Attachment 4

Minutes
IAPWS Thermophysical Properties of Water and Steam WG
BUENOS AIRES, ARGENTINA JULY 22-25, 2002

NOTE: Items are listed according to their order on the preliminary agenda. Items added to that agenda are noted approximately in the order they were considered. Bold print denotes significant actions taken.

1-3. The preliminary agenda was adopted with several additions and revisions. Allan Harvey was appointed Clerk of Minutes. The minutes from the 2001 TPWS WG meeting in Gaithersburg were approved without objection.

4. Dr. Friend reviewed the status of current releases and other documents. The highest priority for revision is the transport property releases, followed by the releases for properties of heavy water.

5. Prof. Wagner reported on the work of the Task Group appointed in 2001 on "Uncertainty of IAPWS-IF97 in Enthalpy." The Task Group had decided that the mandate it had received in 2001 did not really meet the identified needs. **The WG agreed with the suggestion that a document discussing the uncertainty of IAPWS-95 in enthalpy, and one discussing the uncertainty of IAPWS-IF97 enthalpies (consisting of the IAPWS-95 uncertainties and the differences between the two formulations), should be produced.** A schedule was adopted where these documents would be drafted by April 30, 2003 and circulated to the Task Group and the IRS WG. By May 31, 2002, the Chair of IRS will send the corrected document to national representatives with the intent of approving it at the 2003 IAPWS Annual Meeting.

6-8. For these items (Report of evaluation of Tabular Taylor Series Expansion (TTSE); Report on informal survey of industrial needs for IAPWS-IF97 backward equations for Region 3; Progress Report of Task Group for Region 3 backward equations), see the minutes of WG IRS.

9. A proposed ICRN was presented describing the need for reliable data for the thermodynamic properties of metastable steam; this is of importance in LP turbines. After several revisions, **the TPWS and IRS WGs endorsed this ICRN**. A second proposed ICRN was presented describing the need for reliable thermophysical properties of humid air and combustion gases. After revision, **the TPWS and IRS WGs endorsed this proposed ICRN**.

10. The Task Group on "Uncertainty of IAPWS-IF97 in Enthalpy" recommended that IAPWS should withdraw its Skeleton Tables of thermodynamic properties; it was felt that these tables now served no purpose and mostly created confusion. **The TPWS and IRS WGs decided to recommend that the withdrawal of these tables be simultaneous with the adoption of the uncertainty documents mentioned in item 5.**

11. (a) Dr. Friend described the status of work on transport properties and a work plan for the future. Dr. Mareš reported information on the effect of temperature scale changes on thermal conductivity data; the Transport Properties Task Group will further discuss these issues during the week. **Prof. Marc Assael was added to the Transport Properties Task Group**. **TPWS authorized the Task Group to draft revised releases for D_2O viscosity and thermal conductivity reflecting the change in temperature scale**.

(b) D_2O thermodynamics was discussed in a joint session with PCAS. Preliminary results were presented for a way of correcting the current D_2O release to the ITS-90 temperature scale. Peter Tremaine from PCAS will meet with people from the Canadian nuclear industry in August to assess their needs for D_2O properties. **TPWS authorized J. Cooper to draft a revised release for D_2O thermodynamic properties reflecting the change in temperature scale**.

(c) J. Cooper was authorized to continue liaison efforts with the IEC. He also reported on correspondence with F. Franks, and was authorized to send an additional letter clarifying some matters.

(d) A. Harvey reported for the Fundamental Constants Task Group that the revisions in the past year to the fundamental constants guideline had been very minor, basically the updating of two references. **TPWS endorsed these revisions to the Fundamental Constants guideline**.

(e) In joint session with PCAS, I. Svishchev reported on the work of the Task Group on Computer Simulation. The TG is moving toward preparing a Guideline for standard properties of the commonly used SPC/E model of water, probably using a "short" fundamental equation of state developed by the group of W. Wagner. The Task Group was encouraged to continue this work.

(Added item #1) Prof. Nagashima reported about two database projects underway relating to properties of water and aqueous systems.

12. In joint session with PCAS, several presentations were made in addition to those mentioned in item 11. A. Chialvo reported on "Molecular-based study of Ion Pair Association in Dilute NaCl Aqueous Solutions Along a Near- and a Sub-Critical Isotherm." W. Wagner reported on VDI 4670 and the real-gas behavior of combustion gases (primarily their heat capacity). A. Plyasunov reported on "Prediction of Vapor-Liquid Distribution Constants in High-Temperature Water." V. Mayer reported on "Prediction of Henry's Law Constant for Organic Compounds in Water." A. Harvey reported on a proposed IAPWS guideline to replace two existing guidelines for the Henry's constant and vapor-liquid distribution constant for gases in water and heavy water at high temperatures. This work will proceed forward toward a guideline for adoption in 2003; J. Cooper volunteered to check the equations and coefficients in the

proposed guideline for accuracy by programming them independently. D. Friend reported the production of a Closing document for the ICRN on ammonia-water mixtures. At this point, the main potential for this mixture as a working fluid is at relatively low temperatures, where the thermodynamic properties are well known but the transport properties are not. **Dr. Blangetti will work on a new ICRN reflecting this situation, to be proposed for adoption in 2003**.

(Added item #2) Because of the proliferation of IAPWS products for calculating water properties, it was suggested that a document should be prepared listing all IAPWS products for thermodynamic properties and discussing the relationships between them and appropriate uses for each. This document would be proposed for adoption in 2003. **A Task Group was appointed to draft this document, consisting of J. Cooper (chair), A. Harvey, and W. Wagner**.

13. With regard to the IAPWS Website, more ideas for FAQs are encouraged to be sent to the IAPWS Webmaster (A. Harvey) by WG members. It was suggested that the Website should have more information easily available on what each Working Group does.

14. A proposed IAPWS collaborative project was described where a young scientist from Greece would come to the U.S. to work on transport properties. **The WG endorsed this proposed collaboration**. It was suggested that those proposing such projects should try to distribute the proposals prior to the IAPWS meetings if possible.

15. The WG had nothing to say with regard to the proposed IAPWS monograph.

(Added item #3) The WG had a discussion in response to the request for input regarding the structure of IAPWS. The following input was given from TPWS and IRS: (1) Most important recent products have been IAPWS-95 (TPWS) and IAPWS-IF97 (IRS). (2) Future directions for electric power include gas turbines with high water content, fuel cells (in conjunction with microturbines), utilization of low-temperature heat sources (including geothermal), nuclear fission, and issues of reduced emissions of CO2 and other pollutants and reduced environmental impact in general; decentralization of production may continue. (3) With regard to the structure of IAPWS, there is satisfaction with the way IRS and TPWS are working now. The focus of IAPWS should be on providing products that are high-quality information of value to industry, based on the best available science. TPWS is (and will be) dealing with thermophysical properties of all sorts of mixtures containing water. It was felt that the name of the WG should better reflect this. **A tentative new name was selected: Thermophysical Properties of Aqueous Fluids**. It is suggested that the Wednesday symposia at IAPWS meetings should somehow be used as a springboard for discussions on future directions of IAPWS. With regard to the ICPWS, a clear preference was expressed for leaving it at a 5-year schedule. It was suggested that the educational role of IAPWS could be expanded.

16. WG members were invited to participate in the newly organized International Association for Transport Properties. WG members were invited to give ideas for sessions at the next ICPWS (2004 in Japan) to Dr. Friend. Ideas for future new tasks included: more work on properties of aqueous systems for environmental uses; work on
educational materials, possibly including a textbook; the diffusion of solutes in water, and further computer simulation work.

(Added item #4) The WG was asked to nominate a member to serve on the committee for selecting the recipient of the IAPWS Gibbs award. **A. Harvey was appointed to this task**.

17. The membership of R. Hendricks (USA) is withdrawn. Five new members were nominated: M. Assael (Greece), B. Baptista Filho (Brazil), Prof. Kadrnozka (Czech Republic), K. Knobloch (Germany), and R. Span (Germany). All five were unanimously endorsed to be proposed to the EC for membership.

18-20. The Chair and Clerk of Minutes were authorized to prepare the motion to the EC, and the WG meeting was adjourned.