



REFRIGERATION COMMITTEE (REF) MINUTES

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**PRINCIPAL MOTIONS
JUNE 22^h, 2008**

No.	Page No.	Motion
1	1	The minutes of the January 20, 2008 meeting in New York City be approved.
2	2	REF recommends that Operations Subcommittee recommend approval of the draft of the Natural Refrigerants PD.
3	5	REF recommends that a seminar program for Chicago titled 'CO ₂ Developments in Refrigeration' be approved
4	5	REF recommends that a forum program for Chicago related to 'activities and ideas for refrigeration courses and technical program involvement.' be approved

**ACTION ITEMS FROM ANNUAL MEETING
SALT LAKE JUNE 22th 2008**

No.	Page No.	RESPONSIBILITY	SUMMARY
1	3	Staff	Forward procedures for ASHRAE Best Paper Award to Harel for review.
2	3	Siller	Contact incoming SAC chair to discuss refrigeration related topic for next student design competition
3	3	Siller	Contact ALI to volunteer to assist review of refrigeration SDL
4	4	REF TC liaisons	Return TC Liaison checklist forms to Sluga
5	4	Staff	Contact the IIAR in writing, through their President, Bruce Badger, requesting their permission for ASHRAE to use the materials developed for the IIAR CO ₂ Handbook.
6	4	Topliss	Submit latest draft for distribution for review.
7	4	Staff/Topliss	Distribute to relevant TC's and interested individuals for assistance in review.
8	4	Sluga	Distribute 2010 introductory chapter outline to REF.
9	5	Kazachki	Submit CO ₂ seminar program(s) for Chicago prior to deadline
10	5	Gage, Harel	Submit forum program for Chicago prior to deadline

**ACTION ITEMS FROM WINTER MEETING
NEW YORK JANUARY 20th 2008**

No.	Page No.	RESPONSIBILITY	SUMMARY	STATUS
1	3	Garbarino	Communicate to CTTC need to promote REF Awards	Complete
2	3	Bevington/Staff/Shepherd	Work to promote awards in Insights	Complete

No.	Page No.	RESPONSIBILITY	SUMMARY	STATUS
3	3	Kelso	Ensure REF Award submissions are emphasized in PAOE points.	Complete
4	4	Halel, Shepherd, Bevington	Design Briley Award for approval in Salt Lake. Suggest any minor editorial changes to procedure/form as appropriate.	Ongoing
5	4	Staff	Compile list of ASHRAE Journal Articles from 07-08 to REF for Annual Meeting.	Ongoing
6	4	Ayub	Forward recommendation for Professional Development Committee for their consideration.	Complete
7	5	Staff	Draft email requesting info (on courses and research programs) and other programs at other universities. Send info to REF subcommittee.	Complete
8	5	Reindl	Send poultry based plant design as model for Student Design Competition to Ayub, Mueller, and Staff	Complete
9	5	Staff	Review process for input on Student Design Completion and distribute information to appropriate committee.	Complete
10	6	Reindl, Gage	Submit seminar programs for Salt Lake prior to deadline	Complete

LIST OF APPENDICES

Appendix 1:	REF Agenda for Salt Lake City
Appendix 2:	2007-2008 MBO's final report
Appendix 3:	2008-2008 MBO's final report
Appendix 4:	Natural Refrigerants PD
Appendix 5:	REF Award Promotion in Insights Article
Appendix 6:	Liaison Report
Appendix 7:	Liaison Checklist

LIST OF ACRONYMS

AA	-	Administrative Assistant
AI	-	Action Item
AMORTS	-	Assistant Manager of Research and Technical Services
ASHRAE	-	American Society of Heating, Refrigerating, and Air-conditioning Engineers
BOD	-	Board of Directors
CNV	-	Chair Not Voting
CO ₂	-	Carbon Dioxide
CRC	-	Chapter's Regional Conference
CTTC	-	Chapter Technology Transfer Committee
DOE	-	Department of Energy
DOT	-	Director of Technology
DSL	-	Distinguished Speaker List
GCCA	-	Global Cold Chain Alliance
H&A	-	Honors & Awards Committee
HQ	-	Headquarters
IARW	-	International Association of Refrigerated Warehouses
IIAR	-	International Institute of Ammonia Refrigeration
IIR	-	International Institute of Refrigeration
LEED	-	Leadership in Energy and Environmental Design
MBO	-	Management by Objective
MOP	-	Manual of Procedures
MOU	-	Memorandum of Understanding
ODS	-	Ozone Depleting Substances
PAOE	-	Presidential Award of Excellence
PD	-	Position Document
PDC	-	Position Document Committee
PES	-	Project Evaluation Subcommittee
RAC	-	Research Administration Committee
REF	-	Refrigeration Committee
RL	-	Research Liaison
ROB	-	Rules of the Board
RP	-	Research Project
RTAR	-	Research Topic Acceptance Request
RVC	-	Regional Vice Chair
SAC	-	Student Activities Committee
SDL	-	Self Directed Learning
TC	-	Technical Committee
TPS	-	Title, Purpose, Scope
WS	-	Work Statement

MINUTES
REFRIGERATION (REF) COMMITTEE
JUNE 22, 2008
SALT LAKE CITY, UT

MEMBERS PRESENT:

Zahid Ayub, Chair
Don Siller, Vice-Chair
John Bevington
Don Cleland
Cynthia Gage
Danny Halel
Doug Reindl
Doug Scott
Jim Shepherd
John Sluga
Ron Vallort
Art Garbarino, Consultant
Lynn Bellenger, Coordinating Officer
Richard Kelso, BOD Ex-Officio

GUESTS:

Kent Anderson, Incoming Vice Chair
Georgi Kazachki, Incoming Member
Bruce Badger
Marc Chasserot
Kirsten McNeil
Apichit Lumlertpongpana
Bruce Griffith
Scott Smith
John Topliss

STAFF:

Donna Daniel, AA
Steve Hammerling, AMORTS
Bruce Hunn, DOT

MEMBERS ABSENT:

Bruce Nelson

1.0 CALL TO ORDER AND ROLL CALL

Chair Zahid Ayub called the meeting to order at just after 8:00 a.m. Members, incoming members, and guests introduced themselves.

2.0 APPROVAL OF MINUTES

It was moved and seconded that,

1. The minutes of the January 20, 2008 meeting in New York City be approved.

MOTION 1 PASSED: 10-0-0 CNV

3.0 REVIEW OF AGENDA

The agenda distributed prior to the meeting was reviewed. No changes were made. The agenda is included with these minutes as **Appendix 1**.

4.0 CHAIRMAN'S REPORT

4.1 Disposition of REF Motions from Last Meeting

REF recommended that ASHRAE work to agree to the Memorandum of Understanding (MOU) with the Global Cold Chain Alliance (GCCA). ExCom considered this and will move forward with the MOU as recommended by REF. Furthermore, REF recommends that Ron Vallort be the appointed as the ASHRAE liaison to the GCCA in support of this MOU. Bellenger took an action item to contact the BOD to recommend appointment of Vallort as liaison to GCCA.

REF recommended to Technology Council that they approve MOP changes to incorporate the George Briley ASHRAE Journal Award. Siller reported that this was approved as a committee level award, not a Society level award. REF can award this plaque to the winner at the REF meeting. Functional Planning subcommittee recommended that the procedures for the award be included in the REF reference manual.

The estimated \$200 cost of the award is available in the REF budget.

REF recommended that the Special Projects subcommittee not award the Green Guide on Refrigerated Warehouses project as proposed. Siller reported that a project evaluation subcommittee (PES) from TC 10.5 was subsequently asked to evaluate the proposal as an Unsolicited Research Proposal (URP) 1539. The PES voted not to approve the proposal. Their recommendation will be considered by TC 10.5 at their upcoming meeting.

4.2 Management by Objectives (MBOs)

Ayub's reviewed the final status MBO's for the 2007-2008 Society Year. Items in the MBO's would be discussed throughout the meeting. A final MBO report will be reported to Technology Council. This report is included with these minutes as **Appendix 2**.

5.0 VICE CHAIRMAN'S REPORT

Siller presented his draft MBO's for the upcoming Society Year 2008 – 2009. Siller requested input from members if they'd prefer to be assigned to specific tasks. The final MBO list with assignments is attached (**Appendix 3**). Siller noted that some of the MBOs were carried over from the previous year.

Siller attended the Fiscal Planning Subcommittee meeting in New York and would do so in Salt Lake tomorrow. There was nothing of significance to REF to report. Siller confirmed that a budget would be available for the new George Briley ASHRAE Journal Article Award.

6.0 POSITION DOCUMENTS (PD)

6.1 Ozone Depleting Substances (ODS)

Ayub reported the ODS PD was approved in New York. A new PDC, chaired by Julian DeBullet, was formed to address changes to the format desired by Technology Council. This committee is meeting in Salt Lake for the first time.

6.2 Natural Refrigerants

Ayub reported that the PDC had met via conference call and email discussions to develop a draft of the committee. The draft PD was approved by the PD Committee via letter ballot and was presented to the Operations Subcommittee of Technology Council prior to Salt Lake for their review.

It was moved and seconded that,

2. REF recommends that Operations Subcommittee recommend approval of the draft of the Natural Refrigerants PD.

MOTION 2 PASSED: 10-0-0, CNV

BACKGROUND: The draft approved by the PD Committee is shown in **Appendix 4**.

7.0 REFRIGERATION AWARDS

7.1 Milt Garland & Comfort Cooling Awards

Vallort and Scott reported there were numerous leads for submissions in the works for Chicago. Promotional article was published on front page of May 2008 Insights (**Appendix 5**). More promotional efforts are planned.

7.2 ASHRAE Journal Article Award

As noted previously, the Journal Article Award was approved as a Committee level award. The procedures will be maintained in the REF Reference Manual and money is available in the REF operating budget.

An action item to design the plaque is ongoing. Bevington developed a preliminary design based on an existing ASHRAE award. Staff will handle the administrative issues to procure a plaque once the design is settled upon.

Related to the procedures, Reindl asked if the Briley Article Award had the same format as the ASHRAE Best Paper Award for Transactions papers. Reindl suggested using this as a model if necessary.

Action Item 1 – Staff – Forward procedures for ASHRAE Best Paper Award to Halel for review.

8.0 BOD EX-OFFICIO/COORDINATING OFFICER

Coordinating Officer Lynn Bellenger thanked REF for their efforts on the committee over the past year. Lynn thanked incoming chair Siller for his participation at Technology Council's spring planning meeting. Bellenger referred to the Strategic Plan Branding document available at WWW.ASHRAE.ORG/STRATEGICPLAN.

BOD Ex-Officio Dick Kelso addressed REF as well. Kelso commended the committee for progress on MBO's for the past year, specifically, the swift completion of the Natural Refrigerants PD.

9.0 SUBCOMMITTEE REPORTS

9.1 Functional

Bevington reported there were no changes to the MOP or ROB to consider at this meeting. Past changes have all been incorporated.

9.2 Education

Reindl reported that REF contacted the SAC chair with information on the poultry plant refrigeration themed topic. The chair noted that the theme for next year had already been developed. Participation through the SAC may be the best way to go about getting an influence in the competition. Bellenger suggested working with the incoming SAC chair to incorporate refrigeration into the next competition theme.

Action Item 2 – Siller – Contact incoming SAC chair to discuss refrigeration related topic for next student design competition

REF discussed the lack of US/Canada colleges and universities that offer refrigeration related courses. REF discussed what could be done to assist universities or to develop interest among students. This was an MBO from last year and an effort that can continue into next year.

Reindl reported that REF forwarded a detailed outline and speakers for a webinar entitled Introduction to Refrigeration to the Professional Develop Committee (PDC) and CTTC. However, the PDC noted they are developing some self directed learning (SDL) courses online with Elsevier, one of which is on refrigeration fundamentals. The ALI and did not want another program to compete with SDL. REF agreed to assist with the SDL as necessary, either in development or review of this program or any other ALI courses on this topic.

Action Item 3 – Siller – Contact ALI to volunteer to assist review of refrigeration SDL

9.3 Liaisons

Sluga distributed a summary of TC liaison checklists which is included with these minutes as **Appendix 6**. A TC liaison checklist for future use is included as **Appendix 7**.

Action Item 4 – REF TC liaisons – return TC Liaison checklist forms to Sluga

9.4 Publications

Topliss reported that significant progress has been made on a CO₂ chapter for the 2010 Refrigeration volume of the ASHRAE Handbook. He has worked with the IAR to develop an outline and rough draft with nearly 70 pages of content. Vallort suggested settling any IAR copyright issues that may exist. Badger noted he did not think this would be difficult or would hold up project as the IAR wants the chapter in the ASHRAE Handbook.

Action Item 5 – Staff – Contact the IAR in writing, through their President, Bruce Badger, requesting their permission for ASHRAE to use the materials developed for the IAR CO₂ Handbook.

Siller noted that there are many parties interested in this chapter. Topliss should get material distributed for review and input. REF will work to assure wide distribution for review by all interested parties. Halel noted several Section 3 TC's would have an interest as well.

Action Item 6– Topliss –submit latest draft for distribution for review.

Action Item 7 - Staff/Topliss – distribute to relevant TC's and interested individuals for assistance in review.

Sluga reported that there was an outline for an Introductory chapter to the 2010 Refrigeration Handbook that was developed by the Handbook Workshop participants but little else is currently available. Work needs to be done if something is to be included in the 2010 Handbook.

Action Item 8 – Sluga – distribute 2010 introductory chapter outline to REF.

9.5 Program

REF sponsored the following green refrigeration programs for Salt Lake:

- Seminar 59, Greening Refrigeration, Part 1: Commercial
- Seminar 63, Greening Refrigeration, Part 2: Industrial

Several other refrigeration related programs in Salt Lake were sponsored by Section 10 TC's and are listed below. Additional refrigeration-related presentations were sponsored by other sections and committees.

- Seminar 5, Oil Circulation Issues of R-22 Alternatives in Supermarket Refrigeration Systems
- Seminar 17, Experiences with Alternate Refrigerants as Replacements for R-22 in Commercial Refrigeration
- Seminar 32, Olympic Bobsled Tracks: Design and Construction Challenges
- Transactions Session 11, Reduction of Refrigeration Loads
- Seminar 40, Refrigerant Applications with IAR
- Seminar 73, Striving for a LEED Certified Refrigerated Warehouse

REF discussed program ideas for future meetings. A forum to seek input on the CO₂ chapter was suggested. However, it was noted that the chapter was due for submission prior to the Chicago meeting so input could not be considered at that time.

Vallort suggested 50 years of ASRE as a theme for a program as Chicago will mark the 50 year anniversary of the ASRE/ASHVE merge.

A program on use of CO₂ and developments in refrigeration was suggested. Two parts or two separate seminars on commercial applications and industrial applications may be warranted. One of the speakers could talk about the CO₂ chapter in the 2010 Refrigeration volume. Potential speakers suggested were Ayub, Scott, Hind, Pearson, and Groll. Chasserot noted he could suggest a speaker as well. Kazachki agreed to chair the program or programs.

It was moved and seconded that,

3. REF recommends that a seminar program for Chicago titled 'CO₂ Developments in Refrigeration' be approved:

MOTION 3 PASSED: 10-0-0, CNV

Action Item 9 – Kazachki – Submit CO₂ seminar program(s) for Chicago prior to deadline

A forum program was suggested to collect ideas on what REF can do to develop involvement in REF at the university, chapter, and Society level.

It was moved and seconded that,

4. REF recommends that a forum program for Chicago related to 'activities and ideas for refrigeration courses and technical program involvement.' be approved:

MOTION 4 PASSED: 10-0-0, CNV

Action Item 10 – Gage, Hael – Submit forum program for Chicago prior to deadline

10.0 CTTC LIAISON

REF's CTTC liaison, Art Garbarino, attended the CTTC meeting and reported to REF with an oral presentation. Garbarino noted a decline in refrigeration related chapter presentations. He delivered a list of programs on interesting topics. Such a list is also posted on the REF website - www.ashrae.org/members/page/797. Vallort stated that there are resources available to each chapter such as researchers, speakers list, and tour facilities. Vallort noted that RETA and RSES chapters could be included in chapter meetings to help expand the potential audience.

Other ideas presented to increase the emphasis on refrigeration activities at the Chapters included: promotion of the George Briley Award, the Milt Garland Award, and the Comfort Cooling Award through articles and announcements in the Insights and Journal; promote and deliver the Webinar on refrigeration; contact the incoming ASHRAE President and influence him to emphasize refrigeration activities in his PAOE points; update the list of speakers on refrigeration topics and promote them to chapter. Topliss noted he used to do a REF chair newsletter to refrigeration contact in each chapter to reach and inform each chapter on issues. Perhaps this could be reinstated.

Siller noted that many of his MBO's for the next year are related to chapter and CTTC activities.

11.0 NEW BUSINESS

Gage notified REF that the US DOE plans to develop rating standards for walk-in coolers and freezers. They have approached ASHRAE TC 10.7, Commercial Food and Beverage Cooling Display and Storage, to discuss at their meeting. Gage noted that TC 10.5, Refrigerated Distribution and Storage Facilities, may be even more appropriate and REF agreed. Gage will suggest this to the DOE through TC 10.7.

12.0 NEXT MEETING

The next meeting of REF is scheduled for Sunday, January 25th, 2009 in Chicago, IL. REF will also have an opportunity to report on REF business at the Technology Weekend meeting in October. Also, Siller noted that he planned to hold quarterly conference calls to assist REF in completing their tasks. Siller will poll committee members for their availability after the meeting.

13.0 HANDOVER TO NEW CHAIR

Ayub thanked REF and the committee for their contributions over the past Society Year. Ayub noted Bevington and Hael are rolling off REF and presented them with Certificates of Appreciation for their work. Cleland and Reindl were also thanked and recognized as rolling off of the committee. Staff will send their certificates from HQ upon their return to the office.

Siller thanked Ayub for his services as Chair and presented him with a Certificate of Appreciation as well. Siller welcomed incoming members Kent Anderson and Georgi Kazachki and noted that Brian Fricke and Donald Hay are also joining the committee, but were not in attendance.

14.0 ADJOURNMENT

The REF meeting was formally adjourned at approximately 11:45 a.m.

Refrigeration Committee Meeting Agenda

Sunday, June 22nd, 2008

8:00 AM – 12:00 PM

(M) Grand Ballroom Salon B (L)

- 1.0 CALL TO ORDER
- 2.0 ROLL CALL & INTRODUCTIONS
- 3.0 APPROVAL OF MINUTES- Winter Meeting – New York, January 20th, 2008
- 4.0 REVIEW OF AGENDA
- 5.0 CHAIRMAN'S REPORT – Z. Ayub
 - 5.1 Disposition of Motions from Last Meeting
 - 5.1.1 REF recommends that ASHRAE work to agree to the MOU from the GCCA
 - 5.1.2 REF recommends to Technology Council that they approve MOP changes to incorporate the George Briley ASHRAE Journal Award
 - 5.1.3 REF recommends that the Special Projects subcommittee not award the Gree Guide on Refrigerated Warehouses as proposed
 - 5.2 New Action Items for REF
 - 5.3 2007-08 MBO's – Final Report
 - 5.4 Other
- 6.0 VICE-CHAIRMAN'S REPORT – D. Siller
 - 6.1 2008-09 MBO's
 - 6.2 Fiscal report
 - 6.3 Other
- 7.0 Position Documents
 - 7.1 Ozone Depleting Substances
 - 7.2 Natural Refrigerants – Z. Ayub
- 8.0 REFRIGERATION AWARDS - J. Shepherd
 - 8.1 Milt Garland Award
 - 8.2 Comfort Cooling Award
 - 8.3 ASHRAE Journal Award
- 9.0 BOD EX-OFFICIO – D. Kelso
- 10.0 COORDINATING OFFICER – L. Bellenger
- 11.0 SUBCOMMITTEE REPORTS
 - 11.1 Functional – J. Bevington
 - 11.1.1 MOP & ROB
 - 11.2 Education – Reindl
 - 11.2.1 Webinar/Professional development course
 - 11.2.2 Student design competition
 - 11.3 Liaisons – J. Sluga
 - 11.4 Publications – Z. Ayub
 - 11.4.1 CO₂ chapter status
 - 11.4.2 Intro chapter for 2010 Handbook
 - 11.5 Program - Reindl
 - 11.6 International – Z. Ayub
- 12.0 CTTC LIAISON – A. Garbarino
- 13.0 UNFINISHED BUSINESS
- 14.0 NEW BUSINESS
- 15.0 NEXT MEETING – Chicago, IL, January 25th, 2009
- 16.0 RECAP
- 17.0 HANDOVER TO NEW CHAIR – Z. Ayub & D. Siller
 - 17.1 Closing Remarks
 - 17.2 Announce Subcommittee Assignments
- 18.0 ADJOURNMENT

Committee Objectives
Society Year: 2007 - 2008
Refrigeration Committee - Zahid Ayub, Chairman
Submitted: 6/24/2007
Status: 6/22/2008

No	Objective	Completion Date	Fiscal Impact	Responsibility	Status
1	Submit RTAR - "Evaluate Various Refrigerant Options for Equipment and Applications"	Jul-07	\$45K or more!	Ayub	A RTAR was developed but failed in a REF letter ballot. RTAR not active for time being. Never submitted to RAC.
2	Update Ozone Depleting Substances PD	Jun-08	UK	Goldschmidt	PD was approved but is being revised once more by PDC.
3	Develop PD on "Natural Refrigerants"	Jun-08	UK	Ayub	PD submitted to Operations Subcommittee
4	Identify US/Canada colleges and universities that offer refrigeration and refrigeration related courses	Jan-08	None	Gage, Sluga, Reindl, Bevington, Scott, Mueller	Some subcommittee members have forwarded information to Ayub. Effort will continue into next year.
5	Promote "Green" Refrigeration by awareness through forums, seminars/symposia	Jun-08	None	Reindl	2 'green' refrigeration seminars in Salt Lake.
6	Liaison with C-Dig, Eurammon, NRTB and other international bodies involved in Natural Refrigerants	Jun-08	None	Ayub, Cleland	Ongoing
7	Include CO ₂ Information in Refrigeration Handbook Volume - 2010; Co-ordinate with Section 10 TC's	Jun-09	UK	TC 10.3, Siller	Topliss reported significant progress on draft chapter. Working with IIAR on project. An outline and rough draft are prepared. REF will work to assume wide distribution for review of interested parties
8	Update and maintain website	Jun-08	None	Staff	Complete
9	Seek nominations for Garland and Comfort Cooling Awards	Jun-08	None	Bevington	Numerous leads are in the works for submission in Chicago. Promotional efforts were published in Insights. More are planned.
10	Strive for a "Refrigeration" related topic for next year's ASHRAE Student Design Competition	Jun-08	None	Ayub Siller	Contacted SAC to discuss topic. Communication will continue.
11	Liaison with other TC's on refrigeration related research	Jun-08	None	Sluga	Complete. TC Liaison report presented to REF

**ASHRAE Refrigeration Committee (REF) Objectives
Society Year 2008-2009
Donald A. Siller, Chairman
Final: 6/22/2008**

No.	Objective/Goals	Completion Date	Fiscal Impact	Responsible Person(s)	Status
1.	Increase REF Committee Activity Level and Visibility				
	a. Assign each REF member to at least (1) goal, and encourage quarterly progress reports and participation in quarterly conference calls.	06/08	None	All REF Committee Members	
	b. Publicize the George Briley ASHRAE Journal Award and encourage refrigeration related articles published in the Journal, through Insight announcements.	Quarterly	\$200	Gage, Bevington	
	c. Publicize, develop and deliver Webinar to increase awareness and interest in refrigeration.	06/09	UK	Fricke, Reindl, Halel	
	d. Assist in reviewing the Self-Directed Learning Course (SDL) on Refrigeration.	UK	UK	Vallort, Nelson	
	e. Work with RAC to improve communications with Section 10 TC's and streamline process of generating and approving RTAR's and WS's.	01/09	None	Siller, Anderson	
	f. Work with TAC to improve communications between REF and refrigeration related TC's, and Projects (SDL).	06/09	None	Siller, Anderson	
	g. Develop the Scope for a refrigeration related topic for the 2009 Student Design Competition, and forward it to Student Activity Committee.	06/09	UK	Nelson, Ayub, Reindl,	
	h. Coordinate development of a chapter on CO ₂ to be published in 2010 Handbook, and communicate information to All Section 10 TC's, and TC 3.2, 3.3, 3.4, 3.5.	06/09	None	Topliss, Siller, Anderson, Halel	
	i. Promote 'Green Refrigeration' through programs at the Winter Meeting in Chicago and the Annual Meeting in Louisville.	01/09, 06/09	UK	Kazachki, Gage	
	j. Liaison with C-Dig, Eurammon, and other international bodies involved in natural refrigerants.	06/09	None	Hay, Ayub,	
	k. Maintain and update the REF website.	01/09, 06/09	None	Staff	
	l. Liaison with TC's on refrigeration related research and programs.	01/09, 06/09	None	Sluga, All REF Members	

Voting Members: Kent Anderson, Brian Fricke, Cynthia Gage, Donald Hay, Georgi Kazachki, Bruce Nelson, Doug Scott, Jim Shepherd, John Sluga, Don Siller, Ron Vallort

Non-Voting: Zahid Ayub, John Bevington, Danny Halel, Doug Reindl, John Topliss

**ASHRAE Refrigeration Committee (REF) Objectives
Society Year 2008-2009
Donald A. Siller, Chairman
Final: 6/22/2008**

No.	Objective/Goals	Completion Date	Fiscal Impact	Responsible Person(s)	Status
2.	Support Chapter Refrigeration Activities				
	a. Submit recommendations to incoming President for 2009-2010 Refrigeration PAOE points and emphasize that refrigeration be included in a separate category.	01/09	None	Anderson, Vallort	
	b. Update list of speakers on refrigeration topics.	01/09	None	Gage, Fricke	
	c. Expand Distinguished Lecturer List to include at least (6) additional experts on refrigeration.	01/09	None	Vallort, Siller	
	d. Publicize refrigeration programs and speakers through Insight announcements.	Quarterly	None	Gage, Bevington, Vallort	
	e. Publicize the Milton W. Garland Commemorative Refrigeration Award for Project Excellence, and the Refrigeration Comfort Cooling Award for Project Excellence, through Insight announcements.	Quarterly	\$400	Gage, Bevington, Vallort	
3.	Develop a Plan for Sustainable Refrigerated Building and System Design				
	a. Coordinate the development of an RTAR to establish 'Benchmarks for Energy Efficiency and other aspects of Sustainability in Refrigerated Storage Facilities.'	01/09	UK	Scott, Nelson, Ayub	
	b. Coordinate the development of an RTAR for a 'Design Guide for Energy Efficient, Sustainable Refrigerated Storage Facility.'	01/09	UK	Vallort, Scott, Ayub	
	c. Coordinate the development of an RTAR for a 'Design Guide for Energy Efficient, Sustainable Refrigeration Systems.'	06/09	UK	Scott, Nelson, Kazachki	
	d. Coordinate the development of RTAR's for the research necessary to support the above 'Design Guides.'	06/09	UK	Scott, Nelson, Ayub	

Voting Members: Kent Anderson, Brian Fricke, Cynthia Gage, Donald Hay, Georgi Kazachki, Bruce Nelson, Doug Scott, Jim Shepherd, John Sluga, Don Siller, Ron Vallort

Non-Voting: Zahid Ayub, John Bevington, Danny Halel, Doug Reindl, John Topliss

ASHRAE POSITION DOCUMENT (year)- (number)
Approved by BOD on (date)

Natural Refrigerants

Executive Summary:

Driven by international agreements such as the Montreal and Kyoto protocols as well as a desire for a higher degree of sustainability, there is a renewed interest in increasing the application of natural refrigerants. The class of refrigerants commonly referred to as “natural refrigerants” offers the potential to improve the environmental performance of refrigeration systems. Because of its alignment with sustainability initiatives, ASHRAE supports research, assessment, and strategic growth in the use of natural refrigerants such as ammonia, carbon dioxide, hydrocarbons, air and water in refrigeration systems and technologies.

Taking a leadership role means ASHRAE and its members will continue to extend the scope of refrigeration and air conditioning technology by conducting research, disseminating knowledge, developing standards and guidelines, and promoting the responsible use of sustainable refrigerants. Several technical committees within ASHRAE are committed to achieve this goal; however, the pace has been somewhat slow. Limited research has been undertaken within a few ASHRAE technical committees during the past decade with most efforts focused on ammonia and carbon dioxide.

In light of the current global scenario, ASHRAE’s response to the demand for environmental sustainability is to promote the development of systems which use natural refrigerants safely, economically and efficiently.

The Position Document Committee:

- Zahid Ayub, Chair
- Donald A. Siller
- Cynthia Gage
- Doug Reindl
- Norbert Mueller
- Julian deBullet
- Andy Pearson
- Risto Ciconkov

1.0 Issues

Refrigerants play a vital role in society by their use in systems to preserve food and produce ice, to condition space for human welfare and controlled environments, and to support industrial processes. As world economies grow the application of refrigeration and air conditioning systems also grows, which leads to a proliferation in refrigerant production by virtue of the “banked” refrigerant existing in deployed equipment and a greater quantity of refrigerant needed for servicing and maintenance. Both of these factors result in a greater potential for refrigerant emissions to the environment with the

potential adverse impacts. At the same time as the need for refrigerants is growing, the world's societies are becoming more concerned about the environmental consequences of the refrigerants being used and the systems which use them. Through the Montreal Protocol, the world developed an unprecedented response for the environmental problem of stratospheric ozone depletion by phasing out the manufacture and the eventual use of ozone depleting refrigerants. The primary substitutes for these refrigerants are hydrofluorocarbons (HFCs) but they are greenhouse gases which have been implicated in global climate change. Consequently, options for the reduction of greenhouse gas emissions are now under investigation.

In the search for alternatives which have low Global Warming Potential (GWP) and reduced likelihood of other environmental impacts, natural refrigerants are gaining increased interest. Natural refrigerants are substances that can be found naturally occurring in the environment. Natural refrigerants include ammonia, carbon dioxide, hydrocarbons, water, and air. Some of the natural refrigerants have been used in the market place for many decades although at varying degrees of application. Although environmentally superior, natural refrigerants are not free of other concerns, such as corrosion, toxicity, high pressures, flammability, or in some cases lower operating efficiencies.

Selection of the correct refrigerant for an application requires careful review of such criteria as capital cost, operating cost (including energy and maintenance), equipment size and location, operating temperatures/pressures, facility staff capability and local, national, and international regulations.

The American Society of Heating, Refrigerating, and Air-conditioning Engineers (ASHRAE) is an international leader in the field of refrigeration and air conditioning (R&AC). Through its mission to advance the arts and sciences of heating, ventilating, air conditioning and refrigerating to serve humanity and promote a sustainable world, ASHRAE and its members are uniquely qualified to contribute to the correct advancement of natural refrigerants.

2.0 Background:

Natural refrigerants include a range of organic and inorganic compounds suitable for use in a variety of R&AC system applications and presenting a variety of issues and challenges. Thus the successful application of these refrigerants will vary depending on the compound. A useful definition is "Natural refrigerants occur in nature's biological and chemical cycles without human intervention. These materials include ammonia, carbon dioxide, natural hydrocarbons, water and air."

The advantages of natural refrigerants have led to a significant increase in their use in recent years in applications traditionally served by fluorocarbons. For ammonia and hydrocarbons, a major goal of current development is to decrease the refrigerant charge in refrigerating systems in order to address safety concerns. Through careful design, it is often possible to reduce the required quantity of refrigerants in systems by the application

of design techniques such as plate heat exchangers and dry expansion evaporators – both of which are already common in a number of applications.

Another way to decrease the refrigerant charge is the use of indirect refrigeration systems with secondary coolants. In these systems the refrigerant is limited to the machine room, and the secondary coolants circulate in the occupied spaces. In addition to traditional secondary coolants, such as glycols and salt brines, new coolants appeared on the market, and particularly beneficial results have been reported with CO₂ as a secondary coolant. These alternatives tradeoff environmental benefits of reduced refrigerant charge with lower system operating efficiency due to the presence of a secondary working fluid.

Another common issue for several of the natural refrigerants is the need to advance the development of system components which can cost effectively achieve desired energy and performance efficiencies.

2.1 Ammonia – R-717

Ammonia is the most important of the natural refrigerants because of its longstanding and widespread use in food and beverage processing and preservation, and because of its growing adoption in HVAC chillers, thermal storage systems, process cooling and air conditioning, district cooling systems, supermarkets, and convenience stores. Since the middle of the nineteenth century there have been many changes in types of refrigerants, but ammonia is unique because it has seen continued use over this 150 year period.

Ammonia has Ozone Depletion Potential (ODP) and GWP equal to zero. It has inherently high refrigeration system energy performance, excellent thermodynamic properties, and high heat transfer coefficients. In a vapor state it is lighter than air. It is easily detected by smell, or by a variety of electrochemical and electronic sensors, and is readily available at a relatively low price. Less than 2% of all ammonia commercially produced in the world is used as a refrigerant; however, ammonia enjoys low cost due to the large volume of production for use as a fertilizer.

The primary disadvantage of ammonia is its toxic effect at higher concentrations (i.e. well above 300 ppm); however, this risk is somewhat mitigated by its pungent smell alerting humans of its presence since even at lower concentrations (5 ppm) it is self-alarming in the event of a leak. Ammonia is classified as, “moderately flammable” in air when its concentration ranges between 16% and 28% (weight); and it is not compatible with copper and copper alloys.

In some jurisdictions, ammonia refrigerating systems are subject to legal regulations and standards because of personnel safety considerations. These do not necessarily present additional barriers because legal regulations, proper maintenance and training of personnel are required for other refrigerants as well. Furthermore, the use of fluorocarbon refrigerants is discouraged in many countries with imposition of environmental legislation and taxes, and uncertainty concerning the Kyoto Protocol consideration. If the regulations and standards are applied in practice, and if suitable

training for maintenance personnel is provided, then danger from ammonia use is no different from that of most other refrigerants.

Ammonia provides useful cooling across the range of temperatures, from air conditioning to low temperature applications. Some air conditioning systems with ammonia chillers have recently been installed in commercial and public buildings. These units are currently more expensive than fluorocarbon-based chillers, but the price difference is expected to reduce as production volumes increase. A semi-hermetic ammonia compressor is already on the market and will be applied in chillers and in factory-packaged refrigeration units which are used commonly in ice plants and smaller food processing and storage facilities. In order to reduce the potential for ammonia leakage, compact refrigerating units are built, fully sealed and tested in factories, and can be supplied with a charge of less than 50 kg of ammonia for 1000kW cooling capacity. Lastly, in large industrial systems where there is a need for low temperatures (-30 to -50°C) ammonia has been used in cascade refrigerating systems with CO₂.

Absorption chillers with ammonia/water mixture are suitable and cost effective for some specific applications, especially using a waste heat, in Combined Chilling, Heat and Power (CCHP) systems and district cooling.

2.2 Carbon dioxide – R-744

Like ammonia, carbon dioxide was also used in the mid- to late-nineteenth century, particularly on board ships and in shops and theatres where the smell of ammonia was not acceptable. However, as ammonia system safety and efficiency improved at the beginning of the twentieth century carbon dioxide systems became less common. With the introduction of fluorocarbons in the 1930s carbon dioxide fell out of use by the 1950s. The low toxicity, non-flammability, zero ozone depletion potential and low global warming potential have attracted the attention of system designers beginning in the early 1990s when alternatives to chlorofluorocarbons (CFCs) were being sought. Since then, carbon dioxide has found widespread acceptance in the full range of vapor-compression systems, from low temperature freezers to high temperature heat pumps. It has also been widely used as a secondary refrigerant, offering significant improvements in efficiency compared with traditional water, glycol or brine systems.

One major difference between carbon dioxide and other refrigerants is in its pressure/temperature characteristic because the pressures experienced are approximately ten times higher than those in ammonia or R-404A systems. This high pressure requires special equipment designs, but it also offers many advantages over other refrigerants. The high pressure results in high gas density, which allows a far greater refrigerating effect to be achieved from a given compressor. It also produces very small reductions in saturation temperature for a given pressure drop allowing higher mass flux in evaporators and suction pipes without efficiency penalties. This effect is particularly noticeable at low temperatures (-30 to -50°C), which is why carbon dioxide systems perform so well under these conditions. Exceptionally good system performance has been noted in low temperature plate freezers and multi-chamber blast freezers where improvements in efficiency and reductions in freezing time have been reported.

When the pressure is raised above the critical point (7.3773MPa) it is not possible to condense carbon dioxide. Under these conditions heat rejection is achieved by cooling the very dense gas which results in a temperature glide effect. This has been used to great advantage in water-heating heat pumps for a range of applications from domestic to industrial. These trans-critical heat pumps are particularly efficient when the incoming water is low temperature, for example from the cold water supply. They are less effective over a small temperature range, for example in central heating systems.

The unusual fluid properties of carbon dioxide, including its high density and low critical point, make it particularly well suited for cooling very dense heat loads, such as those found in Information Technology applications like blade servers and trader rooms. The optimal temperature for transferring heat to carbon dioxide is 14°C, which happens to be exactly the evaporating temperature required for IT cooling in order to avoid dehumidification. In comparison the optimum temperature for R-134a is 77°C, and at 14°C the heat transfer capability of R-134a is only one-sixth of carbon dioxide.

Carbon dioxide is proposed as a good alternative for car air conditioning. The German Association of the Automotive Industry (VDA) has confirmed the joint decision of the German car industry to choose carbon dioxide for the next-generation of mobile air conditioning by 2011.

Today there are many trans-critical carbon dioxide systems in supermarkets. For about 90% of the year the Coefficient of Performance (COP) of systems with carbon dioxide is higher than in HFC systems. This is the reason that it is an attractive choice for beverage cabinets and vending machines.

The carbon dioxide used as a refrigerant is generally of industrial or scientific grade, and is typically recovered from the waste streams of industrial processes. The embedded energy required to reclaim, clean, liquefy and transport carbon dioxide is estimated to have a carbon equivalent of 1kg CO_{2eq} per kg. In contrast the ammonia production process has a carbon equivalent of 2kg CO_{2eq} per kg and for fluorocarbons this is typically about 9kg CO_{2eq} per kg.

2.3 Hydrocarbons

In nature, hydrocarbon refrigerants are constituents of oil and natural gas. Hydrocarbon refrigerants have excellent environmental, thermodynamic, and thermo-physical properties, however they are highly flammable. As a result of these factors, hydrocarbons are the molecular basis for the halocarbon refrigerants wherein some or all of the hydrogen molecules have been replaced by halogens such as chlorine, fluorine, and bromine which reduce flammability but can cause unwelcome effects on the environment.

Hydrocarbon refrigerants provide a range of boiling points with applicability from cryogenics to air conditioning. In the past hydrocarbon refrigerants have had limited applications primarily within the petrochemical industry to provide industrial chilling and

process refrigeration. With the phase out of the CFCs, hydrocarbon refrigerants are entering into new arenas. One of the first uses has been as a small quantity constituent in halocarbon blends to provide enhanced thermo-physical properties, such as oil miscibility. For the last decade in the European and Asian countries, the commercial market for systems using hydrocarbon refrigerants has been growing as a result of concerns about the environmental consequences of the halocarbon refrigerants.

Examples of commercially available equipment using hydrocarbon refrigerants are:

- systems with small charges including domestic refrigerator/freezers and portable air conditioners,
- stand-alone commercial refrigeration systems including beverage and ice-cream machines,
- as the primary refrigerant in centralized indirect systems for supermarket refrigeration,
- transport refrigeration systems for trucks, and
- chillers in the range 1kW – 150kW (0.3TR – 40TR)

The hydrocarbons most commonly used as refrigerants are:

Methane	R-50
Ethane	R-170
Propane	R-290
Butane	R-600
Isobutane	R-600a
Ethylene	R-1150
Propylene	R-1270

2.4 Water- R-718

Water is another natural refrigerant with a renewed interest because it is non-toxic, non-flammable low cost, and abundant. Water is widely used as a refrigerant in higher temperature lithium bromide – water (LiBR-H₂O) absorption chillers where water is the refrigerant and lithium bromide is used as an absorbent. The challenge for absorption chillers is that even a double- effect absorption cycle only has a COP (Coefficient of Performance) slightly greater than 1. As a comparison electric drive centrifugal chillers have a COP greater than 5.

It is far less common to find water in use within a vapor compression refrigeration system, although it does have one particularly noteworthy attribute – its thermo-physical properties enable it to achieve a high coefficient of performance. R-718 systems present a number of technological characteristics that have, to date, limited their growth into the industry. First, the operating pressures for water-based refrigeration systems are extremely low – approaching a near perfect vacuum making their continued operation free of contaminants (air) difficult. Second, the density of water vapor is extremely low; thereby, necessitating compressors capable of processing extremely high volume flow rates. Lastly, water is inherently limited to refrigeration applications for high temperature only. However, developments at the proto-type level in the vapor compression-based R-718 systems continues and is paving way for the introduction of chillers in large sizes that could become a significant part of the chiller and ice-water markets.

2.5 Other

In addition to carbon dioxide, air and some of its constituents are used as refrigerants in niche industrial applications. As with carbon dioxide, pressure and efficiency considerations are important criteria for selection. Liquid nitrogen in direct contact freezing is not considered to be a natural refrigerant because the embedded energy required for the production and transport of the liquid is so high.

Recommendations:

Through its Strategic Plan, ASHRAE has recognized that the advancement of sustainable building design and operations is critical to the protection of our global environment and to society. Expanding the safe and efficient application of natural refrigerants supports this move towards sustainability and continues ASHRAE's legacy as an international leader in the field of refrigeration and air conditioning.

ASHRAE holds a strong position that:

- the use of natural refrigerants helps to meet growing HVAC&R demands in a sustainable manner
- there are still research needs in order to achieve this in a safe, cost-effective, and environmentally beneficial manner
- projects must be assessed in a rational, fact-based, systematic manner to ensure that environmentally beneficial technologies are not rejected on the basis of false information or irrational fears.

ASHRAE recommends that further research be conducted on

- safety, energy efficiency, costs and environmental impact for all refrigerants using a consistent and comprehensive methodology
- the development of systems and components which can ensure the safe application of natural refrigerants without compromising energy efficiency
- the behavior of natural refrigerants in operating systems
- the role of natural refrigerants in achieving sustainability

ASHRAE is committed to

- the application of natural refrigerants
- the development of strategic relationships to advance natural refrigerants
- the consideration of natural refrigerants in existing and new guidelines, codes and standards
- the provision of guidance and education to policy makers and the public
- the creation and dissemination of methods and tools for environmental assessment of refrigeration systems
- the publication of technical information highlighting best practices from a safety, reliability and efficiency standpoint
- the promotion of authoritative information on natural refrigerants through seminars and publications

ASHRAE Documents

ASHRAE Handbook: Fundamentals - Refrigerants

ASHRAE Handbook: Fundamentals – Thermo-physical Properties of Refrigerants

ASHRAE Handbook: Refrigeration - System Practices for Ammonia and Carbon Dioxide Refrigerants

ASHRAE Standard 15 - Safety Standards for Refrigeration Systems

ASHRAE Standard 34 - Designation and Safety Classification of Refrigerants

ASHRAE Position Document: Ozone Depleting Substances

ASHRAE Position Document: Climate Change

ASHRAE Position Document: Ammonia as a Refrigerant



Three 'Cool' Awards

ASHRAE Insights

The ASHRAE Refrigeration Committee is sponsoring three awards for 2008–09.

The Milton W. Garland Commemorative Refrigeration Award for Project Excellence recognizes the designer and the owner of a non-comfort cooling refrigeration application that incorporates new technology in a unique manner. Submission for the Award is through the Chapter and Region levels and is due by Nov. 1.

The Refrigeration Comfort Cooling Award for Project Excellence highlights innovation and/or new technologies in a comfort cooling refrigeration application and is made to the designer and owner. Submission for the award is through the Chapter and Region and is due by Nov. 1.

The George Briley ASHRAE Journal Award recognizes an individual for excellence of a refrigeration related article published in the Journal. George Briley has made significant contributions to the Journal, including publication of almost 30 refrigeration-related articles. Submission for the Award is through the Refrigeration Committee Chair, and is due by Sept. 1.

For more detail, email REFchair@ashrae.net or go to the Refrigeration Committee Web page at www.ashrae.org/members/page/797 (or go to ASHRAE.org, click on "Membership," "Committees," then "Refrigeration").

Click here to view on the Web:

<http://www.ashrae.org/publications/detail/16739>

TC No	TC Name	REF Liaison	TC Chair	TC Vice Chair	Members Voting / CM	Handbook Chapters	Standards	Programs for Salt Lake City	Site Future of Programs	Active Research	WS's Released for Bid	Proposed RTAR's	Research Closed	Comments
REF	Refrigeration Committee		Don Siller	Kent Anderson		Intro to Refrigeration		Seminar 59 Seminar 63						
TC 1.3	Heat Transfer & Heat Flow	Zahid Ayub	Steven Eckels			Fundamentals 2 thru 5 & 39		Seminar 28 Seminar 51		1270-RP 1280-RP 1352-RP 1444-RP 1327-RP				
TC 3.1	Refrigerants & Secondary Coolants	Cynthia Gage	Barbara Minor	Sean Cunningham		Fundamentals 19 thru 21				1484-RP	1507-RP		1303-RP 1308-RP	Final reports were submitted at January meeting
TC 3.8	Refrigerant Containment	Danny Halel	Danny Halel			Refrigeration 8								
TC 8.1	Positive Displacement Compressors	Charles Klockner	Curt Slayton			Refrigeration 45								
TC 8.2	Centrifugal Machines	Norbet Mueller	Ajay Iyengar					Seminar 25						
TC 8.3	Absorption & Heat Operated Machines	John Bevington	Laura Schaefer			Fundamentals 1 Refrigeration 41								
TC 8.5	Liquid to Refrigerant Heat Exchangers	Zahid Ayub	James Bogart			Equipment 35 & 37		Seminar 28 Seminar 51		1316-RP 1394-RP	1324-RP			
TC 8.9	Residential Refrigerators & Food Freezers	Cynthia Gage	Pradeep Bansal	Gregory Rosenquist		Refrigeration 48		Seminar 22		RP1302				
TC 10.1	Custom Engineered Refgn Systems	Don Siller	Scott Smith	Doug Scott		Refrigeration 1, 4, 36, 37 & 43	15	Seminar 32 Seminar 40 Seminar 63		1327-RP	1513-RP 1514-RP			
TC 10.2	Ice Making/Skating Rinks	Don Siller	John Scott	William Wladyka		Refrigeration 35 & 37		Seminar 32					1289-RP	
TC 10.3	Refgn Piping, Controls, Acc	John Sluga	Todd Jekel	Don Siller		Refrigeration 2, 3 & 33 (new CO2 Chapter)		Seminar 5		1327-RP	1513-RP 1514-RP	1531-URP		
TC 10.4	Ultra Low Temp/ Cryogenics	James Shepard	Arthur Gabarino			Refrigeration 38 thru 40				1472-RP				
TC 10.5	Refgn Distrib/Storage Facilities	John Sluga	John Miranda	Dennis Halsey		Refrigeration 11 & 14		Seminar 73			1434-RP	1433-RP		
TC 10.6	Transport Refrigeration	Don Cleland	Alison Andrews			Refrigeration 30 thru 32								
TC 10.7	Food Display/Storage Equip	Cynthia Gage	David Hinde	Scott Mitchell		Refrigeration 46 & 47	32.1 32.2 72	Seminar 17 Seminar 59		1402-RP	1467-RP			
TC 10.8	Refgn Load Calculations	Don Siller	Don Siller			Refrigeration 13		Transactions 11		1210-RP 1434-RP	1434-RP			
TC 10.9	Refgn for Food & Beverage	Dan Dettmers	Gus Mastro			Refrigeration 9, 10, 12 & 15 thru 29		Transactions 11						
TC 10.10	Managemnet of Lubricant Circulation	Doug Reindl	Pega Hrnjak					Seminar 5						
USNC/IIR		Zahid Ayub	P. Fairchild											

Refrigeration Committee TC Liaison Check List

Refrigeration Committee Member Name: _____

TC Assignment: _____

Location of TC Meeting: _____

Item	Information Required	Status
1.	TC Chair name:	
2.	Number of members attending this TC meeting:	
3.	Does this TC appear to be organized?:	
4.	For what Handbook Chapters is this TC responsible	
5.	Does this TC need help locating members or Handbook reviewers?	
6.	Does this TC have any seminars, forums or symposia planned or scheduled for;	
	This meeting:	
	The next meeting:	
7.	Does this TC have any,	
	Active Research projects underway:	
	Research projects planned:	

News from the Refrigeration Committee (Update on recent Refrigeration Committee business that may be of interest to this TC, such as seminars planned, website revisions, awards, etc.)