

**Minutes: Properties Subcommittee,
ASME Research & Technology Committee on Water and Steam in Thermal Systems
Gaithersburg, MD, April 29-30, 2009**

Attendance:

Richard Harwood, Siemens Energy, Inc. (Chair)
Allan Harvey, NIST (Secretary, U.S. IAPWS Delegate)
Jim Bellows, Siemens Energy, Inc.
Dan Friend, NIST
John Gallagher, NIST
Peter Huang, NIST
Dick Jacobsen, Idaho State University
Anneke Levelt Sengers, NIST
Serguei Lvov, Penn State University
Peter Murphy, General Electric (by phone)
Bill Parry, General Electric (by phone)
Jan Sengers, University of Maryland

[NOTE: Items numbered as on Preliminary Agenda, which is attached.]

1-2. Approval of Agenda and Review of Action Items

A preliminary agenda (attached) was distributed. Minutes of the Fall 2008 meeting had been approved by email. Progress on action items was briefly reviewed. Leftover **Action** items carried over (and amended items and new ones generated after discussion) are as follows. Bellows to circulate 2009 IAPWS PCC minutes to ASME's PPEC committee and Water Technology Subcommittee. Harvey to contact Michael Tinkleman about getting item(s) in *ASME News* about new IAPWS viscosity and seawater formulations, and to do something similar after the 2009 IAPWS meeting. Harvey to send email reminder of September IAPWS meeting in the Netherlands. Sengers to send Jacobsen information about the importance of desalination for ASME. Harvey and Harwood to investigate whether there is a need for compact printed tables of seawater properties.

3. ASME Steam Tables Books

The Second Edition of the book, reflecting the new IAPWS viscosity formulation and new Region 5 formulation, became available for sale in early 2009.

As of 4/09, total sales of the book are 1334, reflecting 84 books sold in the last 12 months, including 33 of the Second Edition. Annual sales have been "flat" for several years. The new Compact Steam Tables booklet has sold 4362 copies (3660 in bulk orders), with approximately 1300 in the past 12 months.

There was discussion of the usefulness of having one or both of these books as a PDF. It was considered useful, but there was concern about whether ASME Press had the information in suitable format and about the ease of distributing such copies without payment.

Further discussion on Thursday concerned the current absence of properties more in the physical chemistry category (ionization constant, dielectric constant, refractive index) from the Steam Tables book, and whether enough of those who would buy the book might be interested in these other properties to justify a brief description and one-page table and/or plot.

[**Actions:** Harvey to check with ASME Press about possible electronic availability of files to make a PDF of the steam tables book and/or the compact book, and how such a PDF might be distributed. Long-range item to consider other properties for Third Edition of book and to consider adding ionization constant to scientific/general software distributed by NIST.]

4. ASME Software for IAPWS-IF97

Total sales are 577 “Professional” version, reflecting 23 sales in the past 12 months; sales have been fairly flat for several years. No new bugs have shown up.

Bill Parry and Peter Murphy reported progress on the DLL. It contains the new viscosity and Region 5 equations. Documentation will be electronic, as a PDF file, mostly similar to the existing software documentation but also with something about how to use the add-in, installation information, and a few words about the possible “drifting” problem and how to tighten tolerances to prevent it. There was some discussion of what products should exist – it was decided that our preference would be for a simple “DLL-only” product (with the XLA “locked” so it could not be changed) that cost less than \$100, and for a version containing the Fortran source code with XLA unlocked for sophisticated users, which would cost at least as much as the current “Professional” version (which is \$150).

Discussion also ensued about whether it would be adequate for the future to have the code for IAPWS-IF97 in Fortran; it was decided that the best place to consider this issue would be IAPWS.

[**Actions:** Parry and Murphy send DLL (as CDs by mail) to people for testing. Jacobsen and Bellows to see if he has access to 64-bit Vista for testing. All to test the DLL to the extent possible, reporting feedback to Parry and Murphy by the end of May. Parry put issue of other languages on IRS agenda for next IAPWS meeting. Parry discuss products and pricing with Mary Grace at ASME Press.]

5. Web sites

There was nothing new to report on this item.

6. U.S. Implementation of New Formulation for General and Scientific Use

Allan Harvey reported that sales of Version 2.21 in the first half of Fiscal 2009 had been 17 (8 with source code), with sales roughly constant for several years. Version 2.22 has recently been issued, containing the new IAPWS viscosity formulation, new melting and sublimation curves, and slightly revised thermal conductivity formulation.

In the medium term (perhaps coinciding with the new thermal conductivity formulation in 2 or 3 years), things will be switched over to the interface used for NIST’s Refprop software, perhaps including a DLL version, since the existing interface cannot be maintained or upgraded and probably will not work on 64-bit systems.

7. Transport Properties

Jan Sengers reported that the comprehensive article on the new IAPWS viscosity formulation has been published in *J. Phys. Chem. Ref. Data*, as has a smaller paper for *Int. J. Thermophysics* on the critical enhancement. For the thermal conductivity, the critical-region theory has been tested and the agreement with data (including viscosity) is excellent. There are issues to look at with the dilute gas where there is disagreement between low-density calculations and experiment, especially at high temperatures. It is expected to have a preliminary fit by the September 2009 IAPWS meeting, at which point an Evaluation Task Group should be appointed.

8. IAPWS Issues

With regard to awards, no vote request for IAPWS Honorary Fellow has been received. *The U.S. National Representative was authorized to act, consulting others as needed, if any request for our vote is received before the next IAPWS meeting.*

With regard to documents, one ICRN (on flue gas) has been circulated with a comment deadline of June. There was some discussion about the forthcoming document about a simpler pure-water thermodynamic formulation for oceanographic use, with general consensus that a “Supplementary Release” was the most

appropriate category. The need for IAPWS recommendations for desalination applications was mentioned. Other documents will see small revisions without any expected controversy.

[**Actions:** Bellows to look at flue gas document by end of May. *If nothing is seriously wrong, the U.S. National Representative was authorized to give our approval for this document.* Parry to engage the Task Group on desalination from item 15.1 from the TPWS/IRS minutes from the 2008 IAPWS meeting.]

Updates were given of activities of the various Working Groups at the 2008 IAPWS meeting in Berlin and upcoming activities for the 2009 meeting. From the PCAS Working Group, the IUPAC/IAPWS project on hydration properties has been revived and will be led by J. Sedlbauer. A monograph on high-temperature electrolyte data edited by Prof. Valyashko has been published.

A proposal has been prepared for U.S. participation in an international collaboration involving a Czech scientist visiting the University of Maryland to work on modeling supercooled water. It was noted that the thermodynamics (particularly the vapor pressure) of supercooled water is important for dew-point measurements in the humidity field. The U.S. committee is in favor of this project.

Concern was expressed about organization for the upcoming IAPWS meeting (Sept. 6-11) in the Netherlands, which will be held near Arnhem.

[**Action:** Friend to send note to IAPWS Executive Secretary offering U.S. assistance if needed for planning of Symposium.]

9. Membership

No changes in membership. We noted the difficulty for some of our members in getting permission to travel to meetings in the current financial climate. There was discussion of teleconferencing and web-based applications like LiveMeeting as options for the future, although the importance of face-to-face meetings was also recognized.

[**Action:** Harwood to investigate with Parry whether LiveMeeting conferences can be set up between their respective companies.]

10. Old Business

Royalties: Allan Harvey reported that we have begun getting royalties for the Compact Steam Tables booklet, and that royalties will be forthcoming for the Second Edition of the large book (and the DLL product when it is ready).

Funding: Jim Bellows reported on his discussions with Jim Mathews at EPRI regarding our financial support. While we will not recover funds from past years that slipped through the cracks, it seems like support of \$10K this year and \$12K in future years should be feasible. The difficulty of getting a clear picture of our income and expenses from ASME financial reports was discussed. Dan Friend reported (in an action item from our last meeting) that he had looked at the IAPWS dues structure and found it to be working as intended, with dues roughly proportional to GDP.

[**Actions:** Harwood send our annual report and 2009 funding request for \$10K to Norma Johnston at ASME for forwarding to EPRI. Bellows to contact Jim Mathews to let him know a request is coming. Jacobsen to get relevant financial information from Norma before our next meeting.]

11. New Business

An item brought to us from the main committee (Water and Steam in Thermal Systems) was the importance of crystallization processes in zero-liquid-discharge plants. These are very concentrated aqueous electrolyte solutions. Both thermodynamic and kinetic aspects are not well enough understood. There are plans to organize a mini-symposium at our April 2010 meeting.

[**Action:** Harvey to represent our Subcommittee in planning in this area, involving subcommittee member A. Anderko if possible.]

Lvov mentioned recent work on making corrosion measurements to high temperatures (up to 400 °C and 20 MPa), with current efforts on extending the measurements to electrical conductivity.

It was suggested that we create a list of “long-range” projects, issues, and questions for items that need not be on every agenda but which should not be forgotten. Several items for such a list were suggested, including inclusion of other properties (see Minute 3) in future editions of products, possible incorporation of more recent IAPWS “backward” equations in ASME software, table lookup methods for industrial property calculations, ASME’s strategic directions in water and energy, education, and IAPWS ICRNs.

[**Actions:** Harvey to create such a list. Bellows to prepare discussion of IAPWS ICRNs for our Fall 2009 meeting.]

12. Next Meetings

For Fall 2009, because it appears there will not be a desalination session at the International Water Conference (Orlando, Oct. 4-7) after all, there is less incentive to meet in Orlando. Instead, our first choice will be to meet at the Alstom facility in Connecticut, for 1.5 days (probably a full day and then a morning), where we would plan to have a Symposium with both Committee members and Alstom people presenting. This would be sometime at least a week separated from the IAPWS meeting and from the IWC, which leaves one week in September or else mid/late October as possibilities. If meeting at Alstom does not work out, the fallback position is to meet in Orlando around the time of the IWC.

[**Action:** Harwood contact Frank Gabrielli at Alstom, with the goal of getting dates established (or determining that it won’t work) by the end of May. All send Harwood summary (ASAP) of our available and unavailable dates for meeting in late September and October.]

Our Spring 2010 meeting is scheduled at NIST in Gaithersburg April 7-8, 2010.

Preliminary Agenda: ASME Subcommittee on Properties of Water and Steam

Location: NIST Admin Bldg, Room B-111 , Gaithersburg, MD

Time: Wednesday, April 29, 2009, 10:30 AM to 5 PM, Thurs. April 30, 8:30 to 10:30

- 1. Approval of Agenda**
- 2. Review of Action Items from Fall 2008 Minutes**
- 3. ASME Steam Tables book and booklet**
 - 3.1. Report on sales Allan Harvey
 - 3.2. Report on Second Edition of book Harvey
 - 3.3. PDF availability Harwood, Harvey, Parry
- 4. ASME Software for IAPWS-IF97**
 - 4.1. Report on sales Allan Harvey
 - 4.2. Technical support, bugs John Gallagher, Allan Harvey
 - 4.3. DLL/Excel product Bill Parry, Peter Murphy
 - 4.4. Plans for new backward equations & transport Allan Harvey, Bill Parry
 - 4.5. Testing All
- 5. U.S. Subcommittee and IAPWS Web pages** Allan Harvey
- 6. Update on implementation of general/scientific formulation** Allan Harvey
 - 6.1. Report on sales Allan Harvey
 - 6.2. Report on Version 2.22 Harvey
 - 6.3. Future versions Harvey, All
- 7. Report on transport properties** Dan Friend, Jan Sengers
- 8. IAPWS issues**
 - 8.1. IAPWS Awards Allan Harvey
 - 8.2. IAPWS documents for consideration Allan Harvey
 - 8.3. Current WG activities Harvey, Parry, Bellows, Lvov
 - 8.4. Preparation for IAPWS meeting All
- 9. Membership**
 - 9.1. Travel restrictions, Live meeting option All
- 10. Old Business**
 - 10.1. Royalties
 - 10.2. EPRI reports and funding Bellows
- 11. New Business**
 - 11.1. Education and website Sengers, Lvov, Harvey
 - 11.2. 5-year plan for committee Bellows, All
- 12. Next Meeting – Time, Orlando, etc.**
- 13. Adjournment**