THE INTERNATIONAL ASSOCIATION FOR THE PROPERTIES OF WATER AND STEAM

MEMBERS

Argentina and Brazil
Britain and Ireland
Canada
Czech Republic
Denmark
France
Germany
Greece
Italy
Japan
Russia
United States of America

ASSOCIATE MEMBER

Switzerland

EXECUTIVE SECRETARY

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Minutes of the Meetings

of the

Executive Committee

of the

International Association for the Properties of

Water and Steam

Berlin, Germany
7-12 September 2008

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Minutes of the Meetings
of the
Executive Committee
of the
International Association for the Properties of Water and Steam
held in
Berlin, Germany
7-12 September 2008

Plenary Session. Sunday, 7th September 2008. 9:07 am

The President of IAPWS, Cooper, welcomed the Executive Committee (EC) and other IAPWS members to Berlin for the ICPWS, EC and Working Group (WG) Meetings of IAPWS. The President officially opened the 2008 EC Meetings by introducing the National Delegates. Each of the Member and Associate Member countries of IAPWS was in attendance with the exception of Argentina/Brazil, France, Greece and Italy.

The President asked the head of the German National Committee to provide some opening comments. Rukes welcomed everybody to Germany and to the 2008 ICPWS Conference and the IAPWS meetings.

1. Adoption of Agenda

Provisional agendas had been posted on the IAPWS Website for all IAPWS members by the Executive Secretary in May and August 2008. There were no further agenda suggestions from the EC. The agenda was then approved by the Heads of all National Delegations and forms Attachment 1 of these minutes.

2. IAPWS Business and Appointment of Committees

2.1 Releases, Advisory Notes and Guidance Documents

The President indicated that the following seven documents had been circulated on the dates indicated to the National Committees by the Executive Secretary for final review prior to being approved during the current EC Meeting:

- Release on the Viscosity of Ordinary Water Substance. 7th December 2007.

- Supplementary Release on Properties of Liquid Water at 0.1 MPa. 1st May 2008.

- Release on the IAPWS Formulation 2008 for the Thermodynamic Properties of Seawater. 5th June 2008.

- Revised Release on the IAPS Formulation 1985 for the Thermal Conductivity of Ordinary Water Substance. 5th June 2008.

- Revised Advisory Note No. 3: Thermodynamic Derivatives from IAPWS Formulations. 4th August 2008.

- Revised Release on the Pressure along the Melting and Sublimation Curves of Ordinary Water Substance. 4th August 2008.

- Procedures for the Measurement of Carryover of Boiler Water into Steam. 19th May 2008.

Because the TPWS WG needed to have a final review of the first six documents, there was a possibility that the documents might not be approved by the EC before the General meeting on Thursday. Discussion followed and eventually a proposal was formulated that the documents should be approved by the EC and that only major exceptions should be reported to the EC at the Friday meeting. (Minute 7.1 reports on the confirmation of these documents by the TPWS and IRS WGs).

The EC approved the first six documents unanimously.

The President then proposed that the final document developed by PCC on Carryover should also be approved. But in this case the name for this new series of IAWPS products had not been approved by the EC. He asked the Chairman of PCC for clarification. Svoboda indicated that PCC suggested *IAPWS Technical Guidance Documents*. The President asked the EC for approval of both the name of these documents and for the Carryover Guidance.

The EC approved both items unanimously.

2.2 Press Release.

The President asked Bellows to serve on this Committee. The Clerk of Minutes from each WG will also provide input. Span will also be added to the Committee to ensure information on ICPWS is included. The Press Release is discussed in Minute 17.1 and Attachment 6.

2.3 Evaluation Committee on International Collaboration.

The President indicated that no proposals had been received by the Executive Secretary prior to the meeting, and that any suggestions from WGs should be given to the Executive Secretary by the end of day. The President then reminded the EC that if any were received that the Committee to review any proposals would consist of the WG Chairmen, with the President and Executive Secretary as ex. officio members. A chairman would be chosen by the Committee. The discussion of this Committee is reported in Minute 14.1.

2.4 IAPWS Awards Committees

2.4.1 Helmholtz Award Committee

The President indicated that there was a Helmholtz Awardee this year and that the Award would be presented during the ICPWS following the General Meeting. The Executive Secretary then reminded the EC that the Helmholtz Committee for the 2009 award would consist of a member from Japan, Russia, USA, Argentina/Brazil, and BIAPWS. The President asked the Japan delegate (Watanabe) to organize the committee and to report back to the EC on Friday with the names of the members of this committee (Minute 15.1).

2.4.2 Honorary Fellow Award Committee

The Executive Secretary requested that Tremaine remain as the Chairman of this committee for 2009 with Watanabe as the other member. The IAPWS President would be ex. Officio.

2.5 Host Country Location and Date for 16th ICPWS

The President indicated that the Vice President, the Executive Secretary and himself had reviewed the history of ICPWS locations and that BIAPWS was the primary country for the next location of an ICPWS. Initial discussions within BIAPWS had raised some problems with regards to having the ICPWS in 2012 because of the Olympic Games in London. The President suggested that a small committee be formed to discuss some of the overall aspects of ICPWS with regards to frequency, locations and expenditures. Vice President Friend was asked to lead this committee and report back to the President and Executive Secretary before the General Meeting on Thursday. Other members of the committee selected were: Rudge, Tremaine and Weber.

2.6 IAPWS Member Countries Defaulting on Dues

The President indicated that the Executive Secretary had been requested by the EC at the 2007 meeting to make contact with the countries defaulting on dues and to determine their future prospects. The President requested that Watanabe chair a committee with Daucik and Alexandrov to determine how the EC should approach this situation. The President requested that a report be provided before Thursday so that he could include it in his report to the General Meeting. This report is provided in Minute 12.1.

2.7 IAPWS Statutes and By-Laws

The President requested the Chairman of this Committee (Harvey) to provide a short report on the activities since the last EC meeting. Harvey reported that the following suggested changes had been made to the IAPWS Statutes and By-Laws:

- The authority for Statutes and setting IAPWS policy goes to the EC instead of the General Meeting, which in the future will become informational.

- Statutes changes must be voted on by the EC at a General Meeting.

- Members defaulting on dues will become an Associate Member after three years, but the EC may grant an exception.

- A number of minor changes were also made to the Statutes: a) to consistently allow for combined committees, b) clarification that the President cannot be the National Delegate, c) the ICPWS will be held at "approximately every four years".

- A number of changes were made to the By-Laws: a) to allow electronic approval of WG documents, b) to allow for minor changes to ICRNs without delaying the document by a year, c) modification to the Helmholtz Award Procedures as approved by the EC in 2006.

Changes to the Statutes require approval by the EC and the General Committee. Changes to the By-Laws require only approval by the EC. The revised Statutes and By-Laws had been circulated to the National Committees in February 2008 and no comments had been received by the Executive Secretary, so the President proposed that the EC approve the process which will take these suggested revisions to the General Meeting on Thursday.

The EC Approved this Process Unanimously.

The Japanese Delegate then thanked the Committee and particularly Harvey as Chair for leading this effort.

2.8 and 2.9 Other business for General Meeting or Requiring Extensive Discusssions

No other business was raised by the EC.

3. EC Mandate to Working Groups and Membership

3.1 Releases, Guidelines and Certified Research Needs.

The President indicated that Releases had been dealt with under item 2.1. The Executive Secretary indicated that three ICRNs needed completing by the WGs during the week: #17 on Amines, #21 on Ultra-supercritical plant chemistry, and #22 on Steam Chemistry in the Phase Transition Zone. He also indicated that two ICRNs were going to expire in September 2008 and needed a closing statement or revision: # 14 on Humid Air, and #15 on Metastable Steam.

3.2 Working Group Directions.

The President reminded the WG Chairmen that they should only report to the EC on Friday, those activities that needed approval or discussion by the EC.

4. Preview of ICPWS and by WG Chairmen of Weeks Activities

President Cooper requested the 16th ICPWS Chairman, Span, to provide a short overview of the ICPWS activities, and each WG Chairman to review briefly the main topics which would be covered in their WGs during the week. The ICPWS is covered in Minute 17.2. The details of the WG meetings are covered in detail in Minutes 7, 8 and 9 (Attachments 3-5).

The President closed the opening session of the EC at 10:05am.

Activities During the Week

The first day activities of the WGs and Executive Committee were followed by the ICPWS sessions on Monday to Thursday.

The full IAPWS program for the week is shown in Attachment 2.

Executive Committee Meeting. Friday, 12 September 2008

President Cooper opened the continuation of the EC Meeting at 8:37am. All members of IAPWS were present except Argentina/Brazil, France, Greece, and Italy. Cooper first asked the EC if there were any additional items that should be added to the Agenda. None were suggested. The Executive Secretary showed the latest Agenda with additional items relating to the new activities from the Sunday EC Meeting.

5. Acceptance of Minutes of Previous Meeting

President Cooper asked for comments and changes to the minutes of the EC meeting held in Lucerne, Switzerland in September 2007. No changes were noted, thus the 2007 Minutes were accepted.

6. President's Report

President Cooper indicated his comments at the General Meeting were the same as his report to the EC. He particularly wanted to emphasize that IAPWS had been very productive in the period since Lucerne with seven new/revised documents. He thought that the new PCC Technical Guidance documents would become very important for IAPWS in the coming years. On an IAPWS personality note, he wanted the EC to note that Professor Jan Sengers had received a Distinguished International Service Award at the University of Maryland.

7. Report and Recommendations of the Thermophysical Properties of Water and Steam (TPWS) and the Industrial Requirements and Solutions (IRS) Working Groups

Chairman Kretzschmar highlighted only those activities from the TPWS and IRS working sessions during the week which needed action by the EC or which he thought were of interest to the EC. He indicated that all of the WG activities had been conducted jointly. Full Minutes and the Agenda can be found in Attachment 3.

7.1 Kretzschmar indicated that the combined WGs had conducted final reviews of the Releases, Supplementary Releases and Advisory Notes which had been approved at the Sunday EC meeting (delineated in Minute 2.1). He then provided the following confirmatory notes for the EC:
IAPWS Formulation 2008 for Seawater. This Release is confirmed by the two WGs with some minor editorial corrections.
Release on Melting and Sublimation Pressure Curves. This release was confirmed by the two WGs.
Supplementary Release on the Properties of Liquid Water at 0.1 MPa. The WGs confirmed the Release.

Release on the IAPWS Formulation 2008 for Viscosity. The WGs confirmed the editorial changes associated with the references.
Revised Release on IAPWS Formulation for Thermal Conductivity. The WGs confirmed the Revised Release.
Revised Advisory Note Number 3. The WGs confirmed the revised Advisory Note Number 3.

7.2 Kretzschmar next provided information on activity with respect to other Releases, Guidelines and Advisory Notes:
Release on IAPWS Formulation 1995. The editorial changes to the Release were confirmed by the two WGs.
Revision of Release on IAPWS Formulation 1995. The two WGs agreed to change the proposed footnote on Table 1 of the Release so that it did not report different constants. The WGs plan a revised IAPWS-95 Release for 2009.
New Formulation for Thermal Conductivity. The WGs will have a draft ready for the 2009 meeting.
New Supplementary Release for Liquid Water for Oceanographic Use. This will include a Gibbs energy equation (F03 equation) for liquid water. SCOR/IAPSO recommends this equation for liquid water as their standard because it is computationally simpler than IAPWS-95 and more accurate than the IAPWS-IF97 equation for region 1. The WGs plan a Supplementary Release in 2009.
Revised Release on Ice. The WGs plan a revised release in 2009.
Revised Release on Seawater. The WGs plan an extension of the Seawater Release in 2009 for industrial use including desalination.
Guideline on Fundamental Constants. The WGs approved a minor update of this Guideline to reflect the latest CODATA adjustment. Kretzschmar proposed to the EC that this update be approved by the EC.

The EC approved this update unanimously.

Advisory Note Number 2 on the Role of Various IAPWS Documents. The President explained that the updates were necessary to explain the position of new documents to outside organizations. There were no changes of any numbers or equations. Chairman Kretzschmar then requested that the EC approve these updates.

The EC approved the updated Advisory Note unanimously.

7.3 Chairman Kretzschmar next discussed the activities of the two WGs on ICRNs:
ICRN 14 on Humid Air. The WGs recommend to EC that this ICRN be expired. A closing statement will be prepared and forwarded to the Executive Secretary. A new Task Group has been formed to consider the future related needs and to produce a draft new ICRN for 2009.

New ICRN 23. The WGs approved a new ICRN on Dew Point for Flue Gas of Power Plant Exhaust with the provision that oxyfuel items will be added. The ICRN will need final Editorial Committee review prior to sending to the Executive Secretary for Postal Ballot.

7.4 The Chairman next discussed the liaison with CCM (Consultative Committee for Mass and Related Quantities). The WGs had authorized the Task Group to proceed with the joint publication concerning recommendations for computing the density of water for metrology and other purposes to be submitted to *Metrologia* and to prepare an Advisory Note for adoption in 2009. Kretzschmar then proposed that the EC approve the following joint recommendations:

a) For use in metrology over its recommended range which is liquid water from 0 ^{o}C to 40 ^{o}C at pressures near atmospheric. It should be extrapolated outside of this range.
b) Densities computed from the IAPWS-95 formulation are consistent with the CIPM standard within the region of validity of the CIPM formulation. For uses outside the CIPM range of validity, the IAPWS-95 formulation is the preferred method for obtaining accurate densities for water.
c) For uses covering a range of conditions, some of which are inside the range of validity of the CIPM standard and some of which are not, it is generally preferable to use the IAPWS-95 formulation for the entire calculation in order to avoid discontinuities.

The EC approved this set of joint recommendations unanimously.

7.5 The Chairman next informed the EC that 1,158 downloads of the software "*Steam Tables for Pocket Calculators*" had occurred from the IAPWS website under the "Education" category. 606 of these had occurred since the last IAPWS meeting. A proposal to place a similar link for an Excel add-in was approved by the two WGs. The Chairman requested that the EC approve and indicated that the German NC must also give its approval as required by the existing IAPWS policy.

The EC approved unanimously.

7.6 With regards to membership Kretzschmar requested that the following six new members are approved:

J. Gernert, Ruhr University Bochum, Germany (TPWS)
T. McDougall, CSIRO, Australia (TPWS)
S. Seitz, PTB Braunschweig, Germany (TPWS)
R. Tailleux, University of Reading, UK (TPWS)
D. Wright, Bedford Institute of Oceanography, Canada (TPWS)
R. Harwood, Siemens Orlando, USA (IRS)

The Chairman also requested that the following three people are withdrawn from membership:

H. Sato, Japan (TPWS and IRS)
M. Uematsu, Japan, (TPWS)
J.G. Feller, USA (IRS)

The EC approved these membership changes unanimously.

8. Report and Recommendations of Physical Chemistry of Aqueous Systems Working Group (PCAS)

Chairman Lvov provided the PCAS Report to the EC. Full Minutes can be found in Attachment 4. He covered the following items with the EC:

8.1 International Collaboration. The WG approved the progress report on the international collaboration project between Canada (Tremaine) and the Czech Republic (Sedlbauer) which is budgeted with an IAPWS contribution of $14,000 for the living expenses of PhD student Jana Ehlerova. The project is for measurements on copper (II) complexation vs. temperature.

8.2 Task Groups. The WG had conducted a joint symposium with the Electrochemical Society in Washington, DC in 2007. The financial support of IAPWS had been used to support seven invited speakers and to help organize the symposium. The Chairman reported that this was a very successful symposium.

8.3 With regards to membership of PCAS, Lvov requested that two people become members of the WG:

D. Guzonas, AECL, Canada
N. Matubayasi, Kyoto University, Japan

The EC approved these two members unanimously

8.4 Chairman Lvov indicated that he was going to step down as Chairman of PCAS and that the WG had discussed the possibilities for a Chairman and Vice Chairman of the WG. He reported that he had received a letter from the current Vice Chariman, Corti, requesting that he would not be able to continue in that position. Lvov then proposed to the EC that Professor Nakahara becomes the new PCAS Chairman and that Dr. Anderko becomes the Vice Chairman. A gradual transition from himself would take place between now and 1st January 2009.

The EC approved the new chairmanship of PCAS unanimously

8.5 Lvov reported to the EC that the PCAS WG had met jointly with PCC to discuss ICRNs 17, 21 and 22 (Minute 9.2).

8.6 The Data book on *"Hydrothermal Properties of Materials"* is expected to be published in December 2008.

8.7 Chairman Lvov next reported on the joint IUPAC/IAPWS Project on Standard Partial Molar Properties of Solutes. He reported that the IAPWS representative (Mayer) had changed jobs and had withdrawn from the project. Mayer had developed a status report as requested at the 2007 EC Meeting. Lvov presented some of the salient features. He then indicated that PCAS member, Sedlbauer, had indicated that he was prepared to take over the project and had been requested to develop a status report for continuing the project. The Japanese delegate, Watanabe, suggested to the EC that IAPWS did not want to delay this project and encouraged PCAS (Sedlbauer) to develop quickly an accurate financial analysis and to interface with IUPAC. Much discussion by other EC delegates then took place. Finally Chairman Lvov made the proposal that Sedlbauer should prepare the status report which would be reviewed and approved by four PCAS members prior to sending it to the Executive Secretary in the time period January to March 2009. A postal ballot for continuing the project would then be conducted.

The EC agreed unanimously with this proposal.

9. Report and Recommendations of Plant Cycle Chemistry Working Group (PCC)

Chairman Svoboda highlighted those activities that needed action/approval by the EC. A full written report of the PCC WG activities forms Attachment 5.

9.1 International Collaboration on *Assessment of the State of Art of Sampling Corrosion Products from Water/Steam Cycles* has been completed under budget. The WG will propose a follow-on activity on sample processing. This will be forwarded to the Executive Secretary for Postal Ballot by the end of 2008.

9.2 ICRNs. Svoboda reported that ICRNs on Amines (17) and Ultra-supercritical plant chemistry (21) were reviewed in a joint meeting with PCAS. They will be amended and forwarded to the Editorial Committee and then for postal ballot. ICRN 22 on Nucleation in Steam Turbines is still under review by PCC. The Czech Republic delegate (Hruby) indicated that he would like to coordinate the development with PCC.

9.3 Technical Guidance Documents. Svoboda indicated that the first of these new IAPWS documents on Drum Carryover was approved by the EC at the Sunday meeting.

9.4 Task Groups. The PCC Chairman reported that the WG had two continuing Task Groups on Risk for Asset Damage and on Review of European Standard EN 12952.12. He also indicated that a new Task Group had been formed on Technical Guidance Documents on Cycle Chemistry.

9.5 PCC Membership. The Chairman proposed two new members for PCC:

F.U. Leidich, Alstom, Germany
D. Smetanin, Moscow Power Institute, Russia

The EC approved these membership changes unanimously.

10. Future Collaboration on Seawater

The President requested the German Delegate, Rukes, to make a motion on this topic. Rukes proposed to the EC that a Subcommittee on Seawater (SOS) be established. This new subcommittee will work in close cooperation with TPWS and IRS but will separately address its own specific topics including: a) the description of the properties of seawater, b) the formulation of documents on definitions, properties and standards for seawater, and c) the endorsement of those standards by international bodies. The subcommittee is suggested to consist of members from the SCOR/IAPSO WG 127 and also members of TPWS/IRS and PCAS with interest in seawater problems. SOS may additionally rely on support by external colleagues.

The EC unanimously approved the formation of the new IAPWS Subcommittee on Seawater (SOS), which will report directly to the EC.

The President then proposed Feistel as the first chairman of SOS.

The EC unanimously approved this officer choice.

Feistel indicated that SOS will be populated by members from four areas: oceanography, industrial applications, transport properties and chemical properties.

11. Editorial Committee Report

President Cooper reported that Editorial Committee Chairman Harvey had returned home but had left a report on the Editorial Committee. Cooper reported that the Editorial Committee had reviewed and approved all the IAPWS documents delineated in Minute 2.1. In addition the Editorial Committee had

provided assistance on the proposed ICRN on Dewpoint and updated Advisory Note Number 2.

The President next proposed to the EC that another English speaking person should be added to the Editorial Committee. The US Delegate, Friend, suggested that the English speaking National Committees (BIAPWS, Canada and USA) should consider nominating one of their members at the 2009 EC Meetings.

Action: BIAPWS, Canada and the USA to consider nominating somebody to the Editorial Committee in 2009.

12. Membership and Associates

12.1 Members Defaulting on Dues.

The President asked the Chairman of the Committee formed on Sunday (Minute 2.6) to report on the deliberations during the week. Watanabe indicated that his committee (Daucik and Alexandrov) had reviewed the information provided by the Executive Secretary. This indicated that France had not been able to pay the IAPWS Dues for the last four years, Argentina/Brazil for the last three years and Italy since prior to 2004. Letters had also been sent by the Executive Secretary to a number of Member Countries to determine the current status of their IAPWS activities. No response had been received from France and Italy. Argentina/Brazil had responded that participation in IAPWS in the future is unlikely. Russia indicated positively that the Russian National Committee had been reconstituted and had new direction which had allowed payment of the IAPWS dues for the last two years. With regards to the National Committee of Greece, Assael had indicated that he was stepping down as Chairman and that Kastanaki from PPC would be taking over.

Based on this information Watanabe indicated that his Committee proposes the following to the EC:

- Italy should become an Associate Member. Italy had previously requested this action in 2004, but the EC at that time had decided to allow the National Committee to remain as a Member “for the time being”.
- Argentina/Brazil should become an Associate Member as suggested in the recent correspondence from Corti.
- France should remain as a Member with the decision being reviewed by the EC in 2009. The President and Executive Secretary had met during the week with seven individuals from France and they had given some assurance that they were very

interested in reactivating the National Committee. They will report to the Executive Secretary by January 2009.

The EC approved the proposal unanimously.

Action: The President will send a letter to Italy and Argentina/Brazil explaining the action taken by the EC.

12.2 Switzerland as an Associate Member

The President requested the Head of the National Committee of Switzerland, formed in 2007, to say a few words. Svoboda reported that the Swiss National Committee has hardened its local committee and held a meeting of members during the last year.

13. Executive Secretary's Report

13.1 Financial, Auditors and Dues

The Executive Secretary reported that IAPWS remained on a sound financial footing with currently over SFrs 67,193 in the Swiss bank account and about $17,969 in the US account for a total of $79,054 combined. The status as at 24 August 2008 in the bank accounts had been provided to each National Delegate present at the EC meeting.

The Executive Secretary next reported that the 2007 financial statements had been forwarded to the IAPWS Auditors in January 2008. Both VDI in Germany and Mr. Miyagawa in Japan had reviewed and approved the financial statements. The Auditors' reports had also been provided to all the National Delegates present.

The Executive Secretary proposed that these organizations continue to act as auditors.

The EC approved this unanimously.

The Executive Secretary proposed to the EC that the dues structure for member countries remain unchanged for 2009.

The EC unanimously agreed to this proposal.

The Executive Secretary also provided a rough estimate of the income and known planned expenditures for 2008/9. He apologized that he had not included any expenses which might be associated with the reactivation of the IAPWS/IUPAC project (Minute 8.7).

13.2 Time and Place of the 2009, 2010 and 2011 Meetings

The Executive Secretary reported that he had received information from Zeijseink about holding the 2009 EC and WG Meetings in Arnhem, The Netherlands on 6-11 September 2009. The meetings will be held at the Business Park in Arnhem (KEMA Location) and will be supported by the Dutch group of power plant chemists. Further details will be developed in October 2008. The EC requested that a website is developed for the meetings.

The Executive Secretary also indicated that it is tentatively planned to hold the 2010 meetings in Canada and the 2011 meetings in the Czech Republic. The final decision on these will be made after the timing and location of the 16th ICPWS are developed (Minute 17.2).

14. Guidelines, Releases, Certified Research Needs, and International Collaborations

The President indicated that the Releases and ICRNs had been discussed within the WG Reports so no further action was required by the EC.

14.1 International Collaborative Projects.

The President indicated that no new international collaboration projects had been proposed.

15. IAPWS Awards

15.1 IAPWS Helmholtz Award

The President reported that Dr. N Yoshii from Japan had been selected as the 2008 Helmholtz Awardee and that he had been presented with the award prior to his Helmholtz Lecture immediately following the General Meeting of IAPWS on Thursday. He then asked the Japanese Delegate for the names of the 2009 Helmholtz Award Committee. The 2009 Helmholtz Committee will consist of: Chairman Nakahara (Japan), Petrova (Russia), Anderko (USA), Corti (Argentina/Brazil) and Rudge (BIAPWS). Nominations will be due to the Executive Secretary by January 31, 2009.

15.2 IAPWS Honorary Fellowships

The President reported that Svoboda (Switzerland) had been elected Honorary IAPWS Fellow, following the established procedures and after unanimous approval through the postal ballot conducted by the Executive Secretary. The Fellowship Award had been presented at the ICPWS/IAPWS Dinner on Wednesday evening by the IAPWS President.

The President reminded the EC of the Awards Committee for 2009 with Tremaine as Chairman and Watanabe as member with the IAPWS President as ex.-officio member. Nominations are due to the Executive Secretary by January 31, 2009.

16. Election of Officers for 2009 and 2010

The President indicated that he would step down at the end of 2008 and that Vice President Friend will assume the position of IAPWS President on January 1, 2009. According to the Statutes, the election of the next Vice President should be made at the end of the EC meeting in even years. The President and Executive Secretary had checked the recent history and proposed that the Danish National Committee should be asked to nominate one of their committee members for the position. The President asked the EC if there were any other suggestions. None were suggested, so he then requested the EC to approve this selection.

The EC unanimously approved this selection.

Action: The Danish National Committee should inform the Executive Secretary of their nomination for Vice President after the next meeting of their committee, and before the end of 2008.

17. New Business

17.1 Press Release

The President requested that Bellows project the Press Release for review by the EC. Suggestions were provided by the EC and the final version is contained in Attachment 6.

17.2 15^{th} and 16^{th} ICPWS

The President first requested Span as the 15^{th} ICPWS Chairman to present a short status report. Span indicated that there had been 202 participants from 23 countries, and that 150 presentations had been given. Poster sessions and paper presentations were included. He mentioned that VDI had taken care of the registrations and the ICPWS Website. CDs of the proceedings with an ISBN number were available and he requested that each National Committee took 15 copies to distribute in home country libraries. Discussion by the EC requested that investigations be made as to whether the proceedings could be made available on the IAWPS website.

The President once again wanted to provide his appreciation on behalf of IAWPS for the ICPWS arrangments and to the local organizing committee as well as the international program committee.

The President then asked the BIAPWS Delegate, Rudge, to report on the decision making process for the 16th ICPWS. Rudge indicated that he had collected data during the week which BIAPWS would now analyze and report back with a decision to the Executive Secretary by the end of January 2009 on whether BIAWS would host the 16th ICPWS. The Executive Secretary indicated that a contingency plan has been developed in the case that BIAPWS decides negatively.

The last item with respect to future ICPWS, Friend provided detail on the committee formed at the Sunday EC meeting. The committee had considered the relevant by-laws and statutes, the financial impact on IAPWS, the needs of several research communities, and the tentative proposal from the delegation from BIAPWS. The committee recommends to the EC that the proposal be accepted to hold the 16th International Conference on the Properties of Water and Steam in 2013 in a location (and on dates) to be determined by the local organizing committee from BIAPWS.

17.3 Review of Progress of Research in Member Countries

Written reports on progress in member countries were not reported to the EC but were either distributed to other members and the Executive Secretary during the IAPWS week, or sent to the Executive Secretary after the meetings. They are attached to these minutes as follows:

Britain and Ireland	Attachment 7
Canada	Attachment 8
Czech Republic	Attachment 9
Germany	Attachment 10
Russia	Attachment 11
USA	Attachment 12

17.4 Participants

Attachment 13 provides a list of participants at the 16th ICPWS and IAPWS EC and WG Meetings in Berlin, Germany in September 2008.

17.5 List of Members

An up-dated list of members of the Executive Committee, Working Groups, and Honorary Fellows will be developed by the Executive Secretary following the Berlin Meetings. This will be forwarded electronically to the Head of each National Committee.

18. Closing Remarks and Adjournment

The President thanked the German National Committee for hosting the 16th ICPWS and the IAPWS Meetings. He also thanked everybody for participating at this EC meeting. Then he formally closed the 2008 EC meeting at 12:21 pm.

AGENDA for the EXECUTIVE COMMITTEE of IAPWS
Berlin, Germany. 7-12 September 2008

Sunday, 7 September. Opening Session (9:00 – 10:30am)

Opening Remarks and Welcome by IAPWS President and Head of German Committee
1. Adoption of Agenda
2. IAPWS Business and Appointment of Committees
   - 2.1 Releases, Advisory Note, and Guidance Document
   - 2.2 Press Release
   - 2.3 Evaluation Committee on International Collaboration
   - 2.4 IAPWS Awards Committees for 2009 (Honorary Fellow and Helmholtz)
   - 2.5 Host Country, Location and Date for 16th ICPWS
   - 2.6 IAPWS Member Countries Defaulting on Dues
   - 2.7 IAWPS Statutes and By-Laws (Finalization for General Meeting))
   - 2.8 Other EC business for the General Meeting
   - 2.9 Other business requiring special/extensive discussions
3. EC Mandate to Working Groups and Membership
   - 3.1 Releases, Guidelines and Certified Research Needs
   - 3.2 WG Directions (minor activity because of ICPWS)
4. Preview of ICPWS Conference and of Week's WG Activities

Friday, 12 September 2008. Executive Meeting. (8:30am – 1:00pm)

5. Acceptance of Minutes of Previous Meeting
6. President's Report
7. Report and Recommendations of TPWS
8. Report and Recommendations of PCAS
9. Report and Recommendations of PCC
10. Future Collaboration on Seawater
11. Editorial Committee Report
12. Membership and Associates
    - 12.1 Report on Membership (Including Members Defaulting on Dues)
13. Executive Secretary's Report
    - 13.1 Financial, Auditors and Dues
    - 13.2 Time and Place of 2009/2010 Meetings
14. Guidelines, Releases, Certified Research Needs, and International Collaborations
    - 14.1 International Collaborations
15. IAPWS Awards
    - 15.1 Helmholtz Award Committee
    - 15.2 Honorary Fellowship
16. Election of Officers for 2009 and 2010
17. New Business
    - 17.1 Press Release
    - 17.2 15th and 16th ICPWS
18. Adjournment

Schedule

IAPWS Meetings and ICPWS
Berlin, Germany. 7-12 September 2008

(Radisson SAS Hotel, Berlin)

Sunday 7 Sept.	**9:00am**	**EC Initial Meeting**
	11:00am	TPWS/IRS Joint Meeting to 5:00pm
	11:00am	PCAS Separate Meeting to 5:00pm
	11:00am	PCC Separate Meeting to 5:00pm
	Registration for ICPWS will be open all day	
	7:00pm	IAPWS Welcome Reception (Room Nikolai in SAS Hotel Dom Lounge)
Monday 8 Sept.	9:00am.	Opening Plenary Session – ICPWS
	9:45am	**IAPWS Gibbs Award Lecture**
	1:00-2:30pm	Gibbs Award Luncheon (Room Nikolai in SAS Hotel Dom Lounge)
	2:30pm.	ICPWS Symposia - Afternoon
	6:00pm	TPWS/IRS Meeting (if needed after Sunday)
Tuesday 9 Sept.	9:00am.	ICPWS Symposia All Day
	9:00am	PCC Separate Meeting
	5:10pm	PCC Separate Meeting (if needed)
Wed. 10 Sept.	9:00am	ICPWS Symposia and Nucleation Workshop
	4:00pm	ICPWS Poster Session
	6:00pm.	**15th ICPWS Banquet (House of World Cultures)**
Thursday 11 Sept.	**9:00-9:45am**	**General Assembly Meeting of IAPWS**
	9:45-10:15am	**IAPWS Helmholtz Lecture**
	10:45am.	ICPWS Symposia
	12:25-12:55pm	ICPWS Closing Ceremony
	2:00pm	Excursion (Palaces of Potsdam)
Friday 12 Sept.	**8:30am.**	**IAPWS Executive Meeting <u>(8:30 – 1:00pm)</u>** (To include one member from each National Delegation)

TPWS - Thermophysical Properties of Water and Steam WG
PCAS - Physical Chemistry of Aqueous Solutions WG
PCC - Power Cycle Chemistry WG
IRS - Industrial Requirements and Solutions WG

Barry Dooley
26 August 2008

Minutes
IAPWS Thermophysical Properties of Water and Steam WG
IAPWS Industrial Requirements and Solutions WG
Berlin, Germany, September 7, 2008

NOTE: Because the working groups met jointly, these Minutes combine the activities of Working Groups TPWS and IRS. Items are listed according to their order on the TPWS agenda, which is attached as Attachment A. **Bold print** denotes significant actions.

1-2. The meeting was opened on Sunday, September 7 at 10:55 by the IRS Chair, Bill Parry. TPWS Chair Hans-Joachim Kretzschmar added his welcome, thanking the Working Groups for extensive work during the year with particular appreciation to K. Miyagawa and A. Harvey. The agenda (Attachment A) was adopted. Allan Harvey was appointed Clerk of Minutes to take combined Minutes for TPWS and IRS. The Chair noted that, in accordance with our new procedure, the 2007 Minutes had been circulated and approved shortly after the 2007 meeting.

3. H.-J. Kretzschmar demonstrated access to a password-protected website for documents and presentations of the TPWS and IRS Working Groups. The site is accessible from the Working Groups page on www.iapws.org.

4. No new collaborative projects were proposed by the WGs TPWS or IRS for this year.

5. (Seawater) J. Hruby presented the favorable report of the Evaluation Task Group for the draft release on thermodynamic properties of seawater, describing the extensive process of testing and adjustment of the release to improve consistency with other IAPWS products and to improve the description of uncertainty. Acceptance was recommended. **The WG approved the Release on the IAPWS Formulation 2008 for the Thermodynamic Properties of Seawater, with the provision that some minor editorial items be corrected before posting of the final document.**

6. (Melting/Sublimation) J. Cooper presented the favorable report of the Evaluation Task Group for the draft revised release on the melting and sublimation curves of water. **The WG approved the Revised Release on the Pressure along the Melting and Sublimation Curves of Ordinary Water Substance.** Because it became known during the work on this document and the Seawater release that the 2006 release on thermodynamic properties of ice Ih was very slightly inconsistent with other IAPWS releases, a Task Group (the same as the Seawater Task Group) was appointed to consider the preparation of a minor editorial revision to the ice release. The evaluation Task Group for this effort will consist of Hruby, Miyagawa, and Harvey.

7. W. Wagner reported on suggested editorial changes to the IAPWS-95 release document, in order to clarify the conditions at the critical point and to correct some entries in tables of check values that had been generated with slightly wrong (truncated) coefficients. K. Miyagawa presented an informal evaluation report on the changes. There was much discussion about whether the change intended to clarify the adjustment of two constants in

order to meet the convention for values of entropy and internal energy at the triple point was helpful or might create confusion. It was finally agreed to change the proposed footnote on Table 1 so that it did not report different (adjusted) constants, but rather pointed users to the existing instructions on page 4 concerning this adjustment. **After this amendment, the WG voted to adopt these editorial changes to the Release on the IAPWS Formulation 1995 for the Thermodynamic Properties of Ordinary Water Substance for General and Scientific Use.** It was decided to prepare a minor revision of the IAPWS-95 release for 2009 that would give correctly adjusted numbers in Table 1 and otherwise clarify the current confusion (without changing the thermodynamic calculations). A Task Group of Wagner and Harvey was appointed to make this revision, with Miyagawa to test and evaluate it.

8. (0.1 MPa properties) A. Harvey and J. Hruby presented the proposed supplementary release to produce convenient formulations for properties of liquid water as a function of temperature at 0.1 MPa pressure. J. Sengers presented the favorable evaluation report. **The WG voted to approve the Supplementary Release on Properties of Liquid Water at 0.1 MPa.** The issue came up about possible properties to add to this document in the future. It was pointed out that any property correlated as a function of temperature and density could be computed fairly simply by using the supplementary release to calculate density as a function of temperature, and then using that density in the correlation. An opportune time to consider adding other properties will be when the new IAPWS thermal conductivity correlation is completed, since that will require revision of the supplementary release.

9.1 A. Harvey explained the need for a minor editorial change in the viscosity release (in the references) to be consistent with the just-adopted release on the melting and sublimation curves. There are also some minor issues with consistency of notation pointed out by Jan Sengers. **The WG authorized these minor editorial changes to be made before publication of the viscosity release.**

9.2 A. Harvey presented the proposal for a minor revision of the thermal conductivity release to make it consistent with the new viscosity release. K. Miyagawa presented the favorable report of the Evaluation Task Group. **The WG voted to approve the Revised Release on the IAPS Formulation 1985 for the Thermal Conductivity of Ordinary Water Substance.**

9.3 J. Sengers reported that the journal article on the new viscosity formulation would be submitted soon, and he commended the international cooperative effort on this project. He reported that there is now a firm theoretical basis, confirmed by experiment, for the critical enhancement of the thermal conductivity. Work on the new thermal conductivity formulation is proceeding well, and it is hoped to have a draft of the new formulation ready for our 2009 meeting.

10. R. Feistel reported on the need for a computationally simpler formulation (compared to IAPWS-95) formulation for pure water that was a function of temperature and pressure designed for the oceanographic range of conditions (temperatures from approximately 0 °C to 40 °C and pressures to 100 MPa). SCOR/IAPSO is recommending a previously developed function known as F03. T. McDougal presented information showing that F03 was much more accurate than IAPWS-IF97 in this range, and stated that the improvement was

significant for oceanography. K.. Miyagawa presented further comparisons. It was proposed that IAPWS should issue a supplementary release with this formulation for oceanographic use. There was discussion that, in order to avoid confusion and inappropriate use, the range and use of such a formulation must be delineated very clearly. An Evaluation Task Group was set up consisting of Miyagawa (chair), Mares, and Hruby. A schedule should be set leading to possible adoption of the Supplementary Release by IAPWS in 2009.

11. H.-J. Kretzschmar presented the proposed revision of Advisory Note 3 to include seawater and heavy water. **The Revised Advisory Note No. 3: Thermodynamic Derivatives from IAPWS Formulations was approved by the WG with two abstentions**.

12. N. Okita presented a report on the need for better dew-point prediction for flue gases, and a proposed ICRN prepared by the Task Group. R. Span pointed out the need to update one table to include oxyfuel additions. **The WG voted to recommend to the EC that the proposed ICRN be sent out for approval, with the caveat that before being sent out the edits suggested by Prof. Span should be made and one more round of editorial corrections for English should be made.**

13. R. Span presented the background of the current ICRN on properties of humid air and combustion gases. He pointed out how much research had been done along the lines called for in the ICRN, but that new realities, particularly involving carbon capture and sequestration, were creating some different (but related) property needs, particularly in the areas of experimental data, liquid-liquid equilibrium and solids, and CO_2 in brines and geological systems. **The WG decided to allow the current ICRN 14 to expire (a closing statement should be provided in the coming year). A Task Group consisting of Span (chair), Harvey, Hruby, Kretzschmar, and Wendland was appointed to consider the future related needs and produce a draft ICRN for 2009.**

14. H.-J. Kretzschmar presented some preliminary results on using spline interpolation for fast calculation of steam properties with consistency between backward and forward calculations, which is a promising approach for the future.

15.1 The possibility of using IAPWS-IF97 instead of IAPWS-95 with the seawater formulation was mentioned (see also item 10). This is not accurate enough for oceanographers, but may be appropriate for desalination plants. B. Parry expressed the concern that people working in desalination needed some clear guidance about what to do for property calculations. **A Task Group was appointed consisting of Parry (chair), Feistel, Hiegemann, and Miyagawa to think about recommendations for desalination users. The Task Group was authorized to solicit advice from a desalination expert; R. Feistel will attempt to recruit such a person.**

15.2 A. Harvey presented a proposed minor update to the Fundamental Constants Guideline to reflect the latest CODATA adjustment. **The WG approved this update.**

15.3 A. Harvey presented the updates he and J. Cooper had made for Advisory Note 2, which explains the roles of various IAPWS documents for the thermodynamic properties of

water, to reflect new and revised formulations adopted in the past 2 years. **The WG approved this update**.

15.4 H.-J. Kretzschmar reported on the success of the site for steam tables for pocket calculators linked to the IAPWS website. It was proposed to have a similar link for an Excel add-in that has been developed. This was agreeable to the WG; by existing IAPWS policy the German National Committee must give its approval for this product (communicated to the Executive Secretary and the Webmaster) and then the link can be put on the website. It was suggested that the website should be more clear that these Steam Tables were the formulation for industrial use.

15.5. There was nothing to report on liaison with the IEC.

15.6. A. Harvey reported on the liaison with the CCM concerning recommendations for computing the density of water for metrology and other purposes. Consensus has finally been reached on the content of a joint paper and on some joint recommendations (subject perhaps to minor wording adjustments). The WG authorized the Task Group (Harvey and Span) to go forward with the publication to be submitted to *Metrologia*, and to prepare an Advisory Note for adoption in 2009 (with no Evaluation Task Group needed in this case). **In the meantime, the WG endorses, and asks the EC to endorse, the agreed-upon joint recommendations:**

1. **for use in metrology over its recommended range, which is liquid water from 0 °C to 40 °C at pressures near atmospheric. It should not be extrapolated outside this range.**
2. **Densities computed from the IAPWS-95 formulation are consistent with the CIPM standard within the region of validity of the CIPM formulation. For uses outside the CIPM range of validity, the IAPWS-95 formulation is the preferred method for obtaining accurate densities for water.**
3. **For uses covering a range of conditions, some of which are inside the range of validity of the CIPM standard and some of which are not, it is generally preferable to use the IAPWS formulation for the entire calculation in order to avoid discontinuities.**

16. We were informed by the Japan delegation that **H. Sato is withdrawn from TPWS and IRS membership and M. Uematsu is withdrawn from TPWS membership.** We were informed by the U.S. delegation that **G.J. Feller is withdrawn from IRS membership. It was voted to accept J. Gernert (Ruhr Univ. Bochum, Germany), T. McDougal (CSIRO, Australia), D. Wright (Bedford Inst. of Oceanography, Canada), R. Tailleux (U. of Reading, UK), and S. Seitz (PTB, Germany) as members of TPWS, and R. Harwood (Siemens, US) as a member of IRS.**

17 There were no collaborative projects proposed from TPWS or IRS.

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

19. The meeting was adjourned at 18:00.

Agenda
IAPWS Thermophysical Properties of Water and Steam WG
Berlin, Germany, 7 September 2008

1. Opening Remarks; Adoption of Agenda
2. Appointment of Clerk of Minutes
3. Web Space for Working Material for WGs TPWS and IRS
4. Potential International Collaborative Projects
5. Release on the IAPWS Formulation 2008 for the Thermodynamic Properties of Seawater, joint with WG IRS
   - Report of the Evaluation Task Group (J. Hruby, K. Miyagawa)
   - Formal consideration of the Release by the WGs TPWS and IRS
6. Revised Release on the Pressure along the Melting and Sublimation Curves of Water, joint with WG IRS
   - Report of the Evaluation Committee (J.R. Cooper, K. Miyagawa, R. Mares)
   - Formal consideration of the Revised Release by the WGs TPWS and IRS
7. Editorial Changes on the Release on the IAPWS Formulation 1995 for the Thermodynamic Properties of Ordinary Water Substance for General and Scientific Use
   - Report (W. Wagner)
   - Test Report (K. Miyagawa)
   - Formal consideration of the Editorial Changes by the WG TPWS
8. Supplementary Release on Properties of Liquid Water at 0.1 MPa, joint with WG IRS
   - Report of the Task Group (A.H. Harvey, J. Hruby)
   - Report of the Evaluation Task Group (J. Sengers, R. Mares, K. Miyagawa)
   - Formal consideration of the Supplementary Release by the WGs TPWS and IRS
   - Future extensions of the Supplementary Release (G. Bignold, J.R. Cooper, A.H. Harvey, J. Hruby)
9. Transport Properties of Water and Steam
   - 9.1 Editorial Adjustment to the Release on the IAPWS Formulation 2008 for the Viscosity of Ordinary Water Substance, joint with WG IRS
     - Report of the Task Group (A.H. Harvey)
   - 9.2 Revised Release on the IAPWS Formulation for the Thermal Conductivity, joint with WG IRS
     - Report of the Task Group (A.H. Harvey)
     - Report of the Evaluation Task Group (K. Miyagawa, R. Mares)
     - Formal Consideration of the Revised Release by the WGs TPWS and IRS
   - 9.3 Development of a New Thermal Conductivity Formulation
     - Report of the Task Group (J.V. Sengers, D.G. Friend)

10. New Equation of State for Liquid Water for Oceanographic Use, joint with WG IRS
    - Report of the Task Group (R. Feistel, K. Miyagawa, T. McDougal)
    - Discussion about Preparing a Supplementary Release for Oceanographic Use and Establishing an Evaluation Task Group
11. Revised Advisory Note No. 3 on Thermodynamic Derivatives from IAPWS Formulations, joint with WG IRS
    - Report of the Task Group (H.-J. Kretzschmar, R. Feistel, J.R. Cooper)
12. ICRN # 23: Dew Point for Flue Gas of Power Plant Exhaust, joint with WG IRS
    - Report of the Task Group (N. Okita)
13. Update for ICRN # 14: Thermophysical Properties of Humid Air and Combustion-Gas Mixtures, joint with WG IRS
    - Report of the Task Group (R. Span)
14. Industrial Requirements for Steam Property Calculations, joint with IRS
    - Report of the Task Group (H.-J. Kretzschmar, W.T. Parry)
15. Reports on Other TPWS & IRS Activities
    - 15.1 Calculation of Seawater Properties Using IAPWS-IF97 (R. Feistel, M. Hiegemann, K. Miyagawa), joint with WG IRS
    - 15.2 Guideline on Fundamental Constants (A.H. Harvey), joint with WG IRS
    - 15.3 Update of Advisory Note # 2: Roles of Various IAPWS Documents (J.R. Cooper, A.H. Harvey), joint with WG IRS
    - 15.4 Steam Tables for Excel®, Mathcad®, and Pocket Calculators for Education on the IAPWS Website (H.-J. Kretzschmar)
    - 15.5 Liaison with IEC (J.R. Cooper), joint with WG IRS
    - 15.6 Liaison with CCM (A.H. Harvey, R. Span)
16. Membership
17. Other Business
    - Report on International Collaborative Projects
18. Preparation of the Formal Motion to the EC
19. Adjournment

Note, the time for the Working Group Meeting is short due to the ICPWS, so we must limit the agenda to essential business and can cannot have any extra presentations.

In case the discussions can not be finished on Sunday they will be continued on Monday evening after the conference sessions.

September 07, 2008

H.-J. Kretzschmar (Chair) and A.H. Harvey (Vice-Chair)

IAPWS Annual Meeting 2008, Berlin
PCAS WG Minutes

Sunday Sept. 7th, Morning

Present: *Serguei Lvov (Chair); Peter Tremaine (Clerk of Minutes); Anneke Levelt Sengers; Bill Marshall; Masaru Nakahara; Josef Sedlbauer; Milan Sedlar; Pavel Safarik; Masakatsu Uneo; Vladimir Valyashko.*

1. Opening Remarks were made by Serguei Lvov (Chair) and Peter Tremaine. Members introduced themselves with a short description of their research interests. Peter Tremaine was appointed Clerk of Minutes. Serguei Lvov proposed a meeting agenda (PCAS Attachment A).

2. Minutes from 2007 meeting (Lucerne) were approved as written.

Actions Arising: Three outstanding actions from 2007 remain. (i) Horacio Corti has expressed concern about the difficulties he is having in attending meetings as co-chair. The question will be discussed today. (ii) The delay in the IAPWS/IUPAC project associated with Vladimir Majer's departure must be resolved. (iii) An ICRN on the need for a new equation of state for NaCl(aq) was to be prepared.

Tremaine presented a verbal summary of the need to a new equation of state for NaCl, compatible with the current IAPWS formulations for the PVT properties. He noted that the current equation of state for NaCl(aq) by Don Archer, is based on the Hill (1991) equation for water and Archer's dielectric constant model.

ACTION: **(Tremaine, Levelt Sengers):** To develop a draft ICRN for 2009 in collaboration with NIST (Levelt Sengers will be replaced by A. Harvey)

3. IAPWS International Collaboration: Peter Tremaine presented the progress on the international collaboration between Canada (Tremaine) and the Czech Republic (Sedlbauer), budgeted with an IAPWS contribution of $14,000 for living expenses of PhD student Jana Ehlerova. The project is for measurements on copper (II) complexation vs. temperature as part of an International Generation IV Forum research project on hydrogen co-generation. Dr. Tremaine and Dr. Trevani will supervise the experimental portion of the project at Guelph; Dr. Sedlbauer will supervise fitting the available models to the new data. Ms. Ehlerova started at Guelph in July, 2008, and returned to Europe for this ICPWS conference. A completely new UV-visible system, flow cell, and automated injection system have been constructed and commissioned. The first results (100 ^{o}C) were obtained just before she left Guelph.

MOTION(Lvov): To approve the progress report project. Unanimous approval (Tremaine: abstained).

4. Task Groups and Committees:

4.1. Joint Electrochemical Society IAWS Symposium Topics (Washington, 2007): Serguei Lvov presented a status report on the Joint IAPWS/ECS Symposium (PCAS Attachment B). It was two-day symposium with 25 papers. The financial support of IAPWS and other organizations were used to support seven invited speakers, organize and conduct the symposium, and print out a few copies of the symposium proceedings (in print). Full manuscripts of the submitted for publishing papers will be shortly available in ECS Transactions (http://www.ecsdl.org/ECST), an online journal of the ECS (http://www.ecsdl.org/ECST).

IT WAS AGREED: PCAS members compliment Serguei on this very successful initiative.

5. New Members: The following new members were suggested.

(i) Dave Guzonas (Chalk River National Laboratories, Canada);
(ii) Nobuyuki Matubayasi (Institute of Chemical Research, Kyoto University, Japan)
Moved (Serguei Lvov) that both be approved as PCAS members. Both were approved unanimously.

6. Election of new Chair and Vice-Chair

Possible candidates for chair and vice chair were identified and discussed their willingness to serve.

MOTION: Masakatsu Ueno nominated Masura Nakahara chair of PCAS by e-mail. The nomination was supported by a number of PCAS members and acclaimed.

MOTION: Peter Tremaine nominated Andre Anderko vice-chair of PCAS. The nomination was supported by a number of PCAS members and acclaimed.

Sunday Sept. 7th, Afternoon

Present: *Serguei Lvov (Chair); Peter Tremaine (Clerk of Minutes); Anneke Levelt Sengers; Bill Marshall; Masaru Nakahara; Josef Sedlbauer; Milan Sedlar; Pavel Safarik; Masakatsu Uneo; Vladimir Valyashko, Dave Guzonas (for Item 8).*

7. ICRNs and Releases (Joint with PCC): The working groups met together to discuss three PCC ICRNs that could require PCAS input.

7.1 ICRN Number 17 (Amines): Jim Bellows presented modifications to ICRN on needs for thermochemical and kinetic data for thermal power station boilers. Temperature range up to

850 F, key areas are 150 ^{o}C (nuclear PWR transition point) and 850 F (thermal station turbines). Lower alloys and carbon steels are priority.

7.2 ICRN Number 21 (Steam Chemistry in the Turbine Phase-Transition Region): No discussion. Draft is awaiting PCAS input.

***ACTION (Svoboda)*:** To circulate draft to PCAS (to Lvov and Nakahara) for distribution and discussion.

7.3 ICRN Number 22 (Chemistry in Ultra-supercritical Steam): No discussion. Draft had comments from Don Palmer, mostly minor. It was agreed that Don would be asked to indicate whether these need further input, or whether they can be regarded as editorial.

ACTION (Dooley) To contact Don today.

7.4 ICRN (No Number) (NaCl Eqn of State)....See Item 2.

4. Task Groups and Commitees (CONTINUED):

4.2. Data Book Project: Prof. Valyashko (editor) presented an update on his data book project *"Hydrothermal Properties of Materials"*. The project started in 2003. Chapter 7 on calorimetric properties of hydrothermal solutions by Dr. Majer has been withdrawn and was written in more limited form by Dr. Valyashko. The draft manuscript is complete and has been reviewed by the publisher (Wiley). It is expected to be published by December, 2008.

IT WAS AGREED: PCAS members compliment Vladimir on this very successful, major project.

4.3: Joint IUPAC/IAPWS Project on Standard Partial Molar Properties of Solutes Serguei Lvov presented a report from Vladimir Majer (PCAS Attachment C) outlining his withdraw from the project and summarizing its status. After discussion, Dr. Josef Sedlbauer was invited to prepare a proposal for continuing the project, possibly with a more focused set of objectives and a new budget. Issues to be resolved are the state of IUPAC involvement, and whether funds can be released before the next IAPWS meeting by the executive subject to receiving a suitable proposal.

IT WAS AGREED: To request from the EC that the project funding remain in place for one year, or until the proposal from Dr. Sedlbauer has been received.

8. Research Presentations:

8.1 Andrei Anderko: OLI Software Andrei presented the underlying models for standard state properties, activity coefficients, transport properties and the capabilities of the OLI Electrolyte Simulation Package, and other OLI systems.

Serguie Lvov and Anneke Levelt Sengers noted that PCAS should be more involved in modeling of aqueous solutions.

8.2 Masuru Nakahara: Masuru presented an overview of NMR methods for hydrothermal studies, and examples of applications from his laboratory including the self-diffusion of water, ionic solvation, speciation in SCW and a new probe design (up to 420 ^{o}C).

8.3 Josef Sedlbauer: Josef presented his research on functional group additivity models for organics in high-temperature water. Software is available Majer, Sedlbauer, Begin (2008) Fluid Phase Equil, in press. Gibbs energy of hydration extrapolates well for const C_p^o.

8.4 Bill Marshall: Bill presented density-temperature correlations for the dielectric constant of water and dioxane-water mixtures, which yield simple predictive correlations over a wide range of temperature and pressure.

9. Wrap-up: Serguei Lvov led a brief discussion of future directions in PCAS activities. The need to include practical simulation and ab initio methods where they can lead to practically applicable results was noted.

10. The meeting adjourned at 5:40 pm.

Working Group on Physical Chemistry of Aqueous Systems (PCAS WG)

Meeting Schedule

Berlin, Germany, September 7th, 2008
Radisson SAS Hotel

Chair: Serguei Lvov, lvov@psu.edu
Pennsylvania State University, University Park, PA, USA
Vice-Chair: Horacio Corti, hrcorti@cnea.gov.ar
CNEA, Buenos Aires, Argentina

11:00 - 12:30 (Aquamarin Room)

- Opening remarks
- Approval of agenda
- Appointment of clerk of minutes
- Approval of minutes of PCAS WG in Lucerne, Switzerland, 2007
- Reports on IAPWS International Collaborations
- Reports on ICRNs, Releases etc.
- Reports of task groups and committees
- Proposals for membership
- Other business

12:30 - 13:30 Lunch (Conference Foyer)

13:30 - 15:00 (Aquamarin Room)

- Proposals on new IAPWS International Collaborations
- Proposals for new ICRNs, Releases etc.
- Proposals on new task groups and committees
- Research presentations

15:00 – 15:30 Coffee Break

15:30 – 17:00 (Aquamarin Room)

- Research presentations
- Preparation of PCAS WG Report to Executive Committee

Confirmed Research Presentations:

- Peter Tremaine: Equilibrium Constants and Speciation of Aqueous Transition Metal Chloro-complexes over a Wide Range of Temperatures and Pressures

- Masaru Nakahara: The Self-diffusion Coefficient for Supercritical Water

- Andre Anderko: Thermophysical Property Research at OLI Systems

- Josef Sedlbauer: Thermodynamic Modeling of Aqueous Organics in a Wide Range of Conditions

- Bill Marshall: Density-Temperature Correlations for the Dielectric Constant of Water and Dioxane-Water Mixtures

ECS/IAPWS Joint Symposium

212th ECS Meeting - Washington, DC

October 7 - October 12, 2007

Symposium B4 - Interfacial Electrochemistry and Chemistry in High Temperature Media

Symposium Organizers:

S. N. Lvov, Department of Energy and Geo-Environmental Engineering, The Pennsylvania State University, University Park, PA 16802, USA, tel: 814.863.8377, fax: 814.865.3248, e-mail: lvov@psu.edu; **S. R. Narayanan**, NASA-Jet Propulsion Laboratory, 4800 Oak Grove Drive, Mail Stop 277-207, Pasadena, CA 91109, USA, tel: 818.354.0013, fax: 818.393.6951, e-mail: s.r.narayanan@jpl.nasa.gov; **D. D. Macdonald**, Department of Materials Science and Engineering, The Pennsylvania State University, University Park, PA 16802, USA, tel: 814.863.7772, fax: 814.863.4718, e-mail: ddm2@psu.edu; **R. B. Dooley**, Electric Power Research Institute, 1300 West W.T. Harris Blvd., Charlotte, NC 28262, USA, tel: 650.855.2458, fax: 650.855.1026, e-mail: bdooley@epri.com; **D. J. Wesolowski**, Chemical Sciences Division, Oak Ridge National Laboratory, P.O. Box 2008, Oak Ridge, TN 37831, USA, tel: 865.574.6903, fax: 865.574.4961, e-mail: wesolowskid@ornl.gov

Sponsors: ECS Energy Technology Division/ECS Corrosion Division/IAPWS/ASME Steam Properties Subcommittee

Tuesday, October 9, 2007

Exhibit Hall, Concourse Level

Co-Chairs: Poster Session

Time	Abs#	Title and Authors
o	229	The Development of Monolithic Design for Methanol Micro-Reformer and CO Clean-Up O. Jeong Hoon, C. Chung (Sungkyunkwan University), S. Haam and J. Park (Yonsei University)
o	230	Novel Cathode Catalyst for Use in DMFC: The Role of Carbon Support and Promoter M. Lo, Y. Lee and Y. Chen (ITRI)

Wednesday, October 10, 2007

Edison Room, Terrace Level

Co-Chairs: J. Payer and D. Macdonald

Time	Abs#	Title and Authors
08:00		Introductory Remarks (20 Minutes)
08:20	231	Applied and Theoretical Aspects of Interfacial Electrochemistry vs. Room/Near Room Temperature Measurements A. Wieckowski (University of Illinois at Urbana-Champaign)
09:00	232	Kinetics of the Hydrogen Electrode Reaction on Platinum in Alkaline Solutions at Elevated Temperatures J. Bao and D. Macdonald (Pennsylvania State University)
09:20	233	Chemistry in Surface Boundary Layers Related to Flow Accelerated Corrosion of Carbon Steel in High Temperature Water S. Uchida, M. Naitoh, Y. Uehara, H. Okada (Nuclear Power Engineering Corporation) and S. Koshizuka (Unversity of Tokyo)
09:40		Intermission (20 Minutes)
10:00	234	Experimental System for Studying Interfacial Electrochemistry at Temperatures Above 300oC V. Balashov, M. Fedkin, S. Lvov (Penn State University) and R. Dooley (EPRI)
10:20	235	Crevice Corrosion Damage Evolution in High Temperature Brines J. H. Payer, X. Shan, A. S. Agarwal (Case Western Reserve University) and U. Landau (CWRU)
11:00	236	Corrosion of Combustion Turbine Blades M. Caldwell and R. Viswanathan (EPRI)
11:20	237	High Temperature Corrosion of Materials in Supercritical Water and Liquid Lead Environments K. Sridharan, Y. Chen, L. Tan, M. Machut, A. Kruizenga, X. Ren and T. Allen (University of Wisconsin-Madison)
11:40	238	Influence of Temperature and pH on the Identities and Electronic Properties of Surface Films Formed on Chromium and Alloy C22 T. Cohen-Hyams, S. Harrington, M. Miyagusuku, F. Wang and T. Devine (University of California, Berkeley)

Co-Chairs: D. J. Wesolowski and S. Paddison

Time	Abs#	Title and Authors
14:00	239	Structure of and Transport in the Interfaces of Solid Oxide Fuel Cells S. Singhal and X. Zhou (Pacific Northwest National Laboratory)
14:40	240	A Mechanistic Understanding of Solid Oxide Fuel Cell Chemistry Through In-Situ Raman Spectroscopy M. Pomfret (University of Maryland, Naval Research Laboratory), J. Owrutsky (Naval Research Laboratory) and R. Walker (University of Maryland)
15:00	241	Interfacial Resistivity of Yttria Stabilized Zirconia in Operating Solid Oxide Fuel Cells M. Pomfret (University of Maryland, Naval Research Laboratory), E. Bryan and R. Walker (University of Maryland)
15:20	242	Computational and Experimental Analysis of Solid Oxide Fuel Cell Anodes in the Presence of H2S D. A. Daramola, M. Muthuvel, A. Marquez and G. Botte (Ohio University)
15:40		Intermission (20 Minutes)

16:00 243 Thin Film Electrochemical Deposition at Temperatures up to 180 {degree sign}C for Photovoltaic Applications C. Levy-Clement (CNRS)

16:40 244 Applicability of the Yttria-Stabilized Zirconia pH Sensor on Concentrated Acidic Metal Sulphate Solutions Z. Jankovic, V. Papangelakis (University of Toronto) and S. Lvov (Penn State University)

17:00 245 Study of the Electrochemical Step of Novel Active Metal Alloy Thermochemical Cycles for Hydrogen Production V. Rodriguez-Santiago, M. Fedkin and S. Lvov (Penn State University)

Thursday, October 11, 2007

Edison Room, Terrace Level

Co-Chairs: S. N. Lvov and S. R. Narayanan

Time	Abs#	Title and Authors
08:00	246	Direct Observations of Mineral-Water Interface Reactivity at Elevated Temperatures with Interfacial X-ray Scattering P. Fenter (Argonne National Laboratory) and N. Sturchio (University of Illinois at Chicago)
08:20	247	The Protonation Behavior of Metal Oxide Surfaces to Hydrothermal Conditions M. L. Machesky (Illinois State Water Survey), D. Wesolowski (Oak Ridge National Laboratory), M. Ridley (Texas Tech University), D. Palmer, J. Rosenqvist (Oak Ridge National Laboratory), S. Lvov, M. Fedkin (Penn State University), M. Predota (University of South Bohemia), L. Vlcek and P. Cummings (Vanderbilt University)
08:40	248	Ion Adsorption on Metal Oxide Surfaces to Hydrothermal Conditions. D. Wesolowski (Oak Ridge National Laboratory), M. L. Machesky (Illinois State Water Survey), M. Ridley (Texas Tech University), D. Palmer, J. Rosenqvist (Oak Ridge National Laboratory), J. Kubicki (Penn State University), M. Predota (University of South Bohemia), L. Vlcek, P. Cummings (Vanderbilt University), Z. Zhang, P. Fenter (Argonne National Laboratory), A. Bandura (Saint Petersburg State University, Russia) and P. Benezeth (CNRS, Toulouse, France)
09:20	249	Interfacial Chemistry of Hydrothermal Deposition of Zirconia on Metal Substrates Z. Zhou, E. Chalkova, V. Balashov and S. Lvov (Penn State University)
09:40		Intermission (20 Minutes)
10:00	250	Ab Initio Modeling of Structure, Reactivity, and Transfer at Water/Ionomer and Water/Catalyst Interfaces S. J. Paddison (University of Alabama in Huntsville)
10:40	251	Understanding the Water Retention of Composite PEMs Based on Surface Chemistry of Inorganic Fillers M. Fedkin, E. Chalkova (Penn State University), D. Wesolowski (Oak Ridge National Laboratory) and S. Lvov (Penn State University)
11:00	252	An Overview of Interfacial Processes in Polymer Electrolyte Fuel Cells Operating at Elevated Temperatures S. Sambandam, P. Trogadas and V. Ramani (Illinois Institute of Technology)
11:40	253	The Study of Ethoxy Surface Species on Pt-Sn Surface Alloys by the Decomposition of Chemisorbed Ethyl Nitrite A. Hightower (Occidental College), H. Haibo Zhao (University of Southern California) and B. Koel (Lehigh University, Chemistry Department)

Number of presented papers: 25 (23 oral and 2 posters)

Invited Speakers:

1. A. Wieckowski (University of Illinois at Urbana-Champaign)
2. J. H. Payer (Case Western Reserve University)
3. S. Singhal (Pacific Northwest National Laboratory)
4. C. Levy-Clement (CNRS, France)
5. D. Wesolowski (Oak Ridge National Laboratory)
6. S. J. Paddison (University of Alabama in Huntsville)
7. V. Ramani (Illinois Institute of Technology)

Physical Chemistry of Aqueous Solutions Working Group (PCAS WG)

Chair: Serguei Lvov, lvov@psu.edu
Pennsylvania State University, University Park, PA, USA
Vice-Chair: Horacio Corti, hrcorti@cnea.gov.ar
CNEA, Buenos Aires, Argentina

Statement regarding the status of the IAPWS / IUPAC project *"Establishing recommended data on thermodynamic properties of hydration for selected organic solutes and gases"* and the review of the IAPWS costs

August 31, 2008

This short report has been prepared on request of S. Lvov, Chairman of the Physical Chemistry of Aqueous Solutions Working group, in preparation of the 2008 IAPWS EC meeting in Berlin (Germany).

The project was approved by the EC of IAPWS at the 2004 Meeting in Kyoto (Japan) for the period 01/2005 – 06/2007, the total funding allotted to the project by IAPWS was of 12,000 euros (with 5K in 2005, 5K in 2006 and 2K in 2007). These funds were aimed at supporting young scientists from the IAPWS member countries contributing to the Project.

During 2005 and 2006 I have sent to the IAPWS and IUPAC representatives as well as to the Project participants three progress reports describing all the activities carried out in the frame of the project. One Workshop on thermodynamic properties of hydration of nonelectrolytes was organized during the Thermo International held in Boulder, Co (July 30 – August 4, 2006). Most groups participating in the project presented their contributions, this one day workshop attracted a large audience participating in the event.

Unfortunately for the project, I have changed my professional assignment in the fall 2006, named for two years as Director of the Representation of the French National Centre for Scientific Research (CNRS) for Russia and CIS; this Office is attached to the Science Department of the French Embassy in Moscow. Although I had hoped to continue some of my scientific activities while being in the Office, it turned out during the first half of 2007 that my working load did not let me any spare time. I informed about it S. Lvov (IAPWS) and J. Dymond (IUPAC) in the electronic message of May 1, 2007. I discussed with some key participants of the Project the possibility of my replacement in the coordination task but nobody was available for taking over the job. For that reason no progress was made after my departure for Moscow with the exception of the group of R. Fernadez-Prini (Buenos Aires) that has completed an evaluation and correlation work concerning several aqueous gases. I have received their report on March 23, 2007 and after examined it I sent it on May 1, 2007 to both IAPWS and IUPAC as a partial result of the Project.

Moreover, I will very probably extend my mission in Moscow for additional two years (up to the fall 2010), provided there is no major diplomatic crisis between the Western

democracies and Russia in future. This will therefore make my involvement in the Project impossible for additional two years or so.

Payments made by IAPWS for the Project are as follows; only a brief survey is given here, more details can be found in the three progress reports; approximately 30 % of the allotted IAWPS funds (12,000 euros) were spent by now:

1. 18th July 2005. Hugues Arcis, PhD student at the Blaise Pascal University, Clermont-Ferrand, France, stipend for data processing during July 2005. *$963.20*.

2. 18th July 2005. Martin Slavik, young assistant professor at the University of Liberec, Czech Republic, partial support for travel to Clermont-Ferrand, experimental determination of heat capacities as a function of temperature for several aqueous oxygen containing compounds, (was published in JSC, 2007), September 15 to October 30, 2005. *$1,444.80*.

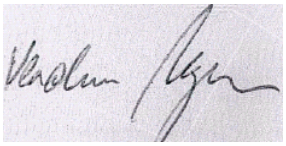
3. 18th July 2005. Pavel Vrbka, young assistant professor at the Institute of Chemical Technology, Prague, Czech Republic, partial support for travel to International Conference on Solution Chemistry in Portoroz, Slovenia, August 21 to 26, 2005. Presentation of a poster directly related to the Project. *$722.40*.

4. 19th December 2005. Hugues Arcis, PhD student at the Blaise Pascal University, Clermont-Ferrand, France, stipend for data processing in period September to December, 2005. *$961.12*.

5. 14th August 2006. Pavel Vrbka, young assistant professor at the Institute of Chemical Technology, Prague, Czech Republic, partial support for travel to the Thermo International, Boulder, July 30 – August 4, 2006. Presentation of a contribution during the Project workshop. *$1,463*.

Enclosures:

1. Progress reports 1 to 3
2. Final report gases (Prini's group)
3. Literature list for the Final report gases



Vladimir MAJER
Project coordinator

IAPWS Working Group Power Cycle Chemistry (PCC)

Minutes of IAPWS PCC WG Meetings

Berlin, Germany 7 and 9 September 2008

Chairman: Robert Svoboda
Members present See PCC Attachment A

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1. Agenda

1.1. Amendments / Adoption of Agenda

An item was added to 7, "Other business" on ISO5667, dealing with the revision of the part of the standard on sampling water and steam.
The content of the agenda was agreed. The order of consideration of topics was adjusted to enable actions to be placed after full coverage of relevant topics.

2. Appointment of Clerk of Minutes

Richard Harries agreed to record the minutes.

3. Approval of Minutes of PCC WG in Lucerne, Switzerland, 2007

The minutes were agreed without any corrections or additions.

4. Progress Reports on PCC Activities 2007 / 2008

4.1. PCC Guidance Document "Mechanical Carry-Over from Drum Boilers"

The draft document that was tabled in 2007 had been reviewed by a small group (M Ball, A Bursik, B Dooley) with further comments by F Gabrielli and a revised document had been circulated to the members of the task group. It has also been reviewed by the IAPWS editorial committee. The document will be submitted to the IAPWS Executive Committee for approval at the meeting in Berlin, 09/09/2008 and is ready for issue as IAPWS first Technical Guidance document.

4.2. ICRN (Joint Meeting with PCAS)

Draft ICRN #17 "Research on Amines for the Power Industry" (Maughan)

It was noted that this proposal differed from work in the 1970's to identify alternative amines for power cycles in that the current requirement is for a better understanding

of the properties and decomposition of commercially available amine products for use in power cycles; particularly the interaction of the amines with the materials of construction and their service developed oxides. J Bellows to review text of this draft ICRN and modify as necessary. It will then be circulated within PCC and re-submitted to the Executive Secretary for postal ballot.

Draft ICRN #21 "Thermophysical properties associated with ultra-super critical coal fired steam generators". (Dooley / Palmer)

The first draft had been prepared in 2006. Comments have been received, but no further progress has been made, to date. The draft will be revised by Tremaine, circulated again to members of PCC and PCAS, and re-submitted to the Executive Secretary for postal ballot.

Draft ICRN #22 "Steam Chemistry in the Turbine Phase-transition Zone". (Stastny)

Comments received suggested the addition of additives to steam for turbine efficiency improvement was too narrow an area for an ICRN and that scope should be widened. A small group comprising M Stastny, B Dooley, R.Harries, R Svoboda will review and re draft this ICRN.

4.3. European Standard EN 12952

The PCC chairman announced that the current task group leader, E Maughan, had withdrawn from that position due to difficulty in accessing the relevant standards bodies in Germany. G Bignold had agreed to take over the task group leadership as BIAPWS had been able to establish membership of the relevant committee on the Brtitish standards Institute (BSi).

4.4. International Collaboration on Sampling

The international collaboration on sampling from steam / water cycles (Lister/ Srisukvatananan) has been completed, with a final paper published at the 15th ICPWS. K Daucik noted that there was a possibility that DONG Energy (Denmark) may be able to continue collaboration on sampling. It was proposed that a new International Collaboration proposal be prepared for submission to IAPWS in 2009. The end product could be a new Technical Guidance document on sampling.

5. Priority List Review

The priority list was discussed and the results of the discussion are presented in PCC Attachment B. It was decided to move certain items to a watch list where developments would be monitored but work not actively pursued. It was further decided to identify a limited number of items on the priority list as having precedence over others. One item (Guidance on Mechanical Carry Over) has been resolved by PCC producing a Guidance Document (see 4.1); this item was therefore removed from the Priority List.

6. PCC Task Groups

6.1. Progress Reports

6.1.1. Task Group on "Assessment of plant lifetime consumption resulting from operation outside of chemistry guideline targets". Karol Daucik (chairman). Following an initial meeting in Lucerne in 2007, the task list was distributed to group members. K Daucik had received inputs from two members of the task group. These have been co-ordinated and distributed to task group members. The report of the meeting of the Task Group in 2008, Berlin is given in Attachment C.

6.1.2 Task Group on “Review of EN12952: Part 12”

Eric Mauhan, TG chair, has asked that, following difficulties in influencing the German Standards body, DIN, to accept the need for changes, the organization of the TG be passed to Geoff Bignold. The report of the TG meeting in Berlin 2008 is given in PCC Attachment C.

6.2. New Task Group – Cycle Chemistry Guidance.

A new Task Group was proposed on “Technical Guidance Documents on Cycle Chemistry” to be chaired by Barry Dooley. It was considered that PCC needed to raise its profile within IAPWS, where it acted as an international forum on power cycle chemistry. It was felt that just as TPWS defined the basic equations of state from which steam tables could be calculated, so PCC could act to produce definitive guidance on power cycle chemistry that overlay the current guidance from various national or individual standards bodies. Areas for guidance would include not only conventional fossil fired plant, but combined cycle plant, nuclear and lower pressure industrial plant; each with their specific requirements.
It was also considered that the task group could be instrumental in developing a series of IAPWS Technical Guidance Documents, similar to that formulated for Drum Carryover. Areas proposed for consideration included: sampling; instrumental analysis; chemical cleaning.

Members of the Task Group are; B Dooley (chair), J Bellows, G Bignold, K Daucik, M Rziha, S-E Thirkildsen, R Svoboda, M de Wispelaere; others yet to be decided.

Three tasks were defined as focus for the next new Guidance Documents:

- "PCC Technical Guidance on the Philosophy of Cycle Chemistry Control for Fossil and Combined Cycle/HRSG Plants"; Rziha (lead), Gabrielli, Leidich, Ball.
- "PCC Technical Guidance on Fundamental Instrumentation for Fossil and Combined Cycle/HRSG Plants" Bignold (lead), DeWispelaere, Therkildsen, Dooley
- "PCC Technical Guidance on Steam Purity Specifications for a Wide Range of Steam Turbines", to be set up by Svoboda and Bellows

7. Other Business

7.1. ISO 5667 standard on sampling.

ISO 5667 – Water Quality; Part 6 – Sampling; 6.7 Guidance on sampling water and steam in boiler plant. BIAPWS has agreed to the approach by the British Standards Institute (BSI) for technical support in revising this part of ISO 5667. BIAPWS proposes as part of this support to make informal consultation with members of PCC. Andy Rudge will co-ordinate these activities.

7.2. PCC Mission

The PCC WG has revised its mission to reflect new developments discussed at the 2008 meeting. These include:

- to reinforce the link between industrial needs and related research work by PCAS WG,
- to emphasise the research aspects of the priority list;
- to highlight the intention to produce a number of Technical Guidance Documents.

An updated summary of the PCC Mission is found in PCC Attachment D.

8. Proposals for International Collaboration

At this meeting there were no proposals for International Collaboration in 2008. However, discussions at the meeting identified further research needs that could be pursued by such collaboration (see 4.4 above). A proposal for another International Collaboration on water and steam sampling (University of New Brunswick, DONG, Svoboda Consulting) will therefore be prepared before Dec 2008 and submitted to the Executive Secretary for further processing.

9. Changes in Membership, election of Officers

The meeting unanimously approved the proposal of Dr Frank Udo Leidich and Denis Smetanin to the executive committee for membership of PCC.

The following members will be contacted to establish their willingness to continue as PCC members:

W.Allmon	Jim Bellows to contact.
L Guinard	Robert Svoboda to contact.
V.Kritski	Tamara Petrova to contact.
P.Saidl	Robert Svoboda to contact.

The interest in further membership by A.Banweg , J.Jensen and J.Vosta (see PCC Minutes 2007) has been verified.

10. Preparation of Action List 2008 / 2009, Task Distribution, Next Year's Agenda

Proceed with ICRN #17, 21, 22 (see 4.2)
Proceed with Task Group work (see 6.)

11. Preparation of PCC WG Report for Executive Meeting

12. Miscellaneous and Adjournment

There was no other business.

Those present at the PCC meeting were as follows:

M Ball	UK
M Bachet	France
J Bellows	USA
G Bignold	UK
P Colman	Ireland
K Daucik	Denmark
C Davutluoglu	Turkey
B Dooley	Canada / USA
A Drexler	Germany
F Gabrielli	USA
R Harries	UK
B Hughes	UK
Y-C Kuo	Taiwan
B Larzik	Russia
F U Leidich	Germany
W Macatangay	Philippines
J Matthews	USA
T Petrova	Russia
T Robertson	USA
A Rudge	UK
M Rziha	Germany
D Smetanin	Russia
M Stastny	Czech Republic
R Svoboda	Switzerland (Chair PCC)
S-E Therkildsen	Denmark
J Thiebault	France
K Thomsen	Denmark
S Uchida	Japan
J Waldenback	Denmark
M de Wispelaere	Belgium
J Withergow	USA
I Woolsey	UK
D Zinemanas	Israel

PCC Priority List for Further Research

1. Interfacial situation in advanced ultra supercritical plants

Formation and exfoliation mechanism of scale (oxide films) in steam lines
effects of chemistry (oxygen, ammonia ?)
Corrosion interactions materials / steam, influence / effect of
supercritical parameters, protective layers, radiation
Faster decomposition of chemicals (TOC, ammonia etc)?

Status 2008: Joint PPC/PCAS ICRN (Palmer, Dooley) to cover some of these topics has been drafted; pending approval (Tremaine to pursue)

2. Mechanism of Decomposition of Ion-exchange Resin

Operating conditions, quality control of resin; leak rates are slow, but sulphate is one of the products, organic leachables, oxidation
Additional information has to be researched

Status 2008: ICRN # 18 has been issued in 2007, no activities known in 2008

3. Development / Application of Sensors (Ambient and High Temperature Sensors)

ECP (nuclear, fossil application), ORP,
problem: abstract parameters, acceptance by plant operators

Status 2008: ICRN #20 has been issued in 2007, no activities known in 2008

4. Improved analysis of low concentration of metals (Fe, Cu, Co, etc)

Techniques for analysis are known, but problems with implementation
Additional problems with adequate sampling

Status 2008: IAPWS collaboration finished, 2 papers by Piti et al, collaboration to go on between UNB / DONG / SC

5. * Corrosion mechanisms that are related to the presence of contaminants in steam/water circuits, particularly in boiler-water

Define critical species / quantify critical quantities of steam generator water impurities, synergy with other species (e.g. oxygen), consideration of the materials

Status 2008: Geoff Bignold to draft ICRN; supported by Bellows, Svoboda

6. The relationships between the chemistry of the contaminants and their concentration at point of measurement

Detailed definition of the problem

ICRN: Lister + Daucik; ICRN #19 on sampling of corrosion products has been issued. International collaboration 2006/7 has been performed: Piti S.(Lister, Daucik, Svoboda). Paper presented at ICPWS 2008,
Status 2008: no further progress. Consider ICRN for 2009 (Daucik, Lister Bellows, et al)

7. * The quantification of risk of asset damage

problems of getting background data, important long-term issue
need: tool for operators, design engineers & commercial persons
PCC: to provide basic background data, e.g. corrosion / deposition rates

PCC task group has been set up (chair: K.Daucik)
Status 2008: task group in progress

8. Improved understanding of condensation mechanisms

- dropwise vs filmwise condensation in condensers (improve heat transfer)
- heterogenous – homogeneous nucleation models for prediction of condensation in steam turbines (chemistry, electrostatic,...)
- chemistry of the phase transition zone in nuclear turbine systems

ICRN draft to be processed 2007 / 2008 (Stastny with support by RS, BD, RH)
Status 2008: pending

9. Deposition of contaminants and corrosion products in steam and water circuits

- supersaturation,
- mass transfer,
- adsorption,
- crystal nucleation,
- deposit re-dissolution,
- scouring and exfoliation,
- activation and activity transport in reactor systems
- Mechanism and Influence of Cu Deposition :
  (essentially a solved problem from a scientific viewpoint)
  - mechanism of deposition on a turbine blade is not understood
  - discrepancies in temperature influence on deposition (?)

Status 2008: opportunity for several ICRN, one to be drafted for 2009 (Robertson)

10. Radiation chemistry of water

Radiolysis

2007 PCAS/PCC presentations have been made
Status 2008: no activities

11. * Behaviour of Aluminium in the steam / water cycle

- volatile carry-over and deposition in the turbine
- depsoition on boiler tubes
- behaviour in condensate purification
- interaction of Al with boiler chemistry
- specfication values for Al in feedwater, boilerwater, steam

Status 2008: topic still pending, practical data to define scope of problem incoming, ICRN for 2009 (Rziha, Svoboda)

12. Water cooling of copper in electrical machines

- generator stators
- accelerators

Status 2008: paper at ICPWS; ongoing: EPRI guideline, CIGRE guidance

**** urgent priority***

The numbering in the list is made for reference only and does not contain any information on actual priority

In addition, PCC should maintain awareness of the following items

- Chemistry and corrosion related items to future nuclear generation systems (6-best-design-reactor concepts, fusion reactor)

- High pressure / high temperature steam and humid air (24 MPa and up, 2000°C), thermophysical properties and chemistry formulation.
  (Long term interest in power industry, Treated in TPWS)

REPORTS FROM TASK GROUPS

A3.1 Task group – The quantification of risk of asset damage

Report the group was presented to the WG PCC and discussed. The report contains a classification of different types of chemical costs grouped in two groups:

- Costs of efforts to mitigate negative effects of chemical environment
- Costs of damage due to inappropriate chemical conditions.

Furthermore a list of published information on efforts to quantify the damage caused by chemical excursions is included. The discussion of the task group resulted in agreement on further development of chemical indexes to express a quantitative relationship to possible damage.

A3.2 Task Group – European Standard EN12952; Part 12

Geoff Bignold reported that comments have been submitted via BSi and the initiative taken to support CEN via the Maintenance Help Desk for EN12952.
R Svoboda reported that a letter indicating the need for revision of Part 12 had been sent , at a senior level, to the Swiss Standards Organisation.
All European members were encouraged to make independent, and specific, recommendations for revision via their national standards organisations. Although general representations have been made from Belgium, Denmark and German representatives, more specific comments are required to reinforce the need for revision.

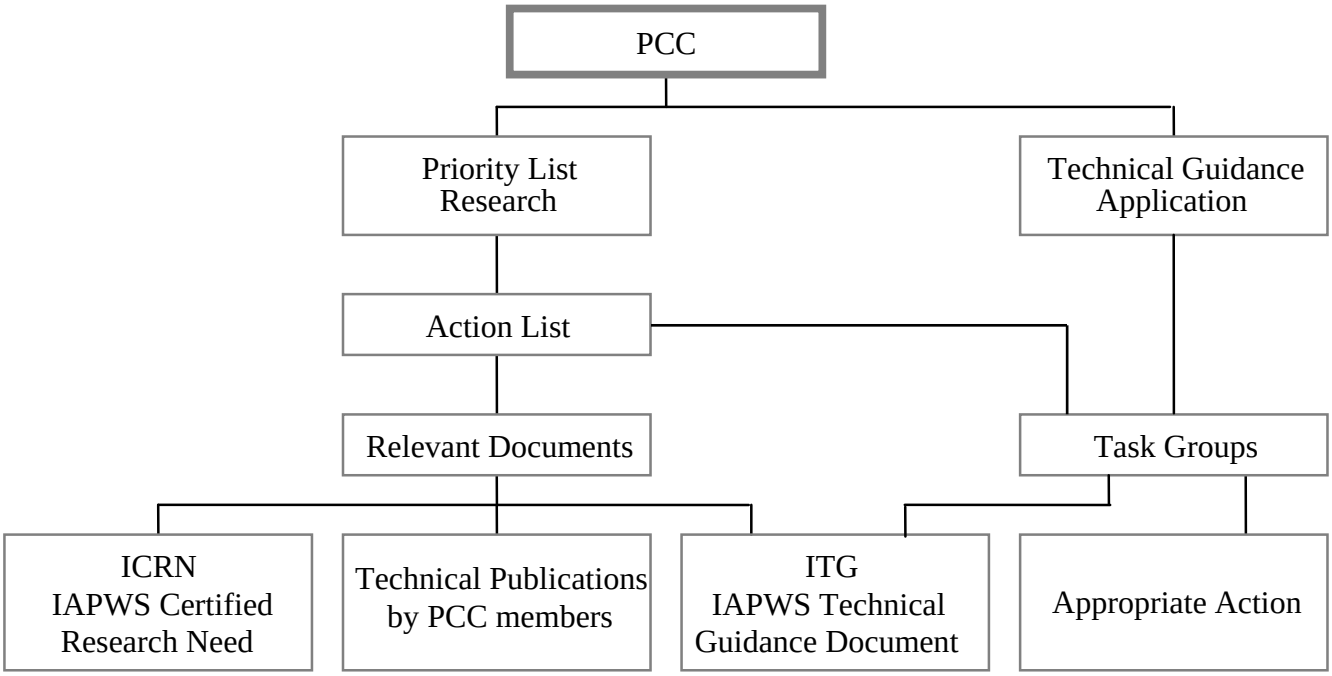
PCC MISSION (2008)

The Power Cycle Chemistry Working Group (PCC) brings together scientists and engineers from academia, research organizations, power plant operators, equipment manufacturers and other relevant interested parties from around the world with an interest in power cycle chemistry to

- Share results of scientific and engineering research and experience
- Identify gaps in technical information relating to power cycle chemistry
- Seek resolution of these gaps through international cooperative projects and the release of appropriate documents

for the benefit of industry. Within IAPWS, it serves as a liaison between industrial needs and related research represented by PCAS Working Group.

PCC WORKING PROCESS
Workflow



Working Tools

- Discussions at annual IAPWS meeting (mainly for steering)
- Individual or group work on PCC assigned tasks throughout the year
- IAPWS International Collaboration

Press Release
15th International Conference on the Properties of Water and Steam
and
International Association for the Properties of Water and Steam
2008 Meeting

Continuing a series of conferences started in 1929, 202 scientists and engineers from 23 countries met from Sept. 7-11 in Berlin, Germany at the 15th International Conference on the Properties of Water and Steam. Over 150 papers were given on thermodynamic and transport properties of pure water and steam, on critical phenomena, on chemistry in subcritical and supercritical water, on seawater, on chemical processes occurring in power plant equipment, and on power cycle chemistry. The conference connects academic researchers with engineers who use their information. It provides the researcher with guidance on useful problems and provides the engineers with the latest research.

The International Conference on the Properties of Water and Steam (ICPWS) is sponsored approximately every 4 years by the International Association for the Properties of Water and Steam (IAPWS). The General Assembly of IAPWS met at the conference and reviewed the progress since the 14th ICPWS in 2004. Major progress was demonstrated in the thermodynamic understanding of seawater, formulation of the viscosity of steam and water, properties of steam in the high temperature-high pressure region. Work continues on properties of metastable steam. IAPWS also produces guidelines, certified research needs, and has started to issue technical guidance documents. Information may be found at the IAPWS website: **www.iapws.org**.

Highlighting the conference and the IAPWS meeting were the conference sessions on seawater and the release of the "IAPWS Formulation 2008 for the Thermodynamic Properties of Seawater." Keith Alverson from of the Intergovernmental Oceanographic Commission of UNESCO attended the ICPWS to explain the new formulation's importance for global ocean observation and modeling. The release is the culmination of a cooperation with the Scientific Committee on Oceanic Research (SCOR) and the International Association for the Physical Sciences of the Ocean (IAPSO) that started at the 2006 IAPWS meeting. This thermodynamic description of seawater replaces the previous standard developed more than thirty years ago. The new IAPWS standard will significantly improve global ocean circulation models as well as the prediction of global climate change. At the same time, it serves as the first thermodynamic seawater standard to be used in the rapidly growing area of energy-efficient freshwater production facilities.

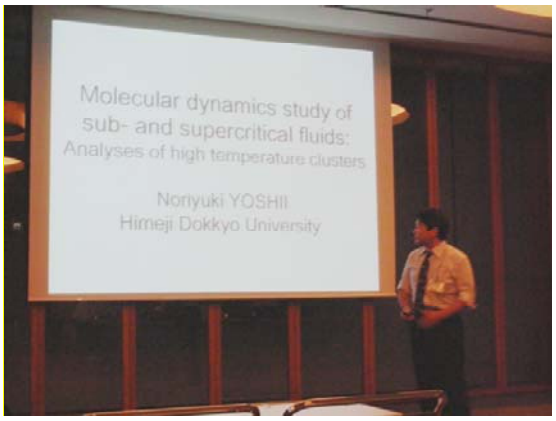
A new viscosity formulation for water and steam was released as "The IAPWS Formulation 2008 for the Viscosity of Ordinary Water Substance," replacing older versions. This was the culmination of a long multinational cooperative effort involving both IAPWS and the International Association for Transport Properties, and represents a significant improvement over the previous standard formulation which was over 20 years old.

The Power Cycle Chemistry Working Group completed a technical guidance document, "Procedures for the Measurement of Carryover of Boiler Water into Steam". The working group keeps a priority list for research related to power plant chemistry. It is currently headed by the Behaviour of Aluminium in the steam / water cycle, the quantification of risk of asset damage relating out of specification chemistry to damage to equipment, and the metal-water/steam interface in advanced ultra supercritical plants.

IAPWS produces Certified Research Needs (ICRN) as guidance for funding agencies and as an aid to people doing research in defining important research. While no new ICRN's were issued this year, 11 remain active in a variety of areas related to the properties of water and steam and the chemistry of power plants.

Wolfgang Wagner presents the Gibbs lecture "From the Beginning to this Day – My First Naïve ideas and the Research Results Achieved."

The IAPWS Gibbs award was presented to Professor Wolfgang Wagner. The IAPWS Gibbs Award is given at the ICPWS for a distinguished career body of work of interest to IAPWS. The IAPWS Helmholtz Award was presented to N. Yoshii, of Hemeji Dokkyo University, Japan. The IAPWS Helmholtz award is given annually to a young scientist who is working in a field of interest to IAPWS. It includes a trip to the IAPWS meeting to present a paper. In addition, there were 5 awards for best presented student papers at the ICPWS.



Nobuyuki Yoshii presents the IAPWS Helmholtz Award talk "Molecular dynamics study of sub- and supercritical fluids: Analysis of high temperature clusters," furthering IAPWS interests in molecular modeling of thermophysical properties of water and aqueous systems.

IAPWS has prepared a book, *Hydrothermal Properties of Materials*, edited by Vladimir M. Valyashko, containing chapters on phase equilibria, pVTX, calorimetry, potentiometry, electrical conductivity, thermal conductivity and viscosity. This book evaluates various high-temperature techniques and collects and summarizes all of the relevant experimental data available in the literature with emphasis on results obtained above 200 °C. The book is expected to be published by Wiley by the end of 2008.

IAPWS welcomes scientists and engineers with interest in the thermophysical properties of water, steam, and aqueous systems and in the application of such information to industrial uses. The next IAPWS meeting is will be in Arnhem, the Netherlands, probably September 6-11, 2009. Further information on meetings can be found at the IAPWS website, www.iapws.org, as it becomes available.

People interested in IAPWS documents and activities should contact the chairman of their IAPWS National Committee (see website) or the IAPWS Executive Secretary, Dr. Barry Dooley, Structural Integrity Associates, Inc., 2904 South Sheridan Way Suite 303, Oakville, Ontario L6J 7L7, Canada, bdooley@structint.com. People do not need to be citizens or residents of member countries to participate.

BIAPWS Annual Report to IAPWS for 2008

BIAPWS Committee

The BIAPWS Committee has continued to develop in 2008. Three BIAPWS committee meetings have been held since the IAPWS Meeting in Lucerne, with typical attendance of around fifteen members. The number of BIAPWS sponsors now stands at seventeen - an increase of one, Camlab Ltd, in the last year.

Following on from its introduction in 2007, BIAPWS has continued to host technical presentations and discussions immediately prior to BIAPWS committee meetings. There has been a noticeable increase in attendance at committee meetings as a result. The discussions provide a useful forum for updating information and exchanging views on a number of topics. In the last year, these have included the conversion and application of oxygenated treatment to drum boilers, methods and procedures for water/steam circuit storage, and decomposition of ion exchange resins. The opportunity is also taken for sponsors to bring members other than their BIAPWS representative to the meeting to benefit from and contribute to the discussions.

The BIAPWS committee is looking into ways that it can improve its representation in areas of interest to TPWS, IRS and PCAS whilst still maintaining its important role as a representative body for Power Plant Chemistry in the UK and Ireland.

Finally, there has been an election of officers in 2008, and BIAPWS would like to express its gratitude to Dr. Richard Harries and Mr. Malcolm Ball, who have stepped down from their roles as Chairman and Secretary respectively, for their time and dedication to the organisation of BIAPWS.

BIAPWS Award

The BIAPWS Award is given annually by BIAPWS to qualifying students as a means of promoting awareness of the topics of interest to BIAPWS. In 2008 the BIAPWS award is co-sponsored by E.ON Engineering. The award recipient is Joe Hook, who is currently studying for a Masters Degree in Physics at the University of York. The Award is given in the form of contributory funding by BIAPWS for a work experience placement for the student. Joe is spending three months working on a range of projects at E.ON's Technology Centre at Ratcliffe-on-Soar near Nottingham.

The BIAPWS Award recipient from 2007, Rochelle Green, gave an excellent presentation of her Award placement at Barking Power Station, entitled "Biocide induced corrosion in closed circuit cooling systems", at the 10th BIAPWS Symposium. Rochelle has since gone on to full time employment in power plant chemistry with one of the BIAPWS sponsors, demonstrating a significant success for the Award.
BIAPWS has also supported a further educational initiative in 2008, sponsoring and judging prizes for energy related projects at a schools science fair in Hinckley, Leicestershire.

BIAPWS Symposium

The 10th BIAPWS Symposium, 'Progress in Environmental and Cycle Chemistry', took place at the Village Hotel, Nottingham, on April 10th 2008. This was preceded by a half day

workshop on April 9th. Two sessions were held in the Symposium: 'Environmental Issues in Power Plants' and 'Flexibility in Cycle Chemistry', whilst two sessions were also held in the workshop, on cycle chemistry instrumentation and waste water in power cycles. This proved to be another successful meeting, with sixty delegates attending the Symposium and thirty delegates attending the workshop. A summary report of the meeting was published in Power Plant Chemistry **10** (May 2008) 274-277. In response to feedback from delegates, BIAPWS aims to host the Symposium on an annual basis commencing in 2009, compared to the current frequency of approximately every eighteen months.

BSI Representation

BIAPWS continues to represent the power industry on the BSI committee dealing with standards for power cycle chemistry, ie BS-EN 12952: 12 and BS-EN12953:10. Through its original initiative to review these standards BIAPWS has engaged the European members of IAPWS to make representations to CEN via their own national committees.

In 2008, BIAPWS has also joined the BSI committee with responsibility for the administration of ISO 5667 – Water Quality, Sampling. BSI has joined this committee with the aim of supporting a revision to Part 7 of this standard: 'Guidance on sampling water and steam in boiler plants'. BIAPWS is liaising with IAPWS PCC working group in this activity.

Canadian National Committee of IAPWS

2008 Annual Report
IAPWS Meeting, Berlin, September 7-12, 2008

Executive: *Peter Tremaine (Chair); David Guzonas (Secretary Treasurer); Igor Svischev (Past Chair); Derek Lister (Member at Large); CANDU Owners Group Representative (Ian Hey).*

1. Canadian National Committee: Dues for the Canadian National Committee of IAPWS are supported by the National Research Council of Canada. This arrangement requires support and participation by a national association representing industry. For the past three years, this role has been taken on by the CANDU Owner's Group ("COG"), on a trial basis. We are pleased to report that COG has agreed to accept this responsibility for a five year term, which began in 2007 and includes travel support for the CNC and organization of an annual meeting to provide liaison with the electric power industry. COG has been supportive and proactive in supporting the CNC since this arrangement was put in place. The COG member of the Canadian National Committee is Ian Hey.

2. University Network of Excellence in Nuclear Engineering (UNENE). Since 2004, the Canadian government and nuclear industry have co-funded an initiative to create a number of NSERC University Research Chairs which will form a research network, and a common postgraduate MSc program in nuclear engineering. Companies are: Atomic Energy of Canada Ltd., Ontario Power Generation, Bruce Power, and the CANDU Owners Group. The first chairs come up for renewal next year. The Chairs relevant to IAPWS are listed below, along with related NSERC Industrial Chairs that form part of the network, with one-on-one funding by companies:

$ **Roger Newman (University of Toronto):** Corrosion, materials performance, electrochemistry in primary and secondary coolant

$ **Dave Shoesmith (University of Western Ontario):** Electrochemistry, materials performance and corrosion for high-level nuclear waste repositories.

$ **Clara Wren (University of Western Ontario):** Radiolysis and radiation chemistry under nuclear reactor primary-coolant conditions and reactor accident scenarios.

$ **Derek Lister: (University of New Brunswick, Associate Member of UNENE)** Primary and secondary coolant chemistry, activity transport, corrosion.

Canadian researchers are also involved with UNENE as members of universities who are associate members in UNENE. In water-chemistry, the faculty member is:

$ **Peter Tremaine: (University of Guelph, Associate Member):** Solution thermodynamics, phase relations, and solubility in sub-critical and super-critical water; also D_2O isotope effects under CANDU-PHW conditions.

3. Atomic Energy of Canada Limited (AECL)

AECL provides the major Canadian Government R&D capabilities for CANDU reactor development, most of which takes place at Chalk River Laboratories. Water chemistry support for the CANDU 6 and other CANDU designs, and R&D for the new Generation III Advanced CANDU Reactor (ACR) 1000 reactor is carried out by the Reactor Chemistry and Corrosion, and Component Life Technology Branches (CRL):

$ **Dave Guzonas (Atomic Energy of Canada Ltd.)** Section Head, Heat Transport System and Core Chemistry. Materials performance and chemistry control in primary side circuits.

A new program to develop the Generation IV Supercritical-Water-Cooled Reactor concept was announced in July. This includes funding for 10-15 university research projects by Natural Resources Canada, NSERC and AECL, some of which are expected to be of direct interest to IAPWS. Dr. Guzonas will act as industrial lead and co-ordinate the chemistry and materials projects in this program.

4. Other Research Relevant to IAPWS

Other researchers with active programs in high-temperature water chemistry are:

$ **Igor Svischev (Trent University):** Molecular simulations of high temperature aqueous systems
$ **Vladimiros Papangelakis (University of Toronto)** Hydrometallurgy of pressure-leach processes involving nickel, cobalt, copper and zinc ores.
$ **Paul Percival (Simon Fraser University):** Muonium ion chemistry and radiolysis in sub-critical and super-critical water using the TRIUMF cyclotron national facility.
$ **Alan Anderson (St. Francis Xavier University);** Solubility and phase relations in supercritical water using diamond anvil cell methods.

5. IAPWS Collaborations:

The Canadian Committee has two ongoing international collaborations. One is with the Czech National Committee (Tremaine, University of Guelph; and Sedlbauer, University of Liberec). Czech PhD student, Jana Ehlerova, started at Guelph in July, and the work is progressing well. The results of her previous IAPWS project, reported last year, were published as:

$ **Spectrophotometric Determination of the Ionization Constants of Aqueous Nitrophenols at Temperatures up to 225°C**, J. Ehlerova, L.N. Trevani, J. Sedlbauer and P.R. Tremaine, *J. Solution Chem.* **37**, 854-857 (2008).

A further international collaboration among Lister (University of New Brunswick), Svoboda (formerly Alstom, Switzerland) and Daucik (Dong Energy, Denmark) has been successfully

completed. The UNB student, Piti Srisukvatananan, spent time at a fossil power plant in Denmark and a nuclear plant in Switzerland, gathering information on high-pressure, high-temperature sampling systems, and then simulating typical sampling systems with a commercial CFD code. The results were presented in a report to IAPWS and published as a paper in the proceedings of ICPWS XV:

- **Corrosion Product Sampling in Power Plants under Water/Steam Cycle Conditions.** P. Srisukvatananan, D.H. Lister, C-E. Ng, R. Svoboda and K. Daucik. *Proc. 15th ICPWS, Berlin, Germany,* Sept. 7-11 (2008).

Further needs of such sampling systems have been identified and a proposal for further collaboration is being prepared.

6. Canadian National Committee Executive for 2009 and 2010

The executive for 2009 and 2010 is: David Guzonas (Chair); Derek Lister (Secretary Treasurer); Peter Tremaine (Past Chair); Member at Large (to be elected): CANDU Owners Group Representative (Ian Hey).

Peter Tremaine, CNC Chair
September 12, 2008

The Czech National Committee

International Association for the Properties of Water and Steam

REPORT on IAPWS related activities – August 2007 / August 2008

Submitted to the EC Meeting of IAPWS, Berlin – September 2008.

National Committee Contacts:

CZ NC PWS, Institute of Thermomechanics AS CR, v.v.i., Dolejškova 5, 182 00 Prague 8,
Czech Republic, Fax: + 420 2858 4695, E-mail: secr.czncpws@it.cas.cz
Head: Dr. Jan Hruby, E-mail: hruby@it.cas.cz

Following Institutions participated in the research into the thermophysical properties and chemical processes:

Institute of Thermomechanics (IT) AS CR, v.v.i., Department of Thermodynamics, Dolejskova 5, CZ-182 00 Prague 8.

Czech Technical University in Prague (CTU), Faculty of Mechanical Engineering, Department of Fluid Mechanics and Power Engineering, Technicka 4, CZ-166 07 Prague 6.

Technical University Brno (TU), Faculty of Mechanical Engineering, Energy Institute, Department of Power Engineering and Department of Thermodynamics and Environmental Engineering, Technicka 2, CZ-616 69 Brno.

Institute of Chemical Technology Prague (ICT), Power Engineering Department (ICT-IE) and Department of Physical Chemistry (ICT-IPC), Technicka 5, CZ-166 28 Prague 6.

University of West Bohemia (UWB), Faculty of Mechanical Engineering, Department of Power System Engineering, Univerzitni 8, CZ-306 14 Plzen.

SKODA POWER, Plzen, Inc., Tylova 57, CZ-316 00 Plzen.

Nuclear Research Institute, plc. (NRI), Rez, CZ-250 68 Rez.

Technical University of Liberec (TUL), Department of Chemistry, CZ-461 19 Liberec.

SIGMA Research and Development Institute, Jana Sigmunda 79, CZ-783 50 Lutin.

Activities were sponsored by the Grant Agency of the Academy of Sciences and Grant Agency of the Czech Republic, SKODA POWER Plzen, Ministry of Education, Youth and Sport of the Czech Republic, and Ministry of Industry and Trade of the Czech Republic.

- Dr. Hruby (IT) with his collaborators, in collaboration with A. Harvey of NIST (USA), developed a formulation of thermophysical properties of liquid water at atmospheric pressure. The formulation was described in a draft of a Supplementary Release to be adopted in Berlin 2008.
- Dr. Hruby (IT) led the Evaluation Task Group of the proposal of “Release on the IAPWS Formulation for the Thermodynamic Properties of Seawater” by R. Feistel.
- Prof. Mares (UWB) with his collaborators took part at evaluation reports. Refs. [1 to 3] and contributed on data on thermal conductivity of water, on behaviour of super-cooled water, and on thermodynamic properties of water and steam. Refs. [5 to 7]
- Prof. Marsik (IT) coordinated research in the metastable states, nucleation and development of a new model of cavitation erosion potential. Refs. [7 to 9].

- Prof. Sedlbauer (TUL) and his team collaborated with team of Prof. Tremaine (Canada) and investigated the ionization constants of aqueous nitrophenols. Refs [10 to 11, 22].
- Research activities at the (CTU) continued in further improvement of the knowledge on following subjects: Determination of the particles in the super-heated steam using a new sampling technique, Refs. [12, 17]. Measurement of the electrostatic charge of water droplets during wet steam expansion Refs. [13 to 14]. Humidification of compressed and aftercooled air in the evaporative gas turbine cycle, Ref. [15].
- The activities of the SIGMA Research and Development Institute solved problems of erosion effects of cavitation bubbles on the blades of water pumps and the problems of the effect of water properties on cavitation phenomena. Refs. [7 to 9, 16].
- Dr. Jiricek (ICT-IE) with collaborators investigated corrosion processes and chemical effects in water and steam systems of power plants. Refs. [17 to 20].
- ICT-IE will organize the 7th International Power Cycle Chemistry Conference (CHEO 7), held from 11th to 12th September 2008.
- Dr. Hnedkovsky (ICT-IPC) with collaborators investigated properties of organic solutes in water. Published articles and conference contributions are under Refs. [21 to 29].
- Prof. Stastny (SKODA POWER) with co-workers studied effects of condensation of flowing steam with nucleation in salt solution zone and surface structure of artificial roughness on experimental blades, and collaborated in frame of the IAPWS ICRN 22. Refs. [30 to 33].

Young Scientists IAPWS Fellowships

- J. Ehlerova finished the 2007 Young Scientist IAPWS (CZ-Canada) Project "Predictive Scheme for Standard Thermodynamic Properties of Aqueous Substituted Benzenes over a Wide Range of Temperatures and Pressures" under supervising of Prof. J. Sedlbauer, and Prof. P. R. Tremaine. The project had two main objectives:
  - to develop the extended group contribution scheme by simultaneous treatment of all available standard thermodynamic data for nitro- and phenolate aqueous systems,
  - to supplement the existing scarce experimental results available on these aqueous systems at high temperatures by measurements of the ionization constants of isomeric nitrophenols to 250°C using hydrothermal indicators and UV-VIS spectroscopy.

  Her Final Report was submitted to EC IAPWS. The publication of the fellowship holder is in Ref. [10].
- J. Ehlerova performs her Young Scientist IAPWS (CZ-Canada) Project "Equilibrium Constants and Speciation of Aqueous Transition Metal Chlorocomplexes over a Wide Range of Temperatures and Pressures" under supervising of Prof. J. Sedlbauer, and Prof. P. R. Tremaine. The purpose of the collaborative project with IAPWS is to measure and model stepwise formation constants for the copper (II) chloride complexes at temperatures from 75 to 250°C. The low end of this range will provide thermochemical data needed for process design and optimization of the reactor and heat exchanger. The higher

temperature data are of fundamental value for steam generator design, both for the SCWR and more conventional power stations.
The Final Report of the Project will be finished by the end of the year 2008.

References:

[1] Revised Release on the Pressure along the Melting and Sublimation Curves of Water.

[2] Supplementary Release on Properties of Liquid Water at 0.1 MPa.

[3] Revised Release on the IAPWS Formulation for the Thermal Conductivity.

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[13] Bartos O.: *A Study of Electrostatic Charge of Droplets during Expansion in Steam Nozzle and Low-Pressure Part of Steam Turbine,* PhD Thesis, CTU, Prague, 2008.

[14] Bartos O., Petr V.: *A Study of Electrostatic Charge of Droplets during Expansion of Wet Steam,* pp. 15-20. In: Proceedings of XXVIIth Meeting of Departments of Fluid Mechanics and Thermomechanics, University of West Bohemia, Pilsen, 2008.

[15] Zidova L.: *Analysis and Optimization of Gas Turbine Cycle with Evaporation Humidification of Air*, PhD. Thesis, CTU, Prague, 2008.

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[31] Šťastný M., Šejna M.: *Condensation of Flowing Steam with Nucleation In Salt Solution Zone*, IAPWS PCC Meeting, Lucerne, 2007.

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[33] Stastny M.: *ICRN 22 Steam Chemistry in Turbine Phase-Transition Zone*. IAPWS PCC Meeting, Lucerne, 2007.

German National Committee to IAPWS

Research Activities on the Thermodynamic Properties of Water and Steam

Report "Research in Progress 2008"

Baltic Sea Research Institute, Warnemünde, Germany, Dr. rer. nat. habil. R. Feistel

1. Preparation of Draft Release “Seawater”:
   R. Feistel (proposer)
   Release on the IAPWS Formulation 2008 for the Thermodynamic Properties of Seawater
   The International Association for the Properties of Water and Steam
   Berlin, Germany, September 2008

2. Preparation of the background paper of the “Seawater Release”:
   R. Feistel,
   A Gibbs Function for Seawater Thermodynamics for -6 °C to 80 °C
   and Salinity up to 120 g/kg
   Deep-Sea Research I, doi: 10.1016/j.dsr.2008.07.004, in press

3. Publication regarding salinity definition:
   Millero, F.J., Feistel, R., Wright, D.G., McDougall, T.J.
   The Composition of Standard Seawater and the Definition of the Reference-Composition
   Salinity Scale
   Deep-Sea Research I, 55(2008) 50-72

4. Complementary paper for the new seawater properties standard:

   R. Feistel, D.G. Wright, K. Miyagawa, J. Hruby, D.R. Jackett, T.J. McDougall, W. Wagner:
   Development of Thermodynamic Potentials for Fluid Water, Ice and Seawater:
   A New Standard for Oceanography
   Proceedings ICPWS Berlin 2008, accepted

   R. Feistel, D.G. Wright, K. Miyagawa, J. Hruby, D.R. Jackett, T.J. McDougall, W. Wagner:
   Development of Thermodynamic Potentials for Fluid Water, Ice and Seawater:
   A New Standard for Oceanography
   Ocean Science Discussion 5(2008)375-418
   www.ocean-sci-discuss.net/5/375/2008/

   Feistel, R.: Thermodynamics of Water, Vapour, Ice and Seawater.
   Accreditation and Quality Assurance, 2008, accepted

   Trevor J. McDougall, Rainer Feistel , Frank J. Millero , Brian A. King ,
   Daniel G. Wright , David R. Jackett , Giles M. Marion , Chen-Tung Arthur
   Chen , Petra Spitzer:
   Improved seawater thermodynamics: How should the proposed change in salinity be implemented?
   DGM-Mitteilungen 3-4/2007, S.2-7
   CLIVAR Exchanges 45, Vol. 13, No. 2, 27-29, 2008

   Rainer Feistel, Stefan Weinreben
   Is Practical Salinity conservative in the Baltic Sea?
   OCEANOLOGIA, 50 (1), 2008, 73-82.
   http://www.iopan.gda.pl/oceanologia/50_1.html#A6

5. Contribution to the Preparation of Revised Advisory Note No. 3
   Hans-Joachim Kretzschmar, Rainer Feistel (proposers)
   Revised Advisory Note No. 3,
   Thermodynamic Derivatives from IAPWS Formulations

The International Association for the Properties of Water and Steam
Berlin, Germany, September 2008

6. Preparation of 15th ICPWS, liaison with SCOR / IAPSO-WG127, preparation of the WG127 meeting

7. ICRN 16:
Feistel, R.: (proposer)
IAPWS Certified Research Need
Thermophysical Properties of Seawater
http://www.iapws.org/icrn/ICRN16.pdf

University of Applied Sciences Zittau/Görlitz, Faculty of Mechanical Engineering, Department of Technical Thermodynamics, Prof. Dr.-Ing. habil. H.-J. Kretzschmar

1. Supplementary Backward Equations $v(p,T)$ for Region 3 of IAPWS-IF97
   - The comprehensive article on the backward equations $v(p,T)$ was submitted to the "Journal of Engineering for Gas Turbines and Power"

2. Thermodynamic Derivatives from IAPWS Formulations
   - A revision of the "Advisory Note No. 3 Thermodynamic Derivatives from IAPWS Formulations" with extended contents was prepared.

3. Development of Fast Property Algorithms Based on Spline Interpolation
   - A fast spline-interpolation method was developed and applied to the calculation of thermodynamic properties of steam.

4. Thermodynamic Properties of Humid Air
   - The research project "Thermodynamic Properties of Real Moist Air, Dry Air, Steam, Water, and Ice" of the American Society of Heating, Refrigerating, Air-Conditioning Engineers (ASHRAE) was investigated.

Recent Publications

- Wagner, W., Kretzschmar, H.-J., International Steam Tables, Springer, Berlin (2008)
- Kretzschmar, H.-J., Stöcker, I., Mollier *h-s* Diagram for Water and Steam, Springer, Berlin (2008)
- Kretzschmar, H.-J., Cooper, J. R., Dittmann, A., Friend, D. G., Gallagher, J. S., Harvey, A. H., Knobloch, K., Mareš, R., Miyagawa, K., Okita, N., Span, R., Stöcker, I., Wagner, W., and Weber, I., Supplementary Backward Equations $p(h,s)$ for the Critical and Supercritical Regions (Region 3), Equations for the Region Boundaries, and an Equation for the Two-Phase Region of the IAPWS Industrial Formulation 1997 for the Thermodynamic Properties of Water and Steam, Journal of Engineering for Gas Turbines and Power, Vol. 129 (2007) p. 1125-1137
- Kretzschmar, H.-J., Kraft, I., Kleine Formelsammlung Technische Thermodynamik, first and second Editions, Carl Hanser, Munich (2007)
- Kretzschmar, H.-J., Chapter 8 Technische Thermodynamik, In: Hering, E.; Modler, K.-H. Grundwissen des Ingenieurs, 14. Edition. Carl Hanser, Munich (2007)

Ruhr University Bochum, Germany, Faculty of Mechanical Engineering, Department of Thermodynamics, Prof. Dr.-Ing. W. Wagner

1. IAPWS-95 formulation

   – To bring some of the numerical information given in the release on IAPWS-95 in consistency with the results obtained when using the coefficients with 14 significant figures (the current results are based on the coefficients with 12 figures), the following values were recalculated: Pressure at the triple point, the coefficients n_1^0 and n_2^0 of Table 2 and last digits of a few calculated values in Tables 6-8

   – A suggestion for the corresponding editorial changes was made.

2. Revised Release for the melting pressure and the sublimation pressure of ice Ih

   – Some calculations were carried out to bring the melting-pressure equations for ice Ih and ice III into a better consistency with each other at the triple point ice Ih-ice III-liquid.

   – A draft revised release on the pressure along the melting and sublimation curves of ordinary water substance was prepared.

3. The manuscript of the book on the industrial formulation IAPWS-IF97 were completed. In the meantime the book was published. The reference of this book reads:

   Wagner, W., Kretzschmar, H.-J. International Steam Tables – Properties of Water and Steam Based on the Industrial Formulation IAPWS-IF97. Springer-Verlag, Berlin, 2008.

International **A**ssociation **f**or **t**he **P**roperties **o**f **W**ater **a**nd **S**team

Russian National Committee

Report of Russian National Committee (2008)

List of Publications

1. The Effect of Heat Flux on the Rate of Iron and Copper Corrosion Product Deposition in Boilers. *T.I. Petrova, V.I. Kashinskii, V.N. Semenov, V.V. Makrushin, A.E. Verkhovslii, P.A. Nikolaev and R.B. Duli Thermal Engineering vol. 55 No. 7, 2008*
2. Assessment of Efficiency of High-Temperature Filters Used for Reducing Exposure Dose Rate Received from the Equipment of the Primary Circuit. *V.F. Tyapkov, L.P. Khamyanov and N.B. Povalishin Thermal Engineering vol. 55 No. 7, 2008*
3. Determination of Phosphate Concentration in Boiler Water using Conductivity Measurements *B.M. Larin, E.N. Bushuev, Yu. Yu. Tikhomirova and S.V. Kiet Thermal Engineering vol. 55 No. 7, 2008*
4. Improvements in the Procedure for Design of Boiling-Type Evaporators for Highly Mineralized Media *A.S. Sedlov, Yu. A. Kuzma-Kitcha, I.P. Il'ina, E.O. Kon'kov and A.V. Lavrikov Thermal Engineering vol. 55 No. 7, 2008*
5. Steam-Oxygen and Steam-Water-Oxygen Methods for Cleaning, Passivation and Conservation of Power Engineering Equipment *N.N. Man'kina, A.A. Gol'din and A.A. Stolyarov Thermal Engineering vol. 55 No. 7, 2008*
6. Experience from Using AV-17-8 Anionite in Mixed-Bed Filters *D.V. Shevelev and O.M. Vladenkova Thermal Engineering vol. 55 No. 7, 2008*
7. The Influence of Filmformation Amines on Brass Corrosion Rate in Condenser Cooling Systems. *Petrova T.I., Repin D.A., New in Russian electroenergetics, No 8, 2008*

8. Some General Features of Phase Behavior for Ternary Sub- and Supercritical Mixtures with One Volatile Component. *Valyashko V.M. Presentations for the 13th International Symposium om Solubility Phenomena and Related Equilibrium Processes, July 27-31 (2008), Dublin, Ireland*
9. Na2CO3 Solubility Behavior in Ternary Hydrothermal Systems with Various Salts of Type 1. *Urusova, M.A.,Presentations for the 13th International Symposium om Solubility Phenomena and Related Equilibrium Processes, July 27-31 (2008), Dublin, Ireland*
10. Phase diagram of the system K2SO4-K2HPO4-H2O in a range of supercritical fluid heterogenization. *Urusova, M.A., Valyashko, V.M. Zh.Neorgan.Khimii, v.53, n.4, pp.660-672 (2008)*
11. Finding the values of steam properties with Mathad. *A.A. Alexandrov, V.F. Ochkov, K.A. Orlov and A.V. Ochkov. PTC Express. P. 1 -8, no 4.*
12. The properties of heat carriers and working substances of energetics: information in Internet. *V.F. Ochkov, A.A. Alexandrov, K.A. Orlov and A.V. Ochkov., New in Russian electroenergetics 2008, No 1, P. 28 -43*
13. The calculation and visualization of thermohysical properties 0f water and steam in Internet. *V.F. Ochkov, A.A. Alexandrov, K.A. Orlov and A.V. Ochkov A.A. New in Russian electroenergetics, 2008, No 9.*
14. Annual scientific session of the International Association on the Properties of Water and Steam (IAPWS). *A.A. Alexandrov, T.I. Petrova, V.F. Ochkov, D.S. Smetanin. Thermal engineering, 2008, No 7, P. 621-622*
15. Steam tables and diagrams on Mathcad Calculation Server for personal computers, pocket computers and smart phones. *V.F. Ochkov, A.A. Alexandrov, K.A. Orlov. Paper on ICPWS XV*
16. Experimental investigations of superheated and supercooled water. (A review of papers of the school of the academician V.P. Skripov). *V.G. Baidakov. Paper on ICPWS XV*

17. Heterogenization of supercritical fluids in ternary water-salt systems. *V.M. Valyashko Paper on ICPWS XV*
18. Effect of Water Chemistry on deposition Rate Iron Corrosion Products in Boiler Tubes. *T. I. Petrova, V.I. Kashinsky, N.R. Isianova, B. Dooley Paper on ICPWS XV*
19. Behaviour of Aluminium Corrosion Products in Water-Steam Cycle Power Plant. *T.I. Petrova, P.A. Nikolaev Paper on ICPWS XV*

U.S. National Committee to IAPWS
2008 Report on Activities of Potential Interest to IAPWS

Communicated from The Pennsylvania State University, University Park, PA:
The Energy Institutes' Electrochemical Laboratory (S.N. Lvov) at Penn State University continues to work in fundamental and applied areas on a variety of electrochemical and materials science studies related to traditional and renewable energy conversion systems. We lead interdisciplinary studies on electrochemistry of high-temperature aqueous systems in a number of scientific areas including electrochemical corrosion measurements, proton exchange membrane and solid oxide fuel cells, surface electrochemistry, etc. The key publications in 2007-2008 are as follows:

1. Lvov S.N. Electrochemical Techniques for Studying High Temperature Subcritical and Supercritical Aqueous Systems, in "Encyclopedia of Electrochemistry" (A. Bard, M. Stratmann, D.D. Macdonald, Eds.), Vol. 5, 2007, Wiley-VCH, pp. 723-747.
2. Zhou Z. F., Kumar, R., Thakur S. T., Rudnick L. R., Schobert H., Lvov S. N. Direct Oxidation of Waste Vegetable Oil in Solid-Oxide Fuel Cells, *Journal of Power Sources*, 2007, **171**, 856-860.
3. Chalkova E., Fedkin M. V., Komarneni S., Lvov S. N., Nafion/Zirconium Phosphate Composite Membranes for PEMFC Operating at up to 120 ^{o}C and Down to 13% RH. *J. Electrochemical Soc.,* 2007, **154**, B288-B295.
4. Gong Y., Yeboah Y.D., Lvov S.N., Balashov V., and Wang Z., Fe-Modified, Pt-Based Cathodic Electrocatalysts for Oxygen Reduction Reaction with Enhanced Methanol Tolerance, *J. Electrochemical Soc.,* 2007, **154**, B560-B565.
5. Engelhardt G. R., Biswas R., Ahmed Z., Lvov S. N., Macdonald. D. D., The Use of Channel Flow Cells for Electrochemical Kinetic Studies in High Temperature Aqueous Solutions, *Electrochim. Acta*, 2007, **52**, 4124-4131.
6. Zhou Z.F., Chalkova E., Lvov S.N., Chou P., and Pathania R. Development of a Hydrothermal Deposition Process for Applying Zirconia Coatings on BWR Materials for IGSCC Mitigation. *Corrosion Science,* 2007, **49**, 830-843.
7. Z. Zhou, E. Chlkova, S. N. Lvov, and P. H. Chou, *Hydrothermal Deposition of Zirconia Coatings on Pre-Oxidized BWR Structural Materials*, NACE Corrosion 2007, Paper #07414.
8. Balashov V.N., Fedkin M.V., Lvov S.N., and Dooley, B., Experimental system for electrochemical corrosion studies in high temperature aqueous solutions, NACE Corrosion, 2007, Paper #07403.
9. Z. Zhou, E. Chlkova, S. N. Lvov, and P. H. Chou, Hydrothermal Deposition of Zirconia Coatings on Pre-oxidized BWR Structural Materials, *J. of Nuclear Materials* (in press).
10. Rodriguez-Santiago, V., Fedkin, M.V., and Lvov, S.N., Study of The Electrochemical Step of Novel Active Metal Alloy Thermochemical Cycles for Hydrogen Production, *Electrochem. Soc. Trans*. (in press).
11. Fedkin, M.V., Chalkova, E., Wesolowski, D.J., Lvov, S.N., Understanding the Water Retention of Composite PEMs Based on Surface Chemistry of Inorganic Fillers, *Electrochem. Soc. Trans*. (in press).
12. Balashov, V.N., Fedkin, M.V., Lvov, S.N., Dooley, B., Experimental System for Studying Interfacial Electrochemistry at Temperature above 300 ^{0}C, *Electrochem. Soc. Trans*. (in press).
13. Chung, T.C., Zhang, Z., Chalkova, E., Wang, C., Fedkin, M.V., Komarneni, S., Sharma, S., and Lvov, S.N., Proton Conductive Composite Materials Using Functionalized and Crosslinkable VDF/CFTE Fluoropolymers and Proton Conductive Inorganics, *Electrochem. Soc. Trans*. (in press).

Communicated from the National Institute of Standards and Technology, Boulder, CO:
A collaboration is continuing with Prof. Richard Wheatley at the University of Nottingham, developing intermolecular pair potentials for aqueous systems for the quantitative calculation of second virial coefficients. Results for the water-carbon-monoxide binary have been obtained and a publication is in preparation. These results, along with previous results for water-hydrogen and literature data for water-CO_2, were used in performing vapor-liquid equilibrium calculations for water with synthesis gas at conditions that might be encountered in advanced power cycles.
Reference: Harvey, A.H., *Thermodynamic Data to Support High-Temperature Syngas Quench Design: Vapor-Liquid Equilibrium Calculations*, NISTIR 6654 (National Institute of Standards and Technology, Boulder, CO, 2008).

In collaboration with workers in Greece and Germany and at the University of Maryland, work is continuing on the joint IAPWS and IUPAC efforts to update the formulations for the transport properties of water and steam. The correlating surface for viscosity has been completed and a paper is being prepared for publication in *J. Phys. Chem. Ref. Data*. Work is well underway on the thermal conductivity.

NIST's Experimental Properties of Fluids group has designed and is building apparatus for two projects to measure thermophysical properties of aqueous gas mixtures at high temperatures. One apparatus is a high-temperature (up to 770 K) magnetic-suspension densimeter, which will be used to measure H_2O-N_2 and H_2O-CO_2 mixtures of interest for understanding the thermodynamics of combustion gases. An existing high-temperature thermal conductivity apparatus (using the transient hot-wire technique) is being converted to alternating-current operation (needed for polar fluids like water) in order to measure the thermal conductivity of H_2O-N_2 and H_2O-CO_2 mixtures at similar conditions (up to 750 K).

Communicated from Jonas, Inc., Wilmington, DE (www.steamcycle.com)**:**
Jonas, Inc. is working on the following projects related to IAPWS interests:
1. Effects of Corrosion Inhibitors on Corrosion of the Nuclear Component Cooling Water Piping Long term (over 20000 hrs) corrosion and SCC testing of four corrosion inhibitors - carbon steel base metal and welds. EPRI project.
2. Effects of Airborne Impurities on Corrosion of Gas Turbine Compressors Continuous measurement of the transport of airborne salts and acids from their sources (sea shore, cooling tower) to the GT compressor surfaces. Effects of weather, relative humidity, air filtration. Continuous long time measurement of the corrosion rate, surface conductivity, and weather parameters.
3. Development of a Moisture/Carry-over Monitor Two types of Moisture Monitors are being developed: separator based and heater based. The separator based monitor has been used in several PWR secondary systems.
4. Selection of the Piping material for the ITER Tokamak 500 MW Experimental Fusion Reactor Oak Ridge/Battelle project in which 316L ss and neutral water treatment with elevated oxygen and partial flow Powdex were recommended. Unresolved items include radiolysis in the neutron zone, corrosion and FAC of Cu and CuCrZr, crevice corrosion, and the effects of strong magnetic fields on corrosion, deposition, and piping stresses vs. delta ferrite.
5. Measurement of Separation of Water from Natural Gas An instrument which measures size distribution of water droplets in natural gas has been developed and used to determine efficiency of separators on a N. Sea platform, in piping, and in a lab.

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