

**DRAFT MINUTES**

**MTG.LowGWP COMMITTEE**  
January 13 & 16, 2019 Meeting (Part A & Part B)  
PART A

**SUNDAY, January 13, 2019**

**5:00 PM - 6:00 PM EST**

**Omni Hotel, Atlanta, GA**

**Grand C Room – M4 floor – North Tower**

**MEMBER ATTENDEES, STAFF & GUESTS: Total Attendance - 48**

Voting Members			Staff			Guests						
<b>Chair</b>	<b>Jim Wolf</b>	x	Mike Vaughn	x	Osami Kataoka	x	Cheng Chen	x	J. Francisco Caicedo	x	Julius Ballanco C&S	x
<b>Vice Chair</b>	<b>Bill McQuade</b>	x			Alireza Behfar	x	John Withouse	x	Patrick Coughlan	x	Mary Koban C&S	x
Res. Co-Chair	Brian Fricke	-			Harshad Inamdar	x	Dennis Manthes	x	Jian Sun-Blanks	x	Chris Forth	x
Res. Co-Chair	Phil Johnson	-			Shawn Wang	x	Devendra Kulkarni	x	James Battaglia	x	Avinish Gholap	x
Codes & Stds Chair	Doug Tucker	-	See attached list for additional guests									
Program Chair	Danny Halel	-	Alternate 1		Alternate 2		Alternate 3		Alternate 4		Alternate 5	
<b>REF</b>	Jason Robbins		<b>Charles Hon</b>	x								
SSPC 34	Samuel Yana-Motta		Chris Seeton		Sean Cunningham							
SSPC 15	Dennis Dorman		Greg Scrivener									
<b>TC 1.1</b>	<b>Ray Rite</b>	x	Sankar Padhmanabhan		Samuel Sami							
<b>TC 1.3</b>	<b>Omar Abdelaziz</b>	x	Satheesh Kulankara	x	Evraam Gorgy							
<b>TC 2.5</b>	<b>Larry Burns</b>	x	John Karakash									
<b>TC 3.1</b>	<b>Barbara Minor</b>	x	Steve Kujak		Bob Richard		Greg Linteris		Kenji Takizawa		Bob Low	
TC 3.2	Thomas Leck		Sonny Sundaresan		Alan Cohen							
<b>TC 3.3</b>	<b>Marc Scancarello</b>	x	Joe Nigro									
<b>TC 3.4</b>	<b>Joe Karnaz</b>	x	Chris Seeton		Danny Halel	x						
<b>TC 3.8</b>	<b>Danny Halel</b>	x	Mark Adams									
<b>TC 6.3</b>	<b>Roy Crawford</b>	x	Kevin Mercer									
<b>TC 8.2</b>	<b>Phil Johnson</b>	x	Laurent Abbas		Ray Good	x						
<b>TC 8.4</b>	<b>Vikrant Aute</b>	x	Yirong Jiang		Patrick Geoghegan		Chad Bowers					
<b>TC 8.5</b>	Satheesh Kulankara	x	Kashif Nawaz	x								
<b>TC 8.7</b>	Dermot McMorrow		<b>Doug Tucker</b>	x								
<b>TC 8.11</b>	<b>Dutch Uselton</b>	x	Ankit Sethi									
<b>TC 10.1</b>	<b>Doug Scott</b>	x	Dan Dettmers		Wayne Borrowman							
<b>TC 10.7</b>	<b>Brian Fricke</b>	x	Tim Anderson		Charles Hon	x						
<b>AHAM</b>	<b>Randy Cooper</b>	x	Masud Chowdhury									
<b>AHRI</b>	<b>Xudong Wang</b>	x	Helen Walter-Terrinoni	x								
<b>NASRC</b>	<b>Danielle Wright</b>	x	Morgan Smith	x								
<b>U.L.</b>	<b>Brian Rodgers</b>	x	Mark Skierkiewicz	x								
<b>UNEP</b>	Shamila Nair-Bedouelle		<b>Ayman Eltalouny</b>	x								

x – Denotes Member, Alternate, Guest, or Staff noted was in attendance for this meeting.  
P – Denotes Member, Alternate, Guest, or Staff noted was in attendance for part of this meeting.  
# - Denotes Non-Voting MTG leadership position  
**Bold** – Denotes committee or person was represented in MTG votes at this meeting  
a - Denotes voting member that arrived after votes cast

**26 Voting Members Currently – 14 needed for Quorum – Quorum? – YES, 16 present at start of meeting and 5 more joined later – 21 voting members present**

ADDITIONAL GUEST ATTENDEES:

Guests							
Chao Ding	x	Caho Ding	x				
Lydia Dobler	x	Carl Huber	x				
Karim Amrane	x	Ahmad Abuheiba	x				
Scott Creamer	x	Dominique Taudin	x				
Rosa Leal	x	Glenn Hourahan	x				
Dave Palty	x	Fouad Hamad	x				
Richard Weekley	x	Jim Tidwell	x				
Dominic Kolandayan	x	Robert Richard	x				
Neal Lawrence	x	Richard Burcher	x				
Shenglan Xuan	x	Patrick Coughlan	x				
Siva Gopalnarayanan	x	Junichi Ishikawa	x				
KeonWoo Lee	x	Alaa Olma	x				
Rajiv Karkhanis	x						
Helen Walter-Terrinoni C&S	x						
Samantha Slater	x						
Allen Karpman	x						
Jiro Inoue	x						
Motoki Shimohara	x						
Michael Taras	x						
Mark Menzer	x						
Walid Chakroun	x						
Bassam Elassaad	x						
Hassan El Mogy	x						
Detlef Westphalen	x						
<b>Vijay Peniannan</b>	x						
<b>Chris Repice</b>	x						

**PRINCIPAL MOTIONS  
MTG.LowGWP COMMITTEE  
2019 WINTER MEETING**

NO.	PAGE	MOTION
1	6	Draft minutes of the MTG.LowGWP 2018 Houston annual meeting be approved as drafted. Vote: 15-0-1-10 (26) CNV – MOTION PASSED
2	6	MTG.LowGWP accepts the Jan. 16th Codes & Standards Subcommittee report to the MTG and the report will be appended to the Atlanta meeting minutes for the MTG. Vote: 17-0-1-8 (26) CNV – MOTION PASSED
3	7	MTG.LowGWP formally refers the RP-1807 final report to SSPC 15 for review and asks that the SSPC respond back to us by 2019 Annual meeting with a list of potential affects, if any, that these research results will have on Standard 15. Vote: 20-0-1-5 (26) CNV – MOTION PASSED
4	8	MTG.LowGWP formally refers the RP-1808 final report once PMS required edits are made to SSPC 15 for review and asks that the SSPC respond back to us by the 2019 Annual meeting with a list of potential affects, if any, that these research results will have on Standard 15. Vote: 20-0-1-5 (26) CNV – MOTION PASSED
5	8	MTG.LowGWP conditionally approves WS-1855 for submission to RAC by RAC deadline of March 15 <sup>th</sup> 2019 contingent upon required edits to Recommended Bidders List, References, and Deliverables sections of WS have been completed. Vote: 20-0-1-5 (26) CNV – MOTION PASSED
6	13	MTG.LowGWP sponsor a seminar for KC on the results from RP-1807 & RP-1808 – Chaired by Kashif Nawaz and supported by Fricke, Johnson, and Uselton. Vote: 18-0-1-7 (26) CNV – MOTION PASSED
7	13	MTG.LowGWP sponsor a seminar for the Orlando meeting titled Fundamentals of Refrigerants Flammability – Chaired by Barbara Minor. Vote: 17-0-1-8 (26) CNV – MOTION PASSED
8	13	MTG.LowGWP co-sponsor a seminar for the Orlando meeting titled State-of-the-Art Refrigeration for LowGWP Refrigerants. – Sponsored by Refrigeration Committee Vote: 18-0-1-7 (26) CNV – MOTION PASSED

**MTG.LowGWP  
New Action Items – 2019 Winter Meeting**

Action #	Responsibility	Summary of Action	Pg.	Done
1	MORTS	Append Codes & Standards Subc. 1/15/19 activity report as <u>ATTACHMENT #1</u> to MTG.LowGWP minutes for this meeting.	6	X
2	Johnson	Schedule a RP-1806 PMS/Contractor meeting by January 31, 2019 in order to finalize a new completion plan, schedule, and end date for project and to make a joint decision on whether to proceed with a pilot study or more experimental work.	7	X
3	Fricke & Johnson	Schedule web meeting or teleconference with Std. 15 members Dennis Dorman & Greg Scrivener to discuss RP-1807 results.	7	
4	Fricke & MORTS	RP-1807 Final report posted to ASHRAE website before the end of January 31, 2019.	7	
5	Halel & Walter-Terrinoni	In an effort to try and research the effectiveness of current flammable refrigerants “best practices”, write a concept paper on incident evaluations with help from Helen at AHRTI.	7	
6	Fricke & Johnson	After RP-1808 completed, brief Std. 15 members on results.	7	
7	Fricke & Abdelaziz	Finalize list of recommended bidders, references, and deliverables for WS-1855 so WS can be submitted to RAC by March 15 <sup>th</sup> deadline for review at RAC spring 2019 meeting.	8	
8	Fricke	Solicit one or more volunteers from Std. 15 to serve on PES/PMS for WS-1855.	8	
9	MORTS	Send copy of RP-1794 final report to Randy Cooper of AHAM once report is approved by TC 3.1.	10	
10	MORTS	Schedule an MTG.Low.GWP ExCOM meeting for an update on RP-1806 and WS-1855 in the 1 <sup>st</sup> week of March, 2019.	10	
11	MORTS	Invite MTG.LowGWP voting members to PMS meetings for RP-1806.	10	
12	MORTS	Formally refer the final report for RP-1807 to SSPC 15 for review and ask that they respond back to us by 2019 Annual meeting with a list of potential affects, if any, that these research results will have on Standard 15.	10	
13	MORTS	Formally refer the final report for RP-1808 once final edits are complete to SSPC 15 for review and ask that they respond back to us by 2019 Annual meeting with a list of potential affects, if any, that these research results will have on Standard 15.	10	

**MTG.LowGWP New Action Items – 2019 Winter Meeting - CONTINUED**

Action #	Responsibility	Summary of Action	Pg.	Done
14	Abdelaziz	Develop draft white papers on results of RP-1807 & 1808 for distribution to ICC, ISO, UNEP, and others.	10	
15	Wang	Give update next MTG meeting on how AHRTI is getting research results into standards.	10	
16	Fricke & Johnson	<p>Come up with an initial plan on how to disseminate the RP-1807 and RP-1808 results by Wed. 1/16/19 meeting.</p> <ul style="list-style-type: none"> <li>✓ White paper to GAC by June 2019</li> <li>✓ SSPC 15 referrals on 1807/1808</li> <li>✓ 1-page fact sheet on every project done &amp; links to reports</li> <li>✓ One online site for all research partners (AHRI, ASHRAE, ORNL)</li> <li>✓ Simplified language for outside world - Ayman</li> </ul>	10	
17	Wang & Uselton	Clean-up spreadsheet listing all AHRTI research projects in development, underway or completed on LowGWP Refrigerants for presentation at Wed. 1/16/19 meeting.	10	X
18	MORTS	Identify Research Summit Track Chair for Kansas City Meeting	13	X
19	Ballanco	Send Jim Wolf IAPMO UMC 2021 meeting details	14	
20	Johnson	Update initial draft communication plan based upon feedback from MTG meeting in Atlanta and present updated plan at next MTG meeting.	14	

DRAFT MINUTES PART A**MTG.LowGWP COMMITTEE**

January 13, 2019 Meeting (Part A) – Atlanta, GA

MAIN MTG MEETING - PART A:

- A. CALL TO ORDER, Welcome comments and round of introduction
- B. REVIEW ROSTER & DETERMINE QUORUM  
**YES, 16 present at start of meeting and 5 more joined later – 21 voting members present**
- C. ASHRAE Code of Ethics Commitment – Chair  
 In this and all other ASHRAE meetings, we will act with honesty, fairness, courtesy, competence, integrity and respect for others, and we shall avoid all real or perceived conflicts of interests. (See full Code of Ethics: <https://www.ashrae.org/about-ashrae/ashrae-code-of-ethics> )
- D. ADDITIONS AND/OR CHANGES TO THE AGENDA  
 a) **None**
- E. APPROVAL OF HOUSTON MEETING DRAFT MINUTES  
**Motion #1** - Draft minutes of the MTG.LowGWP 2018 Houston annual meeting be approved as drafted.  
**Vote: 15-0-1-10 (26) CNV – MOTION PASSED**
- F. CODES & STANDARDS Working Group Interim Meeting Activity Reports since Houston meeting – All Reports will be appended to the MTG draft minutes for this meeting  
**Motion #2** - MTG.LowGWP accepts the Jan. 16th Codes & Standards Subcommittee report to the MTG and the report will be appended to the Atlanta meeting minutes for the MTG.  
**Vote: 17-0-1-8 (26) CNV – MOTION PASSED – vote occurred on Jan. 16 meeting**  
**AI#1 Atlanta (MORTS)** – Append Codes & Standards Subc. 1/15/19 Activity Report as **ATTACHMENT #1** to MTG.LowGWP minutes for this meeting.
- G. CHAIR'S REPORT - WOLF  
 a) Status on Joint AHRTI / ASHRAE / DOE-ORNL effort on A2L Refrigerants  
**AHRTI** - All A2L projects completed and final reports available. Follow-on A3 project (9007-02) with California Air Resource Board (CARB) with U.L. as contractor is also complete and results from this project may be used to support restart of RP-1806 effort. Project 9007-02 looked at PTAC, Mini-split, and single & 3-door reach-in coolers for A3 releases. See **ATTACHMENT #3** for additional information.  
**ASHRAE** – Four of the five ASHRAE led projects 1794, 1806, 1808, and 1855 are either in development, still underway, or being considered for completion. **RP-1794** (White paper investigation on use of odorants in flammable refrigerants) draft final report is now being considered for approval by TC 3.1. **RP-1806** (Post Ignition Risk Assessment) Task 1(Model Improvement, Calibration, and Validation) completed and being reviewed now by PMS for approval before proceeding to Task 2 (Simulation Study) and Task 3 (Risk Assessment Updates). PMS reviewed **RP-1808** (Servicing and Installing Equipment using Flammable Refrigerants: Assessment of Field-made Mechanical Joints) 1<sup>st</sup> draft of final report and requested edits to the report. Once these edits are completed, the report will be shared with the MTG for an approval vote. **WS-1855** is almost ready for RAC review and the goal is to submit to RAC by March 15, 2019. The final report for the fifth ASHRAE project **RP-1807** (Guidelines for Flammable Refrigerant Handling, Transporting, Storing and Equipment Servicing, Installation and Dismantling) was approved by the MTG for publication in Dec. 2018.  
**DOE-ORNL** working on following two projects:  
 i. NIST modeling tools for burn velocity  
 ii. Investigate the Proper Basis for Setting Charge Limits of A2L, A2, and A3 for Various Types of Products

Part 1 (Comprehensive Lit. Review) complete – Summarized output from workshop

Part 1 final report issued in August 2018

Part II: Methodology for Estimating Safe Charge Limits of Flammable Refrigerants in HVAC&R Applications.

This part of the project is underway now and will provide a summary of the development of reduced order models (ROM) for estimation of safe charge limits based on a computational fluid dynamics (CFD) parametric study. The study focus is on refrigerant releases in a single room for a range of parameters including refrigerant, refrigerant release rate, quantity and height, outdoor air ventilation rate, and room floor area. Two ROM versions are planned: one with no room air circulation (air conditioner blower off) and one with circulation.

b) New & On-going Action Items – See Pages 14 & 15

c) New Information Items

1. Draft final report for RP-1807 approved by MTG on 12/17/18 via web meeting by a vote of 14-1<sup>1</sup>-1<sup>2</sup>-10 (26) CV

#### H. RESEARCH SUBC. REPORT – FRICKE & JOHNSON

a) **RP-1806**, *Flammable Refrigerants Post-Ignition Simulation and Risk Assessment Update*

Contractor: Gexcon US - P.I.: Scott Davis – Cost: \$843.5k – 12 month duration – Johnson lead – New completion plan needed.

**AI#2 Atlanta** (Johnson) - Schedule a RP-1806 PMS/Contractor meeting by January 31, 2019 in order to finalize a new completion plan, schedule, and end date for project and to make a joint decision on whether to proceed with a pilot study or more experimental work.

b) **RP-1807**, *Guidelines for Flammable Refrigerant Handling, Transporting, Storing and Equipment Servicing, Installation and Dismantling*

Contractor: Navigant Consulting - P.I.: William Goetzler – Cost: \$95k - 9 month duration – Fricke lead – Project Completed

**Motion #3** - MTG.LowGWP formally refers the RP-1807 final report to SSPC 15 for review and asks that the SSPC respond back to us by 2019 Annual meeting with a list of potential affects, if any, that these research results will have on Standard 15.

Vote: 20-0-1-5 (26) CNV – MOTION PASSED

**AI#3 Atlanta** (Fricke & Johnson) - Schedule web meeting or teleconference with Std. 15 members Dennis Dorman & Greg Scrivener to discuss RP-1807 results.

**AI#4 Atlanta** (Fricke & MORTS) - RP-1807 Final report posted to ASHRAE website before the end of January 31, 2019.

**AI#5 Atlanta** (Halel & Walter-Terrinoni) – In an effort to try and research the effectiveness of current flammable refrigerants “best practices”, write a concept paper on incident evaluations with help from Helen at AHRTI.

c) **RP-1808**, *Servicing and Installing Equipment using Flammable Refrigerants: Assessment of Field-made Mechanical Joints*

Contractor: Creative Thermal Solutions - P.I.: Stefan Elbel – Cost: \$115k – 6 month duration – Fricke lead – MTG vote on draft final report needed.

**AI#6 Atlanta** (Fricke & Johnson) - After RP-1808 completed, brief Std. 15 members on results.

<sup>1</sup> Danny Halel voted against the motion because he felt that the contractor should have also provided information in the report on the effectiveness of each of these guidelines listed for Flammable Refrigerant Handling, Transporting, Storing and Equipment Servicing, Installation and Dismantling regarding A2L refrigerants.

<sup>2</sup> Vice Chair McQuade abstained from the vote since the work on RP-1807 preceded his term on the committee and the Chair, Jim Wolf, voted for the motion.

**Motion #4** - MTG.LowGWP formally refers the RP-1808 final report once PMS required edits are made to SSPC 15 for review and asks that the SSPC respond back to us by the 2019 Annual meeting with a list of potential affects, if any, that these research results will have on Standard 15.  
Vote: 20-0-1-5 (26) CNV – MOTION PASSED

- d) **WS-1855, Determination of the Impact of Combustion Byproducts on the Safe Use of Flammable Fluorinated Refrigerants.** Status: WS being finalized by MTG.LowGWP Research Subc. so that RAC can review & approve for bid. – Est. Cost & Duration: Phase 1 \$40k – 4 month duration

**Motion #5** - MTG.LowGWP conditionally approves WS-1855 for submission to RAC by RAC deadline of March 15<sup>th</sup> 2019 contingent upon required edits to Recommended Bidders List, References, and Deliverables sections of WS have been completed. Vote: 20-0-1-5 (26) CNV – MOTION PASSED

**AI#7 Atlanta** (Fricke & Abdelaziz) – Finalize list of recommended bidders, references, and deliverables for WS-1855 so WS can be submitted to RAC by March 15<sup>th</sup> deadline for review at RAC spring 2019 meeting.

**AI#8 Atlanta** (Fricke) – Solicit one or more volunteers from SSPC 15 to serve on PES/PMS for WS-1855

- I. AHRTI Proposed New Research Projects in Support of LowGWP Refrigerants – WANG  
See ATTACHMENT #3 for AHRTI update given at this meeting.

J. PROGRAM SUBC. REPORT - Part A - HALEL

- a) Solicit and Review TC Co-sponsoring requests for Atlanta & future Program Proposals.

b) Atlanta 2019 Meeting – Program – Sessions Related to LowGWP refrigerants

1. **Seminar #7 – Refrigeration Track - Sponsor TC 10.6 (Transport Refrigeration)**  
Sunday, January 13 – 9:45 am to 10:45 am – Room A302, Building A, GWCC  
Chair: William Murphy, Ph.D., P.E., Fellow Member, University of Kentucky, Paducah, KY  
While we typically think of commercial food refrigeration as being associated with grocery stores or over-the-road transport, there are a number of critical applications for refrigeration needed in support of deployed military personnel. This session addresses novel system designs using low-GWP refrigerants supporting both field and submarine personnel. These refrigeration systems can provide for food storage above and below freezing and must operate satisfactorily under extreme design conditions. The success of these systems indicate that low-GWP refrigerants can be successfully used for food refrigeration in even the most demanding applications.  
**1. Design of a Refrigerated Transport Container Using CO2 (R744) as a Refrigerant**  
Neal Lawrence, Ph.D., Associate Member, Creative Thermal Solutions, Urbana, IL  
**2. Mission Critical Submarine Food Refrigeration System Using R1234ze as a Refrigerant**  
Augusto San Cristobal, Member, Bronswerk, Brossard, QC, Canada
2. **Technical Paper Session #2 – Studies in Energy Efficiency – Renewables and Natural Systems Track**  
Monday, January 14 – 8 am to 9:30 am – A408, Building A, GWCC  
Chair: Hyojin Kim, PhD., Member, Catholic University of America, Washington, D.C.  
Understand the bearing requirements imposed by the use of the new low GWP refrigerants  
**2. Effects of System Materials towards the Breakdown of Lubricants and Low GWP Refrigerants (RP-1774) (AT-2019-005) Ngoc Dung (Rosine) Rohatgi, Ph.D., Member, Spauschus Associates Inc., Bethlehem, GA**
3. **Seminar #33 – Low GWP Refrigerants: Components and Systems Designs - Refrigeration Track - Monday, January 14 – 11 am to 12 pm – Room B313a, Building B, GWCC**  
Sponsor: TC 8.4 (Air-to-Refrigerant Heat Transfer Equipment), TC 8.1 (Positive Displacement Compressors)  
Chair: Pega Hrnjak, Ph.D., Fellow ASHRAE, University of Illinois, ACRC and CTS, Urbana, IL  
This seminar focuses on low GWP refrigerants and the methodology of adopting them in system design. The performances of a variety of lower GWP alternatives at various temperatures are presented. The design method of compressors is also included.  
**1. Evaluation of Alternative Lower GWP Refrigerants**  
Paul de Larminat, Ph.D., P.E., Member, Johnson Controls Industries, York, France  
**2. Development of a Light-commercial Hot-gas Bypass Load Stand for Accelerated Compressor Development** Craig Bradshaw, Ph.D., Member, Oklahoma State University, Stillwater, OK
4. **Seminar #40 –Update on Global Policies and Programs for Best Use of Refrigerants - Refrigeration Track - Monday, January 14 – 2:15 pm to 3:45 pm - Room: B313b, Building B, GWCC**  
Sponsor: 7.3 (Operation and Maintenance Management)  
Chair: Yunho Hwang, Ph.D., Member, University of Maryland, College Park, MD



Fluorinated gases are used in refrigeration and air-conditioning applications worldwide and contribute to global warming. The Montreal Protocol was extended to control the production and consumption of HFCs in the Kigali Amendment. EU adapted new F-gas Regulation from 2015. As switching of high GWP refrigerants to low GWP and confining refrigerants within the system become important, UN, IIR, US and EU are striving their efforts. UN Environment OzonAction promotes proper refrigerant management in developing countries. The US DOE directs building energy consumption reductions. This session provides updates on global refrigerant regulations and efforts to best use of refrigerants throughout lifetime.

a) **An Overview of Refrigerants Related Policies in Article 5 Countries and UN Environment Partnerships to Support**

**Compliance with the Protocol** *Ayman Eltalouny, UN Environment, Manama, Bahrain*

b) **The Application of the EU F-Gas Regulations: An Example for Other Regions?**

*Didier Coulomb, International Institute of Refrigeration, Paris, France*

c) **IIR Actions to Reduce Refrigerant Emissions**

*Didier Coulomb, International Institute of Refrigeration, Paris, France*

d) **US GHG Regulation and EERE Program Update**

*Antonio Bouza, U.S. Department of Energy, Columbia, MD*

**5. Seminar #46 – Refrigerant Flammability Fundamentals** - Refrigeration Track - Tuesday, January 15 – 2:15 pm to 3:45 pm – Room: A302, Building A, GWCC

Sponsor: 3.1 (Refrigerants and Secondary Coolants)

Chair: Stephen Kujak, Member, Trane, Ingersoll Rand, La Crosse, WI

Concerns about the impact of refrigerants on climate change are driving new regulatory policies to restrict and lower the global warming potential (GWP) impact of fluorocarbon refrigerants used in the HVAC&R industry. In response, the industry is developing and examining a new class of lower GWP refrigerants, many of which are flammable. As this transition moves forward, many questions exist about changing to flammable refrigerants options and requirements to use them safely. This seminar highlights research into important considerations unique to flammable refrigerants that engineers, designers and building owners should keep in mind regarding next-generation refrigerants.

1. **Flammability Fundamentals**

*Gregory Linteris, Ph.D., Associate Member, National Institute of Standards and Technology, Gaithersburg, MD*

2. **Evaluation of Experimental Methods for Burning Velocity of Flammable Refrigerants**

*Gregory Linteris, Ph.D., Associate Member, National Institute of Standards and Technology, Gaithersburg, MD*

3. **Flammability and Risk Assessment of Low GWP Refrigerants, John Kondziolka, Associate Member, Gradient, Arcadia, CA**

4. **Hot Surface Ignition Testing of Low GWP 2L Refrigerants, Patrick E. Coughlan, Chemours Fluoroproducts, Wilmington, DE**

5. **Effects of Temperature and Pressure on Quenching Distances of Low GWP 2L Refrigerants, Kenji Takizawa, National Institute of Advanced Industrial Science and Technology, Tsukuba, Japan**

**6. Seminar #52 – Latest Research Highlights** - HVAC&R Fundamentals and Applications Track - Tuesday, January 15 – 9:45 am to 10:45 am – Room: A405, Building A, GWCC

Sponsor: (Publication and Education Council)

Chair: Reinhard Radermacher, Ph.D., Fellow ASHRAE, University of Maryland, College Park, MD

3. **CFD Modeling of Flammable Refrigerant Leaks inside Machine Rooms – Emergency Ventilation Rate for Different Size Chillers** – United Technologies Research Center, East Hartford, CT.

**7. Seminar #54 – Chemistry of New and Retrofit Systems with Low GWP Refrigerants** - Refrigeration Track - Tuesday, January 15 – 11:00 am to 12:30 pm – Room: A410, Building A, GWCC

Sponsor: TC 3.2 (Refrigerant System Chemistry, Co-Sponsor: **MTG.LowGWP** (Lower Global Warming Potential Alternative Refrigerants))

Chair: Edward Hessell, Ph.D., Member; Lanxess Solutions US, Inc. Naugatuck, CT

1. **System Chemistry Comparison of HFC and LowGWP Alternatives, Julie Majurin, Member, CPI Fluid Engineering, Midland, MI**

2. **Evaluation of the Chemical Stability of HFC and HFO Alternatives When Applied as R22 Retrofit in Refrigeration Equipment, Hitomi Arimoto, Associate Member, Daikin Industries, Ltd., Settsu, Japan**

3. **Chemical Stability of New Low GWP Olefin Based Refrigerants, Stephen Kujak, Member, Trane, Ingersoll Rand, La Crosse, WI**

4. **What do We Need to Understand About System Chemistry and Low GWP Refrigerants?, Joe Karnaz, DSc, Member, Shrieve Chemical, Houston, TX**

**8. Conference Paper Session 19 – Advances in Refrigerants** - HVAC&R Fundamentals and Applications Track - Wednesday, January 16 – 11:00 am to 12:30 pm – Room: B409, Building B, GWCC – Chair: Lorenzo Cremaschi, Ph.D., Member, Auburn University, Auburn, AL

1. **Flammable Refrigerants: Performance Comparison, Safeties and Lessons Learned (AT-2019-C063)**

*Sean O'Hern, Associate Member, Amir Jokar, Ph.D., P.E., Member, David Anderson, Ph.D., P.E., Michael Cundy, Ph.D., P.E. and Russell Ogle, Ph.D., P.E., Exponent, Inc., Menlo Park, CA*

c) Kansas City 2019 Meeting Program Tracks & Deadlines

1. Tracks

- Systems and Equipment in the Built Environment

- Fundamentals and Applications
- Optimization in HVAC&R
- Commissioning New & Existing Buildings
- Occupant Health & Safety
- Modeling Throughout the Building Life Cycle
- Professional Development
- Research Summit
- Radiant Heating & Cooling Mini-Track

## 2. Upcoming Deadlines

- Website opens for Seminar, Workshop, Forum, Debate, and Panel Proposal – 1/2/19
- Seminar, Workshop, Forum, Debate and Panel submissions due – 2/8/19
- Final Conference Papers & Requests for Conference Paper sessions due – 2/8/19
- Extended abstracts due.- 2/8/19
- Conference Paper Accept/Revise/Reject Notifications sent – 2/19/19
- Extended abstracts final accept/reject notifications – 3/7/19
- Extended abstracts scheduled for presentation – 3/8/19

Conference Webpage: <https://www.ashrae.org/conferences/annual-conference>

**AI#9 Atlanta (MORTS)** – Send copy of RP-1794 final report to Randy Cooper of AHAM once report is approved by TC 3.1.

**AI#10 Atlanta (MORTS)** – Schedule an MTG.Low.GWP ExCOM meeting for an update on RP-1806 and WS-1855 in the 1st week of March, 2019.

**AI#11 Atlanta (MORTS)** – Invite MTG.LowGWP voting members to PMS meetings for RP-1806.

**AI#12 Atlanta (MORTS)** – Formally refer the final report for RP-1807 to SSPC 15 for review and ask that they respond back to us by 2019 Annual meeting with a list of potential affects, if any, that these research results will have on Standard 15.

**AI#13 Atlanta (MORTS)** – Formally refer the final report for RP-1808 once final edits are complete to SSPC 15 for review and ask that they respond back to us by 2019 Annual meeting with a list of potential affects, if any, that these research results will have on Standard 15.

**AI#14 Atlanta (Abdelaziz)** – Develop draft white papers on results of RP-1807 & 1808 for distribution to ICC, ISO, UNEP, and others.

**AI#15 Atlanta (Wang)** – Give update at next MTG meeting on how AHRTI is getting research results into standards.

**AI#16 Atlanta (Fricke & Johnson)** – Come up with an initial plan on how to disseminate the RP-1807 and RP-1808 results by Wed. 1/16/19 meeting.

- ✓ White paper to GAC by June 2019
- ✓ SSPC 15 referrals on 1807/1808
- ✓ 1-page fact sheet on every project done & links to reports
- ✓ One online site for all research partners (AHRI, ASHRAE, ORNL)
- ✓ Simplified language for outside world - Ayman

**AI#17 Atlanta (Wang & Uselton)** – Clean-up spreadsheet listing all AHRTI research projects in development, underway or completed on LowGWP Refrigerants for presentation at Wed. 1/16/19 meeting.

RECESS

MEETING RECESSED AT 6 PM EST, SUNDAY, 1/13/19

**DRAFT MINUTES PART B**  
**MTG.LowGWP COMMITTEE**  
**January, 16, 2019 Meeting**

**Wednesday, January 16, 2019**  
**10:00 AM - 12:00 PM EST**  
**Omni Hotel, Atlanta, GA**  
**Grand C Room – M4 floor – North Tower**

MEMBER ATTENDEES, STAFF & GUESTS: Total Attendance - 43

Voting Members			Staff		Guests							
<b>Chair</b>	<b>Jim Wolf</b>	x	Mike Vaughn	x	Mary Koban	x	Dominique Taudin	x	Stephen Spletzer	x	Tyler Karnaz	x
<b>Vice Chair</b>	<b>Bill McQuade</b>	x			Julius Ballanco	x	Jim Kelsey	x	Andrew Klein	x	Chris Campo	x
Res. Co-Chair	<b>Brian Fricke</b>	-			Jeff Newel	x	Dominic Kolandayan	x	Roy Crawford	x	Casey Scruggs	x
Res. Co-Chair	<b>Phil Johnson</b>	-			Minao Mehdizadeh	x	Joshua Hughes	x	John Whithouse	x	Jeremy Smith	x
Codes & Stds Chair	<b>Doug Tucker</b>	-	See attached list at end of minutes for additional guests									
Program Chair	<b>Danny Halel</b>	-	Alternate 1		Alternate 2		Alternate 3		Alternate 4		Alternate 5	
<b>REF</b>	Jason Robbins		<b>Charles Hon</b>	x								
SSPC 34	Sam Yana-Motta		Chris Seeton		Sean Cunningham							
SSPC 15	Dennis Dorman		Greg Scrivener									
<b>TC 1.1</b>	<b>Ray Rite</b>	x	Sankar Padhmanabhan		Samuel Sami							
<b>TC 1.3</b>	<b>Omar Abdelaziz</b>	x	Satheesh Kulankara	x	Evraam Gorgy							
<b>TC 2.5</b>	<b>Larry Burns</b>	x	John Karakash									
<b>TC 3.1</b>	<b>Barbara Minor</b>	x	Steve Kujak		Bob Richard		Greg Linteris		Kenji Takizawa		Bob Low	
TC 3.2	Thomas Leck		Sonny Sundaresan		Alan Cohen							
<b>TC 3.3</b>	<b>Marc Scancarello</b>	x	Joe Nigro	x								
<b>TC 3.4</b>	<b>Joe Karnaz</b>	x	Chris Seeton	x	Danny Halel	x						
<b>TC 3.8</b>	<b>Danny Halel</b>	x	Mark Adams	x								
<b>TC 6.3</b>	<b>Roy Crawford</b>	x	Kevin Mercer									
<b>TC 8.2</b>	<b>Phil Johnson</b>	x	Konstantinos Kontomaris									
<b>TC 8.4</b>	<b>Vikrant Aute</b>	x	Yirong Jiang	x	Patrick Geoghegan		Chad Bowers					
<b>TC 8.5</b>	<b>Satheesh Kulankara</b>	x	Kashif Nawaz	x								
<b>TC 8.7</b>	Dermot McMorrow		<b>Doug Tucker</b>	x								
<b>TC 8.11</b>	<b>Dutch Uselton</b>	x	Ankit Sethi	x								
TC 10.1	Doug Scott		Dan Dettmers	x	Wayne Borrowman							
<b>TC 10.7</b>	<b>Brian Fricke</b>	x	Charles Hon	x	Tim Anderson							
<b>AHAM</b>	<b>Randy Cooper</b>	x	Masud Chowdhury									
<b>AHRI</b>	<b>Xudong Wang</b>	x	<b>TBD</b>									
NASRC	Danielle Wright		Morgan Smith									
<b>U.L.</b>	<b>Brian Rodgers</b>	x	Mark Skierkiewicz									
<b>UNEP</b>	Shamila Nair-Bedouelle		<b>Ayman Eltalouny</b>	x								

- x – Denotes Member, Alternate, Guest, or Staff noted was in attendance for this meeting.
- P – Denotes Member, Alternate, Guest, or Staff noted was in attendance for part of this meeting.
- # - Denotes Non-Voting MTG leadership position
- Bold** – Denotes committee or person was represented in MTG votes at this meeting
- a - Denotes voting member that arrived after votes cast

**26 Voting Members Currently – 14 needed for Quorum – Quorum? – YES, 18 present for votes**

ADDITIONAL GUEST ATTENDEES:

Guests									
Karim Amrane	x								
Bassam Elasso	x								
Miguel Boscan	x								
Skip Ernst	x								
Niel Hayes	x								
Jeff Warther	x								
Sarah Kim	x								
Carolina Solano	x								
Shelby Kent	x								
Lydia Dobler	x								
William Schultz	x								
Chandra Gollapudi	x								
Mike Saunders	x								
Hewitt Gaudin	x								

**DRAFT MINUTES PART B**  
**MTG.LowGWP COMMITTEE**  
**January, 16, 2019 Meeting – Atlanta, GA**

MAIN MTG MEETING - PART B:

RECONVENE

K. ADDITIONAL DISCUSSION ON SSPC 15 & SSPC 34 LowGWP EFFORTS

L. PROGRAM SUBC. REPORT - Part B - HALEL

- a) Kansas City 2019 Annual Meeting  
 Program Website – <https://www.ashrae.org/conferences/annual-conference> - Opened 1/2/19
1. Seminar, Workshop, Forum, Debate and Panel submissions due – **2/8/19**
  2. KC Conference Tracks:
    - Systems and Equipment in the Built Environment
    - Fundamentals and Applications
    - Optimization in HVAC&R
    - Commissioning New & Existing Buildings
    - Occupant Health & Safety
    - Modeling Throughout the Building Life Cycle
    - Professional Development
    - **Research Summit**
    - Radiant Heating & Cooling Mini-Track

**Motion #6** - MTG.LowGWP sponsor a seminar for KC on the results from RP-1807 & RP-1808 – Chaired by Kashif Nawaz and supported by Fricke, Johnson, and Uselton.

Vote: 18-0-1-7 (26) CNV – MOTION PASSED – See **ATTACHMENT #2** for proposal.

**AI#18 Atlanta (MORTS)** – Identify Research Summit Track Chair for Kansas City Meeting - Res. Summit Chair: ChairBing Liu – bliu@nea.org

b) Orlando 2020 Winter Meeting -

Program Website – <https://www.ashrae.org/conferences/winter-conference/2020-ashrae-winter-conference>

1. Seminar, Workshop, Forum, Debate and Panel submissions due – **8/2/19**
2. Conference Tracks:
  - i. HVAC&R Fundamentals and Applications
  - ii. Systems and Equipment
  - iii. Refrigeration and Refrigerants
  - iv. Cutting Edge Approaches
  - v. High Efficiency Design and Operation
  - vi. Big Data and Smart Controls
  - vii. Ventilation, IAQ and Air Distribution Systems
  - viii. Standards, Guidelines and Codes

**Motion #7** - MTG.LowGWP sponsor a seminar for the Orlando meeting titled *Fundamentals of Refrigerants Flammability* – Chaired by Barbara Minor.

Vote: 17-0-1-8 (26) CNV – MOTION PASSED

**Motion #8** - MTG.LowGWP co-sponsor a seminar for the Orlando meeting titled *State-of-the-Art Refrigeration for LowGWP Refrigerants*. – Sponsored by Refrigeration Committee

Vote: 18-0-1-7 (26) CNV – MOTION PASSED

M. CODES & STANDARDS SUBC. REPORT – TUCKER

- a) ASHRAE Standard 15 Update
- b) ASHRAE Standard 34 Update
- c) Codes Update:
  - 1. ICC IMC
  - 2. ICC IFC
  - 3. IAPMO UMC

**AI#19 Atlanta (Ballanco) – Send Jim Wolf IAPMO UMC 2021 meeting details**
- d) Other Standards Activities:
  - 1. IEC Standard 60335-2-40 Updates
  - 2. UL Standard 60335-2-40 Updates
  - 3. IEC Standard 60335-2-34 Updates
  - 4. UL Standard 60335-2-34 Updates
  - 5. ISO 817
  - 6. ISO 5149

N. AHRI AREP-II UPDATES – WANG

O. OLD BUSINESS

P. NEW BUSINESS

**AI#20 Atlanta (Johnson) – Update initial draft communication plan based upon feedback from MTG meeting in Atlanta and present updated plan at next MTG meeting**

**Open Action Items**

**MTG.LowGWP**

OPEN ACTION ITEMS FROM PREVIOUS MEETINGS

ACTION ITEMS FROM HOUSTON MEETING

Action Item	Action	Responsible Party	Status
4	Send our program ideas to TC 10.7 for co-sponsorship vote	Halel	<b>TBD</b>

OPEN ACTION ITEMS FROM LONG BEACH MEETING

Action Item	Action	Responsible Party	Status reported in Atlanta
1	Develop answers to the nine questions proposed by David Underwood in order to support <i>ASHRAE Ottawa Day on the Hill</i> . See <b>ATTACHMENT 1 – Long Beach meeting</b>	Fricke / Schultz/ Johnson/ Eckels	<u>Complete</u>
5	Request for LowGWP Refrigerant slide donations in order to develop Chapter & GGAC slide deck for Code Officials and others. Send slides to Julius Ballanco on C&S Subc.	All MTG.LowGW P Members	<u>On-going</u>

6	Investigate further and propose a plan for the slide deck that will define the following: 1. How do we want to roll it out? 2. Copyright? 3. Can end users customize? 4. What is our process for adding, modifying, or deleting slides to deck? 5. Should we consider using Distinguished Lecturers (DLs) on this topic? 6. Add Disclaimer to deck when distributed	Tucker	<u>On-going as of 15-Jan-2019</u>
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**Past Letter Ballot Results  
MTG.LowGWP**

Vote #	Motion	Voting Period	Vote Count
1	Letter Ballot Motion to approve draft final report for RP-1807 in fall 2018 failed due to lack of quorum.	August 8 <sup>th</sup> , 2018 to September 5 <sup>th</sup> , 2018 Extended to September 19 <sup>th</sup> 2018	<b>9-2-0-15 (26) CV Failed to reach quorum. 14 members responding to ballot needed for quorum.</b>

**Update on Recent Web Meeting Results  
MTG.LowGWP**

Vote #	Motion	Voting Period	Vote Count or Status
1	Draft final report for RP-1807 be approved for Publication	Web meeting vote on 12/27/18	<b><u>14-1<sup>3</sup>-1<sup>4</sup>-10</u> (26) CV</b>

ADJOURN

MEETING ADJOURNED – 11:47 PM EST, WEDNESDAY, 1/16/19

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<sup>3</sup> Danny Halel voted against the motion because the suggested best practices listed in the report have not been evaluated to show that they will actually work.

<sup>4</sup> Chair not Voting

**ATTACHMENT 1**

MTG.LowGWP Codes & Standards Activity Reports

Activity Report from 15-Jan-2019 Atlanta meeting





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1791 Tullie Circle, NE • Atlanta, Georgia 30329-2305 ☎404-636-8400 • Fax 404-321-5478

### MTG.LowGWP MEETING

Time: **Wednesday, January 16, 2019 10:00 AM – 12:00 PM**  
Location: **Birch room - AT Floor – South Tower – Omni Hotel - Atlanta, GA**

### Codes & Standards Subcommittee STATUS REPORT

#### Membership

The subcommittee currently has 28 members, plus an additional 29 people are on the distribution list for subcommittee correspondence (past guests and interested persons).

#### Meetings

Codes & Standards Subcommittee held meetings as follows in the past 6 months:

- Tuesday, June 26, 2018 in Houston, TX
- Tuesday, January 15, 2019 in Atlanta, GA [12 members and 24 guests in attendance]

Future monthly web conference meetings planned for March, April, and May 2019.

#### Basecamp <https://3.basecamp.com/3106353/projects/2779045> (or <https://basecamp.com/>)

All primary and alternate MTG.LowGWP members have been added to the project collaboration tool (can login via e-mail). Interested persons also have been added. As of today, 81 people have access to the Basecamp web site for the MTG.LowGWP Codes & Standards Subcommittee.

#### Stakeholder List

There have been no changes to the list since our meeting in Houston.

#### Advocacy Plan

Updates to the advocacy plan will be made after this meeting to keep the time-dependent priorities up-to-date and to add new events. The subcommittee will continue to work on this during spring 2019. Nanette Lockwood prepared a new document titled Code and Standard Activity Related to A2L for HVAC, which has been added to Basecamp. This document addresses requirements (documents and dates) for inclusion of safety standards with requirements for A2L refrigerants in the model mechanical and residential codes. Since there is currently an absence of direction from the federal government regarding HFCs, several states are moving forward on their own. The presentation also provides a chart showing the code adoption timing anticipated for the states which have initiated efforts to phase down HFCs, and it includes state code updates necessary for these key states to enable and enforce a 2023 transition date for residential and commercial comfort conditioning equipment. The presentation will be updated soon to include commercial refrigeration.

#### Presentation Slide Deck for Advocacy & Communication Efforts

The slide deck has been updated and includes additional materials since the last meeting. It has been downloaded and used for presentations outside ASHRAE, including the AHRI FRS conference.

#### Subcommittee Plans

Now that the path forward for use of lower GWP refrigerants is becoming clearer, the focus of the subcommittee will be to develop technical documentation for dissemination to local and state jurisdictions through GAC. We will also

place an emphasis on developing a comprehensive set of methods to facilitate the timely transmittal of research project results to relevant stakeholders, including codes and standards developers.

## AHRI

Helen Walter-Terrinoni, AHRI's VP of Regulatory Affairs, addressed the subcommittee and provided an overview of AHRI activities dedicated to implementation of low GWP refrigerants in the global end-to-end supply chain, from production to use to recovery and recycling. She welcomed involvement of the MTG and this subcommittee in AHRI's efforts to coordinate efforts around research and codes/standards.

## Standards Updates (quick highlights only)

### ASHRAE 15-2016

Addendum	Review	Dates	ANSI Approval
A (remove R-717)	PPR1	Feb9-Mar11, 2018	June 28, 2018
D (2L direct systems for human comfort)	PPR4-ISC	Jul6-Aug20, 2018	October 23, 2018
E (refrigerant conversion & mixing)	PPR1	Mar16-Apr15, 2018	June 28, 2018
H (2L in machinery rooms)	PPR3-ISC	Jul6-Aug5, 2018	October 9, 2018
15.2P (residential systems)	APR1	May25-Jun24, 2018	n/a

SSPC 15 decided in Atlanta that 15.2 should be a standalone document so that a user will not have to possess a copy of Standard 15 or Standard 34 for reference.

**ASHRAE 34-2016.** Two addenda have been published recently. Addendum G (make 2L a separate class, not subclass of 2) was approved by ANSI on June 28, 2018 and has been published. This addendum is a prerequisite for any Standard 15 addenda that use 2L (and vice versa, to avoid conflict between 15 and 34). Addendum I was also approved on June 28, 2018 and has been published. This addendum adds R-463A to Table 4-1. R-463A is an A1 classified refrigerant intended as a lower GWP (~30% lower than R-410A) retrofit and new equipment replacement for R-410A. Another addendum to publish LFL values is in process (CMP from Rusty Tharp for use by 15/15.2).

**UL 60335-2-40 edition 3.** Preliminary comment draft adding requirements for class 2L had public review 1-Dec-2017 thru 30-Jan-2018. Over 300 comments received. Includes national deviations from the content of IEC 2-40 edition 6. CANENA WG10 addressed comments and revised draft, meeting approximately monthly. Ballot phase draft has a closing date of February 5, 2019.

**IEC 60335-2-40 edition 6.0.** Publication date of January 26, 2018. Replaced edition 5.1 published 28-Apr-2016. Edition 7 is in process with a target late 2020 or early 2021.

**UL 60335-2-89 edition 2.** CANENA will form WG when IEC 60335-2-89 ed3 nears FDIS.

**IEC 60335-2-89 edition 3.** CDV released for vote April 2018 with voting closed July 14. WG4 met at the end of July 2018. IEC shows a forecasted publication date of August 9, 2019.

**ISO 817:2014 edition 3.** Published 1-Jun-2014. Amendment 1 published Nov-2017.

**ISO 5149-1:2014 edition 1.** Published Apr-2014 (replaced 1993 edition). Amd1 published Oct-2015.

**ISO 5149-2:2014 edition 1.** Published Apr-2014 (replaced 1993 edition).

**ISO 5149-3:2014 edition 1.** Published Apr-2014 (replaced 1993 edition).

**ISO 5149-4:2014 edition 1.** Published Apr-2014 (replaced 1993 edition).

## Codes Updates

<b>ICC IMC 2018.</b>	Published. Includes 2L for machinery rooms, but does not include reference to UL 60335-2-40.
<b>ICC IFC 2018.</b>	
<b>ICC IRC 2018.</b>	Published. No provisions for 2L, but does include reference to UL 60335-2-40 edition 1 (no flammable refrigerants).

<b>ICC IMC 2021.</b>	Code change cycle has started. 11-Jan-2018: deadline for Group A code change proposal submittals 28-Feb-2018: proposals published
<b>ICC IFC 2021.</b>	15/25-Apr-2018: Committee Action Hearing (CAH) 30-May-2018: CAH Report published 16-Jul-2018: public comment deadline
<b>ICC IRC 2021.</b>	24/31-Oct-2018: Public Comment Hearing [ <b>15 Addenda d &amp; h rejected</b> ] Dec-2018: Final Action after voting period & certification <b>2019: Group B codes go through same cycle (IECC, IRC-E, IgCC, etc.)</b> 2020: code correlation activities Fall 2020: forecast Publication.

**IAPMO UMC 2018.** Published early-2018. Some 2L related proposals from task force public comments were accepted, but some rejected, creating inconsistencies. Petition attempting to resolve was rejected. Provisions allow 2L for machinery room applications but not for direct systems (high probability per ASHRAE 15) for human comfort.

<b>IAPMO UMC 2021.</b>	Code change cycle has started: 16-Mar-2018: deadline for code change proposal submittals 13-Apr-2018: proposals published 15/18-May-2018: Technical Committee Meetings 20-Aug-2018: Report on Proposals published 3-Jan-2019: public comment deadline <b>22-Mar-2019: public comment monograph published</b> <b>29-Apr/2-May-2019: Technical Committee Meetings</b> 21-Aug-2019: report on comments published 2/16-Oct-2019: balloting 13/15-Nov-2019: Standards Council Meeting early 2021: forecast publication
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**Motion:** That the January 15, 2019 Codes & Standards Subcommittee Agenda and this Activity Report be appended to the end of the MTG draft minutes for this meeting in Atlanta.

Respectfully Submitted,

Douglas Tucker  
Chair, MTG.LowGWP Codes & Standards Subcommittee

**ATTACHMENT 2**

MTG.LowGWP Seminar Program Submission

for

2019 Annual Meeting in Kansas City

**Seminar Title:** ASHRAE Research Overview for Lower GWP Flammable Refrigerants

**Track:** Systems & Equipment in the Built Environment/Research Summit

**Program type:** Seminar

**Session length:** 60 minutes (20 minutes per presentation)

**Chair:** Kashif Nawaz

**Affiliation:** Oak Ridge National Laboratory

**Title:** Research and Development Staff

**Learning Objectives:**

- To understand the background, purpose, and results of three recent ASHRAE research projects: 1806, 1807, & 1808.
- To understand potential uses of the findings and conclusions from the completed projects.
- Gain awareness of current US practices and potential gaps in standards for the use of flammable refrigerants.
- Learn about international sources for best practices information regarding flammable refrigerants.

**Presentation 1**

**Presentation Title:** Flammable Refrigerants Post-Ignition Simulation and Risk Assessment (Overview of RP-1806)

**Presenter:** Phillip Johnson

**Affiliation:** Daikin Applied

**Title:** Senior Director, Applied Development Center

**Abstract:** This presentation briefly introduces the background for all three projects included in the seminar. Then it reviews the scope of research project 1806 and current status towards completion.

**Presentation 2**

**Presentation Title:** Flammable Refrigerants Post-Ignition Simulation and Risk Assessment (Overview of RP-1807)

**Presenter:** Dutch Uselton

**Affiliation:** Lennox International

**Title:** Mechanical Engineer, Fellow

**Abstract:** Recently completed ASHRAE 1807 TRP is a report that surveys and contrasts worldwide practices for flammable refrigerant handling, transporting, storing and equipment servicing, installation and dismantling. This presentation will provide an overview of the contents of the report and summarize gaps in current US practices as compared to best practices seen internationally.

### **Presentation 3**

**Presentation Title:** Servicing and Installing Equipment using Flammable Refrigerants: Assessment of Field-made Mechanical Joints (Overview of RP- 1808)

**Presenter:** Brian Fricke

**Affiliation:** Oak Ridge National Laboratory

**Title:** Group leader, Building Equipment Group

**Abstract:**

### **Assessment Questions:**

1. *True/False.* RP-1806 will simulate the refrigerant dispersion process and the combustion process after an ignition event. **TRUE.**
2. *True/False.* RP-1806 will conduct risk assessments for all classes flammable refrigerants (A2L, A2, A3, B2L, B2, B3). **FALSE**
3. *Multiple Choice.* RP-1806 will conduct risk assessments for which types of equipment: a) residential air conditioner and heat pump, b) rooftop unit, c) chiller, d) all of the above. **D.**
4. *True/False.* ANSI/ASHRAE 15 contains practices for the safe storage and design of refrigerant cylinders, but does not distinguish between non-flammable and flammable refrigerants. **TRUE.**
5. *True/False.* In the US, some local jurisdictions may require that flammable refrigerants be transported in explosion-proof cabinets vented to the vehicle's exterior. **TRUE.**
6. *True/False.* It is good practice for service technicians to decant flammable refrigerants from their storage cylinders and place them into smaller cylinders. **FALSE.**

**ATTACHMENT 3**

AHRTI FRS Subc. Update to MTG.LowGWP  
for  
2019 Winter Meeting in Atlanta

		Urgency	
		Low	High
Importance	High	<ul style="list-style-type: none"> <li>• <b>Burning Velocity (BV) Investigations:</b> Set standard humidity levels &amp; effects of humidity and temperature on BV, establish a well-defined test method for burning velocity measurement, understand impacting factors for low burning velocity materials (Schlieren test method), standardize the test method for low burning velocity materials, and develop predictive tools for flammability risk <b>(NIST project funded by DOE)</b></li> <li>• Establish appropriate requirements for refrigerant detection, alarming, and mitigation</li> <li>• Understand the relative ignition event risk of using A2L refrigerants versus the existing risk of using A1 refrigerants with oil (investigate the oil effect on flammability change): Results of risk assessment</li> <li>• Create a rating system for electrical components using quenching distance concept, and conduct Minimum Ignition Current (MIC), and Maximum Experimental Safety Gap (MESG) Investigations</li> <li>• Lower Flammability Limit (LFL) documentation: ASHRAE Standard 34 needs to publish LFL value for each flammable refrigerant (ALL flammable refrigerants, single component and blended)</li> <li>• ASHRAE Standard 15 needs to consider application by class and refrigerant quantity</li> <li>• Characterization of potential ignition sources within the equipment, equipment rooms, and occupied space</li> <li>• Examine mitigation concepts through simulation and full-scale testing</li> <li>• Literature review and industry information sharing</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Whole Room or Real Life Leaks and Ignitions &amp; Calibration of Risk Assessment:</b> Investigate the severity of events, understand the risk/consequence after the refrigerant is ignited, establish quantified risk tolerance limits for probability versus severity, evaluate the ability of 2L refrigerants to sustain an ignition with oil included, and cause a secondary combustion event. <b>(AHRTI-9007, AHRTI-9007-02)</b></li> <li>• Investigate the proper basis for setting charge limits of A2L, A2, and A3 for various types of products: Evaluate existing CFD results, identify gaps, and conduct CFD to fill in the gaps <b>(ORNL Project)</b></li> <li>• Investigate ignition temperatures for various 2L refrigerants at various ambient conditions (temperature and humidity) with oil and air velocity effects included <b>(AHRTI-9008)</b></li> <li>• Understand the viability of flame propagation (deflagration versus explosion). Using experimental data obtained from prior work, develop and/or improve a deflagration model for equipment using the following refrigerant and lubricant combinations: A1+oil, A2L, A2L+oil. Prior work will include component leak and ignition testing (AHRI Project 8019), and the FRS whole room leak &amp; ignition test scenarios. The purpose is to quantify the range of event severity levels (none, minor, light, major, lethal), given a range of assumed safety mitigation methods (i.e. pre-existing codes &amp; standards developed primarily for A1 refrigerants, versus proposed codes &amp; standards intended to apply to A2L refrigerants). Assume that acceptable risk tolerance levels will be defined separately (not in the scope of this work; such as that established following the process of ISO/IEC Guide 51). <b>(ASHRAE-1806)</b></li> <li>• Refrigerant handling and system installation and servicing: develop installation and servicing procedure manual/guide to support ASHRAE 15, and 15.2 <b>(ASHRAE-1807, ASHRAE-1808)</b></li> <li>• Refrigerant leak detector long-term reliability assessment: a white paper summarizing the sensor technology adaptable for the use with HVACR equipment. <b>(AHRTI-9009)</b></li> </ul>
	Low	<ul style="list-style-type: none"> <li>• Machine room ventilation analysis</li> <li>• Occupied space ventilation analysis</li> <li>• Investigate how the air flow velocity affects the refrigerant dispersion and mixing, as well as flammability of refrigerants</li> <li>• Need to understand confinement effect in terms of volume, shape, vent size, and location, etc.</li> <li>• Minimum Ignition Energy (MIE) investigations</li> <li>• The definition of "non-connecting spaces" for use with applying Refrigerant Concentration Limits (RCL) needs clarification (section 7.3 of ASHRAE Standard 15-2013)</li> <li>• Need to develop a comprehensive metric to evaluate risk, not only based on LFL</li> <li>• More risk assessment: update existing ones, conduct large scale equipment, piping with connections passing through ceiling plenums and crawl spaces, and over charged systems</li> <li>• Understand the influence of furniture, room geometry, etc. on developed concentrations arising from refrigerant leaks</li> <li>• Development of a design tool to optimize the location of flammable refrigerant sensor(s)</li> <li>• Evaluate additives used to stabilize unsaturated substances and their associated risks</li> <li>• Need to list applicable building codes, ongoing standard activities, and process of updating into building codes, as well as understand the time constraints</li> <li>• Understand the refrigerant leak rate</li> <li>• Evaluate benefits and risks of using an odorant in flammable refrigerants</li> </ul>	<ul style="list-style-type: none"> <li>• None identified in this category so far; however, the priority list may change in the future.</li> </ul>



2<sup>nd</sup> round survey identified top priority research needs among the remaining topics plus new input:

- Refrigerant sensors reliability, robustness, effectiveness and sensor performance (AHRTI-9014/ASHRAE co-funding)
  - Phase I RFP issued and several proposals are expected by Jan 18.
- Assess the effectiveness of mitigations for AC and Reach-in coolers (AHRTI-XXXX)
  - AC WS is approved and Reach-in coolers portion is in progress with the 2-89 being finalized.
- Leak rate characterization (include evaluation of different types such as A2Ls vs A3s and include ducted systems (AHRTI-9012)
  - A follow-on testing (ducted AC and VFR) is being scoped out.
- HF risk study (ASHRAE-1854/AHRTI co-funding)