



Shaping Tomorrow's
Built Environment Today

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Michael R. Vaughn, P.E.
Manager Research & Technical Services

mvaughn@ashrae.org

TO: Christopher Seeton, TC Chair 3.1, cseeton@shrieve.com
Stephen Kujak, Research Subcommittee Chair 3.1, skujak@trane.com

FROM: Michael R. Vaughn, Manager of Research and Technical Services, MORTS@ashrae.net

CC: Omar Abdelaziz, Research Liaison, omar.abdel.aziz@gmail.com
Steve Kujak, George Rusch, Gary Jepson, Work Statement Author(s), gary.w.jepson-1@chemours.com; george.rusch9@gmail.com

DATE: January 23, 2019

SUBJECT: Work Statement (1797-WS), "Assessment of the A/B toxicity classification used in Standard 34"

During their recent winter meeting, the Research Administration Committee (RAC) reviewed the subject Work Statement (WS) and voted 9-0-2 (CNV) to conditionally accept it for bid provided that the RAC approval conditions are addressed to the satisfaction of your Research Liaison in either written responses or revisions to the work statement.

See the approval conditions below.

1. Provide more relevant literature on the difference between ATEL and OEL as to how they impact the perceived toxicity
2. Better define the state-of-the-art
3. Better define and clarify the task and objectives.

The WS review summary also contains comments from individual members of RAC that the TC may or may not choose to also consider when revising the WS; some of these comments may indicate areas of the WS where readers require additional information or rewording for clarification.

Lastly, please provide ASHRAE staff with the final names and contact information for the Proposal Evaluation Subcommittee (PES) roster, and the Technical Contact that will respond to questions from prospective bidders during the bid posting period (typically this is a WS author or PES member). The technical contact and all members of the PES must also agree to not bid on this project.

Please coordinate changes to this Work Statement with your Research Liaison, Omar Abdelaziz, omar.abdel.aziz@gmail.com or RL6@ashrae.net. Once he is satisfied that the approval conditions have been met, the project will be ready to bid.

The first opportunity that you will have for this project to possibly bid is spring 2019. To be eligible for this bid cycle, a revised work statement that has been approved for bid by your research liaison should be sent (electronically) to Mike Vaughn, Manager of Research and Technical Services, mvaughn@ashrae.org or morts@ashrae.net, by **March 15, 2019**. The next opportunity for bid after that will be May 15, 2019.

Project ID	1797	
Project Title	Assessment of the A/B toxicity classification used in Standard 34	
Sponsoring TC	TC 3.1 (Refrigerants and Secondary Coolants)	
Cost / Duration	\$75,000 / 10 Months	
Submission History	2nd WS Submission, WS Returned A16, RTAR Stage Skipped	
Classification: Research or Technology Transfer	Basic/Applied Research	
RAC 2019 Winter Meeting Review	COMPLETE RTAR CHECK LIST CRITERIA BELOW IF RTAR STAGE WAS SKIPPED BY TC	
RTAR Check List Criteria	Voted NO	Comments & Suggestions
State-of-the-Art (Background): The WS should include some level of literature review that documents the importance/magnitude of a problem. If not, then the WS should be returned for revision. RTAR Review Criterion		12 - the WS didn't include a conventional literature review - however it indicated the relevance of research through its impact on ASHRAE and international standards that support the refrigerants activities. 10 - 3 identified.
Advancement to the State-of-the-Art Is there enough justification for the need of the proposed research. Will this research significantly contribute to the advancement of the State-of-the-Art. RTAR Review Criterion		12 - it was not clear from the small paragraph provided
Relevance and Benefits to ASHRAE: Evaluate whether relevance and benefits are clearly explained in terms of: a. Leading to innovations in the field of HVAC & Refrigeration b. Valuable addition to the missing information which will lead to new design guidelines and valuable modifications to handbooks and standards. Is this research topic appropriate for ASHRAE funding? If not, Reject. RTAR Review Criterion		12 - good linkage and statements
IF THE THREE CRITERIA ABOVE ARE NOT ALL SATISFIED - MARK "REJECT" BELOW BUT ADDRESS THE FOLLOWING CRITERIA AS APPROPRIATE		
RTAR STAGE FOLLOWED		
WS Check List Criteria - START HERE		Comments & Suggestions
Detailed Bidders List Provided? The contact information in the bidder list should be complete so that each potential bidder can be contacted without difficulty.		12 -missing contact emails. 10 - 3 identified.
Proposed Project Description Correct? Are there technical errors and/or technical omissions that the WS has that prevents it from correctly describing the project? If there are, then the WS needs major revision.		
Task Breakdown Reasonable? Is the project divided into tasks that make technical and practical sense? Are the results of each task such that the results of the former naturally flow into the latter? If not, then major revisions are needed to the WS that would include: adding tasks, removing tasks, and re-structuring tasks among others.		10 - 5 tasks defined.
Adequate Intermediate Deliverables? The project should include the review of intermediate results by the PMS at logical milestone points during the project. Before project work continues, the PMS must approve the intermediate results.		
Proposed Project Doable? Can the project as described in the WS be accomplished? If difficulties exist in the project's WS that prevent a successful conclusion of the project, then the project is not doable. In this situation, major revision of the WS is needed to resolve the issues that cause the difficulty.		5 - I feel there should be better and more detailed direction to the bidders for Task 3 and Task 4
Time and Cost Estimate Reasonable? The time duration and total cost of the project should be reasonable so that the project can be as it is described in the WS.		
Proposed Project Biddable? Examining the WS as a whole, is the project described in the WS of sufficient clarity and detail such a potential bidder can actually understand and develop a proposal for the project? This criterion combines the previous three criteria into an overall question concerning the usefulness of the WS. If the WS is considered to not be biddable, then either major revisions are in order or the WS should be rejected.		12 - some minor grammatical errors. Also, on the bottom of page 3, item 2.d. should read 2a-c instead of 1a-c! 5 - Need further details on the tasks in the tasks and scope/technical description
Decision Options	Initial Decision	Suggested Approval Conditions
ACCEPT		12 - I think this is an important and timely research that needs to be conducted to support the international community transition to natural and lower-global warming potential refrigerants. 4 - I did not rank this WS since I am one of the co-authors of this work. 7 - The goal of updating the toxicity categories seems sound but the work statement as written does not clearly define how the new categories will be determined. 5 - further identify task 3 and task 4 items to assist in the bid and deliverables. 13 - Some relatively minor suggested wording changes attached. Specify ASHRAE Standard 34 in title. Midway in Exec Summary, "...is focuses..." should be "...it focuses...". Also same error in background. Applicability section, is the 2010-2015 version the current Strategic Plan? Last sentence of background, perhaps say something like, "This research project will focus on the impacts of...". Under Objectives, perhaps something like, 1. Develop a comprehensive database of how... Also, for item 2, if there is only one subheading, the subheading is not needed. If what is listed as item (a) is not part of item 2, then make it a standalone item 3. For the current item 3, perhaps something like, 3. Develop a consistent alternative for modernizing... In Task 1d and Task 2d, the use of "state of the art" may be inappropriate or misleading. Perhaps something like, "Write a summary report to show comparisons of the standard documents where ATELS replace OELs." Under Deliverables, third bullet, you show Tasks 1-4, should be Tasks 1-5. Also, last bullet item should be reworded. In your schedule layout, technically you should show 5 reports since you also include a comprehensive Final Report at the conclusion of the project. 10 - Well written WS. Covers all the bases.
COND. ACCEPT		
RETURN		
REJECT		

ACCEPT Vote - Work statement(WS) ready to bid as-is

CONDITIONAL ACCEPT Vote - Minor Revision Required - RL can approve WS for bid without going back to RAC once TC satisfies RAC's approval condition(s) to his/her satisfaction

RETURN Vote - WS requires major revision before it can bid

REJECT Vote - Topic is no longer considered acceptable for the ASHRAE Research Program due to duplication of work by another project or because the work statement has a fatal flaw(s) that makes it unbiddable

WORK STATEMENT COVER SHEET

Date: May 9, 2016

(Please Check to Insure the Following Information is in the Work Statement)

A. Title	X
B. Executive Summary	X
C. Applicability to ASHRAE Research Strategic Plan	X
D. Application of the Results	X
E. State-of-the-Art (background)	X
F. Advancement to State-of-the-Art	X
G. Justification and Value to ASHRAE	X
H. Objective	X
I. Scope	X
J. Deliverables/Where Results will be Published	X
K. Level of Effort	
Project Duration in Months	X
Professional-Months: Principal	X
Professional-Months: Total	X
Estimated \$ Value	X
L. Other Information to Bidders (optional)	-
M. Proposal Evaluation Criteria & Weighting Factors	X
N. References	X

Title: 1797
Assessment of the A/B toxicity classification used in Standard 34

WS# 1797
 (To be assigned by MORTS - Same as RTAR #)

Results of this Project will affect the following Handbook Chapters, Special Publications, etc.:

ASHRAE SSPC 34, "Designation and Safety Classification -Refrigerants"
ASHRAE SSPC 15, "Safety Standard for Refrigeration Systems"
ISO 817, "Designation and Safety Classification of Refrigerants"
ISO 5149, "Refrigerating systems and heat pumps- Safety & env req"

Responsible TC/TG: TC 3.1

Date of Vote: 10/24/17

For		<u>11</u>
Against	*	<u>0</u>
Abstaining	*	<u>0</u>
Absent or not returning Ballot	*	<u>2</u>
Total Voting Members		<u>13</u>

This W/S has been coordinated with TC/TG/SSPC (give vote and date):
na
na

Work Statement Authors: **
Debbie Kenroy, Arkema
Steve Kujak, Ingersoll Rand - Trane
George Rusch, Honeywell
Gary Jepson, Chemours Chris Seeton, Shrieve

Has RTAR been submitted ? No -SSPC 34 direction was direct to
 Strategic Plan Goal 8
 Theme/Goals Objectives 1 & 5
Technical Challenges 1 & 5
Needed Research 9
(both related to facilitate low-GWP)

Proposal Evaluation Subcommittee:
 Chair: Steve Kujak, Ingersoll Rand - Trane
 Members: Debbie Kenroy, Arkema
George Rusch, Honeywell
Gary Jepson, Chemours
Chris Seeton, Shrieve

Project Monitoring Subcommittee:
 (If different from Proposal Evaluation Subcommittee)
(same)

Recommended Bidders (name, address, e-mail, tel. number): **
1) Navigant Consulting Inc, 77 South Bedford St, Burlington, MA
William Goetzler 781-270-8300,
2) ICF International, 9300 Lee Highway, Fairfax, VA
Mark Wagner, 703-934-6000
3) University of Colorado Boulder, Dr Shelly Miller, 303-492-0587

Potential Co-funders (organization, contact person information):

(Three qualified bidders must be recommended, not including WS authors.)

Is an extended bidding period needed?
 Has an electronic copy been furnished to the MORTS?
 Will this project result in a special publication?
 Has the Research Liaison reviewed work statement?

Yes	No	How Long (weeks)
X	X	-
X	X	
X	X	

* Reasons for negative vote(s) and abstentions
10/25/17 - TC revoted on revised work statement. Vote is recorded above.

** Denotes WS author is affiliated with this recommended bidder
 Use additional sheet if needed.

WORK STATEMENT #1797

SPONSORING TC/TG/MTG/SSPC# & NAME: TC 3.1 Refrigerants and Secondary Coolants

Title: Assessment of the A/B toxicity classification used in Standard 34

Executive Summary:

ANSI/ASHRAE Standard 34 (STD 34) offers guidance on the safe use of refrigerants, including toxicity considerations. The establishment of “safe” refrigerant concentrations for the purposes of design and use are appropriately defined by acute (short-term) toxicology data and are known as Acute Toxicity Exposure Limits (ATELs). The ATELs are intended to protect the general population in the event of refrigerant leaks or inadvertent exposures. However, the current process for refrigerant safety classification, A or B, is disconnected from the acute toxicity data and instead is based on chronic occupational exposure limits (OELs) designed for use only in healthy worker populations and only where exposures last for an entire working lifetime. The use of OELs for safety classification is not only problematic from the perspective that it focuses on the irrelevant exposure scenarios and only on healthy workers, but it is also problematic in that the establishment and application of OELs has transformed over the past 5 years and is subject to increasing subjectivity (bias) and misapplication. To align STD 34 toxicity safety classification with the appropriate exposure scenarios and to establish safety classifications based on sound, objective toxicological data, there is an effort to use acute toxicity data as the basis for STD 34 toxicity safety A/B classification. However, it is unclear what the impact would be on ANSI/ASHRAE Standard 15 (STD 15), “Safety Standard for Refrigeration Systems”, and others who use STD 34 safety classifications and OELs. Therefore, technical guidance is needed to understand the downstream impact of using acute data for STD 34 safety classification and how to incorporate this approach into activities relying on STD 34.

Applicability to the ASHRAE Research Strategic Plan:

This project supports the ASHRAE Research Strategic Plan 2010 – 2015 for support of research into new alternative Low Global Warming Potential refrigerants by addressing difficulties and inconsistencies with setting toxicity classification limits in STD 34.

Plan Goal 8: Facilitate the use of natural and low global warming potential (GWP) synthetic refrigerants and seek methods to reduce their charge

Objectives

- 1 – Effectively incorporate natural and low GWP synthetic refrigerants in Air Conditioning & Refrigeration (AC&R) equipment.*
- 5 – Study safety and health issues related to these equipment/systems*

Technical Challenges

- 1 – Use of natural refrigerants that are identified as toxic or flammable by regulatory authorities.*
- 5 – Determination of risks associated with naturally occurring and low GWP synthetic refrigerants that have properties that make them “less safe” than the current refrigerants. What changes will need to be made in codes and standards to allow safe usage of these refrigerants?*

Needed Research

- 9 – Develop basic data to support industry risk assessments to determine what types of applications can use flammable or toxic refrigerants safely and what system modifications could be made to improve safety.*

Application of Results:

The results of this project will be incorporated into the ASHRAE Handbook Fundamentals Chapter 29, ANSI/ASHRAE Standard 34, ANSI/ASHRAE Standard 15; the results will be available through these publications. The practical benefits of a technically sound classification system will be to ensure the assignment of the correct toxicity safety classification for refrigerants.

State-of-the-Art (Background):

STD 34 is a standard for refrigerants that describes a shorthand way of naming refrigerants and assigns safety classifications and refrigerant concentration limits based on toxicity and flammability data. Members of the STD 34 committee have established a uniform system for toxicity safety classification that is used by STD 15. Refrigerants are assigned to one of two classes - A or B - based on allowable chronic toxicity exposure or long term toxicity effects while the establishment of “safe” refrigerant concentrations for the purposes of design and use are appropriately defined by acute (short-term) toxicology data and are known as Acute Toxicity Exposure Limits (ATELs) and Refrigerant Concentration Limits (RCLs). STD 15 uses the toxicity classification (Class A or B), along with the RCL from STD 34 to specify safe design, construction, installation, and operation of refrigeration systems.

The A or B safety classification is not only used in STD 15. It is used directly by other similar standards, such as EN378 (Refrigerating systems and heat pumps - Safety and environmental requirements), ISO5149 (Refrigerating systems and heat pumps - Safety and environmental requirements), IEC 60335-2-40, GB/T 7778 (Number designation and safety classification of refrigerants). The A or B classification is used indirectly and inappropriately as it implies that all Class B refrigerants are highly toxic and that is not a correct interpretation. The inappropriate interpretation of the differences between toxicity safety classifications of A and B are a consequence of an arbitrary 400 ppm threshold for classification based on the OEL instead of a being based on more appropriate acute toxicity data. The use of OELs for safety classification is not only problematic from the perspective that it focuses on the irrelevant exposure scenarios and only on healthy workers, but it is also problematic in that the establishment and application of OELs has transformed over the past 5 years and is subject to increasing subjectivity (bias) and misapplication.

Since there is a classification inconsistency between acute and chronic limits, STD 34 needs a technically sound classification system to properly classify refrigerants for toxicity (safety). SSPC 34, with input from SSPC 15, requests that the same - A or B - classification system be employed to limit the impact on changes to STD 15 and related codes. This research request focuses on the impact of setting acute based limits for the toxicity safety classifications A or B.

Advancement to the State-of-the-Art:

The project will identify impacts and modifications needed to apply an acute toxicity based, technically sound A or B refrigerant toxicity safety classifications. Thus, STD 34 will be able to appropriately assign toxicity safety classifications for new and existing refrigerants that meet industrial needs and are appropriate for use in industry standards including STD 15. It is likely that the result of this work will allow for an expanded use of refrigerants.

Justification and Value to ASHRAE:

Societal expectations and demands for refrigerants with lower global warming impact drive the industry to development new refrigerants that are both safe and functional. Understanding the impact of using acute versus chronic toxicity for setting limits based on technically sound toxicity criteria for HVACR products will

- increase the safety understanding of refrigeration based products
- facilitate the adoption of lower GWP refrigerants including natural refrigerants

-further the application and understanding of refrigerants and products for the industry

An improved, technically sound approach to refrigerant classification for toxicity will aid in the development of standards and codes for the relevant equipment areas. Additionally, this will enhance the likelihood of acceptance and use of refrigerants including the newer low GWP candidates. Faster adoption of lower GWP refrigerants will help with the sustainability of HVAC&R products. Adoption could occur within 5 years of the completion of this work. No intellectual property is expected from this work.

A detailed understanding of the application and downstream impact of adopting a toxicity safety classification process based on acute toxicity data would allow a targeted approach to adopting and implementing a toxicity safety classification process change.

Objectives:

1. Create a clear description of how STD 34 OELs and toxicity safety classifications are used in other ASHRAE standards and in international standards and/or processes.
2. Provide a basis for understanding the impact on other ASHRAE standards of using acute toxicity data for STD 34 safety classification A/B.
 - a. Describe how the use of acute toxicity data for safety classification would be incorporated into STD 34 and all other impacted standards and relevant activities.
3. Create a foundation for modernizing the STD 34 toxicity A/B safety classification based on acute toxicity data rather than the outdated, vulnerable and scientifically inferior OEL method currently used.

Scope/Technical Approach:

Task 1: Identify ANSI/ASHRAE standards (including specific sections) that use OELs or toxicity safety classifications (A or B).

- a. Study and report on how OELs listed in STD 34 are used in these standards.
- b. Identify and describe any areas of the standards that directly link the ASHRAE A/B safety classification to the OEL.
- c. Identify and describe the impact of using an acute basis for safety classification instead of the 400 ppm OEL threshold in any areas of the standards (assume that an OEL value is still available for use in activities other than safety classification determination).
- d. Write a summary report to show comparisons of the current state of the art. This report is to include a description of the information identified in item 1a-1c, along with a list of references.

Task 2: Identify international refrigeration standards outside of ANSI/ASHRAE that use STD 34 OELs and toxicity safety classifications A/B.

- a. Study and report on how OELs listed in STD 34 are used in these standards.
- b. Identify and describe any areas of the standards that directly link the ASHRAE A/B safety classification to the OEL.
- c. Identify and describe the impact of using an acute basis for safety classification instead of the 400 ppm OEL threshold in any areas of the standards (assume that an OEL value is still available for use in activities other than safety classification determination).
- d. Write a summary report to show comparisons of the current state of the art. This report is to include a description of the information identified in item 1a-1c, along

with a list of references.

Task 3: Identify and describe the impact on other ASHRAE standards of using acute toxicity data for STD 34 safety classification A/B.

- a. Provide a detailed report of the specific areas impacted and basis for impact by using an acute basis for STD 34 toxicity safety classification rather than the OEL method currently used.
- b. Identify the areas that would be the most immediately impacted by a change in STD 34 safety classification basis.

Task 4: Describe how the acute based safety classification could be incorporated in STD 34 and other relevant standards and activities.

Task 5: Provide solution recommendations to resolve any substantial “issues” or “concerns” identified in standards or processes that use STD 34 OELs or toxicity safety classifications A/B.

Deliverables/Where Results Will Be Published:

- Contractor(s) will meet with the Project Monitoring Subcommittee (PMS) to kick-off the project and review the scope. This may be done via teleconference.
- **Intermediate reports:**
 - Quarterly progress and financial **reports** to the Society’s Manager of Research and Technical Services (MORTS), to be reviewed by the PMS, specifically on or before each January 1, April 1, June 10, and October 1 of the contract period.
 - Technical reports will be prepared after completion of Task 1 and Task 2 and submitted to the Research Manager and the PMS.
 - At the completion of Task 1 – As defined in Task 1, provide a written report on the ANSI/ASHRAE standards (including specific sections) that use OELs or toxicity safety classifications A/B
 - At the completion of Task 2 – As defined in Task 2, provide a written report on the international refrigeration standards outside of ANSI/ASHRAE that use STD 34 OELs and toxicity safety classifications A/B.
 - At the completion of Task 3 – As defined in Task 3, provide a written report on the identify and describe the impact on other ASHRAE standards of using acute toxicity data for STD 34 safety classification A/B
 - At the completion of Tasks 4 and 5 – As defined by Tasks 4 and 5, provide (1) a written report on solution recommendations to resolve any substantial “issues” or “concerns” identified in standards or processes that use STD 34 OELs or toxicity safety classifications A/B and (2) a written report describing detailed recommendations on how to implement the use of acute-based safety classifications A/B in STD 34 and relevant standards and activities.
- A final report, in a form approved by the Society, shall be prepared and submitted to the Society’s MORTS by the end of the contract period covering all finding related to requests in Tasks 1-4, including complete details of all research including references and the basis for search and reference strategies. Unless otherwise specified, six draft copies of the final report shall be furnished for review by the Project Monitoring Subcommittee (PMS).
- Following approval by the PMS and the TC, final copies of the final report will be furnished as follows:
 - Executive Summary suitable for wide distribution to the industry and to the public
 - Two bound copies

- One unbound copy, printed on one side only, suitable for reproduction
- Two copies on CD-ROM, one in pdf and one in Microsoft Word
- Contractor(s) will prepare one technical Paper for publication and **present** the results of this project in a form suitable for presentation at an ASHRAE Society meeting. The paper(s) shall conform to the “ASHRAE’s Author’s Manual”.
- Contractor will prepare a project synopsis.
- Contractor may be requested to prepare a Technical Article suitable for publication in the ASHRAE Journal may be requested by the Society.

Level of Effort:

Total dollars: \$75,000

Professional Months:

Principal: to be determined

Total: 10 months

Duration: 10 months

Task	M1	M2	M3	M4	M5	M6	M7	M8	M9
1	x	x							
2			x	x					
3					x	x			
4							x	x	
5							x	x	
report		x		x		x			x

M = Month

Other Information for Bidders (Optional):

Data

The Institution agrees to maintain true and complete books and records, including but not limited to notebooks, reports, charts, graphs, analyses, computer programs, visual representations etc. (collectively, the “Data”) generated in connection with the Services. Society representatives shall have access to all such Data for examination and review at reasonable times. The Data shall be held in strict confidence by the Institution and shall not be released to third parties without prior authorization from the Society, except as provided by GENERAL CONDITION VII, PUBLICATION. The original Data shall be kept on file by the Institution for a period of two years after receipt of the final payment and upon request the Institution will make a copy available to the Society upon the Society’s request.

Principal Investigator presence at ASHRAE Conference

The Institution’s Principal Investigator, subject to the Society’s approval, shall, during the period of performance and after the Final Report has been submitted, report in person to the sponsoring

Technical Committee/Task Group (TC/TG) at the annual and winter meetings, and be available to answer such questions regarding the research as may arise.

Information regarding the technical paper

The paper shall be submitted first to the ASHRAE MORTS and then to the “ASHRAE Manuscript Central” website-based manuscript review system in a form and containing such information as designated by the Society suitable for publication. Papers specified as deliverables should be submitted as either Research Papers for HVAC&R Research or Technical Paper(s) for ASHRAE Transactions. Research papers contain generalized results of long-term archival value, whereas technical papers are appropriate for applied research of shorter-term value, ASHRAE Conference papers are not acceptable as deliverables from ASHRAE research projects. The paper(s) shall conform to the instructions posted in “Manuscript Central” for an ASHRAE Transactions Technical or HVAC&R Research paper. The paper title shall contain the research project number (XXXX-RP) at the end of the title in parentheses.

Note: A research or technical paper describing the research project must be submitted after the TC has approved the Final Report. Research or technical papers may also be prepared before the project’s completion, if it is desired to disseminate interim results of the project. Contractor shall submit any interim papers to MORTS and the PMS for review and approval before the papers are submitted to ASHRAE Manuscript Central for review.

Project Synopsis

A written synopsis totaling approximately 100 words in length and written for a broad technical audience, which documents 1. Main findings of research project, 2. Why findings are significant, and 3. How the findings benefit ASHRAE membership and/or society in general shall be submitted to the Manager of Research and Technical Services by the end of the Agreement term for publication in ASHRAE *Insights*.

Proposal Evaluation Criteria:

- | | |
|--|-----|
| 1. Contractor's understanding of Work Statement as revealed in proposal. | 15% |
| a) Logistical problems associated | |
| b) Technical problems associated | |
| 2. Quality of methodology proposed for conducting research. | 20% |
| a) Organization of project | |
| b) Management plan | |
| 3. Contractor's capability in terms of facilities. | 25% |
| a) Managerial support | |
| b) Data collection | |
| c) Technical expertise | |
| 4. Qualifications of personnel for this project. | 25% |
| a) Project team 'well rounded' in terms of qualifications and experience in related work | |
| b) Project manager person directly responsible; experience and corporate position | |
| c) Team members' qualifications and experience | |
| d) Time commitment of Principal Investigator | |
| 5. Probability of contractor's research plan meeting the objectives of the Work Statement. | 10% |
| a) Detailed and logical work plan with major tasks and key milestones | |

- b) All technical and logistic factors considered
 - c) Reasonableness of project schedule
6. Performance of contractor on prior ASHRAE or other projects. 5%
(No penalty for new contractors.)
7. Other_____

References:

ANSI/ASHRAE Standard 34-2016 (“Designation and Safety Classification of Refrigerants”)
ANSI/ASHRAE Standard 15-2016 (“Safety Standard for Refrigeration Systems”)

Authors:

Steve Kujak
Debra Kennoy
Chris Seeton
Gary Jepson
George Rusch



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Michael R. Vaughn, P.E.
Manager
Research & Technical Services

mvaughn@ashrae.org

TO: Mark McLinden, Chair TC 3.1, markm@boulder.nist.gov
Stephen Kujak, Research Subcommittee Chair TC 3.1, skujak@trane.com
Debbie Kennoy, Steve Kujak, George Rusch, Gary Jepson, Work Statement Author(s),
debra.kennoy@arkema.com, george.rusch9@gmail.com, gary.w.jepson-1@chemours.com

FROM: Michael Vaughn, Manager of Research and Technical Services (MORTS)

CC: Mark Spatz, Research Liaison 3.0, Mwsbuf@msn.com
Stephen Kujak, (NEW) Research Liaison 3.0, skujak@trane.com

DATE: July 19, 2016

SUBJECT: Work Statement (1797-WS), "Assessment of the A/B toxicity classification used in Standard 34"

During their recent Annual meeting, the Research Administration Committee (RAC) reviewed the subject Work Statement (WS) and voted to return with comments.

Below are the issues, concerns, and questions that must be addressed in your next submission of the WS if you choose to resubmit.

1. Work statement needs to be improved. Task, scope and deliverables need to be better defined.

Please coordinate changes to this Work Statement with your Research Liaison, Stephen Kujak, RL3@ashrae.net or skujak@trane.com prior to resubmitting it to the Manager of Research and Technical Services for further consideration by RAC.

Also, it is necessary that you provide a new TC vote on the revised Work Statement, and a letter describing how each of the above items were addressed in the revision.

If you wish for this work statement to be reconsidered at the next RAC meeting, the revised Work Statement must be sent (electronically) to Michael Vaughn, Manager of Research and Technical Services (morts@ashrae.net) by **August 15, 2016**. The next opportunity for consideration after this deadline is **December 15, 2016** for consideration at RAC's 2017 winter meeting.

Project ID	1797	
Project Title	Assessment of the A/B toxicity classification used in Standard 34	
Sponsoring TC	TC 3.1, Refrigerants and Secondary Coolants	
Cost / Duration	\$190,000 / 18 Months	
Submission History	1st WS Submission, RTAR Stage Skipped	
Classification: Research or Technology Transfer		
RAC 2016 Annual Meeting Review	RTAR STAGE SKIPPED	
Check List Criteria	VOTED NO	Comments & Suggestions
State-of-the-Art (Background): The WS should include some level of literature review that documents the importance/magnitude of a problem. If not, then the WS should be returned for revision. - RTAR Review Criterion		11 - Excellent background and state-of the art, but it's not a literature review. That is part of Task 1.
Advancement to the State-of-the-Art Is there enough justification for the need of the proposed research. Will this research significantly contribute to the advancement of the State-of-the-Art. RTAR Review Criterion		
Relevance and Benefits to ASHRAE: Evaluate whether relevance and benefits are clearly explained in terms of: a. Leading to innovations in the field of HVAC & Refrigeration b. Valuable addition to the missing information which will lead to new design guidelines and valuable modifications to handbooks and standards. Is this research topic appropriate for ASHRAE funding? If not, Reject. RTAR Review Criterion		11 - Clearly specifies need and value of replacing current inconsistent refrigerant toxicity criteria with a single criterion to be determined by this study. This is a classic chemical safety study, but critical for adoption of new low GWP refrigerants.
IF ABOVE THREE CRITERION ARE NOT ALL SATISFIED - MARK "REJECT" BELOW		
Detailed Bidders List Provided? The contact information in the bidder list should be complete so that each potential bidder can be contacted without difficulty.		12 - 3 potential bidders listed, but address info is incomplete.
Proposed Project Description Correct? Are there technical errors and/or technical omissions that the WS has that prevents it from correctly describing the project? If there are, than the WS needs major revision.	#9	5- YES -- Seems to be very well written.
Task Breakdown Reasonable? Is the project divided into tasks that make technical and practical sense? Are the results of each task such that the results of the former naturally flow into the latter? If not, then major revisions are needed to the WS that would include: adding tasks, removing tasks, and re-structuring tasks among others.	#9, #12	11 - I suggest that Task 3 be amended with a "Plan B." What should the contractor do if the findings do not support establishing a "technically sound A or B toxicity limit and a lower threshold B limit." 9 - Tasks need to be defined in detail along with PMS approval requirements. 12 - The task descriptions are very brief and are inadequately defined. Tasks are described as reports with no detail about what needs to be done.
Adequate Intermediate Deliverables? The project should include the review of intermediate results by the PMS at logical milestone points during the project. Before project work continues, the PMS must approve the intermediate results.	#9	9 - Not enough detail.
Proposed Project Doable? Can the project as described in the WS be accomplished? If difficulties exist in the project's WS that prevent a successful conclusion of the project, then the project is not doable. In this situation, major revision of the WS is needed to resolve the issues that cause the difficulty.		11 - I think so
Time and Cost Estimate Reasonable? The time duration and total cost of the project should be reasonable so that the project can be as it is described in the WS.	#9, #12	11 - Appears to be, but there is inherent uncertainty in the experimental work, if that route is selected by the winning contractor. 9 - The lack of detail shown in the WS does not justify the expense of \$190K. 12 - WS should not provide project schedule. This should be left to the bidders. The cost is on the high-side for an ASRAE research project. Duration is OK.
Proposed Project Biddable? Examining the WS as a whole, is the project described in the WS of sufficient clarity and detail such a potential bidder can actually understand and develop a proposal for the project? This criterion combines the previous three criteria into an overall question concerning the usefulness of the WS. If the WS is considered to not be biddable, then either major revisions are in order or the WS should be rejected.	#9	9 - Not enough detail in task and details on what the PMS will review.
Decision Options	Initial Decision	Approval Conditions
ACCEPT		6 - Changing the classification scheme for the toxicity of refrigerants is long overdue. Successful completion of this work should go a long way to enable std 34 to address the inconsistencies that are present in the current method Std 34 uses. 11 - if Liaison satisfied that concerns have been met. 9 -
COND_ACCEPT		This seems to be a good research project and will have value. The WS is poorly written and the project needs to be better defined. 5 - The TC adequately described the need, the approach seems sound, and the cost and level of effort seem reasonable. 12 - WS needs to be improved and task described more rigorously.
RETURN		
REJECT		

RETURN Vote - Topic is probably acceptable for ASHRAE research, but RTAR is not quite ready.

REJECT Vote - Topic is not acceptable for the ASHRAE Research Program

WORK STATEMENT COVER SHEET

Date: May 9, 2016

(Please Check to Insure the Following Information is in the Work Statement)

A. Title	X
B. Executive Summary	X
C. Applicability to ASHRAE Research Strategic Plan	X
D. Application of the Results	X
E. State-of-the-Art (background)	X
F. Advancement to State-of-the-Art	X
G. Justification and Value to ASHRAE	X
H. Objective	X
I. Scope	X
J. Deliverables/Where Results will be Published	X
K. Level of Effort	
Project Duration in Months	X
Professional-Months: Principal	X
Professional-Months: Total	X
Estimated \$ Value	X
L. Other Information to Bidders (optional)	-
M. Proposal Evaluation Criteria & Weighting Factors	X
N. References	X

Title: Assessment of the A/B toxicity classification used in Standard 34

WS# 1797
(To be assigned by MORTS - Same as RTAR #)

Results of this Project will affect the following Handbook Chapters, Special Publications, etc.:

ASHRAE SSPC 34, "Designation and Safety Classification -Refrigerants"
ASHRAE SSPC 15, "Safety Standard for Refrigeration Systems"
ISO 817, "Designation and Safety Classification of Refrigerants"
ISO 5149, "Refrigerating systems and heat pumps- Safety & env req"

Responsible TC/TG: TC 3.1

Date of Vote: 1-25-2016

For		<u>10</u>
Against	*	<u>0</u>
Abstaining	*	<u>0</u>
Absent or not returning Ballot	*	<u>0</u>
Total Voting Members		<u>10</u>

This W/S has been coordinated with TC/TG/SSPC (give vote and date):
na
na

Work Statement Authors: **
Debbie Kenoy, Arkema
Steve Kujak, Ingersoll Rand - Trane
George Rusch, Honeywell
Gary Jepson, Chemours Chris Seeton, Shrieve

Has RTAR been submitted ? No -SSPC 34 direction was direct to
Strategic Plan Goal 8
Theme/Goals Objectives 1 & 5
Technical Challenges 1 & 5
Needed Research 9
(both related to facilitate low-GWP

Proposal Evaluation Subcommittee:
Chair: Steve Kujak, Ingersoll Rand - Trane
Members: Debbie Kenoy, Arkema
George Rusch, Honeywell
Gary Jepson, Chemours
Chris Seeton, Shrieve

Project Monitoring Subcommittee:
(If different from Proposal Evaluation Subcommittee)
(same)

Recommended Bidders (name, address, e-mail, tel. number): **
1) Navigant Consulting Inc, 77 South Bedford St, Burlington, MA 781-270-8300
2) ICF International, 9300 Lee Highway, Fairfax, VA 703-934-6000
Mark Wagner might be a direct contact
3) University of Colorado Boulder, Dr Shelly Miller, 303-492-0587

Potential Co-funders (organization, contact person information):

(Three qualified bidders must be recommended, not including WS authors.)

Is an extended bidding period needed?
Has an electronic copy been furnished to the MORTS?
Will this project result in a special publication?
Has the Research Liaison reviewed work statement?

Yes	No	How Long (weeks)
X	X	-
X	X	
X	X	

* Reasons for negative vote(s) and abstentions

** Denotes WS author is affiliated with this recommended bidder
Use additional sheet if needed.

WORK STATEMENT#

SPONSORING TC/TG/MTG/SSPC# & NAME: TC 3.1 Refrigerants and Secondary Coolants

Title: Assessment of the A/B toxicity classification used in Standard 34

Executive Summary:

ANSI/ASHRAE Standard 34 (STD 34) offers guidance on the safe use of refrigerants, in part, based on toxicity. This acute “short term toxicity effects” classification is based on escape impairment. However, refrigerant toxicity is classified by STD 34 as a toxicity class - A or B - based on chronic exposure “long term toxicity effects”. From this chronic exposure consideration, a uniform system based on refrigerant concentration limit (RCL) evolved that is used by ANSI/ASHRAE Standard 15 (STD 15), “Safety Standard for Refrigeration Systems”, and others to limit the amount of refrigerant charge in the event of a sudden and large leak. With this toxicity use and classification inconsistency between acute and chronic limits, sound technical guidance is needed.

Applicability to the ASHRAE Research Strategic Plan:

This project supports the ASHRAE Research Strategic Plan 2010 – 2015 for support of research into new alternative Low Global Warming Potential refrigerants by addressing difficulties and inconsistencies with setting toxicity classification limits in STD 34.

Plan Goal 8 : Facilitate the use of natural and low global warming potential (GWP) synthetic refrigerants and seek methods to reduce their charge

Objectives

- 1 – Effectively incorporate natural and low GWP synthetic refrigerants in Air Conditioning & Refrigeration (AC&R) equipment.*
- 5 – Study safety and health issues related to these equipment/systems*

Technical Challenges

- 1 – Use of natural refrigerants that are identified as toxic or flammable by regulatory authorities.*
- 5 – Determination of risks associated with naturally occurring and low GWP synthetic refrigerants that have properties that make them “less safe” than the current refrigerants. What changes will need to be made in codes and standards to allow safe usage of these refrigerants?*

Needed Research

- 9 – Develop basic data to support industry risk assessments to determine what types of applications can use flammable or toxic refrigerants safely and what system modifications could be made to improve safety.*

Application of Results:

The results of this project will be incorporated into the ASHRAE Handbook Fundamentals Chapter 29, ANSI/ASHRAE Standard 34, ANSI/ASHRAE Standard 15; the results will be available through these publications. The practical benefits of a technically sound classification system will be to ensure the assignment of the correct toxicity safety classification for refrigerants.

State-of-the-Art (Background):

STD 34 is a standard for refrigerants that describes a shorthand way of naming refrigerants and assigns safety classifications and refrigerant concentration limits based on toxicity and flammability data. Members of the STD 34 committee have established a uniform system for toxicity safety classification and RCL for refrigerants that is used by STD 15. Refrigerants are assigned to one of two classes - A or B - based on allowable chronic toxicity exposure or long term toxicity effects while

the RCL is based on acute toxicity related or escape impairment effects. STD 15 uses the toxicity classification (Class A or B) along with the RCL to specify safe design, construction, installation, and operation of refrigeration systems (Figure 1).

The A or B classification is not only used in STD 15. It is used directly by other similar standards, such as EN378 (Refrigerating systems and heat pumps - Safety and environmental requirements), ISO 5149 (Refrigerating systems and heat pumps - Safety and environmental requirements), IEC 60335-2-40, GB/T 7778 (Number designation and safety classification of refrigerants). The A or B classification is used indirectly and inappropriately implies that all Class B refrigerants are highly toxic while STD 34 indicates that Class B refrigerants are refrigerants with higher toxicity. Refrigerants have some of the lowest acute and chronic toxicity characteristics as a group of compounds.

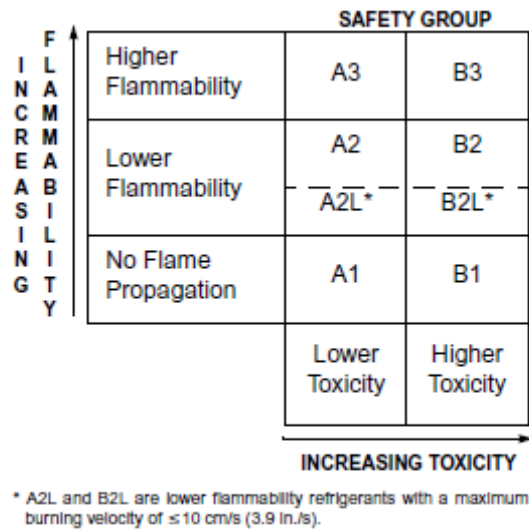


Figure 1 Refrigerant safety group classification.
(from ANSI/ASHRAE Standard 34-2013)

Since there is a classification inconsistency between acute and chronic limits, STD 34 is in need of a technically sound classification system to properly classify refrigerants for toxicity and identify their RCL to drive the safe use of refrigerants. SSPC 34, with input from SSPC 15, requests that the same - A or B - classification system be employed to limit the impact on changes to STD 15 and related codes. This research request focuses on safety knowledge gaps in setting the acute based limits for the Class A or B classification system.

Advancement to the State-of-the-Art:

The project will identify modifications needed to move to a technically sound A or B classification system for refrigerants. As a result, STD 34 will be in a position to accurately assign toxicity safety classifications and identify RCL values for new and existing refrigerants that meet industrial needs and are appropriate for use in industry standards including STD 15. It is likely that the result of this work will allow for an expanded use of refrigerants.

Justification and Value to ASHRAE:

As a consequence of societal demands to lower the global warming impact of refrigerants, the industry is looking to the development of new refrigerants that are both safe and functional.

Understanding the application of acute versus chronic toxicity and setting limits based on technically sound toxicity criteria for HVACR products will

- increase the safety understanding of refrigeration based products
- facilitate the adoption of lower GWP refrigerants including natural refrigerants
- further the application and understanding of refrigerants and products for the industry

An improved, technically sound approach to refrigerant classification for toxicity will aid in the development of standards and codes for the relevant equipment areas. Additionally, this will enhance the likelihood of acceptance and use of refrigerants including the newer low GWP candidates. Faster adoption of lower GWP refrigerants will help with the sustainability of HVAC&R products. Adoption could occur within 5 years of the completion of this work. No intellectual property is expected from this work.

STD 34 assesses the safety of submitted newly-proposed refrigerants and identifies safety classifications following a peer-review process. Since the modifications to the toxicity classification would be incorporated into STD 34, those interested in introducing new refrigerants through the STD 34 process would be compelled to adopt the modifications.

Objectives:

Select a contractor to perform the following tasks:

1. Provide a compiled review of applicable acute- and chronic-based safety limits or classification systems used by governments and relevant industry associations, groups, or companies.
 - a. Study and report on how these limits relate to the toxicity classifications and RCLs of the refrigerants published in STD 34.
 - b. Identify the basis, acute- or chronic-based, used by each system and offer, where possible, the rationale for this choice.
2. Provide a review of applicable risk assessment studies based on flammability, toxicity, or other similar safety studies conducted on refrigerants or other chemicals.
 - a. Propose how these studies could be used as part of the rationale for the selection of acute- or chronic-based values for the toxicity classification and the RCL calculation in STD 34.
3. Propose a risk assessment study to obtain the necessary information to justify setting an A or B acute toxicity system based on the RCL of refrigerants. This plan may include reviewing existing studies and modifying them appropriately to apply to acute toxicity, i.e. conversion of existing data on flammability to toxicity parameters. The plan could include further computational fluid dynamics (CFD) and testing which would include various leak rate scenarios, room size and different HVACR equipment. The proposed study must be approved in advance by the Project Monitoring Subcommittee (PMS) before starting objective 4.
4. Conduct the risk assessment study identified in objective 3 and approved by the PMS.
 - a. Report and summarize findings to include comparison or studies of various refrigerants with RCLs >10,000 ppm, between 10,000 and 1,000 ppm, and <1000 ppm
 - b. Propose potential classification limits for A or B and potential application safety factors to be recommended in the event of use of a B-classified refrigerant.
5. Document these findings in a report and prepare / present to the ASHRAE community as requested.

Scope/Technical Approach:

Task 1: Write a summary report to show comparisons of the current state of the art. This report is to include:

- a review of comparable acute- and chronic- based classification safety limits
- findings with an annotated list of references
- a summary of each classification system or limits

Task 2: Report from the contractor on risk assessment study proposal and methodology. This report is to include:

- a summary of published related risk assessment studies
- a risk assessment proposal and methodology which may consist of:
 - CFD and/or testing with varying conditions and physical setups to measure difference in results
- report findings and proposal must be reviewed with the PMS and the proposal refined and approved by the PMS before moving on to Task 3.

Task 3: Conduct risk assessment(s) as approved in Task 3 with the anticipation that the contractor will recommend a technically sound A or B toxicity limit and a lower threshold B limit.

Deliverables/Where Results Will Be Published:

- Contractor(s) will meet with the Project Monitoring Subcommittee (PMS) to **kick-off** the project and review the scope. This may be done via teleconference.
- **Intermediate reports:**
 - **Quarterly progress and financial reports** to the Society’s Manager of Research and Technical Services (MORTS), to be reviewed by the PMS, specifically on or before each January 1, April 1, June 10, and October 1 of the contract period.
 - **Technical reports** will be prepared after completion of Task 1 and Task 2 and submitted to the Research Manager and the PMS.
 - At the completion of Task 1 – report on the current state of art:
 - a report on the applicable acute- and chronic- based safety limits or classification systems with how these limits relate to various refrigerants RCL published in ASHRAE Standard 34
 - At the completion of Task 2 – report on current and proposed risk assessments:
 - a summary of published related risk assessment studies
 - a risk assessment proposal and methodology
 - note that the proposal must be approved by the PMS before moving to Task 3
- A **final** report, in a form approved by the Society, shall be prepared and submitted to the Society’s MORTS by the end of the contract period covering all theoretical findings, complete details of all research including supportive modeling, and recommendations for method improvement from work performed on this project. Unless otherwise specified, six draft copies of the final report shall be furnished for review by the Project Monitoring Subcommittee (PMS).
- **Following approval** by the PMS and the TC, final copies of the final report will be furnished as follows:
 - Executive Summary suitable for wide distribution to the industry and to the public
 - Two bound copies

- One unbound copy, printed on one side only, suitable for reproduction
- Two copies on CD-ROM, one in pdf and one in Microsoft Word
- Contractor(s) will prepare one **Technical Paper for publication and present** the results of this project in a form suitable for presentation at an ASHRAE Society meeting. The paper(s) shall conform to the “ASHRAE’s Author’s Manual”.
- Contractor will prepare a **Project Synopsis**.
- Contractor may be requested to prepare a Technical Article suitable for publication in the **ASHRAE Journal** may be requested by the Society.

Level of Effort:

Total dollars: \$190,000

Professional Months:

Principal: to be determined

Total: 18 months

Duration: 18 months

Task	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16	M17	M18
1	x	x	x	x														
2				x	x	x												
3							x	x	x	x	x	x	x	x	x	x		
report			x			x										x	x	x

M = Month

Other Information for Bidders (Optional):

Data

The Institution agrees to maintain true and complete books and records, including but not limited to notebooks, reports, charts, graphs, analyses, computer programs, visual representations etc., (collectively, the “Data”), generated in connection with the Services. Society representatives shall have access to all such Data for examination and review at reasonable times. The Data shall be held in strict confidence by the Institution and shall not be released to third parties without prior authorization from the Society, except as provided by GENERAL CONDITION VII, PUBLICATION. The original Data shall be kept on file by the Institution for a period of two years after receipt of the final payment and upon request the Institution will make a copy available to the Society upon the Society’s request.

Principal Investigator presence at ASHRAE Conference

The Institution’s Principal Investigator, subject to the Society’s approval, shall, during the period of performance and after the Final Report has been submitted, report in person to the sponsoring Technical Committee/Task Group (TC/TG) at the annual and winter meetings, and be available to answer such questions regarding the research as may arise.

Information regarding the technical paper

The paper shall be submitted first to the ASHRAE MORTS and then to the “ASHRAE Manuscript Central” website-based manuscript review system in a form and containing such information as designated by the Society suitable for publication. Papers specified as deliverables should be submitted as either Research Papers for HVAC&R Research or Technical Paper(s) for ASHRAE Transactions. Research papers contain generalized results of long-term archival value, whereas technical papers are appropriate for applied research of shorter-term value, ASHRAE Conference papers are not acceptable as deliverables from ASHRAE research projects. The paper(s) shall conform to the instructions posted in “Manuscript Central” for an ASHRAE Transactions Technical or HVAC&R Research paper. The paper title shall contain the research project number (XXXX-RP) at the end of the title in parentheses.

Note: A research or technical paper describing the research project must be submitted after the TC has approved the Final Report. Research or technical papers may also be prepared before the project’s completion, if it is desired to disseminate interim results of the project. Contractor shall submit any interim papers to MORTS and the PMS for review and approval before the papers are submitted to ASHRAE Manuscript Central for review.

Project Synopsis

A written synopsis totaling approximately 100 words in length and written for a broad technical audience, which documents 1. Main findings of research project, 2. Why findings are significant, and 3. How the findings benefit ASHRAE membership and/or society in general shall be submitted to the Manager of Research and Technical Services by the end of the Agreement term for publication in ASHRAE *Insights*.

Proposal Evaluation Criteria:

- | | |
|--|-----|
| 1. Contractor's understanding of Work Statement as revealed in proposal. | 15% |
| a) Logistical problems associated | |
| b) Technical problems associated | |
| 2. Quality of methodology proposed for conducting research. | 20% |
| a) Organization of project | |
| b) Management plan | |
| 3. Contractor's capability in terms of facilities. | 25% |
| a) Managerial support | |
| b) Data collection | |
| c) Technical expertise | |
| 4. Qualifications of personnel for this project. | 25% |
| a) Project team 'well rounded' in terms of qualifications and experience in related work | |
| b) Project manager person directly responsible; experience and corporate position | |
| c) Team members' qualifications and experience | |
| d) Time commitment of Principal Investigator | |
| 5. Probability of contractor's research plan meeting the objectives of the Work Statement. | 10% |
| a) Detailed and logical work plan with major tasks and key milestones | |
| b) All technical and logistic factors considered | |
| c) Reasonableness of project schedule | |
| 6. Performance of contractor on prior ASHRAE or other projects. | 5% |
| (No penalty for new contractors.) | |

7. Other_____

References:

ANSI/ASHRAE Standard 34-2013 (“Designation and Safety Classification of Refrigerants”)
ANSI/ASHRAE Standard 15-2013 (“Safety Standard for Refrigeration Systems”)

Authors:

Steve Kujak
Debra Kennoy
Chris Seeton
Gary Jepson
George Rusch