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: June 19, 2000

TC/TG/TRG TITLE: Energy Calculations

DATE OF MEETING: February 8, 2000 LOCATION: Dallas

MEMBERS PRESENT	YEAR APPTD	MEMBERS ABSENT	YEAR APPTD	EX-OFFICIO MEMBERS & ADDIT'L ATTENDANCE
Bill Bahnfleth	1998	Fred Winkelmann	1996	
Chip Barnaby	1999			
Dru Crawley (SEC)	1999			
Dan Fisher	1998			
Carol Gardner	1998			
Jeff Haberl	1999			
Moncef Krarti	1999			
Jean Lebrun (INTL)	1996			
Les Norford	1998			
Agami Reddy	1999			
Klaus Sommer (INTL)	1999			
Robert Sonderegger (CHM)	1999			
Jeff Spitler (VC)	1999			
George Walton	1996			
Michael Witte	1998			

DISTRIBUTION

ALL MEMBERS OF THE TC/TG/TRG

TAC CHAIR	Dennis O'Neal
TAC SECTION HEAD	Byron Jones
SPECIAL PUBLICATIONS LIAISON	Ramon Pons
STANDARDS LIAISON	David Knebel
JOURNAL/INSIGHTS LIAISON	Steve Taylor
HANDBOOK LIAISON	David Claridge
PROGRAM LIAISON	Emil Friberg
REFRIGERATION LIAISON	Hugh Crowther
RAC RESEARCH LIAISON	Carl Speich
TEGA LIAISON	William Knight
EDUCATION LIAISON	Donald Colliver
ENV HEALTH COMMITTEE LIAISON	William Fisk
STAFF LIAISON (RESEARCH)	William Seaton
STAFF LIAISON (TECH SERVICES)	Martin Weiland
STAFF LIAISON (STANDARDS)	Claire Ramspeck

ASHRAE TC 4.7 Energy Calculations
DALLAS MEETING
ACTION ITEMS

1. **No-cost time extension to March 31, 2001 for 1093-RP. Approved 12-0-1, chair not voting.**

2. **No-cost time extension to March 31, 2001 for 865-RP. Approved 11-0-2, chair not voting, contractor abstaining.**

3. **No-cost time extension to March 1, 2001 for 1052-RP. Approved 10-0-3, chair not voting, 2 contractors abstaining.**

4. **WS Updated Energy Models for Residential HVAC Equipment, Approved 10-0-2, chair not voting, 1 abstention.**

5. **WS Development of Detailed Descriptions of HVAC Systems (Templates) for Simulation Programs, approved 11-0-1, chair not voting.**

6. **Program plan approved, 11-0-1, chair not voting.**

7. **1163-TRP, contractor recommended, approved 11-0-1, chair not voting.**

ASHRAE TC/TG/TRG ACTIVITIES SHEET

DATE: June 19, 2000

TC/TG/TRG NO.: TC 4.7 **TC/TG/TRG TITLE: Energy Calculations**

CHAIRMAN Robert Sonderegger **VICE CHAIRMAN Jeff Spitler** SECRETARY **Dru Crawley**

TC/TG/TRG MEETING SCHEDULE

LOCATION - past 12 months	**DATE**	**LOCATION - planned next 12 months**	**DATE**
Dallas	2/28/2000	Minneapolis	6/27/2000
Seattle	6/22/1999	Atlanta	1/30/2001

TC/TG/TRG SUBCOMMITTEES

Function	**Chair**
Simulation and Component Models Applications Inverse Methods	Dan Fisher Joe Huang Jeff Haberl

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

LONG RANGE RESEARCH PLAN

Rank	Title	W/S Written	Approv	To R & T
1.	See attachment 12.			
2.				
3.				
4.				

HANDBOOK RESPONSIBILITIES

Year & Volume	Chapter Title	**No.**	Deadline	**Handbook Subcom. Chair/Liaison**
2001 Fundamentals	Energy Estimating Methods	30	February 2000 Dallas	Norford/Claridge

STANDARDS ACTIVITIES - List and Describe Subjects

SPC 140P Standard Method of Test for Building Energy Software - Ron Judkoff

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

Appendix 2

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

Appendix 3

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

Appendix 4

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

Characterizing the Performance of Central Plants for Multi-Building Campuses, Chicago (1/99)
Who Needs Moisture Calculations in Building Energy Simulations? What Do You Need?, Toronto (6/98)
How should ASHRAE Computer Models be Expressed? Boston (6/97)

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

Additional Attendance*

Present at TC 4.7 Meeting?				Last Name	First Name	E-Mail
Dallas February 2000	Seattle June 1999	Chicago January 1999	Toronto June 1998			
X	X			Abushakra	Bass	b0a7654@unix.tamu.edu
X				Addison	Marlin	Marlin.Addison@doe2.com
		X		Ayres	J. Marx	JMAyres@gte.net
X	X	X	X	Bahnfleth	Bill	WPB5@psu.edu
X	X	X	X	Barnaby	Chip	CBarnaby@wrightsoft.com
	X	X	X	Beausoleil-Morrison	Ian	IBeausol@nrcan.gc.ca
	X	X	X	Black	Al	ABlack@mcclureng.com
	X			Blair	Nathan	Blair@tess-inc.com
X	X	X	X	Brandemuehl	Mike	Michael.Brandemuehl@colorado.edu
X	X	X	X	Buhl	Fred	WFBuhl@lbl.gov
	X			Callan	David	Callan@drexel.edu
	X			Carpenter	Allen	ACarpenter@nrcan.gc.ca
X		X		Claridge	David	Claridge@esl.tamu.edu
		X		Clark	Dan	Dan.Clark@carrier.utc.com
X	X	X	X	Crawley	Dru	Drury.Crawley@ee.doe.gov
X			X	Degelman	Larry	Larry@archone.tamu.edu
	X			Desjarlais	Andre	yt7@ornl.gov
X				Eldridge	David	eldridd@okstate.edu
X	X	X	X	Fisher	Dan	DFisher@okstate.edu
	X			Flake	Barrett	Barrett.Flake@afit.af.mil
	X			Fraser	Kathleen	KFraser@transalta.com
X	X		X	Gardner	Carol	GEMS@teleport.com
X				Gu	Lixing	Gu@fsec.ucf.edu
X	X		X	Haberl	Jeff	JHaberl@esl.tamu.edu
		X		Haddad	Kamel	KHhaddad@nrcan.gc.ca
X				Hanby	Victor	V.I.Hanby@lboro.ac.uk
X	X	X	X	Haves	Philip	PHaves@lbl.gov
	X	X	X	Hensen	Jan	JaHe@fago.bwk.tue.nl
X				Henze	Gregor	henze@mit.edu
	X			Holmes	Michael	Michael.Holmes@arup.com
X		X	X	Huang	Joe	YJHuang@lbl.gov
		X		Hydeman	Mark	MHydeman@taylor-engineering.com
		X	X	Judkoff	Ron	Ron_Judkoff@nrel.gov
X	X	X	X	Katipamula	Srinivas	S_Katipamula@pnl.gov
	X			Kissock	Kelly	Jkissock@engr.udayton.edu
X	X	X	X	Knappmiller	Kevin	KevinK@kevtec.com
	X	X		Knebel	Dave	DKnebel@mammoth-inc.com
X				Kosny	Jan	kyo@ornl.gov
X	X		X	Krarti	Moncef	Krarti@bechtel.colorado.edu
X	X	X		Kreider	Jan	Kreider@bechtel.colorado.edu
X				Lamberts	Roberto	Lamberts@ecv.ufsc.br
		X		Lawrie	Linda	L.Lawrie@computer.org
X	X	X		Leber	Jon	jahbata@aol.com

Present at TC 4.7 Meeting?				**Last Name**	**First Name**	**E-Mail**
Dallas February 2000	Seattle June 1999	Chicago January 1999	Toronto June 1998			
X	X			Lebrun	Jean	J.LeBrun@ulg.ac.be
	X			Levermore	Geoff	Geoff.Levermore@umist.ac.uk
		X		Liesen	Richard	R-Liesen@uiuc.edu
X				Loomans	Marcel	M.Loomans@bouw.tue.nl
X	X	X	X	McDowell	Tim	Mcdowell@tess-inc.com
	X			McGowan	Alex	Alex@enermodal.com
	X	X		Medina	Mario	MMedina@ukans.edu
X	X	X		Morner	Svein	SMorner@dorganai.com
X				Mottillo	Maria	Mmottilo@nrcan.gc.ca
X	X	X	X	Neymark	Joel	NeymarkJ@sni.net
X	X	X		Norford	Les	LNorford@mit.edu
X	X	X	X	Pedersen	Curt	CPederse@uiuc.edu
	X			Purdy	Julia	JPurdy@nrcan.gc.ca
X	X	X	X	Reddy	T. Agami	ReddyTA@drexel.edu
X	X	X	X	Rees	Simon	SJRees@okstate.edu
X				Rittelmann	Bill	Brittelmann@ibacos.com
X				Rock	Brian	barock@ukans.edu
		X		Selkowitz	Steve	SESelkowitz@lbl.gov
X	X	X	X	Smith	Vernon	VSmith@archenergy.com
	X			Somasundaram	Sriram	Sriram.Somasundaram@pnl.gov
X	X	X		Sommer	Klaus	Klaus.Sommer@vt.fh-koeln.de
X	X	X	X	Sonderegger	Robert	RCS@src-systems.com
X			X	Sowell	Ed	Sowell@fullerton.edu
X		X	X	Spitler	Jeffrey	Spitler@okstate.edu
X	X	X		Strand	Rick	R-Strand@uiuc.edu
			X	v Heerden	Eugene	VHeerden@eng.up.ac.za
X	X	X	X	Walton	George	GWalton@nist.gov
	X			Wetter	Michael	MWetter@lbl.gov
X	X	X	X	Willson	Jim	jimwill@indy.net
	X	X	X	Winkelmann	Fred	FCWinkelmann@lbl.gov
X	X	X	X	Witte	Mike	MJWitte@gard.com
X	X	X	X	Wray	Craig	CPWray@lbl.gov
	X	X	X	Wright	Jonathan	J.A.Wright@lboro.ac.uk
X	X	X	X	Yuill	Gren	Yuill@unomaha.edu

*** In order to preserve the e-mail addresses for all attendees, this is a complete list of attendees at this and the prior three meetings. It includes the voting members of the committee listed on the first page. An X in the "Present this meeting?" column indicates presence at this meeting.**

Appendix 1
Current Research Projects

#	Title	Joint TC	Cognizant subcom / Contractor	PMS	Dates / status
865-RP	Accuracy tests for Mechanical System Simulation		Sim/Comp Penn/TAMU Gren Yuill	George Walton (chair), Ron Judkoff, Robert Sonderegger, Dave Knebel	Rec: 2-20-96 (San Antonio) NCE: until 2-28-98 (7-1-97) NCE: until 8-31-98 (1-20-98) NCE: until 3-31-99 (6-23-98) NCE: until 3-31-00 (1-27-99) NCE: until 3-31-01 (2-8-00)
987-RP	Preparation of a Toolkit for Building Load Calculations	4.1	Sim/Comp Univ. of Illinois Curt Pedersen	Dru Crawley (chair), Chip Barnaby, George Walton, Dave Knebel; Tom Romine (TC 4.1)	Rec: 1-28-97 (Phil) End: 12-31-99 NCE until 7-31-00 (6-22-99)
1049-RP	Building System Synthesis and Design	1.5	Sim/Comp Loughborough University	Curt Pedersen (chair), Ed Sowell, Dave Knebel, Ron Nelson (TC 1.5), Mike Brandemuehl (TC 4.6), Jan Hensen	WS: 1-20-98 (SF) Rejected all proposals: 6-23-98 (Toronto) Rec: 6-22-99 (Seattle) End:
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) End:
1052-RP	Development of an Analytical Verification Test Suite for Whole Building Energy Simulation Programs – Building Fabric		Sim/Comp OSU Jeff Spitler	George Walton (chair), Ron Judkoff, Joel Neymark, Fred Winkelmann	WS: 7-1-97 (Boston) Rec: 6-23-98 (Toronto) Start: 1-1-99 NCE: until 3-1-01 (2-8-00)
1093-RP	Compilation of Diversity Factors and Schedules for Energy and Cooling Load Calculations	4.1	App TAMU (TEES) Jeff Haberl	Agami Reddy (chair), Bill Bahnfleth, Joe Huang, Suzanne LeVisuer (TC 4.1)	WS: 1-20-98 (SF) Start: 2-1-99 NCE: until 3-31-2001 (2-8-00)
1145-RP	Modeling Two- and Three-Dimensional Heat Transfer Through Composite Wall and Roof Assemblies in Hourly Simulation Programs		Sim/Comp Enermodal Engineering Ltd	Ian Beausoleil-Morrison (chair); George Walton; Fred Winkelmann, Doug Hittle (TC 4.1)	Approved in Toronto (6-23-98) Rec: 6-22-99 (Seattle) End:
1163-TRP	Standard Operating Conditions for North American Residential Buildings		Danny Parker, Joe Huang, Fred Buhl	Craig Wray (chair), Joel Neymark, and Vernon Smith	WS: 6-22-99 (Seattle)

Appendix 2

TECHNICAL PAPERS FROM SPONSORED RESEARCH

June 1997

664-RP Fisher, D.E., C.O. Pedersen. 1997. Convective Heat Transfer in Building Energy and Thermal Load Calculations. ASHRAE Transactions V 103 n 2.

Appendix 3

TC/TG/TRG SPONSORED SYMPOSIA

PLANNED:

Atlantic City, June 2001

Interoperability and Tool Portability (Sim. Comp./Chip Barnaby)
Inverse Method Toolkit and Applications (Inverse/Jan Kreider)

Cincinnati, June 2001

The Stories that Utility Records Tell Us about Energy Performance in Commercial Buildings
(TC 9.6 and 4.7/Chair Taghi Alereza)
Recent Innovations in HVAC System Modeling (Applications/Chair: Tim McDowell)

Atlanta, January 2001

Tools and Techniques for Calibration of Component Models (TC1.5 co-sponsor/Chair: Agami Reddy)
Simulation Models for Low-Energy Cooling (Simulation & Component/Chair: Joe Huang)
Better Inputs for Better Output (Applications, TC 9.6 co-sponsor/Chair: Jim Willson)

Minneapolis – June 2000

International Experience with Weather Data for Simulation and Design (Chair, Dru Crawley, TC 4.2 Co-sponsor)

PAST:

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)

Chicago - January 1999

Application of Heat Balance Methods to Energy and Thermal Load Calculation (Chair, Chip Barnaby)

Toronto - June 1998

Baseline Calculations for Measurement and Verification of Energy and Demand Savings (Chair, Robert Sonderegger)

Boston - June 1997

Symposium- *Field Methods for Analyzing Equipment, Building and Facility Energy Use* (Chair, Agami Reddy, co-sponsor TC 9.6)

Appendix 4

TC/TG/TRG SPONSORED SEMINARS

PLANNED:

Atlanta - January 2001

Low Energy Cooling Case Studies chaired by Phil Haves

Commercial Use of Building Energy Simulations (Applications/Hofu Wu)

Inverse Regression Methods for Optimizing Simulations (Inverse/Marlin Addison)

PRESENT:

Dallas - January 2000

ASHRAE's Software Toolkits for Energy Calculations chaired by Dru Crawley

PAST:

Chicago - January 1999

Simulation Tool Interoperability and Component Model Portability chaired by Phil Haves

Toronto - June 1998

Neural Nets: What Are They and What Can They Do? chaired by Moncef Krarti

Boston - June 1997

Practical Applications of Energy Calculations chaired by Chip Barnaby

ASHRAE TC 4.7 Energy Calculations
Meeting Minutes

Dallas, Texas
February 8, 2000

1. Chair Sonderegger called the meeting to order at 6:08 PM. The following members were present: Bill Bahnfleth, Chip Barnaby, Dru Crawley, Dan Fisher, Carol Gardner, Jeff Haberl, Moncef Krarti, Jean Lebrun, Les Norford, Agami Reddy, Klaus Sommer, Robert Sonderegger, Jeff Spitler, George Walton, Fred Winkelmann, and Michael Witte.

2. Chair Sonderegger introduced RAC liaison Carl Speich. Mr. Speich reminded the TC that 1051-WS was to be acted on at next meeting and the TC needed to recommend a contractor for 1163-TRP. The new Section 4 head, Byron Jones, was also introduced.

3. Barnaby moved/Walton seconded to accept proposed **agenda** and approve **minutes of Seattle meeting** as amended. Approved by unanimous voice vote. The Agenda is shown as attachment 1.

4. **Announcements.**
   - Information about the International Institute of Refrigeration (IIR) was circulated to the TC. IIR covers high to low temperature applications.
   - Journal/Insights looking for more contributions from TCs. TC corner being renamed 'TC News'. Sonderegger looking for volunteer—Spitler volunteered to write newsy paragraphs for the TC News.
   - The Environmental Health Committee is looking to coordinate with TCs on research topics relating to EH. Contact EHC Chairman Bill Fisk with topic ideas.
   - Research funds for ASHRAE research not as copious as previous years—reaching a plateau. Work Statement (WS) quality and justification are now more critical than before. WS must correspond to the TC priorities in their Research plan.
   - Symposium chairs cannot also make a presentation (or even a co-author). Seminar chairs can make presentations.
   - Discussion of selection of RP contractors now must be done in executive session only (voting members only)—corresponding members, guests, and proposers must leave. Item 5.4 (1163-TRP) moved to the end of the meeting.

5. **Membership.** Sonderegger reported the changes in the membership roster. Winkelmann and Walton will roll off the TC after the June meeting. Due to problems, Neymark and Willson were not added to the roster for 1999-2000. They and Vern Smith and Craig Wray will join as members after the June meeting. Norford will become secretary, Crawley vice chair, and Spitler chair.

6. **Applications Subcommittee.** Huang reported on the Applications subcommittee which met Monday evening 7:30-9:00 pm. Minutes of the subcommittee meeting are shown as attachment 2.

7. **1093-RP Diversity Factors and Schedules for Energy and Loads.** Reddy reported on the meeting of the project monitoring subcommittee (PMS) for 1093-RP with the contractor, Texas A&M University. Contractor has requested and the PMS recommended a 1-year, no-cost time extension to March 31, 2001. Reddy moved /Norford seconded to grant a no-cost time extension as requested, approved 12-0-1 (chair not voting (CNV)). Minutes of the 1093-RP PMS meeting are shown as attachment 3.

8. **Inverse Methods**. Haberl reported on the activities of the Inverse Methods Subcommittee, which met on 3:30-5:00 PM on Tuesday. Minutes of the Subcommittee meeting are shown as attachment 4.

9. **865-RP Accuracy Tests for Mechanical System Simulation.** Walton reported on the 865-RP PMS meeting with the contractor, Pennsylvania State University/Texas A&M University, which was held 1:15 PM on Monday. The contractor has requested and the PMS is recommending a no cost time extension to March 31, 2001. Walton moved/Reddy seconded to grant a no-cost time extension as requested, approved 11-0-2 (CNV, contractor not voting). Minutes of the 865-RP PMS meeting are shown as attachment 5.

10. **1050-RP Inverse Toolkit**. Kreider reported on the meeting of the 1050-RP PMS with the contractor, University of Dayton. The project is on schedule for completion of end of June 2000. Minutes of the 1050-RP PMS meeting are shown as attachment 6.

11. **Simulation and Component Models Subcommittee**. Fisher reported on the meeting of the Simulation and Component Models Subcommittee, which met Monday evening at 6:00 PM. Several Work Statements (WS) are in progress—will be discussed under Research. Minutes of the Simulation and Component Models Subcommittee Meeting are shown as attachment 7.

12. **987-RP Loads Toolkit**. Crawley reported on the meeting of the 987-RP PMS with the contractor, University of Illinois. The PMS and the contractor worked out a plan to complete the work so that the final product could be reviewed and approved at the June meeting. Minutes of the 987-RP PMS Meeting are shown as attachment 8.

13. **1145-RP Modeling 2&3-D Heat Transfer Through Composite.** Chairman Beausoleil-Morrison was absent, Walton reported on the PMS meeting with the contractor, Enermodal. The project is just under way and is on schedule. The PMS and the contractor had discussed whether the work should be 'surface to surface'. The TC agreed. The minutes of the 1145-RP PMS meeting are shown as attachment 9.

14. **1049-RP Building System Design Synthesis Update** Pedersen reported on the meeting of the 1049-RP PMS with the contractor, Loughborough University. Project has just begun; PMS approved use of IDA for the project. The minutes of the 1049-RP PMS meeting are shown in attachment 10.

15. **1052-RP Analytical Test Suite for Whole Building Energy Programs. W**alton reported on the meeting of the 1052-RP PMS with the contractor, OSU. Although the project is progressing well, the contractor has requesting and the PMS recommends a no-cost time extension through 1 March 2001. Walton moved/Norford seconded that the TC approve a no-cost time extension as requested, approved 10-0-3 (CNV, 2 contractors not voting). The minutes of the 1052-RP PMS meeting are shown as attachment 11.

16. **Research**. Barnaby reported on research activities—received a semiannual report from ASHRAE. Included summary of research projects and funding for the last decade. TC 4.7 tied for most projects (14); top funding – >$1 million. From the TC 4.7 Research plan, the Residential HVAC Equipment project is included on the ASHRAE prioritized list. The other two projects are not prioritized but included on the ASHRAE research list. A summary of the TC 4.7 research activities is shown in attachment 12.

17. **WS Updated Energy Calculation Models for Residential HVAC Equipment**. (draft work statement is attachment 13.) Barnaby reported that the subcommittee had discussed the WS in detail and made numerous corrections. Editorial changes proposed to add charge level/air flow rate across evaporator. Barnaby moved /Krarti seconded to recommend to the RAC that this WS be approved for bidding (with editorial corrections, generic treatment of other factors that influence as installed performance significantly). Approved 10-0-2 (CNV, Reddy abstained).

18. **WS Development of Detailed HVAC Templates.** (draft work statement is attachment 14.) The WS has been reviewed several times by the subcommittees and numerous changes incorporated. Crawley moved/Fisher seconded to recommend to the RAC that this WS be approved for bidding. Approved 11-0-1 (CNV).

19. **Handbook.** Norford reported on the handbook subcommittee meeting (minutes in attachment 15). Chapter is ready except for one section. Expect that the final chapter will be ready for approval (possibly by e-mail) before the Minneapolis meeting.

20. **Program**. Bahnfleth reported on the TC 4.7 program activities (see attachment 16). Seminar chaired by Crawley on the Toolkits. 150 attendees, well received, 'use and love the HVAC 2 Toolkit, looking forward to seeing the new HVAC 1 Toolkit, keep up the work' said one attendee. Double symposium on using weather data planned for Minneapolis. Three seminars and three symposiums proposed for Atlanta. Proposed program plan and TC priorities for Atlanta: 1 Tools/Techniques, 2 Simulation Models, 3 Low Energy Case, 4/5 two new seminars, 6 Better Input. Bahnfleth moved /Barnaby seconded to accept program plan as presented. Approved, 11-0-1 (CNV). Bahnfleth moved /Barnaby seconded to accept proposed program plan for Cincinnati/Atlantic City. Approved, 11-0-1 (CNV).

21. **SPC-140 Standard Method of Test for Building Simulation Computer Programs.** Neymark reported on SPC 140P activities. Last year the SPC voted to approve the draft 140P for public review, this meeting SPLS and Standards committee approved for public review. Minutes of SPC 140P are shown in attachment 17.

22. **Reports on related activities**
    - **IBPSA.** Pedersen reported on the IBPSA-USA software exposition held Saturday afternoon with a dinner meeting that evening. The expo and dinner were well attended. Vic Hanby was the dinner speaker. The Building Simulation 2001 conference will be held in Rio de Janeiro, Brazil in August. Roberto Lamberts of FUSC is the chair of the conference. Web page and call for papers to come soon. Abstract due September 15. Call for papers will be distributed on the TC 4.7 mail listserve.
    - **GPC 14P Measurement of Energy and Demand Savings.** Reddy reported on GPC 14P—draft going out for public review soon. Plan a seminar in Minneapolis.
    - **IAI International Alliance for Interoperability.** Crawley reported that the IAI is moving forward to extend their Industry Foundation Classes (IFC) to include HVAC and other building equipment—probably in version 2.X.
    - **SPC 152P MOT Design & Seasonal Efficiencies of Residential Thermal Distribution Systems.** Walton reported that this standard is probably outside the scope of this TC (no report required in future).
    - **TC 4.1 Load Calculations**. Barnaby reported on load calculations activities. TC 4.1 plans to use a test office building to demonstrate the new load calculation heat balance method. Under 1117-RP, they are building test cells and collecting experimental data to validate the heat balance and RTS load calculations methods.
    - **TC 4.2 Weather Information**. Barnaby reported that TC 4.2 is developing IWEC, 200+ weather years for energy calculations around the world. 200 locations are not in the US or Canada. Possibly the CWEC (Canada) and TMY2 (US) could be wrapped together with the IWEC in a new CD-ROM product.
    - **TC 4.5 Fenestration**. Pedersen reported on TC 4.5—where much of the activity focuses on fenestration ratings not contribution of the windows to the energy and loads. Pedersen & Huang volunteered to keep the TC up to date on activities within TC 4.5.
    - **TC 4.6 Building Operation Dynamics**. Brandemuehl reported the 4.6 has written a WS on dynamic modeling of cooling coils (submitted to RAC), not focusing on energy calculations but should be of interest to TC 4.7.
    - **TC 4.11 Smart Building Systems**. Norford reported that 4.11 concentrating on communications between utilities and customers. 4.7's component level models and toolkits are useful to 4.11 to help them determine what is correct or faulty equipment performance.
    - **TC 9.6 Systems Energy Utilization**. Reddy reported on 9.6 activities including a short course—'First Look at Standard 90.1'—which will be ready for Minneapolis and a Professional Development Seminar on compliance with Standard 90.1 will be ready by Atlanta. Mark Hydeman is the contact. 9.6 research agenda includes trying to use energy performance standards

that ASHRAE has been developing (probably of interest to 4.7). Application subcommittee should be kept informed—Applications chair should keep good track of what 9.6 is doing (agenda item for Applications).

23. **Old Business.** No old business.

24. **New Business.** TC 4.3 is working on a WS on infiltration heat recovery and calculation methods. They also have an upcoming seminar on measuring leakage from ducts in residence. May be a need for our tools to simulate pressure in ducts.

25. **Executive Session**. At 8:30 PM, the TC went into Executive Session to discuss contractor selection for 1163-TRP Standard Operating Conditions in North American Buildings. Wray (chair, PES) presented the recommendations of the PES (Wray, Neymark, and Smith). After discussion of the proposals, the PES recommended a contractor to the TC. Spitler moved/Haberl seconded that the TC accept the recommendation of the PES and recommend selection of the contractor to RAC. Approved 11-0-1 votes (CNV).

TC 4.7 was adjourned at 8:45 PM.

ASHRAE TC 4.7 Energy Calculations

Agenda

Tuesday, February 8, 2000, 6:00-8:30 p.m.
Convention Center, Room Houston A (3rd floor)

1. Roll call and introductions		Crawley
2. Accept agenda & approve minutes of Toronto meeting		Sonderegger
3. Announcements		Sonderegger
4. Membership		Sonderegger
5. Subcommittee reports		
5.1 Applications		Huang
1093-RP Diversity Factors & Schedules for Egy & Loads	(TA&M)	Reddy
1049-RP Building System Design Synthesis update		Pedersen
5.2 Inverse Methods		Haberl
865-RP Accuracy Tests for Mech System Simulation	(Penn/TA&M)	Walton
1050-RP Inverse Toolkit	(U Dayton)	Kreider
5.3 Simulation & Component Models		Fisher
987-RP Loads Toolkit	(UoIll)	Crawley
1052-RP Analyt Test Suite Whole Bldg Egy Progs	(OSU)	Walton
1145-RP Modeling 2&3-D Ht Transfer Thru Composite	(Enermodal)	Beausoleil-Morrison
5.4 Research		Barnaby
1163-TRP Standard Operating Conditions in North American…		Wray
5.5 Handbook		Norford
5.6 Program		Bahnfleth
5.7 Standards (SPC-140 SMOT)		Judkoff/Neymark
6. Reports on related activities		
IBPSA		Pedersen
GPC 14P Measurement of Energy and Demand Savings		Sonderegger
IAI International Alliance for Interoperability		Crawley
SPC 152 MOT Design & Seasonal Eff'cies of Resid Thermal Distr Systems		Walton
TC 4.1 Load Calculations		Spitler
TC 4.2 Weather Information		Barnaby
TC 4.5 Fenestration		Volunteer
TC 4.6 Building Operation Dynamics		Brandemuehl
TC 4.11 Smart Building Systems		Norford
TC 9.6 Systems Energy Utilization		Reddy

7. Old Business
8. New business
9. Adjourn

Web Site and Mailing List

TC 4.7 Web Site: http://www.mae.okstate.edu/tc47/

TC 4.7 E-mail List: This list is to be used **only** for communications related to TC 4.7. Do not distribute messages of any commercial nature. To subscribe or unsubscribe to the list, you must send an e-mail command to the address:

MAIL-SERVER@GARD.COM

Leave the subject line blank (if your e-mail software requires a subject, you may use a space). To subscribe to the mailing list, the body of the message should include the following:

SUBSCRIBE TC47-L

To unsubscribe from the mailing list, include the following in the body of the message:

UNSUBSCRIBE TC47-L

To see a list of subscribers, include:

LIST TC47-L

For a list of all available commands, include:

HELP

To send a message to all subscribers to the list, address your message to:

TC47-L@GARD.COM

Note: ASHRAE staff is not involved in the operation of these lists. Please do not ask them for help. If you have any questions, please contact: Mike Witte mjwitte@gard.com 847-698-5685 FAX 847-698-5600

TC 4.7 Meeting Schedule

(excerpted from http://www.ashrae.org -- Search for TC 4.7)

TC 4.7 Sunday 9:00-10:00a Pearl 2 (H/2) – This room is up for grabs to anyone…
TC 4.7 1049-RP Sunday 10a-12:00p Pearl 2 (H/2)
TC 4.7 1050-RP Sunday 12:00-2:00p Pearl 2 (H/2)
TC 4.7 1145-RP Sunday 2:00-3:00p Pearl 2 (H/2)
TC 4.7 987-RP Sunday 5:00-6:00p Pearl 3 (H/2)

865-RP Accuracy Tests 1-2:15 Pearl 2 (H/2) – not on ASHRAE schedule!
1163-TRP Standard Operating Conditions… 7:00 pm Meet at HQ Hotel Registration Desk
SPC 140P Standard MOT Monday 2:15-4:30p Pearl 2 (H/2)
TC 4.7 1093-RP Monday 7:00-8:00a Pearl 3 (H/2)
TC 4.7 1052-RP Monday 4:30-5:30p Pearl 2 (H/2)
TC 4.7 Handbook Monday 5:00-6:00p San Antonio B (CC/3)
TC 4.7 Simulation & Component Models Monday 6:00-7:30p San Antonio B (CC/3)
TC 4.7 Applications Monday 7:30-9:00p San Antonio B (CC/3)

TC 4.7 Inverse Methods Tuesday 3:30-5:00p Houston A (CC/3)
TC 4.7 Energy Calculations (50)(OVH) Tuesday 6:00-8:30p Houston A (CC/3)

Editor's Note: Don't miss Sunday's Seminar 11 at 1 p.m., *First Time at an ASHRAE Meeting?*. Specifically the fourth presentation: The Fun Side of ASHRAE Meetings

MINUTES

TC 4.7 Subcommittee on Applications
Monday, 7 February, 7:30 - 9:00 p.m.
San Antonio B, Conference Center
February 7,2000, Dallas, TX

Chair: Joe Huang
Secretary: Jeff Haberl

AGENDA

1. **Introductions (5 minutes)**
2. **Accept agenda & approve minutes of Seattle meeting (5 minutes)**
3. **Announcements (5 minutes)**
4. **Program (10 minutes)**

   Dallas : Seminar on "ASHRAE Software Toolkits for Energy Calculations" (S&C/Crawley)

   Minneapolis : *Symposium on "Recent Innovations in HVAC System Modeling" (Appl/McDowell)*
   Symposium on "Tools and Techniques for Calibrating Component Models" (S&C/Reddy)

   Atlanta: *Symposium on "Better Inputs for Better Outputs" (Appl/Willson)*
   Symposia and Seminar on "Low Energy Cooling" (S&C/Huang, Haves)

5. **Research**

- **Ongoing Projects (5 minutes)**

  1093-RP Diversity Factors & Schedules for Energy and Loads (Reddy, PMC Chair)

- **New Projects (5 minutes)**

  1163-TRP Standard Operating Conditions in North American Residential Buildings

- **Work Statements (30 minutes)**

  "Development of standardized computer input files for describing typical residential homes and the most common energy conservation retrofits" (Haberl, Huang)

  "Development of representative detached single family house for North America" (Kosny fr. TC4.4)

  "Characterization of building thermal loads from chiller electric use data" (Reddy, Sonderegger)

  "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" (Reddy)

  "Development of ground coupling cases for the proposed ASHRAE SMOT 140" (Neymark, Beausoleil)

  "Defining performance factors for primary and secondary equipment simulation inputs for commercial buildings" (Nall et al.)

  "Compilation of input data for air flow models" (Walton)

- **Long Range Research Plan (10 minutes)**

6. Old Business (5 minutes)

7. New Business (5 minutes)

8. Adjourn

ATTENDANCE LIST

NAME:	*EMAIL:*
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The meeting was called to order by Joe Huang at 7:37 p.m

An attendance list was passed around for people to sign. Introductions were then made. Joe Huang then thanked Jeff Haberl for chairing the meeting and Kevin for typing the meeting. Minutes where moved and approved.

Discussion then moved on to Program.

The first program item for discussion was the Minneapolis Symposium "*Symposium on "Recent Innovations in HVAC System Modeling" (Tim McDowell).*

Tim discussed the progress with the Symposium and suggested that this be moved to Atlanta. Otherwise the Symposium was in pretty good shape.

ACTION: McDowell needs to complete the Symposium, get papers reviewed, etc.

The next item on the program was the Symposium "Better Inputs for Better Outputs" (Appl/Willson). Joe mentioned that this was in progress. Chair has received two papers and is looking for a third.

ACTION: Willson need to find another paper for this Symposium, find reviewers, etc.

Joe then asked for any additional program items. The committee offered none.

Robert Sonderegger then reminded the subcommittee that this subcommittee was under-represented by program at the ASHRAE meetings.

Jean Lebrun asked for further clarification on the Symposium "Better Inputs for Better Outputs". Did this mean better inputs for occupants, or better inputs for buildings & equipment?

Joe Huang said that he thought that this was for better inputs for energy savings calculations from simulations.

Joe Huang then mentioned that there has been a lot of discussion on the "bldg-sim" bulletin board about "what do we use simulation programs….what is the need".

One suggestion was that this type program is sometimes hard to promote…since it is not well represented within ASHRAE.

Joe mentioned that this was not to discuss the difference between different programs.

Claus Sommer said that this type of thing is very useful to make it clear why simulation tools are needed.

Haberl mentioned that there were several presentations at the Dallas meeting that were basically about uses of simulation in various applications.

Addison mentioned that often the people that we need to do these presentations are not always interested in coming to an ASHRAE meeting to give presentations.

Wray mentioned that there were some surveys done by NRC Canada about what simulation programs are being used for. Also, some surveys may have been done for ENERPLUS.

Haberl mentioned that perhaps someone might query the TC 4.7 mailing list and see what members are doing with simulations.

Addison also mentioned that Prof. Donn at Wellington did a survey (maybe this was previously mentioned) and that perhaps there is more that can be gleaned from this survey.

Lebrun mentioned that an IEA project has been recently been completed concerning this project. The survey asked how simulation is used for all stages of the design project. Ove Arup was involved in this project.

Haberl suggested using a Building Energy User's News survey…and posting the results.

Haberl also suggested contacting people at TRACE (Mick Schwedler) and HAP (Jim Pegues).

ACTION: Addison will develop a Seminar entitled something like "Commercial use of Simulation Programs".

Lebrun said that he thought that this would certainly get participation from the IEA authors.

Conversations then moved on to research. Joe mentioned that he was merely reading the minutes from Seattle and asked the subcommittee to fill-in as needed.

Discussion first started to with Ongoing Projects.

"1093-RP Diversity Factors & Schedules for Energy and Loads (Reddy, PMS Chair)". Joe Huang said that a progress report was received from the contractor in December. A conference call followed. Comments were made and responded to by the contractor at the meeting Monday morning.

Questions were then raised about the progress. One question concerned whether there was any occupancy data. Another question concerned whether contractor was going to develop the heat gains from the lights.

Haberl mentioned that this was probably beyond the scope of the project.

Sommer asked whether or not the project was going to look at standards for lighting levels, and or how this related to the input for the program.

Barnaby said that here would at least be 50 different standards in the U.S.

Huang then moved on to the discussion of new projects starting with "1163-TRP Standard Operating Conditions in North American Residential Buildings "

Wray reported that the PES met and have come to a decision regarding contractor selection and that this would be discussed at the TC 4.7 Executive session.

Discussion then moved on to new work statements. Huang then asked the subcommittee to read the work statements.

First WS is "Development of standardized computer input files for describing typical residential homes and the most common energy conservation retrofits" (Haberl, Huang)

Second WS is "Development of representative detached single family house for North America" (Kosny From TC4.4). Basically to develop a new house for distribution with ENERPLUS.

Discussion then moved on to "Development of standardized computer input files for describing typical residential homes and the most common energy conservation retrofits" (Haberl, Huang)

Haberl discussed the WS.

Wray asked how this varied from information available on the LBNL web site.

Sonderegger thought that this would not fly through ASHRAE…telling them that industry is doing this wrong and ASHRAE needs to do this right.

Sonderegger said that this needed to use only one platform…not two. What particular needs for a specific state, etc.

Huang expressed some concerns. He thought that modeling was still an art form and that this work statement was not addressing this.

Haberl commented on his experience with contacting several banks in his local area.

Haves mentioned that there was language in this WS about a public/private partnership…and that ASHRAE was probably not interested in such a WS.

Haberl responded that perhaps this WS should be reduced to just producing templates for residences.

Wray said that maybe these templates should have a sensitivity analysis performed to determine which variables are the most important.

Sonderegger agreed that the templates were interesting.

Barnaby said that this would need to identify the house shapes for North America, etc.

Huang said that this was similar to the next WS about "what are the parameters". However, he thought that this was a very different project.

Barnaby said that this did not have to be DOE-2 or BLAST…just determine the meaningful independent variables…and how they map into a meaningful, reduced-knob template.

ACTION: It was suggested that Haberl will work with Evan Mills at LBNL to revise this WS given the comments that have been gathered at this subcommittee.

Discussion then went on to Second WS is "Development of representative detached single family house for North America" (Kosny From TC4.4). Basically to develop a new house for distribution with ENERPLUS.

One comment was that this was needed better justification.

ACTION: Huang will forward comments to Kosny and ask him to revise for Minn.

Discussion then went on to "Development of ground coupling cases for the proposed ASHRAE SMOT 140" (Neymark, Beausoleil)

Neymark said that he did not have any progress to report for this WS.

Discussion then went on to "Characterization of building thermal loads from chiller electric use data" (Reddy, Sonderegger).

Sonderegger said that there had been no progress on this WS. Some discussions had been made since the last meeting but this seems to have fell between the cracks.

Huang has talked with Reddy about this WS and the next WS and Reddy said that he would like to have additional input.

Sonderegger then reviewed the discussion that had taken place at Seattle.

ACTION: Sonderegger will take a look at the WS and pass to Haberl for review and have this back for comment at Minn.

"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" (Reddy)

Huang discussed the one pager that he had from Agami.

ACTION: Addison agreed to take the one pager and create a WS for discussion at Minn.

"Defining performance factors for primary and secondary equipment simulation inputs for commercial buildings" (Nall et al.)

Lebrun said that he was one of the people that had agreed to push this one pager ahead, and that he was willing to move this forward.

ACTION: Lebrun said that he would move this forward into a WS.

There was not old business, no new business.

A motion was then made to adjourn.

Report by PMS on Progress of ASHRAE 1093-RP

Compilation of Diversity Factors and Schedules for Energy and Cooling Load Calculations

(February 7, 2000)

The PMS and the contractors (Jeff Haberl, David Claridge and Bass Abushakra) met at 7:00 am in room Pearl 3) to review progress.

The contractors had previously (December 1999) mailed to the PMS their Phase II report that was a comprehensive document of about 110 pages. The contents of the report were discussed during a conference call between the PMS and the contractors on January 14, 2000, the minutes of which are included as an attachment. There were essentially 12 concerns and issues raised during the conference call, which the contractors were requested to think about and follow up for the Dallas review meeting. The contractors came fully prepared, and submitted a written document addressing each of these issues point by point. Though there were a number of technical issues and alternatives discussed which the contractors will evaluate over the next few months, the overall agreement was that the performance of the contractors was satisfactory.

Key milestones/activities:

1) The project is officially due to end in March 2000. The contractors requested a no-cost one-year extension.
2) The contractors will, over the next 2 months, send the results of their analysis applied to a few sites in the form of a report to the PMS for approval prior to extending their analysis to the entire data set of about 30 buildings. This will be followed up by a conference call for the PMS to provide feedback.
3) The contractors propose to have a draft final report for the June meeting.

Minutes of ASHRAE 1093-RP Conference call

Friday, January 14, 2000

Jeff Haberl, Bass Abushakra, Agami Reddy (PMSC Chair), Bill Bahnfleth, and Joe Huang participated in the call.

1. Reddy raised the question of whether monitored "Lighting" and Equipment" loads exist separately, as this might be a need in the forward simulation programs, to provide diversity factors for lighting and equipment in separate profiles.

   Our response was that most of the data that we have at ESL constitute "lighting and receptacle" aggregate. Most buildings that we acquire from LBNL have separate lighting and receptacles.

2. **Action Item**:
   Reddy, also, asked if we are going to aggregate the results from all buildings into a typical profile, representative of a certain category (small office, large office, etc.), instead of providing a library of individual profiles from individual buildings.

   Our response was that we can provide, in addition to the library of individual buildings, an aggregate profile built up for different categories by normalizing the individual profiles (0 to 1) and adding them up and dividing by the total number of buildings, or by multiplying each of them by the correspondent square footage and dividing by the total square footage of all buildings.

3. Huang raised the question of having information on the efficiency and the type of the lighting, in order not to mix buildings that have different type of lighting together. He noted that the type and efficiency of lighting in a building is much important than the age of the building.

4. **Action Item**:
   Reddy, asked to see, in the next 3 weeks before the ASHRAE meeting in Dallas, some work done on approximately 6 buildings, as of how our proposed method will work; one building can be done "from A to Z", if possible.

5. Reddy wanted to assure that all steps in the proposed method are really needed. He asked why we did not opt for a much simpler method; for instance, why not separate the data in different seasons.

6. Reddy asked why we need the "Mean" and the "Maximum" in doing the calculations.
   We responded that this is required to distinguish between a profile needed for energy calculations and one that is required for a "design day"; a profile that is required to size the HVAC equipment.

7. Reddy asked if we have some "small retail" commercial buildings in the ESL database, and that it is of great value to include this category of buildings in the analysis.

   We responded that we do not have such buildings in the ESL database. We actually acquired a retail facility (Evergreen Plaza, 21,100 ft^2, from LBNL) that we can include in the analysis.

8. Bahnfleth noted that the report was somehow difficult to read.

9. Huang noted that describing the methods with the flow charts was difficult to follow as some features in the flow charts are not included in our proposed method. Also, the description of other method confuses the reader.
   We responded first that "other methods" we included in an appendix in order not to confuse the reader, and focus on the methods that can be used in our analysis. Second, we extracted features from some existing methods, and show these features in the flow charts. The original work referred to in the flow charts include more features (as in the case of Thamilseran and Haberl 1994) that is not required in the analysis and therefore was not shown in the flow charts.

10. **Action Item**:
    Reddy noted that the typical load shapes from the literature that we showed in the report have a great value and should be included in the final report.

    We responded that we will try to digitize these load shapes and include them in a tabulated format as well to make them usable.

11. **Action Item**:
    As a conclusion to the conference call, the following points were emphasized, and the PMSC asked that we provide a few pages report to bring to Dallas that will address:
    - Why did we propose our method (which is somehow sophisticated) instead of a much simpler tool
    - Show how our method works for one or more buildings (ESL: Medium, Large; LBNL: Medium, Large)
    - Show that there exists a variability from one building to another in the same category, which supports providing individual buildings profiles instead of a representative typical profile for the category.
    - Provide a sample "template" of our final product (how the results will look like).
      We responded that we will show a template that might be 4 pages long:
      - Page 1 will have the title and information about the building(s)
      - Page 2 will show the typical load shapes (weekend, weekdays, holidays)
      - Page 3 will include the diversity factors in a tabulated format with the corresponding statistics
      - Page 4 will include the schedules that can be ready to use in DOE-2 and BLAST.

12. Finally, Reddy reminded everybody that the PMS will meet with us in the ASHRAE meeting in Dallas, on Monday February 7th, at 7:00 am, and we will have a discussion.

MINUTES
TC 4.7 SUBCOMMITTEE ON INVERSE METHODS

Tuesday, February 8th, 2000, 3:30 to 5:00 p.m.
Majestic 7 (H/27), Dallas, Texas

Chair: Jeff Haberl
Secretary: Ron Nelson, Joe Huang

AGENDA

1. Introductions (all)

2. Discussion of the minutes from the Seattle meeting, June 1999 (all)

3. Program (all)
- June 2000 meeting (Minn.).
- Jan 2001 meeting (Orlando).
  Seminar: Inverse Regression for Simulation (Marlin Addison)
- June 2001 meeting (Cincinnati)
  Symposium: Inverse Methods for Calc. Energy Savings (Jan Kreider)
- January 2002 meeting (Atlantic City)
- June 2002 meeting (Honolulu)

4. Discussion of Work Statements (all):
- PMSC RP1050 "Inverse Methods Toolkit (Sonderegger)
- WS 1051 "Toolkit for comparing computer simulation program..." (Sonderegger)
- WS "Methodology Development to Extend ASHRAE Semi-empirical Chiller Models to include Models for Screw Chillers, Package Air-conditioners, and Heat Pumps." (Reddy)
- WS "Development of procedures for analyzing energy savings from weather dependent and weather independent energy usage using an inverse bin method." (Haberl)
- WS "Development of a procedure for baselining energy use at large central plants." (Krarti)
- Other work statements (all)?

5. Long Range Research Plan (all)
- **WS 1051 "Development of Toolkit for Comparing Results of Hourly Building Energy Simulation Programs against Measured Energy and Internal Environmental Data" (Sonderegger)**
- WS "Methodology Development to Extend ASHRAE Semi-empirical Chiller Models to include Models for Screw Chillers, Package Air-conditioners, and Heat Pumps." (Reddy)
- WS "Development of procedures for analyzing energy savings from weather dependent and weather independent energy usage using an inverse bin method." (Haberl)
- WS "Development of a procedure for baselining energy use at large central plants." (Krarti)
- One Pager: Genetic Methods (Ron Nelson)
- One Pager: Inverse Methods for Parameter Determination for HVAC01 and HVAC02 (Jean Lebrun)

6. Old Business (all)

7. New Business (all)

8. Adjourn

ATTENDEES:

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The meeting started at 3:43 pm and began with introductions.

Everyone was given a few minutes to review the minutes of the Seattle meeting.
The minutes are also available electronically.

Action Items were discussed.

ACTION: TC 4.7 Inverse Chair will remind people monthly about getting the action item done.

MOTION: Sonderegger moved to accept minutes, Bass seconded. All approved.

Next, Haberl discussed several announcements regarding the program, research, etc.

Sonderegger discussed a Symposium for Orlando by TC 9.6 about "The stories that utility bills tell us about energy performance in buildings" Co-sponsor by TC4.7?

One comment from the subcommittee brought up the idea that there would be more papers for this Symposium if it were moved to the summer of 2001.

ACTION: Haberl then mentioned that there would be an Atlantic City Symposium "Inverse Methods for calculating savings from energy conservation retrofits" and volunteered Jan Kreider to chair since Kreider was the Chair of the PMS for RP 1050 Inverse Toolkit.

ACTION: Bass Abushakra agreed to submit a paper to this Symposium.

ACTION: Moncef Krarti agreed to have a paper for the Inverse Symposium for Atlantic City on Neural Networks.

ACTION: Marlin Addison suggested a Seminar for Orlando Entitled "Inverse regression for simulation" and agreed to chair the Seminar.

The discussion then moved on to Research.

Sonderegger gave a report on RP1050 "Development of an inverse toolkit…". He reported that the object of this project was to document the existing methods that could be used for 1P, 2P, 3P, 4P, 5P, MVR, VBDD and combined models in a FORTRAN toolkit that could be widely distributed. Contractor (Univ. of Dayton/Texas A&M) has delivered software requirements specs and is on track for a beta version and final draft report for June 2000.

Sonderegger then discussed RP 1051Work Statement. WS 1051 "Toolkit for comparing computer simulation program...". Copies of the edited WS were handed out to everyone. Robert reported that he had significantly edited the WS and had received and incorporated comments from several persons.

Jim Wilson wanted to know if this project was intended for users, developers, what?

Sonderegger reported that he felt that this was ultimately pointed towards users of simulations programs.

Sonderegger reported that this is supposed to be more general than just hourly data, therefore, language has been added to allow for this.

Chip Barnaby then reported that some of the deliverables were not in the scope.

ACTION: Sonderegger agreed to check this for the next meeting.

It was also suggested that this might not be delivering only FORTRAN code like HVAC01 or HVAC02, therefore, the name should be changed from "toolkit" to "procedures" with possibly a reference to "toolkit".

ACTION: Sonderegger agreed to look at this again.

A question was then asked about if this was a teaching toolkit or a guide for users.

ACTION: Sonderegger agreed to clarify this.

Another question asked if there would be examples of procedures that could be used by real life engineers. All agreed that this would be helpful.

Another question asked if these procedures could be taught at all. Sonderegger replied that this was the ultimate goal of the project – to provide procedures to facilitate this.

It was suggested that the "procedures" developed be tested by the PMSC and that the WS needed to be revised to reflect this.

ACTION: Sonderegger agreed to incorporate this.

Another comment suggested that the ideal contractor for this project would be someone who does this for a living.

Another comment asked if computer simulation were the best tool to perform this?

Someone pointed out that several sections were out of place. For example, the purpose comes after the Significance of the Work.

ACTION: Sonderegger agreed to recheck this.

It was also suggested that the word "calibrating" be replaced with "reconciling".

ACTION: Sonderegger agreed to check this.

ACTION: Jim Wilson asked that it not just limited to hourly data. Sonderegger said that he intended it to say "measured data" without regard to time scale.

A comment was then made about the reference to GPC-14P regarding the reconciliation of computer simulations to measured energy savings from energy conservation retrofits.

ACTION: Haberl agreed to reread the WS and provide these references to Sonderegger.

Jean Lebrun said that there is no mention of "interior moisture conditions" only "interior temperature".

ACTION: Haberl agreed to work with Sonderegger to check this.

Lebrun felt that 2 variables are missing in the scope – no mention of moisture conditions. Haberl said that all references to "interior temps" should be replaced by "interior conditions".

Haberl asked the subcommittee to read the WS and forward comments to Robert Sonderegger for incorporation into the next draft for June.

ACTION: Sonderegger will champion The WS with help from Marlin Addison, Vern Smith, and Haberl.

Next WS – "Methodology Development to Extend ASHRAE Semi-empirical Chiller Models to include Models for Screw Chillers, Packaged Air-Conditioners, and Heat Pumps" (Agami Reddy)

Haberl reported that Agami had not been able to make any progress on this WS since June. Haberl took a few minutes to explain this WS.

Lebrun mentioned that he felt that this WS was already covered by HVAC01. Haberl Commented that this was intended to be semi-empirical methods.

Lebrun suggested that the WS needed to be very specific about why it was different that HVAC01.

ACTION: Reddy will have a draft ready for next June with help from Haberl. Haberl and Reddy will make sure to have a convincing argument about why this WS is not already covered in HVAC01

Next WS – "Development of procedures for analyzing energy savings from weather dependent and weather independent energy usage using an inverse bin method." (Haberl)

Haberl gave a brief introduction to the WS and why it's needed – typical inverse methods can cover 80% of buildings, but for the rest, the method does not work. This WS will provide another tool will bring the buildings coverable to 90% using inverse bin methods.

Barnaby felt the title of the WS is too wordy and need to be simplified.

Sonderegger suggested the word "inverse method" be removed from the title.

ACTION: Haberl agreed that this would be reworked for next June meeting with the above-mentioned items.

Next WS – "Development of a procedure for baselining energy use at large central plants." (Krarti).

Krarti gave a brief explanation of the WS. One model to predict energy use of the building(s), another to predict that of the central plant – needed for baselining energy use for multi-building facilities , and expand inverse methods to cover these situations.

Barnaby suggested that we get support and possible co-sponsorship from TC 9.2.

ACTION: Krarti agreed to contact someone on TC 9.2 and revise the WS. Haberl agreed to help.

Ron Nelson has the title of a one-pager on genetic algorithms that he will flush out for Minneapolis.

ACTION: Nelson agreed to have one-pager for June meeting.

ACTION: Lebrun and Sonderegger agreed to have one-pager and title about "Inverse Methods to Determine Parameters for use with HVAC01 and HVAC02 Toolkit" for June.

MOTION: To adjourn the meeting passed.

Meeting Adjourned at 5:00 p.m.

RP-865
Development of Accuracy Tests for Mechanical System Simulations

The PMS and contractor team meet at 1:15 on Monday, February 7, 2001. The following persons were present.

PMS:
George Walton (chair)
Ron Judkoff
Robert Sonderegger
Joel Neymark

Contractor:
Gren Yuill
Jeff Haberl

The status of the work was reviewed. It consists of 7 different systems for each of six weather/load conditions. Four of the systems are nearly complete. Most of the differences in the results on these systems appear to be due to differences in fan models with lesser differences in cooling coil models used by the two researchers. This represents considerable progress from the last meeting when all systems had several instances with large unresolved differences.

Some time was spent reviewing the fan models to resolve differences. Based on the current rate of progress, it was determined that a final report was unlikely before the end of summer. Therefore, the review committee decided to recommend to TC4.7 that it request a no-cost time extension for RP-865 to March 1, 2001.

submitted by
George N. Walton

1050-RP
Development of a Toolkit for Calculating Linear, Change-Point Linear and Multiple-Linear Inverse Building Energy Analysis Models

PMS Minutes

PMS Attendance: Jan Kreider, Chair, Moncef Krarti, Agami Reddy, Robert Sonderegger

Contractor Attendance: Kelly Kissock (University of Dayton), PI, David Claridge, Jeff Haberl

Contract Start Date: 1/1/99

Contract End Date: 6/30/00

Scope: The objective of ASHRAE Research Project 1050 is to develop a toolkit of well-documented FORTRAN 90 computer source code for calculating steady-state, linear, change-point linear and multiple-linear building energy analysis models. The scope of work includes:

(i) a literature search into the current algorithms,

(ii) design of toolkit software

(iii) development of FORTRAN 90 computer code that performs linear, change-point linear and multiple linear calculations,

(iv) development of estimates of uncertainty,

(v) assembly of such code into a well documented ASHRAE toolkit that can be distributed by ASHRAE, and

(vi) preparation of a technical paper, research note, and/or ASHRAE Journal Article.

The contractor presented the software requirements specification (SRS) prior to the meeting. It has been reviewed by the PMS. The contractor in accordance with an agreed to schedule will issue a final revision. Nomenclature used in the models, documentation and code will be made consistent and will be chosen to express the generality of the toolkit beyond just energy vs. temperature models. Consistent acronyms such as “2P-MVR” will also be used throughout.

The SRS embodies uncertainty measures agreed to by the PMS and the contractor; these include all GPC-14P measures. The contractor will propose a method of evaluating the “flatness” of the RMSE vs. independent variable plot. For example, the toolkit user may have an interest in how DD base temperature or change point temperature variation affects model accuracy.

Coding of the toolkit is well underway. The alpha version of the software will be distributed to the PMS for evaluation by March 6, 2000 followed shortly thereafter by draft documentation. The software issued to the PMSC will be accompanied by documented test data sets and “instruction” files. A beta software version is due 5/1/00. A software status report was issued.

Twenty actual test data sets and ten synthetic data sets (the latter for each model type) will be used by the contractor to examine the accuracy and functionality of the toolkit. In addition, sets of test data with known errors (wrong character type, concatenated columns, missing data, etc.) will be used to check error trapping in the toolkit. Some of the PMS - provided data sets will have independent variables other than just dry bulb temperature. The contractor will report on the results of all toolkit tests.

Following the last PMS meeting in Seattle a clarification of scope has been agreed to by the PMS and the

contractor. It is attached to these minutes.

A PMS member raised the matter of testing the toolkit regressions against a set of data not used to make the regression models (so-called training/testing set approach). The contractor will respond to the committee on this matter. It appears that the toolkit, as now designed, will handle such cases with no modification whatsoever.

The contractor intends to complete all work on time and by the contract end date of 6/30/00.

Summary of Action Items

Contractor: Final revision of SRS due 2/14/00.

Issue final schedule by 2/14/00.

Issue write-up of proposed method of handling degree-days as one independent variable in multivariate regression model

Issue monthly project updates by e-mail to PMSC.

PMS: Provide test data sets in proper format to contractor by 4/10/00 with copy to PMS chair

Submitted by,

Jan F. Kreider, PMS Chair

M E M O R A N D U M

TO: 1050-RP PMS distribution

FROM: Jan F. Kreider

SUBJECT: Agreement with Contractor on Scope

DATE: August 31, 1999

Kelly and I have had conversations to clarify the scope of work for the captioned project. He has generously offered to expand the scope as described below. The project will be improved by his suggested new work that goes well beyond what is contracted for. However, no work will be undertaken that is peripheral to the main thrust of the project. The essential details are:

The contractor will create only a basic UI for testing the tool. This is in keeping with the procedure used by TC 4.7 in its Secondary Toolkit, for example. After the completion of the present RP, others may prepare UIs and data pre- and post-processing features. Kelly will decide on the test data file format and publish it for test data set purposes. He will also decide on the data output format and prepare a simple testing executable for 1050 RP tool testers and evaluators. The scope of 1050RP includes testing of algorithms but is not a data formatting exercise. Users and suppliers of data will need to preformat the data to comply with the contractor's specifications.

The contractor will expand the scope of his work to include features that support some of the needs of GPC-14P. Specifically, the 3P, 4P and 5P models will be enhanced to include multiple input variables. VBDDs could be one of these additional inputs. This is an important expansion of the work because it assures a user group immediately. For example, statistical measures used by 14P will be included. The software requirements document will detail these added features.

The MVR aspect of the tool will test VBDDs as one of the input variables. The contractor will not be required to develop algorithms to determine the best base temperature (as PRISM does, for example) but will, rather, calculate DDs to various bases and use them as one of the inputs, one base temperature at a time, to the MVR tool.

Seven different measures of tool accuracy will be reported. All GPC-14P measures will be included.

To summarize, I find that the contractor is undertaking additional work, without additional compensation, in a positive spirit to address concerns raised at the Seattle PMSC meeting. I suggest that we agree with his proposals, compliment him on the generous spirit in which they were made and allow him to proceed with all deliberate speed to meet deadlines.

TC 4.7 Simulation and Component Models Subcommittee

Dallas Minutes

February 7, 2000

Introductions

The meeting was called to order at 6:05 pm with 37 people in attendance (see attendance list below).

Program

Atlanta: seminar and symposium

Symposium: *Simulation Models for Low Energy Cooling* (Joe Huang)
Joe Huang reported considerable interest in the symposium, with 5 to 7 potential authors willing to submit papers. A double symposium session may be required.
Seminar: *Low Energy Cooling Case Studies* (Phil Haves)
A number of European authors have expressed an interest in presenting either models (in the symposium) or case studies (in a seminar).

Dan Fisher reported that he had notified Steve Comstock of European papers that were reportedly republished in the ASHRAE Transactions. Comstock noted that BSRIA already indexes ASHRAE papers and asked for evidence substantiating the extent of the problem. The committee agreed that aggressive follow up was not a priority, but that it would be worthwhile to instruct symposium chairs to watch for this type of infraction.

Atlantic City

Symposium *Interoperability and Portability*
Fred Buhl reported that he had contacted John Seem as requested by the committee to solicit his opinion on the suitability of Modelica as a replacement for NMF. Seems' opinion was that Modelica was a suitable replacement. Ed Sowell noted that in the 11 years since NMF was introduced it has not generated any interest in the U.S. Vic Hanby countered that there is a large NMF users base Scandinavia (due to the popularity of IDA), but that it is not widely used outside of Scandinavia.

Chip Barnaby agreed to chair a symposium on interoperability and tool portability. He will contact Per Sahlin and find others to help him solicit papers from Scandinavian authors.

Work Statements in Progress

Ideal Energy Calculation Models for Residential HVAC Equipment

Chip Barnaby argued the case for the specification and development of ideal energy calculation models for residential HVAC equipment. Due to perceived ASHRAE budgetary constraints, the committee approved an abbreviated version of the work statement that covered only vapor compression equipment. The rest of the equipment will be taken up in a follow on work statement.

Jon Leber reported that the California Energy Commission would co-sponsor the work at a low level (~$10k). Additional co-funding could be available if compelling arguments showing the State of California's vested interest in the project could be articulated.

Development of HVAC System Templates for Simulation Programs:

Dru Crawley presented the work statement for the development of HVAC System Templates for Simulation programs.

- Fred Buhl noted that there was no mention of ASHRAE's Air Handling Systems Design book, which includes a set of system templates. The committee felt that this comparison was critical to the success of the work statement.
- Phil Haves suggested that Asia within the scope of the project…or that wording to the effect of "worldwide" be included.
- Jeff Haberl suggested a statement under "Information for Bidders" that would require bidders to show proof of access to proprietary data they plan to use in their work.
- Phil Haves noted again ASHRAE's budgetary constraints and suggested trimming the work to reduce the budget. Dru suggested eliminating the residential templates from the work statement, but there was not a clear consensus on how the cuts should be made..

Extension of the ASHRAE Loads Toolkit to deal with Systems with Significant Intra-zone Airflow

Simon Rees presented the case for the development of multi-node zone models. Although the work statement is essentially complete, the committee agreed to delay submittal until Minneapolis for the following reasons:

- Chip Barnaby noted that the justification section needed to show a compelling reason for funding the work. He suggested including a discussion of the need for atrium models in the justification section. Dan Fisher agreed to work on this section with Simon.
- Mike Brandemuehl felt that the testing section was unclear. He agreed to work with Rees to clarify that section

Research projects

RP 987 Loads Toolkit

Dru Crawley reported that the Loads toolkit is behind schedule, but will nevertheless be ready for the next meeting. Those who are interested in reviewing the toolkit and are not already on the list were advised to contact Dru.

RP 1052 Modeling Two- and Three-dimensional Heat Transfer Through Composite Wall and Roof Assemblies in Hourly Energy Simulation Programs.

George Walton reported that a glitch in getting a researcher's visa approved had set the project back slightly, but that the contractor had a work around solution in place.

RP 1049 Design Synthesis

Curt Pedersen reported that the project is underway. The contractor's plans to use IDA were approved by the PMSC.

Meeting Adjourned at 7:03 PM

ATTTACHMENT 1

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	X	X	Brandemuehl	Mike	michael.brandemuehl@colorado.edu
X		X	Buhl	Fred	wfbuhl@lbl.gov

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		X	Wright	Jonathan	J.A.Wright@lboro.ac.uk
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Report from the Contractor on 987-RP Loads Calculation Toolkit

University of Illinois
C. O. Pedersen
R. K. Strand
R. J. Liesen

Oklahoma State University
D. E. Fisher
D. S. Eldridge

Punch List 1

Section needing revision	**Revision needed**	**Comments**
RTS Section	Write section, write steady periodic transfer function module, write RTS coefficient module, write procedure module	Dan Fisher will write an RTS module
2.2.1 Heat balance equations	Define nz, replace 12 with nsurf in eq 2-9	Editing only
2.2.2 Heat Balance Solution Methods	Coordinate with Asmundsson's thesis	Code Required
3.1.1 Outdoor Air Temperature	Must be written-ASHRAE profile discussed	Code Required
3.3.1 Incident Solar Calculations	Test inputs and outputs needed	Testing required
3.3.2 Sky Models	Isotropic and Anisotropic models included	Code Required
3.3.3 Shading	Needs to be updated	Code revision
3.4 Ground Heat Transfer	Waiting on Bahnfleth's revised code.	
5.1.3 Forced and mixed Convection	Eliminate	
5.3.1 Radiation Fraction (internal sources)	Needs to be written-abstracting HOF	Writing
5.3.2 Distribution	Needs to be written	Writing
5.4 Transmitted Solar Radiation	Needs to be written	Writing
5.5 Conduction	Eliminate—covered in chapt 4	
5.6 References	Need to be compiled	
6.1.4 Comis	Eliminate—covered in section 8.4	
6.2 Interzone Air flow	Eliminate section or briefly tell how to do it, no implementation since only one zone is considered	Writing
6.4 HVAC System Air	Write brief section relating it to deck temperature	Writing
6.5 References	compile	
1.4 Toolkit Testing	Include results of Asmundsson and Turner	Currently in Progress

Sample Zone Testing Results

TABLE 1

Parametric Run

	Construction Types					
Parameter	L	M-L	M	M-H	H	**Test Values**
Zone Geometry						
Zone Level	3	3	3	3	3	2,3
Zone Number	1	1	1	1	1	1,2,9
Room Size [m]	9	9	9	9	9	3,9,30
Zone Aspect Ratio	0.5	0.5	0.5	0.5	0.5	0.1,0.5,2.1,9.9
Window Percentage	20	20	20	20	20	0,30,60,90
Walls						
Exterior Wall Type	1	2	3	4	5	1,3,5
Interior Wall Type	1	2	2	2	2	1,2
Roof Type	1	2	2	2	2	1,2
Floor/Ceiling Type	1	1	2	2	3	1,2,3
Window Type	1	1	2	2	2	1,2
Thermal Mass Type	1	2	3	4	5	1,3,5
Internal Heat Gains						
Schedule	3	3	3	3	3	0,3,6
People [m^2/Person]	20	20	20	20	20	20
Lighting [W/m^2]	5	5	5	5	5	0,50,99
Equipment [W/m^2]	5	5	5	5	5	5
Design Days						
Weather Day Type	3	3	3	3	3	1,2,3,4

Schedule for Review and Completion

Schedule:
Received Beta 3b 2/5/2000

April 1st — PMS and additional reviewers to review and get comments to Crawley. Crawley to compile and forward comments as received. PMS to discuss and resolve any areas of disagreement.

May 1st — UI to distribute new CD incorporating comments and new code. PMS/reviewers to review and send comments to Crawley.

June 15th — UI to distribute new CD incorporating comments. This CD is a candidate for approval by the PMS at our meeting in Minneapolis in late June. PMS/reviewers to review and bring FINAL comments to the PMS/TC meeting in Minneapolis.

June 25th — PMS meets (approve); TC meets (approve)

July 31st contract ends

Reviewers/Topic Areas:

PMS:	
Chip Barnaby	solar, CTF, ground, CD structure
Tom Romine	exercise from viewpoint of design engineer, review text
Dave Knebel	
George Walton	internal radiant exchange, CTF
Dru Crawley	
Other Reviewers:	
Fred Winkelmann	solar availability, solar shadowing, window conduction / solar gain, outside surface heat balance, inside surface heat balance, exterior convection, exterior long-wave radiation, sky temperature, sky radiance
Robert Sonderegger	infiltration/ventilation air, HVAC system air, conduction through walls
Vernon Smith	
Ian Beausoleil-Morrison	internal heat balance, internal convection, internal airflow
Svein Morner	solar radiation (chapter 3)
Steve Bruning	
Simon Rees	psychrometrics, CTF
Jan Kreider	writing, algorithms (CD structure)
Alexander Knirsch	CTF
Kamel Haddad	transmitted solar
Moncef Krarti	infiltration/ventilation, long wave radiation
Hofu Wu	
Klaus Sommer	
Fred Buhl	System/zone air, inside heat balance, outside heat balance
Linda Lawrie	CD structure
Vic Hanby	
Hugh Henderson	
Contractor:	
Curt Pedersen	
Rich Liesen	
Rick Strand	
Dan Fisher	
Dave Eldridge	

MINUTES 1145-RP
Modeling Two and Three-dimensional Heat Transfer through Composite Wall and Roof Assemblies in Hourly Energy Simulation Programs.

Sunday, February 6, 2000, 2:00 to 3:00 p.m.
Adam's Mark Hotel, Pearl 2
Dallas, Texas

In attendance:

Jeff Blake, Natural Resources Canada (for Ian Beausoleil-Morrison)
Steve Carpenter, Enermodal Engineering
Jan Kosny, Oakridge
George Walton, NIST
Peter Armstrong, PNL
Guest: Sean Hockersmith

1. Introductions (all)
2. No discussion of last meeting minutes (not available)
3. No agenda to follow. Discussed Progress of project.

- Jan summarized the progress of the project and submitted a progress report (dated February 6, 2000).

- Elisabeth Kossecka (Polish Academy of Sciences) has had trouble getting a visa and is behind schedule. She is submitting some work via Email.

- Discussed several issues:

1) Boundary conditions
Current simulations are made for temperature excitations located directly on the surface of the wall. Film coefficients are not included. Recommended using ASHRAE film coefficients.

2) Amount and type of data output.
a) U, C, series of response factors,
b) same, z transfer function coefficients instead of RF,
c) multilayer equivalent wall,
Consensus to provide both b) and c)

3) Validation of computer model
Don't have test data for the ICF wall requested so will provide a variation of the wall in the original list

Future activities:
- Completion of theoretical analysis - end of May 2000
- Completion of simulations - end of May 2000
- Development of DOE-2 readable database containing 1-D equivalent walls for selected wall systems - winter 2000

RP: 1049 Progress Report Feb 7, 2000

Project Monitoring Subcommittee:

Curt Pedersen (TC 4.7), chair
Dave Knebel (TC 4.7)
Ron Nelson (TC 1.5)
Ed Sowell (TC 4.7)
Mike Brandemuehl (TC 4.6)

Contractor: University of Loughborough, UK

The PI, Vic Hanby, made a presentation to the monitoring committee on Sunday February 6, 2000. Current staff applied to the project consists of one graduate student, one new faculty member, and the PI, who is spending a large share of his time on the project since he is on administrative leave following his term as Head of Department.

A prototype version of the configuration generator is working at the present time. The generator works with nodes representing individual components and links representing physical information flows between components. Any component type is considered to have a fixed 'valency', or number of links for each of the three main channels (air-, water-, and information**)**. A rule base controls the generation process. Work will continue to expand the link configurations allowed.

The main discussion with the PMS centered on the choice of a simulation program. The contractor evaluated eight candidates, and proposed to use IDA. After a lengthy discussion of the pros and cons, the committee agreed with the contractor's choice, and they were told to proceed on that basis.

1052-RP
Development of an Analytical Verification Test Suite for Whole Building Energy Simulation Programs - Building Fabric

The Project Monitoring Subcommittee and contractor team met at 3:30 on Monday, February 7, 2001. The following persons were present.

Review Committee:
George Walton (chair)
Ron Judkoff
Joel Neymark

Contractor:
Jeff Spitler
Simon Rees
Xiao Dongyi (student)

Others:
Fred Bauman
Dru Crawley

The contractor presented a 78-page draft document describing in detail the verification tests developed to date. Work was progressing on the in-house testing of how to use the tests with an energy analysis program. The out-of-house testing would be done after all tests were developed and tested in-house. There was considerable discussion and suggestions for the tests still to be developed: internal radiant transfer, internal solar distribution, heat transfer to ground, and infiltration. It was noted by Dru Crawley that weather files should use the IWEC instead of the WYEC2 formats.

The contractor anticipated that all in-house work on the project would be complete by the next ASHRAE meeting in June. Given the relatively short time until that meeting and the uncertainty of when the out-of-house testing would be done, it appeared to the committee that the end of summer would be a safer estimate for completion. Therefore, the review committee decided to recommend to TC4.7 that it request a no-cost extension for RP-1052 to March 1, 2001.

submitted by
George N. Walton

4.7 Research Status

Last updated Mar. 22, 2000

Active projects

#	Title	Joint TC	Cognizant subcom / Contractor	PMS	Dates / status
865-RP	Accuracy tests for Mechanical System Simulation		Sim/Comp Penn/TAMU Gren Yuill	George Walton (chair), Ron Judkoff, Robert Sonderegger, Dave Knebel	Rec: 2-20-96 (San Antonio) NCE: until 2-28-98 (7-1-97) NCE: until 8-31-98 (1-20-98) NCE: until 3-31-99 (6-23-98) NCE: until 3-31-00 (1-27-99) NCE: until 3-31-01 (2-8-00)
987-RP	Preparation of a Toolkit for Building Load Calculations	4.1	Sim/Comp Univ. of Illinois Curt Pedersen	Dru Crawley (chair), Chip Barnaby, George Walton, Dave Knebel; Tom Romine (TC 4.1)	Rec: 1-28-97 (Phil) End: 12-31-99 NCE until 7-31-00 (6-22-99)
1049-RP	Building System Synthesis and Design	1.5	Sim/Comp Loughborough University	Curt Pedersen (chair), Ed Sowell, Dave Knebel, Ron Nelson (TC 1.5), Mike Brandemuehl (TC 4.6), Jan Hensen	WS: 1-20-98 (SF) Rejected all proposals: 6-23-98 (Toronto) Rec: 6-22-99 (Seattle) End:
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) End:
1052-RP	Development of an Analytical Verification Test Suite for Whole Building Energy Simulation Programs – Building Fabric		Sim/Comp OSU Jeff Spitler	George Walton (chair), Ron Judkoff, Joel Neymark, Fred Winkelmann	WS: 7-1-97 (Boston) Rec: 6-23-98 (Toronto) Start: 1-1-99 NCE: until 3-1-01 (2-8-00)
1093-RP	Compilation of Diversity Factors and Schedules for Energy and Cooling Load Calculations	4.1	App TAMU (TEES) Jeff Haberl	Agami Reddy (chair), Bill Bahnfleth, Joe Huang, Suzanne LeVisuer (TC 4.1)	WS: 1-20-98 (SF) Start: 2-1-99 NCE: until 3-31-2001 (2-8-00)
1145-RP	Modeling Two- and Three-Dimensional Heat Transfer Through Composite Wall and Roof Assemblies in Hourly Simulation Programs		Sim/Comp Enermodal Engineering Ltd	Ian Beausoleil-Morrison (chair); George Walton; Fred Winkelmann, Doug Hittle (TC 4.1)	Approved in Toronto (6-23-98) Rec: 6-22-99 (Seattle) End:
1163-TRP	Standard Operating Conditions for North American Residential Buildings		Danny Parker, Joe Huang, Fred Buhl	Craig Wray (chair), Joel Neymark, and Vernon Smith	WS: 6-22-99 (Seattle)

In process

#	Title	Joint TC	Champion(s)	Committee	Dates / status
1051-WS	Procedures for Reconciling Computer Calculated Results Against Measured Energy Data (note new title)		Inv Jeff Haberl Robert Sonderegger	Curt Pedersen (chair), Dave Knebel, Fred Winkelmann	WS: 7-1-97 (Boston) Returned by RAS Resubmit soon?
1198-WS	Development of Detailed Descriptions of HVAC Systems (Templates) for Energy Simulation Programs		Dru Crawley, Ian Beausoleil-Morrison	Ian Beausoleil-Morrison (chair), Dru Crawley, Jan Hensen	WS: 2-8-00 (Dallas)
1199-WS	Updated Energy Calculation Models for Residential HVAC Equipment (formerly Standard HVAC Equipment Characteristics for Energy Calculations)	7.6	Simp/Comp Chip Barnaby	Chip Barnaby (chair), Craig Wray, Mike Brandemuehl	WS: 2-8-00 (Dallas)

Work Statements – Applications

Title	Champion(s)	Ranking	Dates/status
Define Performance Factors for Primary and Secondary Equipment Simulation Inputs for Commercial Buildings	Dan Nall, Bill Bahnfleth	2	WS being developed
Characterization of Building Secondary Thermal Loads from chiller of electric use data	Robert Sonderegger, Agami Reddy		
Standard 140/BESTEST Ground Coupling Test Cases	Ian Beausoleil-Morrison, Joel Neymark		
Development of Standardized Computer Simulation Input Files for Describing Typical Residential Homes and Common Energy Conservation Retrofits	Jeff Haberl Joe Huang		

Work Statements – Inverse Methods

Title	Champion(s)	Ranking	Dates/status
Extend and Develop Methodology of 827-RP to include models for Air-Conditioners and Heat Pumps	Jeff Haberl, Robert Sonderegger, Vern Smith		WS being developed
Development of a Procedure for Baselining Energy Use of Large Central Plants	Jeff Haberl, Moncef Krarti		
Development of Procedures for Analyzing Energy Usage Using an Inverse Bin Method	Jeff Haberl		

Work Statements – Simulation and Component Models

Title	Champion(s)	Ranking	Dates/status
Development of Detailed Descriptions of HVAC Systems (Templates) for Energy Simulation Programs	Dru Crawley, Ian Beausoleil-Morrison	3	WS being developed
Incorporation of Nodal Room Heat Transfer Models into Energy and Load Calculation Procedures (formerly Extension of the ASHRAE Loads Toolkit to deal with Systems with Significant Intra-zone Airflow)	Simon Rees, Kevin Knappmiller		

Work Statement

Updated Energy Calculation Models for Residential HVAC Equipment

From TC 4.7, Energy Calculations

Background

Computerized energy calculations are now routinely used for evaluating equipment alternatives during engineering design and specification. However, this application is less accurate and efficient than possible due to limitations in available equipment models and a mismatch between input required by those models and the data published by manufacturers. In some cases, pertinent information is available only in manufacturer-specific formats; sometimes data is not available at all.

These shortcomings are particularly significant with respect to residential equipment. Commercial projects (at least some of them) enjoy sufficient design budgets to allow reformatting of manufacturer's data so alternatives can be compared. Residential projects have no such luxury – equipment comparison and selection must be virtually automatic and instantaneous. This goal requires the existence of a coherent set of standard equipment models and readily available data that can be directly (and probably automatically) input into those models.

First order cross-brand comparisons of residential equipment are currently possible using mandated ratings such as SEER and HSPF. These ratings and associated calculation techniques provide rough estimates of annual operating cost and thus allow simple cost-effectiveness evaluations to be done. However, the accuracy of such estimates is limited. For example, two speed air conditioners often have extremely high SEER ratings and thus appear to offer low operating costs. The stellar ratings result from the high fraction of time the units are assumed to operate at low speed in the SEER rating procedure. When cooling a building with a different load distribution, the actual cost will usually be different (generally higher). Even larger discrepancies can occur with air-source heat pumps, where differences in load distribution can alter the use of resistance heat. Resulting energy use and cost can deviate substantially from predictions based on the standard HSPF rating. Finally, even optimal sizing and equipment selection for humidity control requires manufacturer's information beyond the standard ratings (see, for example, ACCA Manual S). In short, the standard rating values are approximate guides at best.

Simulation-based energy calculations allow evaluation, comparison, and selection of equipment operating under anticipated project conditions. However, modeling of residential equipment is currently hampered by at least three interrelated problems:

1. Available data are not sufficient for the models of interest. Single rating statistics such as SEER or HSPF do not embody useful information about the full range of operating conditions. Tabulated "performance map" data are often presented in manufacturer-specific formats. Equipment rating standards in some cases allow round off, defaulting, and/or adjustment of published data, any of which can seriously confound computer models.
2. Available models do not cover the universe of equipment in use. For example, multi-speed units, variable speed fan controls, and non-standard external pressure drops often cannot be directly evaluated.
3. Available models are not sufficiently granular to allow separate accounting of primary fuel, distribution electricity, and auxiliary electricity. This limits the range of model applicability; for example, distribution system optimization cannot be accurately performed without separate accounting of distribution energy requirements.

This project will address these problems by developing improved residential equipment energy calculation models and identifying the data required by those models. The ideal residential equipment model would offer an array of capabilities that would support many different applications. These capabilities are described in general terms in the following table. The models must operate over the full range of expected operating conditions (temperature, humidity, elevation, etc.).

Item	Inputs	Outputs
Heating/cooling	Outdoor conditions Return air state Air volume flow rate Operating mode (as applicable)	Supply air state Primary fuel consumption rate (or efficiency) Secondary fuel consumption rate

		(e.g. heat pump backup)
Distribution	Distribution system characteristics Operating mode	Air flow rate Fan power
Cycling	Run fraction Cycle time	Part load efficiency
Controls/auxiliary	Outdoor/indoor conditions as appropriate Operating mode, run fraction etc.	Auxiliary power

A necessary attribute of the updated models is that they require only readily available (or potentially readily available) input data. Thus the models developed under this project must depend on a minimal set of inputs that can be straightforwardly measured and/or estimated with detailed models such as those currently used by manufacturers. The HVAC industry is clearly some years from routinely making available all of the required information. A key project objective is to identify candidate sets of equipment characteristics that meet the needs of energy calculation modeling. These requirements will serve as a starting point for development of future data publication standards.

There are many possible representations for the equipment characteristics that will be required by the updated models. In the past, data intended for "human" use has be published as tabulated performance maps giving capacity and efficiency (for example) at various combinations of indoor and outdoor conditions. Computer model input has traditionally been coefficients for curve fits. This project will identify a suitable representation given the needs of the new models.

Note that the intended purposes of these models include energy calculations, operating cost prediction, equipment selection, and overall (building + equipment) optimization. Detailed equipment design is *not* an intended use. It is not anticipated that the models will contain anything beyond an idealized representation (if that) of the internal operation of the equipment.

Justification of Need

There is currently no coherent set of models and associated standard equipment data that allow unbiased comparison of the entire spectrum of residential HVAC equipment for a given design problem. At least four groups will directly benefit from the existence of models having the capabilities outlined here:

- *Individual designers.* The models and associated data proposed here will allow more rational selection of equipment for lower operating cost, improved comfort, and higher efficiency.
- *Policy makers.* Government agencies, public utilities, and similar entities will use these models to determine the benefits associated with regulations and incentives related to residential equipment energy efficiency and peak demand.
- *Manufacturers.* Equipment vendors will be able to better tailor their equipment to representative load profiles. Computerized interactive equipment selection tools could replace printed catalog data. Some manufacturers have selection software, but the underlying assumptions and algorithms may not be published or consistent across manufacturers.
- *Residence owners and occupants.* The ultimate beneficiary of better system design and equipment selection will be the building owners and occupants, who will enjoy better comfort and lower operating costs.

Residential space conditioning consumes 9% of the U.S. energy budget. It is crucial that up-to-date and complete models exist to provide accurate energy use prediction and optimal application of the equipment that moves this huge energy consumption segment.

Objective

The objective of this project is to lay the groundwork required for a quantum improvement in the rigor and detail of generalized simulation models of residential equipment. This improvement requires upgrading both models of equipment operation and readily available data that can serve as model input. The interlocking nature of the two requirements has prevented progress in this area for many years.

The approach here is to proceed with model development, attempting to limit new data requirements to the minimal and practical. The identified requirements will serve as a starting point for future data standardization efforts.

Scope

To keep the scope of this work within practical limits, only air-source vapor compression equipment will be addressed. Additional projects may be initiated in the future to cover more equipment types.

The following tasks are anticipated:

- *Identify range of equipment.* Identify, characterize, and classify the universe of air-source residential air conditioners and heat pumps that are in significant use in North America. All relevant high-efficiency and multi-speed systems are to be included. Advanced control systems, such as variable speed fans, should be identified. Both packaged and split types should be included, but direct-delivery systems (window air-conditioners and "mini-splits") should be omitted. Reduce the assembled information to a specification that covers all equipment sufficiently common and/or promising to warrant inclusion in the modeling effort. While this list appears open-ended, it is anticipated that only two fundamental models are required:
  1. Air-source heat pump (including control of backup heat but excluding fuel-fired backup)
  2. Air conditioner (including possible evaporatively cooled condenser)

  The key task is to fully enumerate operating modes and control strategies.
- *Model development.* Obtain PMS concurrence on the list of identified equipment. As appropriate, adapt available models or develop new ones for each identified situation.
  - Each model should have the range of capabilities discussed above in Background, allowing separate accounting of primary, secondary, distribution, and auxiliary energy consumption for the full range of operating conditions, assuming the equipment is installed as specified (proper refrigerant charge, air-flow within design limits, etc.).
  - In addition, the models should be capable producing generic results for equipment that is *not* installed properly with respect to refrigerant charge and air flow. Under these conditions, model results would be based on typical equipment behavior. It is not the intent that equipment-specific behavior or data be required for out-of-spec conditions.
  - The models should be suitable for energy calculations – that is, they should be sufficiently computationally efficient that they can be used in practical full-year simulations.
  - Sections within the models should be shared. For example, the air-conditioner model and the cooling portion of the heat pump model will be identical or nearly so.
- *Specification of equipment data.* An essential aspect of model development is specification of the required equipment data. To the extent possible, equipment characteristics required by the models should be based on tests currently in standard use by manufacturers. Additional required data must be determinable using techniques that are minimally disruptive to current procedures, such as extension of existing standard tests (additional test conditions), enhanced detail modeling, or new test procedures as a last resort. It is not expected that the contractor develop full testing protocols; however, all required data items must be described unambiguously and rigorously.
- *Model implementation and testing.* Implement the models in a suitable programming environment. Test and debug all models. To allow limited immediate use of the models and to facilitate comparative testing, the implementations should be capable of outputting coefficient sets suitable for use with at least one energy simulation code, such as DOE-2.
- *External testing.* With PMS assistance, arrange and manage testing of models by people not members of the primary project team. Resolve problems that are discovered.
- *Reporting.* Document all models in textbook format with suitable narrative and commentary to support modeling approaches and compromises. Provide machine-readable implementations of each model, including sample input and output data to support verification of alternative implementations. As applicable, ASHRAE Toolkits should serve as the model for report format. Several interim reports are also required during the project (see Deliverables).

Deliverables

- A *Preliminary Report* that enumerates and describes equipment to be included in the modeling effort.
- A *Model Description Report* that outlines the proposed modeling approach(es) for each equipment type and identifies the input data required by that approach. This report is to be delivered and approved by the PMS before extensive model development is undertaken.

- A *Final Report* that incorporates the contents of the prior reports and adds full model descriptions, source code, testing data. With the agreement of the PMS and ASHRAE, some or all of this report may be delivered in appropriate machine-readable form such as CD-ROM.
- Verbal presentation to the PMS at each ASHRAE meeting throughout the span of the project.
- ASHRAE technical paper summarizing all work.
- Administrative reports as required by ASHRAE contract procedures.
- The submission form of final materials shall conform to standard ASHRAE contract requirements, as documented on the ASHRAE web site.

Additional Information for Bidders

This project is an ambitious effort to lay the groundwork required to radically improve the rigor and detail of generally-used simulation models of residential equipment. To effectively respond to this work statement, the bidder must assemble a multi-disciplinary team having expertise and experience in at least the following areas:

- Engineering and energy modeling
- Software development; availability of and experience with a suitable development environment
- Residential system design and specification
- Residential equipment testing and rating procedures

Proposals must describe and justify the development environment for model implementation and testing. For testing, models could be embedded in an existing simulation program or driven by hourly files written by a simulation program.

The principal investigator and significant team members should attend all ASHRAE meetings during the project to meet with the PMS.

Proposal evaluation criteria:

- Bidder's understanding of the work statement as revealed in proposal: 15%
- Quality of methodology proposed for conducting the research: 25%
- Bidder's capability in terms of facilities: 5%
- Qualifications of personnel for the project (per discussion just above): 20%
- Involvement of students: 5%
- Probability of bidder's research plan meeting the objectives of the work statement: 25%
- Performance of bidder on prior ASHRAE projects or related projects (no penalty for new bidders): 5%.

Level of Effort

Staff time: PI, 3 person months; staff, 1 person year. Total cost: $95,000

Project duration: 24 months spanning 4 ASHRAE meetings.

References

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ASHRAE, 1993. *HVAC 2: A Toolkit for Secondary HVAC System Energy Calculations.* ASHRAE, Atlanta, GA.

ASHRAE, 1999. *HVAC 1: A Toolkit for Primary HVAC System Energy Calculations.* ASHRAE, Atlanta, GA.

ASRHAE Standard 37-1988R. *Methods of Testing for Rating Electrically Driven Unitary Air Conditioning and Heat Pump Equipment.* ASHRAE, Atlanta, GA.

ASHRAE Standard 116-1995. *Methods of Testing for Seasonal Efficiency of Unitary Air Conditioners and Heat Pumps.* ASHRAE, Atlanta, GA.

Work statement Contributors

Chip Barnaby, Kevin Knappmiller

WORK STATEMENT
FROM
TC 4.7 ENERGY CALCULATIONS

TITLE

Development of Detailed Descriptions of HVAC Systems (Templates) for Simulation Programs

BACKGROUND

Many popular building simulation programs (e.g. DOE-2 and BLAST) use a 'system-based' approach to model HVAC systems. With this approach the user is presented with a list of pre-configured common system types (e.g. variable-air-volume, constant-volume variable-temperature, distributed heat pump). Users select the type from the list that most closely resembles the system they wish to analyse. They then input airflow rates and specify the capacities, peak efficiencies, and off-design characteristics of the system's components (fans, furnaces, cooling coils, etc.). The behaviour of the individual components and their interactions are simulated within the program, but the user is not able to reconfigure the components or alter the pre-defined control strategies.

Other simulation programs (HVACSIM+, TRNSYS, and ESP-r), in contrast, use a 'component-based' approach to model HVAC systems. Rather than presenting users with a list of pre-configured common systems, they rely on users to assemble components into a coherent system. Data must be provided to define each component and arrangement of the components must be described. Users must also specify how components are controlled, indicating what variables are sensed (air temperature in a duct, air temperature in a room, etc.), and how components are actuated (fan speed, water flow through a coil, etc.). They must also specify the control laws relating how the component is actuated in response to the signals from the sensor (e.g. proportional control, on/off control).

Each approach has its strengths and weaknesses. The system-based approaches allow users to simulate common HVAC systems with minimal effort, but the treatment of innovative HVAC systems, or even the assessment of alternate control strategies is impossible without additional software development. Additionally, with some programs descriptions of how components are connected and controlled in the pre-configured systems are unclear and difficult to understand.

The component-based approach gives maximum flexibility, but the modelling of even common systems can be onerous. Significant detail must be provided to describe each component, connection, and control strategy. As a consequence, it is difficult for users to compare alternate HVAC system configurations within a simulation-based analysis. Indeed, it is often difficult or impossible (due to time constraints) to assess realistic HVAC systems with some programs.

JUSTIFICATION OF NEED

Frequently the greatest challenge in applying a system-based simulation program is creating a realistic representation of the HVAC system under consideration. Designers usually accomplish this by choosing the system type with the closest match and tweaking the model using engineering judgement (i.e. fitting a square peg in a round hole). The following examples illustrate the point:

- With distributed systems (heat pumps, fan coils) tempered outdoor air is usually supplied to the zones by a central air-handling unit (AHU), perhaps with air-to-air heat recovery. As this configuration cannot be directly represented in common programs, it is necessary to represent the air-handling unit in an abstract fashion. As a result, fan energy usage patterns are distorted.
- With VAV systems, the flow rate of outdoor air normally varies with the total system flow. However, this situation cannot be adequately treated with common programs because their models have been hard-wired to simulate a constant flow rate of outdoor air (in the absence of an economizer cycle).

Users of these programs quite often introduce errors into their simulations because they do not realize that the program's system description does not closely match the case they are modelling. The program developer and user often have different concepts of how systems are configured and controlled, even very common system types such as VAV. Additionally, it is difficult for users to compare the results of one program to another, because a system in one program may differ from a system of the same name in another program. Finally, the mismatch or ambiguity between a program's HVAC system description and the reality is a barrier to the adoption of simulation by the design professions.

The development of a consistent set of HVAC system templates, providing detailed descriptions of the common system types would improve this situation considerably. These templates would provide schematics and control descriptions that would enable developers of system-based programs to create model systems as they are used in practice. This would improve the accuracy of simulation results and increase confidence in the use of simulation tools. A common understanding of system descriptions would also create consistency amongst simulation programs and prove a useful tool for program validation.

Furthermore, the templates could advance the component-based programs. These are infrequently used to analyse HVAC systems, simply because the creation of system descriptions is too onerous and error-prone. Developers of these tools could use the templates to populate their programs with pre-configured component-based models. This would give users the timesaving advantages of the system-based programs, while still providing flexibility to alter the models.

OBJECTIVE

The objective of this project is to develop a set of detailed descriptions of common HVAC systems ("templates"). These templates would provide schematics and control descriptions that would fully characterize the common HVAC systems used throughout North America and Europe. Details on the handling of outdoor air, control of ventilation rates, control of dampers, the arrangement of components, and the operation of heating and cooling coils (or furnaces and DX) would be provided. The general systems types for both high-rise residential and commercial buildings would be covered, including but not limited to the following:

- Variable air volume (including fan-powered boxes)
- Constant-volume variable-temperature
- Constant-volume dual-duct
- Water-loop heat pumps
- Fan coils (2-pipe and 4-pipe)
- Residential hydronic systems (including integrated mechanical systems)
- Residential heat pump systems (air-to-air and ground-source)
- Displacement ventilation systems

Due to diversity, it is quite likely that numerous templates will be created for each of the generic system types listed above (e.g. VAV-1, VAV-2). For example, the treatment of outdoor air, system controls, and thermal storage will vary within the general system types.

SCOPE

The contractor will undertake the following tasks, assisted as specified by the TC Project Monitoring Subcommittee (PMS).

Task 1. The contractor will perform a comprehensive survey of the HVAC systems currently in use in all climatic regions of North America and Europe. The objective is to cover a significant portion of the building stock categorized by the following building types:

- Low-rise offices
- High-rise offices
- Small retail
- High-rise residential

The contractor will propose a list of systems to be covered. This list will be approved by the PMS before work begins on Task 2. Each HVAC system will be documented in a draft report for review by the PMS. This system documentation is not to be a complete template description, but rather bullet lists at this stage. The draft report will also indicate how common each system is and where and how it is used.

Task 2. The contractor will create logical groupings of similar systems (all VAV grouped together, all air-based single-duct systems grouped together). This will be documented in a draft

report. The contractor and PMS will collectively decide which groupings will be developed into complete templates in the next task.

Task 3. A detailed schematic diagram will be created for each logical grouping formed in Task 2 (the 'master template'). The schematic will be accompanied by a detailed text description of the components comprising the system and will completely describe the control of the components. These descriptions will go beyond the level of detail provided in typical system control schematics [1,2] and provide the level of detail required to model the systems at the component level. Then, each element of the group (an 'instance') will be described by detailing its deviation from the master template (e.g. VAV master but with zone-reset strategy on the supply-air temperature). This will result in a draft report for review by the PMS.

Task 4. For each template defined in Task 3, the contractor will provide a listing of the minimum data required to perform an accurate simulation. This will be a useful guideline for users of the templates.

Task 5. Prepare final report and ASHRAE paper.

DELIVERABLES

1. Progress and Financial Reports shall be made to the Society through its Manager of Research at quarterly intervals; specifically on or before each January 1, April 1, June 10, and October 1 of the contract period.

2. The Principal Investigator shall report in person to the TC at the annual and winter meetings, and answer such questions regarding the research as may arise.

3. Draft reports for review and approval by the PMS that document the results of the tasks described above:
   - Survey of HVAC systems used in all climatic regions of North America and Europe for review by PMS.
   - Comprehensive list of systems into 'master templates' groupings.
   - Description of each 'master template' and each 'instance' (or template).
   - Summary of minimal data necessary to allow each template to be simulated.

4. A Final Report encompassing revised versions of all drafts into one comprehensive document shall be prepared and submitted to the Manager of Research by the end of the contract period covering complete details of all research carried out on the project. The final report shall include all developed computer code, in both fully commented source and executable versions. All computer code shall comply with ASHRAE requirements for delivery and documentation as determined by TC 1.5. Unless otherwise specified, six draft copies of the final report shall be furnished for review by the PMS.

   Following approval by the PMS and the TC, final copies of the final report will be furnished as follows:

- An Executive Summary suitable for wide distribution to the industry and to the public.
- Six bound copies for the PMS and six bound copies for the Manager of Research.
- One unbound copy printed on one side only and suitable for reproduction.
- Two copies on diskette(s), one in ASCII format and one in Microsoft Word 6.0.

5. One or more Technical Paper(s) shall be submitted in a form suitable for presentation at a Society meeting. The Paper(s) shall conform to the Society's "Submitting Manuscripts for ASHRAE Transactions" which may be obtained from the Special Publications Section.

6. All papers or articles submitted for inclusion in any ASHRAE publication shall be made through the Manager of Research and not to the publication's editor.

7. A Technical Article suitable for publication in the ASHRAE Journal may be requested by the Society. This is considered a voluntary submission and not a deliverable.

LEVEL OF EFFORT

It is estimated that the project will require 20 person months and a total cost of $120,000.

ADDITIONAL INFORMATION FOR BIDDERS

Submissions that propose to use or modify information from proprietary sources shall provide written permission from the owner(s). This includes, but is not limited to, data from proprietary databases and reprints of published schematics/diagrams.

Proposal evaluation criteria:

- Bidder's understanding of the work statement as revealed in proposal: 15%
- Quality of methodology proposed for conducting the research: 25%
- Bidder's capability in terms of facilities: 5%
- Qualifications of personnel for the project: 20%
- Involvement of students: 5%
- Probability of bidder's research plan meeting the objectives of the work statement: 25%
- Performance of bidder on prior ASHRAE projects or related projects (no penalty for new bidders): 5%.

REFERENCES

1. John I. Levenhagen. 1998. *HVAC Control System Design Diagrams*, McGraw Hill.
2. Harold G. Lorsch, Principal Investigator, ASHRAE 581-RP Project Team,. 1993. *Air Conditioning Systems Design Manual*.

AUTHORS

Ian Beausoleil-Morrison, Dru Crawley, Jan Hensen

TC 4.7 Handbook Subcommittee Meeting

Handbook of Fundamentals Chapter 30
Energy Estimating and Modeling Methods

Monday, February 7, 2000

Present:

Marlin Addison	marlin.addison@doe2.com
Marroj Chullipasantal	chullip@okstate.edu
David Eldridge	eldridd@okstate.edu
Sean Hockersmith	shocker@okstate.edu
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Chris Subbarao	chris.subbarao@ps.net
Jim Willson	jimwill@indy.net
Les Norford (chair)	lnorford@mit.edu

The meeting began at 5:10 p.m. Norford reviewed the organization of the chapter and the status of the revisions to each section, as noted in the table at the end of the minutes.

Krarti answered questions about the simplified procedure for calculating peak and seasonal energy flows through slabs and basements.

Norford reviewed the schedule for the chapter. At the Seattle meeting (June 1999), he had announced that a review draft would be distributed no later than October 31, 1999 and that comments would be incorporated in time for a vote by TC4.7 at the Dallas meeting. Several chapter authors, including the subcommittee chair, did not produce new material in time for committee review and a vote. However, only the section on system modeling requires further work and the draft chapter will be ready for email distribution to members within 45 days. Claridge, the Handbook Liaison, noted after the meeting that the approved chapter is not due at ASHRAE Headquarters until September 14, 2000, although the Handbook staff would very much like to have it earlier.

The meeting adjourned at 5:40 p.m.

Status of Revision to ASHRAE Handbook of Fundamentals Chapter 30
Energy Estimating and Modeling Methods

Section of current (1997) chapter	Revision status
GENERAL CONSIDERATIONS (3 pages)	**DONE**. New material provided by Reddy, edited by Norford.
Purposes	
Common Factors	
Choosing an Analysis Method	
COMPONENT MODELING AND LOADS (13)	DONE
Calculating Instantaneous Space Sensible Load	Revised by Spitler; section is substantially shortened because the new Loads Calculations chapter will include the heat-balance method
Secondary System Components	Revised by Brandemuehl (new examples, relatively minor editing)
Primary System Components	Revised by Brandemuehl (new examples, relatively minor editing)
SYSTEM MODELING (6)	**IN PROGRESS**. Partially edited by Norford; needs bin-method example.
Overall Modeling Strategies	
Degree Day and Bin Methods	
Correlation Methods	
Simulating Secondary and Primary Systems	
Modeling of System Controls	
Integration of System Controls	
INVERSE MODELING (6)	**DONE**. Inverse modeling section in its entirety has been re-written by Reddy and edited by Norford
Hybrid Modeling	
Classification of Methods	
Selecting an Approach	
REFERENCES	**IN PROGRESS**. Authors have provided updates.
NEW MATERIAL (NOT IN 1997 CHAPTER)	**DONE**. Ground-coupled heat transfer, with simplified calculation procedures for slabs and basements and examples; provided by Krarti, partially edited by Norford

ASHRAE TC 4.7
SUMMARY OF PROGRAMS/PROGRAM PLAN

Dallas, February 2000 (actual)

Seminar: ASHRAE's Software Toolkits for Energy Calculations (Sim-Comp/Chair: Dru Crawley drury.crawley@ee.doe.gov)

Minneapolis, June 2000 (Submissions closed)

Symposium International Experience with Weather Data for Simulation and Design (TC 4.2 co-sponsor/ Dru Crawley drury.crawley@ee.doe.gov)

Atlanta, January 2001 (April 7 Tech Paper submit/August 4, 2000 package to ASHRAE)

1. Symposium: Tools and Techniques for Calibration of Component Models (TC1.5&4.7/Agami Reddy reddyta@drexel.edu)--4 papers in process (1 manuscript draft received) as of Seattle meeting 6/99

2. Symposium: Simulation Models for Low-Energy Cooling (Sim-Comp/Joe Huang YJHuang@lbl.gov)

3. Seminar: Low Energy Cooling Case Studies (Sim-Comp/Phil Haves phaves@lbl.gov)

4. Seminar: Commercial Use of Building Energy Simulations (Applications/Hofu Wu hwu@csupomona.edu)

5. Seminar: Inverse Regression Methods for Optimizing Simulations (Inverse/Marlin Addison marlin.Addison@doe2.com)

6. Symposium: Better Inputs for Better Output (Applications, TC 9.6 co-sponsor/Chair: Jim Willson jimwill@indy.net)--commitment for 2 papers, call for papers published 1/00

Cincinnati, June 2001 (September 29, 2000/February 9, 2001)

1. Symposium: The Stories that Utility Records Tell Us about Energy Performance in Commercial Buildings (TC 9.6 and 4.7/Chair Taghi Alereza)

2. Symposium: Recent Innovations in HVAC System Modeling (Applications/Chair: Tim McDowell mcdowell@tess-inc.com)

Atlantic City, January 2002 (April 2, 2001/August 3, 2001)

1. Symposium: Inverse Method Toolkit and Applications (Inverse/Jan Kreider jfk@well.com)

2. Symposium: Interoperability and Tool Portability (Sim. Comp./Chip Barnaby cbarnaby@wrightsoft.com)

MINUTES
SPC-140 SMOT FOR BUILDING ENERGY SOFTWARE
Dallas, February 7, 2000

CORRESPONDANCE SINCE LAST MEETING

Frequent emails and telephone calls by Neymark and Judkoff to ASHRAE Staff (Liz Baker, Sandra Armstrong, Bruce Hunn) to encourage ASHRAE to put Standard 140P into the proper format so that it can be formally submitted to SPLS by ASHRAE staff. This resulted in a draft getting to SPLS in time for them to review it in Dallas.

GENERAL

None

INTERMODEL COMPARISON BASED TESTS

The purpose of the meeting was:

- give update to the committee regarding public review status
- have a mini-seminar with presentations by Witte and Yuill regarding validation projects relevant to Standard 140P.

Attendees (see mailing list for full names, etc)

Voting Members	Non-Voting Members
Crawley	Neymark
Haberl	Spitler
Judkoff (chair)	Yuill
Sonderegger	Other
Walton	Armstrong
Wilcox	Blake
Witte	Calla
	Chullip???????
	Ramamoorthy
	Jin
	Rees
	Watson
	Xiao

Committee Discussion

Tom Watson (SPLS liaison) notified SPC 140 that SPLS voted to accept previous SPC 140 recommendation to submit Standard 140P for public review, and that the Standards Committee

voted to submit Standard 140P for public review. He said it was possible that public review could be announced in the March ASHRAE Journal, but that April is more likely.

Approval of Prior Minutes

Motion (Sonderegger): Accept Minutes of June 1999 meeting (Seattle). 2nd (Witte): Vote: Yes = 6, No = 0, Absent = (Fraser, Haberl, Maeda, Winkelmann). Motion passed.

Yuill presented an overview of 865-RP.

Witte presented an overview of comparative testing EnergyPlus (beta version) with Standard 140P.

Adjourned

Meeting Agenda
SPC 140P, February 7, 2000, Adam's Mark Hotel, Dallas, TX
2:15P - 4:30P, Room Pearl 2

Approval of prior meeting minutes (June 21, 1999, Seattle)

- Update on SPLS review of Standard 140P (brief)

- BESTESTing of EnergyPlus (Witte) - (30 minutes)

- Overview of 865-RP (Yuill) - (30 minutes)

- Other?

SPC 140 ADDRESS LIST
21 January 2000

(note: in general email attachments should go out as both *.DOC, *.RTF and *.WP5)

VOTING MEMBERS

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