

Workshop Report

Improving the Refrigeration Volume of the ASHRAE Handbook

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**Prepared on behalf of the
workshop participants by:**

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Introduction

The Refrigeration volume is the most “self-contained” of the four-volume Handbook series. It contains aspects of the subject matter of the other volumes in the series, namely: fundamentals, systems & equipment, and applications. But in the refrigeration volume, these topics are addressed from the perspective of refrigeration alone.

Readership for Refrigeration is very broad in terms of applications and industries. And perhaps even more than other volumes, Refrigeration is widely used internationally. At the same time, the target audience is narrower than for the other handbook volumes. Refrigeration is very much focused on the needs of an engineer rather than those of an owner, Architect, academic or service professional. The volume targets the design engineer who is new to the subject—one who picks up the book to gain the “bird’s eye view” of the topic in question, and one who might be seeking tables of values to serve as a foundation for design. The volume does not attempt to provide comprehensive guidance for *detailed* system design, nor does it contain the essentials needed for day-to-day operation and maintenance.

Perhaps as a result of this “bird’s eye view” emphasis, the Refrigeration volume has escaped the critical comments sometimes aimed at the Fundamentals and Systems & Equipment volumes. In those books, some chapters are perceived as overemphasizing background theory and are under detailed with respect to the needs of everyday practitioners. For the most part, the Refrigeration volume seems a model of an appropriate balance between useful fundamental data and practical descriptions of the defining issues for equipment and application.

On the other hand, some have said that Refrigeration has “a somewhat antique look and feel,” because it does not provide very much information on topics of current interest such as CO₂ refrigeration, and because some of the chapters describe equipment which is no longer state of the art. Also, most chapters have not been *extensively* updated in recent times, probably because compared to heating and air conditioning, the ASHRAE volunteer community is very small in refrigeration. For example, nobody seems to quite remember

who wrote chapter 36 (Concrete dams and subsurface soils), or whether the information it contains is still relevant, nor who might be relied upon to give the material a critical review from the perspective of an experienced practitioner.

Consequently the goals of the Handbook Improvement Workshop for the Refrigeration volume included a review of the whole volume, to identify the issues which prevent the book from being perceived as “state-of-the-art.” We also focused heavily on developing ideas for how the volume could become and remain more current, given the problem of the more limited number of ASHRAE volunteers who are active in refrigeration.

The workshop project began in the fall of 2006. Ten professionals were recruited, with the principal perspectives of:

- Design and installation (6)
- Service (1)
- System operation or industrial application (3)

After the workshop participants reviewed the entire volume, they met as a group during a teleconference in January 2007. That meeting discussed the broad structural issues and identified items for the agenda of our two-day workshop in Atlanta. Between January and April, each member reviewed several chapters in detail, providing specific written comments and suggestions for improvement.

Finally the participants met as a group in Atlanta for two days in April 2007, guided by a facilitator and under the observation of the Chairs of Handbook and TAC and the Refrigeration volume Chair for the 2010 revision. Also, the group had strong support from the ASHRAE Staff—in particular the Manager of Technical Services and the Handbook Editor.

This report was prepared by the facilitator and reviewed by the group during a conference call in May 2006. The report represents the consensus of the group. It consists of three parts:

- I. Summary of observations and recommendations for improvement of the Refrigeration volume and for the revision process
- II. Implementation plan
- III. Appendices

I. Summary of Recommendations

Participants in this workshop were impressed with the utility, accessibility, practicality and breadth of the information contained in the Refrigeration volume. Most participants had not been involved with handbook preparation, and they expressed both admiration and dismay for the wide variety of expertise which is needed to generate and to maintain this book.

Our principal recommendations to improve the volume are divided into four categories:

- **Keeping the volume more current**, using volunteers.
- **Adding new information**, specifically: a general introduction to refrigeration, a designer's concerns with respect to safe servicing of systems, and information about CO₂ refrigeration.
- **Improving guidance to handbook authors and revisors** through encouragement to discuss service safety issues, and through an actionable definition of "sustainability" as it relates to refrigeration systems.
- **Improving usability** by adding a glossary of terms, and by simplifying navigation through reorganization of chapter groups and updated titles.

Keeping the volume more current, using volunteers

Given the small size of the refrigeration volunteer pool, keeping the volume current is a real challenge. For example, one single technical committee was responsible for reviewing and providing updates for 18 chapters in the current edition. To improve this situation:

1. Award PDH credit (using a yet-to-be-developed online system) for successful tests of reader knowledge of ASHRAE Handbook chapters. In addition to testing the reader's understanding of current chapter contents, the test would include questions evaluating the clarity and utility of the chapter, and would also require submission of suggestions for improvement. **This is may be the most important recommendation to come out of this workshop.**

2. Rely on the electronic edition as a warehouse for the valuable information that cannot fit into the printed edition (and material which, in some cases, can be brought back from earlier handbook editions). In the future, consider the printed edition as "the Overview" and the electronic edition as "the Encyclopedia" of refrigeration.
3. From the ASHRAE Board level, make formal requests to four corresponding technical societies, asking for assistance in reviewing and updating the material in the ASHRAE Refrigeration volume. (International Institute of Ammonia Refrigeration, the Refrigeration Service Engineers Society, the Intl. Institute of Refrigeration and the Refrigeration Engineers & Technicians Assn).
4. Allow refrigeration technical papers to be submitted for both IIAR and ASHRAE transactions/ASHRAE Journal without writing separate versions for each organization.
5. Allow TC Handbook Subcommittee Chairs to email requests for assistance to members who have expressed interest in refrigeration on their membership form.
6. Via the CTTC, ask local chapters to provide reviews and text for improving refrigeration volume chapters, as part of their eligibility for the Presidential Award of Excellence

New information on critical and current topics

Recognizing the limitations of volunteer efforts, we have identified the most pressing needs for additional material for the Refrigeration volume. These include:

7. "An Introduction to Refrigeration Systems" - A new chapter describing the basic components of a refrigeration system, how they work together, how the result differs from cooling systems intended for air conditioning, and how it is the same.
8. "Designing Refrigeration Systems for Safe Service" - a new chapter explaining the basics of

what a designer needs to understand (and to do) so that his system can be serviced safely, and so his design will allow system operators and service technicians to comply with regulatory requirements.

9. Add service safety discussions to all appropriate chapters. In particular, discuss the appropriate type and placement of sensors and alarms, and any flammability and toxicity issues and exposure limits. Make service safety a checklist item that all chapter revisors need to discuss in appropriate sections of the chapters.
10. "CO₂ Refrigeration" - a new chapter with a structure which parallels that of chapter 3 (Ammonia Refrigeration). In addition to the basics, the chapter would add any CO₂-specific issues, such as of working with higher pressures, lubrication issues and cascade systems.
11. Add CO₂-specific information to chapters 5, 6, 7, 8, 44, 45 and 46 in the Refrigeration volume, and also to chapter 34 of Systems & Equipment and ASHRAE Std 15.

Improving guidance to authors and revisors

The ASHRAE Handbook Authors and Revisors Guide is an ideal location for archiving the enduring, long-term concerns for each volume. We suggest three brief additions to the guidance for the Refrigeration volume:

12. Highlight service safety issues. Much of the ASHRAE readership has a professional responsibility to the public. In some applications, the system designer has the responsibility of making decisions with life and death consequences as he plans the layout and installation of a refrigeration system. The Handbook is not the place for detailed design guidance. But it is an appropriate document to make designers aware of which decisions are likely to have those consequences, and to suggest where the designer can look for

wise advice in making those decisions. Simple wording for this purpose is suggested in the implementation section of this report.

13. Provide an actionable definition of a sustainable refrigeration system. The ASHRAE strategic plan is to "Advance the arts and sciences of HVAC & R to serve humanity and to promote a sustainable world." But to be effective, that strategy needs effective tactics and measurable goals. In the implementation plan, we suggest wording which defines a "sustainable refrigeration system" to help guide decisions.

Improving usability: Restructuring and Glossary

To speed navigation, we have provided suggestions for moving chapters and sections, and a few changes in titles. Also, the volume could benefit from a glossary, and from some extraction of information in current chapters into new chapters. Specifically:

14. Change chapter and section titles as described in figure 4, in the implementation section.
15. Add a new chapter containing a glossary of refrigeration terms. The field of refrigeration uses many words which have multiple meanings, and terms which are misunderstood because they are used differently in different parts of the world, or used differently between different vendors. Including a glossary of terms in the volume will be very helpful to those who have not worked in the field.
16. At some future date, consider adding new chapters in the "SYSTEM COMPONENTS" section describing refrigeration compressors and condensers. The information can be gathered from the current chapters 2 and 3, which contain perhaps more detail on these components than what is essential to understanding the overview of a system.

Recommendation	Effort	Resources			Implementation Requires Action From...			
		Funds	Staff	Pages	TAC	Handbook	Other	Board
Keeping the volume more current, with volunteers								
1. System for PDH Credit, with Chapter Reviews	3	Major	Major	-	Approval	Agreement	ALI (Approval + Proj Mgt)	Funding approval
2. Electronic edition "The Encyclopedia of Refrigeration"								
3. ASHRAE Board Requests to RSES, RETA and IAR	1	-	Minor	-	Draft the Ltr	-	Refgn chair followup	Sign & send ltr
4. Allow TC Chairs to email members	1	-	Minor	-	Agreement	-	-	Approval
5. Allow publication without rewriting (ASHRAE + IAR)	1	-	Minor	-	Agreement	-	Both publishers approvals	-
6. Ask local chapters to help (PAOE credit)	1	-	Minor	-	Agreement	-	-	-
Adding new information								
7. New chapter - Introduction to Refrigeration	2	-	Significant	10	Agreement	Approval	-	-
8. New chapter Designing for safe service	2	-	Significant	10	Agreement	Approval	-	-
9. Add service safety to chapters	2	-	Minor	5	Agreement	-	-	-
10. New chapter - CO2 Refrigeration	2	-	Significant	15	Agreement	Approval	-	-
11. Add CO2 information chapters and standard 15	2	-	Minor	5	Agreement	-	-	-
Improving guidance to authors and revisors								
12. Text describing inclusion of service safety	1	-	Minor	-	Agreement	Approval	-	-
13. Text defining "Sustainable Refrigeration System"	1	-	Minor	-	Agreement	Approval	-	-
Improving usability								
14. Proposed structure & new sections	2	-	Significant	-	Agreement	Approval	-	-
15. New chapter - Glossary of Refrigeration terms	2	-	Significant	-	Agreement	Approval	-	-
16. New chapters - Compressors & Condensers	1	-	Significant	10	Agreement	Approval	-	-
Effort Codes								
	1	An improvement which can be implemented with volunteers						
	2	Significant improvement, at little or no additional cash outlay						
	3	Major Improvement which needs cash outlay or major staff time						

Figure 1. Summary of recommendations with requirements for implementation

II. Implementation Plan

Figure 1 provides a summary of our recommendations and their general categories, along with their priorities and the approval levels which will probably be needed. Below, we discuss how these suggestions can be implemented

1. ASHRAE PDH Credit for Reading, Testing and Commenting on Handbook Chapters

This idea first surfaced two years ago as a recommendation from workshop participants who reviewed the Systems & Equipment volume. The Refrigeration workshop participants also came up with a similar but improved concept, and are enthusiastic about it's potential.

We see the ability to increase ASHRAE revenue while providing a valuable service to members and at the same time ensure a constant review of Handbook chapters by readers who are not usually involved in Handbook revisions.

The idea, which basically the same as what the American Institute of Architects has had in place for several years using articles in their *Architectural Record* magazine, requires four items which do not currently exist:

- a. Questions and answers about the content of each chapter, generated by the technical committees responsible for their revision. Added to these would be "comment questions" generated by the handbook committee. (See attached suggestions in the WORD document in the appendix to this report) These would rate the clarity, utility and completeness of the material. Readers would also be required to comment, suggesting which parts of the chapter need improvement, and what should be done to improve it. For implementation, the TAC will need to direct the TC's to generate lists of questions and answers for each chapters.
- b. A web-based system for self-administering the test questions and to accept payments for the test results. The system would also generate a PDF of a course completion certificate indicating completion of each "self-taught course." And each certificate would describe the number of hours of PDH credit awarded by ASHRAE for

The screenshot shows the ASME Product Catalog interface. At the top, there are navigation links for 'MEMBERS ONLY', 'Join', 'Renew', 'Shop', 'About', 'Contact Us', and 'Home'. Below this is a search bar and a 'Go' button. The main content area is titled 'Product Catalog - Education/Training - Online Self-Study Course'. It features a 'SEARCH BY KEYWORD:' section with radio buttons for 'All Products' and 'Current Results'. A 'SORT ALL PRODUCTS BY:' section lists various categories like 'Bollers and Pressure Vessels (4)', 'Certification & Accreditation (EDU) (5)', 'Controls (1)', 'Conveyors (1)', 'Design (3)', 'Electronic / Photonic Packaging (1)', 'Fluids Engineering (1)', 'Geometric Dimensioning & Tolerancing (GD&T) (1)', 'Heat Transfer (1)', 'Management (10)', 'Manufacturing (2)', and 'Project Management (1)'. There are also filters for 'Language', 'Category', and 'Format'. A 'YOUR SHOPPING CART:' section indicates 'your cart is currently empty.' Below this, several courses are listed with their 'List Price' and 'Member Price'. For example, 'Section VIII Division 1 and Section VIII Division 2 Cluster' has a List Price of \$1,339.00 and a Member Price of \$1,098.02. Other courses include 'Total Quality Management (TQM) Online Self-Study Course' (List Price: \$69.00, Member Price: \$49.00), 'Benchmarking Online Course' (List Price: \$69.00, Member Price: \$49.00), 'Changing Organizational Culture Online Course' (List Price: \$69.00, Member Price: \$49.00), and 'Advanced Concepts in Global Engineering Project Management Online Self-Study Course' (List Price: \$595.00, Member Price: \$494.98).

Figure 2. Example 1 - ASME continuing education
 Note the wide range of costs and courses available through ASME for continuing education. ASHRAE can provide members with a similar range by allowing credit for reading Handbook chapters. The reader will need to pass a test of the chapter content, one which also requires making specific suggestions for improvements to Handbook chapters.

The screenshot shows the PDHengineer.com website. The header includes the logo, 'PDHengineer.com', and navigation links for 'HOME', 'FAQ', and 'CONTACT US'. Below the header are buttons for 'COURSES', 'HOW IT WORKS?', 'TEACH A COURSE', and 'MY ACCOUNT'. The main content area is titled 'Online Engineering Continuing Education for PE License Renewal'. It features a 'Get All the PDHs You Need - 3 Easy Steps' section with a list of steps: 1. Find a Course, 2. Purchase and Complete the Quiz, 3. Print Your Certificate Instantly. Below this, there are bullet points listing benefits: '1400+ Hours of Courses', 'Online Quiz - Unlimited Quiz Attempts', 'Instant Online Certificate of Completion', and 'Money-Back Guarantee'. A prominent offer states '17%-25% OFF All Courses (thru 5/15/07)'. There are links for 'Learn More', 'Browse Courses', and 'Free Course'. A testimonial from Arthur Willis, PE, Arnett, WV, states 'Professional and easy to use.' and includes a 'More User Feedback...' link. The 'Civil' section lists 'Retaining Walls for Non-Geotechnical Engineers (2 PDH)' (Course No: C-2005) with a List Price of \$60.00 and a Buy Price of \$49.90. The 'Mechanical' section lists 'Gas Turbine Performance Enhancements (2 PDH)' (Course No: M-2017) with a List Price of \$60.00 and a Buy Price of \$49.90. A blue circle highlights a 'Board-Approved' badge that reads 'PE Board APPROVED PROVIDER' and 'Board-Approved PDHengineer.com is an approved provider of PDHs for professional engineers in FL, #109, LA, NC & NY. PDHengineer courses have been accepted in all other states.'

Figure 3. Example 2 - For-profit education
 Many commercial organizations have achieved a high level of endorsement for their technical content, even though their courses are modest in scope and cost. ASHRAE can certainly do the same. Such a system would produce revenue, provide a service to members, and most importantly gather real-world user input to improve Handbook chapters.

those efforts. Given current staff workloads, it is unlikely that the system can be created without special project funding from the board. This special project would be best administered through the ASHRAE Learning Institute.

- c. Approval from selected States for registered professional engineers to use the ASHRAE PDH credits generated by this system to satisfy their requirement for continuing education. The ASHRAE Learning Institute would be responsible for discussing this project with selected States. The goal is to ensure that the program is implemented in a way which minimizes the burden of coordinating with the States, while ensuring the system meets the requirements of *enough* States to be useful to those who would like to use it and to pay ASHRAE for the privilege.

This system has the ability to provide an ongoing “real-world perspective” on what needs to be done to keep the chapter content relevant to everyday practitioners. It can also provide some of the “building blocks” needed for ongoing efforts to develop and maintain meaningful ASHRAE professional certification programs.

The board could decide to make this system a member benefit, either reducing the costs to members or providing the system at no additional cost beyond membership.

The worldwide market for this service could be a very powerful *new* economic engine for ASHRAE, while contributing to ever-more-relevant Handbook volumes—currently the main reason for membership renewals and therefore the financial foundation of the society.

2. Create “The Encyclopedia of Refrigeration” in electronic rather than printed form

The two previous Handbook Improvement Workshops have recommended this same strategy, and indeed the practice is already implemented in concept. The difference in our recommendation is that Handbook Subcommittee Chairs should be made encouraged to review earlier editions of the volume, with an eye towards bringing back some of the information that was removed from the printed volume because it was no

longer considered current or not considered well-enough documented to retain in print.

Rather than integrating this material into the current chapters, it can be included as separate PDF's, linked to the electronic version of the current chapters. Implementation of this suggestion would include:

- a. The Handbook committee should remind the Subcommittee Chairs that old editions can contain useful information, and that an effort to re-enter that text and scan its graphics is a very quick way to generate useful material to increase detail electronically, rather than the far more difficult path of integrating older or highly-detailed information into the printed version.

3. Board-level Requests to RSES, RETA IIR and IIAR for Assistance in Revising the Refrigeration Volume

A low-cost way to improve the Refrigeration volume is to ask others who are expert in the field to provide their perspectives and suggestions. These three other technical societies have useful information that would be beneficial to the readers of the handbook.

But meaningful cooperation between ASHRAE and other technical societies has been sporadic in the past. The workshop participants believe that it will require high-level communication to break through to those in other societies who would be willing to contribute their time to improving ASHRAE publications. If a request came from an ASHRAE board member - preferably at the Vice Presidential or Presidential levels, it would be clear to the other societies that ASHRAE is serious about wanting input, and that we will be committed to putting that input to good use.

Implementation of this recommendation would include:

- a. A draft letter requesting assistance. Specifically, the letter would request the assistance of volunteers to review and correct/expand content, and also to allow access to the electronic archives of the organizations for Handbook Subcommittee Chairs who are seeking to improve/add material to ASHRAE Handbook chapters. This can be

drafted by either the Refrigeration volume chair or the Handbook committee chair, for signature by the appropriate ASHRAE board member.

- b. An appropriate ASHRAE board member. An ideal choice would be one who has either an ongoing personal interest in refrigeration, or one who believes personally in the importance of meaningful cooperation between ASHRAE and other societies.
- c. Knowledge of the appropriate specific person at each society to receive the request. These include Kent Anderson at IAR, Mark Lowry (847-759-4051) at RSES, either Robert heap or Didier Coulomb at IIR (www.iifir.org) and Dave Murphy (717-259-9755 Ext. 11) at RETA.

4. Allow technical material to be submitted for both IAR and ASHRAE publication without rewriting

Much of the day-to-day expertise in designing and operating refrigeration systems is available from the IAR membership rather than from the ASHRAE membership. While there are some who belong to both, most professionals choose only one or the other societies.

In recent years, IAR members have written more frequently and extensively on refrigeration than have ASHRAE members. But if those authors want the information to be available to the ASHRAE membership, the work must be re-written to satisfy the current ASHRAE requirement for unique material. So usually this does not happen, and ASHRAE members are the losers.

The issues revolve around the copyright. ASHRAE understandably needs to control its intellectual property to ensure the financial security of the society. So does IAR.

But these issues are not insurmountable. Both the workshop participants and the ASHRAE Publisher (Steve Comstock) believe an agreement can be worked out to benefit both societies.

Implementation of this recommendation would only require:

- a. Discussion and agreement between Steve Comstock (the ASHRAE Publisher and Director of Communications) and Kent Anderson (the current President of IAR and also a long-time, active ASHRAE volunteer).

5. Allow TC Handbook Subcommittee Chairs to eMail requests to members who have expressed interest in refrigeration

Many ASHRAE members have no interest in assisting in the task of improving the Handbook. But we believe that at least a few of ASHRAE's 50,000 members are just waiting to be asked to help "straighten out that chapter."

TC chairs could ask ASHRAE members who have expressed interest in refrigeration (on their annual membership renewal form) to help review and/or revise the chapters. But as a practical matter, those requests would have to be made easily, through eMail.

Implementation of this recommendation would include:

- a. Board approval for allowing TC Handbook Subcommittee Chairs to send messages to portions of the membership who have expressed interest in refrigeration. Currently, there is no approval nor any system for such mass-market communication between committee chairs and the membership.
- b. Procedures through which the Handbook Subcommittee Chairs can contact members. One suggestion is for TAC to take the lead. Subcommittee Chairs would draft the email, which would then be sent by the ASHRAE staff, not the Subcommittee Chairs. That way, the message could be proofed and reviewed, and all gathering of names and sending the message could be controlled internally at ASHRAE HQ.
- c. Notification of Subcommittee Chairs of this capability and the procedures. This can be handled as part of normal communication between TAC and Committee Chairs, and also added to the Guide for handbook Authors and Revisors.

6. Ask local ASHRAE chapters to help as part of qualification for the PAOE

For some local chapters, at some times, achieving the Presidential Award of Excellence is a significant motivator. Reviewing handbook chapters has always been a part of winning points toward that goal, but the Handbook Editor has *never* actually received even one such review.

We believe that, if the chapters were reminded of the usefulness of handbook reviews in meeting the needs of their members and also reminded that the effort results in points towards the PAOE, at least a few chapters might be motivated to actually provide reviews.

We suggest an eMail request, from the Chair of the current Refrigeration Volume to chapter Presidents. We also suggest the practice be continued for other volumes in future years.

Implementation of this recommendation would include:

- a. A draft letter, asking for assistance in reviewing and improving chapters in the refrigeration volume. The letter would point out the advantages in achieving the PAOE, and that technology transfer is best achieved from members educating members about real-world issues, concerns and solutions. Attached to that message would be the chapter review guidelines from the author's/revisor's guide. The letter can be drafted by the current Refrigeration Volume Chair, in consultation with the ASHRAE Chapter Technology Transfer staff.
- b. Sending that letter, via eMail and the regular communications between the CTT and local chapter presidents.

7. **New chapter: Introduction to Refrigeration**

Most workshop participants were a bit surprised, upon reading though the entire volume, to realize that there is no overview or introduction to refrigeration. Some participants—those who have an engineering background other than refrigeration—felt a bit adrift in a sea of unfamiliar details.

All agreed that most readers for the volume are likely to be most familiar with air conditioning, and therefore would expect and appreciate a brief “birds eye view” of refrigeration at the beginning of the volume.

Implementation of this recommendation would include:

- a. TAC can task one or more of the refrigeration technical committees to develop a brief chapter which outlines the basics of refrigeration. TC's 10.1 and 10.3 are logical candidates.

- b. The purpose of the new chapter should be to inform a competent technical professional—and specifically one who is already familiar with air conditioning— about the basic issues involved with refrigeration systems. A second section could deal with how refrigeration systems are similar to air conditioning, and a third section could explain how refrigeration systems are different. The bibliography would include the more basic publications, those which help introduce a technical professional to the field, rather than references which take the reader into great detail.
- c. By assuming knowledge of air conditioning and by keeping to a discussion of similarities and differences, and by re-using graphics from other chapters, the new chapter can be brief, and therefore practical to produce in time for the 2010 edition.

8. **New chapter: Designing for Safe Service**

Safety is usually associated with guidance from manufacturers and from societies and government agencies aimed at operation and service rather than at design of systems.

And yet, the system designer is responsible (at least morally if not legally) for the baseline risks associated with operation and servicing of the system. And refrigeration service safety risks is a subject that a new designer is not likely to know very much about.

Workshop participants are agreed that the topic needs to be included as a separate chapter, in addition to including information throughout other chapters.

Implementation of this recommendation would include:

- a. TAC can task one or more of the refrigeration technical committees to develop a brief chapter outlining what the designer should keep in mind about safe operation and servicing of equipment when making design decisions and when laying out a refrigeration system. TC's 10.1 and 10.3 are logical candidates. Also, TG-3 (HVAC&R Contrac-

tors and Design-Build Contractors) is a logical contributing group, since some service-oriented members participate in their activities.

- b. The technical committees should be made aware of, and follow up on, the letter sent by the ASHRAE board which actively seeks the input of RSES, RETA and IIAR in this area. The goal is to have at least a brief version of this new chapter ready for the 2010 edition.

9. Add service safety to other chapters

In addition to guidance about the general issues of service safety, many chapters need more specific details. Workshop participants suggest that design issues with respect to service safety be included as a checklist item for several chapters. Recognizing the limited resources for accomplishing this task, workshop participants suggest that this not be a mandatory requirement for the 2010 edition, but rather an item to be addressed over time.

Specifically, implementation of this recommendation would include:

- a. TAC can task the technical committees to include a discussion of issues that the designer should address for safe servicing of refrigeration systems and equipment. As a starting point, discuss toxicity and exposure limits, flammability, the type and placement of sensors and alarms, and provide advice for safe and clear access to components for any regular required service.
- b. The Handbook committee can include safe service guidance in the author/revisor's guide, and add safe service design issues as a checklist item for chapter reviews. (Some suggested wording for both is provided under item 11.)

10. New chapter: CO₂ Refrigeration

The current volume has included some of the many CO₂ design issues and system types in chapter 3 (formerly "Ammonia Refrigeration", and now "Ammonia and CO₂ refrigeration").

This was an admirable effort in a short time. But for the next edition, workshop participants believe a separate chapter

is appropriate, given the rapid adoption of CO₂ systems in both commercial and industrial applications, and the probable future of CO₂ systems in cars, trucks and rail cars.

Implementation of this recommendation would include:

- a. TAC can task one or more of the refrigeration technical committees to develop a brief chapter outlining what the designer should know about the differences between CO₂ and other refrigeration systems, where CO₂ is being applied at the present and where it might be applied in the future. Again, TC's 10.1 and 10.3 are logical candidates, with TC 10.7 as a logical contributor of information describing modern CO₂ systems in Supermarkets.
- b. The outline for the chapter could be based on the current chapter 3.
- c. Much of the information for the new chapter can come from IIAR. The letter requesting assistance (recommendation 2) and the agreement for joint publication rights (recommendation 3) become important in achieving a new chapter in time for 2010.

11. Add CO₂ information to other chapters and to Standard 15

In addition to a new chapter, the information contained in many other chapters, and in ASHRAE Standard 15 (Safety code for mechanical refrigeration) needs to be updated to include appropriate text that addresses CO₂ systems.

This task will probably require more time than what is available for the 2010 edition, but the technical committees need to be aware of the issue, and to address it as time allows.

Implementation of this recommendation would include:

- a. Adding CO₂-related discussion to chapters 5, 6, 7, 8, 44, 45, 46 of Refrigeration, chapter 34 of Systems & Equipment, and Standard 15.
- b. Notification of TC's by TAC that CO₂-related discussions should be added to these documents as soon as time allows.

2006 REFRIGERATION VOLUME - SECTIONS AND CHAPTERS

REFRIGERATION SYSTEM PRACTICES

- 1 Liquid Overfeed Systems
- 2 System Practices for Halocarbon Refrigerants
- 3 System Practices for Ammonia and Carbon Dioxide Refrigerants
- 4 Secondary Coolants in Refrigeration Systems
- 5 Refrigerant System Chemistry
- 6 Control of Moisture and Other Contaminants in Refrigerant Systems
- 7 Lubricants in Refrigerant Systems
- 8 Refrigerant Containment, Recovery, Recycling, and Reclamation

FOOD STORAGE AND EQUIPMENT

- 9 Thermal Properties of Foods
- 10 Cooling and Freezing Times of Foods
- 11 Commodity Storage Requirements
- 12 Food Microbiology and Refrigeration
- 13 Refrigeration Load
- 14 Refrigerated-Facility Design
- 15 Methods of Precooling Fruits, Vegetables, and Cut Flowers

FOOD REFRIGERATION

- 16 Industrial Food Freezing Systems
- 17 Meat Products
- 18 Poultry Products
- 19 Fishery Products
- 20 Dairy Products
- 21 Eggs and Egg Products
- 22 Deciduous Tree and Vine Fruit
- 23 Citrus Fruit, Bananas, and Subtropical Fruit
- 24 Vegetables
- 25 Fruit Juice Concentrates and Chilled Juice Products
- 26 Beverages
- 27 Processed, Precooked, and Prepared Foods
- 28 Bakery Products
- 29 Chocolates, Candies, Nuts, Dried Fruits, and Dried Vegetables

DISTRIBUTION OF CHILLED AND FROZEN FOOD

- 30 Cargo Containers, Rail Cars, Trailers, and Trucks
- 31 Marine Refrigeration
- 32 Air Transport

INDUSTRIAL APPLICATIONS

- 33 Insulation Systems for Refrigerant Piping
- 34 Ice Manufacture
- 35 Ice Rinks
- 36 Concrete Dams and Subsurface Soils
- 37 Refrigeration in the Chemical Industry

LOW-TEMPERATURE APPLICATIONS

- 38 Cryogenics
- 39 Ultralow-Temperature Refrigeration
- 40 Biomedical Applications of Cryogenic Refrigeration

REFRIGERATION EQUIPMENT

- 41 Absorption Cooling, Heating, and Refrigeration Equipment
- 42 Forced-Circulation Air Coolers
- 43 Component Balancing in Refrigeration Systems
- 44 Refrigerant-Control Devices
- 45 Factory Dehydrating, Charging, and Testing

UNITARY REFRIGERATION EQUIPMENT

- 46 Retail Food Store Refrigeration and Equipment
- 47 Food Service and General Commercial Refrigeration Equipment
- 48 Household Refrigerators and Freezers

GENERAL

- 49 Codes and Standards

REFRIGERATION SYSTEMS AND PRACTICES

- 1 *Introduction to Refrigeration Systems* (New)
- 2 *Designing for Save Service* (New)
- 3 ~~System Practices for Halocarbon Refrigeration Systems~~ (2)
- 4 ~~System Practices for Ammonia Refrigeration Systems~~ (3)
- 5 *Carbon Dioxide Refrigeration Systems* (New)
- 6 Liquid Overfeed Systems (1)
- 7 Component Balancing in Refrigeration Systems (43)
- 8 Refrigerant System Chemistry (5)
- 9 Control of Moisture and Other Contaminants in Refrigerant Systems (6)
- 10 ~~Factory Equipment and System~~ Dehydrating, Charging, and Testing (45)
- 11 Refrigerant Containment, Recovery, Recycling, and Reclamation (8)

SYSTEM COMPONENTS

- 12 Insulation Systems for Refrigerant Piping (33)
- 13 Refrigerant-Control Devices (44)
- 14 Lubricants in Refrigerant Systems (7)
- 15 Secondary Coolants in Refrigeration Systems (4)
- 16 Forced-Circulation Air Coolers (42)

COMMERCIAL AND RESIDENTIAL EQUIPMENT

- 17 Retail Food Store Refrigeration and Equipment (46)
- 18 Food Service and General Commercial Refrigeration Equipment (47)
- 19 Household Refrigerators and Freezers (48)

DESIGNING FOR FOOD COOLING AND STORAGE

- 20 Thermal Properties of Foods(9)
- 21 Cooling and Freezing Times of Foods (10)
- 22 Commodity Storage Requirements (11)
- 23 Food Microbiology and Refrigeration (12)
- 24 Refrigerated-Facility Design (14)
- 25 ~~Refrigeration~~ *Refrigerated-Facility* Loads (13)

TRANSPORTATION OF CHILLED AND FROZEN FOOD

- 26 Cargo Containers, Rail Cars, Trailers, and Trucks (30)
- 27 Marine Refrigeration (31)
- 28 Air Transport (32)

FOOD AND BEVERAGE APPLICATIONS

- 29 Methods of Precooling Fruits, Vegetables, and Cut Flowers (15)
- 30 Industrial Food Freezing Systems (16)
- 31 Meat Products (17)
- 32 Poultry Products (18)
- 33 Fishery Products (19)
- 34 Dairy Products (20)
- 35 Eggs and Egg Products (21)
- 36 Deciduous Tree and Vine Fruit (22)
- 37 Citrus Fruit, Bananas, and Subtropical Fruit (23)
- 38 Vegetables (24)
- 39 Fruit Juice Concentrates and Chilled Juice Products (25)
- 40 Beverages (26)
- 41 Processed, Precooked, and Prepared Foods (27)
- 42 Bakery Products (28)
- 43 Chocolates, Candies, Nuts, Dried Fruits, and Dried Vegetables (29)

INDUSTRIAL APPLICATIONS

- 44 Ice Manufacture (34)
- 45 Ice Rinks (35)
- 46 Concrete Dams and Subsurface Soils (36)
- 47 Refrigeration in the Chemical Industry (37)

LOW-TEMPERATURE APPLICATIONS

- 48 Cryogenics (38)
- 49 Ultralow-Temperature Refrigeration (39)
- 50 Biomedical Applications of Cryogenic Refrigeration (40)

GENERAL

- 51 Codes and Standards (49)

MOVE TO SYSTEMS AND EQUIPMENT VOLUME

- Absorption Cooling, Heating, and Refrigeration Equipment (41)

Figure 4. Current vs. proposed 2010 structure and contents

12. Service safety - add text and checklist item to the authors-revisor's guide

In addition to the new chapter, Handbook revisors can be reminded of the need to include design-related safety discussions in all other appropriate chapters.

Implementation of this recommendation would include:

- a. Revise item 7 of the revisor's guide, page 12, Outline for Applications, Systems & Equipment and Refrigeration Chapters. New title: *Operation and safety considerations for system designers*. Then, add after the last sentence: "In particular, the chapters in the Refrigeration volume will benefit from discussions of how decisions made during design will affect the safe servicing of equipment and systems. Normal servicing and operation of some refrigeration systems can have life safety consequences which must be addressed by their designers."
- b. Revise section 8.0 - Chapter review checklist, item 3: "Is there any information that has not been included? (In particular, information which helps a designer ensure that equipment and systems can be serviced and operated without undue risk to the health and safety of technicians and the public)."

13. Sustainable refrigeration systems - add a definition with metrics to the refrigeration volume section of the authors-revisor's guide

The ASHRAE strategic plan requires that the efforts of the society to be directed towards "Advancing the arts and sciences of HVAC & R to serve humanity and to promote a sustainable world." Consequently, we propose an *actionable* definition of a sustainable refrigeration system (one which includes criteria for measuring the relative sustainability of alternatives)

We recommend that this instruction and definition be added to section 3.2 of the author/revisors guide:

- a. "The content of refrigeration volume chapters should also contribute to achieving the ASHRAE strategic goal of a sustainable world. Towards this end, authors and revisors can be guided by this definition:

"A sustainable refrigeration system includes a building or a process from which the annual cooling loads have been reduced to the minimum needed to achieve their owners' purposes. The equipment which removes the remaining loads is designed and constructed to be robust, maintainable with minimal effort and flexible with respect to changes in owner needs and future improvements in technology. These characteristics are measured by the system's annual cost of maintenance and its years of service life. The equipment will operate at high energy efficiency, as measured by its annual energy consumption. It will be constructed of sustainable materials, as measured by their toxicity, their recycled content and their cost of recycling after they no longer serve their original purposes. Its refrigerant will be environmentally friendly, as measured by its ozone depletion and global warming potentials compared to other refrigerants which can perform the same function at the same annual energy consumption."

14. Improved section and chapter titles, and improved organization

Figure 2 shows the current and proposed changes to structure and titles of chapters in the Refrigeration volume, as well as new chapters and one which we believe would be better placed in Systems and Equipment.

Implementation of these recommendations would include:

- a. Revising the section titles and order as shown in figure 2. The proposed sections are roughly parallel to the topics of familiar Handbook volumes. Refrigeration volume sections now begin with systems, and then move on to equipment, then to fundamentals for design and finally to specific applications. General reference material remains at the end of the volume.
- b. Revising the titles of chapters 3, 4, 10 and 25 for clarity, as shown in figure 2.
- c. Moving the current chapter 41 (Absorption cooling, heating and refrigeration equipment) to the Systems & Equipment volume. This chapter contains much more information about air conditioning than about refrigeration.

15. New chapter: Glossary of Refrigeration Terms

Refrigeration has terms which are new and confusing to those approaching the technology for the first time. Further, the refrigeration industry is global, and the same object is known by different names in different parts of the world, and called by different names by different equipment vendors.

So to an even greater degree than in HVAC, overlapping meanings and multiple meanings create confusion. Sometimes this confusion can increase the risks associated with designing, operating and servicing the equipment. So we suggest the addition of a short glossary at the end of the Refrigeration volume.

Implementation of this recommendation would include:

- a. TAC assigning one or more TC's the task of assembling a list of confusing terms and writing descriptions and clarifications for them in the form of a new chapter.
- b. Workshop participants have generated a list of terms to assist any TC in generating this glossary. The list is contained as an attachment to this report, in MSoft WORD format.
- c. In addition, there are some refrigeration-related terms currently contained in ASHRAE's "Terminology of HVAC & R". These can also be included in the new chapter.

16. New chapters - Compressors and Condensers

The revised structure, specifically the "SYSTEM COMPONENTS" section, highlights the fact that there are no chapters which deal specifically with refrigeration compressors and condensers. Much of the detailed information for such chapters is contained in chapters 2 and 3. Indeed, perhaps these chapters could benefit from a little less detail on those components and more discussion of component integration and control issues.

Recognizing the considerable amount of work involved to implement this suggestion, it may not be possible to have new chapters in time for the 10010 edition. But as a future goal, implementation would include:

- a. TAC tasking one or more TC's with developing new chapters for compressors and condensers, consisting in part of material extracted from the current chapters 2 and 3.



Appendix A - Workshop Participants

- Rob Borik - Anheuser-Busch, St. Louis, MO
- Joe Buck - CIMCO Refrigeration, Mobile, AL
- James Carver - Colonial-Webb, Richmond, VA
- Oscar Delgado - Stellar Group, Jacksonville, FL
- Robert Hollembeak - McQuay International, Stanton, VA
- Jaimie Horton - Electromotor Refgn., St. Louis, MO
- Ted Iverson - General Mills, New Albany, IN
- Andy Pearson - Star Refrigeration, Glasgow, Scotland
- Don Stroud - Kraft, Madison, WI
- Cliff Timco - Giant Eagle Supermarkets, Pittsburgh, PA

Oversight

- TAC Chair - Pat Graef
- TAC Liason - Frank Mills
- 2010 Refrigeration Volume Chair - Bill McCartney
- Refrigeration TC 10.1 and 10.3 - Dan Dettmers
- Handbook Chair - Norm Maxwell

Staff Support

- Mike Vaughn - Manager of Technical Activities
- Mark Owen - Handbook Editor

Facilitator

- Lew Harriman - Mason-Grant, Portsmouth, NH

Appendix B Suggested Text & Glossary Terms

(Printed version of attached MSFT WORD file)

Recommendation 1

Chapter review questions (add to questions on content)

1. Which subsections of the chapter were unclear, incomplete or confusing from your perspective? (Type the titles of the subsections and any explanatory text)
2. Which subsections are likely to be most helpful to you when you expect to work in this area of the industry? (Type the titles of the subsections and any explanatory text)
3. Describe at least one change, correction, expansion or modification of this chapter that you believe would be helpful to you in understanding or working in this area of technology (Provide as much text as believe will allow a volunteer chapter revisor to understand your recommendations)
4. Rate your judgement of the utility of the information and graphics in this chapter using a three point scale:
 - 1 = I am likely to use or apply this information to a project in the future.
 - 2 = The information is useful to me as background, but I'm unlikely to apply it directly myself.
 - 3 = The information may be useful to others, but is not useful to me.
5. If you are willing to help the ASHRAE volunteers revise, correct and improve this chapter, or to provide them with useful text or graphics, please provide your full name, affiliation and email address below.

Recommendation 12

Author guidance for service safety

Revise item 7 of the revisor's guide, page 12, Outline for Applications, Systems & Equipment and Refrigeration Chapters. New title: Operation and safety considerations for system designers.

Then, add after the last sentence: "In particular, the chapters in the Refrigeration volume will benefit from discussions of how decisions made during design will affect the safe servicing of equipment and systems. Normal servicing and operation of some refrigeration systems can have life safety consequences which must be addressed by their designers."

Revise section 8.0 - Chapter review checklist, item 3: "Is there any information that has not been included? (In particular, information which helps a designer ensure that equipment and systems can be serviced and operated without undue risk to the health and safety of technicians and the public)."

Recommendation 13

Author guidance and an actionable definition of: "Sustainable Refrigeration System":

The content of refrigeration volume chapters should also contribute to achieving the ASHRAE strategic goal of a sustainable world. Towards this end, authors and revisors can be guided by this definition:

A sustainable refrigeration system includes a building or a process from which the annual cooling loads have been reduced to the minimum needed to achieve their owners' purposes.

The equipment which removes the remaining loads is designed and constructed to be robust, maintainable with minimal effort and flexible with respect to changes in owner needs and

future improvements in technology. These characteristics are measured by the system's annual cost of maintenance and its years of service life.

The equipment will operate at high energy efficiency, as measured by its annual energy consumption.

It will be constructed of sustainable materials, as measured by their toxicity, their recycled content and their cost of recycling after they no longer serve their original purposes.

Its refrigerant will be environmentally friendly, as measured by its ozone depletion and global warming potentials compared to other refrigerants which can perform the same function at the same annual energy consumption.

Recommendation 15

Terms to be defined and described in the new glossary chapter

Recirculator, aka:

Pumped accumulator

Low pressure receiver

Trap - avoid this term, in favor of the more specific terms below, and define them:

Suction accumulator

Low pressure receiver

Knock-out drum

Piping configured as a trap

Oil separator

Dump trap

Dumper drum

Use "suction accumulator", rather than:

Surge drum

Knock-out drum

Suction trap

Condensate return - avoid this term, in favor of the specific type of condensate:

Refrigerant condensate return

Water condensate return

Economizer - avoid this term, in favor of the specific type of system or component:

Air-side economizer

Refrigerant-side economizer

Refrigerant subcooler

Flash tank

Economizer tank

Hot gas - avoid this term in favor of the more specific terms:

Discharge gas

Compressor discharge gas

Note that "hot gas" is often confused with "hot gas bypass" - a totally different object

Suction line - distinguish between compressor suction line (typically what is meant by the term in air conditioning practice) vs. the terms "wet suction" and "dry suction", which are different from each other, and which are usually used when referring to refrigeration systems.

Define: Low pressure side vs. low pressure return

Distinguish the term "head pressure" from what the speaker sometimes means to say, which could be:

Discharge pressure

Compressor discharge pressure

Condensing pressure

"Machine room" needs a better definition that what is currently in the ASHRAE Terminology volume. The current definition is inadequate to support its frequent use in refrigeration industry regulations which have life safety and legal consequences. Also, define the variants of this term separately, including:

Engine room

Compressor room

Refrigeration plant

Equipment room

Define “efficiency” vs. “effectiveness”, and note clearly that these terms are often confused

Define “makeup water” vs. “potable water” and “process water”, and note clearly that these terms are often confused

Define “qualified personnel” in a refrigeration context

Define separately or together:

Standard practice

Industry practice

Good engineering practice

Good practice

Define “Safety issue” and “Safety hazard”

Define:

Flammable

Inflammable

Combustible

Explosive

Define “unitary” and “applied” equipment

Define:

Refrigeration rack

Compressor rack

Define:

Condensing unit

Condenser

Define: “approach temperature” with respect to an azeotropic mixture (the mean temperature of the mixture is perhaps a good clarification)

Define and clarify:

Bleed

Bleed-off

Blow-down

To drain

Appendix C

STATEMENT OF WORK

ASHRAE HANDBOOK IMPROVEMENT WORKSHOP

2010 REFRIGERATION VOLUME

(8 November 2006)

OBJECTIVES

The objective of this workshop is to provide a blueprint for improving the clarity and utility of the 2010 Refrigeration volume of the ASHRAE Handbook. This blueprint will identify and describe actions which can:

1. Increase the utility of the information for ASHRAE's primary professional constituencies; designers, installers, owners and operators of functionally effective and energy-efficient refrigeration systems, as well as students and instructors.
2. Provide new content for topics of broad importance that should be added to the Refrigeration volume in particular, or the other handbook volumes in general.
3. Allow less widely used, but still-important topics to be moved to other publications.
4. Improve the connection between the information in the Refrigeration volume and the daily, real-world needs of professionals engaged in the engineering, installation and operation of refrigerating systems for the benefit of their owners and the public.

BACKGROUND

The four-volume ASHRAE Handbook is the most widely used and recognized ASHRAE publication both by members and non-members. Within this set, the Refrigeration volume may be the most clearly defined in its technical focus—it only discusses refrigeration-related topics. But at the same time its range within these topics is very broad—from ice rinks to biomedical cryogenics to food microbiology to refrigerant chemistry and household refrigerators. Of the four volumes of the handbook, Refrigeration may be the least likely to be in everyday use by most HVAC designers. On the other hand, it is probably the most comprehensive and useful worldwide refer-

ence for HVAC designers and all other professionals when they need rapid understanding of the essentials of refrigeration and its related topics. So while it's important that the information remain current for the thousands of professionals deal with refrigeration on a daily basis, it must also be clear and useful for the hundreds of thousands of professionals who less frequently need an overview of refrigeration-related topics.

The workshop described by this statement of work is a follow-on to similar, successful reviews of the 2004 Systems & Equipment and the 2005 Fundamentals volumes. These workshops are organized and managed jointly by the ASHRAE Handbook Committee (HBC) and Technical Activities Committee (TAC) with the approval of the Publishing & Education and Technology Councils.

SCOPE OF WORK

The workshop will be a two-day working session conducted at ASHRAE Headquarters in Atlanta and preceded by a series of planning activities, telephone conferences, and detailed review of volume content. The workshop participants will establish criteria and methods for review, conduct the review, document specific issues, identify needed improvements, propose modifications to handbook content, propose modifications to the Authors and Revisers Guide and suggest specific committee actions by the HBC, TAC or both. Criteria for review of chapter content may include accuracy, balance, usefulness, references, consistency, continuity, practicality, degree to which contemporary issues are addressed, and others. A key element in the definition of criteria will be identification of the primary and secondary users of the Handbook and what their needs are.

The workshop will focus especially on the usability and practicality of the information contained in the volume, and offering detailed suggestions for improvements in each chapter as well as suggestions for the overall structure and organization of the volume. Any proposals to remove material from the "paper" Handbook must also include a recommendation on whether it should be relocated to a special publication or to the CD+ version of the handbook.

Participants will be asked to do the following in addition to attending the two-day working session in Atlanta:

- Participate in two pre-session conference calls
- Read the current Handbook Author's and Reviser's Guide
- Skim the entire Fundamentals volume
- Review recommendations for the 2004 Systems and Equipment and 2005 Fundamentals volumes, and actions taken in response that are applicable to all Handbook volumes
- Review and compile comments on assigned chapters of the Refrigeration volume in detail (including the latest additions and corrections and corrections posted on the ASHRAE web site)
- Review other background materials provided by the Facilitator, including summaries of comments on the Handbook from various sources.
- Participate in at least one post-session conference call to review the workshop report prepared by the co-facilitators

PARTICIPANTS

Workshop participants will include:

- a) TAC and HBC Chairs.
- b) Handbook 2009 Fundamentals Volume Chair
- c) ExCom members from HBC and TAC as assigned by the HBC and TAC Chairs,
- d) ASHRAE staff members who support the activities of the handbook and TAC committees
- e) Eight to ten (8 to 10) practicing professionals from several fields representing a cross-section of handbook users,
- f) The Facilitator

The practicing professionals will be selected for their broad perspective and their many desirable professional attributes, including age and stage of career. Priority will be given to those currently engaged in the daily practice of their particular profession, at the working level. First priority for selecting participants shall be ASHRAE members or past members, but non-ASHRAE members shall also be included to ensure objective assessment of the needs of the public and other relevant professions.

For this workshop, between the core working group and the practicing professionals, the principal ASHRAE constituencies will be represented by at least these numbers of individuals: Four [4] Design Engineers, two [2] refrigeration service engineer, one [1] Educator, two [2] Building Owner/Operators, one [1] Manufacturer. At least one participant should be from outside the U.S. and Canada. (A given individual may count toward the total in more than one of these categories.)

- The Facilitator should be experienced in conducting meetings involving brainstorming to develop creative solutions to problems, and have organizational skills, knowledge of editing techniques, and technical writing experience. The co-facilitators will be paid for their services. They shall be responsible for planning, leading, and reporting on the workshop, with oversight from a TAC/Handbook monitoring committee. The facilitators shall also participate in the identification and selection of workshop participants in collaboration with the TAC and Handbook Committee chairs.

- Engineer/Designer participants should have experience in refrigeration systems and/or equipment design and application.

- Refrigeration service engineering participants should have experience in refrigeration system and equipment installation, operation and maintenance.

- Educator participants should have experience in teaching of refrigeration system and/or equipment design and application.

- Owner/Operator participants should have experience in refrigeration system and/or equipment application and facility management or facilities engineering.

- Manufacturer participants should have experience in refrigeration system and/or equipment application, as well as design of the equipment itself.

Emphasis in selection of workshop participants will be placed on experience as users of the Handbook. In addition, experience in writing, in general or of revising Handbook chapters in particular, is also desirable.

IMPLEMENTATION

The workshop final report will be distributed to all TC's with responsibility for chapters in 2006 Refrigeration Volume and to all members of TAC and Handbook Committees. Comments on specific chapters will be provided to the cognizant TC's, which will be asked to indicate to their respective section heads and handbook liaisons how they will respond, by the next national meeting after they receive the comments. Other recommendations of the workshop may result in modifications to HBC and/or TAC Committee objectives or action, or the Authors and Revisers Guide. General conclusions and recommendations of the workshop will be discussed in TAC Section and HBC committee meetings at the first meeting following their release to these committees.

DELIVERABLES

A final report will be prepared by the Co-Facilitators with assistance of the workshop participants and supervision by HBC and TAC:

- Criteria and methods for review
- Summary assessment of volume
- Description of specific issues
- Description of proposed improvements
- Implementation plan
- Individual reviewer comments on each chapter

Workshop findings and recommendations will be presented at a winter or annual meeting of the Society by the facilitator and other workshop participants

TENTATIVE SCHEDULE

- Planning and recruitment of members [November-December 2006]
- Get-acquainted conference call [December 2006]
- Preparation [January-April 2007]
- Volume overview conference call [January 2007]
- Workshop [Saturday & Sunday, April 21-27, 2007]
- Post-workshop report review [late May 2007]
- Report [June 2006]

ADMINISTRATION

TAC/Handbook staff support (minutes and arrangements)

The facilitator shall report to a monitoring committee chaired by the TAC Chair and including at a minimum the Handbook Chair and Current Fundamentals Chair.

Appendix D.
Individual chapter reviews
(See the attached WORD document)