THE INTERNATIONAL ASSOCIATION FOR THE PROPERTIES OF WATER AND STEAM

MEMBERS
Britain and Ireland
Canada
Czech Republic
Germany
Japan
Russia
Scandinavia (Denmark, Finland, Norway, Sweden)
United States of America

ASSOCIATE MEMBERS
Argentina and Brazil
Australia
France
Greece
Italy
New Zealand
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

Greenwich, London, UK
1st – 6th September 2013

Prepared by: Barry Dooley

IAPWS

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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
Greenwich, London, UK
1st – 6th September 2013

Plenary Session. Sunday, 1st September 2013. 9:20pm (39 people in attendance)

The President of IAPWS, Professor Tamara Petrova, welcomed the Executive Committee (EC) and other IAPWS members to Greenwich for the Executive Committee (EC), Working Group (WG) and General Committee Meetings of IAPWS. The President officially opened the 2013 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, Greece and Italy.

The President asked the delegate of BIAPWS to provide some opening comments. McCann welcomed everybody to Greenwich and to the 2013 IAPWS meetings and ICPWS Conference. He briefly reviewed some of the events planned for the ICPWS week. He recognized the sponsors for the meetings: Veolia Water, Swan Analytical Instruments, ABB, Ecolutia, and RSC.

1. Adoption of Agenda

Provisional agendas had been posted on the IAPWS Website for all IAPWS members by the Executive Secretary. 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, ICRNs and Technical Guidance Documents

The Executive Secretary indicated that four documents had been circulated to the National Committees during the year since the Boulder meeting for final review prior to being approved before or during the current EC Meeting. The Executive Secretary reminded the EC of these documents:

- Draft of IAPWS Statutes and By-Laws. Distributed 4th April 2013. A few minor suggestions were received, which were incorporated into the final which was then distributed to National Committees on 10th July 2013.

- Advisory Note Number 5: *Industrial Calculation of the Thermodynamic Properties of Seawater*. Distributed 22nd July 2013. No objections had been received by 1st September 2013. The document will be reviewed by the TPWS working group during the week prior to approval at the Friday EC.

- Revised Guideline: *The Critical Locus of Aqueous Solutions of Sodium Chloride*. Distributed on 2nd November 2012. One minor change was received from Canada, the changes were made and the Guideline was approved on 2nd February 2013.

- Technical Guidance Doument: *Steam Purity for Steam Turbines*. Distributed on 28th May 2013. No objections had been received by 1st September 2013. The document will be reviewed by the PCC working group during the week prior to approval at the Friday EC.

The respective Working Groups will report to the EC at the Friday meeting on any further changes prior to requesting approval.

2.2 Press Release.

The President asked McCann and Guzonas to develop a Press Release on the IAPWS and 16th ICPWS proceedings during the week. Petrova also requested Bellows to provide any assistance to the the committee after developing the Press Release for the last 15 years. The Clerks of Minutes from each WG were asked to provide input. The Press Release is discussed in Minute 17.1 and is Attachment 8.

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 the Committee to review any proposals received would consist of the WG Chairmen, with the President and Executive Secretary as ex. officio members. A chairman would be chosen by the Committee.

2.4 IAPWS Awards Committees

2.4.1 Helmholtz Award Committee

The President indicated that there was a Helmholtz Awardee this year. The Executive Secretary then reminded the EC that the Helmholtz Committee for the 2014 award would consist of a member from Russia, USA, BIAPWS, Canada and Czech Republic. Russia will provide the committee chairman. The President asked delegate Orlov to organize the committee and to report back to the EC on Friday with the names of the members of this committee (Minute 16.1).

2.4.2 Honorary Fellow Award Committee

The President requested that Bellows remain on the Committee for a second year as the Chairman for 2014. The IAPWS President requested that Kretzschmar join the two man committee. The President would be ex. Officio.

2.5 IAPWS Website.

The President requested that Harvey form an unofficial committee to discuss search engine access priority to ensure that the IAPWS documents are found easily by people worldwide. Harvey was asked to report back at the Friday EC with a plan.

2.6 Preparation for the General Meeting

2.6.1 IAPWS Statutes and By-Laws

The President requested that the chairman of the committee formed in Plzen provide a status report. Harvey first reminded the EC that currently the Statutes can only be changed at a General Meeting by a two-thirds vote of the EC Members present at the meeting in association with each ICPWS. He indicated that the committee (Svoboda and Watanabe) had developed a draft to include the items raised in Boulder and a few other items that had been raised by the committee. This version was sent to the National Committees of IAPWS for review. A few minor changes had been received and a final version sent to the EC for consideration at Greenwich before presenting this version to the General Meeting. The main changes to the Statutes and By-Laws include:

- Information on the IAPWS Technical Guidance Documents was added as a major activity and objective of IAPWS.
- The IAPWS Bank Account will be kept in a currency of convenience to the Executive Secretary. In future the IAPWS dues for a year will be in that currency converted from Swiss Francs on 1st January of that year. Concern was expressed about the IAPWS bank account in the event that the Executive Secretary is not able to work.

  The President requested that the US Delegate (Friend) report back on this issue at the Friday EC.
- Two procedures have been included to address associate members: those coming in to IAPWS and those former Members moving away.
- The procedure for changing the statutes only at ICPWS is difficult to manage. The suggested change is that approval of ¾ of the EC at annual meetings will be required to approve changes.
- ICRNs will move to a five year cycle.
- It is suggested to eliminate the Executive Secretariat and to have the Executive Secretary appointed by the EC.

The President asked the EC if there were any other comments or objections to putting these changes forward at the General Meeting for approval. There were no comments and no objections.

2.6.2 Host Country for 17th ICPWS

The Executive Secretary indicated that the next country in line to host the 17th ICPWS is the Czech Republic followed by the US, and requested that the head of the Czech Republic National Committee discuss the possibility of holding the next conference by the end of 2013. If it is not possible then the request would be made to the US to provide an answer by the next EC meeting in Russia in 2014.

2.7 Other Business Requiring Extensive Discusssions

No other business was raised by the EC.

3. EC Mandate to Working Groups and Membership

The President then provided the following mandates to the WG Chairmen for action during the week.

3.1 Releases, Guidelines and Certified Research Needs.

The Executive Secretary indicated that five ICRNs had either expired already or will expire in September 2013 and thus needed attention by the WGs during the week: #16 on thermophysical properties of seawater, #17 on amines, #22 on steam chemistry in the phase transition zone (PTZ), #24 on thermal conductivity of water at low pressure / high temperature, and #25 on corrosion mechanisms..

3.2 Working Group Directions.

The President emphasized that each WG Chairmen should only report to the EC on Friday about those activities that need approval or discussion by the EC.

4. Preview by the WG Chairmen of the Week's Activities

President Petrova requested each WG Chairman to review briefly the main topics which would be covered in their WGs during the week. The details of the WG meetings are covered in detail in Minutes 7 to 11 (Attachments 3 to 7).

The President closed the opening session of the EC at 10:15am.

Activities During the 16th ICPWS Conference Week in Greenwich

The first day activities of the WGs and Executive Committee were followed on Monday to Thursday by the symposia and workshops of the 16th ICPWS.

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

Executive Committee Meeting. Friday, 6th September 2013

President Petrova opened the continuation of the EC Meeting at 8:40 am. Each of the Member and Associate Member countries of IAPWS was in attendance with the exception of Argentina/Brazil, France, Greece, Italy and Switzerland. In total there were 24 people assembled for the EC meeting.

Petrova 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 from the Sunday EC Meeting.

5. Acceptance of Minutes of Previous Meeting

President Petrova asked for comments and changes to the minutes of the EC meeting held in Boulder, USA in 2012. No changes were noted, thus the 2012 Minutes were accepted.

6. President's Report

President Petrova indicated that she had given her report at the General Meeting (GM) on Tuesday and asked the EC if this needed to be repeated. The EC were pleased with the GM report.

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

TPWS Chairman Harvey opened this item by indicating that he would report on activities within TPWS, IRS and SCSW during the week. He then highlighted only those activities from the 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 with the exception of separate meetings for IRS and the Subcommittee on Seawater which are reported in Minutes 8 and 9. Full Minutes and the Agenda for TPWS can be found in Attachment 3.

7.1 Advisory Note 5 on the Properties of Seawater for Industrial Use. As per Minute 2.1 this document had been circulated to National Committees. The Working Groups (WG) reviewed and approved, and recommended adoption by the Executive Committee (EC).

The EC approved Advisory Note 5 Unanimously.

7.2 Task Group on Supercooled Water. Chairman Harvey informed the EC that IAPWS-95 can be recommended as a pure-fluid reference model for the formulation of thermodynamic properties of seawater, and when discussing IAPWS-95 outside its range of validity then "extrapolated IAPWS-95 formulation" should be used.

7.3 Metastable and Low Temperature Water. Chairman Harvey informed the EC of three Task Groups:

- Task Group to work on possible Guideline on thermodynamic properties of supercooled water with the following members: Hruby (chair), Anisimov, Feistel, Hellmuth, Holton, and Orlov.
- Task Group to examine behavior of IAPWS-95 for superheated liquid with the following members: Kretzschmar (chair), Feistel, Hruby, Orlov, and Rukes.
- Task Group to re-examine some uncertainty estimates of IAPWS-95 in light of new data with the following members: Harvey (chair), Trusler, and Wagner.

7.4 Harvey indicated that there had been progress on the new formulation for thermodynamic properties of heavy water, and that the WG expects this to be ready for evaluation in 2014.

7.5 Harvey indicated that ICRN-24 (Thermal conductivity of H_2O at low pressures and high temperatures) was extended by three years at the Boulder meeting but that some revisions were needed before being posted on the IAPWS Website. The TPWS Chairman will address this in the near future.

7.6 The TPWS Chairman informed the EC that Advisory Note 2 had been updated to reflect the latest documents.

7.7 TPWS Membership. Chairman Harvey requested that the following new TPWS WG members are approved:

S. Bell (NPL, UK).
J. Lovell-Smith (NMI, New Zealand).
S. Herrmann (TU Zittau/Görlitz, Germany).

The EC approved these Membership Additions Unanimously.

8. Report and Recommendations of the Industrial Requirements and Solutions (IRS) Working Group

IRS Chairman Weber indicated that many of the activities of IRS during the week had been reported in the TPWS report. Minutes for IRS and the Agenda can be found in Attachment 4. He covered the following items with the EC.

8.1 Proposed Guideline on Fast Water/Steam Properties based on Spline Interpolation. Chairman Weber informed the EC that the work presented should be developed into a guideline, and that a draft proposal already exists. The guideline will contain a description of the general method and its application to IAPWS-IF97 and IAPWS-95. An Evaluation Task Group was set up consisting of Novy (chair), Blangetti, Miyagawa, Pawellek, Bonifay and Weber.

8.2 Task Group on Industrial Survey. Weber informed the EC that there had been no progress and that the Task Group will be discontinued after the guideline on fast property calculations is available.

8.3 Task Group on Advisory Notes. The Chairman informed the EC that: a) the current set of advisory notes is suitable, b) an additional advisory note summarizing all documents relevant for industrial purposes will be developed, c) the task group will prepare such a document for the 2014 meeting, and d) the WG formally renamed the task group "Industrial Advisory Note".

8.4 IRS Membership. Chairman Weber requested that the following new member be approved:

F. di Mare (German Aerospace Center (DLR), Germany)

The EC approved this Membership Addition Unanimously.

9 Report and Recommendations of the Subcommittee on Seawater (SCSW)

SCSW Chairman Pawlowicz indicated that many of the activities of SCSW during the week had been reported in the TPWS report. Minutes for SCSW can be found in Attachment 5. He covered the following items with the EC.

9.1 The SCSW Chairman informed the EC that there had been three IAPWS/BIPM Workshops during the ICPWS week: a) pH (with 30 participants), b) salinity/density (with 25 participants), and c) Relative Humidity (RH) (with 13 participants). Each workshop had resulted in a number of JCS tasks to be worked on over the next year. In terms of future IAPWS/BIPM cooperation, the following two suggestions were made by BIPM representatives in the workshops (Bell (chair CCT/WG6), Lovell-Smith (CCT/WG6), Spitzer (CCQM), Seitz (CCQM) and Heinonen (CCT/WG6)):

- IAPWS should send a representative to the next CCQM/BIPM Meeting (April 2014, location TBD)
- IAPWS should send a representative to the next CCT/BIPM Meeting (June 2014, Paris)

In relation to these two suggestions, the SCSW Chairman proposed to the EC that IAPWS funding is made available for IAPWS representatives to attend these two meetings as follows:

- CCQM/BIPM Meeting - Pawlowicz or substitute (~$3,000US)
- CCT/BIPM Meeting - Hellmuth or Feistel (~$2,000US)

This resulted in some discussion from the EC which resulted in a proposal to the EC that IAPWS will provide support for two official IAPWS people to attend the two BIPM meetings in 2014. At this stage US Delegate Friend suggested that approval should be delayed until after the financial discussions. The EC returned to this item at the end of the meeting with an amendment proposed by the US Delegate that the total expenses are not to exceed $5000 US.

The EC then approved this proposal unanimously.

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

Chairman Nakahara provided the PCAS Report to the EC. Full Minutes can be found in Attachment 6. He covered the following items with the EC:

10.1 PCAS Officers. Chairman Nakahara will step down as chair of the PCAS WG after the London meeting. The chairman requested to the EC that Anderko will take over as chair and Sedlbauer will be appointed as vice chairman.

The EC approved these PCAS Officer Changes Unanimously.

The President acknowledged the five years that Nakahara had lead the PCAS WG and the EC provided applause.

10.2 PCAS Membership. Chairman Nakahara requested that the following new member be approved:

L. Qiu (AECL, Canada)

The EC approved this Membership Addition Unanimously.

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

Chairman Rziha highlighted those activities that needed action / approval by the EC. A full written report of the PCC WG activities forms Attachment 7. He covered the following items with the EC

11.1 Technical Guidance Documents.

Steam Purity for Turbine Operation. Chairman Rziha informed the EC that this document had been prepared over the last two years and was discussed in Boulder. During 2013 the draft was finalized and circulated to the Task Group, PCC, Editorial Committee and National Committees as indicated in Minute 2.1. No comments had been received as a result of the NC review and the PCC had conducted a final review at the Sunday meeting. Chairmen Rziha requested that the EC approve this document.

The EC approved the Steam Purity Technical Guidance Document Unanimously.

Corrosion Product Sampling and Analysis. Chairman Rziha informed the EC that this document had been prepared over the last year since Boulder. During 2013 the draft was finalized and circulated to the Task Group and to all the PCC members. The comments received were reviewed at the Sunday PCC meeting and the final changes will be made by the end of September 2013. Chairmen Rziha requested that the EC approve this document for Postal Ballot following review by the Editorial Committee.

The EC approved this Technical Guidance Document (TGD) for Postal Ballot Unanimously.

A BIAPWS delegate (Cooper) suggested that the TGD could be numbered to ease the process of revision. The President requested that PCC discuss this possibility at the next meeting in Moscow.

11.2 ICRNs

ICRN 17 on Amines. The Chairman reported that the revision of this ICRN will be completed by 15th October 2013 and it will need a new closing date. Additionally a new ICRN on filming amines will be developed for discussion in Moscow.

ICRN 22 on Steam Chemistry in the Phase Transition Zone. There was no information on this ICRN so it will be discussed in Moscow.

ICRN 25 on Corrosion Mechanisms that are related to the presence of contaminants in steam / water circuits, particularly in boiler water. This was finalized during the week and circulated to PCC members present. It now needs a light review by the Editorial Committee and will then be forwarded to National Committees for a Postal Ballot.

11.3 PCC Membership. Chairman Rziha requested that the following new members be approved:

W. Hater (BKG Water Solutions, Germany)
H. Kido (MHI, Japan)

It should be mentioned that an administrative error had occurred in the membership discussion at PCC and Kido had not been proposed for PCC membership at that time. The Japanese delegate (Nakahara) notice this. After some discussion the Executive Secretary suggested that the EC approve Kido for membership but Chairman Rziha will need to inform the PCC members.

The EC approved these Membership Additions Unanimously with the caveat that the PCC Chairman needs to inform the members of PCC.

12. Editorial Committee Report

Editorial Committee Chairman Harvey reported that in the preceding year, the Editorial Committee had reviewed the following documents:

- Revised Guideline on the Critical Locus of Aqueous Solutions of Sodium Chloride.
- Technical Guidance Document: Steam Purity for Turbine Operation.
- Advisory Note 5: Industrial Calculation of the Thermodynamic Properties of Seawater.
- Informal review and editing of Closing Statement for ICRN-23 (Dew Point for Flue Gas of Power-Plant Exhaust).

Editorial Committee Members. Harvey indicated that McDougall had resigned from the Editorial Committee and requested that Cook (Canada) be appointed.

The EC approved the Addition of Cook to the Editorial Committee Unanimously.

At this point the Executive Secretary discussed that all IAPWS documents included the mailing addresses of the President and the Executive Secretary. He then suggested that in today's communication world this was not needed, and that e-mails and telephone numbers would suffice. There were no objections from the EC. A Canada delegate (Pawlowicz) suggested that IAPWS should investigate having the e-mail addresses as IAPWS.org.

13. Membership and Associates

13.1 Members Defaulting on Dues.

The President asked the Executive Secretary to report on the members that are deficient in paying their dues. All IAPWS Members have paid their 2013 dues.

13.2 Reports on Associate Members

The Executive Secretary requested the delegate from each Associate Member and potential Associate Member to provide a short update.

Australia. Chairman Joy indicated that activities in ANAPWS were moving along nicely with an initial concentration on power plant chemistry. They are seeking other possible involvements in sea water, carbon sequestration and thermodynamics. ANAPWS now has 45 members. They are involved in two major conference activities in Australia: Australasian HRSG Users Group (AHUG) and API PowerChem. An Austalian wide steering committee has been formed. Joy indicated that they are planning to apply for IAPWS Membership at the Moscow Meeting in 2014.

New Zealand. Chairman Addison provided an update on NZAPWS. They have been targeting the last quarter 2013 for industry funding. They are planning another one-day symposium in early 2014 and to apply for full IAPWS Membership at the Moscow Meeting in 2014. NZAPWS members have already been heavily involved in the development of the latest IAPWS TGDs on Steam Purity and Corrosion Products.

France. The Executive Secretary had received a note from the French NC Chairman Dorey after meeting with him during the ICPWS week along with five other French attendees. At the present time the French NC of IAPWS had not yet recovered, but the French delegates at Greenwich had shown good will to bring a new start to the French NC. A process has been established to identify and link people together. There is hope that a foundation meeting will be organized in the future.

Switzerland. The Executive Secretary had received a note from the Swiss NC Chairman that there were seven members, but the committee had not yet been able to acquire fincancial commitment.

South Africa. Delegate Marais indicated that South Africa is intending to establish a national committee and become a member of IAPWS. This has been launched by Eskom, the national utility that has a large array of power stations. Discussions have also taken place with potential members that include: Petrochemical (Sasol), Paper and Pulp (SAPPI), Sugar (Hullett), Academic Institutions (Stellenbosch) and a Research Institution (CSIR). They plan to hold an initial formulative workshop in November 2013.

Argentina/Brazil, Greece and Italy. The US Delegate, Friend, requested an update on the membership status of these three Associate Members. The Executive Secretary indicated that there has been no contact on membership with these members for a number of years. Friend indicated that the revised Statutes and By-laws were approved by the General Meeting on Tuesday and that to be fair to the incoming Associate Members and potential Associate Members, these three previous members should be contacted by the Executive Secretary.

14. Executive Secretary's Report

14.1 Financial, Auditors and IAPWS Dues

The Executive Secretary reported that IAPWS remained on a sound financial footing with currently over $60,000 in the US bank account. The status as at 22nd August 2013 in the bank account had been provided to each National Delegate present at the EC meeting.

The Executive Secretary next reported that the 2012 financial statements had been forwarded to the IAPWS Auditors in January 2013. Both Dr. Hencke of VDI in Germany and Professor Savarik in Czech Republic had reviewed and approved the financial statements. Savarik's report had also been provided to the Heads of all the National Delegates present, but Hencke's had not been received until the week before the IAPWS meetings.

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 remains unchanged for 2014.

The EC Unanimously Agreed to this Proposal.

The Executive Secretary had also provided a rough estimate of the income and known planned expenditures for 2013 / 2014.

14.2 Time and Place of the 2014, 2015 and 2016 Meetings

2014 IAPWS Meetings. The Head of the Russian NC, Orlov, indicated that the Russian NC looks forward to welcoming IAPWS and the EC to Moscow. The meetings will be supported by the Russian NC and Moscow Power Engineering Institute on 23 – 27 June 2014. Two local hotels have been booked and will be reserved up to 1st May 2014. Visa application will be critical and the application process will start at the beginning of 2014. Information will be available at www.IAPWS.org and http://twt.mpei.ac.ru/rnc/iapws2014. There will an accompanying person's program.

2015 IAPWS Meetings. The Head of SIAPWS NC, Hellman, indicated that SIAPWS has agreed to host the 2015 meetings in mid-September in Stockholm.

2016 IAPWS Meetings. The Head of the German NC, Kretzschmar, indicated that the German NC would like to invite IAPWS to Dresden. Initial details will be provided in Moscow.

Future Years and the 17th ICPWS. The Head of the Czech Republic NC, Hruby, had already indicated at the GM that the Czech National Committee will support the 17th ICPWS. Discussion of the EC focused on whether this would be in four or five years, and the New Zealand delegate, Addison, indicated a willingness to hold an annual meeting and will discuss with the NC.

15. 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.

15.1 International Collaborative Projects.

The President indicated that no international collaborations had been suggested in 2013.

16. IAPWS Awards

16.1 IAPWS Helmholtz Award

The President reported that the 2013 Helmholtz Award had been presented to Hank Ashbaugh of Tulane University at the ICPWS Plenary Session on Monday.

Petrova then asked the Russian Delegate, Orlov, for the names of the 2014 Helmholtz Award Committee. The 2014 Helmholtz Committee will consist of: Chairman Orlov (Russia), Friend (USA), Guzonas (Canada), Vinš (Czech Republic) and McCann (BIAPWS.

Nominations will be due to the Executive Secretary by 31st January 2014.

The 2013 Helmholtz Committee Chairman, Kretzschmar, indicated that some thought should be given to an age restriction because different countries had varying "highest earned degrees" as required by the IAPWS Statutes and By-Laws and within the Helmholtz procedures. The consensus of the EC was that this had been discussed a number of times at past EC meetings. Finally it was decided that the committee for 2014 should again consider this factor and report back to the EC in Moscow.

16.2 IAPWS Honorary Fellowships

The President reported that Feistel (Germany) had been elected an Honorary IAPWS Fellow, following the established procedures and after unanimous approval through the postal ballot conducted by the Executive Secretary. The Fellowship Award was then presented to Feistel by the IAPWS President.

Petrova then reminded the EC of the Awards Committee for 2014 with Bellows as Chairman and Kretzschmar as member with the IAPWS President as ex.-officio member.

Nominations are due to the Executive Secretary by 31st January 2014.

17. New Business

17.1 Press Release

The President mentioned that McCann and Guzonas had been asked on Sunday to develop a Press Release. This was developed with input provided by each WG and SC. McCann briefly projected the developed Press Release which is Attachment 8. The President indicated that this release will be sent to all NCs and WGs of IAPWS and it should be distributed as widely as possible and sent to any journals and publications.

17.2 IAPWS Website Visibility for IAPWS Products

The President requested Harvey to report on input received during the week on how to improve the visibility of IAPWS products when searched on the internet. Harvey provided the following inputs:

- Continue what we are doing by making individual pages for each document which includes a link to that document. The WG chairs were requested to develop these pages and send them to Harvey.
- Insert as many links to IAPWS.org in as many published papers as possible.
- Hire an expert in internet searching to help structure the IAPWS.org site and the web pages.

The PCC chairman indicated that PCC had discussed this and supports IAPWS providing funds to allow the TGD to be found faster and more often. The question of who to hire was raised by the EC. Discussion resulted in a proposal that all NC will provide suggestions by 31st October 2013, and that if two or more are found then EC approves the expenditure without conducting a postal ballot.

The EC Approved this Motion Unanimously.

17.3 BIAPWS Feedback on the 16th ICPWS and Discussion on the 17th ICPWS

BIAPWS Feedback. The Head of BIAPWS NC, McCann, indicated that BIAPWS had three main criteria for judging the success of the 16th ICPWS. The first was attendance and there had been 229 people from 28 countries in attendance during the week. The second was the technical content and this was very difficult to judge because of the very wide range of topics, but BIAPWS hoped that each WG had been satisfied. The third factor was satisfaction with the venue and facilities. McCann also provided a couple of thoughts for the next organizers of an ICPWS. The first was that a list of IAPWS requirements should be provided and the second that these were available to the host country as early in the process as possible. These comments lead to an open discussion by the EC. The IAPWS President mentioned that it is important to develop a detailed

agenda as early as possible (six months before ICPWS) which includes dates, locations, and timing for presentations. A BIAPWS delegate, Cooper, indicated that the ICPWS is an IAPWS event and that IAPWS people need to be involved in the early decisions along with the local organizing committee (LOC) so that substantial revisions do not need to be made in the key dates for things like meetings of the international program committee (IPC), call for papers, date for abstracts, date for paper or presentation submissions, and paper reviews.

The consensus of the EC developed for a motion that a short document should be developed by the Executive Secretary in conjunction with the BIAPWS Chairman. The main content would be a skeleton of main procedural ICPWS dates and requirements.

The EC approved this Motion Unanimously

The Executive Secretary indicated that BIAPWS needs to provide for IAPWS auditing a final accounting and balance sheet for the 16th ICPWS which clearly indicates how the IAPWS donation was used.

Action: BIAPWS to provide a Final Accounting to the Executive Secretary by the end of 2013.

The final item on the 16th ICPWS came from the US Delegate, Friend, who thanked BIAPWS for arranging the conference and hoped that this had been tremendously beneficial in advertising IAPWS for the membership of BIAPWS. The EC applauded. Another request was then raised for BIAPWS to provide a detailed listing of attendees (names, affilitations, telephone, e-mails) to the Executive Secretary before the end of September 2013 for continuing IAPWS business.

This request was approved unanimously by the EC.

17th ICPWS. The Head of the Czech Republic NC indicated initial enthusiasm for holding the 17th ICPWS. He will respond officially to the Executive Secretary by the end of 2013 and indicate whether the date will be 2017 or 2018.

17.4 IAPWS Bank Account.

The US delegate, Friend, indicated that there was an open item from the discussion on Sunday about the Statutes and By-Laws (Minute 2.6) concerning the signatures required on the IAPWS bank account. Friend had discussed with a number of members during the week and made the motion that the Executive Secretary will report back at the EC meeting in Moscow in 2014.

This motion was approved unanimously by the EC.

17.5 Other New Business

President Petrova asked the EC if there was any further business. No other business was raised.

17.6 Reports from National Committees.

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/ICPWS week, or sent to the Executive Secretary after the meetings. They are attached to these minutes as follows:

BIAPWS	Attachment 9
Canada	Attachment 10
Czech Republic	Attachment 11
Germany	Attachment 12
Russia	Attachment 13
Switzerland	Attachment 14

17.7 Participants

Attachment 15 provides a list of participants at the IAPWS EC and WG Meetings and at the 16th ICPWS in Greenwich, London, UK in September 2013.

17.8 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 Greenwich Meetings. This will be forwarded electronically to the Head of each National Committee and the Working Group Chairs.

18. Closing Remarks and Adjournment

The President thanked McCann and his BIAPWS NC colleagues for hosting the IAPWS and ICPWS Greenwich Meetings. She also thanked everybody for participating at this EC meeting. Then she formally closed the 2013 EC meeting at 12:40pm.

AGENDA for the EXECUTIVE COMMITTEE of IAPWS

Greenwich, UK. 1st - 6th September 2013

Sunday, 1st September 2013. Opening Session (9:00 – 10:30am)

Opening Remarks / Welcome by IAPWS President, T. Petrova and Head of BIAPWS P. McCann

1. Adoption of Agenda
2. IAPWS Business and Appointment of Committees
   - 2.1 Releases, Advisory Note, ICRNs and Technical Guidance Documents
   - 2.2 Press Release
   - 2.3 Evaluation Committee on International Collaborations
   - 2.4 IAPWS Awards Committees for 2014 (Honorary Fellow, Helmholtz)
   - 2.5 IAPWS Website (including search engine access priorities)
   - 2.6 Preparation for General Meeting
     - IAPWS Statutes and By-Laws (Finalization for General Meeting)
     - Host Country for 17th ICPWS
   - 2.7 Other business requiring special/extensive discussions
3. EC Mandate to Working Groups and Membership
   - 3.1 Releases, Guidelines and ICRNs
   - 3.2 WG Directions
4. Preview of Week's WG Activities by WG Chairmen

Friday, 6th September 2013. Executive Committee Meeting. (8:30am – 1:00pm)

5. Acceptance of Minutes of Previous Meeting
6. President's Report
7. Report and Recommendations of TPWS, IRS and the Sub-Committee on Seawater
8. Report and Recommendations of IRS
9. Report and Recommendations of the Sub-committee on Seawater
10. Report and Recommendations of PCAS
11. Report and Recommendations of PCC
12. Editorial Committee Report
13. Membership and Associates
    - 13.1 Report on Membership. Including any Members Defaulting on Dues.
    - 13.2 Report on Associate Members, Australia, France, New Zealand and Switzerland, and potential Associate Member, South Africa.
14. Executive Secretary's Report
    - 14.1 Financial, Auditors and Dues
    - 14.2 Time and Place of 2014/2015/2016 Meetings.
15. Guidelines, Releases, Certified Research Needs, and International Collaborations
    - 15.1 International Collaborations
16. IAPWS Awards
    - 16.1 Helmholtz Award Committee
    - 16.2 Honorary Fellowship
17. New Business
    - 17.1 Press Release
    - 17.2 IAPWS Website
    - 17.3 BIAPWS Feedback on 16th ICPWS and discussion on 17th ICPWS
    - 17.4 IAPWS Bank Account
    - 17.5 Other items raised during the IAPWS / ICPWS week
18. Adjournment

Schedule

IAPWS Meetings and the 16th ICPWS
London, UK. 1 - 6 September 2013

(Greenwich University, London, UK)

Sunday 1 Sept. **9:00am EC Initial Meeting (Queen Anne Building)**
11:00am TPWS/IRS Joint Meeting to 5:00pm
11:00am SCSW Separate and Joint Meetings to 5pm
11:00am PCAS Separate Meeting to 5:00pm
11:00am PCC Separate Meeting to 5:00pm

Registration for ICPWS will be open all day

6:00pm IAPWS Welcome Reception
(Reception Area of Queen Anne Building)

Monday 2 Sept. 9:00am Opening Plenary Session – ICPWS
9:00am IAPWS Gibbs Award Lecture
11:15am IAPWS Helmholtz Award Lecture
1:00-2:30pm Gibbs Award Luncheon
(Trafalgar Tavern)
2:30pm. ICPWS Symposia - Afternoon

Tuesday 3 Sept. 9:00am. ICPWS Symposia All Day
4:30pm General Assembly Meeting of IAPWS
(Large Lecture Theatre, King William Building)

Wed. 4 Sept. 9:00am ICPWS Symposia
7:00pm. 16th ICPWS Banquet (Painted Hall)

Thursday 5 Sept. 9:00am ICPWS Symposia
2:00pm Excursion (River Thames Cruise)

Friday 6 Sept. **8:30am. IAPWS Executive Meeting <u>(8:30 – 1:00pm)</u>**
(Queen Anne Building)
(To include one member from each National Delegation)

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

Barry Dooley
1st September 2013

Minutes

IAPWS Thermophysical Properties of Water and Steam WG
London, England, 01 September 2013

NOTE: These Minutes include many items that were held jointly with the IRS Working Group and/or the Subcommittee on Seawater (SCSW). Items are listed according to their order on the TPWS agenda, which is Attachment A. **Bold print** denotes significant actions.

1-2. The meeting was opened on Sunday morning, September 1 by the TPWS Chair, Allan Harvey. The agenda (Attachment A) was adopted. The Chair noted that, in accordance with our procedure, the 2012 Minutes had been circulated and approved with minor corrections shortly after the 2012 meeting. Jan Hrubý was appointed Clerk of Minutes for TPWS. (Michael Hiegemann was appointed Clerk for SCSW and IRS)

Jan Sengers commemorated William Leitch "Bill" Marshall, Jr., who passed away on August 25, 2013. He was a life-long researcher at Oak Ridge National Laboratory and contributed to IAPWS-related activities in the fields of aqueous chemistry, hydrothermal chemistry and geochemistry. IAPWS has issued three Guidelines on aqueous systems that are primarily based on his work. The members of WGs commemorated Bill Marshall with a moment of silence.

3. S. Herrmann (speaker) and H.-J. Kretzschmar informed about the access to a password-protected website for documents and presentations of the TPWS and IRS Working Groups and the SCSW. The site is accessible from the Working Groups page on www.iapws.org.

4. No collaborative projects were suggested in TPWS.

5. M. Hiegemann presented a Report of the Evaluation Task Group for the Advisory Note on the Properties of Seawater for Industrial Use (joint with WGs IRS and SC SW). The Advisory Note was prepared by H.-J. Kretzschmar and collaborators. According to this Advisory Note, IAPWS-IF97 may be used for the pure-fluid reference equation instead of IAPWS-95 for computation of the properties of seawater. The deviations in computed properties were found to be almost negligible. Using IF97 speeds up the computations by a factor of 200. H.-J. Kretzschmar informed that a publication is being prepared (journal *Desalination*). **The Working groups approved the Advisory Note unanimously.**

6. Supercooled Water

6.1 J. Hrubý presented the Report of the Task Group on Supercooled Water as a Reference for Seawater, joint with SCSW. Validity of IAPWS-95 was investigated in the "seawater range" defined by a pressure range from 0.1 to 140 MPa and by a temperature range from 273.15 K down to 4 K below the equilibrium melting temperature for a given pressure. Several data sets not considered in the development of IAPWS-95 were considered. The uncertainty of density given by IAPWS-95 was estimated to be less than 0.1%, and for the speed of sound the uncertainty is estimated to be less than 0.5%. **Based on these estimates, IAPWS-95 can be recommended as a pure-fluid reference model for the formulation of thermodynamic properties of seawater.**

In addition, an "extended range" extending up to 400 MPa and from 250 K to 300 K was considered. Estimation of uncertainties of IAPWS-95 in this range is more complex. As a side-result, the possibility of reconsidering the uncertainties stated by IAPWS-95 emerged and is reported under item 7 of these minutes.

When talking about the behavior of IAPWS-95 beyond the stable liquid region, it was recommended to use the term **"extrapolated IAPWS-95 formulation"**.

6.2 Possible future IAPWS recommendations for thermodynamics of supercooled water. It was found that volumetric data spanning over the extended range with an uncertainty of 0.01-0.02% would be of high importance. Also, it was found that accurate sound speed data in the supercooled liquid region are needed.
It would be valuable for IAPWS to develop a Guideline with a separate formulation for the supercooled region. **A task group consisting of J. Hrubý (chair), M. Anisimov, R. Feistel, O. Hellmuth, V. Holten, and K. Orlov was established.**
Besides the "seawater region" considered in this report, also the metastable state of superheated liquid ordinary water is relevant for the seawater formulation. **A task group was established, consisting of H.-J. Kretzschmar (chair), R. Feistel, J. Hrubý, K. Orlov, and B. Rukes to examine the behavior of IAPWS-95 in this region.**

7. W. Wagner reported on the possible improvement of the uncertainty estimates of IAPWS-95 in the region of liquid water in the pressure range from 100 to 400 MPa. Based on the recent sound speed data (Lin and Trusler), it appears possible to significantly reduce the uncertainty estimates for the sound speed and to provide uncertainty estimates in regions where no uncertainty estimates are given in the present Release. On the other hand, isobaric heat capacity in the pressure range from 200 to 400 MPa in a band of about 10 to 15 K above to the melting line requires an uncertainty estimate bigger than 6%. **A task group was formed, consisting of A. Harvey (chair), W. Wagner, M. Trusler, to reconsider the IAPWS-95 uncertainty estimates in this region.**

8. Proposal for an IAPWS Guideline on the Fast Calculation of Steam and Water Properties in Computational Fluid Dynamics Using Spline Interpolation, joint with WG IRS
   This item is included in the IRS Minutes

9. Industrial Requirements and Solutions for Steam Property Calculations, joint with WG IRS
   - 9.1 Report of the New Industrial Requirements Task Group
     This item is included in the IRS Minutes
   - 9.2 Report of the Industrial Survey Task Group
     This item is included in the IRS Minutes
   - 9.3 Report of the Task Group "Advisory Notes"
     This item is included in the IRS Minutes

10. Report of Task Group on Extension of Range of Formulation for Thermodynamic Properties of Sea Water, joint with WGs IRS and SC SW
    This item is included in the SCSW Minutes

11. Report of Task Group on Transport Properties of Seawater, joint with SC SW and WGs IRS and PCAS
    This item is included in the SCSW Minutes

12. Cooperation with other international bodies, joint with SC SW
    12.1 IAPWS/IAPSO/SCOR Joint Committee on Seawater
    This item is included in the SCSW Minutes
    12.2 Cooperation with BIPM/CIPM (CCQM and CCT)
    This item is included in the SCSW Minutes
    12.3 ICPWS workshops for IAPWS-BIPM cooperation
    This item is included in the SCSW Minutes

13. Proposal for a Guideline on a Virial Equation for the Fugacity of Water in Humid Air, joint with SC SW
    This item is included in the SCSW Minutes

14. R. Span (speaker) and A. Harvey presented the Report of Task Group on Heavy Water Properties (joint with WG IRS). The present IAPWS Release, adopted in 1984, is based on a fundamental equation of state by Hill et al. In 2005, it was updated for the temperature scale ITS 90. The data situation has not improved very much since 1984, but much better correlation techniques are available now, allowing a better fit and better extrapolation properties. Tentatively the Release will be prepared for submission to an Evaluation Task Group at the 2014 meeting.

15. Reports on other TPWS activities
    15.1 A. Harvey informed that no update was necessary to the Guideline on Fundamental Constants.
    15.2 J. Cooper and A. Harvey (speaker) have updated Advisory Note 2 on the Role of Various IAPWS Documents.

16. Other Business
    16.1 Report on International Collaborative Projects – no reports were presented.
    16.2 Report on ICRNs
    The status of existing ICRNs was reviewed. ICRN 24 (Thermal conductivity of H_2O at low pressures and high temperatures) was extended in term for 3 years at the 2012 meeting, but some minor revisions are needed in the text. A. Harvey is assigned to this task.

17. Membership. **The following memberships were unanimously recommended to EC**:
Dr. Jeremy Lovell-Smith (NMI, NZ) as TPWS (and SCSW) member,
Dr. Stephanie Bell (NPL, GB) as TPWS (and SCSW) member,
Sebastian Hermann (TU Zittau/Görlitz) as TPWS (and IRS) member.

18. Contribution to Press Release
The chair and the clerk of minutes were assigned to prepare the contribution to the Press Release.

19. Preparation of the Formal Motion to the EC
The chair and the clerk of minutes were assigned to prepare the Formal Motion to the EC.

20. Adjournment
The meeting was adjourned at 6:00 p.m.

Agenda for the IAPWS Working Group

Thermophysical Properties of Water and Steam (TPWS)
London, England, 01 September 2013

1. Opening Remarks; Adoption of Agenda
2. Appointment of Clerk of Minutes
3. OPAL Web Space for Working Material for WGs TPWS, IRS, and SC SW, joint with WG IRS and SC SW (H.-J. Kretzschmar)
4. Potential International Collaborative Projects
5. Advisory Note on the Properties of Sea Water for Industrial Use, joint with WGs IRS and SC SW
   - Report of the Evaluation Task Group
   - Formal consideration of the Advisory Note by the Working Groups
6. Supercooled Water
   - 6.1 Report of Task Group on Supercooled Water as a Reference for Seawater, joint with SCSW (J. Hrubý)
   - 6.2 Possible future IAPWS recommendations for thermodynamics of supercooled water
7. Possible Improvement of the Uncertainty Estimates of IAPWS-95 (W. Wagner)
8. Proposal for an IAPWS Guideline on the Fast Calculation of Steam and Water Properties in Computational Fluid Dynamics Using Spline Interpolation, joint with WG IRS (H.-J. Kretzschmar, M. Kunick, J. Hruby, M. Duška, V. Vinš, F. di Mare, and A. Singh)
9. Industrial Requirements and Solutions for Steam Property Calculations, joint with WG IRS
   - 9.1 Report of the New Industrial Requirements Task Group (I. Weber)
   - 9.2 Report of the Industrial Survey Task Group (A. Singh)
   - 9.3 Report of the Task Group “Advisory Notes” (M. Hiegemann, B. Rukes, P. Murphy, A. Harvey)
10. Report of Task Group on Extension of Range of Formulation for Thermodynamic Properties of Sea Water, joint with WGs IRS and SC SW (R. Feistel)
11. Report of Task Group on Transport Properties of Seawater, joint with SC SW and WG IRS and PCAS (A. Anderko, A. Harvey)
12. Cooperation with other international bodies, joint with SC SW
    - 12.1 IAPWS/IAPSO/SCOR Joint Committee on Seawater (R. Pawlowicz)
    - 12.2 Cooperation with BIPM (CCQM and CCT) (R. Feistel, D. Friend, P. Spitzer)
    - 12.3 ICPWS workshops for IAPWS-BIPM cooperation (R. Pawlowicz)
13. Proposal for a Guideline on a Virial Equation for the Fugacity of Water in Humid Air, joint with SC SW (R. Feistel, J. Lovell-Smith)
14. Report of Task Group on Heavy Water Properties, joint with WG IRS (R. Span, A. Harvey)

15. Reports on other TPWS activities
    15.1 Guideline on Fundamental Constants (A. Harvey)
    15.2 Advisory Note 2 (J. Cooper, A. Harvey)
16. Other Business
    16.1 Report on International Collaborative Projects
    16.2 Report on ICRNs
17. Membership
18. Contribution to Press Release
19. Preparation of the Formal Motion to the EC
20. Adjournment

August 26, 2013

A.H. Harvey (Chair), J. Hrubý (Vice-Chair)

Minutes of the IAPWS working group IRS, London, September 1st 2013
(Numbering of topics follows TPWS agenda)

1. Ingo Weber opened the session for IRS at about 11 am. The agenda was adopted unchanged and is IRS Attachment A.
2. Michael Hiegemann was appointed clerk of minutes.
3. Covered in TPWS minutes.
4. Covered in TPWS minutes.
5. Covered in TPWS minutes.
8. Hans-Joachim Kretzschmar reported about the proposed "Guideline on the Fast Calculation of Steam and Water Properties in Computational Fluid Dynamics Using the Spline-Based Table Look-Up Method (STM)". The need for fast evaluation of fluid properties was repeated again, particularly with respect to backward evaluations. Shortcomings of the table look-up method being subject of the "IAPWS Guideline on the Tabular Taylor Series Expansion Method (TTSE) for Calculation of Thermodynamic Properties of Water and Steam" were reminded as they delivered the motivation for the development of a spline based method. This method was applied with a given grid size and respective deviations to the original IAPWS-IF97 were discussed. Some discussion evolved about what exactly the guideline should cover. There was a general agreement that the guideline should consist of two sections: One describing the general concept and another section describing the application to IAPWS-IF97 and IAPWS-95. The working groups decided that the proposed guideline is ready for evaluation and an evaluation task group was appointed to prepare adoption of the final version of the document in the next year. The work group consists of Adam Novy (chair), Francisco Blangetti, Kiyoshi Miyagawa (to be confirmed), Reiner Pawellek, Julien Bonifay (tbc) and Ingo Weber.
9.
   9.1. The task group "New Industrial Requirements" (chaired by Ingo Weber) is an ongoing task group collecting new developments throughout the year. No new developments could be reported at this time.
   9.2. The Task Group "Industrial Survey" could not report any progress. It was decided to discontinue the task group. It may be reactivated after the release of the Guideline on the Spline based Method.
   9.3. The Task Group "Advisory Notes" (Bert Rukes, Michael Hiegemann, Anurag Singh and Allan Harvey) has considered the existing Advisory Notes and has one further proposal concerning the IAPWS documents relevant for industrial application. The document is under preparation and is supposed to be ready for adoption in the 2014 meeting. The task group will be formally renamed to "Industrial Advisory Note".
10. Covered in SCSW minutes.
11. Covered in SCSW minutes.
14. Covered in TPWS minutes.

16. Other business: No International Collaborative Projects were proposed and no ICRNS need the WGs attention
17. Membership:
    The working group accepted Dr. Francesca di Mare of the German Aerospace Center (DLR) as a new member
18. Contribution to Press release will be done by the WG chair during the conference week
19. Formal motion to the EC will be prepared by the WG chair during the conference week
20. Ingo Weber adjourned the meeting at about 6 pm

Agenda for the IAPWS Working Group Industrial Requirements and Solutions (IRS)

London, England, 01 September 2013
(Numbering of topics follows TPWS agenda)

1. Opening Remarks; Adoption of Agenda
2. Appointment of Clerk of Minutes
3. OPAL Web Space for Working Material for WGs TPWS, IRS, and SC SW, joint with WG TPWS and SC SW (H.-J. Kretzschmar)
4. Potential International Collaborative Projects
5. Advisory Note on the Properties of Sea Water for Industrial Use, joint with WGs TPWS and SC SW
   - Report of the Evaluation Task Group
   - Formal consideration of the Advisory Note by the Working Groups
8. Proposal for an IAPWS Guideline on the Fast Calculation of Steam and Water Properties in Computational Fluid Dynamics Using Spline Interpolation, joint with WG IRS (H.-J. Kretzschmar, M. Kunick, J. Hruby, M. Duška, V. Vinš, F. di Mare, and A. Singh)
9. Industrial Requirements and Solutions for Steam Property Calculations, joint with WG TPWS
   - 9.1 Report of the New Industrial Requirements Task Group (I. Weber)
   - 9.2 Report of the Industrial Survey Task Group (A. Singh)
   - 9.3 Report of the Task Group “Advisory Notes” (M. Hiegemann, B. Rukes, P. Murphy, A. Harvey)
10. Report of Task Group on Extension of Range of Formulation for Thermodynamic Properties of Sea Water, joint with WGs TPWS and SC SW (R. Feistel)
11. Report of Task Group on Transport Properties of Seawater, joint with SC SW and WG TPWS and PCAS (A. Anderko, A. Harvey)
14. Report of Task Group on Heavy Water Properties, joint with WG TPWS (A. Harvey, R. Span)
16. Other Business
    - 16.1 Report on International Collaborative Projects
    - 16.2 Report on ICRNs
17. Membership
18. Contribution to Press Release
19. Preparation of the Formal Motion to the EC
20. Adjournment

2013-August-30, Ingo Weber (Chair)

Minutes of the IAPWS Sub Committee on Seawater (SCSW), London, September 1st 2013

Michael Hiegemann, September 1st 2013
Alan Harvey opened the joint session of TPWS, IRS and SC SW at 11:00 am.

1. Jan Sengers remembered IAPWS member William Marshall, who passed away on August 19th 2013. Bill Marshall was working in different working groups of IAPWS.

2. Ingo Weber and Rich Pawlowicz open the session for IRS and SC SW.

3. Appointed for clerks of minutes are Jan Ruby for TPWS and Michael Hiegemann for IRS and SC SW.

4. **Advisory Note No. 5 "Industrial Calculation of the Thermodynamic Properties of Seawater" was approved by the working groups and recommended for adoption by the IAPWS committee, after the report of the evaluation task group.**

5. Results of the Task Group "Supercooled Water as a Reference for Seawater" were reported by Jan Hruby. Recommendations for future work were given. It turns out that IAPWS-95 can be extrapolated for the purposes of the seawater formulation. In the discussion it was stated that the requirement for high precision volumetric data and the need for accurate speed of sound data should result in the formulation of an ICRN. **A task group on the properties of supercritical water was proposed with members Vincent Holten, Jan Sengers and Olaf Hellmuth.**

6. Sebastian Herrmann introduced the OPAL webspace containing material for the different IAPWS working groups.

7. Wolfgang Wagner reported on work being done on the possible changes of the uncertainty estimates for IAPWS-95. **A task group with member Wolfgang Wagner, Martin Trusler and Alan Harvey was appointed to create a revised release of the uncertainties of IAPWS-IF95.**

8. Hans-Joachim Kretzschmar reported about the proposed "Guideline on the Fast Calculation of Steam and Water Properties in Computational Fluid Dynamics Using the Spline-Based Table Look-Up Method (STM)". The need for fast evaluation of fluid properties was repeated again, particularly with respect to backward evaluations. Shortcomings of the table look-up method being subject of the "IAPWS Guideline on the Tabular Taylor Series Expansion Method (TTSE) for Calculation of Thermodynamic Properties of Water and Steam" were reminded as they delivered the motivation for the development of a spline based method. This method was applied with a given grid size and respective deviations to the original IAPWS-IF97 were discussed. **The guideline is ready for evaluation and the working group was asked to continue the work with**

the target to deliver the final version of the document for adoption in the next year. The work group consists of Francisco Blangetti, Kioshi Miagawa, Rainer Pawellek, Adam Nowi and Ingo Weber.

9. The Task Group "Industrial Survey" will be discontinued but may be reactivated after the release of the Guideline on the Spline based Method. The Task Group "Advisory Notes" (Ingo Weber, Bert Rukes, Michael Hiegemann and Alan Harvey) has considered the existing Advisory Notes and has one further proposal concerning the IAPWS documents relevant for industrial application under preparation that is supposed to be ready for adoption in the 2014 meeting.

10. Rainer Feistel presented results of the Task Group on "Extension of Range of Formulation for Thermodynamic Properties of Sea Water". Most important is the publication of recent measurement of density by Safarov and al. as well as measurements of sound speed by Rohden and Rudtsch and of vapor pressure by Safarov et al. to be published soon. The latter work should be extended to higher temperatures, however, there is no funding secured yet.

11. The results of the Task Group "Transport Properties of Seawater" were presented by Andre Anderko and Alan Harvey. A model for thermal conductivity initially developed for general electrolyte solutions was combined with the thermal conductivity model for pure water used for industrial calculations. **A draft of an IAPWS Guideline on the thermal conductivity of sea water has been prepared and is ready for evaluation. Appointed for the evaluation are Reiner Feistel, Rich Pawlowicz and Kioshi Miagawa**. There is no need for a respective recommendation for oceanographic use. A model for viscosity is being developed for general electrolyte solutions similarly. It is expected to be specialized for sea water calculations later.

12. Rich Pawlowicz reported on the work of the "Joint Committee on the Properties of Seawater". The membership list was presented. Several workshops of the different work groups will be held and a list of new and upcoming publications was given.

13. Reiner Feistel explained the cooperation of IAPWS with BIPM. A strategy paper was prepared by CCT in January 2013 with focus on thermometry, with metrology for pressure, temperature and humidity being mentioned explicitly. It is expected that IAPWS will be continue to participate in this collaboration. A Euromet project on seawater issues is organized in four work packages, coordinated by Petra Spitzer. Results of the group on the comparison of conductance ratio from different contributors were given. H. Wolf is coordinating a follow-on project called "Metrology for oceanographic observables".

14. Reiner Feistel and Jeremy Lovell-Smith presented a proposal for a guideline on a virial equation for the fugacity of water in humid air. The proposed equation would provide a

computationally efficient and simple method of calculating fugacity relative to methods using IAPWS-95 at the cost of increased error especially at high pressure. A general discussion occurred but no decision was taken.

15. Roland Span presented results of the task group on heavy water, executed by a joint team of NIST and Ruhr-University Bochum. A preliminary new equation for heavy water is available and considerable advancements and open issues in the liquid region and in the region around the critical point were discussed. It is expected that a new draft release on heavy water will become available in 2014.

16th ICPWS
London, UK
September 1-5, 2013

PCAS WG Minutes

Present:

Masaru Nakahara (chair)	*nakahara@scl.kyoto-u.ac.jp*
Andre Anderko (vice chair, clerk of minutes)	*aanderko@olisystems.com*
Masakatsu Ueno	*sk112652@mail.doshisha.ac.jp*
David Guzonas	*guzonasd@aecl.ca*
Liyan Qiu	*qiul@aecl.ca*

1. **Opening remarks.** Masaru Nakahara opened the meeting and presented the agenda. Andre Anderko was appointed the clerk of minutes. Masaru Nakahara recognized the contributions of William Marshall, a former member of PCAS, who recently passed away.

2. **Change of chair.** Masaru Nakahara will step down as chair of the PCAS WG after the London meeting. As agreed at the Boulder meeting, Andre Anderko will take over as chair and Josef Sedlbauer will be appointed vice-chair.

3. **Progress report and future perspective.** Masaru Nakahara prepared a summary of the work of PCAS since the 2008 Berlin conference.

   PCAS WG has discussed the fundamental thermodynamic and kinetic aspects of aqueous solutions and supercritical water to assist in the development of innovative approaches to a variety of problems encountered in power cycle engineering. In particular, the reactivity of such simple gases as hydrogen, carbon dioxide, and carbon monoxide, simple and complex organics like formic acid etc., and a variety of heavy metal oxides in supercritical water have been presented and discussed in relation to the power cycle chemistry. Attention has been paid to the free energy changes as a measure of the stability of the species involved. Information and opinions have also been exchanged on ionic conductivities and interfacial problems.

   The group briefly discussed the future directions of PCAS activities. Andre Anderko proposed creating a list of research topics that would be of shared interest to PCAS members. Such topics should ultimately result in the creation of IAPWS releases or guidelines. As an example, Andre Anderko mentioned the properties of rare earth metals, which are attracting increasing attention. David Guzonas mentioned solubility and deposition of corrosion products. Masaru Nakahara mentioned solvation free energies of gases and organics.

4. **Possibility of an international collaboration project.** David Guzonas expressed interest in an international collaboration project, which would help him bring a foreign visitor for a short-term project at AECL. The group has agreed to support such a proposal at the next IAPWS meeting after the partner organization is established.

5. **Possible releases (guidelines).** Currently, PCAS is co-sponsoring a guideline for the thermal conductivity of seawater (based on the model developed previously by P. Wang and A. Anderko). This guideline is being prepared in collaboration with the Subcommittee on Seawater and is currently under review. Andre Anderko gave a brief talk at a joint TPWS-SCSW-ICRN-PCAS meeting about the progress towards the guideline.

   Masaru Nakahara described a possible future release (or guideline) on self-diffusion in high-temperature and supercritical water, which would combine results of simulations and experimental data. Such release is currently contemplated but it has not been drafted yet.

6. **Possibility of an ICRN.** Currently, no ICRNs are being planned.

7. **Membership.** David Guzonas proposed his colleague Liyan Qiu as a new member of PCAS. Liyan Qiu is a research chemist at AECL, Canada. The group has endorsed Liyan Qiu's membership.

8. **Contribution to press release:**

   1. PCAS continues to focus on the fundamental thermodynamic and kinetic aspects of aqueous solutions and supercritical water. Particular areas of focus are the reactivity of gases such as hydrogen, carbon dioxide, and carbon monoxide, simple and complex organics such as formic acid, and a variety of heavy metal oxides in aqueous solutions. An additional area of focus is the study of transport and interfacial properties.

   2. A draft IAPWS guideline for the thermal conductivity of seawater has been prepared and is currently under review.

IAPWS Working Group Power Cycle Chemistry (PCC)

Minutes of IAPWS PCC WG Meetings
Greenwich, London 01 – 06 Sep 2013

Chairman: Michael Rziha
Members present See PCC Attachment A

1. Agenda

1.1. Amendments / Adoption of Agenda

There were no amendments to the drafted agenda.

1.2. Week program: split up of PCC for joint workshops and task groups.

M. Rziha summarized the schedule. There will only be a one-day WG meeting. The rest of the week will be dedicated to ICPWS.

2. Appointment of Clerk of Minutes

S. Marais agreed to act as Clerk of Minutes.

3. Approval of Minutes of PCC WG in Boulder, Colorado, USA, 2012

The minutes were approved without any corrections.

4. Progress Reports on PCC Activities 2012 / 2013

4.1. International Collaboration

There have been no new proposals handed in to the chairman of the PCC WG in the last year.

4.2. ICRN

4.2.1. There have been no new proposals handed in to the chairman of the PCC WG in the last year.

4.2.2. ICRN#17 on Amines: J. Bellows finished the draft of this ICRN and sent it to EPRI for their comments. Comments were received. Final draft will be completed by 15 October 2013, after which it will be sent to the PCC group for further comments and then to M. Rziha for approval by EC. M. Rziha will formally request for this IRCN to be extended, as it expires in September 2013.

Action: J. Bellows
M. Rziha

4.2.3. It was agreed that the position paper on filming amines, compiled in October 2012, will be developed as a new ICRN. Stephanie Marais was elected as the task group leader. W. Hater was added as a workgroup member. The task group was asked to prepare a proposal for the development of the ICRN, including a timeline, by this end of this week.

Action: S. Marais

4.2.4. ICRN#25 on Corrosion Mechanism That Are Related To The Presence Of Contaminants In Steam/Water Circuits, Particularly In Boiler-Water: It was agreed in October 2012 that PCC WG would submit the revised draft to EC for approval. This was not done. Task group members were asked to review the ICRN this week, and to send the ICRN to M Rziha so that he can propose it to the EC for approval.

Action: W. Cook
M. Rziha

4.2.5. ICRN#22 Steam Chemistry in Phase Transition Zone: This ICRN is expiring. M. Rziha will contact M. Stastny and A. Rudge to make a decision about the future of this ICRN.

Action: M. Rziha

4.2.6. ICRN #20 on Sensors For Use At Elevated Temperatures: Work is ongoing. Two articles related to this ICRN have been published and two papers will be presented at the 16th ICPWS.

4.2.7. During the development of the Technical Guidance Document (TGD) on Corrosion Product Sampling, an ICRN for corrosion product sampling in cycling plants was identified. This will be added to the priority list for further research. P. McCann was elected as the leader of the task group. Other members will be D. Addison, W. Cook, M. Rziha, and B. Dooley. A proposal will be submitted before the next PCC WG meeting for discussion during the meeting.

Action: P. McCann

4.2.8. ICRN#26 on Behaviour of Aluminium in the Steam Water Cycle of Power Plants: Has been circulated to National Committees for postal ballot in October 2010. M. Rziha, G. Joy, F.U. Leidich: work-out final proposal for approval by the PCC WG.

Action: M. Rziha
G. Joy
F.U. Leidich

4.3. PCC Task Groups

4.4. PCC Technical Guidance Documents (TGD)

4.4.1. B. Dooley reviewed the progress over the last three years. He also highlighted the importance of the IAPWS guidance documents. The existing guidance documents which have been issued so far, all are now in widespread use worldwide.

4.4.2. New TGD's are as follows:

- Steam Purity for Turbine Operation (September 2013). The final draft was accepted by WG and NC's. Official release will be requested at EC meeting.
- Corrosion Product Sampling and Analysis (December 2013). Draft is accepted by WG. Minor editorial comments will be included until mid September. Action: D Addison, Post ballot release will be requested by M Rziha at EC meeting to get official release by end of 2013.

4.4.3. The TGD on Corrosion Product Sampling and Analysis was presented. D Addison gave feedback about the main issues addressed:

- Cycling issues are not addressed in the TGD and will be addressed in a new ICRN, with the goal to produce a separate TGD dealing with this specific operational mode.
- No steam sampling is specified
- For turbulent flow conditions, standard line sizes will be specified instead of the Reynolds number
- All references for the basis of the tables in the TGD must be kept so that the next reviser of the TGD knows what the tables are based on
- Both online monitoring and grab sampling have been included
- Will make reference to widely available T-shaped sample splitter. If more references about Y- shaped sample splitter becomes available, it may be included in the revision of the TGD
- Nuclear plants have not been included in this TGD
- Have included achievable limits for different types of plants and operating regimes
- Have included a table for determination techniques

4.4.4. During the meeting, the following future needs for TGD's were identified:

- Amendment to carryover TGD
- Amines
- Cycling and two-shifting
- Sampling and Instrumentation in nuclear plants

4.4.5. On the third day of the ICPWS, delegates were asked to list future PCC technical guidance document requirements. The list is as follows:

- Consensus guideline for sizing of sampling lines
- How to sample tubes in HRSG's
- Air in-leakage and cycling plants
- Condensate polishers for high temperature plant, such as those with ACC's
- Outage inspection guideline for chemists
- QA/QC
- Understanding effects of organics in make-up plant and cycle and removal techniques

4.5. PCC Public Relations

4.5.1. It was agreed that PCC WG would assist A. Harvey in finding ways of improving the design of the IAPWS website so that it can be picked up by search engines. M. Rziha will explain the context to A. Harvey and explain the need to investigate companies that can assist in optimising the website. J. Bellows will provide inputs to A. Harvey.

Action: M. Rziha
J. Bellows

4.5.2. M. Rziha will prepare an article with the highlights of this meeting for the Power Plant Chemistry magazine.

Action: M. Rziha

4.5.3. P. McCann will prepare the press release.

Action: P. McCann

4.5.4. It was recommended that the names or description of all files stored on the website should make reference to the name of the author and the topic so that it can be more easily retrieved. J. Bellows further proposed to recommend a way of indexing the documents to improve search capability.

Action: J. Bellows

4.6. Other Action List Items

There were no other items not covered on the agenda.

5. Priority List Review

5.1. The priority list was discussed. It was agreed that items in the priority list that have been developed into ICRN's will be removed from this list and that these will be listed under ICRN's in Section 4.2. M. Rziha will revise the list. The purpose and benefits of the Priority List will be reviewed at the next PCC WG meeting.

Action: M. Rziha

6. Other Business

6.1. It was agreed that all documents relevant to the compilation of TGD's will be archived on the IAPWS PCC WG website, with the exception of documents published and readily available in the public domain. This will be password protected. The purpose of archiving this information is to ensure that it is available to future revisers of the TGD. The chairperson of PCC WG will have administrative rights.

6.2. W. Cook gave a presentation on Hydrogen Effusion Probe For Corrosion Monitoring. The presentation will be posted on the IAPWS website.

7. Changes in Membership, Election of Officers

7.1. The following new members of PCC were proposed and unanimously accepted:

New Member	Proposed by:	Seconded by:
Dr W Hater, BKG Water Solutions, Germany	M. Rziha	B. Dooley
T Ichihara, Power Systems - Mitsubishi Heavy Industries Ltd, Japan	S. Uchida	M. Rziha

7.2. M. Rziha will propose acceptance of these additional PCC members by the executive committee.

Action: M. Rziha

7.3. M. Rziha will contact all members that have not attended IAPWS meetings in a long time to determine if they are still interested in participating. M Rziha will provide list of above members within IAPWS to P. McCann so that the latter can contact these members.

Action: M. Rziha
P. McCann

7.4. Alain Kleitz passed away this year. He was a great member from France for many years and the IAPWS PCC WG appreciates his contribution over the years.

7.5. All members were asked to confirm their details on the contact list for further communication.

8. Preparation of Action List 2013 / 2014, Task Distribution, Next Year's Agenda

Action: M. Rziha

9. Preparation of PCC WG Report for Executive Meeting

Action: M. Rziha

10. Miscellaneous and Adjournment

PRESS RELEASE

16TH INTERNATIONAL CONFERENCE ON THE PROPERTIES OF WATER AND STEAM
AND
INTERNATIONAL ASSOCIATION FOR THE PROPERTIES OF WATER AND STEAM
2013 MEETING

Continuing a series of conferences that started in 1929 in London, 230 scientists and engineers from 28 different countries met from 1 - 5 September 2013 at the University of Greenwich in London, United Kingdom for the 16th International Conference on the Properties of Water and Steam (ICPWS). The conference is sponsored every four or five years by the International Association for the Properties of Water and Steam (IAPWS) and, in 2013, it was organised and hosted by the British and Irish Association for the Properties of Water and Steam (BIAPWS) and the Institution of Mechanical Engineers (IMechE). The highlights of the IAPWS working group sessions and general conference proceedings are summarised in this release.

The main purpose of the conference is to connect researchers with the engineers who use their information, providing the researchers with guidance on useful problems and the engineers with the latest research results. During the conference, over 150 papers were given on the thermodynamic and transport properties of pure water and steam, including aqueous solutions at extreme conditions, the properties of sea water and the properties of humid gases. Areas of application included power cycle chemistry, high temperature aqueous technologies applicable to steam cycles and fuel cells, the use of high temperature water and supercritical steam in chemical and metallurgical processes, supercritical synthesis of new materials and destruction of toxic wastes, hydrothermal geochemistry, hydrometallurgy, oceanography, power cycles with carbon dioxide capture and the storage of carbon dioxide in aqueous environments.

IAPWS also produces guidelines and certified research needs and has issued a number of technical guidance documents, notably on power plant chemistry. This information can be found on the IAPWS website at **www.iapws.org**.

The Working Group on Thermophysical Properties of Water and Steam (TPWS) continues to pursue better knowledge of properties for scientific and industrial application. This year, an approach was endorsed for the fast calculation of the thermodynamic properties of seawater in "industrial" situations, such as plant cooling and desalination. Significant progress has been made toward developing a new formulation for thermodynamic properties of heavy water to replace the existing IAPWS standard that is over 30 years old. Sessions of the ICPWS oriented toward thermophysical properties reported, among other things, progress in understanding the properties of supercooled water, improvement in knowledge of the vapour pressure of ice (important for meteorology and climate applications) and work aimed at providing knowledge for carbon capture and sequestration.

The main focus of the Industrial Requirements Working Group was to progress methods with high computational speed to calculate water properties for applications such as computational fluid dynamics and time-dependent power plant simulations that require significant data entries.

An important growing collaboration between IAPWS and the International Bureau of Weights and Measures (BIPM) continued with a series of workshops being held at the conference to further explore the development of standards relevant to environmental science and industry. Coordinated by the IAPWS/SCOR/IAPSO Joint Committee on the Properties of Seawater, which links IAPWS to the ocean science organizations SCOR (Scientific Committee on Oceanic Research) and IAPSO (International Association for the Physical Sciences of the Ocean), steps were taken towards finding a 'traceable link' between the TEOS-10 salinity standard (which uses the IAPWS-2008 Gibbs function formulation for seawater) and the SI (international system of units). A plan was also formulated to investigate the development of a traceable definition of pH that would be relevant at the high salt concentrations found in the ocean and to agree on a standard for the definition of relative humidity in the atmosphere.

The Working Group on the Physical Chemistry of Aqueous Solutions continues to focus on the fundamental thermodynamic and kinetic aspects of aqueous solutions and supercritical water. Particular areas of importance during the conference were the reactivity of gases such as hydrogen, carbon dioxide and carbon monoxide, simple and complex organics such as formic acid, and a variety of heavy metal oxides in aqueous solutions. A further area of focus was the study of transport and interfacial properties. In addition, a draft IAPWS guideline for the thermal conductivity of seawater has been prepared and is currently under review.

The proceedings of the Power Cycle Chemistry Working Group involved a full technical programme that covered a wide range of research, current operational issues and future requirements at both fossil and nuclear power plants. Of particular note was continuing progress over recent years with the increasing worldwide use of the IAPWS power plant chemistry technical guidance documents. In 2013, the release of a new guidance document on Steam Purity for Turbine Operation was approved. It was also expected that a new document on Corrosion Product Sampling and Analysis will be approved by the end of this year. A need for further work on corrosion product sampling in cycling plants was identified.

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 ICRNs were issued this year, eight remain active in a variety of areas related to the properties of water and steam, the properties of sea water and the chemistry of power plants.

The IAPWS Gibbs award was presented to Professor Digby D. Macdonald from the University of California at Berkeley in the USA. 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 Dr Hank Ashbaugh from Tulane University, USA. The IAPWS Helmholtz award is given annually to developing or early career scientists and engineers who are working in a field of interest to IAPWS. It includes an opportunity to attend the IAPWS meeting to present the Helmholtz Award lecture. Dr Rainer Feistel from the Leibniz Institute for Baltic Sea Research in Warnemünde, Germany was nominated to become an IAPWS Honorary Fellow in recognition of

his many years of outstanding contribution to IAPWS. In addition, there were five awards presented by BIAPWS for the best student papers at the ICPWS in memory of their former colleague Dr Geoff Bignold.

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 will be in Moscow, Russia from 23 - 27 June 2014. 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. R. Barry Dooley, bdooley@structint.com. People do not need to be citizens or residents of member countries to participate.

Professor Digby D. Macdonald from the University of California at Berkeley in the USA receives the IAPWS Gibbs award from the President of IAPWS, Tamara Petrova, Moscow Power Engineering Institute, Russia.

Dr Hank Ashbaugh from Tulane University, USA, presents the IAPWS Helmholtz Award lecture furthering IAPWS interests in molecular modeling of thermophysical properties of water and aqueous systems.

David Moed from Delft University of Technology in the Netherlands receives one of BIAPWS Awards from Stella Bignold.

BIAPWS ANNUAL REPORT 2013

1 INTRODUCTION

The British and Irish Association for the Properties of Water and Steam (BIAPWS) is the UK and Ireland national committee of the International Association for the Properties of Water and Steam (IAPWS) and the representative body for Power Plant Chemistry in the UK and Ireland. BIAPWS is a not for profit organisation. This is the annual report of the activities of BIAPWS for the year to August 2013.

2012/13 has been another successful year for BIAPWS. Membership has continued to grow and BIAPWS meetings have been well supported, with finances remaining in good and stable condition. In particular, we look forward to co-hosting with the Institution of Mechanical Engineers (IMechE) the 16th International Conference on the Properties of Water and Steam (ICPWS) at the University of Greenwich, 1-5 September 2013.

With their annual report, IAPWS requests that National Committees provide a listing of relevant technical publications that have originated from the respective nation/s during the year. The purpose of this request is to allow National Committees to share such lists to disseminate the international body of work being done on topics of interest to IAPWS and to IAPWS members. The list of publications for the UK and Ireland for the 2012/13 period is provided in the Appendix to this report.

If you would like to know more about BIAPWS, please feel free to contact one of the BIAPWS Officers listed above, visit our web site www.biapws.org or e-mail contact.us@biapws.co.uk.

2 BIAPWS MEMBERSHIP

BIAPWS membership continues to remain strong, with BIAPWS currently supported by twenty-two industrial sponsors, six honorary members, two ordinary members and fourteen corresponding members.

In 2012/13, BIAPWS was pleased to welcome Air Liquide, GE Power and Water and Doosan Power Systems as new industrial sponsors.

BIAPWS committee meetings are held three times a year and attendance at these continues to be good, with typically around twenty people present. BIAPWS committee meetings are preceded by a technical session with presentations on areas of interest to BIAPWS members, which always generate a high level of interest. Industrial member's representatives are able to bring a colleague to the meetings to benefit from and contribute to the discussions.

In May 2012, the BIAPWS committee meeting was held at Scottish Power's Longannet Power Station in Fife. The meeting was extended to include a one day technical seminar on topics of relevance to power plant chemistry and water treatment, including experience with the sea water washing flue gas desulphurisation (FGD) process, water treatment for organics removal and boiler water carryover issues. A tour was also arranged of Longannet's seawater FGD plant. The event was well attended with some excellent presentations that prompted much interest and discussion. BIAPWS would like to thank Scottish Power for hosting a very successful meeting.

Whilst BIAPWS retains a strong membership representation in the area of power plant chemistry, other areas that are of relevance to IAPWS are less well represented and BIAPWS remains keen to expand its individual membership in these areas. Therefore, in 2012-13, BIAPWS was very pleased to welcome Dr Stephanie Bell from the National Physical Laboratory and Prof. Maxim Fedorov from the University of Strathclyde as corresponding members. Both Stephanie and Maxim are already well involved with IAPWS activities. Stephanie's prior involvement has been through the international metrology committee that she chairs (CIPM CCT WG6), which includes responsibilities for the international harmonisation of humidity terms and definitions and the expression of humidity units within the SI. In 2012, Maxim was the recipient of the IAPWS Helmholtz Award for his work on molecular integral equation theory.

As was reported last year, it was with great sadness that BIAPWS was informed of the sudden death, after a short illness, of Dr Geoff Bignold in August 2012. In recognition of his contribution to power plant chemistry internationally, a tribute to Geoff was published in the PowerPlant Chemistry journal in October 2012 (PowerPlant Chemistry, 2012, 14(9), 544-547).

3 IAPWS ACTIVITIES

BIAPWS has continued to support IAPWS through its formal membership and participation in IAPWS activities. A number of BIAPWS committee members are represented on IAPWS working groups, in particular Power Cycle Chemistry (PCC).

IAPWS holds annual meetings and BIAPWS members support these events by participating in the relevant IAPWS working groups, including attendance at the 2012 IAPWS annual meeting proceedings in Boulder, Colorado (Paul McCann and Jeff Cooper). In addition, BIAPWS is represented on the executive committee of IAPWS.

Every four or five years, IAPWS holds the International Conference on the Properties of Water and Steam (ICPWS) in place of the annual meeting. The next such conference will be the 16th and this will be hosted by BIAPWS and held at the University of Greenwich, 1-5 September 2013. It has been over fifty years since this conference has been held in the UK and BIAPWS is looking forward to a welcome return to London, where the very first such conference was held in 1929.

A BIAPWS sub-group is leading the work on ICPWS 16 in coordination with the Institution of Mechanical Engineers (IMechE), which is co-hosting the event with BIAPWS and has taken on the role of Conference Organiser. We are very grateful to the ICPWS sub-group, comprising Eric Huff, Jeff Cooper, Hugh Lloyd and Peter Calver, and to the IMechE, Stephanie Love, Hannah Atkins and Aman Duggal, for their considerable work, time and effort to make this important event a success. More information on the conference can be found at www.icpws16.org/. Current expectations are for around 200 delegates to be attending and we look forward to another successful conference.

For further information on the activities of IAPWS, visit the IAPWS web site, www.iapws.org.

4 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 and their industrial application.

In 2012, the BIAPWS award was co-sponsored by AMEC Nuclear UK Ltd. and the award recipient was Harry Greenwood, a 3rd year MCHEM student at the University of Liverpool. The Award is given in the form of contributory funding by BIAPWS for a work experience placement for the student. Harry spent a twelve week summer placement with AMEC investigating the effect of temperature on ion exchange resins used in the secondary circuit condensate polishing plants of certain nuclear and conventional power plants. This involved the investigation of the thermal stability and effect of temperature on the mass transfer coefficients of selected commercially available ion exchange resins.

Many past BIAPWS Award winners have since gone on to full time employment in power generation, demonstrating significant success for the Award in attracting high calibre individuals to the industry.

BIAPWS has also continued to sponsor and judge prizes for energy related projects at a schools science fair in Hinckley, Leicestershire. We welcome new opportunities to support ventures of this nature.

5 BIAPWS SYMPOSIUM

BIAPWS has organized a series of annual symposia on topics relevant to power plant chemistry and water treatment. The 14th BIAPWS Symposium, 'Progress in Environmental and Cycle Chemistry', took place at the Village Hotel, Nottingham, on 28-29 March 2012, as reported last year, for which a summary report of the event was published in the Power Plant Chemistry journal (PowerPlant Chemistry, 2012, 14(5), 298-305). This year, the annual symposium has effectively been replaced by the hosting of the 16th International Conference on the Properties of Water and Steam, throughout which there is a technical programme on Power Cycle Chemistry. For the return of the annual BIAPWS symposium next year, provision dates of 2-3 April 2014 have been announced.

6 BSI REPRESENTATION

BIAPWS is currently represented on three British Standards and Euro Norm Committees of relevance to power plant chemistry and water treatment:

- PVE/2: Water Tube and Shell Boilers. The UK standards committee has responsibility for BS EN 12952-12:2003: "Water-tube Boilers and Auxiliary Installations - Requirements for Boiler Feedwater and Boiler Water Quality" and BS EN 12953-10:2003: "Shell Boilers - Requirements for Feedwater and Boiler Water Quality". BIAPWS has led on behalf of other European power plant chemistry specialists to lobby for these Euro standards to be revised and improved. Whilst the European body responsible for these standards has agreed to their revision, there have not been any significant developments.

- CII/62: Treatment of water for boilers. The UK standards committee also has responsibility for BS 2486:1997: "Recommendations for Treatment of Water for Steam Boilers and Water Heaters". Currently, this committee is not active.

- EH/3/6: Water quality - sampling. The UK standards committee is responsible for BS 6068-6.7:1994 (ISO 5667-7:1993): "Guidance on Sampling of Water and Steam in Boiler Plants". The standard is due for revision, but even in its current state, it remains a technically sound and useful document. BIAPWS has joined E/H/3 to act as co-coordinator for the revision. Tony Lister from Lowe Engineering, who manufacture steam and water sampling equipment for the power industry, is representing BIAPWS on the BSI committee that is responsible for leading the revision.

7 INTERACTION WITH PROFESSIONAL ORGANISATIONS

Because of the diverse nature of the interests of IAPWS, BIAPWS has continued correspondence with a number of professional bodies with the aim of sharing information and closer working.

- BIAPWS is represented on the Energy Sector Interest Group of the Royal Society of Chemistry by John Greene;
- BIAPWS is also represented on the Water Science Forum of the Royal Society of Chemistry by Eric Huff;
- Richard Hill, who is a committee member of the Institution of Chemical Engineers (IChemE) Water Subject Group, is also a Corresponding Member of BIAPWS.

BIAPWS is also organising the 16th International Conference on the Properties of Water and Steam with the Power Industries Division of the IMechE on behalf of IAPWS.

Paul McCann
Chair, British & Irish Association for the Properties of Water and Steam
August 2013

APPENDIX: List of UK and Ireland Originated Reference Papers in areas of interest to IAPWS, published between April 2012 and August 2013

Windsor, B. and Hayhurst, D., "A Practical Guide to Investigating Operating Problems on In-Situ Regenerated Polishing Mixed Beds", PowerPlant Chemistry, 2012, 14(5), 282-287

McCann, P. and Robson, M., "Proceedings of the BIAPWS 2012 Symposium on Power Plant Chemistry", PowerPlant Chemistry, 2012, 14(5), 298-305

Armstrong, C., Bull, A.E.A., Mitchell, M.S., Quirk, G.P., Rudge, A. and Woolsey, I.S., "Dimethylamine as a Replacement for Ammonia Dosing in the Secondary Circuit of an Advanced Gas-Cooled Reactor (AGR) Power Station", PowerPlant Chemistry, 2012, 14(6), 372-379

Garbett, K., Woolsey, I.S., Ball, M., Fyfield, R. and Dooley, R.B., "Tribute to Dr. Geoff Bignold", PowerPlant Chemistry, 2012, 14(9), 544-547

Palmer, D., McDonagh, J. L., Mitchell, J. B. O., van Mourik, T. & Fedorov, M. V., "First Principles Calculation of the Intrinsic Aqueous Solubility of Crystalline Druglike Molecules", Journal of Chemical Theory and Computation, September 2012, 8, 9, p. 3322–3337

N. Ottosson, A.O. Romanova, J. Söderström, O. Björneholm, G. Öhrwall and M.V. Fedorov, "Molecular Sinkers: X-Ray Photoemission and Atomistic Simulations of Benzoic Acid and Benzoate at the Aqueous Solution/Vapor Interface", Journal of Physical Chemistry B, August 2012, 116(43), 13017-13023

V.P. Sergiievskyi and M. V. Fedorov, "3DRISM Multi-Grid Algorithm for Fast Solvation Free Energy Calculations", Journal of Chemical Theory and Computation, June 2012, 8 (6), p. 2062-2070.

A. Romanova, E. Chibunova, R. Kumeev, M. Fedorov, M, I. Terekhova, "α-Cyclodextrin/Aminobenzoic Acid Binding in Salt Solutions at Different pH: Dependence on Guest Structure", International Journal of Biological Macromolecules, June 2013, 57, 255-258.

IAPWS Canadian National Committee

Annual Report 2013

Submitted at ICPWS16, Greenwich, UK, Sept. 6, 2013

Executive: *David Guzonas (IAPWS Vice President, member-at-large); William Cook (Chair); Derek Lister (Secretary-Treasurer); Peter Tremaine (Member at Large); Melonie Myszczyszyn (Member at Large); Steve McGee (CANDU Owners Group Representative)*

1. Canadian National Committee: Dues for the Canadian National Committee (CNC) of IAPWS are supported by the National Research Council of Canada. This arrangement requires support and participation by a national organization representing industry. In 2004 the CANDU Owners Group took on this role on a trial basis, and in 2007 the CANDU Owners Group accepted this role for a five-year term, including travel support for the academic members of the CNC. In December 2012, chairman Guzonas meet with the CANDU Owners Group and was able to secure this essential industry support for the CNC for the next five years.

Due to his role as the chair of the Joint Committee on the Properties of Seawater, Prof. Rich Pawlowicz (University of British Columbia) has agreed to sit on the CNC as a member-at-large.

Dr. Dave Guzonas accepted the CNC nomination to be Canada's choice for IAPWS vice-president for 2013-2014. He will transition to IAPWS president for 2015-2016. Prof. William Cook accepted the CNC nomination to become chair of the CNC due to the vacancy left with Dr. Guzonas' promotion.

2. NSERC/NRCan/AECL Generation IV Energy Technologies Program

A major university-based program to study water chemistry in support of the development of the Canadian Supercritical Water-cooled Reactor concept (NSERC/NRCan/AECL Generation IV Energy Technologies Program) is currently in Phase II and includes seven water chemistry projects that cover two main themes: a) corrosion product transport and deposition, and b) water radiolysis. The goal is to develop chemistry control strategies for the SCWR as well as recommend realistic chemistry conditions for corrosion testing for materials selection. The program also funds eight projects examining materials degradation phenomena (e.g., corrosion, stress corrosion cracking, creep) at temperatures up to 850 ºC. The yearly workshop for the program members was held in Toronto in June 2013.

Research on high-temperature water chemistry being funded by this program includes:

P. Tremaine (U. of Guelph): Aqueous chemistry of metals and fission product under SCWR conditions.

C. Pye (St. Mary's University): Ab initio calculations on ionic hydration and complexation.

W. Cook (U. of New Brunswick): Corrosion product transport and deposition under SCWR conditions.

I. Svishchev (Trent University): Water chemistry, pH control and particle formation process in an SCWR.

A. Anderson (St. Francis Xavier University): Time-resolved investigations of metal oxide-water systems under conditions of extreme temperature, pressure and radiation.

P. Percival (Simon Fraser University), K. Ghandi (Mount Allison University): Reaction kinetics in SCW probed using muonium.

J.-P. Jay-Gerin (U. of Sherbrooke): Computational modelling of water radiolysis in high temperature water (including SCW).

C. Wren (U. of Western Ontario): Water radiolysis effects on materials degradation in high temperature water (including SCW).

The chemistry program is co-ordinated by D. Guzonas (AECL).

3. Activities at the University of New Brunswick

D. Lister

Heat exchanger fouling; examining the effects of surfactants on magnetite deposition during boiling heat transfer (collaboration with AECL). Preliminary studies developed an accurate way of measuring local deposit thicknesses ex-situ.

Flow-accelerated corrosion; predicting the characteristics of scallops (the sculpting of surfaces undergoing FAC). Correlating the pattern of FAC recorded in many laboratory experiments at different conditions of flow, pH, etc. will lead to greater understanding of the FAC phenomenon in general.

Modelling reactor primary circuit contamination. Inserting FAC mechanisms and in-core effects into models for material transport will lead to predictions of radiation fields.

Sampling high-temperature water systems; modelling hold-up of corrosion products in coolers and introducing precipitation kinetics provides information relevant to the IAPWS technical guidance document.

Characterising the effects of film-forming amines on FAC in two-phase flow. Scoping studies in single-phase flow are complete and similar experiments under two-phase flow at 200C are imminent.

W. Cook

Active involvement in the Generation IV Technologies Program for development of the SCWR. The major focus is corrosion-product transport and deposition in the core of a SCWR where both experimental techniques and modeling are employed to elucidate material corrosion and the deposition kinetics of the "fall-out" from solution that occurs upon traversing the critical point.

Electrowinning of metals from solutions is an additional industrial project of note. Initial work (modelling and some experimental) has been undertaken on zinc, indium and manganese production. Optimization of modelling involves use of the PCAS thermodynamic models.

4. Activities at the University of Guelph (Prof. Peter Tremaine)

CURRENT PROJECTS

CANDU Nuclear Reactor Chemistry: D_2O Isotope Effects on Acid-base Ionization and Metal Hydrolysis (UNENE/NSREC CRD Grant)

Metals and Fission Products in Sub-critical and Supercritical Water (NRCan/AECL/ NSERC CRD Grants):

Boric Acid Speciation and Phase Behaviour up to 350 ^{o}C at 25 MPa : (EPRI)

Phase Separating Amines for Carbon Capture (NSERC Iinternational Strategic Grant with University Blaise Pascal, France)

5. Activities at the University of British Columbia (Prof. Rich Pawlowicz)

Activities related to the subcommittee on seawater (SCSW):

Proposal of the Joint Committee on the Properties of Seawater to SCOR and IAPSO, who accepted (so it is now the IAPWS/SCOR/IAPSO Joint Committee on the Properties of Seawater (JCS)

Development of membership of JCS, became chair. As JCS chair, organization of workshops at ICPW16 to explore IAPWS/BIPM collaboration.

With the assistance of Chuning Wang, a new graduate student from China, five Chinese-language scientific articles on "Chinese Standard Seawater" (the oceanographic conductivity reference material used in China about which little is known in the west) were translated. The documents were circulated to JCS members for comments from the membership, especially Industry representatives.

6. Activities Planned to next ICPWS (2017/18)

The CNC discussed potential activities over the next 4 - 5 year period and mostly intend to carry on work that is currently ongoing, as described above. The supercritical water-cooled reactor project is a focus for much of the current research activities of the CNC. This university-government-industry program focused on fundamental research will conclude Phase II in 2016 but it is currently planned to have more focused research beginning in Phase III.

Each of the CNC members and IAPWS-involved researchers in Canada are involved in industry-sponsored research with organizations such as EPRI and the Candu Owners Group pertinent to topics of interest to IAPWS.

The CNC identified that the reformulation of the properties of heavy water is of great interest to Canada and will likely provide contacts with the CANDU community to support the work.

7. Select List of Publications

1. Water Chemistry in a Supercritical-Water-Cooled Pressure-Tube Reactor, D. Guzonas, F. Brosseau, P. Tremaine, J. Meesungnoen, J.-P. Jay-Gerin, Nuclear Technol. 179, 205-219 (2012).

2. Ionization Constants and Thermal Stabilities of Uracil and Adenine under Hydrothermal Conditions as Measured by in situ UV-Visible Spectroscopy, E. Balodis, L.N. Trevani, and P.R. Tremaine, Geochim. Cosmochim. Acta 93, 182-204 (2012).

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35. Cook, W. and Olive, R., *Corrosion Product Transport and Deposition in a Supercritical Water-Cooled Reactor,* Accepted to the ICPSW16, Greenwich, UK, September 2013.

36. Cook, W. and Olive, R., *Predicting Corrosion Product Solubility in Supercritical Water using Revisited HKF-model Parameters and Thermodynamic Modelling,* Accepted to the ICPSW16, Greenwich, UK, September 2013.

REPORT

on IAPWS-related activities: August 2012 – August 2013

submitted by the

Czech National Committee for the Properties of Water and Steam (CZ NC PWS)
to the Executive Committee Meeting of 2013 IAPWS Meeting, London, United Kingdom in September 2013

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Participating institutions

The following Czech Institutions have participated in the research of thermophysical properties and chemical processes between August 2012 and August 2013:

Institute of Thermomechanics AS CR, v. v. i., ("IT ASCR"), Department of Thermodynamics, Dolejškova 1402/5, CZ-182 00 Praha 8

Czech Technical University in Prague ("CTU"), Faculty of Mechanical Engineering, Department of Fluid Mechanics and Thermodynamics, and Department of Power Engineering, Technická 4, CZ-166 07 Praha

Institute of Chemical Technology, Prague ("ICT"), Department of Power Engineering ("ICT-DPE") and Department of Physical Chemistry ("ICT-DPC"), Technická 5, CZ-166 28 Praha 6

University of West Bohemia ("UWB"), Faculty of Mechanical Engineering, Department of Power System Engineering, Univerzitní 8, CZ-306 14 Plzeň

DOOSAN ŠKODA POWER, Plzeň, Inc., Tylova 57, CZ-316 00 Plzeň

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

SIGMA Research and Development Institute Ltd. ("SIGMA"), Jana Sigmunda 79, CZ-783 50 Lutín

Funding

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Board of CZ NC PWS for 2010-2013:

Dr. J. Hrubý
Prof. R. Mareš
Dr. T. Němec
Prof. P. Šafařík
Prof. J. Šedlbauer

List of IAPWS-Related Activities

Information about new documents adopted and authorized by IAPWS have been published on the CZ NC PWS website.

The joint project of IT ASCR and UWB sponsored by the Ministry of Education, Youth and Sports of the Czech Republic provided financial support for international collaboration with IAPWS since 2009. The project support ended on 31/12/2012.

The joint project of IT ASCR and TUL sponsored by the Ministry of Education, Youth and Sports of the Czech Republic provided financial support for international collaboration with IAPWS since 2013. The project support will end on 31/12/2016.

The team around Dr. Hrubý and Dr. Vinš (IT ASCR) focused on the development of thermodynamic models for gas hydrates (in joint cooperation with the team of prof. Roland Span from the Ruhr-University Bochum), experimentally investigated surface tension of supercooled water, developed of an experimental apparatus for the measurement of density of supercooled water and developed thermodynamic formulations suitable for computational fluid dynamics [1-7].

Prof. Mareš (UWB) and Dr. Kalová studied thermophysical properties of supercooled water [8]. Dr. Kalová has a research project entitled Thermodynamic modeling of supercooled water.

Prof. Maršík (IT ASCR) and his research team studied problems of the efficiency of hydrogen fuel cells [9-12] and a new hydraulic turbine [13, 14].

Prof. Šedlbauer (TUL) and his collaborators investigated thermodynamic properties of hydration for selected organic solutes and gases [15, 16].

Assoc. Prof. Kolovratník (CTU) and his collaborators investigated wet steam energy losses in LP steam turbines and determined heterogeneous particles in the superheated steam in turbines [17, 18].

Mr. Nový (DOOSAN ŠKODA POWER) and his collaborators studied parameters of shock waves in saturated steam [19-21].

Dr. Sedlář (SIGMA) and his collaborators studied the problems of modelling cavitation erosion in hydrodynamic cavitation [22], [23], and modelling of cavitation instabilities in hydrodynamic pumps [24]. The team collaborates on the project entitled "Experimental research and mathematical modelling of unsteady phenomena induced by hydrodynamic cavitation" funded by the Czech Science Foundation

In September 2012, the Institute of Chemical Technology in Prague, the Faculty of Environmental Technology and the Department of Power Engineering (ICT-DPE) organized the 10th International Power Cycle Chemistry Conference (CHEO-10) focused on water treatment for power and environment, corrosion in power engineering and renewable energy sources [25-31].

Dr. Hnědkovský (ICT-IPC) and his collaborators studied the properties of organic solutes in water [32-36].

Prof. Šťastný (UWB) and his co-workers tested and applied a numerical model of steam flow with and without chemical impurity in nozzles and turbine blades [37-39].

IAPWS Young Scientist Fellowships

In 2012, **Dr. Holten** completed his IAPWS Young Scientist Fellowship Project (exchange between the Czech Republic and USA) entitled "Towards an IAPWS Guideline for the Thermodynamic Properties of Supercooled Water" jointly supervised by Dr. Hrubý, Prof. Anisimov, and Dr. Sengers. The preliminary results were presented and discussed during the 2012 IAPWS Meeting in Boulder. The final Project Report will be presented during the 2013 IAPWS Meeting in London.

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German National Committee to IAPWS

Research Activities on the Thermodynamic Properties of Water and Steam

Report "Research in Progress 2013"

Baltic Sea Research Institute, Warnemuende

Dr. Rainer Feistel

Book Publication

Feistel, R. Tailleux, R., McDougall, T. (Eds.):
Thermophysical Properties of Seawater. Ocean Science Special Issue.
Copernicus Publications, Göttingen (2013), ISSN 1812-0784

Hellmuth, O., Khvorostyanov, V.I., Curry, J.A., Shchekin, A.K., Schmelzer, J.W.P., Feistel, R., Djikaev, Y.S., Baidakov, V.G.: Selected Aspects of Atmospheric Ice and Salt Crystallisation. Review Series on Selected Topics of Atmospheric Sol Formation, Volume 1. Nucleation Theory and Applications, Joint Institute for Nuclear Research, Dubna, Russia (2013)

Papers

Feistel, R., Lovell-Smith. J. (proposers): Guideline on a Virial Equation for the Fugacity of H2O in Humid Air. The International Association for the Properties of Water and Steam, Greenwich, UK, September 2013, submitted

Kretzschmar, H.-J., Feistel, R., Wagner, W., Miyagawa, K., Harvey, A.H., Cooper, J.R., Hiegemann, M., Herrmann, S. (proposers): Advisory Note No. 5: Industrial Calculation of the Thermodynamic Properties of Seawater. The International Association for the Properties of Water and Steam, Greenwich, UK, September 2013, submitted

Safarov, J., Berndt, S., Millero, F., Feistel, R., Heintz, A.,Hassel, E. (2013): (p,rho,T)Properties of seawater at brackish salinities: Extensions to high temperatures and pressures. Deep-Sea Research I, 78 (2013) 95–101

Leibniz Institute for Tropospheric Research, Leipzig
Dr. Olaf Hellmuth

Book Publication

Hellmuth, O., Khvorostyanov, V.I., Curry, J.A., Shchekin, A.K., Schmelzer, J.W.P., Feistel, R., Djikaev, Y.S., Baidakov, V.G.: Selected Aspects of Atmospheric Ice and Salt Crystallisation. Review Series on Selected Topics of Atmospheric Sol Formation, Volume 1. Nucleation Theory and Applications, Joint Institute for Nuclear Research, Dubna, Russia (2013)

Zittau/Goerlitz University of Applied Sciences
Faculty of Mechanical Engineering, Department of Technical Thermodynamics
Prof. Dr. Hans-Joachim Kretzschmar

Projects

1. Development of Fast Property Algorithms Based on Spline Interpolation
   - The algorithms for fast spline-interpolation methods was developed and applied to the calculation of thermodynamic properties of steam and water in CFD and non-stationary calculations.
   - A Draft "IAPWS Guideline on the Fast Calculation of Steam and Water Properties in Computational Fluid Dynamics Using the Spline-Based Table Look-Up Method (STM)" has been prepared.
2. Industrial Calculation of the Thermodynamic Properties for Seawater
   - The Draft "IAPWS Advisory Note No. 5: Industrial Calculation of the Thermodynamic Properties of Seawater" has been evaluated.

     The belonging paper for the Journal Desalination: "The IAPWS Industrial Formulation for the Thermodynamic Properties of Seawater" has been prepared.
3. Steam Tables for Water and Steam,VDI Wärme Atlas 2012
   - Section D2.1 “Stoffwerte für Wasser und Wasserdampf” (Properties of Water and Steam) of the VDI-Wärme Atlas 2012 (VDI-Heat Atlas), 11th German Edition has been completed. The corresponding steam tables are calculated based on the Industrial Formulation IAPWS-IF97 and the current IAPWS formulations for the transport properties and other properties.
4. Property Libraries for Calculating Heat Cycles
   - The property library LibIF97_META for metastable steam has been prepared.
   - A steam tables App for Android smart phones and tablets has been developed.

Recent Publications

Wagner, W., Kretzschmar, H.-J.:
D2.1 Stoffwerte von Wasser und Wasserdampf, In: VDI-Wärmeatlas, 11. Auflage. Springer-Verlag, Berlin, 2013.

Herrmann, S.; Kretzschmar, H.-J.; Gatley, D.P.:
In: 2013 ASHRAE HANDBOOK FUNDAMENTALS, SI and I-P Editions, Chapter 1

PSYCHROMETRICS,
Table 2 Thermodynamic Properties of Moist Air at Standard Atmospheric Pressure.
Table 3 Thermodynamic Properties of Water at Saturation.
American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., Atlanta GA (2013), ISBN 978-1-936504-46-6, www.ashrae.org

Ruhr University Bochum
Faculty of Mechanical Engineering, Department of Thermodynamics
Prof. Dr. Roland Span

The group chaired by Prof. Span has actively been involved in a number of research projects related to CO_2-rich mixtures as they are typical for power generation with carbon capture and storage (CCS), to hydrate formation and to heavy water. The work of Prof. Span primarily addresses the

- improvement of the experimental data base available for CCS-relevant mixtures. Experimental programs are financed by BIGCCS (Norwegian Science Foundation) and IMPACTS (EU). Measurements include densities, speeds of sound and dew points of CO_2 rich mixtures and other relevant binary systems. An international workshop aiming at improved coordination of measurement programs was organized in January 2013.
- improvement of accurate models available for CCS-relevant mixtures. Main foci of this work have been the development of improved mixing models (1) and a consistent description of complex phase equilibria, including the formation of hydrates and other solid phases (2). This work is linked to close co-operations with the group of Dr. J. Hruby at the Czech Academy of Sciences and with Dr. E. W. Lemmon at NIST in Boulder.
- development of a new reference equation of state for heavy water (3). This work is linked to an IAPWS grant awarded in 2012 and to a close cooperation with Dr. A. Harvey and Dr. E. W. Lemmon at NIST in Boulder.

Many aspects of the work on CCS-relevant mixtures are closely related to work on properties of natural gases, particularly in conjunction with LNG processing. However, this work is not considered within the primary scope of IAPWS.

(1) J. Gernert:
A new Helmholtz energy model for humid gases and CCS mixtures.
Dissertation, Ruhr-Universität Bochum (2013).

(2) A. Jäger, Václav Vinš, J. Gernert, R. Span und J. Hrubý:
Phase equilibria with hydrate formation in H_2O + CO_2 mixtures modeled with reference equations of state.
Fluid Phase Equilibria 338, 100-113 (2013).

(3) S. Herrig:
Development of a new equation of state for heavy water.
Master Thesis, Ruhr-Universität Bochum (2013).

Related Papers

F. Dauber und R. Span:
Modeling liquefied-natural-gas processes using highly accurate property models.
Applied Energy 97, 822-827 (2012).

R. Span, J. Gernert und A. Jäger:
Accurate thermodynamic-property models for CO_2-rich mixtures.
Proceedings 11th Greenhouse Gas Technology Conference, Kyoto (2012). Energy Procedia 37, 2914-2922 (2013).

S. W. Løvseth, G. Skaugen, J. Stang, J. P. Jakobsen, Ø. Wilhelmsen, R. Span und R. Wegge:
CO2Mix Project: Experimental determination of thermophysical properties of CO2-rich mixtures.
Proceedings 11th Greenhouse Gas Technology Conference, Kyoto (2012).

Ruhr University Bochum
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Prof. em. Dr. Wolfgang Wagner

Projects

1. Steam Tables for Water and Steam,VDI Wärme Atlas 2012 Section D2.1 "Stoffwerte für Wasser und Wasserdampf" (Properties of Water and Steam) of the VDI-Wärme Atlas 2012 (VDI-Heat Atlas), 11th German Edition, has been completed. The corresponding steam tables are calculated based on the Industrial Formulation IAPWS-IF97 and the current IAPWS formulations for the transport properties and other properties.
2. The behavior of the IAPWS-95 Formulation in the liquid region of water near the melting line at high pressures was investigated. A corresponding report on this matter will be presented on the IAPWS Meeting in Boulder 2012 in the Session of the IAPWS Working Group „Thermophysical Properties of Water and Steam" (TPWS).

Recent Publications

- Wagner, W., Riethmann, T., Feistel, R., Harvey, A. H.:
  New equations for the melting pressure and sublimation pressure of H_2O ice Ih.
  J. Phys. Chem. Ref. Data 40 (2011), 043103-1 - 043103-11 (online publication 05.12.2011).

1. Project: Investigations of the behavior of the IAPWS-95 formulation at temperatures from 250 K to 300 K and pressures up to 400 MPa

   The background for this work was the article

   Holten V., C. E. Bertrand, M. A. Anisimov, and J. V. Sengers:
   Thermodynamics of supercooled water.
   J. Chem. Phys. 136 (2012), 094507-1 – 094507-18,

   where the behavior of IAPWS-95 at low temperatures and high pressures was criticized.

The results of these investigations are summarized in the report "Behavior of the IAPWS-95 formulation at temperatures of 250 K and to 300 K and pressures up to 400 MPa" by Wolfgang Wagner and Monika Thol, Report prepared for the Task Group "Subcooled Water" and the Working Group "Thermophysical Properties of Water and Steam" of the International Association for the Properties of Water and Steam, May 2013.

A corresponding paper will be given at the 16th International Conference on the Properties of Water and Steam, London, 2013; see the papers for this conference below.

2. Publications in the field „Properties of Water and Steam"

   Wagner, W., Kretzschmar, H.-J.:
   D2.1 Stoffwerte von Wasser, In: VDI-Wärmeatlas, 11. Auflage,
   Springer-Verlag, Berlin, 2013.

   Wagner, W., Dauber, F., Kretzschmar, H.-J., Mareš, R., Miyagawa, K., Span, R. Extended equation for region 5 of the Industrial Formulation IAPWS-IF97. Submitted to Proceedings of the International Conference on the Properties of Water and Steam, London, 2013.

3. Further publication

   Kunz, O., Wagner, W. The GERG-2008 Wide-Range Equation of State for Natural Gases and Other Mixtures: An Expansion of GERG-2004. J. Chem. Eng. Data 57 (2012), 3032-3091 (online publication 31.10.2012).

International Association for the Properties of Water and Steam
Russian National Committee (RNC)

Report Second Half-Year of 2012- First Half-Year of 2013

1. RNC active participation in organization of next seminars for engineers and technology specialist from Russian power engineering companies:
    - Cycle chemistry at power plants;
    - Today technologies for cycle chemistry monitoring systems;
    - Today experience of water treatment systems operation;
    - Water treatment and cycle chemistry for combine cycle power plants.
2. RNC active participation at summer school "Bioenergy and biofuels" for graduate, post-graduate students and specialists at University of Mechanical Engineering (Moscow). RNC providing seminar - "Water and waste water problems in biofuel production systems".
3. Three meetings of RNC have been held. Current problems are investigated.

Publications list

1. O. Egoshina. Cycle chemistry monitoring systems. MPEI Publishing House, 2013 (text book).
2. O. Egoshina. Engineering calculations at cycle chemistry monitoring systems. MPEI Publishing House, 2013 (text book).
3. K.Orlov. Basic principles of optimization of chemical and technological processes of water treatment at thermal power plants. MPEI Publishing House, 2013 (text book).
4. P.Gotovtsev. Waste water treatment and reuse at thermal power plants. MPEI Publishing House, 2013 (text book).
5. A. Alexandrov, E. Djuraeva, V. Utenkov. Heat conductivity of aqueous solution of sodium chloride. Thermal engineering 2013, No. 3. P. 36 -40
6. A. Alexandrov, E. Djuraeva, V. Utenkov Dynamic viscosity of aqueous solution of sodium hydroxide. Vestnik MEI 2013, No. 2. P. 22 -25
7. P.Gotovtsev, V.Voronov. Mathematical Modeling of Flow-Accelerated Corrosion under Single-Phase Flow Conditions. PowerPlant Chemistry 2013, 15(2)p. 105-108
8. P.Gotovtsev, J.Tikhomirova, E.Khizova. Mathematical Modeling of Industrial Water Systems. US-China Education Review A. May 2013, Vol. 3, No. 5, 332-338 p.76 – 82
9. P.Gotovtsev, M.Lomonosova, V.Parabin, V.Butylin. Investigation of the possibility of *Chlorella SP* flocculation by different methods. Ovchinnikov bulletin of biotechnology and physical and chemical biology.2013 V9 №1 p. 37 – 43
10. P.Gotovtsev, M.Lomonosova, V.Butylin, E. Mostova, N. Perkovskaya. Today technologies of biodiesel production. Ovchinnikov bulletin of biotechnology and physical and chemical biology.2013 V9 №3 p. 35 – 42
11. B.Larin, A.Larin, E.Kozulina, A.Kolegov. Calculation of water and steam quality and analysis of current state of drum boilers. Thermal engineering 2012, No 7 p.10 – 14
12. B.Larin, A.Larin, A.Kolegov. Determination of salts in boiler water by conductivity and pH measurements. New in Russian Power Engineering. 2012 No 4

13. V.Ochkov, K.Orlov, A.Ochkov, V.Znamensky, V.Chishmakova, V.Voloshuk. “Cloud” services of properties of working fluids for cooling units. Bulletin of International could academy. №2, 2013. p. 23-28
14. V.Ochkov, K.Orlov, E.Ivanov, A.Makushin. Calculation and visual presentation of water treatment for thermal power plant’s cooling system. Thermal engineering №7, 2013 , p. 10-16.
15. V.Ochkov, Joe K.K., Aung T.P.T. Templates for water treatment processes calculations. Water Purification, Water Treatment, Water Supply, № 6, 2013, p. 50-55.
16. V. Voloshchuk, V. Ochkov. Application of today information technologies for the project development of power units. Open education. № 1, 2013 p. 50-55.
17. V.Ochkov, K.Orlov, Joe K.K., D.Anochin. Mathematical functions for engineering calculations for water supply systems. Water supply and sewer systems. 2012. 9-10. P.68-74.
18. A.Ryzhenkov, N.Danilina. For the question about heat transfer units efficiency. Natural and technical sciences. №4(60).2012. - P.324-333.
19. A.Ryzhenkov, M.Morozov, O.Yurenko. Today operation condition for liquid fluids and carbohydrates transportation. Natural and technical sciences. №4(60).2012. - P.334-338.
20. P.Gotovtsev, J.Tikhomirova, E.Khizova. Mathematical modeling of industrial water systems. Hong Kong International Conference on Engineering and Applied Science. December 2012. Conference Proceedings P 252 – 260
21. P.Gotovtsev, A. Doroshin, A. Doroshina, T. Pantsyrnaya. Thermal power plants as a part of the city water reuse system. IWA Regional Conference on Waste and Wastewater Management, Science and Technology. 26-28 June 2013 Lemesos Cyprus Abstracts
22. O. Egoshina. Today cycle chemistry monitoring systems. Water treatment and cycle chemistry for thermal power plants. 21-23 May 2013, Moscow, OAO VTI p.202-210
23. A. Ryzhenkov. Characterization of fluid dynamics at tube with hydrophobic coating. Water treatment and cycle chemistry for thermal power plants. 21-23 May 2013, Moscow, OAO VTI p.6-14
24. V.Voronov, I.Nikitina, M.Repkin. Today technologies for pre-treatment systems reconstruction. Radioelectronics, electrotechnics and power engineering international conference. Moscow. MPEI. 2013. P.110
25. P.Gotovtsev, I.Nikitina, O.Braginskaya. Enchantment of water chemistry control at thermal power plants. Radioelectronics, electrotechnics and power engineering international conference. Moscow. MPEI. 2013. P.93

The Swiss National Committee

International Association for the Properties of Water and Steam

Report on IAPWS related activities – September 2012 / August 2013

Submitted to the EC Meeting of IAPWS, Greenwich, UK - July 2013.

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Research activities in the reporting period:

No new projects were reported

Contributions to current IAPWS activities:

Vice-chairman of Subcommittee on Sea-Water: M.Hiegeman

Task Force Leader and main editor for new IAPWS Technical Guidance Document: Steam Purity for Turbine Operation (R.Svoboda)

Member of the Committee for the revision of the IAPWS Statutes and By-Laws (R.Svoboda)

Status of Associate Membership to IAPWS:

Industry climate and the ensuing activities at universities do presently not favor engagement in traditional science of water and steam in Switzerland. Up to now, no team of sponsors to commit on mid- or long-term to a regular Swiss membership fee has yet been assembled. Activities were therefore limited to few individuals. - It is requested to extend the Associate Membership for another term.

Recent Publications:

none

Participants

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