

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: January 11, 2000

TC/TG/TRG TITLE: Energy Calculations

DATE OF MEETING: June 22, 1999 LOCATION: Seattle

MEMBERS PRESENT	YEAR APPTD	MEMBERS ABSENT	YEAR APPTD	EX-OFFICIO MEMBERS & ADDIT'L ATTENDANCE
Chip Barnaby	1999	George Reeves	1995	
Bill Bahnfleth	1998	Jeff Spitler (VC)	1995	
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			
Robert Sonderegger (CHM)	1999			
George Walton	1996			
Fred Winkelmann	1996			
Michael Witte	1998			

DISTRIBUTION

**ALL MEMBERS OF THE TC/TG/TRG**

TAC CHAIR

TAC SECTION HEAD

RAC RESEARCH LIAISON

STANDARDS LIAISON

PROGRAM LIAISON

JOURNAL LIAISON

HANDBOOK LIAISON

STAFF LIAISON (RESEARCH)

STAFF LIAISON (STANDARDS)

STAFF LIAISON (TECH SERVICES)

Terry Townsend

Byron Jones

Carl Speich

Waller Clements

Emil Friberg

Kelly Cramm

David Claridge

William Seaton

Claire Ramspeck

Martin Weiland

**TC 4.7 Actions  
Seattle, June 22, 1999**

- 1. Request no-cost extension on 987-RP to 7/31/2000.**
- 2. Contractor recommended for selection for 1049-TRP & 1145-TRP.**
- 3. WS “Standard Operating Conditions in North American Residential Buildings” recommended for bid 11-0-2.**

**ASHRAE TC/TG/TRG ACTIVITIES SHEET**

**DATE:** January 11, 2000

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

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

<b>TC/TG/TRG MEETING SCHEDULE</b>			
<b>LOCATION</b> - past 12 months	<b>DATE</b>	<b>LOCATION</b> - planned next 12 months	<b>DATE</b>
Seattle	6/22/1999	Dallas	2/8/2000
Chicago	1/26/1999	Minneapolis	6/27/2000

  

<b>TC/TG/TRG SUBCOMMITTEES</b>	
<b>Function</b>	<b>Chair</b>
Simulation and Component Models Applications Inverse Methods	Dan Fisher Joe Huang Jeff Haberl

  

<b>RESEARCH PROJECTS - Current</b>		<b>Monitoring</b>	<b>Report Mode</b>
<b>Project Title</b>	<b>Contractor</b>	<b>Comm.Chm.</b>	<b>At Meeting</b>
Appendix 1			

  

<b>LONG RANGE RESEARCH PLAN</b>				
<b>Rank</b>	<b>Title</b>	<b>W/S Written</b>	<b>Approv</b>	<b>To R &amp; T</b>
1.	See attachment 7.			
2.				
3.				
4.				

<b>HANDBOOK RESPONSIBILITIES</b>				
<b>Year &amp; Volume</b>	<b>Chapter Title</b>	<b>No.</b>	<b>Deadline</b>	<b>Handbook Subcom. Chair/Liaison</b>
2001 Fundamentals	Energy Estimating Methods	30	February 2000 Dallas	Norford/Claridge
<b>STANDARDS ACTIVITIES - List and Describe Subjects</b>				
SPC 140P Standard Method of Test for Building Energy Software - Ron Judkoff				
<b>TECHNICAL PAPERS from Sponsored Research - Title, when presented (past 3 yrs. present &amp; planned)</b>				
Appendix 2				
<b>TC/TC/TRG Sponsored Symposia - Title, when presented (past 3 yrs. present &amp; planned)</b>				
Appendix 3				
<b>TC/TG/TRG Sponsored Seminars - Title, when presented (past 3 yrs. present &amp; planned)</b>				
Appendix 4				
<b>TC/TG/TRG Sponsored Forums - Title, when presented (past 3 yrs. present &amp; planned)</b>				
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)				
<b>JOURNAL PUBLICATIONS - Title, when published (past 3 yrs. present &amp; planned)</b>				

**Additional Attendance\***

Present at TC 4.7 Meeting?				Last Name	First Name	E-Mail
Seattle June 1999	Chicago January 1999	Toronto June 1998	San Francisco January 1998			
X				Abushakra	Bass	boa7654@unix.tamu.edu
	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	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		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	Carpenter	J. Patrick	jpc@tklp.com
	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		Degelman	Larry	Larry@archone.tamu.edu
X				Desjarlais	Andre	yt7@ornl.gov
X	X	X		Fisher	Dan	DFisher@okstate.edu
X				Flake	Barrett	Barrett.Flake@afit.af.mil
X			X	Fraser	Kathleen	KFraser@transalta.com
X		X		Gardner	Carol	GEMS@teleport.com
X		X		Haberl	Jeff	JHaberl@esl.tamu.edu
	X			Haddad	Kamel	KHHaddad@nrcan.gc.ca
X	X	X	X	Haves	Philip	PHaves@lbl.gov
X	X	X	X	Hensen	Jan	JaHe@fago.bwk.tue.nl
			X	Hittle	Doug	Hittle@engr.colostate.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	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	Knappmiller	Kevin	KevinK@kevtec.com
X	X			Knebel	Dave	DKnebel@mammoth-inc.com
X			X	Krarti	Moncef	Krarti@bechtel.colorado.edu
X	X		X	Kreider	Jan	Kreider@bechtel.colorado.edu
	X			Lawrie	Linda	L.Lawrie@computer.org
X	X			Leber	Jon	jahbata@aol.com
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		McDowell	Tim	Mcdowell@tess-inc.com

Present at TC 4.7 Meeting?				Last Name	First Name	E-Mail
Seattle June 1999	Chicago January 1999	Toronto June 1998	San Francisco January 1998			
X				McGowan	Alex	Alex@enermodal.com
X	X			Medina	Mario	MMedina@ukans.edu
				Mitchell	John	Mitchell@engr.wisc.edu
X	X			Morner	Svein	SMorner@dorganai.com
		X	X	Nall	Dan	DanNall@mindspring.com
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			Rees	Simon	SJRees@okstate.edu
				Reeves	George	George_Reeves@compuserve.com
	X			Selkowitz	Steve	SESelkowitz@lbl.gov
X	X	X	X	Smith	Vernon	VSmith@archenergy.com
X				Somasundaram	Sriram	Sriram.Somasundaram@pnl.gov
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		Spitler	Jeffrey	Spitler@okstate.edu
X			X	Strand	Rick	R_Strand@uiuc.edu
			X	Swami	Muthasumy	Swami@fsec.ucf.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		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, PI	PMSC	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 3-31-2000 (1-27-99)
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
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)
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)
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 LeViseur (TC 4.1)	WS: 1-20-98 (SF) Start: 2-1-99

## 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.

January 1997

787-RP Rock, B., D. Wolfe. 1997. A Sensitivity Study of Floor and Ceiling Plenum Energy Model Parameters. ASHRAE Transactions v 103 n 1 1997.

June 1995

741-RP Spitler, J.D., J.D. Ferguson. 1995. Overview of the ASHRAE Annotated Guide to Load Calculation Models and Algorithms ASHRAE Transactions v 101 n 2 1995.



### Appendix 3 TC Sponsored Symposia

#### **FUTURE:**

##### Atlanta, February 2001

Symposium: *Better Inputs for Better Output*  
(Applications, TC 9.6 co-sponsor/Chair: Jim Willson)

Symposium: *Practical Methods for Baselineing Central Plants at Multi-Building Facilities.*  
(??/Chair: Phil Haves)

##### Minneapolis – June 2000

Symposium: *Recent Innovations in HVAC System Modeling*  
(Applications/Chair: Tim McDowell)

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

Symposium: *Simulation Models for Low-Energy Cooling*  
(Simulation & Component/Chair: Joe Huang or Rich Karney)

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

##### Dallas - February 2000

Symposium: *Calibrating Building System Models*  
Chair – Kevin Knapmiller

#### **PAST:**

##### Seattle - June 1999

Symposium: *Accuracy Test for Simulation Models*  
Chair – Mike Witte

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

##### Chicago - January 1999

Symposium: *Application of Heat Balance Methods to Energy and Thermal Load Calculation*  
Chair – Chip Barnaby

##### Toronto - June 1998

Symposium: *Baseline Calculations for Measurement and Verification of Energy and Demand Savings*  
Chair – Robert Sonderegger

## Appendix 4 TC Sponsored Seminars

### **FUTURE:**

#### Minneapolis - June 2000

"Low Energy Cooling Case Studies", Chair: Phil Haves or Rich Karney

#### Dallas - January 2000

"ASHRAE Software Toolkits for Energy Calculations" (Sim-Comp/Chair: Dru Crawley)

### **PAST:**

#### Chicago - January 1999

"Simulation Tool Interoperability and Component Model Portability", Chair: Phil Haves

#### Toronto - June 1998

"Neural Nets: What Are They and What Can They Do?", Chair: Moncef Krarti

#### Boston - June 1997

"Practical Applications of Energy Calculations", Chair: Chip Barnaby

#### Philadelphia - January 1997

"Calibration of Computer Simulation for Building Energy Analysis", Chair: Taghi Alereza, co-sponsored with TC 9.6, Systems Energy Utilization

## ASHRAE TC 4.7 Energy Calculations Meeting Minutes

Seattle, Washington  
22 June 1999

1. Chairman Robert Sonderegger called the meeting to order at 6:04 p.m. The following members were present: Chip Barnaby, Bill Bahnfleth, Dru Crawley, Dan Fisher, Carol Gardner, Jeff Haberl, Moncef Krarti, Jean LeBrun, Les Norford, Agami Reddy, Robert Sonderegger, Jeff Spittle, George Walton, Fred Winkelmann, and Michael Witte. George Reeves was absent.
2. Sonderegger introduced Carl Speich, RAC liaison for Section 4.
3. The agenda was distributed and is attached (Attachment 1). Haberl moved and Barnaby seconded to accept the agenda and minutes from the Chicago meeting. The motion carried unanimously.
4. Sonderegger made several announcements:
  - a. Continuing education committee is looking for new topics. Let Sonderegger know if you have ideas.
  - b. New technical achievement award to recognize excellence in technical achievement by a TC or TG member. Soliciting nominations—Gren Yuill to collect nominations.
  - c. Steve Taylor, liaison for Journal/Insights, looking for articles. Contact Steve via e-mail: [STaylor@taylor-engineering.com](mailto:STaylor@taylor-engineering.com)
  - d. An Ad Hoc Committee on Strategic Planning Objective 3.2 has been formed. Sonderegger looking for a volunteer. Brandemuehl volunteered to attend.
  - e. New process for symposium and technical sessions includes a double blind review process for papers. Session chairs cannot be authors.
5. Sonderegger then reported on membership changes after this meeting. Jim Willson and Joel Neymark will be new members in 2000 and Klaus Sommer will join as a new international member. Sahlin and Klein have resigned as members and Reeves is rolling off after this meeting.
6. Haberl reporting for the Applications subcommittee. Applications just prior to this meeting.; agenda and minutes are attached (Attachment 2). Subcommittee recommends sending one work statement (WS) forward (Standard Operation Conditions for North American Buildings). Priorities for the four WS from the subcommittee are Standard Operating Conditions for North American Buildings, Ground Coupling Cases for SPC 140P (Neymark/Beausoleil-Morrison), Define Performance Factors for Primary and Secondary Equipment Simulation Inputs for Commercial Buildings (Bahnfleth/Nall), HERS-BESTEST templates, and Building Thermal Loads for Chillers.
  - a. Reddy reported on progress on 1093-RP Diversity Factors & Schedules for Energy & Loads. The minutes from the PMS are shown in Attachment 3.
7. Haberl then reported for the Inverse Methods subcommittee, which met Monday night (minutes are shown in Attachment 4). The TC discussed several of the WS in detail.
  - a. Walton reported on 865-RP. The PMS met with the contractor (PSU/TAMU) on Monday afternoon. Planning to complete work by time indicated in last no cost time extension to contract (March 31, 2000).
  - b. Kreider reported on 1050-RP Inverse Toolkit progress. The PMS met with the contractor (University of Dayton) on Monday. Work under way since beginning of year—this was first report to the PMS. Concerns about dealing with uncertainty—see attached PMS notes (Attachment 5).

8. Fisher reported on the meeting of the Simulation and Component Models subcommittee. Meeting minutes are attached (Attachment 6). Quite a lot of interest in staying abreast of IAI developments (after Chicago seminar). 3 WS on plan, 2 close to being ready, third on its way.
    - a. Crawley reported on 987-RP progress by the contractor (University of Illinois). The PMS plans to publish the toolkit on CD only with space available so that supporting programs such as Window 4.1 and COMIS can be included. Both printable and hyper-linked documents will be included on the CD. The project is about 80% complete with plans for an organized review by PMS and others underway. A wider review will start in late fall with a target completion date prior to the Dallas meeting. The project is running behind the original scheduled completion. The PMS requested a no-cost time extension to the contract through July 31, 2000. Walton moved and Norford second that the TC request a no-cost time extension for 987-RP. Motion passed (13-0-0, CNV).
    - b. Walton reported on 1052-RP Analytic Test Suite Whole Building Energy Programs. The PMS met with the contractor (Simon Rees for Jeff Spitler, Oklahoma State University). [Spitler unavailable to attend because of the birth of his daughter that morning.] Contractor to provide summary report in fall 1999. Test suite will be tested against EnergyPlus. Fisher is leaving the PMS (having joined OSU) but still have 4 PMS members.
  9. Barnaby then discussed TC 4.7 Research. At this meeting, the TC needed to recommend two contractors (1049-TRP and 1145-TRP), discuss WS in progress and adopt the TC's research plan for 2000-2001. Sonderegger first described new research plan method—each TC will submit 3 RTARs, (1-page descriptions) not 10 as in the past. Bahnfleth moved and Fisher seconded that TC 4.7 adopt a policy of selecting contractors in executive session (only TC members and PES). Motion was defeated (6-7-0, CNV). Anyone (other than proposers) can participate in discussions about proposals but only Seaton can inform the bidders (after approval by the RAC). Discussion then focused on the recommendations of the two PES (1049-TRP and 1145-TRP).
    - a. Pedersen reported on the deliberations of the PES (Knebel, Sowell, Nelson, Pedersen) on 1049-TRP Building System Synthesis and Design. Co-sponsored by TC 1.5 and TC 4.6. TC 1.5 had previously approved the recommendation of the PES (7-0-0). Haberl/Reddy moved that TC 4.7 recommend the selection of Loughborough University for 1049-TRP. Motion approved 13-0-0, CNV. Michael Brandemuehl will serve as PMS member for TC 4.6. The following PMS was appointed by Sonderegger: Pedersen (chair), Knebel, Sowell, Nelson (TC 1.5), Brandemuehl (TC 4.6), and Hensen.
    - b. Beausoleil-Morrison reported on the deliberations of the PES (Walton, Winkelmann, and Beausoleil-Morrison) for 1145-TRP Modeling 2- & 3-D Heat Transfer through Composite Wall & Roof Assemblies in Hourly Simulation Programs. Gardner/Witte moved that TC 4.7 recommend the selection of Enermodal Engineering Ltd for 1145-TRP. Motion approved 11-0-2, CNV. (two bidders: Krarti/Fisher out of the room). The PMS will be Beausoleil-Morrison (chair), Walton, Winkelmann, and Hittle (TC 4.1).
- The TC then discussed the WS Standard Operating Conditions for North American Residential Buildings. Barnaby moved and Haberl seconded to recommend forwarding the WS to RAC for bidding. Motion approved (11-0-2, CNV). The PES for this WS is Wray (chair), Neymark, and V. Smith.
- The draft research plan for 2000-2001 was then presented by Barnaby and discussed. Walton moved and Krarti seconded approving the research plan as presented. Motion approved (13-0-0, CNV). See Attachment 7.
10. Norford reported on the significant progress to date on revising Chapter 30 (see notes from the Handbook meeting, Attachment 8). Final draft to be distributed by October 31, 1999 for comments and final approval. The final draft will be distributed for a vote at the Dallas meeting.
  11. Bahnfleth presented the program plan for the TC (shown in Attachment 9). Bahnfleth moved and Barnaby seconded that the plan as presented be approved. Motion passed (13-0-0, CNV).
  12. SPC 140P met on Monday. Notes from the meeting are shown in Attachment 10).

13. Reports on related activities.
  - a. IBPSA, Pedersen reported that IBPSA-USA held a Software Expo and Dinner on Saturday at the Petroleum Museum. Sonderegger was the guest speaker. Next meeting Saturday before ASHRAE in Dallas—with software expo.
  - b. GPC 14P Measurement of Energy and Demand Savings, Sonderegger reported that the GPC voted for public review at their last meeting. The PR draft should be available after editing in a few months.
  - c. IAI International Alliance for Interoperability, Crawley reported that TG 4.IBD Integrated Building Design (TG 4.IBD is now TC 4.12) is the cognizant TG for ASHRAE. ASHRAE has joined the IAI. TC 1.5 and this TC continue to be very interested in this activity.
  - d. SPC 152 MOT Design & Seasonal Efficiencies of Residential Thermal Distribution Systems, Leber reported that the draft is out for public review—closes on July 6<sup>th</sup>. There are simulation aspects that this TC should be interested in. Modera may have speakers for a future seminar on this topic. Reddy to bug Modera (and copy Sonderegger and Sherman).
  - e. TC 4.1 Load Calculations, Barnaby reported that the TC is continuing transition to heat balance method as the method presented in the Fundamentals Handbook. The TC will remove all loads calculation methods except heat balance and radiant time series. PES for a project on Experimental validation of the heat balance method met on Sunday and will be under way soon.
  - f. TC 4.2 Weather Information, Crawley and Barnaby reported that 1015-RP is producing 200 international weather files for use in simulation programs. The 890-RP project, which developed the weather data in the 97 Fundamentals, has developed a CD of joint frequency tables (available soon).
  - g. TC 4.5 Fenestration, no representative.
  - h. TC 4.6 Building Operation Dynamics, Brandemuehl reported that the TC was working on dynamic models of components. Forum at next meeting on dynamic models. Developed an annotated guide to short-time step calculations.
  - i. TC 4.11 Smart Building Systems, Norford said the TC is looking at fault detection, component-level and system-level models. May be opportunities in the future for joint research/program.
  - j. TC 9.6 Systems Energy Utilization, Reddy reported that TC 9.6 looking for program activities and increasing WS generation.
14. Old Business, none.
15. New Business, none.
16. Barnaby moved and Witte seconded that the TC adjourn. Unanimously approved. The meeting adjourned at 8:48 pm.

## Agenda

**Tuesday, June 22, 1999, 6:00-8:30 pm**  
**Washington State Convention Center, Room 605 (6<sup>th</sup> floor)**

- |  |             |                     |
|--|-------------|---------------------|
| 1. Roll call and introductions   |             | Crawley             |
| 2. Accept agenda & approve minutes of Chicago 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               |
| 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              |
| 5.4 Research   |             | Barnaby             |
| 1049-TRP Building System Design Synthesis update   |             | Pedersen            |
| 1145-TRP Modeling 2&3-D Ht Transfer Thru Composite Wall & Roof<br>Assemblies in Hourly Simulation Programs |             | Beausoleil-Morrison |
| 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  |             | Selkowitz           |
| 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   |             |                     |

**MINUTES**  
**TC 4.7 Applications subcommittee**  
**Tuesday, June 22, 1999, 3:30 to 5:00 p.m.**  
**Conference Center #310**  
**Seattle, Washington**

**Chair: Joe Huang (Absent)**  
**Acting Chair: Jeff Haberl**  
**Secretary: Kevin Knappmiller**

- |  |
|--|
| <p>1. Introductions (5 minutes)</p> <p>2. Accept agenda &amp; approve minutes of Chicago meeting (5 minutes)</p> <p>3. Announcements ( 5 minutes)</p> <ul style="list-style-type: none"> <li>• IBPSA Conference in Kyoto</li> </ul> <p>4. Program (10 minutes)</p> <ul style="list-style-type: none"> <li>• Seattle : Symposium on “Accuracy Tests for Simulation Models” (Witte)</li> <li>• Seattle: Symposium on “Applications of Heat and Mass Balance Methods to Energy and Thermal Load Calculations” (Barnaby)</li> <li>• Dallas : Seminar on “ASHRAE Software Toolkits for Energy Calculations” (S&amp;C/Crawley)</li> <li>• Minneapolis : Symposium on “Recent Innovations in HVAC System Modeling” (Appl/McDowell)</li> <li>• Minn: Symposium on “Better Inputs for Better Outputs” (Appl/Willson)</li> </ul> <p>5. Other suggestions and ideas</p> <p>6. Research</p> <p>6.1 Ongoing Projects (5 minutes)</p> <ul style="list-style-type: none"> <li>• 1093-RP Diversity Factors &amp; Schedules for Energy and Loads (Reddy)</li> </ul> <p>6.2 Work Statements (30 minutes)</p> <ul style="list-style-type: none"> <li>• “Standard operating conditions in North American residential buildings” (Parker/Buhl)</li> </ul> |
| <ul style="list-style-type: none"> <li>• “Characterization of building thermal loads from chiller electric use data” (Reddy)</li> <li>• “Defining performance factors for primary and secondary equipment simulation inputs for commercial buildings” (Bahnfleth/Nall)</li> </ul>  |
| <ul style="list-style-type: none"> <li>• “Compilation of input data for air flow models” (Walton)</li> <li>• Other suggestions and ideas</li> </ul> <p>6.3 Long Range Research Plan (10 minutes)</p> <p>7. Old Business (5 minutes)</p> <p>8. New Business (5 minutes)</p> <p>9. Adjourn</p>   |

**ATTENDEES:**

NAME:	EMAIL:
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J.Haberl started the meeting at 3:35 p.m. with introductions. Handouts were passed around and the minutes from the Chicago meeting were reviewed by the sub-committee.

MOTION: A motion was then put forward by George Walton to approve the minutes from the Chicago meeting, 2<sup>nd</sup> by Klaus Sommer. Motion carried.

Chip Barnaby then asked the sub-committee if he could have the Long Range Research Plan (LRRP) discussed first so that he could assemble the LRRP for the main TC 4.7 committee meeting that immediately follows this sub-committee meeting.

Everyone agreed that this was o.k.



J.Haberl then moved to Item #5 on agenda, LRRP and read the titles to the sub-committee. The LRRP from the Chicago meeting included the following research topics:

(WS) “Standard operating conditions in North American residential buildings” (D.Parker, F.Buhl).

(1-pager) “Characterization of building thermal loads from chiller electric use data” (A.Reddy, R.Sonderegger).

(1-pager) “Defining performance factors for primary and secondary equipment simulation inputs for commercial buildings” (Bahnfleth, Nall).

(title only) “Compilation of input data for air flow models.” (Walton).

In addition to the above titles from the Chicago meeting the following titles had been received since the Chicago meeting:

(1-pager) “Development of ground coupling cases for the proposed ASHRAE SMOT 140” (Judkoff, Neymark).

(1-pager) “Development of standardized computer input files for describing typical residential homes & the most common energy conservation retrofits.” (Haberl).

Haberl then proposed that a few minutes would then be taken to discuss each title so that the sub-committee could get a sense of the proposal for purposes of prioritizing the LRRP for the main TC 4.7 meeting that followed.

Haberl proposed that the WS entitled “Standard operating conditions in North American residential buildings” (D.Parker, F.Buhl) be the #1 priority due to the fact that the champions (i.e., Parker and Buhl) had delivered and revised their WS for this meeting. The sub-committee agreed that this was o.k.

Haberl then mentioned to the sub-committee that the WS entitled “Compilation of input data for air flow models.” (Walton) existed only in title, and therefore, unless the author had a 1-pager prepared for this meeting it would go to the bottom of the list.

Walton told the sub-committee that title represented a need for input data that had come out of NIST’s work on interzonal air flow transfer models. NIST wants to do this in support of interzonal models. He said that this work was in progress and that therefore he was not ready to develop a WS but wanted to have a place holder on the TC 4.7 Applications LRRP so that when the work became sufficiently developed that it could then become a WS.

One idea is to leave off of workplan only keep title compilation of input data for airflow models”.

The sub-committee agreed that this would be o.k. to leave this title on the LRRP as a title only at the bottom of the list.

Discussion then moved to the 1-pager entitled: (1-pager) "Characterization of building thermal loads from chiller electric use data" (A.Reddy, R.Sonderegger).

This WS came out of PG&E's efforts to develop chiller load models. The idea is that chiller electric and two temperatures could be used to back-calculate Btu output from the chiller...this would be helpful for sites where only chiller electric & temperatures were available (i.e., condenser return to chiller and chilled water supply) and chiller Btu was not. This could be used to build database of cooling Btu loads from chiller electric data.

ACTION: Robert and Agami will continue to work on WS.

Discussion then moved on to the (1-pager) "Development of ground coupling cases for the proposed ASHRAE SMOT 140" (Judkoff, Neymark).

Neymark: This is needed because there is a lack of data for the current standard. Therefore, cases need to be developed that were intentionally left out of current standard.

Some questions were raised about Krarti's earlier project?

Neymark reminded the committee that this was not to develop a new model. Tasks are to: 1) perform literature search, 2) develop user's guide, 3) generate example results.

It was suggested that the proposal was a bit costly. What are deliverables?

Neymark said: 1) Bestest users manual, 2) example results...using high quality 10x effort than standard simulation.

ACTION: Joel and Ian will commit to WS.

Discussion then moved on to (1-pager) "Development of standardized computer input files for describing typical residential homes & the most common energy conservation retrofits." (Haberl).

Haberl said this is needed for more accurate energy compliance codes. Few, if any that have public domain computation engines. Currently, codes must satisfy BESTEST, but not verifiable that data entered correctly in each case. So start with a few typical building types and put these into public domain. Keep engine public that consists of templates for use by specific engines (i.e., DOE-2 or BLAST).

Crawley said that this need to resemble earlier work by GRI and LBL.

Haberl said that this would be a good place to start.

Crawley said that this needed to be expressed in BESTEST format for generic applicability.

Neymark wanted to know about user interface.

Haberl commented that this would still require someone to develop a user interface...most likely private developers...possibly a bare-bones user interface for testing...

Sonderegger said that this needs to focus on new ENERGYPLUS format.

Haberl said that some of this could be left up to the contractor...either would suffice, DOE-2, ENERGYPLUS, BLAST...any of these would work.

Crawley suggested that this be ENERGYPLUS.

Haberl asked is ENERGYPLUS is far enough along for this to be done.

Crawley said that Huang could lend a hand in developing this.

All agreed that this would force everyone to throw out other engines and fall into new program!  
Put generic description and example implementation in particular program.  
Specify BESTEST caliber description.

Carol - don't presume that user will use anything other than what they already use.

Other questions... what regions? What type of house?

It was also suggested that TRNSYS could be used ...making standard template for is not hard if BESTEST data is given.

**ACTION:** Haberl and Huang will work on this WS.

Discussion then moved on to (WS) "Standard operating conditions in North American residential buildings" (D.Parker, F.Buhl).

Danny Parker explained that there are still too many wrong assumptions being made about residential simulations. Why is this? Who is requiring simulations? What are typical types of inputs that you should use? Thermostats assumptions are not good. What is the reality of vacations? No knowledge of big knobs in residential simulations. Too much focus on small issues but not big. Needs to have big parametric study. Right ballpark. Based on these results then put together guidebook.

It was suggested that the title may need change to reflect what was just mentioned.

There was a question about why the scope was limited to residential?

Parker said that this makes it doable.

MOTION: approve as written and move to TC? Fred B, and 2 Carol. All passed.

ACTION: Parker agreed to carry this forward to the full TC for vote.

Discussion then turned to prioritizing the WS and one pagers:

Proposed priority:

#1 (WS) "Standard operating conditions in North American residential buildings" (D.Parker, F.Buhl).

#2 (1-pager) "Development of ground coupling cases for the proposed ASHRAE SMOT 140" (Judkoff, Neymark).

#3 (1-pager) "Defining performance factors for primary and secondary equipment simulation inputs for commercial buildings" (Bahnfleth, Nall).

#4 (1-pager) "Development of standardized computer input files for describing typical residential homes & the most common energy conservation retrofits." (Haberl).

#5 (1-pager) "Characterization of building thermal loads from chiller electric use data" (A.Reddy, R.Sonderegger).

#6 (title only) "Compilation of input data for air flow models." (Walton).

MOTION: To accept TC 4.7 Long Range Research Plan as stated (Beausoleil-Morrison) 2<sup>nd</sup> (Gardner)...carried.

Discussion then moved on to program.

Had a couple good ones this time.

Dru has 3 or 4 for Toolkits Seminar. For Dallas.

Tim McDowell symposium. "Recent innovations in system modeling." Needs to be done before next meeting for Minn.

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“Whole building energy simulations. Need data on real buildings.” For Atlanta. Call for papers on all media.

Discussion then moved on to RP1093.

Bahnfleth gave report on RP 1093 awarded to Texas A&M. Work underway included literature review...search for data...then choose methods...test methods...report, etc. (see attached handwritten report).

Meeting adjourned 5:08 p.m.

**Minutes**  
**ASHRAE 1093-RP**  
**Compilation of Diversity Factors and Schedules for Energy and Cooling Load Profiles**  
**Seattle, June 21, 1999**

The PMS (Reddy, LeViseur, Huang, and Bahnfleth) met with the contractors (Texas A&M University, Haberl, Claridge, and Abushakra) at 7:00 am on Monday, June 21, 1999. The meeting lasted one hour.

The contractors had a month previous to the meeting, mailed a Preliminary Report to the PMS on literature review and database searches. The contractors presented the main features of this report during the meeting. The following issues were discussed and resolved:

1. It was felt that the contractors should limit themselves to the couple of papers dealing with people schedules and not perform any future work in this regard.
2. The contractors should go ahead and acquire the relevant data from the various sources identified.
3. The contractors should select, among the dozen statistical techniques identified, a few most appropriate for this study.
4. The contractors should spell out their thinking on the uncertainty analysis they propose to perform.
5. The types of building stock classification.

The contractors will submit a brief status report describing their progress in issues 1-5 to all PMS members by September 1999. The project is on schedule and progress to date is to the satisfaction of all PMS members.

**MINUTES****TC 4.7 Subcommittee on Inverse Methods  
Monday, June 21<sup>st</sup>, 1999, 7:30 - 9:00 p.m.  
Convention Center #613, Seattle****Chair: Jeff Haberl  
Secretary: Joe Huang****AGENDA**

1. Introductions (all)
2. Discussion of the minutes from January 1999 (all)
3. Review and vote on 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”**
  - WS “Methodology Development to Extend ASHRAE Semi-empirical Chiller Models to include Models for Screw Chillers, Package Air-conditioners, and Heat Pumps.”
  - WS “Development of procedures for analyzing energy savings from weather dependent and weather independent energy usage using an inverse bin method.”
  - “Development of a procedure for baselining energy use at large central plants.”
4. Discussion of Work Statements (all):
  - WS 1051 “Toolkit for comparing computer simulation program...” (Haberl)
  - WS “Meth. Devel. To Extend ASHRAE Semi-empirical Chiller . . .” (Haberl)
  - Other work statements (all)?
5. Program (all)
  - + January 2000 meeting (Dallas)
  - + June 2000 meeting (Minn.)
6. Old Business (all)
7. New Business (all)
8. Adjourn

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The meeting was called to order by Jeff Haberl at 7:35 p.m. Introductions were then made and all necessary paper work for the sub-committee was distributed to the attendees.

J. Haberl then reviewed the minutes from the Chicago meeting and thanked Agami Reddy for chairing the meeting in J. Haberl's absence.

MOTION: A motion was then made by Agami Reddy to approve the minutes which was 2<sup>nd</sup> by Robert Sonderegger and the minutes were approved by the sub-committee with a verbal vote.

J. Haberl then discussed the agenda for the meeting and reminded the sub-committee that they needed to prioritize their Long Range Research Plan (LRRP) for delivery to the main TC 4.7 meeting. This priority item was also accompanied by the review of WS 1051 and any program items for Dallas, Minn., etc.

J Haberl explained that there is one completed work statement, and 3 one-pagers that are up for discussion.

Discussion then proceeded to WS 1051 "Development of a toolkit for comparing the results of hourly building energy simulation programs against measured energy and internal environmental data". Everyone took 5 minutes to read the WS.

M. Krarti asked whether there was any checking of data.

J. Haberl said the intent of the WS is to provide procedures to compare simulated to measured data.

R. Sonderegger said the WS is very good, but we should be mindful that it has been rejected several times before. R. Sonderegger preferred the description as a "procedure" rather than a "toolkit."

D. Claridge thought the link to GPC-14P should be mentioned earlier.

R. Sonderegger also felt that the procedures are applicable to more than hourly simulation results.



K. Kissock asked whether the WS proposes to develop the software to do the graphical presentation.

R. Sonderegger said that's not the role of ASHRAE.

K. Kissock suggested using "characterizing the deviation" instead of "fitting".

R. Sonderegger suggested using the phrase "identifying the best presentation techniques" instead of saying "graphical". Also, using "such procedures should include but not be limited to..." instead of the current phrase that talks about algorithm development.

J. Haberl suggested adding "procedure development" and "development and document" and "demonstrate" to the WS.

K. Kissock then asked how this procedure differed from BESTEST.

J. Haberl explained the differences.

M. Witte mentioned that this procedure would also be very helpful if it could point to which "knob" to turn in DOE-2 or BLAST to get a better agreement with the measured data.

J. Haberl said that this first WS should probably be limited to "comparing" but that future work might evolve into this. J. Haberl also mentioned that some of the previous literature did have this type of thing in it, and he cited as examples several ASHRAE Transactions papers that showed techniques for determining if the simulation correctly corrected for daylight savings shifts, humidification, and various scheduling comparison techniques.

R. Sonderegger said that the WS needs to reflect that it assumes that the measured data are "accurate".

J. Haberl suggested another title for the WS "Development of procedures for characterizing deviations between simulated and measured data."

ACTION: Many agreed that "toolkit" sounds too much like software, and should be replaced by "procedures". Suggested new title for the WS is "Procedures for evaluating computer calculated results against measured energy data".

M. Witte said this needs to indicate what kind of data are used.

M. Witte said that the first two paragraphs are probably too "historical" and could be chopped.

ACTION: R. Sonderegger agreed to continue work on the WS. V. Smith also agreed to help J. Haberl and R. Sonderegger. Next draft due Sept. 1.

Everyone then took 5 minutes to read the next three WSs on the Inverse Methods research plan that are all in the form of one-pagers.

Discussion then proceeded to the 1-pager entitled: "Methodology development to extend ASHRAE semi-empirical chiller models to include models for screw chillers, package air-conditioners, and heat pumps".

J. Haberl informed the sub-committee that he was about ½ completed with the WS. J. Haberl gave a summary of the previous work by Gordon and Ng as well as work previously performed at the University of Colorado (RP 827) and at Texas A&M/Drexel (RP 1004).

J. Haberl said that the purpose of this WS is to extend this work to other types of refrigeration and/or A/C equipment.

M. Witte asked for clarification about what is an semi-empirical model and why is this WS in the inverse subcommittee.

M. Witte suggested that his explain what “physically-based chillers” means.

A. Reddy suggested that the title should not mention screw chillers and focus only on air-conditioners and heat pumps. He said the reason for this was that the Gordon-Ng semi-empirical model was already suitable generic that it probably covered screw chillers.

J. Haberl mentioned that his thinking on this was that screw chillers did not exhibit the same quadratic curvature that centr. and reciprocating chillers did and therefore the thinking was that there might be fertile ground to investigate this further and see what impacts this had on the formulas in the Gordon-Ng models.

R. Sonderegger noted that all the one-pagers were by J. Haberl and that they should have individual proponents in order for them to move ahead faster.

M. Witte suggested that the justification include that there was poor behavior of pure regression models, too much detail in models such as HVAC-01, and the usefulness of short-term data collection.

ACTION: A. Reddy agreed to be the champion for this WS, and continue to work on it.

Several people suggested that this WS needs to be differentiated from the concurrent WS being developed by C. Barnaby in the Components subcommittee.

The discussion then evolved to the in-situ testing of HVAC01.

ACTION: All agreed that the WS should only cover A/Cs and heat pumps...dropping screw chillers.

ACTION: A. Reddy and D. Claridge agreed approach J. LeBrun on how to adapt the primary toolkit models for in-situ testing.

The sub-committee discussion then proceeded to talk about the next WS “Development of a procedure for baselining energy use at large central plants”.

J. Haberl gave a very brief discussion about this WS

ACTION: M Krarti agreed to work on this WS.

ACTION: J. Haberl agreed to send M. Krarti a copy of recent work by Texas A&M that would help with this WS.

The sub-committee then proceeded with the discussion of “Development of procedures for analyzing energy savings from weather dependent and weather independent energy usage using an inverse bin method”.

R. Sonderegger said that this title seemed to be mixing several messages...that TC 4.7 was now investigating a “backward” method that it had already decided to be obsolete “inverse bin methods”.

J. Haberl took a few minutes and described the work that had been done on inverse bin methods, i.e., more or less of a multiple CP model in more than one dimension and that this was a logical extension to CP models. He also mentioned that the method allowed for a direct comparison of “curves” produced by the “forward” or “design bin”

method against measured curves from real data, and further allowed for separation into “loads = 100% system eff.” And “system” curves – a useful diagnostic.

J. Haberl also said that this method showed promise for including humidity and thermal mass and was as accurate as some of the best neural nets as tested in the Predictor Shootout II data. The method also included techniques for “inverse binning” weather-independent data.

ACTION: J. Haberl will work this into a full WS.

#### Long-Range Research Plan

The first priority research topic is WS-1051. The other three work statements under progress were not assigned any priorities until they are further developed.

#### Program

A. Reddy reported on the status of a symposium on “Tools and Techniques for the Calibration of Component Models” at Minneapolis . There are 4 papers, all coming from the PG&E Cool Tools project.

It was agreed that the symposium belongs in the Applications subcommittee. However J. Haberl thanked Agami for developing this.

No other program items had been developed for Dallas or Minn.

ACTION: J. Haberl asked the sub-committee to please consider topics for Symposiums, Seminars and Forums for the next meeting in Dallas and to forward their suggestions to him before the meeting.

There is no Old Business

There is no New Business

Meeting was adjourned at 9:15 p.m.

ASHRAE ONE PAGE WORK STATEMENT  
FROM TC 4.7 INVERSE METHODS SUBCOMMITTEE

TITLE: RANK # \_\_\_\_\_

Development of procedures for analyzing energy savings from weather dependent and weather independent energy usage using an inverse bin method.

BACKGROUND:

Previous ASHRAE Research has funded the development of RP 1050 "Toolkit for linear, change-point linear & multiple-linear inverse models", and RP 1093 "Compilation of diversity factors for energy load calculations" which are intended to produce distributable FORTRAN code (RP 1050) and calculation procedures (RP 1093) to assist building energy analysts. This WS is intended to expand the capability of the previous projects by developing FORTRAN computer code that would be compatible with code developed for RP 1050 that is capable of performing inverse temperature binning for weather-dependent loads, and 24-hour day type binning (weekday, weekend/holiday) for non-weather dependent loads.

OBJECTIVE:

The objective of this research is to develop and document procedures that will analyze measured data from HVAC and/or lighting retrofits using an inverse bin method. This method would operate on columnar hourly data from on-site measurements of energy use and ambient conditions, and would calculate a bin model that captures weather dependent and/or non-weather dependent loads (i.e., schedule dependent loads). The deliverable from this project is intended to be a FORTRAN subroutine that will execute and be compatible with ASHRAE's Toolkit for calculating linear, change-point linear and multi-linear retrofits that is being developed for RP 1050. This WS will also codify the procedures developed as part of RP 1093 to also execute with the Inverse Toolkit developed for RP 1050.

SCOPE:

This research includes: (1) performing a literature search to determine the previous work that has been accomplished toward inverse bin method calculations on measured data (versus "forward" bin method design calculations), (2) develop and codify inverse bin method procedures that will calculate the average hourly weather-dependent energy use per bin, or weather-independent bins (i.e., 24 hour day type profiles) and (3) documenting the procedures in an ASHRAE report.

BENEFIT:

The project will benefit ASHRAE membership as well as the general public as follows:

1. ASHRAE to develop a standard procedure for analyzing retrofit energy savings using an inverse bin method.
2. Software suppliers as an aid for incorporating inverse bin method calculations into their building energy analysis programs.
3. Text book publishers for documenting the inverse bin method.
4. ASHRAE for developing more effective training programs for teaching engineers how to use an inverse bin method for analyzing building energy retrofits.
5. Improved energy efficiency by providing ASHRAE members with an inverse bin method toolkit for measuring retrofits savings.

ESTIMATED COSTS:  
\$95,000

DURATION:  
18 calendar months

CONTRIBUTORS:  
Jeff Haberl

ASHRAE ONE PAGE WORK STATEMENT  
FROM TC 4.7 INVERSE METHODS SUBCOMMITTEE

TITLE: RANK: #\_\_\_\_\_

Development of a procedure for baselining energy use at large central plants.

OBJECTIVE:

The objective of this research is to develop and document a procedure that will allow energy analysts to baseline energy use at large central plants that serve multiple buildings. This would include the capability of developing a baseline at large central plants that serve many buildings and that contain multiple interconnected chillers, boilers, heat exchangers, electrical generation equipment, etc. This system would be capable of normalizing for different component efficiencies, different operational strategies, addition or subtraction of building stock, weather conditions and other variables such as equipment loading, etc. This type of baseline procedure is intended to be used to measure savings from retrofits to equipment in central plants. Such a procedure could then lead to the development of a toolkit that would be similar to ASHRAE's HVAC-01 and HVAC-02 toolkits in format and would contain algorithms and documented computer code that can be used freely by building energy analysis professionals.

SCOPE:

This research includes: (1) performing a literature search to determine the previous work that has been accomplished in this area, (2) developing an baseline calculation procedure, and (3) validating the procedure with measured data from an actual central plant, and (3) documenting the procedure in the appropriate ASHRAE report.

BENEFIT:

The project will benefit ASHRAE membership as well as the general public as follows:

1. ASHRAE to develop a standard procedure for baselining large central plants.
2. Software suppliers as an aid for incorporating ASHRAE's baseline procedure into their building energy analysis programs.
3. Text book publishers for documenting ASHRAE's baseline procedure.
4. ASHRAE for developing more effective training programs for teaching engineers how to baseline large central plants.
5. Improved energy efficiency by providing ASHRAE members with a procedure to baseline large central plants.

ESTIMATED COSTS:  
\$95,000

DURATION:  
18 calendar months

CONTRIBUTORS:

Jeff Haberl

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**TECHNICAL COMMITTEE 4.7 – ENERGY CALCUALTIONS  
(WS 1051)**

**PROJECT TITLE**

**Development of Toolkit for Comparing Results of Hourly Building Energy Simulation Programs against Measured Energy and Internal Environmental Data**

**OBJECTIVE**

The objective of this research is to develop a toolkit that will assist ASHRAE engineers in comparing the results of hourly simulation programs such as DOE-2 and BLAST to measured data from actual buildings. Such procedures would be delivered in toolkit that would be similar to the ASHRAE HVAC 1 and HVAC 2 toolkits in format and would contain algorithms and documented computer code for assessing how well computer simulations are calibrated to measured building energy data. This research includes performing a literature search to determine the different methods that are currently being used to calibrate hourly simulation programs, development of standard procedures for performing the calibrations, and documenting the procedures.

**BENEFITS**

The project will benefit ASHRAE membership as well as the general public as follows:

1. ASHRAE to develop standard procedures for assessing how well computer simulations are calibrated to measured building energy data.
2. Software suppliers as an aid for incorporating ASHRAE calibration assessment procedures into their building energy analysis programs.
3. Text book publishers for documenting calibration assessment procedures.
4. ASHRAE for developing more effective training programs for teaching engineers how to calibrate computer simulation programs.
5. Improving indoor air quality by providing ASHRAE members with improved procedures for calibrating building energy simulation programs.
6. Improving energy efficiency by providing ASHRAE members with improved procedures for calibrating building simulation programs.

**ESTIMATED COST**

\$95,000

**ESTIMATED DURATION**

18 months

**METHOD OF PUBLISHING RESEARCH RESULTS**

A Technical Paper will be presented at an ASHRAE meeting. An ASHRAE special publication may also result.

**POTENTIAL CO-SPONSORS**

None yet identified.

ASHRAE ONE PAGE WORK STATEMENT  
FROM TC 4.7 INVERSE METHODS SUBCOMMITTEE  
(TC 4.7 6/98 Rank: #4)

**TITLE:**

Methodology Development to Extend ASHRAE Semi-empirical Chiller Models to include Models for Screw Chillers, Package Air-conditioners, and Heat Pumps.

**OBJECTIVE:**

The objective of this research is to expand upon the previous work by RP 827 toolkit (in-situ measurement methods for pumps, fans and chillers), and ASHRAE HVAC-01 Toolkit (component models for primary HVAC systems). Specifically, RP 827 utilized semi-empirical models to characterize chiller performance that can be readily applied to chillers installed in existing building and recommended a test procedure for applying the models (Gordon and Ng 1994). The models cited in RP 827 include centrifugal and reciprocating chillers and required on-site measurements of the thermal output, chiller electrical input, and temperatures for the chilled water supply and condenser water return. This proposed work statement would expand the RP 827 models to develop models for screw chillers, air-conditioners, and heat pumps. This work would be beneficial to building professionals who need to quickly and accurately assess the performance of screw chillers, package air conditioners and heat pumps.

**SCOPE:**

This research includes: (1) Thorough literature search into the current semi-empirical models that are used to model chillers, air-conditioners and heat pumps, (2) development of new semi-empirical models for screw chillers, air-conditioners, and heat pumps, (3) validation and testing of the models with measured data.

**BENEFIT:**

The project will benefit ASHRAE membership as well as the general public as follows:

1. ASHRAE to develop a standard methods for in-situ measurement of screw chillers, package air conditioner and heat pump performance using semi-empirical models.
2. Software suppliers as an aid for incorporating semi-empirical models.
3. Text book publishers for documenting such semi-empirical models.
4. ASHRAE for developing more effective training programs for teaching engineers and architects how to apply such semi-empirical models.
6. Improving energy efficiency by providing ASHRAE members with improved semi-empirical models.

**ESTIMATED COSTS:**  
\$95,000

**DURATION:**  
18 calendar months

**CONTRIBUTORS:**  
Jeff Haberl

Gordon, J.M., Ng, K.C. 1994. "Thermodynamic Modeling of Reciprocating Chillers", *Journal of Applied Physics*, Volume 75, No. 6, March 15, 1994, pp. 2769-2774.

Bourdouxhe, J.P., Grodent, M., LeBrun, J. 1995. "HVAC01 Toolkit: A toolkit for 20 Primary HVAC System Energy System Energy Calculations", Final report submitted to ASHRAE.

Bourdouxhe, J.P., Grodent, M., LeBrun, J. 1994a. "Toolkit for Primary HVAC System Energy Calculation - Part 1: Boiler Model", ASHRAE Transactions, Vol. 100, Pt. 2.

Bourdouxhe, J.P., Grodent, M., LeBrun, J. 1994b. "Toolkit for Primary HVAC System Energy Calculation - Part 2: Reciprocating Chiller Models", ASHRAE Transactions, Vol. 100, Pt. 2.

**Report from PMS Meeting for 1050-RP**

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

June 21, 1999

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:

1. a literature search into the current algorithms,
2. development of FORTRAN 90 computer code that performs linear, change-point linear and multiple linear calculations,
3. development of estimates of uncertainty,
4. assembly of such code into a well documented ASHRAE toolkit that can be distributed by ASHRAE, and
5. preparation of a technical paper, research note, and/or ASHRAE Journal Article.

The contractor presented the first report, a literature survey, to the PMSC. It is a survey of the known methods of regressing one independent variable at a time against one dependent variable. For example, building heating energy consumption might be regressed against outdoor temperature or cooling energy consumption might be regressed against building occupancy. Several comments were noted.

The contractor proposed a method of assessing the uncertainty of independent variable predictions. Acceptance was deferred but will be decided by e-mail among the contractors and PMS members by July 15. The proposed method should be congruent with that included in GPC 14P.

The PMS reiterated that the toolkit must be able to use independent variables other than temperature. The contractor noted that the time scale of the data could be anything between hourly and monthly.

The PMS decided that it was not within the scope of the proposed work to arrive at a method of predicting retrofit energy savings although this may be a likely use of the toolkit. The contractor is to produce a method of predicting energy use, for example, as a function of an independent variable. The toolkit project will develop source code along with executables of that code for performance evaluation using test data sets.

By July 15 the contractor will produce and the PMS decide upon a software design including (1) software requirements and (2) a design specification. The contractor presented a one-page design overview.

According to the contract the contractor will assemble selected algorithms in their native computer language and prepare comments and documentation. This task is due within six months of contract startup (due July 1, 1999).

The contractor will use twenty test data sets to examine the accuracy and functionality of the toolkit. The LOANStar program will supply typical consumption vs. temperature data sets in the prescribed format. The PMS will provide



additional data sets (in the prescribed format) for which the independent variable is not necessarily dry bulb temperature. All data sets will be provided to the PMSC chair who will forward them to the contractor by August 31, 1999.

A PMS member asked that the contractor review the variable base degree-day method and compare it to the various change point models under consideration. This will be accomplished as soon as possible with the contractor providing CP pseudo code to the PMS. This will be compared to VBDD methodology by a PMS member to determine if a VBDD approach can be considered as either similar enough or identical to special cases of the CP methods so that it might be included in the Toolkit.

## **Summary of Action Items**

Contractor:        Submit proposed uncertainty calculation method as soon as possible.  
                      Produce software design – requirements and design specification for PMS review before July 15.  
                      Provide pseudo code of CP method for comparison with VBDD method ASAP.

PMS:                Provide test data sets by August 31, 1999.  
                      Comment on software design by July 15, 1999.

Submitted by Jan F. Kreider, PMSC Chair

**TC4.7 Simulation and Component Models Subcommittee**  
**Seattle Meeting Minutes**  
**6-21-99**

The Meeting was called to order at 5:58 pm with 35 people in attendance.

## Program

1. Report on Chicago Seminar: *Simulation Tool Interoperability and Component Model Portability* The seminar enjoyed a good turnout (35-40 attendees) and was well-received with several attendees requesting additional seminars as needed to keep them abreast of IAI (International Alliance on Interoperability) developments. The chair reminded the committee that one of the purposes of the seminar was to determine the viability of Modelica as a suitable replacement for NMF. The committee agreed that the seminar provided valuable, but information on the two formats, but did not feel sufficiently informed to make a decision on the future of NMF. Sonderegger raised the concern that energy issues might get "lost" in the AIA work and suggested committee involvement in IAI and a possible liaison with TC 1.5.

### ACTION ITEMS:

- Phil Haves will serve as TC 1.5 liaison on IAI issues. He will discuss issues with Hitchcock and Salisbury and report at Dallas. Sonderegger and Barnaby will assist with IAI follow up work.
  - Fred Buhl will investigate Modelica and will contact John Seem who is very interested in the current work.
  - Dan Fisher and Dru Crawley will investigate the possibility of getting papers from the speakers at the Chicago Seminar.
1. Seattle Symposium: *Application of Heat (and Mass) Balance Methods to Energy and Thermal Load Calculations*. About 50 people were in attendance for a good session with spirited discussion!
  2. Dallas Seminar: *ASHRAE Software Toolkits for Energy Calculations*. Dru Crawley is on the case and putting the package together.
  3. Minneapolis Seminar and possible Symposium: The presentation of case studies from IEA Annex 21 (Low Energy Cooling Systems) was suggested as a Seminar. The models developed to analyze these systems were suggested as a concurrent symposium topic. Michael Holmes noted that a potential conflict with the CIBSE conference exists if the research is presented/published at one of their conferences.

### ACTION ITEMS:

- Phil Haves volunteered himself to chair the seminar and volunteered Joe Huang to chair the symposium Seminar Title: *Low Energy Cooling Case Studies*, Symposium Title: *Simulation Models for Low Energy Cooling*. Phil and Joe will contact symposium authors to make sure that symposium entries will not be re-published papers.
- Dan Fisher will write a letter to Steve Comstock to request that co-sponsored European publications be entered into appropriate databases to help ensure that ASHRAE Transactions do not include re-published papers

## Research

1. 987-RP, Loads Toolkit Update: Chip Barnaby reported the PMS's plan to publish the toolkit on CD only. He noted that space on the CD was sufficient to allow supporting programs such as Window 4.1 and COMIS to be

included. He also noted that both printable and hyper-linked documents would be included on the CD. The project is about 80% complete with plans for an organized review by PMSC and others underway. A wider review will start in late fall with a target completion date prior to the Dallas meeting.

**ACTION ITEM:**

- Dru Crawley will request full committee approval of a no cost extension through July 2000.
1. 1051-TRP *Modeling Two- and Three-dimensional Heat Transfer Through Composite Wall and Roof Assemblies in Hourly Energy Simulation Programs*. PESC: Beausoleil-Morrison (Chair), Walton, and Winkelmann will evaluate proposals.

**ACTION ITEMS:**

- Contractor selection by full committee.
  - PMS appointment: Doug Hittle (TC4.1) requested appointment to the PMS.
1. 1145-TRP Building System Design Syntheses. PES: Pedersen (Chair) will evaluate proposals.

**ACTION ITEMS:**

- Contractor selection by full committee.
- PMS appointment:

## Work Statements

1. *Extension of the ASHRAE Loads Toolkit to deal with Systems with Significant Intra-zone Airflow* (Rees, Knappmiller). The committee agreed with the authors' intent to cast the work statement as an extension of the toolkit. The committee further agreed that the work statement would be limited to "order 10" node models and would exclude CFD models. The committee also agreed that the work statement needed to either clearly classify types of models or include model classification as a task.

**ACTION ITEMS:**

- Rees and Knappmiller will prepare a second Draft for Dallas. Work statement should be ready for full committee review by Minneapolis.
1. *Updated Energy Calculation Models for Residential HVAC Equipment* (Barnaby/Knappmiller/Smith): The work statement focuses on what information model developers would request from manufacturers as inputs to their equipment models.

**ACTION ITEMS:**

- Work statement authors with assistance from Tim McDowell will complete the work statement by Dallas.
  - Barnaby will continue to discuss details of the work statement with TC7.6.
  - A reference to the ARI standard will be included in order to tighten the scope of the work statement.
1. *Development of HVAC System Templates for Simulation Programs* (Crawley/Beausoleil-Morrison): This work statement focuses on detailing consistent ways of modeling HVAC systems. The project will characterize HVAC systems in sufficient detail for simulation developers.

**ACTION ITEMS:**

- The authors will complete the work statement for the Dallas meeting.
- The "Justification" section will be strengthened and the "Budget" revisited.

**Research Plan**

The agreed on the following prioritization for the three work statements in progress

1. *Updated Energy Calculation Models for Residential HVAC Equipment*
2. *Development of HVAC System Templates for Simulation Programs*
3. *Extension of the ASHRAE Loads Toolkit to deal with Systems with Significant Intra-zone Airflow*

The meeting was adjourned at 7:28pm

**S&CM ATTENDANCE**

Present this meeting?	Present last meeting?	Last Name	First Name	E-Mail
X		Axley	Jim	James.axley@yale.edu
X	X	Barnaby	Chip	cbarnaby@wrightsoft.com
X	X	Beausoleil-Morrison	Ian	ibeausol@nrcan.gc.ca
X		Blair	Nathan	<a href="mailto:Blair@tess-inc.com">Blair@tess-inc.com</a>
X	X	Brandemuehl	Mike	michael.brandemuehl@colorado.edu
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X	X	Carpenter	Allen	Acarpent@nrcan.gc.ca
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X	X	Neymark	Joel	neymarkj@sni.net
X	X	Norford	Les	lnorford@mit.edu
X	X	Pedersen	Curt	cpederse@uiuc.edu
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X	X	Shirey	Don	Shirey@fsec.ucf.edu
X	X	Smith	Vernon	vsmith@archenergy.com
X	X	Sommer	Klaus	<a href="mailto:KLAUS.SOMMER@VT.FH-KOELN.DE">KLAUS.SOMMER@VT.FH-KOELN.DE</a> , <a href="mailto:Sommer.Roycroft@T-online.De">Sommer.Roycroft@T-online.De</a>

Present this meeting?	Present last meeting?	Last Name	First Name	E-Mail
X	X	Sonderegger	Robert	rcs@src-system.com
	X	Spitler	Jeffrey	spitler@okstate.edu
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**TECHNICAL COMMITTEE 4.7 – ENERGY CALCULATIONS  
SIMULATION & COMPONENT MODELS SUBCOMITTEE**  
**Work Statement under Development**

**PROJECT TITLE**

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

**OBJECTIVE**

An assumption that is commonly made in both loads and annual energy calculation programs is that the room air is well mixed. Consequently convective heat transfer is calculated using a single room air temperature. However, there are a number of systems now in use where this assumption is clearly invalid. The most obvious example of such a system is displacement ventilation, for which a number of nodal models have now been developed. Work has also been done on multiple air node models of simple convective heating and natural ventilation. Although such models have been tested in a ‘stand alone’ manner little has been done to integrate these models in heat balance based load or energy calculation programs. The overall objective of this work would be to develop a generic method for implementing multiple air node models in a heat balance based load or energy calculation program. This could most usefully be done by extension of the ASHRAE loads calculation toolkit.

The tasks of this project would be:

1. Identify existing multiple air node models and evaluate the significance of using such models in terms of prediction of the zone loads and temperatures.
2. The most suitable generic method of integrating such models into a heat balance based load or energy calculation program would be investigated. The proposed method would be implemented as an extension to the ASHRAE Loads Toolkit.
3. One of the displacement ventilation models identified in task1 would be used to demonstrate the method and study specific test cases.

**BENEFITS**

The project will benefit ASHRAE membership as well as the general public as follows:

1. A generic way of incorporating room models with multiple air nodes into a heat balance load calculation would be developed.
2. The accuracy with which loads for displacement ventilation systems could be calculated would be improved.
3. A means would be provided for users to incorporate other multiple air node models into the ASHRAE Loads Toolkit in the future.

**ESTIMATED COST**

\$75,000

**ESTIMATED DURATION**

18 calendar months

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**METHOD OF PUBLISHING RESEARCH RESULTS**

A Technical Paper will be presented at an ASHRAE meeting.

**POTENTIAL CO-SPONSORS**

None yet identified.

**WORK STATEMENT AUTHORS**

Simon Rees, Kevin Knappmiller

**ASHRAE**  
**Technical Committee 4.7 Energy Calculations**  
**2000-2001 Research Plan**  
**1 August 1999**

<b>2000 – 2001 Priority</b>	<b>Title</b>	<b>1999 – 2000 Priority</b>	<b>Subcommittee</b>
1	Updated Energy Calculation Models for Residential HVAC Equipment (formerly Standard HVAC Equipment Characteristics for Energy Calculations)	2	Applications
2	Define Performance Factors for Primary and Secondary Equipment Simulation Inputs for Commercial Buildings	1	Simulation and Component Models
3	Development of Detailed Descriptions of HVAC Systems (Templates) for Energy Simulation Programs	5	Simulation and Component Models
Approved by TC, to be submitted 9/99	Standard Operating Conditions in North American Residential Buildings	3	Applications
WS being revised for resubmission	Procedures for Evaluating Computer Calculated Results Against Measured Energy Data (WS 1051)		Inverse Methods
	Extend and Develop Methodology of 827-RP to include Models for Air-Conditioners and Heat Pumps	4	Inverse Methods
	Extension of the ASHRAE Loads Toolkit to deal with Systems with Significant Intra-zone Airflow		Simulation and Component Models
	Characterization of Building Secondary Thermal Loads from Chiller of Electric Use Data		Applications
	Standard 140/BESTEST Ground Coupling Test Cases		Applications
	Development of Standardized Computer Simulation Input Files for Describing Typical Residential Homes and Common Energy Conservation Retrofits		Applications



## **ASHRAE TC 4.7 Energy Calculations Research Strategy**

### **Scope**

Technical Committee 4.7 is concerned with identifying, evaluating, developing, and recommending procedures for calculating energy performance of buildings.

### **Goal**

Accurate energy models at every engineer's fingertips

### **Research Strategy**

TC 4.7 pursues research in three major areas:

- Simulation and Component Models
- Inverse Methods
- Applications

In the simulation and component model area, research focus includes first principle models, algorithms, and solution techniques for individual components, equipment, systems, and entire buildings.

In the inverse methods area, the focus is on deriving calculation methods from measured data, developing statistical simulation methods, and calibrating simulation models to measured data.

For the applications area, the focus is on use of simulation in practice—development of case studies, problem-solving procedures, and input data compilations such as materials properties and internal gains—in general, technology transfer.

Technical Committee 4.7 actively develops work statements for new projects to keep a balanced portfolio of projects in all three areas.

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**2000-2001 RESEARCH PLAN**  
**TECHNICAL COMMITTEE 4.7 ENERGY CALCULATIONS**  
**PRIORITY 1**

**PROJECT TITLE**

**Updated Energy Calculation Models for Residential HVAC Equipment**  
(formerly Standard HVAC Equipment Characteristics for Energy Calculations)

**OBJECTIVE**

Energy calculation models are often based on limited equipment characteristic data that are published for non-energy-calculation reasons. For example, the sole standard data available for residential air conditioning equipment are SEER and 95 F capacity ("ARI data"). Off-design, part-load, fan power, and latent cooling characteristics must be derived from manufacturer-specific catalog data and/or general correlations of questionable applicability.

The objective of this project is to collect and/or develop models for widely used residential equipment that would represent equipment behavior under the full range of expected operating conditions. In addition, the project would propose practical test procedures to acquire equipment characteristic data required for the models.

**BENEFITS**

The updated models would take into account the following (as applicable), ultimately allowing unbiased cross-brand operating cost comparisons:

Outdoor conditions

Indoor conditions

Multiple (or variable) speeds

Separate accounting of significant consumption components (e.g. fan vs. compressor)

**ESTIMATED COST**

\$60,000

**ESTIMATED DURATION**

18 months

**METHOD OF PUBLISHING RESEARCH RESULTS**

Special publication, technical paper.

**POTENTIAL CO-SPONSORS**

California Energy Commission

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**2000-2001 RESEARCH PLAN**  
**TECHNICAL COMMITTEE 4.7 ENERGY CALCULATIONS**  
**PRIORITY 2**

**PROJECT TITLE**

Define Performance Factors for Primary and Secondary Equipment Simulation Inputs for Commercial Buildings

**OBJECTIVE**

This research project will develop guidelines on how to model commercial HVAC equipment in hourly building energy simulation program relying only on performance specifications obtained from the manufacturer. This is the situation typically confronted by users of simulation programs in engineering applications, but the mapping of manufacturer's performance data to the inputs needed by programs such as DOE-2 or BLAST is neither straightforward nor well understood. The available data are often incomplete, and may differ in their assumptions and terminology. On the other hand, the input descriptions required by simulation programs often appear to many engineers as idiosyncratic and differ from industry conventions. The project seeks to bridge this gap between what the manufacturer's data provide and what the simulation programs need.

**BENEFITS**

The project will benefit ASHRAE membership as well as the general public by:

1. Improving the accuracy of energy simulations and design calculations by eliminating or reducing a source of error in modeling assumptions.
2. Promoting the use of computer simulations as a tool for engineering design and evaluating system performance.
3. Promoting the development of more uniform technical specifications for HVAC equipment.
4. Informing the ASHRAE membership and the wider engineering profession of the relationships between manufacturer's specifications and seasonal performance of HVAC equipment.

**ESTIMATED COST**

\$50,000

**ESTIMATED DURATION**

12 months

**METHOD OF PUBLISHING RESEARCH RESULTS**

Technical paper, special publication.

**POTENTIAL CO-SPONSORS**

California Energy Commission

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**2000-2001 RESEARCH PLAN**  
**TECHNICAL COMMITTEE 4.7 ENERGY CALCULATIONS**  
**PRIORITY 3**

**PROJECT TITLE**

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

**OBJECTIVE**

Develop templates—specifications of components, connections, and controls—for commonly used HVAC systems in North America and Europe.

**BENEFITS**

Many popular building simulation programs, such as DOE-2 and BLAST, use a system-based approach to represent HVAC systems. Description of how components are connected and controlled in these systems is often unclear and difficult to understand. In addition, it is difficult to compare a system type within one program to a system type within another program. Other simulation programs, such as TRNSYS, SPARK, and ESP-r, do not have fixed systems and rely on users to define how components are connected and the system interaction controls.

Simulation program users need a consistent description of commonly used HVAC systems—components (fans, coils, dampers, ducts), how components are connected and controlled—to ensure that the simulation model accurately reflect their system design. Very often it is not exactly clear how the various HVAC systems are specified, and whether a particular system in one simulation program is identical to the system with the same name in another simulation program. The templates will aid in harmonize the representation of common HVAC systems in various software. Further, the templates could be used to represent a particular HVAC system in component-based programs such as TRNSYS, SPARK, and ESP-r.

**ESTIMATED COST**

\$90,000

**ESTIMATED DURATION**

18 months

**METHOD OF PUBLISHING RESEARCH RESULTS**

Special publication, ASHRAE Journal article, technical paper.

**POTENTIAL CO-SPONSORS**

U.S. Department of Energy  
European Commission

### **TC 4.7 Handbook Subcommittee Meeting**

Handbook of Fundamentals  
 Chapter 30  
 Energy Estimating and Modeling Methods  
 Monday, June 21, 1999

Present:

Bill Bahnfleth	<a href="mailto:wpb5@psu.edu">wpb5@psu.edu</a>
Dave Claridge	<a href="mailto:claridge@esl.tamu.edu">claridge@esl.tamu.edu</a>
Moncef Krarti	<a href="mailto:krarti@colorado.edu">krarti@colorado.edu</a>
Jan Kreider	<a href="mailto:kreider@bechtel.colorado.edu">kreider@bechtel.colorado.edu</a>
Agami Reddy	<a href="mailto:reddyta@post.drexel.edu">reddyta@post.drexel.edu</a>
Vernon Smith	<a href="mailto:vsmith@archenergy.com">vsmith@archenergy.com</a>
Michael Wetter	<a href="mailto:mwetter@lbl.gov">mwetter@lbl.gov</a>
Les Norford (chair)	<a href="mailto:lnorford@mit.edu">lnorford@mit.edu</a>

The meeting began at 5:10 p.m. Norford noted that the main thrust of the revision is to make the chapter more useful to practicing engineers. He then reviewed the status of the revised chapter, which is summarized in the following table:

<b>Chapter section</b>	<b>Author</b>	<b>Status</b>
General considerations	Reddy/Norford	Draft from Reddy
Space loads	Spitler	Not submitted; TC4.1 chapter to be in draft form by September 1, 1999
Primary and secondary equipment	Brandemuehl	Not submitted; expected within two weeks
Ground-coupled heat transfer	Krarti	Second draft submitted; revision in one month
Degree-day and bin methods	Norford	Subcommittee asks for bin-method example
Inverse methods	Reddy	Second draft from Reddy

Krarti's material on ground-coupled heat flows was discussed at length. The second draft as submitted provides simplified equations and an example for slab foundations. Krarti will revise the material to delete construction detail and to provide comparable equations and an example for basement heat flows.

Claridge and Norford reviewed progress on the revision of TC 4.1's loads calculation chapter, which will include material on the heat-balance method and therefore affect how much heat-balance material remains in the energy estimating and modeling methods chapter. Norford has been in contact with Tom Romine, TC4.1 handbook subcommittee chair, and that Jeff Spitler will submit a revision of the space-loads material for chapter 30 (proposed new material due June 1999). Claridge noted that TC4.1 has recently started to move on its chapter and that a draft is scheduled for September 1, 1999. Norford will retain the material currently in chapter 30 until that date and then work with Spitler to revise it accordingly.

Reddy noted that the chapter provides a very abbreviated coverage of the bin method, which still has significant value to educators and practicing engineers. There was general consensus that a bin-method example would be helpful. Norford will review the example that was in the 1993 chapter and deleted for the 1997 chapter and simplify it as appropriate, to cover multiple time periods but not loads calculations.

Brandemuehl stated (after the subcommittee meeting) that he will review and revise as appropriate the material on secondary and primary equipment within two weeks.

Norford reviewed the schedule for the chapter. The schedule put forward at Chicago specified that a review draft of the entire chapter would be prepared for the Seattle meeting. This draft was not prepared because necessary material has been recently or not yet submitted. Material in hand was distributed to TC members via email prior to the meeting. A review draft will be distributed no later than October 31, 1999 and comments will be requested. The draft will be presented for a vote at the Dallas meeting.

The meeting adjourned at 6:00 p.m.

**ASHRAE TC 4.7**

**SUMMARY OF PROGRAMS/PROGRAM PLAN**

**Seattle, June 1999**

**Actual**

- Symposium SE-99-6: Accuracy Tests for Simulation Models (Chair: Mike Witte)
- Symposium SE-99-13: Application of Heat and Mass Balance Methods to Energy and Thermal Load Calculations (Chair: Chip Barnaby)

**Dallas, February 2000** (August 6, 1999)

- 1. Seminar: ASHRAE Software Toolkits for Energy Calculations (Sim-Comp/Chair: Dru Crawley)
- 2. Symposium: Calibrating Building System Models (??/Chair: Kevin Knapmiller)

**Minneapolis, June 2000** (January 24, 1999)

- 1. Symposium: Recent Innovations in HVAC System Modeling (Applications/Chair: Tim McDowell)
- 2. Seminar: Low Energy Cooling Case Studies (Sim-Comp/Phil Haves or Rich Karney)
- 3. Symposium: Tools and Techniques for Calibration of Component Models (TC1.5&4.7/Agami Reddy)  
4 papers in process
- 4. Symposium: Simulation Models for Low-Energy Cooling (Sim-Comp/Joe Huang or Rich Karney)
- 5. Symposium International Experience with Weather Data for Simulation and Design  
(TC 4.2 co-sponsor/Geoffrey Levermore)

Note: Items 2 and 4 should be offered at the same program and should not overlap in time (duplicate presenters).

**Atlanta, February 2001**

- Symposium: Better Inputs for Better Output (Applications, TC 9.6 co-sponsor/Chair: Jim Willson)
- Symposium: Practical Methods for Baselineing Central Plants at Multi-Building Facilities. (??/Chair: Phil Haves)

**Cincinnati, June 2001**

None to date

**MINUTES**  
**SPC-140 SMOT FOR BUILDING ENERGY SOFTWARE**  
**Seattle 06/21/99**  
R. Judkoff

**ATTACHMENTS**

- A. Agenda for June 21, 1999 meeting
- B. Message from Winkelmann regarding editorial change
- C. Mailing Lists

**CORRESPONDANCE SINCE LAST MEETING**

In March the Chair discovered that ASHRAE did not implement the roster changes that were previously requested. This meant that previous votes regarding approval of Std 140P and amendments were invalid. ASHRAE implemented roster changes in May; mailing list (Attachment C) indicates voting members and whether Producer, User, or General. ASHRAE also designated a new SPLS Liaison (Tom Watson). This is a welcome change as the previous SPLS liaison would not return phone calls or emails, or otherwise communicate with SPC 140.

In late May 1999, the following letter ballots were submitted to the fully sanctioned committee with results noted below.

SPC 140 Letter Ballot, May 27, 1999, Public Review Approval of Proposed Standard 140

**Motion (Letter Ballot): Recommend SPLS Public Review Approval of ASHRAE Proposed Standard 140P, "Standard Method of Test for the Evaluation of Building Energy Analysis Computer Programs", working draft 98/2 dated June 3, 1998, including changes made during the June 22, 1998, meeting of SPC-140 (Attachment A), and including changes agreed to at the January 25, 1999, meeting of SPC-140 (Attachment B); and to authorize the Chair of SPC-140 to make minor editorial changes as needed to satisfy the requirements of ASHRAE editorial review.**

Yes: 10  
No: 0  
Abstain: 0  
Not Voting: 0

**Motion passed unanimously**

SPC 140 Letter Ballot, May 27, 1999, Recommendation for SPC 140 to become a Standing SPC.

**Motion (Letter Ballot): Recommend SPC 140 become a Standing Standard Project Committee (SSPC) at the time of ASHRAE publication of the Standard (justification as provided in informational Annex B13 of Standard 140P Working Draft 98/2).**

Yes: 9  
No: 0  
Abstain: 0  
Not Voting: 1 (Wilcox, no explanation)

**Motion passed 9 - 0**



Letter ballot paper work regarding recommendation for public review (1<sup>st</sup> listed letter ballot) including the Public Review Draft Submittal Report was sent to ASHRAE (Liz Baker and Claire Ramspeck (MOS)), and Tom Watson (SPLS Liaison) on June 18, 1999.

Per January 1999 discussion the Chair will wait to formally send a request to SPLS regarding becoming an SSPC until later.

**GENERAL**

None

**INTERMODEL COMPARISON BASED TESTS**

The purpose of the meeting was:

- give update to the committee regarding public review status
- meet new SPLS liaison and discuss procedural issues regarding public review

**Attendees** (see mailing list for full names, etc)

Voting Members

Crawley  
Fraser  
Haberl  
Judkoff (chair)  
Sonderegger  
Walton  
Winkelmann  
Witte

Non-Voting Members

Neymark (non-voting)

Other

Beausoleil-Morrison  
Corson  
Rees

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**Committee Discussion**

Approval of Prior Minutes

**Motion (Sonderegger): Accept Minutes of January 1999 meeting (Toronto).**

2nd (Witte):

Vote: Yes = 8, No = 0

Absent = (Wilcox, Maeda)

Motion passed.

Chair gave an update on the letter ballot results indicating unanimous committee approval recommending the SMOT for public review, and indicated that the Public Review Draft Submittal Report was submitted to ASHRAE Staff.

Public Review is expected to occur in the next 6 months.

The committee also reviewed an editorial comment (regarding informational Annex B4) described in email from Winkelmann to Neymark; comments on informative material do not require formal resolution by SPC 140. The committee agreed that Judkoff and Neymark could address this comment without further consultation of the committee.

Adjourned

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**Attachment A - Meeting Agenda**

PRELIMINARY AGENDA

Seattle, Monday 6/21 2:15PM, Room CC/305  
(check final program for changes)

- Approval of Prior Meeting Minutes
  
- Status Update (Judkoff)
  - Roster changes
  - Letter ballot results
  
- Meet our new SPLS liaison, and discussion regarding public review process  
(Watson (SPLS liaison))

The meeting will likely be brief (under one hour, probably closer to a half hour).

Please note that we expect next winter's meeting to go back to the usual length if we have unresolved public review comments.

**Attachment B - Meeting handout of substantive and editorial changes**

Received: from pegasus.lbl.gov (pegasus.lbl.gov [128.3.12.115])  
by lynx.sni.net (8.8.5/8.8.5) with SMTP id LAA05252  
for <neymarkj@csn.net> mail\_from <fcw@pegasus.lbl.gov>;  
Wed, 2 Jun 1999 11:10:59 -0600 (MDT)  
Received: by pegasus.lbl.gov (4.1/SMI-4.0Beta)  
id AA14819; Wed, 2 Jun 99 10:10:58 PDT  
Date: Wed, 2 Jun 99 10:10:58 PDT  
From: fcw@pegasus.lbl.gov (Fred Winkelmann)  
Message-Id: <9906021710.AA14819@pegasus.lbl.gov>  
To: neymarkj@csn.net  
Subject: Annex B4 error  
Cc: fcw@pegasus.lbl.gov  
Content-Type: text  
X-UIDL: be828262d0a75adb233292ada3a71a0b

Joel:

In glancing at Annex B4 of the SPC 140P committee draft that came with the letter ballot I noticed the following problem:

It says (with the corrections) "ASHRAE and several widely used programs such as DOE-2.1D and BLAST 3.0 level 193 calculate the exterior combined radiative and convective surface coefficient as a second order polynomial in wind speed of the form:  $h = a_1 + a_2 * V + a_3 * V^2, \dots$ "

The problem is that DOE-2.1D (and later versions) does not use a "combined" exterior surface coefficient. For exterior surface convection it does use a convective surface coefficient that is a polynomial in wind speed. But the long wave radiation is determined hourly from sky emissivity and does not involve a radiative surface coefficient.

So I would remove DOE-2 from the sentence.

Fred Winkelmann

**Attachment C - SPC 140 ADDRESS LIST, 18 June 1999**

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

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