



ASHRAE American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

RESEARCH MANUAL

REVISED: 11-07-01

RECENT REVISIONS

Summary of Changes for 2011 Revision

Section 1 - Clarified the mission of the Research Advisory Panel (RAP) and eliminated details on the update schedule to the research strategic plan (RSP) to allow for more flexibility and possibly a longer period of time between formal updates. The Research Priorities were also updated to better describe the purpose of the RSP.

Throughout Document – Clarified that a topic need not contribute directly to the goals identified in the RSP; however those that do will likely be given a higher priority for funding when research funds are limited.

Page 3 - Updated the research approval process flowchart.

Disposition of ASHRAE Research Results form revised.

Major update cycle for Research Strategic Plan increased from 5 to 8 years.

MTGs w/research authority and the Refrigeration committee have been given authority to initiate and sponsor research projects.

RESEARCH PROJECT MANUAL

OVERVIEW

The purpose of this manual is to present, in one document, all of the information and procedures needed by individuals who initiate, approve, conduct, monitor and utilize ASHRAE research.

ASHRAE has been sponsoring research to advance the arts and sciences of HVAC&R for the benefit of the public since 1919. It is a unique program that depends on voluntary funding and the many volunteers who plan and monitor the research. ASHRAE research has grown steadily over the years to the current commitment of more than \$10 million for over 100 projects. Research findings have truly benefited our members, our industry and the public. The Research Administration Committee (RAC) is committed to finding ways to improve the operation of the system and to focus research on those areas of technology critical to ASHRAE.

This document details all aspects of ASHRAE research projects from the strategic plan for the program to the dissemination of the information generated. Sample forms and examples of well-done documents are included.

It is intended to supplement, not supplant, the official ASHRAE documentation such as the Rules of the Board, and Manuals of Procedures.

The subject of Special Projects (projects sponsored by or co-sponsored by outside organizations) is not covered in this manual. A document entitled "Policy and Procedures for ASHRAE Special Projects" covers this subject in detail.

YOUR COMMENTS ARE WELCOME

Should you have a comment on this Research Manual, please submit it electronically to the ASHRAE Manager of Research and Technical Services (MORTS).

E-mail: MORTS@ashrae.net

The MORTS will consolidate comments for RAC. RAC intends to maintain the Research Manual as a “living document” and update it as it is needed and practical.

GLOSSARY OF ASHRAE RESEARCH ACRONYMS

ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
BOD	Board of Directors
DAL	Director at Large
EX-O	Ex-Officio Member from the Board of Directors
EXCOM	Executive Committee
GIA	Grant-In-Aid
HVAC&R	Heating, Ventilating, Air-Conditioning and Refrigeration
IRP	International Research Proposal
MOP	Manual of Procedures
MORTS	Manager of Research and Technical Services
MTG	Multidisciplinary Task Group
NIA	New Investigator Award
PI	Principal Investigator
PES	Proposal Evaluation Subcommittee
PMS	Project Monitoring Subcommittee
RAC	Research Administration Committee
RAS	Research Activities Subcommittee
RAP	Research Advisory Panel
RFP	Request-For-Proposal
RIP	Research Implementation Plan

RL	Research Liaison
RP	Research Project
RPS	Research Planning Subcommittee
RTAR	Research Topic Acceptance Request
SSPC	Standing Standard Project Committee
TAC	Technical Activities Committee
TC	Technical Committee
TG	Task Group
TRP	Tentative Research Project
URP	Unsolicited Research Proposal
WS	Work Statement

TABLE OF CONTENTS

OVERVIEW	ii
GLOSSARY OF ASHRAE RESEARCH ACRONYMS	iii
TABLE OF CONTENTS	v
1. RESEARCH STRATEGIC PLANNING AND OVERALL APPROVAL PROCESS	1
2. GUIDELINES FOR THE DEVELOPMENT OF SPECIAL PUBLICATIONS AS ASHRAE RESEARCH PROJECTS	3
3. RESEARCH IMPLEMENTATION PLAN & RESEARCH TOPIC ACCEPTANCE REQUESTS (RTARs)	4
3.1 Relationship between TC/TG/MTG/SSPCs and Society Research Plans.....	5
3.2 RTAR Submission and Approval Process	6
3.3 Research Topic Acceptance Requests (RTARs).....	8
3.4 Example RTAR Review Ballot Form used by RAC.....	9
3.5 Example RTAR Review Summary Form used by RAC..	11
4. WORK STATEMENTS (WS)	13
4.1 Work Statement Development and Approval Process	16
4.2 Work Statement Preparation	18
4.3 Work Statement Cover Sheet.....	17
4.4 Work Statement Outline	18
4.5 Tips for Writing an Effective Work Statement	27
4.6 Example WS Review Ballot Form used by RAC	27
4.7 Example WS Review Summary Form used by RAC	29
5. PROJECTS APPROVED FOR BIDDING.....	31
6. SOLICITED PROPOSALS	45
6.1 Evaluation of Solicited Proposals	45
6.2 Instructions for Proposal Evaluation Subcommittee.....	47
7. UNSOLICITED RESEARCH PROPOSALS.....	52
7.1 Evaluation of Unsolicited Research Proposal	52
7.2 Guidelines For Unsolicited Research Proposals	54
7.3 ASHRAE Innovative Research Grant Program	59
8. RESEARCH AGREEMENT	60
9. PROJECT MONITORING.....	69
9.1 Instructions for Project Monitoring Subcommittee	70

10. PROJECT COMPLETION.....	75
11. DISSEMINATION OF RESULTS.....	78
APPENDIX 1: RESEARCH RELATED TO TECHNOLOGY TRANSFER.....	79
APPENDIX 2: RECOMMENDED METHODOLOGY FOR PROJECTS WITH FIELD MONITORING.....	80
APPENDIX 3: GUIDELINES FOR THE USE OF COMPUTATIONAL FLUID DYNAMICS (CFD)	83
APPENDIX 4: SAMPLE WORK STATEMENT AND COVER SHEET.....	87

1. RESEARCH STRATEGIC PLANNING AND OVERALL APPROVAL PROCESS

ASHRAE Research Strategic Plan

The ASHRAE Research Strategic Plan is updated every eight years by the Research Advisory Panel with input solicited from the TCs (and TGs, MTGs w/research authority, SSPCs, and other committees authorized to sponsor research projects), standing committees/councils and from individuals and organizations outside ASHRAE but with the same or related interests to ASHRAE. The Plan is approved by the Technology Council. The Society's Officers and Board members receive counsel on the strategic plan from the members through the Region-Chapter organization and through the Council-Committee organization.

The Society's Research Strategic Plan covers an eight year period. Between major updates, RAC will review the plan on an annual basis to identify needs for modification, addition, or deletion of goals. The review process will include tracking of alignment of RSP goals with Societies Strategic Plan and with the goals of RTARs generated by TCs, TGs, and MTGs. Based on this review, funding priorities may be changed to encourage under-represented project topics. The current Research Strategic Plan, which is available from ASHRAE Headquarters and posted on the Research Page of the ASHRAE Web site, should be consulted for the latest information on the overall research goals of the Society. The research priorities and broad themes/topics outlined in the strategic plan are communicated to the TCs to guide them in their planning and development of specific research project topics.

Research Advisory Panel

The Research Advisory Panel (RAP) consists of a mixed group of ten experienced design engineers, educators, policy makers, and/or researchers who are all forward-thinking individuals appointed by the ASHRAE President. Their mission is to develop the research strategic plan for the Society by examining research frontiers and critical issues that may form barriers to progress and developing a strategic plan for the benefit of the HVAC&R industry and the general public. RAP makes recommendations to the Research Administration Committee (RAC), TCs and others regarding research, technologies and concepts that the Society should be investigating. Their work is of an advisory nature, and they work within the other procedures outlined in this manual.

Research Priorities

The purpose of the Research Strategic Plan is to identify key HVAC&R research needs and to provide that information to ASHRAE members and Technical Committees as guidance while they develop research projects and to the Research Administration Committee as it approves and funds research proposals. The Research Plan is not meant to take the initiative for research design from the cognizant committees, but rather to use input from ASHRAE members to identify strategic research needs that are appropriate for many committees to collaborate on, that may require larger budgets, and for which additional outside funding may be available to supplement ASHRAE's budget. Proposed research topics that address in part or whole the broad themes/topics of the Society's Research Strategic Plan will receive priority in research funding if approved by RAC. Project topics not related to the strategic plan can still be submitted for review and may be approved for funding if, in the opinion of RAC membership, the topic is timely and needed.

Each year RAC develops a priority list of research topics for further development that have been proposed by TCs to RAC in the form of a "Research Topic Acceptance Request (RTAR)." This list is called the "ASHRAE Research Implementation Plan," and it represents the Society's efforts to implement the Research Strategic Plan's goals.

In addition to projects originated by TCs in the form of RTARs and Work Statements, ASHRAE also supports projects originated by individual researchers in the form of Unsolicited Research Proposal or International Research Proposal. In either case, projects that address the goals of the ASHRAE Research Strategic Plan have a higher probability of being approved for ASHRAE funding.

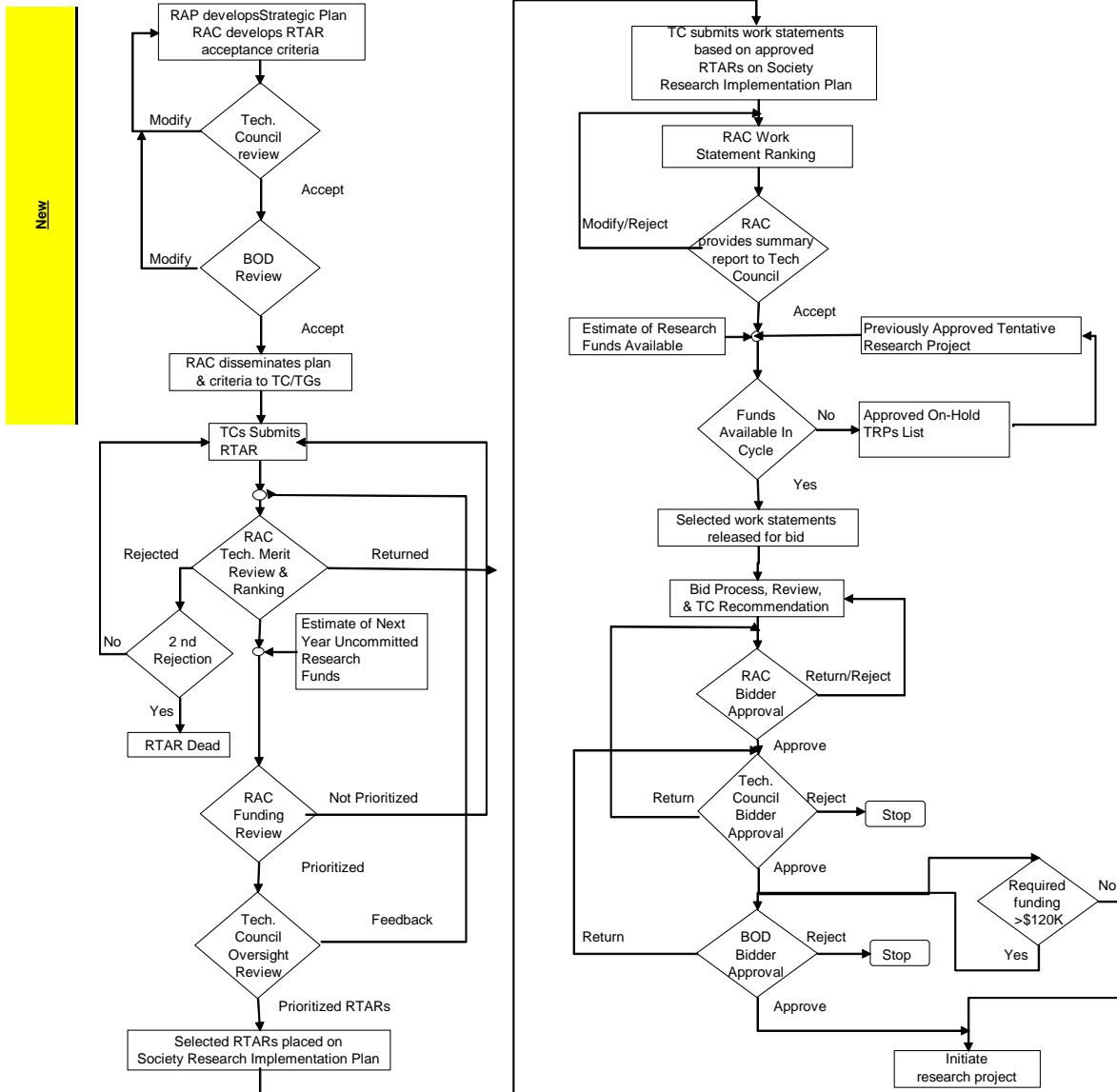
Research Classifications

ASHRAE Research Projects are classified as follows:

- Basic and Applied Research, which constitute the majority of the projects and utilize the majority of the research funding.
- Advanced Concepts Research that has been allocated up to 10% of research funding.
- Research Related to Technology Transfer as described in Appendix 1

Research Approval Process for Projects Initiated by RTARs

(Note: Currently, for projects up to \$100k only approval by RAC is needed. For projects between \$100k and \$200k required approval by both RAC and Technology Council. Projects above \$200k require approval by RAC, Technology Council, and Board of Directors. The flowchart below will be revised to reflect the above change in the approval level required.)



2. GUIDELINES FOR THE DEVELOPMENT OF DESIGN GUIDES AND OTHER SPECIAL PUBLICATIONS AS RESEARCH PROJECTS

Background

ASHRAE research funding is sometimes used to fund “Design Guides.” The need for this funding has increased in recent years because special publications funding – the traditional source of funding for practitioner publications – is now only used when outside funding is available.

Policy

The Research Administration Committee (RAC) feels it is appropriate for approximately 10% of the research budget to be used for developing “design” or “application” guides. The 10% number is not meant to be a strict allocation; in some years research funding for design guide development may be significantly greater or less than 10%.

In submitting the RTAR requesting a design guide, the TC must make the case that this is appropriate for ASHRAE research funding. Allocating research dollars to this purpose is appropriate as long as some (or all) of the following criteria are met:

- The design guide summarizes, combines, or integrates research results from “new” (less than 10 years old) ASHRAE research project(s) or other new sources
- The results have not been summarized anywhere else
- There is a clear need to “boil down” or “present” the research findings in a more understandable form in order for design engineers and other practitioners to adopt or use the findings or approaches.
- The urgency to produce or update the design guide, respecting the ASHRAE strategic plan, should be justified.
- If the proposed project is a design guide revision:
 - Substantially new research, information, technologies, products, or approaches are lacking in the original guide
 - The original design guide is about 15 or more years old.

Design Guide Projects NOT appropriate for funding would include:

- Editorial modifications to update references to outdated standards
- Editorial modifications to adopt more contemporary language: (geothermal vs. ground source heat pumps; cogeneration vs. CHP, green or LEED buildings, etc)

Some past, ongoing and proposed Design Guides (from MORTS report):

- Underfloor Air Distribution Design Guide
- Designer’s Guide for Ceiling-Based Air Diffusion
- Laboratory Design Guide
- Design Guide for Tall Commercial Buildings
- 1267-RP, Development Of An ASHRAE Design Manual For District Heating And Cooling Systems TC 6.02
- 1180-RP, Design Guide for Duct Systems, TC 5.2
- TRP1369, Design Guidelines To Prevent Snow Causing Shutdown Of HVAC Systems TC 5.2

3. RESEARCH IMPLEMENTATION PLAN & RESEARCH TOPIC ACCEPTANCE REQUESTS (RTARs)

3.1 Relationship between TC/TG/SSPC and Society Research Plans

Each TC (TG, MTG w/research authority, SSPC, and other committees authorized to sponsor research projects) should develop and maintain a long-range research plan, which is a prioritized list of prospective research topics. These “Research Plans” should be continually updated and documented in the TC’s minutes for the benefit of incoming Chairs and other interested parties.

Research Topic Acceptance Requests (RTARs) are used by the TC to advance research topics from the TC’s long-range research plans to the ASHRAE Research Implementation Plan. Among other things, the RTAR should demonstrate the research topic supports the ASHRAE Research Strategic Plan, or if this is not the case, provide a strong justification for the need for the proposed research.

Work Statements (WSs) are the means by which TCs transform approved topics on the ASHRAE Research Implementation Plan into research projects, for which the Society solicits bids. Projects with WSs approved for funding by the Society but not yet awarded to the contractor are referred to as Tentative Research Projects (TRPs). Projects awarded to the contractor but not yet completed are classified as Research Projects (RPs).

Within ASHRAE the term “Sponsoring TC” is used to designate the committee which is putting forward first the RTAR, then the WS, and is responsible for selecting the contractor (with assistance of a Proposal Evaluation Subcommittee) and oversight of the project (with assistance of a Project Monitoring Subcommittee). Other committees may assist the Sponsoring TC in this effort; they are referred to as Co-Sponsoring TC(s).

The products of ASHRAE research include improved standards, handbooks, guidelines, codes; special publications, software, web-based tools; and papers and journal articles that advance HVAC&R science and technology. ASHRAE research is the technical underpinning of the Society. It all starts with ideas for research to satisfy a Society need, and these ideas generally originate in the TCs. The bottom-up process just described, and the relationships between TC and Society research plans are summarized in the table below.

ASHRAE Research is the Technical Underpinning of the Society

7. Products of ASHRAE research (improved standards, handbooks, guidelines, codes; special publications, software, web-based tools; papers and journal articles that advance HVAC&R science and technology)
6. Research Projects (RPs), defined as projects awarded to the contractor but not yet completed
5. Tentative Research Projects (TRPs), defined as projects with WSs approved for funding by the Society but not yet awarded to the contractor
4. Work Statements (WSs), the means by which TCs transform topics into research projects, for which the Society solicits bids
3. Research Topic Acceptance Requests (RTARs), used by TC to demonstrate topic support to ASHRAE’s Research Strategic Plan, or the importance of a topic that does not directly support the Research Strategic Plan. An approved RTAR is a prerequisite to advancing topics from TC long-range research plans to the ASHRAE Research Implementation Plan and is also a means to inform other interested TCs and solicit their support and ideas for the topic.
2. TC long-range research plan (list of research topics)
1. Idea for research to satisfy a Society need.



3.2 RTAR Submission and Approval Process

- a) Pick a topic that ranks highly on the TC's long-range research plan (if topics have little support at the TC level they are unlikely to be approved by the Society) and can be described in a manner that demonstrates clear support of the ASHRAE Research Strategic Plan (*Navigation for a Sustainable Future*). The topic need not contribute directly to the goals identified in the Research Strategic Plan; however, those that do will likely be given a higher priority for funding when research funds are limited.
- b) Do your homework:
- Review the key literature and demonstrate you have done so by citing the key references.
 - Demonstrate a firm grasp of relevant prior work.
 - Clearly define the state-of-the-art and information gaps.
 - Define a valuable and doable objective.
 - Identify the specific goals served within the ASHRAE Research Strategic Plan, to what degree and why. If none of the goals in the Research Strategic Plan are supported by the topic, the proposed research will likely receive greater scrutiny by RAC.
 - Clearly define the advancement to the state-of-the-art and provide quantitative estimates of the improvement expected wherever possible.
 - Clearly define the justification and value to ASHRAE, being as quantitative and specific as possible.
 - Obtain TC vote and address all negative and abstention votes by providing the reasons and a solid response.
 - Provide realistic estimated project costs and duration.
 - Coordinate with other relevant TC and seek a letter of support from the interested TC Chairs.
 - Actively solicit interest among possible co-funding organizations and seek a letter of support from an authorized representative. ASHRAE's Manager of Research and Technical Services (MORTS) can assist with this.
 - Provide **ALL** required information.
- c) Work with your Research Liaison:
- Have your RAC Liaison review the RTAR before the TC vote. Liaisons can identify reasons the RTAR might be returned, so reduce cycle time to approval by obtaining this feedback before voting the RTAR forward and submitting it to MORTS/RAC.
 - Make sure your Research Liaison is informed. A Liaison knowledgeable about your project is better able to be a proponent for the approval of your project at RAC.
 - If your project is sufficiently unusual, controversial, or urgent notify, your Liaison that you intend to send a TC emissary to the RAC meeting to speak directly to RAC on the project's behalf, and to answer questions.
- d) Submit RTARs by May 15, August 15 or December 15 to be considered by RAC at the Annual Meeting, Fall Technology Weekend, or Winter Meeting, respectively.
- e) There is no limit to the number of RTARs that a TC can submit. However, approved topics are taken off of the Society's Research Implementation Plan two years after approval unless a WS based on the RTAR has been submitted. Therefore it is recommended that RTAR submittals be limited to those where timely WS submittal is likely.
- f) Since the purpose of submitting RTARs is inclusion of the topic in the Society's Research Implementation Plan, it is pointless to submit RTARs for topics already on the Society's Research Implementation Plan that have been submitted by another TC. If you have suggestions about such a topic on the Plan, you may contact the cognizant TC Chair to discuss preparation of a joint Work Statement.
- g) Topics that expire from the Society's Research Implementation Plan may be resubmitted for approval to be reinstated.

- h) MORTS assigns I.D. numbers to submitted RTARs. Individual RAC members grade them “Priority”, “Accept”, “Return” or “Reject”. MORTS distributes the consolidated grades and comments to all the RAC members, and RAC convenes (Annual Meeting, Fall Technology Weekend, or Winter Meeting) and discusses the RTARs and votes to “Accept”, “Conditionally Accept”, “Return” or “Reject” each RTAR.
- “Accept” means RAC recommends to Technology Council that the RTAR be accepted.
 - “Conditionally accept” means that only minor refinements to the RTAR are required, and when these have been made to the satisfaction of the Research Liaison, then RAC recommends to Technology Council that the RTAR be accepted without further consideration by the full RAC.
 - “Return” means that RAC generally supports the topic but the current RTAR is inadequate and the required revisions are substantial enough that the full RAC must participate in reconsideration.
 - “Reject” means that RAC does not believe the topic is appropriate for ASHRAE research.
- i) In the case of “conditional acceptance” by RAC, the Research Liaison has the discretion to determine whether a full TC re-vote is required on the refined RTAR that is “accepted” by RAC.
- j) If RAC recommends “Accept” and Technology Council agrees, then the topic is added to the Society’s Research Implementation Plan. RAC members may still have comments or suggestions about Accepted RTARs. These comments are conveyed to the TC in a letter from MORTS informing the Committee the RTAR has been accepted. It is RAC’s intent to approve RTARs whenever possible. This means that an accepted RTAR is likely to have comments, and the TC should address these when the WS is prepared.
- k) RTARs may be returned to the TC, either because RAC or Technology Council voted to do so. Since these votes occur within a matter of days, in either event the TC will receive a letter from MORTS within a month of the vote, providing the comments that were the basis for returning the RTAR.
- l) TC re-submitting a returned RTAR must conduct a full TC re-vote and reflect the results on the RTAR. In addition, the RTAR must be returned with a cover letter that provides a point-by-point response to each RAC (or Technology Council) comment explaining how the RTAR was revised in light of the comment or justifying no change.

3.3 Research Topic Acceptance Requests (RTARs)

The required format and content of RTARs is summarized below:

Unique Tracking Number Assigned by MORTS _____

RESEARCH TOPIC ACCEPTANCE REQUEST (RTAR) FORM

(Generally 2 to 6 pages, with 10 pt Times New Roman font)

Sponsoring TC/TG/MTG/SSPC/: _____

Title:

(Concise as possible)

Applicability to ASHRAE Research Strategic Plan:

(For those RTAR submitted prior to July 2010, indicate which specific goal(s) on the ASHRAE Research Strategic Plan 2005-2010 (Navigation for a Sustainable Future) this topic will address, to what degree, and why.

For those RTAR submitted after July 2010, if the RTAR will contribute to any of the goals of the updated ASHRAE Research Strategic Plan 2010-2015 (Navigation for a Sustainable Future), then indicate which goals the topic addresses and how. Projects are not required to contribute directly to the strategic goals, but those that do will likely be given a higher priority for funding when research funds are limited.)

Research Classification:

(Basic/Applied Research; Advanced Concepts; or Technology Transfer)

TC/TG/MTG/SSPC Vote:

(For –Against-Abstentions-Absent-Total)

Reasons for Negative Votes and Abstentions:

(Negative Votes)

(Abstentions)

Estimated Cost:

(Estimate total dollars)

Estimated Duration:

(Months to complete)

RTAR Lead Author

(Name, e-mail address)

Expected Work Statement Lead Author

(Name, e-mail address)

Co-sponsoring TC/TG/MTG/SSPCs and votes:

(List only those committees that have reviewed this RTAR and voted to support it)

Possible Co-funding Organizations:

(List only those organizations (name, contact information) that have reviewed this RTAR and expressed support)

Application of Results:

(Handbook chapters, special publications etc. to be affected by results of this project)

State-of-the-Art (Background):

(Briefly describe the amount and quality of past research, and quantify existing gaps)

Advancement to the State-of-the-Art:

(Provide an estimate – as quantitative as possible – of the improvement expected from this research [i.e. x% energy reduction in product y or building type z, x% increase in heat transfer coefficient between y and z, or x% reduction in design time to do y, etc.]

Justification and Value to ASHRAE:

(Identify by number, profession, or industry the ASHRAE members affected. State the likelihood and how the improvement would be adopted by industry. Estimate the timeframe over which x% of society in total would be affected. Indicate the likelihood of ASHRAE's obtaining any intellectual property rights from this project.)

Objectives:

(List the project goals and succinctly state how this project will accomplish its intended advancement to the state-of-the-art [i.e. a computer simulation will be used to do x, a computer simulation will be developed for x and verified using laboratory data from tests y and z, field test data will be obtained from x and used to do y])

Key References:

(List references cited in the state-of-the art section.)

3.4 Example RTAR Review Ballot Form used by RAC

RAC members use the form below to record their review comments and initial disposition decision on the RTAR prior to the RAC meeting to discuss the RTAR. The completed form is submitted to ASHRAE staff, who in turn incorporates this information into the RTAR Review Summary form.

Example RTAR Review Ballot Used by Individual RAC Members Prior to Meeting

Project ID	0007	
Project Title	Design on A Dime	
Sponsoring TC	TC 12.5	
Cost / Duration	\$250,000/24M	
Submission History	1 st Submission	
Classifications: Research or Technology Transfer	Basic/Applied Research	
Tech Weekend 2010 Meeting Review	Reviewer's Name: AB	
Check List Criteria	Satisfied?	Comments & Suggestions
Is there a well-established need? The RTAR should include some level of literature review that documents the importance/magnitude of a problem. If not, then the RTAR should be returned for revision.	N	This project would greatly benefit the handbook chapter noted but there is no mention of the related standard XXX in development.
Is this appropriate for ASHRAE funding? If not, then the RTAR should be rejected. Examples of projects that are not appropriate for ASHRAE funding would include: 1) research that is more appropriately performed by industry, 2) topics outside the scope of ASHRAE activities.	Y	
Is there an adequate description of the approach in order for RAC to be able to evaluate the appropriateness of the budget? If not, then the RTAR should be returned for revision.	Y	
Is the budget reasonable for the project scope? If not, then RTAR could be returned for revision or conditionally accepted with a note that the budget should be revised for the WS.	Y	
Have the proper administrative procedures been followed? This includes recording of the TC vote, coordination with other TCs, proper citing of the Research Strategic Plan, etc. If not, then the RTAR could be returned for revision or possibly conditionally accepted based on adequately resolving these issues.	Y	
Decision Options	Initial Decision?	Additional Comments or Approval Conditions
ACCEPT		
COND. ACCEPT	X	
RETURN		
REJECT		

ACCEPT - Topic is ready for development into a work statement (WS).

CONDITIONAL ACCEPT Vote - Minor Revision Required - RL can approve RTAR for development into WS without going back to RAC once TC satisfies RAC's approval condition(s)
RETURN- Topic is probably acceptable for ASHRAE research, but RTAR is not quite ready.
REJECT Vote - Topic is not acceptable for the ASHRAE Research Program.

3.5 Example RTAR Review Summary from RAC

When RAC meets, they use the RTAR Review Summary form below to help guide their discussion of the RTAR. In many cases, a RAC member's initial disposition decision on a particular RTAR may change after reading other member's comments on the summary form and after participating to the meeting discussion of the RTAR.

A final version of the review summary form, which reflects the discussion and final decision that was made by RAC on the RTAR during the meeting, is developed and used as the basis for the return letter to the TC/TG/MTG w/ research authority/SSPC or other committees authorized to sponsor research projects.

Example RTAR Review Summary Used by RAC during Meeting and for Return Letter to TC

Project ID	0007	
Project Title	Design on A Dime	
Sponsoring TC	TC 12.5	
Cost / Duration	\$250,000/24M	
Submission History	1 st submission as RTAR	
Classifications: Research or Technology Transfer	Basic/Applied Research	
Winter 2010 Meeting Review	RTAR SUMMARY SCORES & COMMENTS	
Check List Criteria	VOTED NO	Comments & Suggestions
Is there a well-established need? The RTAR should include some level of literature review that documents the importance/magnitude of a problem. If not, then the RTAR should be returned for revision.	AB, CD, EF	AB - This project would greatly benefit the handbook chapter noted but there is no mention of the related standard XXX in development. CD – Needs more references such as these that were found online...
Is this appropriate for ASHRAE funding? If not, then the RTAR should be rejected. Examples of projects that are not appropriate for ASHRAE funding would include: 1) research that is more appropriately performed by industry, 2) topics outside the scope of ASHRAE activities.		
Is there an adequate description of the approach in order for RAC to be able to evaluate the appropriateness of the budget? If not, then the RTAR should be returned for revision.		
Is the budget reasonable for the project scope? If not, then RTAR could be returned for revision or conditionally accepted with a note that the budget should be revised for the WS.		
Have the proper administrative procedures been followed? This includes recording of the TC vote, coordination with other TCs, proper citing of the Research Strategic Plan, etc. If not, then the RTAR could be returned for revision or possibly conditionally accepted based on adequately resolving these issues.		
Decision Options	Initial Decision?	Additional Comments or Approval Conditions
ACCEPT	DD, GB, RS, KL, MJ, CZ,	
COND. ACCEPT	CK	Must reference work from RP-1010 and RP- 656
RETURN	AB, CD, EF,	
REJECT		

ACCEPT - Topic is ready for development into a work statement (WS).

CONDITIONAL ACCEPT Vote - Minor Revision Required - RL can approve RTAR for development into WS without going back to RAC once TC satisfies RAC's approval condition(s)
RETURN- Topic is probably acceptable for ASHRAE research, but RTAR is not quite ready.
REJECT Vote - Topic is not acceptable for the ASHRAE Research Program

4. WORK STATEMENTS

4.1 Work Statement Development and Approval Process

The Work Statement (WS) is normally the responsibility of the Research Subcommittee of a TC (or TG, MTG w/research authority, SSPC, and other committees authorized to sponsor research projects), which should prepare Work Statements for each approved RTAR. The RTARs are developed into Work Statements and are sent to the ASHRAE MORTS. These work statements will be reviewed by RAC to determine if they define a clear and obtainable research result, propose a viable technical approach, and are likely to interest several competitive bidders. A biddable Work Statement clearly explains the objectives, scope, and deliverables. A WS derived from a RAC-approved RTAR has already been determined to be an appropriate research project for ASHRAE. This means that it will advance the state of the art, provide value to ASHRAE membership, and either support the ASHRAE Research Strategic Plan directly, or address a research need not identified in the Research Strategic Plan but deemed timely and important. The ASHRAE Research Implementation Plan (RIP) lists all approved RTARs and all pending and approved for bid work statements submitted to RAC. The RIP is posted on the ASHRAE Web-site for reference.

A Work Statement should be prepared immediately after the RTAR is approved by RAC. A Work Statement may be prepared and submitted without a preliminary RTAR approval if, for example, there is an extremely time-critical need for results. There should be a strong justification for this. However, the TC risks having its basic research goal not approved or needing to rewrite the WS extensively. The RTAR approval is designed:

- To ensure that the topic is suitable for ASHRAE research and the TC addresses the goals of the ASHRAE Research Strategic Plan, or provides a strong justification for topics that do not directly support the goals of the Research Strategic Plan.
- To allow RAC and Tech Council to review the approach and suggest additional references, identify other TCs that should be consulted, and/or suggest enhancements or refinements to the suggested technical approach.

Submission of the RTAR is designed to speed the overall process – reducing the time to go from research idea to release of the Request for Bids.

When preparing a WS, the TC may ask specialists in the area of the Work Statement to assist, even potential bidders. Care must be taken to avoid actual or perceived conflicts of interest. To do this, the principal authors of the Work Statement will be identified on the Work Statement Cover Sheet. Subsequently, bidders who assisted in Work Statement preparation will identify themselves as such in their proposal, and evaluators will satisfy themselves that these preparers did not gain an unfair advantage. The TC should also consider other TCs, which have direct or related interest in the subject project and invite them to participate in the Work Statement preparation, to vote to endorse the WS, and to have representatives on the Proposal Evaluation Subcommittee (PES) and the Project Monitoring Subcommittee (PMS).

In preparing a Work Statement for a project dealing with the monitoring of buildings in the field, the "Recommendations for the Design of ASHRAE Sponsored Field Monitoring Projects" contained in Appendix 2 should be considered. In preparing a Work Statement associated with Computational Fluid Dynamics, the "Guidelines for the Selection and Use of Computational Fluid Dynamics," in Appendix 3 should be reviewed and considered.

The TC Research Subcommittee members shall forward a draft of the Work Statement to their Research Liaison who will provide suggestions for improvement or compliance with ASHRAE practices. They then present the Work Statement to the full TC at one of the semi-annual meetings, or by letter or e-mail ballot, for a vote of approval. The TC members should have received the Work Statement sufficiently prior to the meeting so that each member can review it in depth and comment and vote intelligently. Any negative votes or abstentions from the TC members should be explained. Any dissenting member or corresponding member should be invited to submit comments that will be conveyed to RAC with the WS and cover letter.

After approval by the TC, a copy of the Work Statement and a completed Work Statement Cover Sheet shall be sent to the ASHRAE Manager of Research and Technical Services (MORTS) and to the TC's Research Liaison by May 15, August 15, or December 15. The submittals should be in electronic format, preferably in Microsoft Word and Excel. The MORTS distributes the Work Statements to the members of RAC.

RAC's evaluation of a Work Statement may result in one of four possible outcomes:

- **RAC approves the WS.**
- **RAC approves the WS conditionally with comments.**
The Research Liaison then has the authority to approve the WS after RAC's comments have been implemented. The Research Liaison also has the discretion to decide whether the modified WS needs a full TC re-vote, based on the extent of modifications.
- **RAC returns the WS with comments.**
TC needs to implement the RAC comments and approve the modified WS by a vote. A cover letter explaining how the RAC comments were implemented should accompany the WS sent back to MORTS and RAC. If the TC disagrees with the RAC on any of the comments, the cover letter should also explain the reasons for not implementing the RAC comment.
- **RAC rejects the WS with comments.**

RAC-approved Work Statements are designated as Tentative Research Projects (TRPs). When deciding which TRPs will be sent out for bid, RAC considers the pool of all TRPs (currently approved Work Statements and previously approved Work Statements that were not released for bid due to insufficient funding), and RAC-approved Unsolicited Research Proposals. Table-A is the RAC prioritization criteria for Work Statements when funding is limited and not all approved WS can be put out for bid.

Table A. Factors for Prioritization of Work Statements for Funding

<p>Status of TRP</p> <ul style="list-style-type: none"> • Is this a project rebid? <p>Newly approved TRPs?</p> <ul style="list-style-type: none"> • Age of Project – Based on date of work statement approval <p>Co-Sponsorship</p> <ul style="list-style-type: none"> • Multiple TC sponsors/Co-sponsors • Single TC Sponsor <p>Co-funding – is there a firm co-funding commitment (e.g., from AHRI)?</p> <p>Cost of Project</p> <ul style="list-style-type: none"> • Should we fund more and smaller projects or fewer and larger ones? • Does it require RAC Level Approval, Tech Council approval, Board approval? <p>Overall value of the project and the research, as well as contribution to ASHRAE's Research Plan(s), to ASHRAE and Society</p> <p>Note: the above factors are not listed in any particular order or level of importance</p>

4.2 Work Statement Preparation

The Work Statement submitted by a TC (TG, MTG w/research authority, SSPC or other committees authorized to sponsor a research project) expands the RTAR and is the only technical document that potential bidders will receive. The WS must contain all of the following fourteen elements, eight of which are either imported directly or expanded from RTAR elements.

1. Title: (from RTAR)
2. Executive Summary:
3. Applicability to ASHRAE Research Strategic Plan: (from RTAR)
4. Application of Results: (from RTAR)
5. State-of-the-Art (Background): (from RTAR)
6. Advancement to the State-of-the-Art: (from RTAR)
7. Justification and Value to ASHRAE: (from RTAR)
8. Objectives: (from RTAR)
9. Scope/Technical Approach:
10. Deliverables/Where Results Will Be Published:
11. Level of Effort:
12. Other Information to Bidders (Optional):
13. Proposal Evaluation Criteria & Weighting Factors:
14. References: (from RTAR)

The TC needs to put enough information into the Work Statement to explain to people not familiar with the TC's deliberations what the problem is, why this research is needed, what types of results are expected and how they will be used, and indicate what methods and scope of research the TC expects from the contractor.

The Work Statement should be accompanied by a Cover Sheet as shown in Section 3.3. Section 3.4 contains a Work Statement outline, which explains each element in detail. Appendix 4 is an example of a Cover Sheet and well-written Work Statement.

4.3 Work Statement Cover Sheet

The purpose of the Work Statement Cover Sheet is to ensure that all WS items are complete. Also, the Cover Sheet:

- records the votes of the sponsoring and all co-sponsoring TCs on the Work Statement
- lists the members of the subcommittees which will evaluate the proposals and monitor the project,
- recommends suggested bidders,
- denotes which Handbook chapters or other ASHRAE publications will be affected by the results of the research,
- lists the Work Statement's authors,
- lists at least three prospective bidders in addition to any Work Statement authors who may bid.

It is preferable, but not required, that the authors of the Work Statement also serve on the Proposal Evaluation Subcommittee (PES) and Project Monitoring Subcommittee (PMS). Any persons who bid on the WS, or who are members of organizations who bid on the WS, cannot serve on the PES or PMS. While desirable, it is not necessary that the PES and PMS be comprised of the same people. The PES/PMS should be composed of 3 to 5 sponsoring or co-sponsoring TC members with particular knowledge and experience in the subject of the project, but who do not plan to submit a proposal on the work. In special cases, persons other than TC members may be appointed as PES/PMS members if their particular expertise is not available within the TC or if a co-funding agency is also supporting the project. They are named by the TC Chairman and approved by the Research Liaison or MORTS.

The Research Liaison and MORTS are ex-officio non-voting members of the PES and PMS.

If interest by other organizations in co-sponsoring the project is known, suspected, or even considered a possibility, the name, address, and phone number of the proper contact should be furnished on the Work Statement Cover Sheet as a “potential” sponsor. Once a written letter of support is obtained by a TC from a potential co-sponsor, the ASHRAE MORTS will finalize a co-sponsorship agreement with that organization or individual for the project.

Normally about 60 days is allowed for proposal preparation by potential bidders. Certain projects by their nature may require longer proposal preparation time. This may be due to the need to establish relationships with co-investigators, subcontractors, material or equipment suppliers or owners of test sites. If this is anticipated, the TC should request an extended bidding period. This will delay the start of the project but will result in better proposals and better results. Where needed, TC should request this on the Work Statement Cover Sheet.

To minimize the occurrence of single bidders, the TC shall provide on the Cover Sheet the names of at least three *qualified* potential bidders who were *not involved* in development of the WS. If a WS is not accompanied by the names of at least three such individuals, it shall not be approved by RAC but sent back to the TC for this information. In addition to the usual process of posting the WS to solicit bids, these recommended bidders shall be individually notified by the MORTS when the project is put out for bid.

WORK STATEMENT COVER SHEET

Date: _____

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

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

Title: _____

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

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

Sponsoring TC/TG/SSPC: _____

Date of Vote: _____

For		
Against	*	
Abstaining	*	
Absent or not returning Ballot	*	
Total Voting Members		

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

Has RTAR been submitted ?
 Strategic Plan _____
 Theme/Goals: _____

Work Statement Authors: **

Proposal Evaluation Subcommittee:
 Chair: _____
 Members: _____

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

Recommended Bidders (name, address, e-mail, tel. number): **

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)
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

* Reasons for negative vote(s) and abstentions

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

4.4 Work Statement Outline

WORK STATEMENT# (Same as RTAR#)
SPONSORING TC/TG/MTG/SSPC:# & NAME
CO-SPONSORING TC/TG/MTG/SSPCs (List only TC/TG/MTG/SSPCs that have voted formal support)

Title: (Same as RTAR)

Executive Summary:

(100 word statement that could be used at the BOD level to succinctly summarize the current state-of-the-art, the advancement this project is expected to accomplish, and its value to ASHRAE and society in general.)

Applicability to the ASHRAE Research Strategic Plan:

(Import RTAR list of specific goals of the ASHRAE Research Strategic Plan this project will support by name and number. State how the proposed project will help achieve the goals. If the RTAR was submitted before July, 2010, the goals from the ASHRAE Research Strategic Plan 2005-2010 (Navigation for a Sustainable Future) may be addressed if the TC desires. For RTAR (or WS) submitted after July 2010, please indicate whether the proposed project supports any of the strategic goals of the latest ASHRAE Research Strategic Plan 2010-2015. Projects are not required to contribute directly to the strategic goals, but those that do will likely be given a higher priority for funding when research funds are limited.)

Application of Results:

(Import RTAR list of handbook chapters/special publications etc. to be affected by results of this project. Explain how the results of the proposed project will be disseminated by the TC in practical terms to general ASHRAE membership and society in general. What are the practical benefits expected from this research? Is this project one piece of a larger plan of action developed by the TC?)

State-of-the-Art (Background):

(Import RTAR description of the amount and quality of past research, and quantify existing gaps.)

Advancement to the State-of-the-Art:

(Import RTAR description or quantitative estimate of the improvement expected from this research [i.e. x% energy reduction in product y or building type z, x% increase in heat transfer coefficient between y and z, or x% reduction in design time to do y, etc.], and explain why this information is needed by the public or by industry.)

Justification and Value to ASHRAE:

(Import RTAR identification by number, profession, or industry the ASHRAE members who will benefit. State the likelihood and how the improvement would be adopted by industry.)

Objectives:

(Import RTAR explanation of project's goals and how this project will accomplish its intended advancement to the state-of-the-art [i.e. a computer simulation will be used to do x, a computer simulation will be developed for x and verified using laboratory data from tests y and z, field test data will be obtained from x and used to do y].)

Scope/Technical Approach:

(Provide a complete description of technical approach and task statement. Describe the parameters of the research project, including such items as: subject matter to be explored; materials, equipment, literature or other variables to be researched; materials, equipment, etc to be excluded from the project; outline the research methods to be used; description of the standards to be followed; discussion of how the data is to be reduced, analyzed and presented; description of the format for the reported results; if appropriate, describe project phases.

It is important for the scope of a research project to be broken down into tasks or phases, where a task will yield

results of interest to the TC and the PMS, or where the results of a task will significantly define how subsequent tasks will be carried out. Make sure that the project objectives are reflected in the tasks. The Work Statement should specify deliverables corresponding to these tasks in the “Deliverables” section to facilitate project monitoring by the PMS.)

Deliverables/Where Results Will Be Published:

Insert generic ASHRAE requirements (listed below) as well as and any project-specific requirements defined in the “Scope” section. Each major task or phase of the research method outlined in the Scope should be linked to a deliverable report, memorandum, or summary.

Items *a* through *e* below are generic ASHRAE requirements a contractor is required to provide on every ASHRAE research project. These cover:

- Quarterly progress and financial reports to MORTS (to be reviewed by the Project Monitoring Subcommittee (PMS)).
- A final report.
- A research or technical paper, submitted for peer review and publication in the ASHRAE *Transactions* or *HVAC&R Research*.
- Any data obtained from the research.
- A project summary.

Progress, Financial and Final Reports, Research or Technical Paper(s), and Data shall constitute required deliverables (“Deliverables”) under this Agreement and shall be provided as follows:

a. Progress and Financial Reports

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

Furthermore, 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.

b. Final Report

A written report, design guide, or manual, (collectively, “Final Report”), in a form approved by the Society, shall be prepared by the Institution and submitted to the Society’s Manager of Research and Technical Services by the end of the Agreement term, containing complete details of all research carried out under this Agreement. Unless otherwise specified, six copies of the final report shall be furnished for review by the Society’s Project Monitoring Subcommittee (PMS).

Following approval by the PMS and the TC/TG, in their sole discretion, final copies of the Final Report will be furnished by the Institution as follows:

- An executive summary in a form 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 format and one in Microsoft Word.

c. HVAC&R Research or ASHRAE Transactions Technical Paper

One or more papers shall be submitted first to the ASHRAE Manager of Research and Technical Services (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, e.g., (XXXX-RP).

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.

d. 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.

e. 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*

The Society may request the Institution submit a technical article suitable for publication in the Society’s *ASHRAE JOURNAL*. This is considered a voluntary submission and not a Deliverable.

All Deliverables under this Agreement and voluntary technical articles shall be prepared using dual units; e.g., rational inch-pound with equivalent SI units shown parenthetically. SI usage shall be in accordance with IEEE/ASTM Standard SI-10.

The above deliverables are necessary, *but not sufficient*, to monitor a research project. The PMS and the sponsoring TC have the responsibility to review the contractor’s on-going activities and intermediate results, to ensure that the methods used and results obtained will be valid and well-enough substantiated to be labeled as “ASHRAE-approved findings.” Proper oversight cannot wait until the final report, when most of the budget has already been expended.

Therefore, each major task or phase of the research method outlined in the Scope should also be linked to a deliverable report, memorandum, or summary. These in-progress deliverables should not add to the cost of the project, as they will most likely become chapters of the final report. However, they should help the TC avoid unpleasant surprises due to the research not being conducted according to the TC’s expectations. Examples of

deliverables that could be required during the project include:

- If one task is a literature review, then the deliverable could be an annotated list of references and conclusions/summary of the current state of the art.
- If the contractor must propose specific sites (e.g., buildings), experiment topologies (e.g., duct configurations), materials (e.g., refrigerants, appliances, insulation or building materials), experiment protocols, and/or instrumentation, then short memos describing those proposed methods, materials, etc. should be deliverables to be reviewed and approved by the PMS before moving on to the next research task.
- If analysis of preliminary data or results will decide how to proceed (e.g., CFD models of 12 duct configurations will be used to select 2 duct configurations to be built and subjected to wind tunnel tests), then the contractor should write up the results of the initial analysis, recommend the areas for further more detailed investigation, and justify those recommendations.
- If data from the research are expected to modify or update a *Handbook* table, then the procedure for developing the updated table from the data should be specified and provided to the PMS as a deliverable. (The final report may also require the contractor to prepare a proposed updated table based on the observed data.)

In short, the technical approach for a research project should be broken down into tasks or phases, and where a task will yield results of interest to the TC and the PMS, or where the results of a task will significantly define how subsequent tasks will be carried out. The Work Statement should specify such deliverables for the PMS to review. This approach will make it easier for the PMS and MORTS to gauge progress and technical merit of on-going ASHRAE research projects, and will provide a framework for the cognizant TCs to provide technical oversight and assistance to identify and correct problems as they occur.)

Level of Effort:

(Include estimates of professional-months by category, calendar-months, and total dollars.

An example is:

The project anticipates 3 professional-months for the principal investigator and 8 professional-months for a research technician. The estimated cost is \$60,000 and the project is expected to take 12 months.)

Other Information for Bidders (Optional):

(This section should contain any other information that is not contained elsewhere. This could include information about relationships with the monitoring subcommittee, reports other than the normal quarterly progress reports, special personnel or facilities required by the proposer, special instructions regarding what the proposal should contain, or information as to how the proposals will be evaluated. It is not necessary to include references to quarterly progress reports, semi-annual reports in person to the TC final reports or papers.)

Proposal Evaluation Criteria:

(Include specific list of criteria and weighting factors that will be used to evaluate proposals.

This section should also include a list of the criteria the PES will use to evaluate proposals and select a contractor to recommend. This must include Weighting Factors for the Evaluation Form. It may be the basic list or a subset of the list in the Proposal Evaluation Form and can also include additional categories such as special experience, credentials, equipment or facilities the WS authors think are necessary.)

The commonly used evaluation criteria include:

The commonly used evaluation criteria (and sample weighting factors) are listed below. The WS may include some or all of these criteria, using whatever weighting factors the TC feels are appropriate. For example, a project involving simulation models may not depend upon “facilities,” while experience of the PI in simulation modeling may be crucial. For performance testing of appliances, however, the quality of the Contractor’s facilities may be very important.

- | | |
|--|-----|
| 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. | 25% |
| a) Organization of project | |
| b) Management plan | |
| 3. Contractor's capability in terms of facilities. | 15% |
| a) Managerial support | |
| b) Data collection | |
| c) Technical expertise | |
| 4. Qualifications of personnel for this project. | 20% |
| 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. Student involvement | 5% |
| a) Extent of student participation on contractor's team | |
| b) Likelihood that involvement in project will encourage entry into HVAC&R industry | |
| 6. Probability of contractor's research plan meeting the objectives of the Work Statement. | 15% |
| a) Detailed and logical work plan with major tasks and key milestones | |
| b) All technical and logistic factors considered | |
| c) Reasonableness of project schedule | |
| 7. Performance of contractor on prior ASHRAE or other projects. | 5% |
| (No penalty for new contractors.) | |
| 8. Other_____ | |

References:

(Import or expand the RTAR list of references to any articles, papers, books, etc., that were used in preparing the Work Statement and/or that would be of assistance to the bidders. All listed references should be readily available to contractors.)

Authors:

(List those individuals who were principal authors of the Work Statement.)

If any of the Work Statement authors plan to bid on the project, care must be taken to avoid actual or perceived conflict of interest. In particular, the requirements of the Work Statement should not be tailored to a unique Work Statement author's facility, equipment, or capability that is not reasonably available to other bidders. If WS authors bid on the project, they must identify themselves as such in their proposals, and the evaluators must satisfy themselves that these preparers did not gain an unfair advantage before their proposal may be considered. If it is determined that a submitted proposal does exhibit a conflict of interest, then that proposal should be identified, not evaluated, and written reasons given along with evaluations of the other proposals.

Attached are a sample Work Statement Cover Sheet and a sample Work Statement. They should be used as a guide in completing, reviewing and submitting Work Statements. [NOTE: The actual WS and the TC votes on which this is based have been edited to better illustrate some of the points made in this Research Manual.]

4.5 Tips for Writing an Effective Work Statement

A Work Statement is a document that is utilized to convince ASHRAE to fund research projects and inform the bidders what is expected to be in the final results. The Work Statement contains different items and is found in the Work Statement outline in Section 3.4 of this manual. Incomplete (unclear) entries in these items will lead to delays in approving the Work Statement.

Project Justification

Is the project included in the ASHRAE Research Implementation Plan (i.e., was an RTAR submitted and approved by RAC), or is there a strong rationale provided for submitting the Work Statement without a prior RTAR submittal?

The Executive Summary, Application of Results, State of the Art (background and advancement) sections shall be brief and right to the point about how the project will be a benefit to ASHRAE Society and its members.

Are project benefits evident? Alternatively, are adverse impacts of not pursuing the project apparent? Will the results still be useful when completed?

Do the project objectives fall within ASHRAE's Scope? Involvement of outside professions in performing all or part of the work does not necessarily negate pertinence.

Is the project consistent with the Society's Research Strategic Plan? List specific goals in the Plan that are addressed by the proposed research.

Is the project original (e.g., not an unnecessary duplication of other research completed or underway)? Repetition of prior research may be desirable if pertinent facets have changed, the results are not publicly available, or confirmation is justified. Projects resulting in products that compete with commercial offerings are generally not approved. If previous projects need updating, has the sponsoring TC (original project) been contacted?

Project Definition

If there is more than one objective to the project, is the sequence defined?

Have all avenues been examined to determine a more economical alternate to achieving the objective?

Is there a contingency plan, in case the objectives are not met?

Subsequent phases or follow-on projects are not precluded, but specific projects should provide at least interim results that are beneficial on their own (e.g., no half tunnels).

Would segmenting the project preclude useful interim results or degrade effective procurement of the research needed?

Is the work or likely results free of potential legal problems and of prejudicial implications to a single manufacturer or class of manufacturers?

Are the recommended bidders knowledgeable enough about subject matters of the project to insure success of the project?

Are proposal options recommended for inclusion clearly justified?

Cost

Is the proposed level of effort and funding commensurate with work required? Is the proposed level of effort and funding commensurate with the project's expected benefits?

Can the ASHRAE research budget afford the project for its duration? Consider whether the project can or should be funded protracted for budgetary reasons.

Is there a commitment for co-funding? Did ASHRAE receive a letter (on company letterhead) with the amount of co-funding?

Suitability

Is the background adequately presented?

Are the individual tasks understandable and achievable (e.g., not seeking impossible or improbable results)? Note that high risk (with commensurate high benefits if successful) research is allowable, but it should be so noted in the TC's cover letter conveying the WS to MORTS.

Are the tasks likely to satisfy the project objectives?

Does the work statement foster fair competition?

Is sufficient detail provided to enable competitive pricing?

Are ambiguous tasks (e.g., scope determinations by the Project Monitoring Subcommittee) that could alter contractor costs avoided? No implication is intended that the PMS cannot or should not review the work and approve scheduled decisions or selections, provided that such alternatives entail similar effort and costs.

Is the justification adequate for required use of specified proprietary products or methods?

Are all of the tasks appropriate for ASHRAE research?

Are the products to be delivered clearly identified?

Are appropriate references adequately cited and available? Have copies of unpublished references been provided for distribution with the request for proposals?

Are at least three prospective bidders that were not involved in preparation of work statement identified?

Is a realistic project duration indicated?

Has the Work Statement been reviewed by other related TCs for accuracy and determination whether other previous projects were completed requesting similar results?

Has a Project Evaluation Subcommittee (PES) been proposed for approval? If other TCs co-authored the Work Statement, are they included in this Subcommittee?

Has a Project Monitoring Subcommittee been proposed for approval? If other TCs co-authored the Work Statement, are they included in this Subcommittee?

Has the work statement been coordinated with other organizations' committees? Have they been asked for co-funding?

Other Considerations

Are there other reasons to support the project (e.g., Presidential goals, emerging societal issues, requests from

ASHRAE affiliates or other organizations)?

Is the project likely to contribute to a Handbook update, a proposed ASHRAE or industry standard, or a ASHRAE Journal article of broad interest?

For projects involving Special Publications, is/are the sponsoring committee(s) qualified and prepared to provide adequate review of the work to imply endorsement of the resulting document by ASHRAE as an accepted reference?

Is the project likely to provide an educational opportunity for HVAC&R students?

Is the project likely to enhance the Society's image (e.g., will ASHRAE gain recognition for pursuing it or, alternately, incur censure if ASHRAE ignores it?)

Additional Tips

RAC provides training at the Society's meetings for individuals involved in initiating research projects. RAC welcomes suggestions on topics to be covered.

Each TC has a Research Liaison that is a member of RAC. The Work Statement should be reviewed by the liaison prior to submitting the Work Statement to headquarters. This person will provide assistance in making sure that the Work Statement contains the required information for review.

RAC encourages TCs to prepare and submit Work Statements responsive to "Needed Research" listed in the ASHRAE Research Strategic Plan. Work Statements for projects not listed in the Plan may be prepared and submitted, but a strong justification for approval should be included. RAC is obligated to meet the funding guidelines set by the Board and reflected in the annual Research Budget. If considerably more Work Statements have been approved for bid than the research funding available, bidding on those Work Statements that are less responsive to the ASHRAE Research Strategic Plan may be delayed.

Below is a list of common reasons for returning a Work Statement.

- Need for Coordination
- Cost Problems
- Weak Justification
- Scope Lacks Clarity
- Unable to Bid
- Missing Information
- Does not Conform to ASHRAE Policy

The need for coordination among pertinent TCs, TGs, TRGs, MTGs, SSPCs, and standing committees. Authors must realize that many projects have a rather broad technical base. For instance, a project by a TC concerned with equipment design may cover the development of computer algorithms for operating energy calculations. The project could benefit from coordination with a TC that is expert on energy calculations and may have already developed standardized algorithm formats on other projects. If a TC proposes work in a technical area that falls partly or totally under the scope of another TC, both TCs should review the work statement before it is submitted to RAC. This would help assure RAC that the work had not already been done, the plan is technically correct, and there is a need for research. It would also be an advantage to have a technical expert from the other TC on the project monitoring subcommittee.

The cost caused return of work statements. ASHRAE expects to get a good value from the approved projects. The sponsoring committee should conduct a critical review of the estimated cost before the work statement is submitted. Sometimes the scope is too broad and can be reduced to those items that are of immediate need to the TC.

Also, unnecessary travel or equipment expenses should be omitted. ASHRAE expects contractors to provide test

facilities and equipment in most cases. If the level can't be reduced, it would be advantageous to either suggest additional sources of funding or to segment the project into two or more individually funded phases. RAC Research Liaisons can be a good source of advice on this subject.

Weak justification and value to ASHRAE, industry and society. It is extremely important to state your case for the proposed work clearly and completely. RAC members who review work statements normally are not as knowledgeable in the proposed area of technology as are the authors. RAC members depend on information provided in the background and justification sections of the work statement to understand the need for the research and the benefits to ASHRAE, the public or the industry.

If RAC is not convinced by the work statement that there is a need commensurate with the proposed level of effort and cost, the committee may reject a work statement outright or return it for clarification. Typically, the authors of a returned work statement and TC discuss new arguments justifying their revised work statement to carefully resolve issues raised by RAC. RAC requests that these new arguments be added to the revised justification so there is a good written record to benefit all parties who will be using the work statement in the future.

The scopes lack clarity. Many times the tasks do not satisfy the stated objectives of the research, nor are they related to the objectives. The scope is the heart of the work statement and contains key information the contractor needs to prepare a bid. It should describe in some detail the parameters of the research, including items such as:

- The subject matter to be explored;
- Materials, equipment literature or other variables to be researched;
- An outline of the research method(s) to be used;
- A discussion of any standards to be followed in conducting the research;
- Consideration of how the data obtained might be reduced, analyzed and presented;
- A description of the form in which the results will be reported; and,
- A description of each task and each distinct phase of the project.

The work statements were not biddable. Authors should put themselves in the bidder's position and ask, "Can I bid this project? Is there enough information? Are the tasks clear and logical or are they ambiguous?" If one task depends on the results of another, it would be very difficult for the contractor to estimate the second task. It might be better, under the circumstances, to write the work statement to do the earlier task as the first phase. Then, after the results are known, write a follow-on work statement for a second phase.

The work statements were not complete. To help solve this problem, RAC implemented a Work Statement Cover Sheet that must be completed and submitted with the work statement. It has a checklist for outline items and provides a good place for recording other required information such as the TC vote record, the work statement authors and the proposed project monitoring committee members.

The work statements didn't conform to ASHRAE policy. For instance, work statements to develop computer algorithms must comply with ASHRAE's policy on algorithms.

In other instances, work statements have had the objective of developing computer software. If the authors had recognized in the beginning that it is ASHRAE policy not to develop and market software, the work statement could have been written to develop only the basic computational techniques, which would have satisfied the research need.

Another example is the work statement that proposes to develop a product, such as a sensor. Understanding that it is against ASHRAE policy to do research for product development, the authors could have directed the proposal toward developing the basic principles of an expanded sensing capability.

The work statement proposes to evaluate products or proprietary technologies. Again, this is against ASHRAE's policy on commercialism, and should be avoided. Research Liaisons should be able to help with policy questions

before work statements are approved by the TC.

4.6 Example WS Review Ballot used by RAC

RAC members use the form below to record their review comments and initial disposition decision on the WS prior to the RAC meeting to discuss the WS. The completed form is submitted to ASHRAE staff, which in turn incorporates this information into the WS Review Summary form

4.6 Example WS Review Ballot used by Individual RAC Members Prior to Meeting

Project ID	0007	
Project Title	Design on a Dime	
Sponsoring TC	TC 12.5 – The Example Commission	
Cost	\$250,000/24M	
Submission History	1 st Submission as WS, RTAR Accepted 10.06	
Classifications: Research or Technology Transfer	Basic/Applied Research	
Winter 2010 Meeting Review	Reviewer's Name: AB	
Check List Criteria	Satisfied?	Additional Comments & Suggestions
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.	N	Specify results and deliverables from each task that will be reviewed and approved by the PMS before proceeding to the next task.
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.	Y	
Detailed Bidders List Provided? The contact information in the bidder list should be complete so that each potential bidder can be contacted without difficulty.	Y	
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.	Y	
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.	Y	
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.	Y	
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.	Y	

Decision Options	Decision?	Additional Comments or Approval Conditions
ACCEPT		
COND. ACCEPT	X	Specify results and deliverables from each task that will be reviewed and approved by the PMS before proceeding to the next task.
RETURN		
REJECT		

ACCEPT - 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 - WS requires major revision before it can bid

REJECT- 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 unbidable.

4.7 Example WS Review Summary form from RAC

When RAC meets, they use the WS Review Summary form below to help guide their discussion of the WS. In many cases, a RAC member's initial disposition decision on a particular WS may change after reading other member's comments on the summary form and after participating to the meeting discussion of the WS.

A final version of the review summary form, which reflects the discussion and final decision that was made by RAC on the WS during the meeting, is developed and used as the basis for the return letter to the TC/TG/MTG/SSPC or other committees authorized to sponsor research.

4.7 Example WS Review Summary Form

Project ID	0007	
Project Title	Design on a Dime	
Sponsoring TC	TC 12.5 – The Example Commission	
Cost	\$250,000/24M	
Submission History	1 st Submission as WS, RTAR Accepted 10.06	
Classifications: Research or Technology Transfer	Basic/Applied Research	
Winter 2010 Meeting Review	WORK STATEMENT SUMMARY SCORE & COMMENTS	
Check List Criteria	Voted NO	Additional Comments & Suggestions
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.	AB	AB - Specify results and deliverables from each task that will be reviewed and approved by the PMS before proceeding to the next task.
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.		
Detailed Bidders List Provided? The contact information in the bidder list should be complete so that each potential bidder can be contacted without difficulty.		
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.		
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.		
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.		
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.		
Decision Options	Initial Decision?	Additional Comments or Approval Conditions
ACCEPT	DD, GB, RS, KL	
COND. ACCEPT	AB	Specify results and deliverables from each task that will be reviewed and approved by the PMS before proceeding to the next task.
RETURN		
REJECT		

ACCEPT - 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 - WS requires major revision before it can bid

REJECT- 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 unbidable

5. PROJECTS APPROVED FOR BIDDING

Following approval by RAC, the Work Statement, now designated a Tentative Research Project (TRP), is edited by the Manager of Research and Technical Services, incorporated into a request-for-proposal (RFP) and made available to potential contractors. A sample of the other material, which normally is distributed with the TRP, is shown on the following pages.

The Manager of Research and Technical Services maintains a listserv of research project potential contractors who have expressed interest and expertise in various fields of research interest to ASHRAE (<http://www.ashrae.org/technology/page/39>) These contractors are informed by an e-mail as to the availability of new RFPs posted for bid by ASHRAE. The TC/TG is encouraged to designate other qualified contractors who may wish to receive the RFP.

When the schedule permits, a notice is placed in the ASHRAE JOURNAL/INSIGHTS, and a release made to the trade press, to advertise the RFP to a larger audience who may not be on the list of potential contractors.

The RFPs are also listed on the "Research" Page of the ASHRAE website (<http://www.ashrae.org/technology/page/39>) and may be downloaded by interested bidders.

At the time the RFP is sent to potential contractors, a copy is sent to the Chairman of the sponsoring TC/TG. He/she is asked to confirm that the Technical Contact for bidder's technical questions and the Proposal Evaluation Subcommittee (PES) membership has not changed and that they will evaluate the proposals received in response to the RFP.

The Technical Contact is usually a member of the TC and he or she is available and qualified to answer technical questions regarding the RFP from potential bidders during the bid period (60 days typically). The ideal candidate for this position is a WS author who also serves on the PES. In addition to answering technical questions, the Technical Contact must also record all questions and responses so that this information can be relayed to all registered bidders one week prior to the due date for bids. The MORTS will obtain this information from the Technical Contact approximately one week prior to the bid due date and distribute it to all potential bidders that have registered their interest in the project.

(Sample RFP Notice)

**INVITATION TO SUBMIT A RESEARCH PROPOSAL ON AN ASHRAE RESEARCH PROJECT-
May 15, 2004**

Attached is a Request-for-Proposal (RFP) for a project dealing with a subject in which you, or your institution have expressed interest. Should you not decide to submit a proposal, please circulate it to any colleague who might have interests in the subject.

Title: **INLET INSTALLATION EFFECTS ON SMALL PROPELLER FANS, AIR, AND SOUND, 1223-TRP**

Sponsoring Technical Committee: TC 5.1, Fans

Budget Range: \$70,000 may be more or less as determined by value of proposal and competing proposals.

Scheduled Project Start Date: September 1, 2004 or later.

All proposals (hardcopy or electronic format) must be received at ASHRAE Headquarters **May 15, 2004**
Electronic copies must be sent to rpbids@ashrae.org.

If you have questions concerning the Project, we suggest you contact one of the individuals listed below:

For Technical Matters

Ling-Zhong Zeng
Revcor Inc.
251 Edwards Avenue
Carpentersville, IL 60110
Phone: 847-428-4411
Fax: 847-428-3414
E-Mail: lzzeng@revcor.com

For Administrative or Procedural Matters:

Manager of Research & Technical Services (MORTS)
Michael R. Vaughn
ASHRAE, Inc.
1791 Tullie Circle, NE
Atlanta, GA 30329
Phone: 404-636-8400
Fax: 404-321-5478
E-Mail: mvaughn@ashrae.org

Potential bidders intending to submit a proposal should so notify, by mail, fax or e-mail, the Manager of Research and Technical Services, (MORTS) by April 18, 2004 in order that any late or additional information on the RFP may be furnished to them prior to the bid due date.

All questions and answers fielded by the technical and administrative contacts listed above for this project will be distributed to all registered potential bidders one week prior to the bid due date.

Proposals may now be submitted in either electronic or hardcopy format. Electronic submissions require a PDF file containing the complete proposal preceded by signed copies of the two forms listed below in the order listed below. **Electronic copies must be sent to rpbids@ashrae.org.** Hardcopy submissions require 1-signed original and 15-signed copies organized in the same order. **In all cases, the proposal must be in the hands of the ASHRAE MORTS by 5 p.m. EST May 15, 2004**

The following forms must accompany the proposal:

- (1) **ASHRAE Application for Grant of Funds (signed)**
- (2) **Additional Information for Contractors (signed)**

ASHRAE reserves the right to reject any or all bids.

PROPOSAL FORMATTING GUIDELINES

- a. Enclosed with the Request for Proposal (RFP) are copies of two forms, *Application for Grant of Funds* and *Additional Information for Potential Contractors*. These forms must be completed and signed copies of each must be included with your proposal submission. Proposals may be submitted in either hardcopy or electronic format. Electronic submissions are sent to rpbids@ashrae.org. Hardcopy submissions must include **15** bound copies of the proposal and the required forms. This number of copies is requested so that the Proposal may be sent to members of the various committees responsible for its review and evaluation.
- b. The Proposal should include data in sufficient detail for proper evaluation, covering your approach to the subject, an estimate of the time and cost involved, a work completion schedule and the qualifications of the person, or persons, who would accept responsibility for the Project. All units should be reported in the inch-pound system, with SI units shown parenthetically, in accordance with the ASHRAE Metric Guide.
- c. All proposals shall contain the following statement at the bottom of the title page:

"Members of the research team did not participate in the preparation of the ASHRAE's Request for Proposal on which this proposal is based."
- d. In order to facilitate the receipt, processing, distribution and evaluation of proposals in hardcopy format, the following are strongly suggested:
 - Staple proposals. No notebooks, plastic bindings/spines or covers, no advertising inserts or attachments.
 - Print on both sides of paper. Limit biographies/résumés/CVs to 3 or 4 pages. List only publications applicable to the subject of the research.
 - No faxed proposals or quantities less than the requested 15 copies.
 - Staple "Application for Grant of Funds" form followed by "Additional Information for Potential Contractors" form to front of the proposal, with the project number (--- TRP) appearing on the upper right-hand corner.
 - Don't ship with plastic "peanuts" packing or in envelopes with ground newsprint padding. Wadded paper or bubblewrap is preferred.
- e. In order to facilitate the receipt, processing, distribution and evaluation of proposals in electronic format, the following are strongly suggested:
 - Submit the proposal as a single .pdf file, preferably, with the "Application for Grant of Funds" form first followed by "Additional Information for Potential Contractors" form and then the proposal.
 - All electronic submissions must be sent to rpbids@ashrae.org.
 - Faxed copies of the two signed forms are acceptable if proper advance notification is given to the MORTS that the forms will arrive separate from the proposal and the forms and proposal will both arrive before the bid due date.
- f. ASHRAE will acknowledge the receipt of all proposals received via e-mail. Please include the e-mail address to be used for this acknowledgement in your transmittal letter or transmittal message.

ASHRAE APPLICATION FOR GRANT OF FUNDS (SAMPLE Form)
(to be completed by Applicant)

- 1.0 Title: _____
- 2.0 Principal Investigator (P.I.): _____
- 3.0 Name of Contracting Institution: _____
Mailing Address of P.I.: _____

E-mail address of P.I.: _____
Phone No. of P.I.: _____
Fax No. of P.I.: _____

Other Key Personnel: _____
- 4.0 Any subcontractors: _____
- 5.0 Objective & Scope: * _____
- 6.0 Project Start Date: _____ Total Project Length: _____
- 7.0 Total Cost: US\$ _____ ASHRAE Funding Requested: US\$ _____
- 8.0 Details of Financial Support:
- | | | |
|----------------------------|----------|---------------------|
| a) Professional Salaries | \$ _____ | Person Months _____ |
| b) Research Assistants | _____ | |
| c) Fringe Benefits (%) | _____ | |
| d) Equipment | _____ | |
| e) Supplies & Materials | _____ | |
| f) Computer Costs | _____ | |
| g) Travel & Communications | _____ | |
| h) _____ | _____ | |
| i) Total Direct Costs | _____ | |
| j) Indirect Costs (%) | _____ | |
| k) TOTAL | \$ _____ | |
- 9.0 Qualifications of Principal Investigator: * _____
- 10.0 Signature of Project Manager or P.I.: _____
Title: _____ Date: _____

Signature of Executive Officer of Institution: _____
Title: _____ Date: _____

Key personnel were () were not () involved in writing the ASHRAE's Request for Proposal Document for this project. * All sections must be completed. Use of terms such as "See Attached Proposal" may result in rejection of proposal.

(SAMPLE Form)
ADDITIONAL INFORMATION FOR CONTRACTORS

In preparing a response to this request-for-proposal, contractors should be aware of, and be agreeable to, the following ASHRAE policies, procedures, traditions and contractual requirements. Costs for meeting these should be considered when preparing research proposal budgets.

By submitting a proposal, the Principal Investigator is acknowledging he/she understands and agrees to comply with the policies listed below. The inability or unwillingness to comply should be pointed out in the transmittal letter accompanying any proposal or should result in no proposal being submitted.

1. It is the practice of ASHRAE to use fixed price contracts for research projects. Other contract forms, such as cost plus fixed fee, will be considered only in exceptional cases, and such proposals are discouraged. Unlike some other government or foundation research sponsors, ASHRAE does not approve cost extensions nor accept scope reductions except in the most unusual of cases. Such cases reflect unfavorably on the contractor with regard to future work.
2. All fiscal values should be stated in U.S. dollars.
3. Twenty five percent of the contracted sum will be withheld pending completion of the work. Fifteen percent will be paid upon submission of the final report and the remaining ten percent upon completion and acceptance of all contract requirements. The initial seventy-five percent of the total sum is paid in equal quarterly progress payments during the period of performance. Except for the first payment, which is made within thirty days of contract initiation, all progress payments are made contingent upon receipt of a quarterly progress report.
4. The winning bidder is required to meet with the PMS via a site-visit or a conference call at the start of the project to review the project's scope. The results of this meeting shall be summarized by the contractor in the first progress report.
5. During the period of the contract and following submission of the Final Report, the Principal Investigator is expected to personally address the sponsoring Technical Committee or Task Group and report on the progress of the project at each Annual and Winter ASHRAE meeting.
6. 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.

All Deliverables under this Agreement and voluntary research or technical articles shall be prepared using dual units; e.g., rational inch-pound with equivalent SI units shown parenthetically. SI usage shall be in accordance with IEEE/ASTM Standard SI-10.

7. ASHRAE, in return for their financial support, expects that the sponsored research will be reported first at an ASHRAE meeting and in an ASHRAE publication. This may be ASHRAE *Transactions* or *HVAC&R Research* paper,. The Principal Investigator should be willing to wait for this to take place before publishing or presenting the work elsewhere. The submission of papers for publication by ASHRAE shall be made to the Manager of Research and Technical Services.
8. Any patentable inventions or copywritten computer programs developed as a result of this research shall be made available to ASHRAE in recognition of their financial support of the work.
9. Proposers are encouraged to utilize undergraduate or graduate engineering students where appropriate in conducting this research in order to assist them professionally and financially in their education and in

increasing their interest in the HVAC&R industry.

10. ASHRAE's proposal evaluation committee will make the primary recommendation regarding the selection of a contractor. While bidders may be given some information on their and competitors' scores, ASHRAE is not obligated to do so and will not become involved in negotiating, explaining or defending the decisions made.
11. One section of the final report will be entitled "Utilization" and will state:
 - a. ASHRAE Handbook volume(s) and chapter(s) to which the research is related.
 - b. Aspects of the research confirming present knowledge or extending present knowledge.
 - c. Suggestions for change in the Handbook attributed to the research conducted.
 - d. Suggestions for further research identified through that completed.
12. If invited, the Principle Investigator shall speak at an ASHRAE chapter or regional meeting on the subject of his/her research or research in general. The chapter or region extending the invitation shall reimburse out-of-pocket expenses incurred.
13. The signed original of this document should be enclosed with the proposal's letter of transmittal. Multiple copies are not desired.

The above conditions are acceptable:

Principal Investigator (date)

Institution Authority (date)

6. SOLICITED PROPOSALS

6.1 Evaluation of Solicited Proposals

Following the deadline for receipt of proposals, the Manager of Research and Technical Services (MORTS) records certain salient information about each response and forwards copies of all proposals received to members of the Proposal Evaluation Subcommittee (PES), the TC Chair (or Chair of TG, MTG w/research authority, SSPC, or other committee authorized to sponsor research), and the appropriate Research Liaison.

Evaluation Criteria

The PES uses evaluation criteria and weighting factors as specified in the Work Statement (WS) and applies them to compare the proposals received. Typically, the Evaluation Criteria include "Performance of Contractor on Prior ASHRAE or Other Projects." The MORTS provides the PES with information on performance, including unsatisfactory performance, on previous ASHRAE research projects. A bidder who did not have a prior ASHRAE research project should not be penalized in the evaluation process, i.e, his/her proposal should receive the maximum score for this evaluation criterion.

After discussion and evaluation, each PES member completes the Proposal Evaluation Form (PEF) based on his/her personal preference. Together the PES completes the Summary Sheet for Reporting Evaluations of Proposals. The summary of the scores from all PES members must be reported on the Summary Sheet for Reporting Evaluations of Proposals. The criteria for proposal selection are:

1. By default, select the proposal with the lowest cost that was responsive (i.e., an average score of 70 points or higher),

Or
2. Select the proposal that the PES feels is the best value when ALL the criteria below are also satisfied:
 - a. The proposal has the lowest cost to ASHRAE per point (using average score) among all responsive proposals
 - b. The average proposal score is 5 points higher than the score for the lowest-cost responsive proposal
 - c. The proposal was scored higher than the lowest-cost responsive proposal by at least 2/3 of PES members
 - d. The PES members feel selection of the higher cost proposal is justified and provide a written explanation of their reasons.

Approval Process

The PES presents its recommendation and justification for the selection to the sponsoring committee for the project (TC, TG, MTG w/research authority, SSPC or other committee authorized to sponsor research). The vote of the sponsoring committee is recorded on the Summary Sheet in the form of "For - Against - Abstain - Not Voting - Total." The reasons for negative votes and abstentions on these types of motions shall be recorded on the same form or accompany sheet and transmitted as additional information to RAC. The number of affirmative votes required for approval is at least 2/3 of the voting and international members present and expressing a preference. An abstention is not a vote or expression of preference. A 2/3 vote is required to authorize expenditure of funds (such as recommendation of a contractor or final report approval) (ROB 2.104.006).

The sponsoring committee's chair or another committee member designated by the chair is responsible for submitting hardcopies of: 1) Summary Sheet for Reporting Evaluations of Proposals, 2) copies of all PEFs or other review sheets used by individual PES members, and 3) any other documentation that the committee believes might help to support the committee's recommendation to the MORTS Mailbox by Tuesday night of the ASHRAE Meeting.

A member of Research Administration Committee (RAC) (usually the Research Liaison for the TC) will independently evaluate each proposal using the same weighting factors used by the PES. The Research

Liaison's evaluation scores will be used by RAC in their deliberations prior to approval of the TC's contractor recommendation. The Research Liaison is the TC's champion at the RAC meeting, and therefore, the liaison must be fully confident and supportive of their position. Consequently, only the TC can provide the needed supporting information to the liaison. If the TC does not provide sufficient information to properly answer the questioning likely to result at the RAC meeting, the project may be delayed or the TC's recommendation not be approved. This may introduce at least a six month delay in proceeding with the project.

The proposals submitted to ASHRAE are the official documents to be evaluated. All actions taken by the PES and the TC are to be based on these proposals as written. The recommended contractor's proposal (and **not** the Work Statement prepared by the TC) will be used as the statement of work in the agreement between the contractor and ASHRAE. Written clarification questions of the contractor's proposal and the contractor's responses to these questions, however, can also be referenced in the contract's statement of work, if required.

There shall be no direct communication between the PES or TC and the proposers until after the contract is awarded. If the PES or TC requests further information or clarification, the PES or TC shall notify the MORTS. The MORTS will then contact all proposers to obtain the requested information.

Under exceptional conditions, e.g., when a single bid is received or funding is limited, the Research Administration Committee may authorize the MORTS to negotiate the price or technical content of a contract with the proposed contractor. The PES should contact the MORTS and research liaison to discuss the feasibility of this approach for a particular project before formally submitting their recommendation to RAC. In all cases, care must be exercised to see that no unfair advantage is given to one bidder over another.

If approved by RAC for funding, a Research Project Analysis Sheet is prepared by the MORTS to accompany the Application for Grant of Funds of the recommended contractor when it is forwarded to Technology Council and the Board of Directors. The Project Analysis Sheet contains information to assist these bodies in evaluating the recommendation.

RAC has the authority to approve for funding projects less than \$100,000. Technology Council has authority to approve funding for projects costing from \$100,000 to \$200,000. For projects costing over \$200,000, Technology Council forwards its recommendation to the Board of Directors for their final approval.

Disapproval of any recommendation by either RAC, Technology Council or the Board of Directors results in the proposal's being returned to the next lower body for reconsideration.

Special Considerations:

(i) Only one proposal received

If only one proposal is received when a Work Statement is put out for bid, then MORTS shall contact the other listed potential bidders to determine why they did not bid. Based on the responses received or other considerations, MORTS may decide, without evaluation of the proposal itself, not to accept the single bid received.

If the MORTS does forward a single proposal to the PES for evaluation, then both the PES and RAC must give the proposal a score of 80 or higher, and the proposed budget must be equal or less than 110% of the cost estimate in the WS in order to be accepted.

If the two criteria above are met, but the other bidders stated that they did not bid because they felt only one institution had the qualifications or facilities to do the research, then the MORTS shall negotiate with the bidder to ensure the project will be conducted at the lowest possible cost to ASHRAE.

(ii) Work Statement author bids on the project

Proposals submitted by teams that include a Work Statement (WS) author may be acceptable if the proposal was not selected because of unique information available to the WS authors but not to all prospective bidders.

6.2 Instructions for Proposal Evaluation Subcommittee

Purpose:

The purpose of the Proposal Evaluation Subcommittee (PES) is to provide recommendations and guidance to the TC (or TG, MTG w/research authority, SSPC or other committees authorized to sponsor research) members relative to their evaluation of proposals received, both solicited and unsolicited.

Scope:

Inclusions - The scope of these instructions applies to ASHRAE Research and Technical Projects.

Exclusions - The scope of these instructions does not include provisions for ASHRAE Special Projects as covered in either the Policy or Procedures for ASHRAE Special Projects or Manual of Procedures for Technology Council Special Projects Subcommittee.

Members:

At least three (3) members, but not more than five (5) including a PES Chair, shall be appointed by the Chair of the sponsoring TC to form the Proposal Evaluation Subcommittee (PES). Whenever possible, the Work Statement authors should be members of the PES. An organization co-funding a project has the right to one seat on the PES (and PMS). Any Work Statement authors who may bid on the project cannot be members of the PES (or the Project Monitoring Subcommittee – PMS). The TC Chair shall consult with the TC regarding PES and PMS appointments. All appointments to the PES (and PMS) are subject to the approval of the Research Liaison.

Any TC members, corresponding members, or guests at a TC meeting who may bid on the project shall not participate in discussions about membership of the PES (or membership of the Project Monitoring subcommittee – PMS). All such prospective bidders shall leave the meeting during the discussion of PES (or PMS) membership. If the TC Chair is considering bidding on the project, the Vice Chair shall conduct the meeting during discussions of PES membership and shall appoint the PES members. If the Vice Chair is also considering bidding on the WS, then those TC members without a conflict of interest (i.e., those who will definitely not bid on the project) shall select an individual on the TC to solicit the TC's input on PES and PMS members and to appoint members of the PES and PMS with concurrence of the TC members who will not bid. Appointments to the PES are subject to the approval of the Research Liaison.

The PES shall be tentatively appointed prior to initial submittal of proposed Work Statements to the Manager of Research and Technical Services (MORTS) and shall be finalized when members have determined if they are bidders or otherwise have conflicts of interest.

If a project has co-funding from non-ASHRAE organization (such as ARTI, CIBSE, USGBC, etc) then the Manager of Research and Technical Services (MORTS) will appoint a representative from that organization to be a member of the PES and PMS.

The MORTS and the Research Liaison shall be *ex officio*, non-voting members of the PES and shall receive copies of all PES correspondence and prior notification of all meetings.

Evaluation and Selection of Contractor:

The PES will be responsible for evaluating proposals and for recommending to the TC the contractor to perform the research. The evaluation factors should be weighted and scores assigned to support reasons for the recommendation. The TC shall vote on the selection of the contractor prior to the recommendation's being forwarded to the Research Administration Committee (RAC).

Confidentiality of information contained in proposals and the evaluation of such proposals shall be maintained through appropriate measures, including the following:

- a) Prior to final selection of the contractor, the flow of information should be restricted to the PES, sponsoring TC, RAC, and ASHRAE staff. In particular, other respondents to the RFP and employees of the respondents shall be excluded.

- b) All discussions and evaluations of sensitive information such as costs and qualifications of respondents to an RFP shall be conducted only in executive session of the sponsoring committee, which shall consist only of committee voting, corresponding members, PES members, Research Liaison, and ASHRAE staff, but exclude members of respondent organizations. Recorded votes of the PES, sponsoring committee, or RAC shall be cast in executive session.
- c) Minutes of meetings should report only the action taken without identifying the contractor. Other details of the executive session may be appended to minutes, but these should be distributed only to those persons who participated in the executive session or who have a direct Society role in the awarding of a contract for the project.
- d) Identification of the recommended contractor must be kept confidential until approved by RAC, Technology Council and the Board of Directors.

The goal is to select the proposal that will provide high-quality, technically-sound research at the lowest cost to ASHRAE. The process assumes that proposals that score 70 points or higher are technically sound; therefore the lowest cost proposal meeting this criteria is usually selected. If many proposals are technically sound, but one is clearly better on a technical basis, then that proposal may be selected on a cost-per-point basis (these selection criteria are described in Section 6.1). In such a case, the PES must provide an explanation why the lower-cost bids having a score of 70 or more points were not selected.

Procedures:

The PES shall follow all procedures as described herein (in Section 6.2 of the Research Manual).

The PES shall coordinate all activities with the MORTS and Research Liaison.

Only the office of the MORTS can relay questions of clarification and comments from the PES or TC to the proposers. The MORTS may request the assistance of the PES Chair when communicating with the proposers.

The PES is responsible for assuring the two-way flow of information so that the TC can make informed decisions relative to PES recommendations.

PROPOSAL EVALUATION FORM

(SAMPLE Form)

Project # _____ Submitted by: _____

Title: _____

Factor
Weight x Rating = Score

- 1. Contractor's understanding of Work Statement as revealed in proposal. _____
 - a) Logistical problems associated
 - b) Technical problems associated

- 2. Quality of methodology proposed for conducting research. _____
 - a) Organization of project
 - b) Management plan

- 3. Contractor's capability in terms of facilities. _____
 - a) Managerial support
 - b) Data collection
 - c) Technical expertise

- 4. Qualifications of personnel for this project. _____
 - 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. Student involvement _____
 - a) Extent of student participation on contractor's team
 - b) Likelihood that involvement in project will encourage entry into HVAC&R industry

- 6. Probability of contractor's research plan meeting the objectives of the Work Statement. _____
 - a) Detailed and logical work plan with major tasks and key milestones
 - b) All technical and logistic factors considered
 - c) Reasonableness of project schedule

- 7. Performance of contractor on prior ASHRAE or other projects _____
(No penalty for new contractors.)

- 8. Other _____

TOTAL 100

Note: Evaluation criteria and factor weights should be those specified in the Work Statement. Factors should be selected such that maximum score totals 100 points.

ASHRAE RESEARCH PROJECT ANALYSIS

(This form is completed by ASHRAE Staff)

Project Number & Title:

Sponsoring Committee (TC/TG/MTG/SSPC):

Justification of Need:

Work Statement Author(s):

Research Strategic Plan Goals Applicable to this Research:

Position on TC/TG Research Plan: RTAR Submitted: Year Added to Society Implementation Plan:

Coordinated with TC/TG/MTG/SSPC: Relates to Previous ASHRAE Research Project:

Vote of TC/TG/MTG/SSPC: Vote of RAC:

Vote of RAS: Vote of Tech Council:

<u>Allocation of ASHRAE Funds Per Fiscal Year</u>	<u>Year 1</u>	<u>Year 2</u>	<u>Year 3</u>
	\$	\$	\$

Best Value for ASHRAE:

Lowest cost responsive bid selected? **TBD** If no,

- Did 2/3 of the PES score the selected bid the highest of all responsive bids? **TBD**
- Was the average score of the PES 5 or more points higher than the lowest priced responsive bid? **TBD**
- Was the \$/point ratio of selected bid less than all lower priced responsive bids? **TBD**

Actual or Perceived Conflicts of Interest:

Was bid selected for unique reason not outlined in WS? (Y / N) **TBD**

RAC/Tech Council Conflicts-of-Interest:

<u>ESTIMATED</u>	<u>18M</u>	<u>\$150,000</u>	<u>SCORE</u>	<u>\$/POINT</u>
Bidder 1	XX	\$XXX	XX	XXX
Bidder 2	XX	\$XXX	XX	XXX

MORTS NOTES:

EXAMPLE SUMMARY SHEET FOR REPORTING EVALUATION OF PROPOSALS

(Project # same as RTAR & WS, assigned by MORTS) _____ TRP RECOMMENDED BIDDER _____

Evaluation Criteria ⁽¹⁾	Weight Factor	Bidder 1	Bidder 2	Bidder 3	Bidder 4	Bidder 5	Bidder 6	Bidder 7
1. Contractor’s understanding of Work Statement as revealed in proposal.								
2. Quality of methodology proposed for conducting research.								
3. Contractor’s capability in terms of facilities.								
4. Qualifications of personnel for this project.								
5. Student involvement.								
6. Probability of Contractor’s research plan meeting the objectives of the Work Statement.								
7. Performance of Contractor on prior ASHRAE or other projects ⁽³⁾ .								
8. Other.								
TOTAL SCORE ⁽³⁾ (0-100)								
COST TO ASHRAE / SCORED POINTS (\$/pt)								

TC/TG/MTG/SSPC VOTE: For: _____ Against: _____ Abstain: _____ Not voting: _____ Total: _____

Reason for each negative vote or abstention ⁽⁴⁾: _____

Justification for not selecting lower-cost responsive bids (scoring 70 or more points) ⁽³⁾: _____

Submitted by: _____ Date: _____

NOTE: ⁽¹⁾ These Evaluation Criteria are examples. Evaluation Criteria and Weighting Factors must be those specified in the Work Statement.
⁽²⁾ The minimum score for considering the award of a contract is 70 points. Justification for not selecting lower-cost responsive bids must include specific reasons.
⁽³⁾ No penalty for new contractors.
⁽⁴⁾ Attach a separate sheet if necessary.

7. UNSOLICITED RESEARCH PROPOSALS

An unsolicited research proposal (URP) is a research proposal initiated by a proposer seeking funding from ASHRAE. In order to be considered for funding, URPs should fall within the general research goals of the Society but not overlap significantly with ongoing or planned research activities of individual TC (or TG, MTG w/research authority, SSPC or other committees authorized to sponsor research projects). Unique and innovative projects that cut across research activities within different TCs are especially welcomed.

Unsolicited proposals should be submitted in electronic format to the Manager of Research and Technical Services (MORTS) at MORTS@ashrae.net, who assigns the URP a number and logs it into the project control system. Enclosed with the unsolicited research proposal (URP) submission should be copies of three ASHRAE forms, Application for Grant of Funds, Procedure Statement Regarding Unsolicited Research Proposals (URPs) and Additional Information for Potential Contractors. These forms must be completed and signed by an individual having the authority to commit the institution contractually. Electronic signature is sufficient. Since the ASHRAE review process cannot guarantee the confidentiality of any material contained in a URP and since ideas, processes and/or techniques described may already be under consideration by a TC, the author of any URP is requested to sign the Procedure Statement Regarding Unsolicited Research Proposals (URPs) form releasing ASHRAE from responsibility for proprietary or confidential material in the URP. (See Guidelines for Unsolicited Research Proposals)

7.1 Evaluation of Unsolicited Research Proposal

The MORTS will work with the Chair of Research Activities Subcommittee (RAS) of Research Administration Committee (RAC) to identify an appropriate liaison from RAC, who will have responsibility for guiding the URP through the evaluation process. In most cases, the URP liaison will be the Research Liaison for the section of TCs that best aligns with the focus of the URP. However, in some cases, the MORTS and RAS Chair may choose a URP liaison from RAC who has unique expertise for evaluating the URP. The following process will be followed in evaluating URPs:

- 1) The URP liaison will perform an initial evaluation of the URP to determine whether it should be considered for funding by ASHRAE. If the liaison determines that the URP addresses a topic already contained in the ASHRAE Research Implementation Plan or an RTAR under development within a TC, then the liaison should recommend to RAC that the proposal be rejected and returned to the proposer unless the interests of the Society are better served by its consideration. In very exceptional cases, work that is a follow-on to a previously sponsored project may be considered for a URP when the proposed research offers ASHRAE convincing benefits in budget and schedule, where the original sponsoring TC is supportive, where the previous contractor has a competitive advantage with respect to experience and facilities.
- 2) If the URP liaison determines that the URP should be considered for funding, then the liaison should identify an appropriate TC and ask the TC chair to form a Proposal Evaluation Subcommittee (PES) headed by the TC Research Subcommittee Chair to evaluate the URP. If a PES is appointed, then the URP liaison will follow up with the TC Chair and Research Subcommittee Chair to monitor the timeliness of their evaluation.
- 3) The TC's PES should use many of the same criteria used in evaluating solicited proposals, but must also consider whether the unsolicited work is of equal or greater importance than that already planned by the TC. The TC must consider the cost and benefit of the URP to the TC, the Society and the public to establish the advisability of recommending funding.
- 4) Should the PES recommend that the project be funded, the subsequent approval steps are identical to those of a solicited proposal. If the TC rejects the URP, it shall provide a brief explanation to the MORTS. In some cases, the PES may be empowered by the TC to work with the author of the URP proposal to make modifications to the scope and deliverables to better meet the TC needs. The proposed budget can also be adjusted to accommodate these changes. The TC must vote to authorize the PES to negotiate with the proposal author and then must approve any revised URP.
- 5) If disapproved at any level, the MORTS returns the URP to the proposer with a brief explanation for the reason for the rejection. A copy of this communication is sent to the TC.

Following approval and contract finalization, the sponsoring TC will establish a Project Monitoring Subcommittee (PMS) to oversee the progress of the project and to approve the final report.

ASHRAE UNSOLICITED RESEARCH PROPOSAL EVALUATION FORM

Criteria 1 through 10 should be rated from '0' to '10' with the higher numbers favoring funding

The ratings for individual criteria are to provide guidance for evaluation; they are not meant to be additive. Some criteria may not apply (e.g., student involvement, literature review, performance on previous ASHRAE research projects.)

Project # _____ URP Principal Investigator: _____

URP Title: _____

Evaluation criteria

Is this appropriate ASHRAE research? (If not, state reasons. If so, proceed to evaluation criteria.)

- 1. Applicability to ASHRAE Research Strategic Plan (0-10): _____
Give names & numbers of goals: _____
- 2. Application of Results (0-10) _____
- 3. State-of-the-Art/Literature Review (0-10) _____
- 4. Advancement of the State-of-the-Art (0-10) _____
- 5. Justification and Value to ASHRAE (0-10) _____
- 6. Objectives/Scope/Technical Approach _____
 - a) Theoretical work clearly addressed (0-10) _____
 - b) Experimental work clearly addressed (0-10) _____
 - c) Technical value of the proposed work (0-10) _____
 - d) Detailed and logical work plan with major tasks and key milestones (0-10) _____
 - e) Deliverables clearly defined (including intermediate deliverables (0-10) for project monitoring) _____
- 7. Contractor's capability in terms of facilities (0-10) _____
 - a) Managerial support
 - b) Data collection
 - c) Technical expertise
- 8. Qualifications of personnel for this project (0-10) _____
 - 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
- 9. Student involvement (0-10) _____
 - a) Extent of student participation on contractor's team
 - b) Likelihood that involvement in project will encourage entry into HVAC&R industry
- 10. Performance of contractor on prior ASHRAE projects or other research projects (0-10) _____

11. Other considerations: _____

12. Recommendation and Justification: 1) Approve Funding; 2) Return for Revised Submission (PES/TC to provide suggested modification to scope or technical aspects of project.); or 3) Reject. Justifications should be provided. _____

7.2 Guidelines For Unsolicited Research Proposals

One of the ways in which ASHRAE research projects are initiated is through the Unsolicited Research Proposal (URP). These are proposals, which are developed and planned by a researcher and then presented to ASHRAE with a request for full or partial funding. The URP should include the following information.

1. Title

2. Executive Summary

(100 word statement that could be used at the BOD level to succinctly summarize the current state-of-the-art, the advancement this project is expected to accomplish, and its value to ASHRAE and society in general.)

3. Applicability to ASHRAE Research Strategic Plan

(List specific goals of the ASHRAE Research Strategic Plan this project will support by name and number (e.g., Goal 3 - To reduce significantly the energy consumption for HVAC&R, water heating and lighting in existing homes) State how the proposed project will help achieve the goals. If the project does not contribute to any of the goals in the ASHRAE Research Strategic Plan, a strong justification of the need for the research must be provided, and the proposal will have a lower likelihood of success. The ASHRAE Research Strategic Plan can be found on the ASHRAE.org Web site under the Research page.)

4. Application of Results

(List handbook chapters/special publications etc. to be affected by results of this project, if known. Explain how the results of the proposed project will be disseminated to HVAC&R industry and society in general. What are the practical benefits expected from this research?)

5. State-of-the-Art (Background)

(Description of the amount and quality of past research, and quantify existing gaps.)

6. Advancement of the State-of-the-Art

(Quantitative estimate of the improvement expected from this research [i.e. x% energy reduction in product y or building type z, x% increase in heat transfer coefficient between y and z, or x% reduction in design time to do y, etc.], and explain why this information is needed by the public or by industry.)

7. Justification and Value to ASHRAE

(Identification by number, profession, or industry the ASHRAE members who will benefit. State the likelihood and how the improvement would be adopted by industry.)

8. Objectives - A paragraph describing what this URP intends to accomplish.

(Explanation of project's goals and how this project will accomplish its intended advancement to the state-of-the-art [i.e. a computer simulation will be used to do x, a computer simulation will be developed for x and verified using laboratory data from tests y and z, field test data will be obtained from x and used to do y].)

9. Scope/Technical Approach

(Provide a complete description of technical approach and task statement. Describe the parameters of the research project, including such items as: subject matter to be explored; materials, equipment, literature or other variables to be researched; materials, equipment, etc to be excluded from the project; outline the research methods to be used; description of the standards to be followed; discussion of how the data is to be reduced, analyzed and presented; description of the format for the reported results; if appropriate, describe project phases.

It is important for the scope of a research project to be broken down into tasks or phases, where a task will yield results of interest to the TC/TG/MTG/SSPC and the Project Monitoring Subcommittee (PMS), or where the results of a task will significantly define how subsequent tasks will be carried out. Make sure that the project objectives are reflected in the tasks. The URP should specify deliverables corresponding to these tasks in the "Deliverables" section to facilitate project monitoring by the PMS.)

10. Deliverables

(Insert generic ASHRAE requirements listed below plus any project specific requirements.)

Progress, Financial and Final Reports, Research or Technical Paper(s), and Data shall constitute the only deliverables (“Deliverables”) under this Agreement and shall be provided as follows:

a. Progress and Financial Reports

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

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

b. Final Report

A written report, design guide, or manual, (collectively, “Final Report”), in a form approved by the Society, shall be prepared by the Institution and submitted to the Society’s Manager of Research and Technical Services by the end of the Agreement term, containing complete details of all research carried out under this Agreement. Unless otherwise specified, six copies of the final report shall be furnished for review by the Society’s Project Monitoring Subcommittee (PMS).

The Final Report shall include an Executive Summary of approximately 800 words that includes the need that initiated the project, a brief description of the technical approach, the results and how the results will benefit the industry and/or the public.

Following approval by the PMS and the TC/TG/MTG/SSPC, in their sole discretion, final copies of the Final Report will be furnished by the Institution as follows:

- An executive summary in a form 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 disk or CD-ROM; one in PDF format and one in Microsoft Word.

c. HVAC&R Research of ASHRAE Transactions Technical Paper

One or more papers shall be submitted first to the ASHRAE Manager of Research and Technical Services (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. The papers 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 at the end of the title in parentheses, e.g., (xxxx-RP).

Note: A research or technical paper describing the research project must be submitted after the TC has approved the Final Report. Research 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.

d. 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.

e. Project Synopsis

In addition to the approximately 800 word summary in the final report, Contractor will prepare a written synopsis totaling approximately 100 words in length and written for a broad technical audience. The synopsis shall document 1. Main findings of research project, 2. Why findings are significant, and 3. How the findings benefit ASHRAE membership and/or society in general. The synopsis shall be submitted to the MORTS by the end of the Agreement term for publication in ASHRAE Insights and on the Research Page of the ASHRAE Website (for keyword searches but Internet users) .

The Society may also request the Institution submit a technical article suitable for publication in the Society's ASHRAE Journal. This is considered a voluntary submission and not a Deliverable. Technical articles shall be prepared using dual units; e.g., rational inch-pound with equivalent SI units shown parenthetically. SI usage shall be in accordance with IEEE/ASTM Standard SI-10.

(The above deliverables are necessary, but not sufficient, to monitor a research project. The PMS and the sponsoring TC have the responsibility to review the contractor's on-going activities and intermediate results, to ensure that the methods used and results obtained will be valid and well-enough substantiated to be labeled as "ASHRAE-approved findings." Proper oversight cannot wait until the final report, when most of the budget has already been expended.

Therefore, each major task or phase of the research method outlined in the Scope should also be linked to a deliverable report, memorandum, or summary. These in-progress deliverables should not add to the cost of the project, as they will most likely become chapters of the final report. However, they should help the TC avoid unpleasant surprises due to the research not being conducted according to the TC's expectations. Examples of deliverables that could be required during the project include:

- If one task is a literature review, then the deliverable could be an annotated list of references and conclusions/summary of the current state of the art.
- If the contractor must propose specific sites (e.g., buildings), experiment topologies (e.g., duct configurations), materials (e.g., refrigerants, appliances, insulation or building materials), experiment protocols, and/or instrumentation, then short memos describing those proposed methods, materials, etc. should be deliverables to be reviewed and approved by the PMS before moving on to the next research task.
- If analysis of preliminary data or results will decide how to proceed (e.g., CFD models of 12 duct configurations will be used to select 2 duct configurations to be built and subjected to wind tunnel tests), then the contractor should write up the results of the initial analysis, recommend the areas for further more detailed investigation, and justify those recommendations.
- If data from the research are expected to modify or update a Handbook table, then the procedure for developing the updated table from the data should be specified and provided to the PMS as a deliverable. (The final report may also require the contractor to prepare a proposed updated table based on the observed data.)

In short, the technical approach for a research project should be broken down into tasks or phases, and where a task will yield results of interest to the TC and the PMS, or where the results of a task will significantly define how subsequent tasks will be carried out. The URP should specify such intermediate deliverables for the PMS to review. This approach will make it easier for the PMS and MORTS to gauge progress and technical merit of on-going ASHRAE research projects, and will provide a framework for the cognizant TCs to provide technical oversight and assistance to identify and correct problems as they occur.)

11. Schedule

Description of project milestones and duration.

12. Costs

Detail breakdown of expenses into categories and itemized list of equipment, travel, subcontracts, and other direct expenses; Timing of expenditures; Description of cost sharing of proposing organization or others.

13. Personnel

Education, experience and expertise of researchers that qualifies them to perform the work.

14. References

List references cited in the proposal.

A copy of the URP, containing a completed "Application for Grant of Funds" form, should be submitted to the Manager of Research & Technical Services (MORTS), who will then distribute it to the appropriate research liaison for review and evaluation.

The Research Administration Committee (RAC) normally meets in late June and late January of each year, so URP's should be submitted by mid-May or by mid-December to be considered for the next meeting. The results of the reviewing committees' actions will be made known to the proposer by mid-February or mid-July.

Proposals should be submitted to:

MANAGER OF RESEARCH & TECHNICAL SERVICES
ASHRAE
1791 Tullie Circle, NE
Atlanta, GA 30329
MORTS@ashrae.net

**UNSOLICITED RESEARCH PROPOSAL (URP)
DISCLOSURE ACKNOWLEDGEMENT**

1. ASHRAE recognizes the need to encourage innovative research proposals which address the needs of ASHRAE members and society in general. In order to be considered for funding, URPs should fall within the general research goals of the Society but not overlap significantly with ongoing or planned research activities of individual TC (or TG, MTG w/research authority, SSPCs or other committees authorized to sponsor research projects). Unique and innovative projects that cut across research activities within different TCs are especially welcomed.
2. URPs will be accepted only with the understanding that they are non-confidential, although every attempt will be made to respect the proprietary nature of the proposal. This non-confidentiality will permit, if need be, a modification of the URP into a Work Statement which better meets the needs of the Society and which may be distributed as part of a Request for Proposal to numerous researchers for competitive bidding.
3. If a URP is received which addresses a topic already contained in the ASHRAE Research Implementation Plan or under development within a TC, the URP will be returned to the proposer with an explanation as to its status in the Research Implementation Plan or applicable TC research plan unless the interests of the Society are better served by its consideration.
4. If the URP is considered for funding, then the Research Activities Committee (RAC) will be responsible for managing the evaluation process.
5. Unsolicited proposals will only be accepted by the Society upon receipt of a signed acknowledgment of this Procedure.

I have read and understand the above policy on disclosure of Unsolicited Research Proposals (URPs) submitted to ASHRAE

Signed: _____
Principal Investigator

Date: _____

Printed Name and Title: _____

Signed: _____
Authorized Representative of Proposing Institution

Date: _____

Printed Name and Title: _____

Institution (if applicable): _____

Title of Proposal: _____

7.3 ASHRAE Innovative Research Grant Program

Purpose:

The ASHRAE Innovative Research Grant was established to provide seed funding for novel research deemed to have the potential to significantly advance the state-of-the-art in heating, ventilating, air-conditioning and refrigeration engineering. The idea is to encourage out-of-the-box research to complement the research proposed and guided by technical committees.

Description of the Grant:

The award carries a base grant of \$50,000 per year for two years, with an additional \$25,000 available in the third year if it is matched by an industrial contributor. The maximum award from ASHRAE would be \$125,000 and the maximum available to the recipient would be \$150,000. The industrial support must be from industries engaged in activities related to ASHRAE's areas of interest.

The intent is to fund one (1) award each year subject the following conditions:

- Suitability of Proposals - A competitive process will be used to evaluate research proposals. If, in a given year, there are no proposals that meet the criteria for the award, an award will not be made.
- Funding Constraints - The amount of research funding available for initiating new research projects is highly variable from one year to the next. When research funds are limited, ASHRAE's Research Administration Committee (RAC) may opt to forego requesting proposals for this grant.

The grant will have very little oversight from ASHRAE and is intended to enable the investigator to perform enough work to complete an initial evaluation of the feasibility of a new concept, process, methodology, technology, etc. Projects producing promising results could lead to additional research on a larger scale through a URP or a TC-sponsored RTAR and work statement.

Selection Process:

A two-phase process managed by RAC will be used to select grant awardees. The initial phase will entail the evaluation of pre-proposals consisting of a two-page whitepaper and a two-page curriculum vitae for the principal investigator. Pre-proposals will be invited once a year when funding is adequate to support the award. The evaluation of pre-proposals will be organized through RAC's Research Planning Subcommittee and will be performed in conjunction with the RAC Fall meeting held each year.

Full proposals will be invited from five or fewer individuals each year, and the possibility exists that there will be no invited full proposals if the pre-proposals fail to identify a project of sufficient novelty and merit. Evaluation of the full proposals will be organized through RAC's Research Activities Subcommittee and will be performed in conjunction with the RAC Spring meeting each year. As in the case of the pre-proposals, the possibility exists that all of the invited full proposals could be rejected, in which case there would be no grant awarded in that particular year.

Selection Criteria:

The criteria for selecting projects for funding consists of the following: 1) novelty of the research; 2) importance of the problem; 3) potential for success; 4) student involvement; and 5) cost sharing.

Schedule:

Pre-proposals are due August 15 and should be submitted to ASHRAE's Manager of Research & Technical Services, 1791 Tullie Circle, NE, Atlanta, GA 30329. Full proposals are due March 15.

8. RESEARCH AGREEMENT

Once a project, from whatever source, has been approved for funding, the Principal Investigator is notified and sent a sample of the standard ASHRAE Research Agreement. (See attached copy – the latest approved version of the agreement can be found in Appendix A of the RAC Manual of Procedures and on the “Research” page of the ASHRAE website.) This gives the institution the opportunity to object to any provisions. In the few instances where objections have been raised, they have usually been easily negotiated.

After 2 to 3 weeks, if no objections are received or when objections have been resolved, a final copy of the research agreement is prepared for the specific project listing the cost, payment schedule, report schedule and list of deliverables. Two copies are signed by the President and Executive Vice-President of ASHRAE and forwarded to the institution. Upon receipt of a copy signed by authorities of the institution, the initial payment is made and the project begun.

Subsequent payments are made upon receipt of the quarterly progress reports, the final report (15% of total contract) and upon receipt and acceptance of all deliverables (10% of total contract).

RESEARCH AGREEMENT

This Research Agreement (the “Agreement”) with an effective date of XXX is between American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., (the “Society”) with a principal place of business at 1791 Tullie Circle, NE, Atlanta, GA 30329 and (the “Institution”) XXX, with a principal place of business at XXXX.

Whereas, the Society has indicated a desire to undertake a research project relating to “XXX; and,

WHEREAS, the Institution represents that they have the necessary knowledge, expertise and capability to perform the Services;

NOW, THEREFORE, the parties hereto, in consideration of the mutual promises and undertakings herein contained do thereby mutually promise and agree as follows:

ARTICLE I - STATEMENT OF WORK

The Institution shall perform the Services described in the proposal entitled, “XXX),” dated XXX. The proposal is hereby made a part of this Agreement by reference and designated Appendix A.

ARTICLE II - TYPE OF AGREEMENT

This Agreement shall be a fixed sum contract in the amount of \$XXX which shall include, but not necessarily be limited to: actual direct labor, materials, travel, subcontracts, employee benefits, general and administrative expenses and overhead, as specified in the proposal.

ARTICLE III - PERIOD OF PERFORMANCE

The period of performance shall be from XXX to XXX unless terminated at an earlier date pursuant to the general provision of GENERAL CONDITION IX, TERMINATION, or extended to a later date in accordance with GENERAL CONDITION V, CHANGES IN SCOPE OF SERVICES.

ARTICLE IV - PAYMENTS

During the period of performance, the Society agrees to pay the sum of \$XX to the Institution in [(A)] equal installments of \$[B]. The first installment shall be paid on or within thirty days after the execution of the Agreement. Subsequent payments shall be made within thirty days of the Society’s acceptance of Progress and Financial Reports described in GENERAL CONDITION IV, DELIVERABLES, during the term of the Agreement. In addition, a payment of \$XX shall be made contingent upon submission of the Final Report described in GENERAL CONDITION IV, and the final payment of \$XX shall be made contingent upon completion of all Services, the acceptance of the Final Report and the receipt of the Research or Technical Paper described in GENERAL CONDITION IV.

Payment of each installment, except the first and final two, shall be contingent upon receipt and acceptance, in the Society’s sole discretion, of the Progress Reports described in GENERAL CONDITION IV.

ARTICLE V - COMPLETE AGREEMENT

This Agreement plus the attached GENERAL CONDITIONS I through XVII constitute the complete agreement of the parties hereto with respect to the Services listed herein and supersedes all prior statements oral or written. This Agreement may be modified only by mutual written agreement of the parties.

IN WITNESS WHEREOF, the said parties have caused their corporate names and seals to be affixed hereto by the duly authorized officers.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS, INC.

Name:

Name:

Date:

Date:

Title: President

Jeff H. Littleton
Title: Executive Vice President

(Seal)

INSTITUTION

Name:

Date:

Title:

(Seal)

GENERAL CONDITIONS

GENERAL CONDITION I - WORK PERFORMANCE

The Institution shall perform the Services by the utilization of its best efforts, in a workmanlike manner by qualified personnel, in accordance with standard scientific and technical procedures, and practices.

GENERAL CONDITION II - LIMITATION OF OBLIGATION

Neither party shall be obligated to incur costs (excluding any previously agreed to shared amount) beyond those shown in ARTICLE II, unless agreed to in writing by the parties.

GENERAL CONDITION III - DISBURSEMENTS

The Institution agrees that disposition of the funds paid them for the Services shall be generally in accordance with that outlined in the Application for Grant of Funds previously submitted by the Institution and attached hereto. No expenditures in excess of \$1,000.00 beyond that so defined in the proposal shall be made for equipment or supplies except on written approval by the Society's Manager of Research and Technical Services.

GENERAL CONDITION IV - DELIVERABLES

Progress, Financial and Final Reports, Research or Technical Paper(s), and Data shall constitute the only deliverables ("Deliverables") under this Agreement and shall be provided as follows:

a. Progress and Financial Reports

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

Furthermore, 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.

b. Final Report

A written report, design guide, or manual, (collectively, "Final Report"), in a form approved by the Society, shall be prepared by the Institution and submitted to the Society's Manager of Research and Technical Services by the end of the Agreement term, containing complete details of all research carried out under this Agreement. Unless otherwise specified, six copies of the final report shall be furnished for review by the Society's Project Monitoring Subcommittee (PMS).

Following approval by the PMS and the TC/TG, in their sole discretion, final copies of the Final Report will be furnished by the Institution as follows:

- An executive summary in a form 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 format and one in Microsoft Word.

c. HVAC&R Research or ASHRAE Transactions Technical Papers

One or more papers shall be submitted first to the ASHRAE Manager of Research and Technical Services (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 papers. The paper title shall contain the research project number (XXXX-RP) at the end of the title in parentheses, e.g., (XXXX-RP).

All papers or articles prepared in connection with an ASHRAE research project, which are being submitted for inclusion in any ASHRAE publication, shall be submitted through the Manager of Research and Technical Services first and not to the publication's editor or Program Committee.

d. Data

Data is defined in General Condition VI, "DATA"

e. 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

The Society may request the Institution submit a technical article suitable for publication in the Society's ASHRAE JOURNAL. This is considered a voluntary submission and not a Deliverable. Technical articles shall be prepared using dual units; e.g., rational inch-pound with equivalent SI units shown parenthetically. SI usage shall be in accordance with IEEE/ASTM Standard SI-10.

GENERAL CONDITION V - CHANGES IN THE SCOPE OF SERVICES

The Society or the Institution may, at any time, by written request suggest changes to the scope of Services, including but not limited to (a) revising, adding or deleting from the Services, or (b) revising the period of performance. Such request will be incorporated into this Agreement by mutual consent in writing. If any changes in the Scope of Services result in an increase or decrease in the total cost for the Services, the fixed sum described in ARTICLE II will be adjusted before such change becomes effective.

GENERAL CONDITION VI - 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.

GENERAL CONDITION VII - PUBLICATION

The intent of the parties is to make the results of the Services available to, and for the benefit of, the public. In view of their financial support of the Services, the Society shall own the exclusive rights to publication of all Data, Research or Technical Papers, Progress, Financial and Final Reports resulting from the project for the shortest of the following periods:

- a. Until the Society gives the Institution written permission to publish the results, or
- b. Until the Research or Technical Paper described in GENERAL CONDITION IV, DELIVERABLES, is published, at

which time the paper or derivative paper based on data resulting from the Services, may be published by the Institution with acknowledgement to the Society, or

- c. Until the period of one year has passed from the submission of said Research or Technical Paper to the Society at which time the paper or derivative paper based on data resulting from the Services, may be published by the Institution with acknowledgement to the Society,

Prior to publication by either party, the Institution may catalog and place theses or reports of the Services in the Institution's library for research and reference purposes.

The cooperative character of the investigation shall be recognized in each text, on the title page or on the cover of the Final Reports, Research or Technical Papers or other published accounts of the Services by including the following annotation: "Results of Cooperative Research between the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., and [Name of Institution]."

Prior to the Institution's offering for sale or distribution any book, manual, guide, software, or other such product of commercial value created in connection with the Services, the Institution and/or the Principal Investigator shall enter into a royalty or publication agreement with the Society.

The Institution may not use the ASHRAE name or logo in any manner which may imply the Society's endorsement of any publication or software resulting from the Services without prior written permission from the Society.

GENERAL CONDITION VIII - PATENTS

The Institution agrees to promptly disclose any patentable or copyrightable inventions resulting from the Services to the Society and will assist the Society in seeking a patent(s) with respect to such inventions. Alternatively, the Society may permit the Institution to seek a patent provided: (i) the Institution executes all documents necessary to obtain such patent; (ii) the Institution grants to the Society, a worldwide, non-exclusive, irrevocable, sublicensable, royalty-free license use for any purpose, the patented work; and (iii) the Institution shares its net income from such patent(s) with the Society in the portions 40% to the Society and 60% to the Institution.

GENERAL CONDITION IX - TERMINATION

The Society shall have the right to terminate this Agreement upon 30 days' notice in writing to the Institution for any reason. If the Society exercises this termination right, the Institution agrees to stop all work to the extent specified in the notice and incur no further expenses beyond those authorized in such notice.

Likewise, the Institution shall have the right to terminate this Agreement upon 30 days' notice in writing to the Society for any reason. If the Institution exercises this termination right, the Institution agrees to stop all work immediately upon the date notice is given, except to the extent authorized by the Institution.

In the event of termination by either party, the Society will determine, in consultation with the Institution, the portion of the fixed sum earned to the date of termination. The Institution agrees, upon the Society's request, to complete the portion of the Services initiated prior to the notice of termination. The Society will pay the Institution for such Services and any agreed upon expenses up to the fixed sum of the Agreement stated in Article II, "TYPE OF AGREEMENT." Expiration, cancellation or termination of the Agreement under any circumstances will in no way be construed as a restriction, limitation or waiver of either party's rights to pursue any additional remedy (ies) at law or equity.

GENERAL CONDITION X - KEY PERSONNEL

The Institution agrees to assign the persons listed in the proposal to perform the Services for the time period and at the level of activity stated in the proposal. Should, for any reason, one or more of these persons be unavailable to carry out the assignment, the Institution shall, with prior approval of the Society, replace them with a person(s) of equal abilities and qualifications.

GENERAL CONDITION XI - STATUS, ASSIGNMENT

The Institution's status under this Agreement shall be that of an independent contractor and not that of an agent or employee. The

Institution shall have no right or power to enter into any contract or commitment on behalf of the Society. The parties acknowledge that the identity and expertise of the Institution were and continue to be material circumstances upon which the Society relied in entering into this Agreement, and therefore this Agreement is not assignable by the Institution without the prior written consent of the Society.

GENERAL CONDITION XII - COPYRIGHT INFRINGEMENT

The Institution represents and warrants to the Society that any and all materials to be prepared under this Agreement for the Society do not and will not infringe upon the copyright, patent, or license or otherwise violate the proprietary rights of any person or entity. The Institution hereby agrees to indemnify and hold the Society harmless from and against all liability, loss, damage or injury and reasonable costs and expenses (including reasonable attorneys' fees and costs of any investigation or suit related thereto, and of any judgment under any such suit satisfying any claim described herein) arising from: (i) any misrepresentation by, or breach of the representations and warranties given by, the Institution herein, or from a breach of any covenant or warranty of the Institution contained in this Agreement, or from any misrepresentation in or omissions from any other instruments, or any breach of any covenant or warranty in any instrument, furnished or to be furnished by the Institution hereunder; or (ii) from any suit, action, proceeding, claim or investigation pending or threatened against or affecting the Institution or the Society which alleges any such infringement.

In the event there is such a claim, the Institution agrees to: (i) procure for the Society the continuing right to use of the material without restriction; (ii) replace the material which is the subject of an infringement claim with material of equal suitability, in the opinion of the Society, for the use to which the infringing material was used; or (iii) modify the material which is the subject of the infringement claim so that it is no longer subject to such a claim.

GENERAL CONDITION XIII - INSURANCE

The Institution hereby represents and warrants to the Society, and agrees hereby to furnish the Society with a certificate proving compliance therewith, that it is presently conducting its business so as to comply in all respects with all applicable statutes, ordinances, rules, regulations and orders of any governmental authority with regard to Workers' Compensation Insurance coverage. Such coverage may take the form of a certificate of workers' compensation or proof of self-insurance.

The Institution covenants and agrees to purchase and maintain, during the term of this Agreement Employer's Liability Insurance ("Insurance") in a minimum amount of One Million Dollars (\$1,000,000) for the injury or death of any one employee. The terms of such Insurance shall provide that the Society receive 30 days' written advance notice prior to the cancellation, termination, alteration or material change of any such Insurance coverage.

The Institution shall, at its own expense, purchase and maintain during the performance of this Agreement, Comprehensive Automobile Liability and Comprehensive General Liability Insurance with coverage and in such minimum amounts as provided below:

1. Comprehensive Automobile Liability insurance shall include coverage for owned, hired and non-owned vehicles and shall not be in an amount less than Three Hundred Thousand Dollars (\$300,000) combined single limit for any one occurrence.
2. Comprehensive General Liability insurance shall include coverage for personal injury, bodily injury and property damage for Premises-Operations, and Products/Completed Operations Hazard. The amount of such insurance shall not be in an amount less than One Million Dollars (\$1,000,000) combined single limit for any one occurrence.

All insurance policies referred to herein shall include, by endorsement to the policy(ies), the Society as an "additional insured." The Institution shall incur the cost of any and all premiums and endorsements related to all types of insurance described herein.

Evidence of the coverage for each type of insurance described herein shall state that coverage provided is primary and is not excess or contributing with any insurance or self-insurance maintained by the Institution.

The Society shall have the right to inspect or obtain a copy of the original policy(ies) of insurance. The Institution shall, if requested, furnish the required certificates and endorsements to the Society prior to commencing performance of the Services described herein. All insurance certificates, endorsements, cancellations, terminations, alterations and material changes of such insurance shall be issued and submitted to the following:

Manager of Research and Technical Services
ASHRAE, Inc.
1791 Tullie Circle, NE
Atlanta, GA 30329

GENERAL CONDITION XIV - INDEMNIFICATION

In connection with any and all third party actions, losses, claims, demands and damages arising in connection with the performance of this Agreement.

- A. The Society agrees to indemnify and hold harmless the Institution, from and against any and all losses, claims, demands, and damages that may arise by reason of any acts or omissions on the part of the Society, its agents or employees, in performance of this Agreement, and shall assume full responsibility for the defense thereof, and upon its failure to do so on upon proper notice, the Institution reserves the right to defend such action and to charge all costs to the Society.
- B. The Institution agrees to indemnify and hold harmless the Society, from and against any and all losses, claims, demands, and damages that may arise by reason of acts or omissions on the part of the Institution, its agents, employees, contractors and subcontractors, in performance of this Agreement, and shall assume full responsibility for the defense thereof, and upon its failure to do so on proper notice, the Society reserves the right to defend such action and to charge all costs to the Institution.

GENERAL CONDITION XV - REPRESENTATIONS

Standard of Care. The Institution represents that it is knowledgeable and experienced in research services and possesses the necessary expertise, facilities, and legal right to provide the Services contemplated hereunder. The Institution represents to the Society that the Services shall be performed in a workmanlike manner consistent with the standards of care, diligence, and skill ordinarily exercised by similar professional research institutions.

Laws and Regulations. The Institution represents and certifies that in the performance of the Services it is familiar with, understands and will comply with all applicable statutes, rules, regulations, orders, judgments, directives or other governmental requirements of the United States and of any state or political subdivision or of any foreign nation, jurisdiction, or subdivision where the Services will be conducted, including, without limit, licensing and certification requirements, laws and regulations designed to protect human and animal test subjects, environmental laws, health and safety laws, worker health and safety laws pertaining to labor wages, hours and other conditions of employment. The Institution shall obtain and/or will obtain all permits, licenses, or other forms of documentation required to provide the Services for the Society in compliance with said laws. The Institution shall furnish the Society with certification of compliance with applicable permits and licenses prior to performing the Services. Where appropriate, the Institute shall certify that it complies with all the Department of Health and Human Services (National Institute of Health [NIH]) guidelines regarding use of human and animal subjects in research and that an approved animal or human subjects Board has assured compliance for the Services.

GENERAL CONDITION XVI - WARRANTY

The Institution warrants that all Services performed under this Agreement shall conform to the specifications described in the proposal referenced in Article I, Statement of Work, and the Society shall provide the Institution notice of any non-conformance as soon as practicable after discovery of such non-conformance. Institution shall promptly correct, at no additional charge to Society, any such non-conformance caused in material part by the Institution's acts or omissions.

GENERAL CONDITION XVII - MISCELLANEOUS

- a. Notices. All notices or other communications required to be given hereunder must be in writing and delivered either personally, by facsimile with electronic confirmation, by overnight courier or by U.S. mail, certified, return receipt requested, postage prepaid, and addressed as provided in this Agreement or as otherwise requested in writing by the receiving party. Notices delivered personally will be effective upon delivery and notices delivered by facsimile, overnight courier or U.S. mail will be effective upon their receipt by the party to whom they are addressed.

If to Society:

ASHRAE, Inc.
1791 Tullie Circle, NE
Atlanta, GA 30329
Attn: Michael Vaughn

If to Institution:

XXXXXX
XXXXXX
XXXXXX

- b. Governing Law. This Agreement will be governed by and construed and enforced in accordance with the laws of the State of Georgia, without regard to any conflicts of laws principles applied in that state.
- c. Severability. In the event any provision of this Agreement or any part thereof is declared invalid or unenforceable by a final judgment or decree of a court of competent jurisdiction from whose decision no appeal is taken, or a decree of a competent governmental agency, all other sections, provisions and parts of this Agreement, and the application of such provision in any other circumstances, shall remain in full force and effect.
AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS INC.

Name:

Date:

Jeff H. Littleton

Title: Executive Vice President

INSTITUTION

Name:

Date:

Title:

9. PROJECT MONITORING

Monitoring and technical evaluation of the work being accomplished is the responsibility of the TC (or TG, MTG w/research authority, SSPC or other authorized committee) sponsoring the project. This is assigned to the Project Monitoring Subcommittee (PMS) named by the TC and approved by the Research Liaison.

The PMS is guided in their efforts by the "Instructions For Project Monitoring Subcommittee" (see copy following).

Minutes should be taken at all PMS meetings and copies distributed to the members, the TC Chair, the Research Liaison and the Manager of Research and Technical Services (MORTS). These individuals should also receive copies of any PMS correspondence in their capacity as ex-officio members of the PMS.

If in the opinion of the PMS the principal investigator for the project is not performing as expected, the RP Alert form should be used to notify the MORTS as soon as possible (see copy attached).

At the conclusion of the project, the PMS shall prepare and submit a "Disposition of ASHRAE Sponsored Research Results" form to the MORTS (See Section 10).

9.1 Instructions for Project Monitoring Subcommittee

Purpose:

The purpose of the Project Monitoring Subcommittee (PMS) is to provide direction to the contractors, and provide recommendations and guidance to the TC (or TG, MTG w/research authority, SSPC or other committees authorized to sponsor a research project) members relative to their decisions, and actions in carrying out a research project.

Scope:

Inclusions - The scope of these instructions applies to ASHRAE Research and Technical Projects.

Exclusions - The scope of these instructions does not include provisions for ASHRAE Special Projects as covered in either the Policy or Procedures for ASHRAE Special Projects or Manual of Procedures for Technology Council Special Projects Committee.

Members:

At least three (3) members, but not more than five (5) including a PMS Chair, shall be nominated by the Chair of the sponsoring TC to form the PMS. The procedure for nominating and approving PMS members is the same as that for the members of Proposal Evaluation Subcommittee (PES), including provisions for nominating members of the PMS when the TC Chair is a possible bidder (see Section 6.2). No individual who bid on a project, or who is a member of an organization that bid on a project (whether successfully or unsuccessfully), may serve on the PMS of that project. It is desirable, but not required, that PMS members should be members of the PES. Appointments to the PMS are subject to the approval of the Research Liaison.

If a project has co-funding from non-ASHRAE organization (such as AHRTI, CIBSE, USGBC, etc) then the Manager of Research and Technical Services (MORTS) will appoint a representative from that organization to be a member of the PES and PMS.

The PMS shall be tentatively appointed prior to initial submittal of proposed Work Statements to the Manager of Research and Technical Services (MORTS) and finalized prior to initiation of the project contract.

The MORTS and the Research Liaison shall be *ex officio*, non-voting members of the PMS and shall receive copies of all PMS correspondence.

Monitoring:

The PMS is responsible for maintaining close contact with the contractor and providing necessary direction to accomplish the stated objective(s) of the project, within the limitations of the budget and the Work Statement. This includes the technical editing of any resultant Special Publications, assisting with review and editing of Research or Technical Papers and recommending acceptance of the product of the project.

The PMS shall report to the TC as required to conform to the purpose of this subcommittee.

The ASHRAE staff is the primary coordinator and financial manager of the project, including:

- Receiving invoices from the contractor and arranging timely payments.
- Preparing records on the technical progress of the project and relaying technical reports to the appropriate chair of committee.
- Undertaking detailed editing of publications and arranging for publication.
- Securing approvals as required.
- Providing periodic financial data in appropriate financial reports.

Deliverables:

The deliverables, including the number of copies desired from the contractor, will be clearly identified in the Work Statement accompanying the RFP and in the contract.

Technical Progress Reports, which is one category of deliverable, are required every 3 months.

Financial and management reports are required and are submitted with the Technical Progress Report.

The PMS must review these periodic reports. If the PMS does not agree with the progress, as reported by the Contractor, or if the PMS feels that there are some technical or project management issues that might affect the timely and successful completion of the project, then it must notify the MORTS and Research Liaison of this, as soon as possible, providing descriptions of the causes for concerns and recommendations of specific actions the MORTS should take. The alert form shown below is recommended to be used for this purpose.



ASHRAE RESEARCH

Optional Project Performance Alert Form

Project Information

Project Number: - RP Date:
 Title: Sponsoring
 Contractor: TC/TG:
 PMS
 Membership:
 Contract Period: to

Ratings

	(5) = Poor	(4) = Fair	(3) = Satisfactory	(2) = Good	(1) = Excellent
Contract Statement of Work Compliance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Comments:</i>					
Work Quality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Comments:</i>					
Schedule Compliance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Comments:</i>					
Rate of Expenditures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Comments:</i>					
Communication/Reporting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Comments:</i>					
Responsiveness to PMS Concerns	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Comments:</i>					

Overall Rating (average the rating numbers above):

Concerns of PMS

Additional Comments:

Suggested Corrective Actions (please indicate if progress payments should be temporarily interrupted):

Verification of Alert

By signing this form, you confirm that you have discussed this review in detail with the other members of the PMS.

PMS Chair Signature Date

The final deliverable is a Final Report or a Manual, a Research or Technical Paper, a Special Publication, a journal article, or a combination of these. The final report must be approved by the PMS and by a vote of the sponsoring TC before the project is complete. Publication of any material prior to approval by the PMS and sponsoring TC is not allowed.

Procedures:

The PMS shall follow all procedures as outlined herein (Section 9 of the Research Manual). The PMS shall coordinate all procedures with the MORTS and Research Liaison.

All instructions and comments to the contractor should be made only by the PMS Chair, who speaks for the subcommittee.

The PMS is responsible for assuring the two-way flow of information so that the TC can make informed decisions relative to PMS recommendations.

In the event of dissatisfaction with contractor's performance, the PMS shall advise the MORTS and provide all supporting material and recommended action. In determining the recommended action to the MORTS, the PMS shall present their concerns and supporting materials to the sponsoring TC for consideration and input.

Research results contained in quarterly progress reports or delivered by the contractor in semi-annual presentation to the TC should be considered interim and tentative and should be kept confidential. Results should not be released or discussed outside of the TC until the final report is delivered and approved.

Meeting Requirements:

Project Monitoring Subcommittees shall meet at least twice annually, normally at Society meetings. More meetings may be scheduled as prudent project management may indicate.

Written Progress Reports:

Verbal reports to the TC are usually required at each Winter and Annual Meeting by the PMS and/or the contractor. A written summary of this report shall be included in the TC minutes.

The PMS, at the completion of the project, shall review and, if necessary, edit the Contractor's approximately 800-word Executive Summary from the final report. The final Summary should be suitable for publication in the *ASHRAE Journal* and *Insights*, describing the results of the project, its purpose and its application in simple to understand layman's language. The PMS, in cooperation with the sponsoring and co-sponsoring TC(s), shall prepare a Disposition of ASHRAE Sponsored Research Results Form, as described in Section

Quick Summary of PMS Chair Responsibilities

- Make sure your PMS membership and contact information matches the paper work provided by ASHRAE staff and MORTS. If the project has co-funding from an outside organization make sure their representative is invited to all PMS meetings. Include your Research Liaison (RL) in all correspondence with the PMS, contractor, or MORTS.
- Before each meeting make sure you have requested a room and a meeting time from ASHRAE Meetings staff so that your meeting is printed in the official schedule.
- Review the Technical Progress Reports and Financial/Management Reports provided to you by ASHRAE staff. Use Optional Project Performance Alert Form to report any concerns or problems to MORTS.
- Keep your TC informed about the project progress. The minutes of your PMS meeting should include a summary of your report to the TC.
- When the project is complete make sure all deliverables are completed by the contractor. Make sure that the TC and contractor incorporates findings into the Handbook as defined in the original Work Statement. The PMS chair should work with the contractor to complete the Disposition of ASHRAE Research Form and send it to MORTS..

RESEARCH PROGRESS REPORT

1. Project Number and Title:
2. (a)*Contractual Completion Date: (b)*Estimated Date of Final Report:
3. Sponsoring ASHRAE Technical Committee or Task Group
4. Research Institution:
5. Objective of Research:
6. Period of Report:
7. Summary of Activity including specific accomplishments, trends or conclusions (use additional sheets if needed)
8. Any condition(s) which affect the scheduled completion or cost of the project or which suggests a modification to the scope is reported on a separate sheet.

Such a sheet is _____ is not _____ attached.

(Signature of Principal Investigator)

(Date)

(Typed Name and phone number of Principal Investigator)

(Date)

Submit Copies of this Report to:

Manager of Research & Technical Services
ASHRAE
1791 Tullie Circle
Atlanta, GA 30329

e-mail: MORTS@ashrae.net

*If the date in (b) of #2 is later than that in (a), a no-cost extension request must be made to ASHRAE headquarters. ***Noting a late completion date on this form does not automatically provide such an extension!***

RESEARCH FINANCIAL REPORT

A. Project Number and Title:

B. Research Institution:

C. Period Covered by Report:

1.0 Total ASHRAE Funds Appropriated: \$ _____

2.0 Expenditures prior to period reported: \$ _____

3.0 Expenditures during period reported:

a) Professional Salaries: \$ _____

b) Research Assistants: \$ _____

c) Fringe Benefits: \$ _____

d) Equipment: \$ _____

e) Supplies & Materials: \$ _____

f) Computer Costs: \$ _____

g) Travel & Communications: \$ _____

h) Special Expenses (explain below): \$ _____

j) Indirect Costs: \$ _____

k) TOTAL: \$ _____

4.0 Total expenditures to date: \$ _____

5.0 Balance of appropriated funds: \$ _____

6.0 Explanation of any Special Expenses:

7.0 Statement of anticipated deviation from estimated fund requirements:

8.0 Signature of Project Director: _____

Title: _____

Date: _____

Submit _____ copies to:

Manager of Research & Technical Services
ASHRAE
1791 Tullie Circle, NE
Atlanta, Georgia 30329

e-mail:

10. PROJECT COMPLETION

The completion phase of a project is usually initiated by the submission of the draft of the final report (in some cases this may be a technical manual). The draft of the final report/manual (6 copies and electronic format) is sent to the Manager of Research and Technical Services (MORTS) who distributes copies to the PMS. The PMS reviews and evaluates the report and makes suggestions for corrections and revisions to the Principal Investigator. The PMS shall ensure that an Executive Summary of about 800 words that can be easily understood by a layperson is included in the Final Report. It should include information on project scope, results, and how this project has benefited ASHRAE, the industry and/or the general public.

The PMS comments on the draft final report are considered and incorporated into a final draft. The final draft is reviewed by the PMS and forwarded with a recommendation to the TC (or TG, MTG w/research authority, SSPC, or other authorized committee sponsoring the project) for a vote of approval. When the Principal Investigator feels that he/she has understood the sense of the PMS, he/she will prepare the Research or Technical Paper(s) required by the research agreement.

The paper is submitted first to the 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. The paper should be submitted as either a Research Paper for HVAC&R Research or Technical Paper 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 Journal paper. The paper title shall contain the research project number at the end of the title in parentheses, e.g., (99-9999-RP).

The final approved manuscript of the Final Report is furnished to the MORTS as follows:

- An executive summary in a form 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 disks; one in PDF format and one in Microsoft Word.

For those projects which the RAC feels have appeal to a wide audience, the RAC will recommend to the Editor of the ASHRAE Journal that a journal article be solicited describing the project and the results.

Following completion of all phases of the project, the Chair of the Project Monitoring Subcommittee will work together with the RAC Research Liaison to complete a form entitled "Disposition of ASHRAE Sponsored Research Results". The completed form together with the Executive Summary from the original approved Final Report will be submitted to the MORTS. This summary will be written so as to be easily understood by a layperson and shall include purpose of the project, its results and how the results may be applied for benefit to ASHRAE, the industry and the public. The TC may, if it desires, edit or modify the Contractor's Summary, with approval from the Contractor, as provided in the final report to make it more suitable for wide dissemination.

The TC shall also indicate on the form anticipated ASHRAE publications where the research results will be applied, including Handbook (specific chapters and table), standards, and special publications. It is suggested that the TC also reviews the RTAR and WS for the research, to see where application of the results was originally anticipated. The TC shall report to RAC and MORTS when the project's results are actually incorporated into these ASHRAE publications.

To assist the MORTS in disseminating the results of ASHRAE's research, the TC, PMS and Principal Investigator will list on the Disposition of ASHRAE Sponsored Research Results Form specific organizations, companies, associations, standards bodies, government agencies (local, state, federal, or foreign), universities, or individuals who should be notified directly of the completion of the research and receive the project Summary

DISPOSITION OF ASHRAE SPONSORED RESEARCH RESULTS

Research Project Number and Title of Project _____

Sponsoring TC/TG/MTG/SSPC: _____

Project Principal Investigator and Affiliation: _____

Date Research Completed: _____

Will research be reported in special publication: _____ Yes; _____ No.

If so, has Special Publications been contacted? _____ Yes; _____ No.

Should research results be included in ASHRAE Handbooks? _____ Yes; _____ No.

If so, what chapter(s) in what volume(s)? _____

Should research results be included in an ASHRAE Standard? _____ Yes; _____ No.

If so, which Standard(s)? _____

Will other industry affiliates use this research (ARI, USGBC, EPA, IESNA, etc.) _____ Yes; _____ No.

If so, which Standards, guides or publications? _____

To assist MORTS in disseminating the results of ASHRAE’s research, list specific organizations, companies, associations, standards bodies, government agencies (local, state, federal, or foreign), universities, or individuals who should be notified directly of the completion of the research and receive a Summary of the project and its results. (Use additional sheet if necessary).

Please indicate if and how your responses above contrast to the original plans to disseminate the research results indicated in the “Application of Results” section from the original Work Statement (WS). The WS is available from ASHRAE staff).

Please attach the Executive Summary of this project from the approved Final Report for this project (approximately 800 words). The Summary should include the need that, initiated the project, the scope the results and how the results will benefit the industry and/or the public. (NOTE: The TC/TG/MTG/SSPC may submit a Summary that is edited from the Summary in the Final Report if it so desires.)

Please complete form and send to: Manager of Research and Technical Services
ASHRAE
1791 Tullie Circle NE
Atlanta, GA 30329
MORTS@ashrae.net

Manager of Research and Technical Services will send to Special Publications, Handbook and relevant TC’s, TG’s, MTGs and SSPCs for action.

11. DISSEMINATION OF RESULTS

The dissemination of results of a project and their wide acceptance and use is the ultimate goal of ASHRAE research. The actions in Section 10 on project completion describe how some of the dissemination is started. Those actions will result in one or more papers being published in HVAC&R Research or *ASHRAE TRANSACTIONS*. Reprints of the paper will also be available to the public at an ASHRAE meeting at a nominal charge. The possibility also exists for a Research or Technical Paper to be made part of a TECHNICAL DATA BULLETIN. For those projects for which an *ASHRAE Journal* article is written the research results become available to all ASHRAE members.

A release to the trade press will be made following the completion of research projects. The release will include a short description of the project, the results and conclusions reached and information on how more detailed information can be obtained.

The sponsoring TC (or TG, MTGs w/research authority, SSPC or other committee authorized to sponsor a research project) should utilize the information generated in updating the HANDBOOK chapters for which they are responsible and Standards Project Committees should use it in writing and revising their standards.

Some projects are designed specifically to result in the printing and distribution of a Special Publication in order to fill a void in the available literature. These projects are usually designated technical projects rather than research projects since they collect and organize information rather than generate new information.

The TC indicates on the Disposition of ASHRAE Sponsored Research Results Form the anticipated ASHRAE publications where the research results will be applied. The TC shall report to RAC and MORTS when the project's results are actually incorporated into these ASHRAE publications, and this shall be part of the RAC Research Report to the Society. RAC and MORTS shall monitor the TC's progress in incorporating the results into ASHRAE publications.

The Disposition of ASHRAE Sponsored Research Results Form also indicates entities that should be notified of the completion of the research project. The MORTS shall forward to all of these the Executive Summary from the Final Report.

The MORTS maintains a master copy of all Final Reports. Copies of the full report or portions of the report may be obtained from the MORTS at a nominal charge to cover the costs for reproduction and mailing.

Projects completed in the more recent past required the Final Report also be submitted in an electronic format. The Final Reports of these later projects are therefore also available for downloading in a PDF format.

The MORTS will forward to the Resource Promotion Committee, Chapter Technology Transfer Committee, and Technology Council the Executive Summary as well as an accounting of where the research information will be used to benefit the members (Handbook volumes and chapters, standards, or publications, with approximate dates). This will be used to assist in raising research promotion funds at the chapter level and monitoring the effectiveness of use of ASHRAE's research funds.

APPENDIX 1: RESEARCH RELATED TO TECHNOLOGY TRANSFER

Research related to technology transfer projects takes one of three forms:

1. Applied technology development projects that are intended to come up with new or enhanced techniques for dissemination of research results, Handbook materials, standards, guidelines etc.
2. Tool-kit projects, which involve development and careful validation of libraries of algorithms and computer code for systems design and/or evaluation.
3. Preparation of Research Bulletins for:
 - A. Collection or collation of technical information on a particular subject (from the Handbook, research project reports, and other relevant sources) and synthesizing the source material into a single, relatively comprehensive resource book for use by design professionals, educators, etc., or
 - B. Preparation of User Manuals for ASHRAE Standards and Guidelines.

Documents of the type 3A should be designated as Research Bulletins while type 3B documents could be designated as Research Bulletins or User Manuals, as appropriate.

The Research Administration Committee (RAC) processes projects submitted by TC (or TG, MTGs w/research authority, SSPC and other committees authorized to sponsor research) for categories 1, 2, and 3A where no co-funding appears likely. Projects in category 3A where co-funding is available could be handled by a Special Projects Committee. 3A projects are submitted by a sponsoring TC or by other legitimate ASHRAE groups (standing committees, chapter groups, etc.) to the Manager of Research and Technical Services and RAC research liaison. Projects for User Manuals (3B) are originated by the subject SSPC or SPC (or the cognizant TC/TG/MTG) and forwarded to the Standards Committee (StdC) for handling through Special Projects or StdC as appropriate. All category 3 projects are carefully reviewed at the Work Statement stage to assure RAC or StdC, Technology Council and the Board of Directors (BOD) that:

- a) The work is too extensive for a volunteer effort; and
- b) A well-prepared outline exists and a well-balanced committee will review proposals and monitor the work to assure that a useful document results.

If category 3B projects represent a considerable drain on the Research Fund, additional resources should be sought through one of the following means:

- 1) That the Director of Technology (DOT) solicit outside funding;
- 2) That Publishing Council be asked to provide funds to assist in preparation and printing of User Manuals, with the balance of ASHRAE funds to come from additional Exposition Income (see #3 just below) or from the Research Fund; or
- 3) That Technology Council petitions the BOD for additional Exposition income.

APPENDIX 2: RECOMMENDED METHODOLOGY FOR PROJECTS WITH FIELD MONITORING

Prepared by: Technical Committee 7.6, System Energy Utilization

Introduction

Many of ASHRAE's sponsored research projects involve the field monitoring of building energy systems. The data collected through these projects are very important, and are often used to support ASHRAE Handbook chapters prepared by the Technical Committees. The TC 7.6 Subcommittee on Building Monitoring has sponsored several Forums on the topic of methodology for field monitoring projects. A recurring suggestion by participants has been to disseminate information within ASHRAE on procedures for the effective design of field monitoring projects. This Appendix offers recommendations to Technical Committees interested in commissioning sponsored research projects involving building field monitoring.

How To Use The Recommendations

Field monitoring projects can be problematic and troublesome. At the first National Workshop on Field Data Acquisition for Building and Equipment Energy Use Monitoring, (Dallas, TX, October 1985), both practitioners and data users identified the major cause of these problems as the lack of procedures for monitoring project planning and execution.

To remedy this problem, a sequence of planning activities that is applicable to nearly all projects of this type has been developed, as well as ASHRAE Guideline 14-2002, *For Measurement of Energy and Demand Savings*. Since each research project is different in terms of goals, objectives and data product requirements, the details of implementing this procedure will vary by project. However, use of this recommended methodology and Guideline 14 should insure that all project design parameters are considered.

These recommendations can be used by ASHRAE Technical Committees in two ways. First, TCs and/or their research subcommittees can use this Appendix as a guide for preparing RFPs for sponsored research. The protocol will aid in specifying the requirements for the field monitoring portions of the project. Second, this Appendix can be used as an evaluation checklist when reviewing the proposals from prospective contractors.

The following sequence of planning activities is recommended for the design of building field monitoring projects. The intent of using this approach to structuring a Work Statement is to minimize the possibilities for major oversights in the design and execution of projects of this type.

1. Identification of project goals, objectives and research questions to be addressed.

The first priority should be to clearly state the purpose and expected outcome of the monitoring project, and to unambiguously state the research questions to be answered by the monitored data. This is the first step to insuring that all crucial data items are identified, and that unnecessary data items are eliminated.

2. Specification of results which meet objectives

This activity identifies the specific results that are necessary to answer the research questions of interest. This can be done through mock-ups of data tables, charts, graphs, etc. Data results should also be prioritized to accommodate possible cost trade-offs later on. The results of this activity should provide a clear specification of the data to be delivered on the project.

3. Specification of experimental design approach

Monitoring projects often collect data, which are used to compare the performance of different equipment or systems (e.g., central vs. unitary systems), or to identify the effect of changes to building systems (e.g., retrofits). Various "passive" experimental design approaches are available to do this, including: test reference design; before/after design; and flip/flop (or on/off) design. An "active" design would be to stress test a building system over a range of experimental conditions. The experimental design approach must be evaluated for its

ability to yield sufficient comparative data. The length of monitoring or conditions under which the building is monitored must be considered. For some objectives, it is important to monitor performance under extreme or design conditions; this is where “stress tests” may be considered. For some objectives, the differences in seasonal or annual energy use are important, and year-long or season-long monitoring periods are called for. In this case, there is always the risk that the weather conditions during the monitored period are not typical, and to guard against this one may combine passive monitoring periods that can be adjusted to typical meteorological conditions and active experiment design to capture performance under extreme or design temperatures. Therefore, it is essential to record adequate data on ambient conditions to be able to estimate “annual” and “design condition” performance. This must be considered in the measurement plan, Section 5 below..

4. Specification of data analysis procedures and algorithms

This activity details how the monitored data will be processed to produce the data results previously specified. These procedures may involve the use of engineering calculations, models, statistical methods, etc. The analysis procedures may also involve the use of engineering constants, or one-time field measurements in addition to time-series monitored data. This activity will identify all variables required for data analysis, and their specific use and priority. The entire set of variables required to produce the required data results will include a sub-set of data items to be monitored in the field. This activity identifies them as well. Data analysis procedures and algorithms should also take into account established test and rating standards and methods for building system components and equipment listed in the Codes and Standards chapter of the HVAC Systems and Applications volume.

5. Specification of field monitoring data points – measurement plan

This activity treats the sub-set of variables to be monitored or measured in the field. The output of this task is often referred to as a measurement plan, which details the location of specific data points within the building system. The measurement plan is also the working document for installers of field equipment and sensors. The measurement plan should also include details for the types of sensors required, and procedures for taking any one-time measurements.

6. Specification of building characteristics data

This activity develops the data framework that will be used to describe the building or buildings being monitored. It is usually not possible to understand the relevance of monitored data without a reference framework that describes the building being monitored and the types of activities conducted in the building. The building information collected depends on the systems of interest for the project. However, general building information could include: the type of zone, building or complex being monitored; the types of activities in the facility(s); the age, number of floors and conditioned area; building schedules for occupancy and temperature; a description of the building envelope including items such as walls, glazing, roof, shading and large doors; descriptions of the HVAC and control systems, and their maintenance; descriptions of lighting systems; descriptions of other important energy systems such as large computer or food service operations; the types of fuels or utilities supplied to the building; a history of utility and fuel purchase statements; and any special aspects of all the above that impact the interpretation of the monitored data results.

In addition, if energy improvements are made during the course of the project, a description of the improvements should be documented.

7. Specification of verification and quality control procedures

A common field-monitoring problem is measurement failure, which is often due to failed sensors, that go undetected for long periods of time. Verification and quality control procedures can minimize this problem by: specifying frequent data retrieval and error checking; pre-specification of acceptable ranges of sensor performance; secondary range check calculations using monitored data; and use of back-up sensors for critical measurements or inaccessible locations. Quality control procedures may also reference existing standards for certain measurements such as temperatures and flow rates. Sensor accuracy and total data acquisition system accuracy should also be specified here.

8. Specification of data collection hardware

One of the final steps is to select the sensing and data logging hardware required to collect the specified data, taking the verification and quality control procedures into account. Some guidance on hardware selection is available from the Measurement and Instruments chapter of the ASHRAE Handbook, Fundamentals Volume. Other guidance is available from published measurement standards.

9. Specification of recording and data exchange formats

This activity specifies the formats in which the data will be supplied to the end-user or other data analysts. It is always important to specify both raw and processed data as deliverable items for research projects. Project sponsors often wish to conduct supplemental analyses of the data, and should specify the media and format they require (e.g., database, spreadsheet, ASCII, etc.). Documentation of data file format should be required.

Frequently the goal of a monitoring project is to determine the impact or savings associated with a change or improvement in a building (i.e., the before and after experimental design). This special case commonly occurs when energy service companies (ESCOs) make an improvement and are compensated based on measured "savings". Two standardized methods have been developed to determine savings in these situations:

- 1) ASHRAE Guideline 14-2002 *Measurement of Energy and Demand Savings*
- 2) International Performance Measurement and Verification Protocol

The two references above should be consulted when the goal of the research project is to collect monitored data to discern the impact of a change.

ASHRAE Guideline 14 recommends many of the industry consensus and standard methods to measure and verify energy savings resulting from the implementation of energy-conservation measures developed by the U.S. Department of Energy. The second reference, International Performance Measurement & Verification Protocol (IPMVP), provides standard measurement & verification (M&V) terminology and defines four M&V options to quantify energy and water savings. More information can be found at <http://www.ipmvp.org>. or at <http://www.evo-world.org>

Checklist Of Contractor Evaluation Criteria For ASHRAE-Sponsored Field Monitoring Research Projects

1. Experimental Design Evaluation Criteria
 - A. Understanding of project goals, objectives and research questions to be addressed.
 - B. Responsiveness and completeness of proposed research results to meet project objectives as specified by the TC.
 - C. Appropriateness and practicality of experimental design approach.
 - D. Completeness of data analysis procedures and algorithms including specification of algorithms, analytical tools and models, and analysis variables.
2. Data Collection Evaluation Criteria
 - A. Completeness of specification for field measurement plan.
 - B. Completeness of specification for building characteristics data.
 - C. Completeness of specification for data verification and quality control procedures.
 - D. Appropriateness of proposed data collection hardware to meet project objectives.
3. Product Delivery Evaluation Criteria
 - A. Completeness of specification for data recording and data exchange formats.

APPENDIX 3 GUIDELINES FOR THE USE OF COMPUTATIONAL FLUID DYNAMICS (CFD)

Scope

Many TC and Research Chairs are considering and specifying the use of Computational Fluid Dynamics (CFD) for their Research Projects. CFD is computationally difficult and is not well understood by the average technically trained engineer. These guidelines are intended to help increase the understanding of CFD and its strengths and its disadvantages. These notes should also help the writing of a better work statement and the evaluation of the bids.

Definition

CFD is based on several engineering principles including conservation of mass, and energy and sometimes linear momentum. Quite often the basic Navier Stokes (NS) equations are used. Unfortunately the NS equations are not easily solved and require quite a bit of judgment and a number of assumptions to reach a solution. Basically each application includes constructing the flow field control volume, developing the computational mesh (or grid), which defines the surface of the flow field, applying boundary conditions, solving for field variables and evaluating the results.

Potential Strengths

There are several advantages to using CFD techniques. These include not only the ability to visualize the flow (velocities, temperatures etc.) profiles but also the possibility of modeling several variations of specific situations without the time and cost of building individual test rigs. Complex flows often can be analyzed only by CFD modeling because of experimental difficulties. Accuracy can be comparable to other test methods.

Potential Disadvantages

CFD requires a highly trained investigator with very good judgmental and mathematical skills. Accuracy is entirely dependent on the talents of the principal CFD investigator and the CFD package. Computer runs can be very long (up to a week or more) and require high-speed large memory computers. It is possible for two equally talented investigators to produce very different results for the same problem while using the same CFD package. The proposed investigator should have a very good practical as well as theoretical background in the specific areas of interest

ASHRAE Applications

Our Society continues to see a number of projects which should use CFD methods, including velocity, pressure and temperature predictions for rooms, duct systems, total buildings, airplanes, tunnels and additionally smoke plume determinations and laboratory hood velocity contours.

Structuring the Work Statement

A TC can write clearer work statements if they take advantage of certain fundamentals.

A literature search among past ASHRAE projects using CFD will share questions raised by bidders, responses by the Project Monitoring Sub-committee (PMS) and the final results of the project.

An understanding of the commonly used words as well as strategies used by CFD investigators will help to clarify the work statement. A typical outline follows and applies to the three major portions of the package; the pre-processor (input), the problem solver, and the post-processor portions.

1. Constructing the flow field control volume

A flow field is normally an internal flow within solid walls or an external flow around an immersed body.

Careful selection of a flow field control volume will permit efficient construction of the continuity, energy and momentum equations and also help to simplify later assumptions.

2. Constructing the flow field mesh or grid

This activity defines the flow field by means of a series of shapes (surfaces [2D] use triangles or quadrilaterals, solid models [3D] use bricks, wedges or tetrahedrons) connected to each other at points called nodes. Forces, temperatures and other properties are transferred to adjacent shapes through nodes. The more nodes the more accurate the transfer of these properties but the more computation time is required. The intensity of the mesh (or grid) can be increased or decreased throughout the surface depending on the activity at certain points or the accuracy desired.

This work is performed in the pre-processor portion of the package.

3. Applying boundary conditions

The boundary conditions which describe the flow field profile between the “walls and boundary” and the average fluid velocity as well as project specific data are entered here. Boundary conditions can also include pressure, temperature, turbulence level, heat flux and contamination and levels. The wall roughness should be mentioned if a good correlation with experimental results is desired.

Modeling the turbulence intensity is very difficult but must be done well for accurate estimates of pressure and friction losses, drag, mixing of temperature and other profiles. Turbulence is described as consisting of vortices (eddies or swirl) which are always changing size, position and energy. A popular turbulence model is the $k-\epsilon$ model used primarily for fully developed turbulent flow. Unfortunately the flow fields will contain either turbulent, transitional or laminar flow. Near the “walls” turbulence intensity is much lower, shear forces predominate and the original $k-\epsilon$ formula does not apply. The $k-\epsilon$ formula estimates the overall kinetic intensity (k) and its dissipation rate (ϵ). For estimating partially turbulent flow the $k-\epsilon$ formula can be modified or another method of analysis is selected. Other models include: 1) Using 3D time based NS equations to directly numerically simulate (DNS) only the most important scales of turbulence and 2) Simulating the energy of only the larger eddies (LES) and averaging the effect of the small eddies on the large ones. These last two options require a lot of calculation capacity (and time) which reduces their popularity. Possibly at some time a direct numerical profile of all turbulence energy levels will be developed but for now various approximations must be used.

This work is performed in the pre-processor portion of the package.

4. Solving for the field variables

A series of partial differential equations (based on conservation of mass, momentum and energy) are written describing the fluid flow within the control volume. A special form of these equations are called Navier- Stokes equations which deal well with viscous flows - flows of interest to ASHRAE. Then Finite Element Analysis or Finite Difference Analysis or Finite Volume Analysis are used to reduce these complex differential equations (this is often described as discretizing the primary equations) to algebraic equations describing the elements of the grid or mesh. The turbulence calculations are performed here.

Unfortunately these equations are complex (non-linear, second order, partial differential equations) and require certain simplifying assumptions as well as a computer based equation solver to resolve. One common strategy begins with an initial approximation of the final result and tries in successive calculations to reduce this approximation to a very small value. Often the initial approximations are not accurate and this inaccuracy contributes to long computer runs to achieve the desired results.

This work is performed in the solver portion of the package.

5. Selection and presentation of the results

This includes the plotting of various streamlines including velocities, pressure contours, isotherms etc. The selection of a post-processor with good 3D graphics will help communicate the results of the project. While pressure profiles are normally not presented they can be a useful check on the primary results.

This work is performed in the post-processor portion of the package.

6. Evaluating the results

The theoretical CFD results should be compared to work based on other techniques to validate the assumptions required for CFD calculations. The researcher can also verify his / her work by changing the grid size and comparing results. The different results should relate to each other. However there are normally errors of some size in both sets of data so a discussion of errors is warranted.

Preparation of the Work Statement

The TC should specify whether CFD or other analytical methods are preferred. CFD can often output data in a visual format that facilitates rapid understanding of otherwise complex results. The selection of an analytical method (CFD or other) is often based on the type of project, ease (or lack thereof) of analysis, accuracy desired and final use of the data by others. Sometimes a supplementary note giving the contractor a choice of technologies can be useful if the results will be comparable.

When considering CFD the TC has available several sources for guidance. These sources include data from previous contracts, past members of other PMS and possibly current ASHRAE members who have been prior CFD contractors and for some reason will not bid on the current project.

The TC should discuss the type of flow field; either steady or non-steady state. If non-steady state the minimum and maximum conditions should be reviewed in detail. If the flow has a predictable time period from minimum to maximum and then to minimum value this should also be reviewed.

The level of required accuracy should be discussed in depth and a clear standard be set. An often-asked question is “What is the level of accuracy needed to make this project useful and how much will this accuracy cost?” There is no easy answer here but the PMS should develop this guideline. The bidder's perception of the goals of the contract will influence the estimated time input and the ultimate cost. Ambiguity should be avoided as much as possible. Increased accuracy will require significantly more computational time and possibly a commitment of high capacity hardware. However it is likely that the final work may not be useable by the average consultant if the computational time is too large or special computers are required.

The contractor should discuss a proposed validation method for the specific research project. This validation can include a comparison with actual test data, by changing the mesh sizes or by deleting a major component and observing a predictable result.

Many TC members believe that one can circumvent the technical details mentioned above by writing a performance specification. Unfortunately a good performance specification for CFD should discuss the assumptions available to the contractors so the offers are somewhat comparable. Therefore the preparation of a through performance specification can require as much effort as a normal “task based” specification would require.

The contractors should be advised in the work statement that a standard format for the final report should be followed including at least the following; a table of contents, an abstract, presentation of the research procedures and results, an error (sensitivity) discussion, conclusions and recommendations and, finally, references.

Preparation of the Proposal by the Contractor

Many contractors have resources available from past contracts, which can reduce the time input as well as

hardware (and software) purchases. As long as the goals of the project are met, the contractor should be encouraged to use all resources as efficiently as possible as long as the use of these special resources is communicated to the Society.

The contractors should be asked to specify the type of hardware to be used and the approximate amount of computational time required.

Also the contractor should be asked to explain whether the data could be extrapolated to physically larger (or smaller) models or to other changes in the research parameters such as temperatures, pressures, viscosities etc.

The potential contractor should discuss the following in his application:

1. The reasons for selecting the general purpose CFD package.
2. The ability of the code to meet the computational and modeling needs of the project as well as indicating the strengths of the proposed pre- and post-processors. As an example, not all CFD packages are equal in the modeling of radiation, transitional flows and flows where gravitational and buoyant forces are similar. ASHRAE has no preferred program. The contractor should select the program with which he/she wants to work. The contractor should discuss the validation of the particular package and list the benchmark² problems used by the software designer to validate the program.
3. A detailed discussion of the contractor's computational approach should be included. At least the following areas should be reviewed: the assumptions, the proposed basic equations, element selection (type and resolution), choice of a turbulence problem solver (the k- ϵ model is often used), boundary layer definition and a method of calculating the loss coefficients. The TC may want to define the boundary layer profiles if it is aware of special conditions.
4. The form in which archival results will be provided should be specified. ASCII form is preferable for future readability, but binary formats may be acceptable if the format is clearly documented. The media format that will be used to deliver the results should also be specified.

APPENDIX 4: SAMPLE WORK STATEMENT AND COVER SHEET

This example WS has been edited from the actual WS1388, including changes to text and TC votes, to better illustrate the points made in Section 3 of the Research Manual.

WORK STATEMENT COVER SHEET

Date: December 15, 2006

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

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

Title: Derating recommendations based on field testing and analysis of high-altitude installation of gas-fired boilers and water heaters

WS # 1388
(To be assigned by MORTS - Same as RTAR #)

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

HVAC Systems and Equipment, Chapter on Automatic Fuel Burning Equipment

Sponsoring TC/TG/SSPC: 6.10 Fuels and Combustion

Date of Vote: 12/9/06

For		12
Against	*	1
Abstaining	*	2
Absent or not returning Ballot	*	3
Total Voting Members		18

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

TC6.1 vote 13-0-0-3 on 6.27.06
TC6.6 vote 10-0-4-1 on 6.27.06

Has RTAR been submitted ? Yes
Strategic Plan A1, A6
Theme/Goals:

Work Statement Authors: ******
Hall Virgil
Bill Roy
Tom Butcher

Proposal Evaluation Subcommittee:
Chair: Thomas Butcher
Members: David Bixby, GAMA
Hall Virgil
Ray Albrecht
Bill Roy

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

Recommended Bidders (name, address, e-mail, tel. number): ******
Battelle, Columbus, OH (Dr. Darrell Paul)
Gas Consultants Inc., Waltham Hills, OH (Carl Suchovsky)
Gas Technology Canada, Ontario, Canada (Don Mills)
Gas Technology Institute, Des Plaines, IL (Neil Leslie)
Intertek Testing Services NA, Inc. Cortland, NY (Jackie Wilchek)
Canadian Standards Association, Toronto, Ontario
(John Gorman, Cleveland, OH)

Potential Co-funders (organization, contact person information):
Gas Appliance Manufacturers Association - coordinated donation of appliances for testing

(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)
*	*	
*	*	
*	*	

* Reasons for negative vote(s) and abstentions
One voter who abstained simply did not feel familiar enough with the topic and issues.
One voter who abstained may bid on the project.
Negative voter felt project budget should be larger.

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

WORK STATEMENT# 1388 (Same as RTAR)
SPONSORING TC/TG/MTG/SSPC:# 6.10 – Fuels and Combustion
CO-SPONSORING TC/TGs TC 6.1 and TC 6.6

A. TITLE

Derating Recommendations Based on Field Testing and Analysis of High-Altitude Installations of Gas-Fired Boilers and Water Heaters

B. SUMMARY

Current practice for derating gas-fired heating appliances with altitude is based on outdated data not relevant to modern, high-efficiency burner technology. This project includes an experimental effort to determine derating requirements of boilers and water heaters. An earlier ASHRAE research project addressed furnaces and found that lower derating could be accepted with modern equipment. This project will provide the needed basis upon which to change this practice for boilers and water heaters. Estimated budget: \$150,000.

C. APPLICABILITY TO THE ASHRAE RESEARCH STRATEGIC PLAN

2005-2010 Research Plan: One of the themes in the Strategic Plan is Energy and Resources and the stated goals include providing guidance on techniques and development of best practices. This project addresses the need to reevaluate the derating standards that were developed for combustion systems that existed decades ago. Applying these to modern systems that achieve much higher efficiency through lower excess air operation, forced air flow, and higher backpressure of high efficiency heat exchangers, is needed to eliminate an impediment to the economical adaptation of modern appliances. (Goals A1 and A6). A reduction in the amount of required appliance derating supports sustainability by permitting the use of physically smaller appliances to save on manufacturing materials and energy.

2010-2015 Research Plan: By recognizing the higher efficiency at altitude of modern combustion systems, this project will contribute to Goal 9 (Improved HVAC&R Components) by improving the right-sizing, and therefore cost-effectiveness, of more efficient combustion control systems.

D. APPLICATION OF THE RESULTS

The results of this work will be to provide guidance to manufacturers, design engineers, code committees, and installers on best practices for derating.

E. STATE-OF-THE-ART (BACKGROUND)

Installation codes such as the ANSI Z223.1/NFPA 54 National Fuel Gas Code and CSA B149.1 National Standard of Canada Natural Gas and Propane Installation Code specify that gas-fired furnaces, boilers and water heaters be derated during operation at altitudes of more than 2000 ft above sea level. These appliances are to be adjusted for the lower amount of available oxygen per cubic foot of air. The prescribed method of the fuel gas reduction is to reduce gas input rate by 4% per 1000 feet above sea level. This reduction must be considered before selecting appropriately sized appliances. The usual method to reduce the input rate is to use smaller gas orifices or to reduce the gas orifice manifold pressure. Recent demographic trends have resulted in greater numbers of these appliances being operated at altitudes high enough to require large derating factors. Recent appliance innovations cause many engineers in the industry to question the appropriateness of this simple rule.

F. ADVANCEMENT TO THE STATE-OF-THE-ART

The original 4% derate per 1000 feet above sea level method was developed for Bunsen-burner type appliances. The recent development of state-of-the-art combustion systems and appliances (e.g. fan-assisted combustion,

direct venting, condensing heat exchangers, inshot and pre-mix burners, sidewall venting) may permit some appliances to operate acceptably with less or no derating for altitude. This research will update the altitude derating methods so they apply to modern appliances.

G. JUSTIFICATION OF NEED AND VALUE TO ASHRAE

Some manufacturers' listed appliance instructions already specify less derating than 4% per 1000 feet above sea level. These inconsistencies cause confusion among installers, leading to misapplications similar to the vent misapplications that were common before 1991 and 1992, when the GAMA and ANSI Z223.1/NFPA 54-1992 National Fuel Gas Code (NFGC) venting guidelines were issued for venting mid-efficiency fan-assisted combustion furnaces. The NFGC and other codes need new high-altitude guidelines that are consistent for each current appliance type.

From the consumer's perspective, less derating would mean less need to increase furnace, boiler, or water heater size at high altitudes, with consequent installed-cost savings.

The experience of knowledgeable gas-fired combustion appliance engineers is that different appliance types (i.e., water heaters versus furnaces versus boilers, natural-draft versus fan-assisted combustion, direct-vent versus non-direct-vent, etc.) react differently to the effects of high altitude. Therefore, multiple appliance types are required to be tested and analyzed. Furnaces were previously tested on ASHRAE Research Project RP1182 because they are the highest sales volume gas appliances with the largest gas inputs and because they include a variety of the needed combustion system types. The results of that work were strongly indicative that a much lower derate factor is appropriate for furnaces and that a follow-on project be initiated to analyze two other appliance types, boilers and water heaters.

H. OBJECTIVES

Based on first-principle work and recommendations reported in the Gas Research Institute topical report High Altitude Installation of Natural Gas-Fired Appliances with Fan-Assisted Combustion Systems GRI-95/0014, determine whether less derating than is currently prescribed can be safely permitted for operating natural gas-fired and propane gas-fired boilers and water heaters at high-altitude.

Determine the applicability and validity of National Standard of Canada CAN/CGA-2.17-M91, Gas-Fired Appliances for Use at High Altitudes, section 2.2 for use in testing appliances at near sea level (0 to 2,000 feet altitude) to demonstrate robustness at high altitude (2,000 to 10,000 feet altitude).

Investigate alternate testing and prediction methods, which may be used to provide equivalent high altitude performance and validation.

Work with the Project Monitoring Subcommittee (PMS) to provide industry acceptable data and tools for better understanding of high altitude applications and acceptable high altitude appliance heating capacities.

I. SCOPE/TECHNICAL APPROACH

The proposed research will perform the tasks described in below.

1. Identify three geographical locations for field testing. One location for benchmarking shall be as close to sea level as possible but no higher than 1000 feet. The other two locations shall be in the 4,000 foot and 10,000 foot range, with at least 4,000 feet difference in altitude between any two locations (use population centers as guides).
2. Develop a detailed test plan to include details of test instrument calibration, method of test, test parameters, test data forms, test acceptance criteria, schedule, and locations with altitudes. This test plan shall be submitted to the PMS for review and approval prior to the start of testing.

3. Select and obtain suitable boiler and water heater models for test. The Gas Appliance Manufacturers Association directory of ratings can be used to assist in the selection of appliances. The following boiler and water heater types shall be included:

- One Category I draft hood equipped, standing pilot, water boiler with a rated sea-level input in the range of 50,000 Btu/hr to 150,000 Btu/hr,
- One Category III (induced draft) water boiler with a rated sea-level input in the range of 50,000 Btu/hr to 150,000 Btu/hr,
- One Category III or IV direct vent water boiler with a rated sea-level input in the range of 50,000 Btu/hr to 150,000 Btu/hr,
- One 40 gal., 40,000 Btu/hr residential flammable vapor ignition resistant (FVIR) model,
- One Category III or IV 40 gal., 40,000 Btu/hr residential FVIR model
- One condensing 40 gal., 40,000 Btu/hr commercial FVIR model

Additional qualifications:

- Each of the boiler and water heater models shall be manufactured by a different manufacturer.
- Each of the boiler and water heater models shall be listed for use with natural gas and propane.
- Direct vent appliances shall be installed and tested with maximum listed vent and inlet piping lengths.
- Category III and IV appliances shall be installed and tested with maximum listed vent length.
- The following burner types shall be included in the appliance selections: lanced port tubular, punched port tubular, in-shot, and pre-mix.

Prior to procurement of specific appliances a proposed list shall be submitted to the PMS for approval.

4. Perform the tests listed below on the boilers and water heaters, in accord with the referenced sections of the ANSI Z21.13-2004•CSA-4.9-2004 (Gas-Fired Low Pressure Steam and Hot Water Boilers Standard), ANSI Z21.10.1-2004--CSA 4.3-2004 Vol 1, ANSI Z21.10.3-2004--CSA 4.3-2004 Vol 3 and CAN/CGA-2.17-M91 (Gas-Fired Appliances for Use at High Altitudes). The focus of the testing shall be to determine the effects of altitude on combustion, CO (air-free) and CO₂ levels, burner and pilot or igniter operating characteristics, heat exchanger operating temperatures, and blocked-vent shutoff combustion performance. Each furnace model shall be tested at the conditions specified in OTHER INFORMATION FOR BIDDERS. (Section numbers refer to the boiler and water heater standards, respectively.)

- a) Category Determination (section 2. 4)
- b) Combustion (section 2.5)
Note: Contractor shall insure that 6-1/4% overfire combustion margin is evaluated at all three altitudes, i.e., how much margin exists at these altitudes before combustion exceeds 400 ppm CO (air-free). If clean combustion cannot be achieved within the requirements of section 2.5, gas input and/or combustion air adjustments shall be made and reported to achieve clean combustion.
- c) Burner Operating Characteristics (section 2.6)
- d) Piloted Ignition Systems (section 2.7); Direct Ignition Systems (section 2.8) and Proved Ignition Systems (section 2.9) as applicable.

For all tests listed above, the actual barometric pressure, relative humidity, gas inlet test pressure and temperature, gas orifice manifold pressure, inlet and outlet water temperatures, flue gas temperature, CO and CO₂ concentrations, and the pressure(s) sensed by the pressure switch shall be recorded. Pressure-switch pressure data shall be frequently obtained from ambient startup through steady-state operation and throughout a transient test-to-shutoff blockage. All identifying model numbers, dates, and settings marked on pressure switches shall be recorded. Pressure switches shall be carefully removed and preserved for examination and analysis by the PMS after testing is complete. Fuel gas constituents and concentrations shall be certified by the supplier or other qualified agency at each test location within +/-1% accuracy to for higher heating value, specific gravity and Wobbe number determination, all at standard conditions of 30.00 in. Hg and 60°F.

5. Analyze the data on each appliance at the three altitudes tested in such a manner as will facilitate recommendations on reducing the amount of gas input derating needed for safe and reliable high-altitude

operation.

6. Make specific recommendations concerning improved appliance safety standards and installation code requirements for high-altitude operation of gas-fired boilers and water heaters, and for low altitude test methods to evaluate high altitude performance. These may include, but are not limited to, gas input rate adjustments, air flow adjustments, temperature adjustments and other reasonable modifications or tools to be used for sea level operation. These recommendations shall be arrived at through an iterative process of discussion with the Project Monitoring Subcommittee.

J. DELIVERABLES

- a. Progress and Financial Reports to the PMS must be made at quarterly intervals. All available data must be available at or before the scheduled report time. Data and/or reporting information may be transmitted electronically or on ASHRAE approved digital media.
- b. The Principal Investigator shall report in person to the TC at the annual and winter meetings, and answer such questions regarding the research as may arise.
- c. Test plan for review and approval by the PMS as per the description of Task 2 in the Scope section above.
- d. List of specific appliances to be tested for review and approval by the PMS as per the description of Task 3 in the Scope section above.
- e. Memorandum proposing suggested changes to standards, code requirements, and test procedures, as described in Task 6 of the Scope section. Contractor will present this material and discuss it with the PMS.
- f. A Final Report shall be prepared and submitted to the Society by the end of the contract period covering complete details of all research carried out on the project. The final report shall include, as a minimum, the following:
 1. An Executive Summary suitable for wide distribution to the industry and to the public.
 2. Description of test procedure, locations, and appliances
 3. Data collected, per Task 4 in the Scope section.
 4. Results should be presented in a format that will facilitate direct comparison of the results for the different barometrically determined altitudes and their use in recommending the amount of gas-input derate for the appliance classes for high- altitude operation.
 5. Specific recommendations for changes to standards and test methods as described in Task 6.

Unless otherwise specified, the final report shall be furnished in the following manner:

- Six bound copies
 - One unbound copy, printed on one side only, suitable for reproduction.
 - Two copies on ASHRAE approved digital media; one in ASCII format and one in the latest versions of Microsoft Word format for the report and in Microsoft Excel format for data and approved by the PMS.
- g. One or more papers based on the final results of the project shall be submitted first to the ASHRAE Manager of Research and Technical Services (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. The papers 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 papers shall conform to the instructions posted in “Manuscript Central” for an technical ASHRAE Transactions Technical or HVAC&R Research Journal paper. The technical paper title shall contain the research project number (xxxx-RP) at the end of the title in parentheses, e.g., (9999-RP).
 - h. A Technical Article suitable for publication in the ASHRAE Journal, if requested by the Society.

K. LEVEL OF EFFORT

The level of effort is estimated to be approximately 900 hours of a professional person. A total cost of \$150,000 is estimated. The accepted bidder will be responsible for obtaining the test boilers and water heaters, test equipment and testing facilities. Boiler and water heater manufacturers have shown interest in donating appliances. Appliance requests and donations shall be coordinated through the Gas Appliance Manufacturers Association, Arlington, VA.

L. OTHER INFORMATION FOR BIDDERS

Bidders shall have experience in testing these gas appliances in accordance with the standards specified in Task 4.

Frequent meetings, in person or by conference call with the PMS are deemed essential to the success of the project. As described in the Scope section above, submissions to the PMS for review and approval are requested at several points during the project. It is expected that the PMS will discuss these submissions with the contractor and this will be done either via meetings at the ASHRAE Winter or Annual meetings or conference call, as appropriate. Additional meetings may be held at the contractor's test sites at the discretion of the PMS Chairman. The contractor shall provide to the PMS at these meetings a detailed report of work accomplished and work yet to be done. The PMS shall give the contractor following these meetings a written report of the PMS's assessment of the contractor's progress and any requests for project changes deemed necessary to maintain the objectives and schedule of the project.

This section specifies the test conditions to be used in the tests set forth in item 4. Since barometric pressure can vary over time, the actual barometric pressure shall be recorded for all tests listed above. This is to provide the corresponding test altitude, if found to be different from the designated test location altitude for purposes of setting rate (or derate) and analyzing results. The composition of the inlet air supply (i.e., % oxygen and water in the air by weight) shall be measured during each test. Each boiler and water heater model shall be tested at the following conditions:

- a) at sea level with factory-installed orifice(s) and factory-set manifold pressure.
- b) at sea level with factory-installed orifice(s) and manifold pressure adjusted to achieve nameplate input.
- c) at natural derate with no change in gas orifice size or manifold pressure setting from b).
- d) at natural derate with no change in gas orifice size or manifold pressure setting from b), except for the following:
 1. If any change to orifice size or manifold pressure is required to satisfy CAN/CGA-2.17 or ANSI Z21.13-2004•CSA-4.9-2004, ANSI Z21.10.1-2004--CSA 4.3-2004 Vol 1,ANSI Z21.10.3-2004--CSA 4.3-2004 Vol 3, they must be recorded. If the manufacturer(s) of the tested appliance(s) recommend different derating method(s), then that method(s) shall also be tested.
 2. If there was a difference in Wobbe number between sea level gas and the gas used at altitude that would affect the amount of derate observed, it must be recorded.
- e) at 4% per 1000 ft above sea level derate when installed above 2000 ft. (These tests shall be conducted:
 - i) by changing orifice sizes with constant manifold pressure and ii) by adjusting manifold pressure with constant orifice size.)
- f) depending on the test results for conditions 0, 0 and 0, at the derate necessary to produce the same CO₂ percent at altitude as was obtained at sea level.
- g) repeat 0 to produce clean combustion per ANSI Z21.13-2004•CSA-4.9-2004, section 2. 5. , ANSI Z21.10.1-2004--CSA 4.3-2004 Vol 1, section 2.4 or ANSI Z21.10.3-2004--CSA 4.3-2004 Vol 3, section 2.4 .

In order to obtain data that is unaffected by differing natural and propane gas mixtures, a subset of test data shall be obtained with a reference fuel gas source, such as a single bottled natural gas supply trucked to each test location. In the interest of minimizing the amount of bottled gas required, the appliances can be operated on local gas until data is to be taken. Then the bottled gas can be swapped on-the-run (without interruption of appliance operation) with the local gas for only as long as required to establish a new equilibrium at the specified conditions and take data. Data should also be taken with the local source gas for comparative

analysis. For each appliance, at each altitude, the data subset with the reference gas shall include unmodified combustion performance (CO, excess air, flue temperature, and margin as discussed in Task 4, above). Wobbe index and fuel gas composition shall be the primary parameters used to evaluate impacts of different local gas compositions.

The contractor shall provide to the PMS:

1. Results of benchmark, sea-level tests prior to on-location tests at higher altitudes.
2. Results of on-location tests after tests are complete at each site and before dismantling test capability at each site such that corrective tests could be performed before leaving each site, if needed by the PMS.
3. All raw data: acceptable and unacceptable results are to be identified as such.
4. Analysis of all test results. Detailed methods of analysis shall be provided.
5. Recommendations on how to fulfill the project Objectives.

Beyond the guidance provided in the Scope section above, the PMS is very interested in the specific appliances selected for testing and expects to actively support the contractor in this selection. As discussed in the Scope section, above, the PMS will review and approve the final list of specific appliances.

If bidders feel that additional work is needed to fulfill project Objectives, additional work shall be specified, recommended, and quoted separately with their base bids.

M. PROPOSAL EVALUATION CRITERIA AND WEIGHTING FACTORS

1. Qualifications and relevant experience.....	30%
2. Facilities	30%
3. Work Plan	20%
4. Overall relevance to the project objectives	20%

N. REFERENCES

High Altitude Installation of Natural Gas-Fired Appliances with Fan-Assisted Combustion, topical report GRI-95/0014 prepared by the American Gas Association Laboratories, Cleveland, Ohio for the Gas Research Institute (now the Gas Institute of Technology), 8600 Bryn Mawr Avenue, Chicago, Illinois 60631 (now 1700 South Mount Prospect Road, Des Plaines, IL 60018), January 1995.

ANSI Z21.13-2004•CSA-4.9-2004 American National Standard/CSA Standard for Gas-Fired Low Pressure Steam and Hot Water Boilers (or latest revision), CSA America, Inc., 8501 East Pleasant Valley Road, Cleveland, OH 44131-5575.

ANSI Z21.10.1-2004--CSA 4.3-2004 American National Standard/CSA Standard for Gas Water Heaters Volume I, Storage Water Heaters with Input Ratings 75,000 Btu/h or less (or latest revision), CSA America, Inc., 8501 East Pleasant Valley Road, Cleveland, OH 44131-5575

ANSI Z21.10.3-2004--CSA 4.3-2004 American National Standard/CSA Standard for Gas Water Heaters Volume III, Storage Water Heaters With Input Ratings Above 75,000 Btu/h, Circulating and Instantaneous (or latest revision), CSA America, Inc., 8501 East Pleasant Valley Road, Cleveland, OH 44131-5575

CAN/CGA-2.17-M91 National Standard of Canada for Gas-Fired Appliances for Use at High Altitudes (or latest revision), Canadian Gas Association (Canadian Standards Association), 55 Scarsdale Road, Don Mills, Ontario M3B 2R3 (now 178 Rexdale Boulevard, Toronto, Ontario M8W 1R3) Canada.

ANSI Z223.1/NFPA 54-2006 (or latest revision) National Fuel Gas Code, AGA 400 N. Capital St., NW, Washington D.C. 20001 and National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

CAN/CSA-B149.1 National Standard of Canada Natural Gas and Propane Installation Code (latest revision), CSA International, 178 Rexdale Boulevard, Etobicoke (Toronto), Ontario M9W 1R3 Canada.

Variability of Natural Gas Composition in Select Major Metropolitan Areas of the United States, report GRI-92/0123 [Wobbe numbers], Gas Research Institute (now the Gas Institute of Technology), 8600 Bryn Mawr Avenue, Chicago, Illinois 60631 (now 1700 South Mount Prospect Road, Des Plaines, IL 60018), March 1992.

Standard Atmospheric Data for Altitudes to 60,000 Feet, Table 1, Chapter 6, 2001 or 2005 Fundamentals Handbook, American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., 1791 Tullie Circle, N.E., Atlanta, GA 30329