**Attachment 4**

Minutes of the Working Group TPWS, Prague September 2000

After brief opening remarks by D. Friend, chair, expressing our thanks to our hosts, the agenda was adopted after a few changes in order to accommodate scheduling and it is attached as TPWS Attachment A. Mr. J. Gallagher was appointed Clerk of the Minutes without objection. The Minutes of the last meeting in Toronto, 1999, were approved after a motion to dispense with the reading.

All the current Releases and Guidelines of interest to this Working Group were reviewed and their status with respect to updating was discussed. Already recently updated for the temperature scale and requiring no action at this time were the releases on Thermal Conductivity of Ordinary Water Substance, Viscosity of Ordinary Water Substance, Refractive Index, Surface Tension, Pressure along Melting and Sublimation Curves and the Saturation Properties of Ordinary Water Substance. There are no plans yet for the revision of the Dielectric Constant Release, and the Release on the Critical Constants of Ordinary Water Substance, although revised in September 1992, may be further revised with new data now available. The Releases on the 1984 Formulation for the Thermodynamic Properties of Heavy Water and the 1984 Formulations for the Viscosity and Thermal Conductivity of Heavy Water, in need of revision, will be discussed later in this meeting. The 1980 Release on the Ion Product of Water Substance also is in need of revision and this will be discussed later in joint session with PCAS. The status of a new document on the NaCl-H2O Critical Point Locus will also be discussed with PCAS.

The Task Group on Transport Properties reports a new data paper published in JPCRD 29, 141(2000) and a viscosity publication by Alexandrov and Matveev, which needs evaluation; also that there is a discrepancy in the implementation of the Thermal Conductivity Release on which formulation for the density of H2O to use. This formulation may be reworked and further reported on next year. Drs. Mares and Sifner should be added to the Task Group.

The Task Group on the Thermodynamic Properties of D2O reports that Prof. Hill was not able to make much progress on a new formulation during the last year, and we appointed Prof. Kretzschmar and Prof. Jan Sengers as additions to this group. Prof. Hill will remain as the Chairman until such time as he decides to pass it on.

A Report on the Fundamental Constants applicable to Water by Allan Harvey was given in his absence by D. Friend. This recommends that the values for the basic physical constants recommended by CODATA in 1999 be used with the addition of values for the triple point and critical point of water, and values for the isotopic composition, dipole moment, polarizability and molar mass. He recommended that these values without background details be issued as a Guideline. (This document was distributed to WG Members, and is available from the WG Chairman). We endorsed the concept, and after discussion made the following recommendations: 1. These constants must be kept up to date, as values are revised on occasion, and we should have an annual review for new

values or for additional values of interest. The cover page for the document should contain the statement that "this document is subject to annual review. The latest review was (date)." Allan Harvey is appointed chairman of a permanent task group to conduct this annual review. 2. The document should add the viscosity of water at 20 °C. 3. It is the consensus of the WG that this document only contain material relevant to H2O and D2O and not mixtures. This document will be presented to the EC next year.

Jeff Cooper reported on his attendance at a meeting of the International Electrotechnical Commission (IEC) in London, Mar 2000. He distributed copies of our Releases 1995 and 1997 on the Formulations for H2O to their Working Group TC5, showing them how values they have been using since the 1960s have changed. He suggested to them that they not generate a new formulation of their own but use ours instead. They have produced a Draft Document to this effect. We ask Mr. Cooper to continue as the Liaison from IAPWS (not just TPWS) and urge PCC, that has many concerns of interest with IEC, to coordinate their interests with Mr. Cooper.

A proposed Supplementary Release on Backward Equations for Pressure as a Function of Enthalpy and Entropy p(h,s) by H.-J. Kretzschmar et al. was presented to a joint session with WG IC. (See the minutes of that group) We established a Task Group for the evaluation of these equations to be chaired by Mr. Miyagawa and with Mr. Gallagher as an additional member. They plan to complete their evaluation and make recommendations in time for action on the proposal next year.

A proposal for a Guideline for the use of the Tabular Taylor Series Expansion method for fast industrial calculations was presented to the TPWS-IC joint session (See the minutes for IC for details.)

A proposed Guideline on the properties of NH3-H2O mixtures was presented at a joint session with WG PCAS. (See the minutes for that WG). A paper was also presented at that joint session "Examination of the PVTx Properties for NH3-H2O Mixtures near the Maximum Density" by Oguchi et al. (Again, see the minutes for WG PCAS.) Since the proposed Guideline does not represent the new measurements presented in this paper within the specified tolerance, the proposed guideline will include the statement that the density near the maximum density is not well represented. With this amendment, Prof. Sengers moved, it was seconded and we approved unanimously that this Guideline be proposed to the EC for approval.

Collaborative Projects:

Prof. J. Sengers reported on the completed collaboration of Ms. Abdulagatovna from Dagestan at the Univ. of Maryland. The products of this collaboration include a paper presented at the ICPWS in Toronto, 1999 (This document was distributed to WG Members, and is available from the WG Chairman). This paper contained a new formulation representing the critical region of $H_2O$ and compared the predictions of this

formulation with a formulation by Kiselev and with values calculated from IAPWS-95. This collaboration has also produced a model for the $H_2O$-$D_2O$ critical line and comparisons with recent measurements of this system by Marshall and Simonson.

A new collaboration project was proposed by D. Friend and A. Alexandrov. The senior investigators would be I. M. Abdulagatov of Dagestan and J. W. Magee of NIST, Boulder. The proposal is for an experimental study of the CvVTX properties for aqueous systems. The systems proposed for study are $Na_2HPO_4$-$H_2O$ and $CH_3OH$-$H_2O$ with an instrument over a wide range of T and p, including the critical region and phase boundaries. The request is for $12000 from IAPWS - $2000 for Dr. Magee's travel expenses to Dagestan for a week or two, and $10,000 for a student from Dagestan, probably M. M. Aliev, to visit Boulder for perhaps three months. It was moved and seconded that we endorse this proposal and present it to the EC, and this was passed unanimously.

Web site Issues for TPWS:

The TPWS page on the IAPWS site contains a list of "Frequently Asked Questions," currently seven. This is being managed by Dr. Harvey. The members of this WG were asked to review these questions and check the answers for reasonableness and also to suggest any other questions that should be included. A few were suggested from the floor for consideration.

We received a proposal from Igor Svishchev that a Task Group be set up on Computer Simulation, and suggesting membership and activities that this task group might undertake. As Dr. Svishchev is not yet a member of our WG, we will propose to the EC that he be made a member of TPWS, and that such a task group be then established with him as Chairman according to his proposal with the above modifications.

Future Tasks:
Interest has been expressed

1. In the study of the $H_2O$-$CO_2$ surface as a function of T,p and pH
2. Solid-Liquid Equilibrium as applied to methane hydrates (clathrates)
3. Humid Air Turbines
4. NaCl-$H_2O$ Mixtures and
5. Backwards Equations T(p,h) and T(p,s) in Region 3 of IF97.

With respect to (2), Dr. C. Peters is an expert in this area, and we request our chair to issue a formal invitation to him to attend our meetings in Gaithersburg next year.

With respect to (3.) a book on Humid Gases by Beketov and Rabinovich has been published recently. We request Prof. Alexandrov to report next year on work being done in Russia on this topic.

With respect to (4.) It is noted that there is much existing literature already existing on this subject, and that literature needs to be reviewed before we recommend any future action.

With respect to (5.) we established a Task Group to study this, to be chaired by Prof. Kretzschmar to report next year on the feasibility. He will ask Dr. Mares and Prof. Wagner to join.

The ICRN for $NH_3$-$H_2O$ Mixtures expires this year, and as the current work does not include transport properties as requested in the ICRN, we will ask the EC to continue this for one year, and that it be rewritten to reflect the work already done for approval next year.

Membership: We will propose that Svishchev be proposed to the EC as noted above. We would also recommend Dr. Anderko for membership, but he will already be proposed by PCAS. We will also request the removal of D. Schmaus, as he is no longer active in this field.

The meeting was adjourned at noon, Thursday 7 September.

**TPWS Attachment A**

AGENDA
IAPWS Thermophysical Properties of Water and Steam WG
Prague, Czech Republic, 3-8 September 2000

## MONDAY 4 SEPTEMBER

1. Opening Remarks; Adoption of Agenda
2. Appointment of Clerk of Minutes
3. Approval of Minutes of TPWS WG in Toronto, 1999
4. Review of status of Releases and other documents
    (a) Review of all TPWS relevant documents
    (b) Plans for new documents
5. Reports on various TPWS activities
    (a) Transport Properties
    (b) $D_2O$ Thermodynamics
    (c) Fundamental Constants
    (d) Liaison with IEC
6. Projects of interest to TPWS and IC
    (a) P(h,s) Equation Document: Supplementary Release
    (b) Tabular Taylor Series Expansion

## TUESDAY 5 SEPTEMBER

7. Collaborative Projects
    (a) Report on existing/closing projects
    (b) Plans for new projects
8. Additional presentations from TPWS members
9. Website issues for TPWS
10. Atlas issues for TPWS
11. Projects of interest to TPWS and PCAS members
    (a) Ammonia-water mixtures
    (b) Status of NaCl-H2O Critical Point Locus document
    (c) Combustion Gases(?)
    (d) Aqueous non-electrolytes
    (e) Diffusion coefficient measurements
    (f) Computer Simulation
    (g) Other contributions

## THURSDAY 7 SEPTEMBER

12. Monograph (atlas): with all WGs
13. Final actions on IAPWS documents
14. Future tasks and collaborations
    (a) Mixtures
    (b) New IEC liaison
15. Membership
16. New Business
17. Preparation of Formal Motions to the EC
18. Adjournment