Attachment 4

Minutes

IAPWS Thermophysical Properties of Water and Steam WG

KYOTO, JAPAN 28 AUGUST TO 3 SEPTEMBER 2004

NOTE: Items are listed according to their order on the agenda, which is attached as Attachment A. **Bold print** denotes significant actions. These minutes include some items (4-6) that were done jointly with the WG IRS.

1-3. The meeting was opened at 11 AM on Sunday, August 29 by the Chair, Dan Friend. The agenda (Attachment A) was adopted. Allan Harvey was appointed Clerk of Minutes. The minutes of the 2003 IAPWS TPWS WG meeting in Denmark were approved.

4. The draft Supplementary Release "Supplementary Release on Backward Equations $p(h,s)$ for Region 3, Equations as a Function of h and s for the Region Boundaries, and an Equation $T_{sat}(h,s)$ for Region 4 of the IAPWS Industrial Formulation 1997 for the Thermodynamic Properties of Water and Steam" was distributed along with the favorable report of the evaluation task group. Concern was raised that the draft did not sufficiently deal with the issue of a short extrapolation into the metastable region below the triple point. It was decided that Prof. Kretzschmar, in conjunction with the Editorial Committee, should add a few words to address this issue. **The WGs voted to recommend the adoption of the Supplementary Release "Supplementary Release on Backward Equations $p(h,s)$ for Region 3, Equations as a Function of h and s for the Region Boundaries, and an Equation $T_{sat}(h,s)$ for Region 4 of the IAPWS Industrial Formulation 1997 for the Thermodynamic Properties of Water and Steam" after this minor revision.**

5. The draft revised Supplementary Release "Revised Supplementary Release on Backward Equations for the Functions $T(p,h)$, $v(p,h)$, and $T(p,s)$, $v(p,s)$ for Region 3 of the IAPWS Industrial Formulation 1997 for the Thermodynamic Properties of Water and Steam" was distributed along with the favorable report of the evaluation task group. **The WGs voted to recommend the adoption of the revised Supplementary Release "Revised Supplementary Release on Backward Equations for the Functions $T(p,h)$, $v(p,h)$, and $T(p,s)$, $v(p,s)$ for Region 3 of the IAPWS Industrial Formulation 1997 for the Thermodynamic Properties of Water and Steam".** Thanks was expressed to both the developers and the evaluation task group for all their hard work on both of these Supplementary Releases.

6. A report was given by Prof. Kretzschmar about the work of the Task Group on backward equations. A new Supplementary Release was proposed for the function $v(p,T)$ for Region 3. The proposal divided Region 3 into 20 subregions (or 26 if it was desired to cover all of Region 3, allowing larger deviations very near the critical point); there was some discussion as to whether this was desirable. It was decided to go ahead, but with a version that covered all of Region 3, sacrificing the consistency requirements very close to the critical point. **The WGs voted to appoint the same evaluation task group (chaired by Mr. Miyagawa) as for item #4 above,**

and to adopt a similar schedule of work (with the evaluation completed by the end of January) with the goal of adoption at the 2005 meeting in Greece.

6a. It was brought up that the *Journal of Engineering for Gas Turbines and Power* was imposing excess page charges ($200 for each page above nine) for the publication of the comprehensive article reporting the first Supplementary release with additional backward equations, adopted in 2001. This might amount to approximately $2000. It was felt that this was a necessary expense for the dissemination of IAPWS standards. **The WGs voted to ask the EC to pay these page charges from IAPWS funds.**

7a. Dr. Harvey recommended that no changes be made for the Fundamental Constants Guideline this year.

7b. Dr. Harvey had nothing to report on the Website, but solicited the WGs for more Frequently Asked Questions. Prof. Span mentioned that he was frequently asked about the status of IAPWS recommendations as an engineering standard, relationship with ISO, etc. **It was decided to draft a FAQ on this issue; Dr. Harvey and Prof. Span will work on this.**

7c. Dr. Friend summarized the current status of the project to revise the standard for the viscosity of ordinary water. Progress has been made, and a finished version should be available by the end of 2004 to send to the evaluation task group. The next project will the the thermal conductivity of ordinary water.

7d. There was nothing to report regarding the liason with the IEC.

7e. Mr. Cooper reported no progress on the project for updating the D_2O thermodynamic property release for the ITS-90 temperature scale. He hopes to have a draft of the proposed release and the accompanying report by the end of 2004.

7f. Prof. Span reported the status of the project in the EU on humid air properties for combustion gases and humid air turbines. There are still major needs, particularly for experimental work, for both thermodynamic and transport properties. **A task group of Span, Kretzschmar, Harvey and Cooper was appointed to explore how TPWS might help in this work and how it might turn into an output of some kind for TPWS.**

7g. Dr. Yasuoka, the Interim Chair of the Simulation Task Group, reported on the previous work of the task group and on some existing resources. A meeting of the Task Group and invited researchers was held and decided to hold annual symposia before focusing on a specific IAPWS output.

8. With regard to membership, last year some WG members were asked to attempt to contact members who had not been active to see if they wished to continue. As a result of this, **Dr. Agayev (Azerbaijan) and Dr. Mayinger (Germany) are withdrawn from TPWS membership** Dr. Friend expressed his intention to step down as Chair of the TPWS WG following next year's meeting in Greece; no replacement has been designated at this time.

9. Prof. Wagner brought to the attention of the WG his work with Prof. Feistel on a fundamental equation for the thermodynamic properties of ice. The WG decided that it would be desirable to have an IAPWS document for the thermodynamic properties of ice. Prof. Wagner

was authorized to proceed in this direction, with the goal of having a draft document for next year's meeting in Greece, at which time an evaluation task group will be appointed.

Mr. Cooper pointed out that Advisory Note #2 should be updated to reflect the new Supplementary Releases (items 4 and 5 above) if they are adopted by the EC. He will draft the updated language.

The WG voted to recommend such an update to the EC if the proposed Supplementary Releases are adopted.

With regard to the issue raised in the EC meeting about attracting people (especially young people) to meetings, **the TPWS WG recommends to the EC that the Executive Secretary should send invitations to the Annual Meetings directly to each WG member (either by postal mail or e-mail) rather than relying solely on the Website**.

Dr. Harvey reported on conversations in Kyoto with Drs. Fujii and Tanaka of the National Metrology Institute of Japan, who are involved in the CCM (Consultative Committee for Mass and Related Quantities) and CIPM (International Committee on Weight and Measures). The CCM has adopted a standard for metrology for the density of ordinary water at near-ambient pressures between 0 °C and 40 °C, and questions arise about the relationship of this recommendation to the IAPWS standard. Drs. Fujii and Tanaka are interested in publishing a short note in *Metrologia* to clarify these issues. **Dr. Harvey and Prof. Span were appointed as liasons to deal with the CCM on this issue.**

10. The Chair and Clerk of Minutes were appointed to prepare the formal motion of the TPWS WG to the EC.

11. The meeting was adjourned at 6:20 PM on Tuesday, August 31.

TPWS Attachment A

Agenda

IAPWS Thermophysical Properties of Water and Steam WG

KYOTO, JAPAN 28 AUGUST TO 3 SEPTEMBER 2004

1. Opening Remarks; Adoption of Agenda

2. Appointment of Clerk of Minutes

3. Approval of Minutes of TPWS WG in Vejle, Denmark, August 2003

4. *Supplementary Release on Backward Equations for Region 3, Equations as a Function of h and s for the Region Boundaries, and an Equation for Wet Steam of the IAPWS Industrial Formulation 1997 for the Thermodynamic Properties of Water and Steam
   - 4a) Report of the Evaluation Task Group
   - 4b) Acceptance of the Supplementary Release

5. *Revised Supplementary Release on Backward Equations for the Functions T(p,h), v(p,h), and T(p,s), v(p,s) for Region 3 of the IAPWS Industrial Formulation 1997 for the Thermodynamic Properties of Water and Steam
   - 5a) Report of the Evaluation Task Group
   - 5b) Acceptance of the Supplementary Release

6. *Progress Report of the Task Group for the Development of IAPWS-IF97 Backward Equations in Region 3 (Proposal: supplementary release on v(p,T) equation)

7. Reports on Various TPWS Activities
   - (a) Fundamental Constants
   - (b) Website Issues
   - (c) Transport Properties
   - (d) Liaison with IEC
   - (e) D_2O Properties
   - (f) Humid Air
   - (g) +Simulation Task Group

8. Membership; Officers

9. Other Business

10. Preparation of the Formal Motion to the EC

11. Adjournment

* Joint with WG IRS
+ Joint with WG PCAS