6. Other individual comments (around the table) *[10 minutes]*
7. Next Steps
8. Adjourn

ATTENDEES

Fairey,Glazer,Judkoff,Neymark,Rees,Witte

COMMITTEE DISCUSSION

1. Comments regarding referencing language.

Comments resulted in the following language:

"11.2 Simulation General Requirements
11.2.1 Simulation Program

11.2.1.4 The simulation program shall be tested according to ANSI/ASHRAE
Standard 140, and the results of each test case shall be less than or equal to the maximum value and
greater than [or equal to] the minimum value shown for specific results listed in Table X."

In addition add to Section 12 "Normative References" the following entry "ANSI/ASHRAE Standard
140-2001 Standard Method of Test of the Evaluation of Building Energy Analysis Computer Programs."

Fairey also recommended we state the convention that for this purpose "absolute" heating and cooling loads
are represented by positive numbers (to clarify what to do if a software gives negative values for heating or
cooling loads).

2. Table of Range Values.

2A. Modified Rule Base   Ok for the modified rule base; see Fairey's comment in "1." regarding load value
convention.

2B. Delete 910-610, 920-620, and 930-630 Consensus is ok to delete these; 900-600 sensitivity does the
job.

2C Ok for inclusion of new E+ and 2.1E (395-430, 800) results
There was considerable discussion regaring inclusion of E+ and 2.1E results. Witte explained that there
were several iterations of E+ results where 2 or 3 bugs were corrected (and other cases where
BESTESTing resulted in correction of unintended errors caused by other modifications), and E+ also
went through the RP-1052 (analytical verification for "envelope") cases where a couple other things
were corrected. Regarding the 2.1E results, the quality of those input decks rests on the quality of the
2.1D input decks (originally completed during the IEA work) with some changes for the window
model. In going from 2.1D to 2.1E LBNL did use IEA BESTEST, but we do not know to what extent.

It was further noted that the EnergyPlus results only caused significant changes to 2 range values and
DOE-2.1E only caused significant change to 7 range values, out of 306 total values listed. We asked that
in the next month or so Witte provide a "one-pager" for both the E+ and DOE-2.1E results describing
what they did. We would keep these briefs on file "internally" as modeler reports (recall we have IEA
modeler reports of varying levels of detail for all other results).

It was also noted that expansion of just a few ranges would not have a large impact on the set of ranges
overall, and that details at this level are likely to be less significant to ECB SubC than: overall size of all
ranges in general, what to do if a program fails, etc. We briefly discussed that a table like this
may require maintenance over time.

**Straw poll consensus of those present is to include the new EnergyPlus and DOE-2.1E results for
developing the reference pass/fail ranges.**

2D.Ok with resolutions of ranges spanning 0
Committee agreed with resolutions noted in Attachment A, except Fairey requested that we check hour of
occurrence for peak heating loads in 940-640. If at night he's ok with 0; if any doubt then allow the 0
spanning. [further review indicates hour 7, 8, or 9 for this depending on the software … therefore allow the
spanning]

3. Informal Vote of Acceptance (Straw Poll)

This group is not authorized to propose changes to Standard 90.1, however Glazer desired an informal demonstration of consensus support for the changes. **A motion (Fairey) was made to informally approve: the language shown in Section 1 (above), and the results table included in Attachment A (below, "90.1 Standard 140 Compliance Range Summary using Max + Range*20%, Min – Range*20%)" with modifications including: deletion of 910-610, 920-620, and 930-630 sensitivity results, and possible allowance of zero spanning of the sensitivity result for 940-640 peak heating pending check of time of occurrence of peak [spanning allowed per 2d above], and deletion of color coding of the cells. This straw-poll motion in support of including this material into 90.1 passed unanimously.**

4. Comments regarding possible responses to possible concerns of 90.1 ECB SubC or full 90.1

The objective of this discussion was to focus on the main points to emphasize in future presentation materials. See Attachment A regarding reference numbering for this.

Q1 Do large ranges undermine confidence in the standard?.
Note that comparison with both absolute and sensitivity gives us higher confidence because we have a system of "checks and balances". I.e. looking at 600, 610 and 610-600 gives us better confidence that software is doing what is intended, versus if we only look at 2 of those 3 results.
- A1b. Emphasize that tests were designed to be difficult/robust in terms of testing building physics, and include forcing functions stronger than what would normally be found in typical buildings
- A1b. Emphasizing that we have no truth standard may not help our case
- A1b. Emphasize that advantage of wider ranges is that we are not limiting the state of the art, and more software should be able to pass

Requiring compliance with multiple ranges generally makes the test concept more robust (i.e. we do not have just a single wide range) … many "checks and balances"…

Q2 If point of simulation is to check energy use sensitivities, why worry about absolute results?. See Q1 re checks and balances.

Q3. Why the 20% range expansion Replace "truth standard" with "absolute criteria" [replace "absolute" with something else, "perfect criteria"?] Subdivide question to include 3A: *Why have any range expansion at all?*,
- A3a: Because different software choose to use different algorithms
- A3b: Because there aren't any well done empirical validation sets (perfect criteria) for this yet
- A3c: Allows for advancement of state of the art

Q4. Why have a table of ranges?
- A4a. Current results set gives clear guidance and requires developers to demonstrate the quality of their software.
- A4b. These ranges do uncover bugs [as proven in the IEA field trials]

Q5. More info on compliance ranges
- Create new question: *Why aren't all the Std 140 tests and outputs included?*
- Also note that the in-depth cases can still be used for further diagnostics.

- Emphasize that in the future 90.1 ECB and 140 will continue to work together to maintain compliance ranges

Q6. What if a program fails

Emphasize: If after all found errors are corrected a developer can isolate why their software is disagreeing with the compliance ranges and reasonably explain why their software should still pass, then 90.1 ECB SubC should consider including that software for developing a new set of reference results ranges. The ESP modeler report in old IEA BESTEST is a good example of how a developer has demonstrated reasonableness for disagreeing results. Places for a software developer to seek recourse are:

- address this early on during public review (or trial period)
- obtain an official ASHRAE interpretation
- propose that this table of ranges be placed under continuous maintenance with 90.1 ECB responsible and SSPC 140 assisting.

Q7. related to the ESP issue, see Q6

5. Other Comments: None

6. Next Steps

Jason and Neymark agreed to work on technical support materials for the presentation to ECB SubC that we will send around for comments next week for Compliance SubC short-turnaround review and comment. Rees agreed to assist with new graphs of ranges for this presentation.

Meeting Adjourned.

References

BSR/ASHRAE/IESNA Addendum *e* to ANSI/ASHRAE/IESNA Standard 90.1-2001, *Energy Standard for Buildings Except Low-Rise Residential Buildings.* ASHRAE, Atlanta, GA.

ANSI/ASHRAE Standard 140-2001, Method of Test for the Evaluation of Building Energy Analysis Computer Programs. ASHRAE, Atlanta, GA.