IAPWS Minutes

2025

International Association for the Properties of Water and Steam

Record of the:	Annual Meeting in Helsinki, Finland 22 to 27 June 2025
Includes Minutes of:	EC and all WGs
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THE INTERNATIONAL ASSOCIATION FOR THE PROPERTIES OF WATER AND STEAM

MEMBERS
Australia
Britain and Ireland
Canada
Czechia
Germany and Switzerland
Italy
Japan
New Zealand
NORDIC (Denmark, Finland, Norway, Sweden)
United States

ASSOCIATE MEMBERS
Argentina and Brazil
China
Egypt
France
Greece
India
Israel
Netherlands

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Minutes of the Meetings

of the

Executive Committee

of the

International Association for the Properties of

Water and Steam

Helsinki, Finland
23rd and 27th June 2025

Prepared by Daniel Friend

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Minutes of the IAPWS Executive Committee

Monday 23rd June 2025 9:00 AM

At 9:00 AM, the President of IAPWS, Monika Nielsen, welcomed the Executive Committee (EC) and other IAPWS members to the EC Meeting. A moment of silence was held to honor the memory of the late IAPWS member Wolfgang Wagner.

The President then called the roll and confirmed that all ten Members were present and represented by their official delegates. The only Associate Member present was Netherlands, represented by Ludwin Dall. All Working Groups (WGs) were represented by their Chairs, except that the Industrial Requirements and Solutions (IRS) WG was represented by Nobuo Okita, in the absence of the Chair; Okita would serve as Acting Chair of IRS throughout the week. In addition to the EC members and *ex officio* members, about 15 guests attended this opening session of the IAPWS Annual Meeting.

1. Adoption of Agenda

   Provisional agendas had been e-mailed to all IAPWS members by the Executive Secretary in January of 2025 and posted on the IAPWS and Annual Meeting websites. The final Agenda for the Executive Committee, as adopted, is included as Attachment 1 of these minutes.

2. IAPWS Business and Appointment of Committees

   2.1. IAPWS Business since Last EC Meeting in Boulder, CO USA June 2024

   The Executive Secretary reported that the following items were completed in the time period noted. Referenced agenda items are in *italic* when referring to 2024 agenda and in normal typeface when referring to 2025 items.

   All late dues from 2024 were submitted in calendar 2024; see *12.1* and 16.1. The secure website (https://) was implemented for iapws.org; see *2.6*. BIAPWS has agreed to host the Annual Meeting in 2026; see *13.2* and 16.2. WG PCC released the White Paper on *Sampling, Monitoring and Analysis of Corrosion Products in Flexible and Fast Start Plants*, not an IAPWS document, but discussed as item *10.3*. ICRN 31, *New Thermodynamic Data for Ordinary Water (rev)*, was adopted by postal ballot (*7.4*). TGD 2-09 (2024), *Instrumentation for monitoring and control of cycle chemistry for the steam/water circuits of fossil-fired, combined cycle, and industrial power plants,* was adopted by postal ballot (*10.1*). Duncan McAllister was selected by the Australian National Committee to be IAPWS Vice President beginning on 1 January 2025, and Australia has agreed to host the Annual Meeting in 2027; see items *16* and 16.2. A proposal on the upgrade of the IAPWS website was received and passed postal ballot; see *17.3*, 2.5 and 19.3. Postal ballots were held on ICRN 32, *Conductivity of electrolytes in aqueous solutions;* minor technical corrections were made, and adoption can be confirmed at this Annual Meeting; see *10.4* and 12.

   2.2. IAPWS Highlights / Press Release

   The President asked William Cook to chair the development of the Highlights/Press Release for the IAPWS Annual Meeting this week, working with local organizer Arja Lehikoinen. The Clerks of the Minutes of each WG were asked to provide input. The Press Release is discussed in item 19.1 and is included as Attachment 21**.**

   2.3. Evaluation Committee on International Collaboration

   The Executive Secretary indicated that no proposals for International Collaborative Projects (ICPs) had been received, but recommendations from WG Chairs could be forwarded to the Executive Secretary through the end of the day. The President reminded the EC that the Evaluation Committee on ICPs would consist of the WG Chairs (or Acting Chairs), with the President and Executive Secretary as *ex officio* members. The Committee was asked to consider budgets of all active and proposed ICPs, including yearly breakdowns, choose its Chair, and report back Friday under item 17.1.

2.4. IAPWS Awards for 2026 (Honorary Fellow, Helmholtz)

The President asked if Hrubý and Okita would serve on the Honorary Fellow Award Committee and if Okita would act as Chair; the President asked if any other Fellows in attendance would be interested in serving on the Committee, but no volunteers were identified.

The Executive Secretary noted that Germany/Switzerland rotates off the Helmholtz Award Committee for 2026, Japan rotates into the Chair position, and BIAPWS rotates onto the Committee. The President requested that Yasuoka provide the names of the Committee members from Japan, Nordic IAPWS, USA, Australia, and BIAPWS to be reported to the EC on Friday under item 18.1.

The Executive Secretary indicated that nominations for both Honorary Fellow and Helmholtz Awards would be due to the Executive Secretary by 31st January 2026, and that he would be sending out the usual calls for nominations after the conclusion of the Annual Meeting.

2.5. Refreshment of IAPWS Website

Paul McCann, as Chair of the Website Refreshment Committee, provided a report on progress within this project, and provided the link to the web address being used for testing. He asked that all WGs (and everyone in attendance) look through the website, provide high resolution pictures as appropriate, and suggest final edits that could still be considered. Within the discussion of this topic, McCann indicated that the website would work on any device, final payments should be made to the vendor Tribal Systems, and that IAPWS should establish a support contract with Tribal for one year. It was noted that training would be required for the 4-5 people who would have some administrative access to the site for revision of content, with Friend, Addison, McCann, and Harvey being candidates for these roles, perhaps with other WG chairs to be considered. It was noted that a procedure for implementing website changes, especially considering having multiple people with access, would need to be established. It was noted that a document management system (such as a Microsoft 365 product) needs to be considered separately. McCann was recognized for his IT services to IAPWS, Harvey was thanked for his past and continuing services in this role, and further considerations were set for discussion and vote on Friday (under item 19.3).

2.6. Consideration of Hybrid Approach for Future Annual Meetings

The President reported that several people had indicated to her that virtual participation in this IAPWS Annual Meeting would have allowed them to attend, but that the travel time and costs made participation difficult. A virtual presentation was requested, and this was allowed within one WG. The ensuing discussion touched on the possibility of voting by a virtual delegate for official business; the challenge of time scheduling for a global organization; the effect of allowing virtual attendance on in-person registration (and financial viability of meetings); and whether a hybrid meeting would be conducive to effectively conducting IAPWS business. President Nielsen called for the establishment of a Task Group to consider possibilities for hybrid meetings in the future, with a request for this TG to report on Friday under item 14. Representatives of countries hosting the current meeting and the next two meetings were asked to participate: Lehikoinen, Morris, and McAllister were named to the TG; Cook and Werder joined this group, with Tapio Werder serving as Chair.

2.7. Executive Secretary Succession: Deputy Executive Secretary

The President indicated that under the procedures established last year, a new Deputy Executive Secretary was to be chosen at this meeting, with duties to begin in 2026. The Executive Secretary indicated that he did not feel prepared to effectively work with a deputy, in part because he had not yet completed a full year in the Executive Secretary role. He noted that he did feel responsible for completing a document detailing the business, tax, and administrative aspects of the Executive Secretary role to ensure continuity of operations in an emergency situation; he planned to complete this task before the end of 2025, and provide this information to the President. The President suggested that no new Deputy Executive Secretary should be selected this year, and asked Dooley to serve in the role of deputy for another year, through 2026. Dr. Dooley agreed to this additional service, and this revised procedure was adopted without objection.

2.8. Other business requiring special/extensive discussions

No further business was brought forward at this time.

3. EC Mandate to Working Groups and Membership

3.1. Releases, Guidelines, TGDs, and ICRNs

The Executive Secretary noted that one major purpose of the Annual Meeting was to produce outputs such as these documents, and webinars should be considered an output in future agendas. He noted that ICRN 32 could be adopted this week if Members are prepared to vote. He indicated that TPWS should provide closing documents for ICRNs 16, 28, and 30; PCC needs actions on ICRNs 22, 25 (expires this month), 26, and 28.

4. Future of IAPWS

4.1. Strategic Planning

4.2. Improving Outreach

President Nielsen reviewed the series of one-on-one virtual meetings she had held with the heads of each Member committee to initiate a strategic planning process for IAPWS. A meeting with the Japanese National Committee could not be scheduled, but information was later provided by the Japanese delegate and is included in the analysis. The Executive Secretary participated in these meetings as well.

A major purpose of these meetings was to learn the various membership profiles, financial models, and focus areas of each National Committee, as well as to collect input including ideas for strengthening IAPWS itself. The President presented several slides she had prepared as part of the analysis of these meetings; a portion of the slide set is included as Attachment 2 of these minutes.

Within the analysis, President Nielsen had combined specific comments into a set of 8 strategic priorities, although the number is certainly not fixed. Within several of the categories she reviewed a few specific inputs that had been received from the meetings, such as a focus on attracting members; considerations for recruiting younger active participants; concern with costs of the Annual Meeting; the financial model for IAPWS itself; efforts on digital/social media such as YouTube and Linkedin; possibility for hybrid meetings; effectiveness of outputs and development of outputs; … . One issue was setting priorities, and the President called for a meeting with National Delegates and Working Group Chairs to be held on Thursday after the technical visits, and to report back on Friday.

4.3. Future of ICPWS

President Nielsen noted that there had been questions about the effectiveness of the International Conferences on the Properties of Water and Steam, and whether IAPWS should continue or revise this conference series. She asked that Hrubý, Harvey, and Cook form a task group to consider this subject, as these were the delegates most involved in the recent and next scheduled ICPWS. This TG was to report back on Friday under item 14.

5. Preview of Week's WG Activities by WG Chairmen

TPWS Chair Hrubý noted an emphasis on plans for the replacement formulation of IAPWS 95, a review of ICRNs needing action, and outreach as areas of focus for the week.

PCAS Chair Yoshida reported that several scientific presentations, draft ICRNs, cooperative work on a TGD (acid dew points), and international collaborations would provide focus for the week.

IRS Acting Chair Okita indicated that reports from seven task groups and the establishment of a new task group on a replacement/calculational method for the current IAPWS industrial formulation would provide focus for the week.

SCSW Chair Guiliano Albo noted that discussions would focus on continuation and sustainability issues for the Subcommittee as well as joint work with other WGs.

PCC Chair Addison noted that the week would be busy, with efforts on reviewing ICRNs, activities on film forming substances (with PCAS), revisiting the priority list and mission statement, discussions on the webinar series, reviews of technical guidance documents, and work on electric boilers.

To conclude the meeting, the President presented a few logistical details—noting that shuttle buses would be available for attendees who wished to visit the Helsinki city center in the evenings and that a group photo would be taken at the conclusion of the Symposium on Wednesday.

The EC meeting was adjourned at 10:10 AM.

Activities During the Week

The first day activities of the Executive Committee were followed by Working Group meetings, the IAPWS Symposium, the IAPWS Dinner/Banquet, and the IAPWS Technical Visit. The schedule for IAPWS week is shown in Attachment 3.

Friday 27th June 2025 8:30 AM

President Nielsen opened the continuation of the EC meeting at 8:30 AM. All of the IAPWS Members were in attendance as well as Associate Member Netherlands. All WGs were also represented.

6. Acceptance of Minutes of Previous IAPWS EC Meeting

President Nielsen noted an error in the posted minutes for the 2024 IAPWS EC meeting, namely under item *2.1* (2024), the shortened name NIAPWS should refer to the Associate Member Netherlands, and NORDIC IAPWS would refer to the committee representing neighboring countries Denmark, Sweden, Finland and Norway.

The Executive Secretary was directed to issue this correction to be appropriately posted to the IAPWS website.

The President asked if there were any other comments or corrections to the distributed minutes of the EC meeting held in Boulder, CO USA in June of 2024. No additional changes were noted; thus the 2024 Minutes were accepted as corrected.

7. President's Report

The President provided her report, which is included as Attachment 4 to these minutes.

8. Report and Recommendations of Joint TPWS and IRS (including SCSW)

Minutes of the TPWS WG meetings conducted during the week are in Attachment 5. TPWS Chair Hrubý discussed the following items with the EC.

8.1. Replacement of the IAPWS-95 Formulation

Activities are beginning toward a replacement of the IAPWS-95 thermodynamic formulation, which will be an extensive project. The placeholder IAPWS-xx is being used to denote the new thermodynamic surface. Groups at Ruhr University Bochum, NIST Boulder, and the Institute of Thermomechanics in Prague will work on data collection and evaluation. As part of an ongoing International Collaborative Project, A. Blahut from Prague will visit the Bochum campus during this

calendar year. Harvey and Hrubý will work on ideal gas properties. The key work will be done by a PhD student supervised by Prof. Span in Bochum, with an anticipated start date of 2026.

8.2. Actions on ICRNs

Closing statements are now available for ICRN 16 and ICRN 28. A closing statement for ICRN 30 will be prepared by O. Hellmuth by the end of 2025. ICRN 31 has been updated and remains active.

8.3. Other Significant Business of TPWS

A discussion was held regarding a potential IAPWS document on the enhancement factor of water vapor in important gases. Additional discussion was held on a possible IAPWS document describing boundaries between liquid and solid phases of water (phase diagram).

8.4. Membership and Officers

Baptiste Journaux (winner of the 2025 IAPWS Helmholtz Award) was elected to membership. P. Alberto Giuliano Albo was elected as second TPWS Vice Chair to replace Karsten Meier.

The EC approved this new WG member and new officer unanimously.

9. Report and Recommendations of Separate IRS Meetings

Minutes of the IRS WG meetings conducted during the week are in Attachment 6. Acting IRS Chair Okita discussed the following items with the EC.

9.1. Task Group Updates

Okita provided the EC with brief updates on seven IRS Task Groups, one of which is joint with PCAS and PCC, and one of which is joint with PCC. A draft release on calculations using the SBTL method for industrial calculations may be ready for the 2026 IAPWS Annual Meeting.

9.2 Membership

Peter J. Murphy should be removed from the roster of the IRS WG.

10. Report and Recommendations of Separate SCSW Meetings

Minutes of the SCSW were included in the Minutes of TPWS (Attachment 5). Chair Guiliano Albo discussed the following items with the EC.

The need for continued maintenance of the available seawater models was emphasized, and the idea for a workshop on seawater sensors (hopefully in conjunction with the JCS, Joint Committee on Seawater) is under consideration to be held as part of the 2026 IAPWS Annual Meeting. As part of the efforts toward a workshop, a call to better define the scope of the SCSW and the workshop would be made in the fall of 2025. Participation of companies and manufacturers is one goal, and an effort would be made to exploit the new IAPWS website.

There was a robust discussion of the loss of previous leaders of the Subcommittee, and how to maintain sustainable membership and relevance. In particular, joint membership or liaison activities with other groups, including standards groups such as BIPM, were reviewed. Active IAPWS members continue to engage the BIPM temperature and quantity of matter consultative committees (CCT through humidity and CCQM). Harvey and Guiliano Albo, as employees of national metrology institutes, have ongoing ties with BIPM. However, in consideration of membership losses and lack of productivity, it was suggested that at next year's IAPWS Annual Meeting, a decision to sunset the SCSW might be considered.

11. Report and Recommendations of PCAS

Minutes of the PCAS WG meetings conducted during the week are in Attachment 7. PCAS Chair Yoshida discussed the following items with the EC.

11.1. Task Group Membership

Yoshida indicated that Lucy Platts and Ivo Jiříček should be deleted from the WG roster. Derek M. Hall was proposed as a new member.

The EC approved the new WG member unanimously.

11.2. International Collaborative Projects

Yoshida reviewed the plans for the Joint PCAS/PCC ICP, *Analysis of Film Forming Amine Coatings in High Temperature Water Loops*, detailing budget and spending plan, which had been approved to proceed after the 2024 Annual Meeting. The total cost will be £16,400, of which £1,200 will accrue in 2026. No bills have been sent to IAPWS to date.

Yoshida then reviewed a second PCC/PCAS ICP, *Radiation Chemistry of Iodine Under Low Dose Rate Conditions Relevant to Design Basis Accidents in PWRs*, which had been approved but not funded at the 2024 Annual Meeting. A decreased budget of £12,300 was presented, with £4,800 to be spent in 2025.

11.3. PCAS Officers

It was proposed that the terms of Ken Yoshida as WG Chair and Hugues Arcis as WG Vice Chair be extended until 2028.

The EC approved the extended term for WG Chair and Vice Chair unanimously.

11.4. Additional Discussion of PCAS Business

Dooley commented on the sustainability and productivity of PCAS as a working group, and noted the low attendance at PCAS WG meetings over the last few years. He urged PCAS to continue recruiting potentially active members, and noted the presence of potential PCAS members in the United Kingdom, where the 2026 Annual Meeting would take place.

Dooley noted that a previous International Collaborative Project approved in 2022, *Impact of Metal Ion Complexation on the Radiation Chemistry of Acetohydroxamic Acid in Aqueous Solutions* had received final payment from IAPWS in 2024, but that all project goals had not been completed because of unexpected and unfortunate circumstances. Friend noted that a completion document had been received and forwarded to the PCAS Chair; it is included as Attachment 8 of these minutes.

11. Report and Recommendations of PCC

Minutes of the PCC WG meetings conducted during the week are in Attachment 9. PCC Chair Addison discussed the following items with the EC.

12.1. PCC Highlights

Among the highlights, Addison noted the success of the new PCC Linkedin Page, the release of the first PCC White Paper (on corrosion products), and the update to the Instrumentation TGD in 2024. He pointed to the first IAPWS Webinar, presented by Dooley, supported by the Combined Cycle Journal, attendance by 426 people, and its availability on YouTube (184 views). Addison noted that the new IAPWS website and PCC webpages are ready to go. He was also pleased with the increased attendance at WG meetings and discussed ongoing progress toward new TGD and ICRN approvals.

12.2. PCC Progress 2024-2025

In terms of PCC Progress, Chair Addison pointed to work on the PCC priority list and an update to the mission statement. He reported that support and resources were available for TGDs and WPs, and noted the growth and diversity of active PCC membership. He highlighted an improvement in work flows for the WG and progress on an ICRN concerning film forming substances.

12.3. Technical Guidance Documents

Addison reported that Barry Dooley led a review of activities on technical guidance documents, with seven documents under consideration. Documents with a projected 2026 completion date are a White Paper on Flue Gas Condensation and TGDs on Geothermal Steam Chemistry and on Electrode Boiler Chemistry.

12.4. PCC International Collaborative Projects

Addison noted that a close-out presentation was made for the ICP on Boiler Corrosion at this year's meeting and that the ICP on Corrosion Products was completed in 2024. No new ICPs were under consideration within PCC.

A discussion on the procedure and expectations to close out an IAPWS International Collaborative Project was held. The following policy was proposed:

Each approved International Collaborative Project must have a concise summary to be posted on the website, a presentation at an IAPWS Annual Meeting, and a closing statement upon completion to be posted on the IAPWS website.

The EC approved this policy unanimously.

12.5. PCC ICRNs

Addison requested that ICRN 32 (*Conductivity of electrolytes in aqueous solutions*) be approved. Friend noted that copies of this ICRN, as revised, had been distributed to all National Committees well in advance of this EC meeting. There is an ongoing postal ballot concerning its acceptance, but that the postal ballot would be moot if all IAPWS Members voted at this in-person meeting.

The EC approved ICRN 32 and cancelled the ongoing postal ballot on ICRN 32 unanimously.

PCC requested that ICRN 25 be extended to a 2027 expiration date.

The EC approved this extension unanimously.

Addison stated that a closing statement for ICRN 22 had been sent to the Executive Secretary for posting and that a closing statement for ICRN 26 would be forthcoming.

12.6. PCC Membership and Officers

The PCC proposed that the following individuals be added for membership in the WG: Levie Lensun (Switzerland); Paul Honcoop (Netherlands); Andre de Bache (Germany); Heine Baum Rosendal (Denmark); Lionel Barre (France); David Little (USA); Jørgen Peter Jensen (Denmark); Sarita Weerakul (Canada); Thomas Blank (Switzerland); and André Frank (Sweden). It was noted that Jensen was already a member of the WG.

The EC approved these nine new WG members unanimously.

The PCC requested that Dr. Willy Cook (Canada) be approved as a new Vice Chair of the WG.

The EC approved the new Vice Chair unanimously.

Some agenda items were considered out of the scheduled order for the convenience of individuals who needed to depart the venue; in these minutes, the items are presented in their original order.

13. Editorial Committee Report

Committee Chair Harvey reported that no new IAPWS documents were officially reviewed during the year, but that he had informally commented on a few documents. The Committee comprises Harvey, Cook, and Cooper.

14. Reports and Recommendations of other EC Committees

The President called on the chairs of the several committees in turn.

14.1. Report of the Website Refreshment Committee

McCann reported that the website was ready to go live, as no significant problems had been identified in the test version; he noted that training for website administrators (as discussed in 2.5) would be scheduled; a workflow procedure for any revisions to the website still needs to be established; an expenditure of for annual support and for added technical assistance during the first year (£440 and £850) needed to be approved.

The EC authorized the Executive Secretary to transfer the IAPWS website to the new host service (Tribal) and pay necessary expenses for hosting and support.

14.2. Report of the Committee on Hybrid Annual Meetings

Chair Werder reported that the Committee felt strongly that hybrid meetings were not feasible, as they would be too complicated especially considering the global nature of IAPWS; concerns were raised that a hybrid concept would decrease in-person attendance and reduce effectiveness of the organization. There was further discussion within the EC about the costs of the IAPWS Annual Meeting (travel costs, registration costs, costs of accommodation) and the suitability of one-off virtual presentations. There seemed to be some consensus that costs were too high and that a few important presentations might be made virtually with the approval of a WG chair and agreement with the host National Committee.

14.3. Report of the Committee on Strategic Planning

President Nielsen reported on the meeting of the Committee (comprising delegates from all Members, with President and Executive Secretary *ex officio*). The Committee reviewed the presentation from Monday, with an emphasis on some input that had been received regarding the strategic priorities. The President informed the EC that the strategic planning process would continue with a virtual meeting of the Committee on a date to be determined.

14.4. Report of the Committee on the Future of the ICPWS

Chairmen Cook provided a written summary of the conclusions of the Committee, which is included as Attachment 10. Major discussion points suggest that the ICPWS remains as an effective tool for marketing and promotion with a larger audience; the five-year cycle seems appropriate; and early planning is a necessity. The next planned ICPWS in Canada in 2029 is an appropriate time and venue if we proceed. Further discussion centered around the absence of proceedings or even a CD to archive presentations, with a comment that publications in academic journals are a necessity for some. The possibility of special issues of journals was mentioned as a way forward.

15. Membership and Associates

15.1. Report on Membership and Members Defaulting on Dues

The Executive Secretary reported that 2025 dues from Italy, Germany & Switzerland, and the United States had not been received by 31 May 2025. During the preparation of the Minutes, the dues payment from Italy was received. The German-Swiss National Committee explained that a technical banking issue had delayed payment, but that dues would be submitted by the Fall of 2025.

Harvey, representing the U.S. National Committee, gave a presentation about the status of the Committee and the possibility of dues payment. In particular, he noted that a new Committee structure was formed to represent the U.S. within IAPWS, as the involvement with ASME had been terminated; the Committee is designated USAPWS. Individuals mostly involved in industrial boiler chemistry joined USAPWS in early 2025, providing potential additional U.S. involvement with PCC. Financial assets within the USAPWS comprise "profit" from the last ICPWS, personal donations, and the start of an endowment; fundraising, especially solicitation of sponsorships, has not yet begun. Cash on hand amounts to only about 60 % of the U.S. dues invoice, so there is still much uncertainty about future U.S. financial contributions to IAPWS.

Written reports on progress in member countries provided in conjunction with the Annual Meeting are attached to these minutes as follows:

- Czech Republic — Attachment 11
- Japan — Attachment 12
- Germany & Switzerland — Attachment 13
- New Zealand — Attachment 14
- United States — Attachment 15

15.2. Reports of Associate Members

The Executive Secretary reported that a representative of Associate Member Netherlands, Ludwin Daal, was present and would be giving a report; he reported that the delegate from Associate Member Israel, Yitzhak Nussbaum, had intended to be present but travel had been prevented by the situation at home; a report from Israel is attached. All Associate Members were contacted, and reports that had been received are attached to these minutes as indicated.

- Netherlands: Daal reported on the growth of membership within DIAPW, meetings held in the last year, top technical concerns of the Committee membership, and an upcoming conference to be held 3 March 2026. Attachment 16
- Israel: Nussbaum sent his regrets, the agenda for a conference held by the Israeli National Committee, and a report to the EC. Attachment 17
- Argentina and Brazil: Chair Corti noted that he had lost contact with Brazilian colleagues and sent a report to the EC. Attachment 18
- China — Attachment 19
- Greece: — Attachment 20

16. Executive Secretary's Report

Executive Secretary Friend reported that the transition to the new ES took place during 2024 and was completed in 2025. He acknowledged the ongoing support of the previous ES, Barry Dooley. As part of the transition, IAPWS was incorporated as a non-profit in the U.S. and was granted tax exempt status (501(c)(3)) by the U.S. tax authority (IRS) in late 2024. Required U.S. government tax filings and financial paperwork was submitted by the new ES. Business filings to continue the corporate status will cost about $20 per year, and there is no additional cost for tax filings.

There was some discussion and questions about the new legal status, and for these minutes we note that a small non-profit in the U.S. is generally limited to $50k in "normal" gross receipts, but this just governs the type of paperwork needed. Other restrictions of non-profit organizations are easily met by IAPWS.

16.1. IAPWS Bank Accounts, Financials, Auditors and Dues

The IAPWS banks were transitioned from the UK (HSBC) and US (Wells Fargo) institutions convenient to the former ES to Elevations Credit Union in the U.S. convenient to the new ES. All funds were transferred to the new accounts before 18 March 2025. Dooley closed the books for 2024 and sent the yearend report to the single IAPWS auditor (Pavel Safatik, Czech Republic). Friend forwarded the financial report through 31 May 2025 to all Member Committees on 2 June 2025; there was a problem with this email, and the financial report was re-sent on 27 June 2025. Friend noted that the balance on hand on 31 May was about $100,000 (about 83,000 CHF). (This is slightly less than the balance reported at the 2024 Annual Meeting (about $106,000)).

Friend reported that a second auditor was needed for the 2024 books according to statute, and suggested some alternatives.

The EC voted to waive the requirement for a second auditor for 2024 only.

Friend noted that two auditors were needed for 2025 and suggested that Prof. Safatik continue in that capacity if he was willing. Tapio Werder volunteered to serve as the second auditor.

The EC approved the recommendation of Safatik and Werder as auditors without objection.

Friend suggested to the EC that the dues structure for IAPWS Members remain unchanged for 2026.

The EC approved this proposal without objection.

16.2. Time and Place of 2026 (UK) and 2027 (Australia) Meetings

2026 IAPWS Meetings The BIAPWS delegate, Morris, gave a short presentation on plans for the meeting: the provisional date has IAPWS week beginning on Sunday, 5 July 2026, with meetings taking place in Bristol, UK on the University of Bristol campus; plans for a technical visit to Hinkley Point C in process. Final dates and logistical plans will be confirmed shortly.

The Executive Secretary will notify the EC of details when plans are confirmed.

2027 IAPWS Meetings The Australian delegate, McAllister, indicated that the meeting would be held in early to mid July, 2027 with a location in Brisbane, Queensland.

The Executive Secretary indicated that Germany-Switzerland would be the next host in the regular rotation, but that Associate Members could offer to host an Annual Meeting to help build their National Committees.

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

17.1. International Collaborations (if any)

The Executive Secretary indicated that no new proposals for International Collaborative Projects had been received, but that approval for a spending plan for the proposal *Radiation Chemistry of Iodine Under Low Dose Rate Conditions Relevant to Design Basis Accidents in PWRs*, must be considered. (See 11.2).

The EC approved funding for the iodine ICP without objection.

There was further discussion of the ICP on Metal Ion Complexation (See 11.4), and it was noted that although the project was not executed to a satisfactory completion, a closing document was produced (See Attachment 8).

18. IAPWS Awards

18.1. Helmholtz Award Committee

The President reported that the 2025 Helmholtz Award winner, Babtiste Journaux, gave the opening talk at the Symposium and was elected as a new member of TPWS.

The membership of the 2026 Award Committee was discussed in 2.4, and the members were announced as follows: Kayukawa (Japan, Chair), Jensen (Nordic), Anderko (U.S.), McAllister (Australia), Morris (BIAPWS).

18.2. Honorary Fellowship

The President reported that Andrei Anderko had been awarded an Honorary Fellow Award for 2025, and because of his absence at the Meeting, congratulations and his award would be sent by the Executive Secretary.

The Honorary Fellow Award Committee for 2025 will be Okita (Chair) and Hrubý.

The Executive Secretary confirmed that he would be sending out instructions for nominations for both the Helmholtz Award and Fellow Award in the near future.

19. New Business

19.1. Press Release

Cook reported that the Press Release had been completed; it is included as Attachment 21 to these minutes. The President indicated that this release would be sent to all EC members and that it should be distributed as widely as possible, sent to any journals and publications, and that it would be posted on the new IAPWS website.

19.2. NORDIC IAPWS Committee feedback on 2025 Annual Meeting

The NORDIC Committee delegate, Arja Lehikoinen, gave a short presentation and indicated that attendance at the meetings was 69 for the full week and 98 for the day of the Symposium. Attendees came from 20 countries, with roughly 25 % from Finland. Nine spouses joined the IAPWS week program. With ten sponsors, financial break-even is projected for the event.

A list of attendees is provided in Attachment 22.

19.3. IAPWS Website

This item was covered in Item 14.1

19.4. Other items raised during the IAPWS week

No additional items were raised.

19.5. Membership List

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

20. Adjournment

There being no further business, the President adjourned the meeting at 12:25 pm.

Attachment 1: AGENDA for the IAPWS EC

Helsinki, Finland 22nd – 27th June 2025

Monday, 23rd June 2025. Opening Plenary Session (9:00 – 10:15 am)

Opening Remarks, Welcome and Introductions by IAPWS President Ms. M. Nielsen

1. Adoption of Agenda
2. IAPWS Business and Appointment of Committees
   - 2.1 IAPWS Business since Last EC Meeting June 2024
   - 2.2 IAPWS Highlights / Press Release
   - 2.3 Evaluation Committee on International Collaboration
   - 2.4 IAPWS Awards for 2026 (Honorary Fellow, Helmholtz)
   - 2.5 Refreshment of IAPWS Website
   - 2.6 Consideration of Hybrid Approach for Future Annual Meetings
   - 2.7 Executive Secretary Succession: Deputy Executive Secretary
   - 2.8 Other business requiring special/extensive discussions.
3. EC Mandate to Working Groups and Membership
   - 3.1 Releases, Guidelines, TGDs, and ICRNs
4. Future of IAPWS
   - 4.1 Strategic Planning
   - 4.2 Improving Outreach
   - 4.3 Future of ICPWS
5. Preview of Week's WG Activities by WG Chairmen

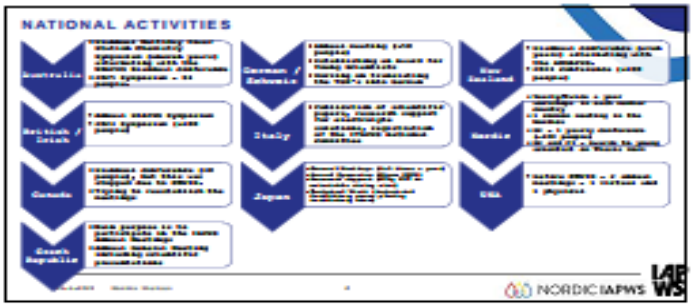
Friday, 27th June 2025. Executive Committee Meeting. (8:30am – 12:30 pm)

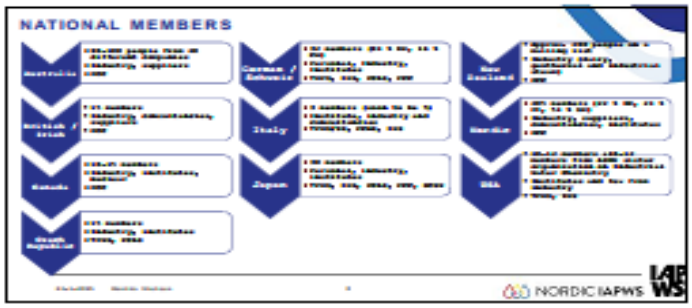
6. Acceptance of Minutes of Previous IAPWS EC Meeting
7. President's Report
8. Report and Recommendations of Joint TPWS and IRS (including SCSW)
9. Report and Recommendations of Separate IRS Meetings
10. Report and Recommendations of Separate SCSW Meetings (if any)
11. Report and Recommendations of PCAS
12. Report and Recommendations of PCC
13. Editorial Committee Report
14. Reports and Recommendations of other EC Committees
15. Membership and Associates
    - 15.1 Report on Membership and Members Defaulting on Dues
    - 15.2 Reports of Associate Members
16. Executive Secretary's Report
    - 16.1 IAPWS Bank Accounts, Financials, Auditors and Dues
    - 16.2 Time and Place of 2026 (UK) and 2027 (Australia) Meetings
17. Guidelines, Releases, Certified Research Needs, and International Collaborations
    - 17.1 International Collaborations (if any)
18. IAPWS Awards
    - 18.1 Helmholtz Award Committee
    - 18.2 Honorary Fellowship
19. New Business
    - 19.1 Press Release
    - 19.2 NORDIC IAPWS Committee feedback on 2025 Annual Meeting
    - 19.3 IAPWS Website
    - 19.4 Other items raised during the IAPWS week
20. Adjournment

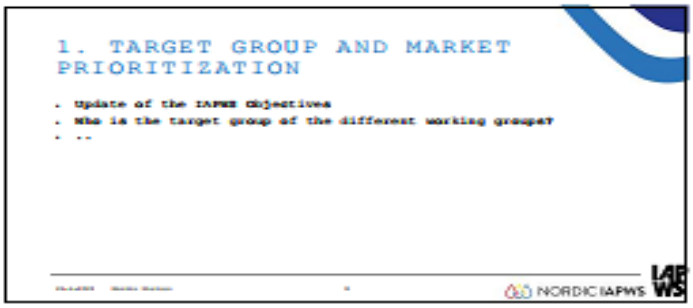
D.G. Friend 22 June 2025

Attachment 2: Slides from One-on-one Meetings

6/28/2025







Attachment 3 Schedule for Week

Schedule of IAPWS Meetings Helsinki, Finland

22nd – 27th June 2025

(All technical meetings will be at Hotel Hanaholmen (Hanasaari)

Sunday 22 June	6:00 – 8:00 pm	Welcome Reception and Registration (Hanaholmen Hotel)	
Monday 23 June	9:00 am	Executive Committee - Opening Plenary Session	Auditorium
	10:15 am	Coffee / Tea Break	
	10:30 am	TPWS/SCSW/IRS Joint Meeting *(To set agendas for the week and to conduct IAPWS Business, thus allowing remainder of week for technical matters)*	Kullager
	10:30 am	PCAS *(To conduct IAPWS Business, thus allowing remainder of week for technical matters)*	Skiftnyckel
	10:30 am	PCC *(To conduct IAPWS Business, thus allowing remainder of week for technical matters)*	Auditorium
	12:00 pm	Lunch	
	1:30 pm	TPWS/SCSW/IRS Joint Meeting	Kullager
	1:30 pm	PCC and PCAS Joint Meeting	Auditorium
	3:00 pm	Coffee / Tea Break	
	3:30 pm	TPWS/SCSW/IRS Joint Meeting	Kullager
	3:30 pm	PCC and PCAS Joint Meeting – until 4.30pm	Auditorium
	3:30 pm	PCAS – continue meeting until 5.00pm	Auditorium
	5:00 pm	Close	
Tuesday 24 June	9:00 am	PCAS and TPWS Joint Meeting	Kullager
	9:00 am	PCC WG Meeting	Auditorium
	9:00 am	SCSW/IRS Joint Meeting	Skiftnyckel
	10:15 am	Coffee / Tea Break	
	10:30 am	PCC	Auditorium
	10:30 am	PCAS and TPWS Joint Meeting	Kullager
	12:00 pm	Lunch – *Sponsored by Waltron Bull and Roberts LLC*	
	1:30 pm	PCAS/PCC Joint Meeting	Auditorium
	1:30 pm	TPWS/SCSW/IRS Joint Meeting	Kullager
	3:00 pm	Coffee / Tea Break	
	3:30 pm	PCC	Auditorium
	3:30 pm	IRS	Kullager
	3:30 pm	PCAS	Skiftnyckel
	5:00 pm	Close	
Wednesday 25 June	8:30 – 4:00 pm	IAPWS Symposium "Industrial Boilers, Flue Gas Condensation and Future Technologies"	Auditorium
	10:10 am	Coffee / Tea break / Exhibition – *Sponsored by Norsk Analyse*	Upper Foyer
	12:10 pm	Lunch – *Sponsored by REICON Wärmetechnik und Wasserchemie Leipzig GmbH*	Upper Foyer
	2:20 pm	Coffee / Tea break – *Sponsored by Norsk Analyse*	Upper Foyer
	5:00 pm	IAPWS Dinner/Banquet (Transport provided to Suomenlinna Sea Fortress)	
Thursday 26 June	9:00 am	TPWS WG Meeting	Skiftnyckel
	9:00 am	SCSW WG Meeting	Blixtlas
	9:00 am	IRS WG Meeting	Propeller
	9:00 am	PCC WG Meeting	Kullager
	9:00 am	PCAS WG Meeting	Tandsticka

	10:15 am	Coffee / Tea Break	
	10:30 am	**TPWS WG Meeting**	Skiftnyckel
	10:30 am	**SCSW WG Meeting**	Blixtlas
	10:30 am	**IRS WG Meeting**	Propeller
	10:30 am	**PCC WG Meeting**	Kullager
	10:30 am	**PCAS WG Meeting**	Tandsticka
	1:00 pm	Lunch	
	2:30 - 4 pm	**IAPWS Technical Visit** (VTT Technical Research Center of Finland)	
Friday 27 June	8:30 am	**Executive Meeting (8:30am - 12:30pm)** (Will include at least one member from each National Member Delegation)	Kullager

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

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Attachment 4 President's Report

Report of IAPWS President Monika Nielsen to IAPWS Executive Committee

27 June 2025

Good morning, everyone.

It's been a real pleasure to have you all here in Finland. I want to begin by expressing my sincere thanks to my colleagues in the Nordic IAPWS Executive Committee and especially to MECCA Concepts for their outstanding work in organizing this event.

We are gathered here at Hanaholmen—an inspiring and unique venue that brings together Nordic culture, art, and thoughtful discussion. This week, Hanaholmen has been more than just a meeting place for the Nordic countries—it has become the global hub of IAPWS, with representatives from 20 countries joining us. I hope you've enjoyed the facilities, explored the art throughout the hotel, and perhaps even taken the opportunity to relax with a sauna and a swim.

It's been a busy and productive week, and I look forward to hearing the reports from our Working Groups. There has been a lot of activity, but more importantly, there has been a great deal of networking and relationship building. I firmly believe that these personal connections are vital to the effectiveness of our organization and essential to the collaboration that hopefully continues throughout the year between our Annual Meetings.

This year, a lot of effort went into making the meeting a success. The Symposium Program was finalized by the New Year—with only minor updates in the final weeks—and the Working Groups began preparing their agendas earlier than usual, which greatly helped our planning. And I think the results speak for themselves: we've had nearly 70 participants attend the full week, and another 30 joined us for the Symposium. Even more encouraging is that many of the attendees are new faces. I also believe that the PCC webinar in May played an important role in raising awareness about IAPWS and PCC, and I encourage us to consider more of these types of activities to attract and retain interest in the future.

Over the past few months, I've invited many of you to have short meetings with me and the Executive Secretary to discuss your National Organization and your perspectives on IAPWS. I want to thank you for indulging what may have seemed like a crazy idea at first. But I truly believe those meetings were both fruitful and inspiring. They provided valuable insight into how our national groups operate and what priorities they hold—and, just as importantly, gave you the opportunity to help shape the future direction of IAPWS. The feedback we received will serve as a valuable foundation for our future strategic planning.

As we look to the future, it's clear that IAPWS is undergoing a generational shift. Many of our longtime members are approaching retirement, and we're seeing new, younger professionals begin to step in. But this transition is not without its challenges. We must not only attract young talent—we must also retain them. Generation Z, in particular, brings a different set of expectations to the workplace. If they don't feel valued or engaged, they will move on—and the same applies to their participation in organizations

like ours. If we fail to retain young professionals, we risk losing valuable knowledge and continuity.

To meet this challenge, we need to adapt. Generation Z is digitally native—they've grown up with the internet and expect communication and collaboration to reflect that. IAPWS must continue evolving in both our use of technology and our internal processes. PCC has already taken meaningful steps in this direction by organizing webinars and increasing our visibility through LinkedIn and other channels. Expanding these efforts, including launching a YouTube channel or other digital platforms, could help us stay relevant and attract new talent to our community.

As we wrap up this week and look ahead to the coming year, I want to thank each of you for your contributions—not just during these meetings, but throughout the year. Your dedication, expertise, and spirit of collaboration are what make IAPWS such a unique and impactful organization.

I also want to acknowledge something important: I know that everyone here has a demanding job outside of IAPWS, and that the priority must always be your everyday responsibilities and families. That's why we must be careful not to take on more than we can realistically manage. It's essential that our involvement in IAPWS remains inspiring and sustainable—not something that adds unnecessary stress. We should focus on what we can do well, rather than trying to do everything.

Let's carry the momentum from this week forward. Let's continue the conversations, strengthen our networks, and build on what we've started here. Together, we can ensure that IAPWS not only remains relevant but continues to lead—both scientifically and strategically—into the future.

Thank you, Dan, for your collaboration over the past six months, it's been a pleasure. Thank you to all the delegates, to everyone who helped make this week a success, and to each of you for being part of IAPWS.

Thank you.

Attachment 5 TPWS Minutes

TPWS Working Group Meeting Minutes
Helsinki, Finland, June 22-27, 2025

1. Opening Remarks; Adoption of Agenda [Monday morning]

The meeting was opened on Monday, June 23, 2025 at 10:30 by the TPWS Chair, Jan Hrubý. The Agenda was adopted (Attachment A). The 2024 Minutes had been circulated and approved by email shortly after the 2024 meeting.

2. Appointment of Clerk of Minutes

K. Meier was appointed Clerk of Minutes for TPWS.

3. Minute's silence for deceased members and colleagues (H.-J. Kretzschmar)

H.-J. Kretzschmar presented a brief tribute to Wolfgang Wagner (1940-2024). Prof. Wagner joined IAWPS in 1975. Under his guidance, the IAPWS-95 Scientific Formulation for the Thermodynamic Properties of Ordinary Water covering the gas, liquid, supercritical and two-phase regions and the IAPWS 97 Industrial Formulation for the Thermodynamic Properties of Water and Steam were developed. He received the IAPWS Honorary Fellow Award in 1998 and the IAPWS Gibbs Award in 2008. Prof. Wagner was also actively involved in the foundation of GSAPWS. H.-J. Kretzschmar led the Working Groups in a moment of silence.

4. Potential International Collaborative Projects

No international project was proposed.

5. State of Development of a New Formulation for the Thermodynamic Properties of Ordinary Water (Replacement of IAPWS-95)

5.1 Report of Task Group (A. Harvey, S. Lago, A. Giuliano Albo, F. Caupin, D. Friend, J. Hrubý, Y. Kayukawa, N. Okita, R. Span)

Deficiencies of the IAPWS-95 were reported by A. Harvey at previous meetings. Within an international project collaborative project, the groups at Ruhr University Bochum, NIST Boulder and Institute of Thermomechanics in Prague will collect, evaluate, and organize the available data for the development of the new formulation IAPWS-XX. The group led by R. Span at RUB plans to re-analyze the data by Osborne et al. (1937) (373 K-647 K), Osborne et al. (1939) (273 K-373 K) for thermodynamic properties at vapor-liquid coexistence (saturation) and review W. Wagner's paper folders at RUB. A Blahut (Institute of Thermomechanics in Prague) will visit RUB for two weeks in autumn 2025. Since E. Lemmon will retire soon, there is no staff available for fitting the new equation of state at NIST Boulder. R. Span plans to start work on a new equation of state with a new Ph.D. student in 2026. Likely, it will not be able to improve IAPWS-95 in all critical aspects. Desirable single van der Waals loops were not yet achieved at low temperatures in the development of equations of state for other fluids. Equations for ideal gas properties could be developed separately by A. Harvey and A. Hrubý.

6. IAPWS Certified Research Needs (ICRNs)
6.1 ICRN 16: Thermophysical Properties of Seawater (R. Pawlowicz), expired 2019, concluding statement.

R. Pawlowicz drafted a closing statement. The statement was generally accepted by the WG. Two publications with recent data by J. Safarov (Universität Rostock) and speed of sound measurements by F. Fehres (PTB Berlin) will be added. J. Hruby will add these references to the closing statement and send it to the president.

6.2 ICRN 28: Thermophysical Properties of Metastable Steam and Homogeneous Nucleation
(J. Hrubý), expired 2019, concluding statement.

A closing statement was drafted by J. Hrubý. The statement was accepted by the WG.

6.3 ICRN 30: Thermophysical Properties of Supercooled Water (O. Hellmuth), concluding statement.

No closing statement was available at the time of the meeting. The Chair will ask O. Hellmuth to write a closing statement by the end of 2025.

6.4 ICRN 31: New Thermodynamic Data for Ordinary Water (A. Harvey and J. Hrubý)
ICRN 31 was updated in 2024. It expires in 2029.

7. Industrial Requirements and Solutions for Property Calculations (joint with WG IRS) [Tuesday afternoon]
The minutes for items 7.1 to 7.7 are reported under items 6.1 to 6.7 in the IRS minutes.

7.1 Report on a white paper for acid gas dew points (N. Okita)

7.2 Report of the Task Group “Categories of industrial requirements” (N. Okita, chairs or representatives of other WG)

7.3 Report of the Task Group “Wet steam properties calculation” (A. Nový, J. Hrubý, R. Span, K. Meier, F. di Mare, S. Senoo, M. Kunick)

7.4 Translation of IF-97 Fortran routines into other programming languages (A. Nový)

7.5 Proposal for a new Industrial Formulation for the properties of water and steam using the SBTL method, as shown in the IAPWS 2015 Guideline (M. Kunick, F. di Mare, B. Lea, A. R. Sachssendahl, A. Novy, H.-J. Kretzschmar, R. Pawellek, T. Löw, R. Harwood, N. Okita, S. Senoo)

7.6 Report on the Evaluation of STBL-Property Functions based on IAPWS-IF97 and IAPWS-95 (M. Kunick, B. Lea, R. Pawellek, T. Löw, A. Sachssendahl)

7.7 Discussion of a way towards a new Industrial Formulation: Discussion on whether IAPWS-95 or IAPWS-IF97 should serve as a basis for the new Industrial Formulation. Proposal to develop and evaluate the new Industrial Formulation. Proposal to establish an evaluation task group aiming for the presentation of evaluation results and a Draft-Release at the IAPWS-meeting in 2026.

8. Heavy Water Properties (joint with WG IRS)

8.1 Progress on a Formulation for the Static Dielectric Constant of Heavy Water (J. Cox, J. Young, A. Harvey, and P. Tremaine) [Monday morning]

A. Harvey presented on the progress of a formulation for the static dielectric constant of heavy water. The detailed description of the first dielectric virial coefficient by Garberoglio et al. (2024) will be used as low-density boundary condition for the new formulation. He proposed to develop two formulations: first a simple formulation based on the H_2O formulation with changed coefficients for liquid heavy water and later a comprehensive correlation for the whole fluid region with the correct D_2O polarizability and dipole terms. It is planned to resume the work in August 2025.

8.2 Thermodynamic property measurements for heavy water in the metastable region. (T. Kutsumi, H. Miyamoto, Y. Kayukawa, R. Akasaka) [Monday afternoon]

T. Kutsumi presented on new density measurements of heavy water in the liquid-gas metastable region with the metal bellows variable volume method. The new measurements cover the temperature range between 310 K to 440 K up to 30 MPa in the stable and metastable liquid regions. The new data agree with the Herrig et al. equation of state within 0.1%. The saturation points were detected from measurements in the two-phase region. It is planned to measure further isotherms of heavy water and to measure ordinary water. New measurements of ordinary water would be interesting for the development of the new scientific formulation because there are not many data available in this state region.

9. Report of Task Group on Surface Tension of Ordinary Water (joint with WG IRS and SC SW) (V. Vinš, A. Harvey, O. Hellmuth, V. Holten, J. Hrubý, R. Mareš, F. Caupin) [Monday morning]

At the 2024 meeting in Boulder, it was decided to retain the current standard for the surface tension of ordinary water. At high temperatures, there are only two data dets from one group, which have a high uncertainty. J. Hrubý proposed to reduce the uncertainty of the current standard in the range of normal temperatures. He will discuss an update of IAPWS Release with V. Vinš.

10. Joint session with WG PCAS [Tuesday morning]

10.1 Surface tension of aqueous mixtures at low temperatures (A. Blahut, M. Čenský, J. Hrubý, O. Prokopová, M. Součková, V. Vinš).

J. Hrubý presented on measurements of the surface tension of binary liquid systems of water + ethylene glycol, water + methanol, and water + NaCl with the capillary rise method with counter pressure carried out at the Institute of Thermomechanics in Prague.

10.2 Calculation of Enhancement Factors Using Virial Coefficients (A. Harvey, G. Garberoglio, R. Hellmann)

A. Harvey presented on the development of a guideline for calculation of the enhancement factor in gas mixture with water (ratio of partial pressure of water in gas phase of mixture to saturation pressure of pure water). He proposed to restrict the pressure range of the guideline to 1 MPa. It should cover binary gas mixtures over ice

and liquid water. A. Harvey introduced the thermodynamic model for the enhancement factor and the involved approximations. The most important parameter is the gas-water cross virial coefficient. The Guideline should recommend $B_{gw}(T)$ functions. R. Hellmann performed state-of-the-art first-principles calculations of cross virial coefficients for most of the interesting systems. The results of these calculations are generally consistent with the available experimental data, but the experimental data mostly have much larger uncertainties. The error introduced by the truncation of the virial equation of state after the second virial coefficient can be estimated by third virial coefficients, which are available for air, argon, and carbon dioxide. The relative error in the enhancement factor is 10^{-4} to 10^{-5} at 0.1 MPa and about 0.1% at 1 MPa for air. Large differences in the enhancement factor are observed for different gases, it is much larger for carbon dioxide than for hydrogen. It was discussed whether the guideline should be based on an iterative calculation of the enhancement factor with the full thermodynamic model or on an explicit equation based on the iterative solution. A proposal for a guideline will be prepared for the 2026 meeting. A book section covering the contents of the presentation by A. Harvey, G. Garberoglio, and R. Hellmann will be published soon.

10.3 Higher virial coefficients determined from IAPWS-95 in comparison with virial coefficients determined from reference formulations of other fluids. (J. Hrubý)

J. Hrubý presented a study on the behavior of high virial coefficients and reaction equilibrium constants for the formation of clusters of molecules calculated from multiparameter equations of state. The theory of the virial equation of state provides relations unique relations between virial coefficients and reaction equilibrium constants. In general, for most investigated substances (argon, methane, carbon dioxide, propane, methanol) the reaction equilibrium constant show a consistent and systematic behavior over temperature. The higher virial coefficients show a less systematic behavior. For the IAPWS-95 formulation, both higher virial coefficients and reaction equilibrium constants do not show a systematic behavior, e.g., the reaction equilibrium constants change slope two times.

10.4 Phase Behavior of Water from Data-Driven Many-Body Simulations (F. Paesani)

F. Paesani presented on molecular simulations of the coexistence of liquid water with different ice phases and the coexistence of different ice phases. The interactions between water molecules are described by a many-body expansion, which is based on a neural network potential that was trained on the MB-pol pair potential and long-range dipole-dipole interactions. Results for the water-ice phase transition deviate by about 10 K from experimental results. Simulated density isobars as a function of temperature in the metastable supercooled region show very steep isotherms near 200 K, indicating a liquid-liquid phase transition. An equation of state fitted to the simulation data exhibits a liquid-liquid transition with an upper critical point at lower temperatures. Water autoionization was also investigated. Simulations with the neural network potential are more than 20 times faster than with the original MB-pol potential.

11. Reports on seawater-related topics (joint with SC SW and PCAS) [Monday afternoon]

11.1. Seawater Sub-Committee: perspectives, collaborative approach and coordinated efforts (A. Albo)

A. Albo proposed several points to help reestablishing the SCSW. The tasks for SCSW are to create opportunities for collaboration among members of national committees, to maintain models and promote complementary models, and to set the scopes of model selections. The following points were suggested: identification of collaborations with external organizations, promotion of participation of companies and manufacturers (desalination, production of hydrogen from seawater, seawater as refrigerant) in national committees, support of national committees to apply for calls from their governments for national and international projects, and exploration of the room on the new IAPWS web-site. Other possible future topics could be seabed exploration or the extraction of lithium from seawater. A. Alberto contacted Simon Clegg (Professor in seawater chemistry, University of Southampton) at the end of 2024 to verify the availability of IAPWS to collaborate with JCS in an international framework. H.-J. Kretzschmar mentioned that MIT provides correlations of seawater properties to industry.
Y. Kayukawa hinted at a session of the BACO 2025 conference in Busan, where three members of the SCSW give presentations on SCSW related topics. It was decided to organize a workshop on seawater related topics at the IAPWS 2026 annual meeting in the UK and to invite Prof. Simon Clegg to the meeting. The list of members of the SCSW should be updated. National committees should provide e-mail addresses of members and interested persons.

11.2 A preliminary equation of state for NaOH(aq) aqueous solution for designing supercritical electrolyzers (A. Albo) [Tuesday morning]

A. Albo presented preliminary models for the density, critical point, viscosity, and electrical conductivity of NaOH(aq) aqueous solutions developed within a project with an industrial partner.

12. Other Business

12.1 Report on International Collaborative Projects
No new international projects were proposed. The running IPC on the IAPWS-95 replacement was reported on under item 5.1.

12.2 Proposals for New Releases [Thursday morning]
B. Journaux presented work done at the University of Washington on correlations for the melting pressure curves of ordinary water, the pressure along phase boundaries between different crystalline phases, equations of state for crystalline phases. The equations of state are piecewise polynomials and can be provided as software. The enthalpy of melting, entropy of melting, free energy of melting along the melting pressure curves can also be calculated. He mentioned a new project at the University of Washington funded by NASA to extend the seawater equation of state to much higher pressures. R10-06(2009) (equation of state of ice Ih) is still state-of-the-art and does not have to be changed. A task group consisting of B. Journaux, A. Harvey, and J. Hrubý, and M. Brown was formed. The TG will propose a revision of Release R14-08(2011) on the melting pressure curves of the ice phases. In a second step, it will develop releases for the equations of state of the crystalline phases and the pressure solid-solid-equilibria.

13. Membership [Thursday morning]
Baptiste Journaux (Helmholtz Awardee 2025) was unanimously elected as a new member.

14. Election of a new Second Vice-Chair
K. Meier stepped down as a second Vice-Chair as planned. A. Albo was unanimously elected as a new second Vice-Chair.

14.-15. Contribution to Press Release and Preparation of the Formal Motion to the EC
The TPWS Chair will prepare a contribution to press release and the formal motion to the EC.

16. Adjournment
The Chair adjourned the meeting on Thursday, June 24 2025 at 10:01 h.

Attachment 6 IRS Minutes

Minutes of the IAPWS working group IRS, Helsinki, Finland, June 22nd – June 27th, 2025

(Numbering of the topics follows IRS agenda)

1. Opening Remarks; Adoption of Agenda [Tuesday Morning]

N. Okita (on behalf of IRS Chair F. di Mare) opened the IRS (joint with TPWS) at 10:30 am, 23rd June 2025 meeting for IRS. Agenda was adopted without changes, just the order of individual points was adjusted to fit joint meetings needs.

2. Appointed Adam Nový as a clerk of minutes for IRS

6. Industrial Requirements and Solutions for Property Calculations (joint with WG TPWS and SCSW)

6.1 Report on a white paper for acid gas dew points (N. Okita)

N. Okita. Summarized the need for the model for acid dew point dependent on $S0_3$ content in wide range is important for safety and longevity of the devices. The current model has to be further adjusted to fit adjusted data so the schedule has been prolonged to reflect necessary adjustments to the model and further survey. First guideline, then TGD.

The following discussion:

T.L. commented that model is based on paper from 1963. But it was answered, that that paper from 1963 is commonly used as reference.

TODO:

Submit a paper regarding formulation until the end of the year (2025). Discuss reliable shutdown and TGD with PCC later after the white paper completed.

6.2 Report of the Task Group "Categories of industrial requirements" (N. Okita, chairs or representatives of other WG)

N. Okita reported no changes since last meeting.

6.2 Report of the Task Group "Wet steam properties calculation" (A. Nový, J. Hrubý, R. Span, K. Meier, F. di Mare, S. Senoo, M. Kunick)

A. Nový reported no progress in theoretical level regarding the wet steam properties.

6.4 Translation of IF-97 Fortran routines into other programming languages (A. Nový)

A. Nový suggested to continue this task as the part of future new SBTL standard evaluation. The testing procedures then can be also adapted for testing of match of other derived 3rd party IF97 libraries.

6.5 Proposal for a new Industrial Formulation for the properties of water and steam using the SBTL method, as shown in the IAPWS 2015 Guideline (M. Kunick, F. di Mare, B. Lea, A. Ranniste Sachssendahl, A. Novy, H.-J. Kretzschmar, R. Pawellek, T. Löw, R. Harwood, N. Okita, S. Senoo)

M. Kunick summarized the SBTL method principle and the need of speeding up CFD calculations and its application to both IAPWS-95 and IAPWS-IF97 and proposed that new I.F. can be based on the new formulation (being prepared for future), IAPWS-95 or IF97. The new formulation is not being ready soon so only 2 options actually exist. Secondary problem is, that for CFD is used independent variable pair of (v, u) and for HBD calculations (p, h) in contrary. The presentation continued as 6.6.

6.6 Report on the Evaluation of STBL-Property Functions based on IAPWS-IF97 and IAPWS-95 (M. Kunick, B. Lea, R. Pawellek, T. Löw, A. Ranniste Sachssendahl)

M. Kunick followed the 6.5. showing evaluation carried out together with B. Lea (RUB) of above described approaches, showing the use of IAPWS-95 based SBTL library for HBD calculations using KRAWAL-modular (SW by Siemens Energy, calculations done by S. Bennoit) showing worst deviation of 0.05% and usual lower than 0.02% for CCPP. For another CCPP example calculation the deviation was about 0.004% for electrical power (at about 440MW output). Similar results were obtained in Ebsilon SW on coal fired powerplant (435MW) SBTL based on IAPWS-95 compared to standard IF97 with 0.015% difference on main steam mass flow and negligible difference in power output. The differences of SBTL based on IF97 compared to standard IF97 showed even better match on the edge of

convergence criteria for the cycle and needed less iterations due the better numerical consistency. R. Pawellek pointed out advantage of numerical consistency of the SBTL implementation. This numerical consistency between forward and backward equations is important not only for the convergence but also for the accuracy of the results. R. Pawellek explained an example from Ebsilon user feedback, where two different models of a 6 MW steam turbine have a difference in the electrical output of the generator of 240 W, although all parameters and boundary conditions were identical in both models. In one model, the entropy was calculated from pressure and temperature in the superheated steam region while in the other, the entropy was always calculated from pressure and enthalpy. Although the difference between the results for the entropy itself occurred only after the 6th significant digit, the final result for the generator power differ in the 5th digit. The reason is that when you take the difference between two numbers of similar size with a certain uncertainty, the calculated difference has a much higher uncertainty than the original numbers.

With the SBTL method, the difference in the generator power between the two models is only 9 nW (nano watts) which means that the calculations are consistent up to 14 significant digits. This is a big advantage of the SBTL method. Without the SBTL, the latter significant digits of the results depend on the usage of the backward equations.

The tests were also successfully done on the CFD ((RUB, F. di Mare and team, https://doi.org/10.1115/1.4049348), on Large eddy simulation of condensing wet steam turbine blade row. These CFD is even possible due the speed of SBTL to finish in acceptable timeframe. This presentation was then followed by broad discussion cover in next point 6.7.

6.7 Discussion of a way towards a new Industrial Formulation: Discussion on whether IAPWS-95 or IAPWS-IF97 should serve as a basis for the new Industrial Formulation. Proposal to develop and evaluate the new Industrial Formulation. Proposal to establish an evaluation task group aiming for the presentation of evaluation results and a Draft-Release at the IAPWS-meeting in 2026.

The three fundamental questions to be answered are:

1) Can IAPWS release more than equations, like tables, grid parameters, algorithms, reference values, test procedures, supplementary material or even open source software library?
2) What should be the basis for the SBTL library? IAPWS-95 or IAPWS-IF97?
3) have separate implementation for CFD (u,v – based) and HBD (p,h – based) or one common?

Summary of discussion regarding the points:

Add 1) DF asked the possibility delivering code and MK explained the repository possibilities (GitHub, or equivalent) and that the grid (tables) will be in the code fixed. HJK mentioned need of proper license, terms of use and liability. Testing procedures of the final compiled library can approve its matching the standard. In general it seems possible to release calculation library but there will be necessary to meet specified requirements.

Add 2) The differences between SBTL of IAPWS-95 and IF97 were reported small, no problem with region boundaries and the metastable region can be covered. This favors the IAPWS-95 base.

Add 3) DF asked about more implementations, possible up to 4 (all combinations). AS, HJK, BL explained that the difference in values should be small between IAPWS-95 and IF97 implementations, but there will be significant benefit in speed, especially for CFD, where speed is crucial. JH suggested reducing the number of equations and using fundamental equation of higher order polynomial, rational. MK explained that some tests in this field were done but the simpler approach leads to better calculation times and keeps the accuracy good.

Conclusion:

1) Releasing library is possible meeting at least criteria discussed above
2) Based on IAPWS-95
3) Two libraries, one for CFD and second for HBD

Other suggestions:

DF, AH, NO suggestion to examine the effect of new possible standard on existing committees and standardization authorities standards to allow smooth transition.

Alan Harvey agreed to join the TG “Proposal for a new Industrial Formulation for the properties of water and steam using the SBTL”.

TODO:
Continue in development, prepare first the CFD version and later also HBD version to be evaluated.
Propose structure of the new release (documentation, test values, test procedure, license statement)
Setup Evaluation TG.

7.1 Dew Point of Low Sulphur Exhaust Gas (N. Okita, same as 6.3 but joint PCC/PCAS/IRS)
The same topic as 6.1 but presented within PCC/PCAS by N. Okita

8. International cooperations/projects/challenges for IRS (Francesca di Mare, N. Okita)
B. Lea presented existence of the activities within the ECCSEL-ERIC focused on CO2 capture, storage and transport. It is an international research project with possibility to access to research facilities and funding from EU.

9. Status of each task of industrial Requirements and Solutions

9.1 Report of the Task Group "Categories of industrial requirements" (N. Okita, chairs or representatives of other WG)
See 6.2, no addition within IRS separate meeting

9.2 Report of the Task Group "Wet steam properties Calculation" (A. Nový, J. Hrubý, R. Span, K. Meier, Francesca di Mare, S. Senoo, M. Kunick)
See 6.3, no addition within IRS separate meeting

9.3 Report of the joint Task Group "Wet Steam Data from Operating Turbines" (S. Senoo, N. Okita, A. Anderko) [Joint with PCAS]
S. Senoo not present, no progress reported

9.4 Report of the joint Task Group on ICRN for acid gas dew points (N. Okita, S. Senoo, T. Němec) [Joint with PCAS]
Covered by PCAS minutes, no addition within IRS separate meeting

9.5 Report of the joint Task Group "White paper on geothermal plant issues" (N. Okita, Francesca di Mare, D. Addison, S. Terada) [Joint with PCC]
Covered by PCC minutes, no addition within IRS separate meeting

9.6 Translation of IF-97 Fortran routines into other programming languages (A. Nový, jointly with TPWS)
See 6.4 no addition within IRS separate meeting

9.7 Calculation of mixture properties of steam and non-condensable gases (N. Okita)
Not available at the time of meeting

10. Other Business
Discussion about possible contribution of IRS to future IAPWS strategy as requested by M. Nielsen as reaction to input from the national committees.

- Maximal focus on "Proposal for a new Industrial Formulation for the properties of water and steam using the SBTL"
- Actively support content creation for the new web pages to cover IRS activities and outputs and possibly participate on active maintenance of the content

11. Membership
A. Harvey informed, that P. Murphy stepped out of the GE company and should be released from IRS.

12. Preparation of the Formal Motion to the EC
Report: The output of discussion about contribution of IRS to future IAPWS strategy
Report: IRS membership change: P. Murphy steps out

Report: Conclusions and TODO of each TG/WG SBTL has the priority!

13. Adjournment

Adjourned 26th June 10:00

Attachment 7 PCAS Minutes

PCAS WG Minutes

Helsinki, Finland, June 23 – 26, 2025

Present:

Ken Yoshida (chair)	yoshida.ken@tokushima-u.ac.jp
Serguei Lvov	lvov@psu.edu
Sarita Weerakul	sarita.weerakul@unb.ca
Derek Hall	dmh5373@psu.edu
Milan Sedlar	m.sedlar@sigma.cz

PCAS separate meeting, June, 23 morning

(1) Agenda was approved.

(2) M. Sedlar was appointed as the clerk of minutes. Derek Hall was appointed as the linguistic reviewer and editor of the minutes.

(3) Minutes of the 2024 meeting were approved

(4) PCAS members in attendance each gave introductions and an overview of their PCAS related research activities

(5) Possibility of ICRNs

K. Yoshida presented two ICRNs (Film Forming Substances (FFS), Conductivity of electrolytes in aqueous solutions) led by PCC WG. The ICRN regarding FFS has reached the stage where the initial draft from PCC Chair Addison has been circulated to PCAS for review, and feedback is being gathered.

The Conductivity ICRN (ICRN 32) is at the stage where an EC Postal Ballot is being conducted. Given these respective stages of development, any insights or observations that emerge could be shared with the PCC WG.

(6) International collaboration

There was an extensive discussion on the possibilities of a new international collaboration project (ICP). Participants debated requirements which young scientists and their supervisors should meet and possibilities of financial support from IAPWS and from other sources.

It was reported that the final report for the completed ICP "Impact of Metal Ion Complexation on the Radiation Chemistry of Acetohydroxamic Acid in Aqueous Solutions" (sponsored by Jacy Conrad, Hugues Arcis, et al.) has been submitted to Executive Secretary Daniel Friend.

Regarding the FFS-related ICP (sponsored by Ken Yoshida, William Cook, Yian Tai, et al.), it was reported that Sarita Weerakul from the University of New Brunswick visited Tokushima University from February to April of this year and also stayed at Taiwan Tech in March to conduct measurements.

Detailed results were presented at the Monday afternoon PCC/PCAS Joint Meeting.

Concerning the ICP on iodine radiation chemistry (sponsored by Hugues Arcis, Pamela Yakabuskie, et al.), which was granted second priority at last year's annual meeting in Boulder, attendees circulated a revised proposal submitted by Arcis in response to Executive Secretary's request to structure the budget planning on a year-by-year basis. There were minor revision suggestions from the PCAS attendees regarding the research schedule. Since Arcis and Yakabuskie were absent from this year's annual meeting, it was decided that Yoshida, as PCAS Chair, would present the budget plan modifications to the EC on Friday.

(7) Discussion of future activities of PCAS
In the framework of future activities participants discussed primarily the possibilities of increasing the number of PCAS active members, the most promising communities (university students, assistant/associate professors, people from industry) and possible laboratories/research centers able to engage new members' attention.

(8) Discussion of the possibility of releases and guidelines
K. Yoshida is actively working on the project to develop a formulation for the acid dew point in collaboration with N. Okita in IRS. This is currently in preparation for publication in a scientific journal and possibly will be developed as a guideline or TGD. At the moment, there are no new proposals.

PCC/PCAS joint meeting, June, 23 afternoon

The following presentations were given by PCAS and PCC members:

- High-Resolution Monitoring of Amine Film Assembly on Low-Roughness Metal Surfaces (K. Yoshida)
- Analysis of Film Forming Amine Coatings in High Temperature Water Loops: Phase - 1 (S. Weerakul)
- Using X-ray CT to characterize localized corrosion rates in steels from high-temperature, high-pressure fluids (D.M. Hall)
- The latest international activities. Film forming substances (B. Dooley)
- An Electrochemical Investigation of Boiler Steel Corrosion Under Chloride and Sulphate Contamination (B. Loader)
- Analysis of Film Forming Amine Concentration in Water Solutions (S. Vidojkovic)

PCAS/TPWS joint meeting, June, 24 morning

The following presentations were given by TPWS members:

- Surface tension of water and aqueous mixtures (J. Hruby)
- IAPWS Task Group on Enhancement Factor (A. H. Harvey)
- Higher viral coefficients by numerical differentiation (J. Hruby)
- Phase Behavior of Water from Data-Driven Many-Body Simulations (F. Paesani, on-line)

- A preliminary equation of state for NaOH(aq) aqueous solution for designing supercritical electrolysers (P. A. G. Albo)

PCAS/PCC joint meeting, June, 24 afternoon

The following presentations were given:

- Japanese Spray Type Electrode Boilers (Y. Kawahara)
- Data collection on E-boilers – Primarily hot water boilers
- Report on a white paper for acid gas dew points (N. Okita)
- Two new studies on the properties of film forming amines in water-steam circuits (W. Hater)

PCAS separate meeting, June, 24 afternoon

The following presentations were given by the working group members:

- Modelling of Hydrodynamic Cavitation in Water at High Temperatures (M. Sedlar)

The presentation resulted in an extended discussion, which has brought new fresh ideas and recommendations for the presented work.

D. M. Hall provided an overview of his research background, experiences and laboratory capabilities relevant to the PCAS working group.

IAPWS 2025 Symposium, June 25

The members of PCAS participated in the Symposium, which contained the Helmholtz Lecture, and 11 presentations divided into 4 topical groups:

- Flue gas condensate water treatment
- Electrical boilers
- Industrial boilers and issues with water chemistry
- Future technologies of interest of IAPWS

List of presentations is a part of the official Symposium program.

In the frame of the Symposium, K. Yoshida gave an introduction of the PCAS working group and its activities and presented key points of the research on Film Forming Amines.

PCAS separate meeting, June, 26 morning

(1) The members of PCAS approved the proposal of Joint PCAS-PCC ICP (low iodine experiment) with a revised budget.
(2) The members of PCAS approved the proposal of extending the terms of Chair K. Yoshida and Vice-Chair H. Arcis. K. Yoshida discussed this proposal with H. Arcis, who declared his interest to continue his active work in this position.
(3) In the framework of PCAS future, participants discussed in detail the possibilities of increasing the number of PCAS active members as well as the possibility of on-line participation in the IAPWS annual meeting to attract new people.

Attachment 8 ICP Radiation Chemistry

IAPWS International Collaboration Project

Impact of Metal Ion Complexation on the Radiation Chemistry of Acetohydroxamic Acid in Aqueous Solutions

IAPWS Sponsors

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Background

Due to its high power density and low carbon emissions, advancements in nuclear power are essential for meeting increasing global energy demands. In order to achieve this goal, efficient reprocessing of used nuclear fuel (UNF) is crucial to recover uranium and other valuable fission products for reuse.

Acetohydroxamic acid (AHA) is proposed as a safer and more effective alternative for selectively separating plutonium and neptunium from uranium in waste reprocessing streams. However, AHA's effectiveness is limited by hydrolytic and radiolytic degradation in the intense radiation fields and high nitric acid concentration of reprocessing environments. This work was intended to build on previous studies exploring the radiolytic degradation of uncomplexed or "free" AHA in aqueous solutions [i-vii] by exploring the impact of metal ion complexation. Understanding AHA's radiation chemistry, particularly in the presence of metal ions, is necessary for predicting its longevity and effectiveness in UNF reprocessing cycles.

Research Goals

The objective of this research was to investigate how metal ion complexation affects the radiation chemistry of AHA in aqueous nitric acid solutions using a combination of steady-state gamma and time-resolved electron pulse irradiation techniques, supported by computational modeling. Iron(III) (Fe^{3+}) was chosen as the surrogate metal ion for AHA complexation, due to its relevance to corrosion processes and its well-studied complexation constants with AHA [].

The originally proposed 9-month project was to involve:

1. ***Steady-State Gamma Irradiations*** with characterization of the irradiated samples by analytical techniques to provide quantitative values for the loss of AHA and yields of chemical products: UV-Visible spectroscopy for the loss of AHA and formation of hydroxylamine, ion chromatography for the loss of nitrate ions and formation of nitrite ions, acetic acid, and formic acid, and gas chromatography, for the formation of hydrogen and nitrous oxide gases.
2. ***Time-Resolved Electron Pulse Irradiations*** to measure the reaction kinetics of the iron(III) complexes of AHA reacting with the transient radical products from water and aqueous nitrate radiolysis, specifically e_{aq}^-, $H^\bullet$, $^\bullet OH$, and $NO_3^\bullet$.
3. ***Multiscale Model Development***. Using the data acquired by the experimental research objectives to expand and evaluate current multiscale models for uncomplexed AHA radiolysis in aqueous solutions.

Work Completed in the Initial Three Months of the International Collaboration

In the initial two months of the project, substantial progress was made in preparing and training the visiting student to complete the research project as originally planned. The student was thoroughly trained on all safety and operational protocols, ensuring compliance with institutional standards for working in the laboratory. The student received hands-on training on operating the cobalt-60 gamma irradiator, including safety procedures and dosimetry experimentation. Comprehensive training was provided on the various analytical chemistry techniques required, including UV-Visible spectroscopy, ion chromatography, and gas chromatography. For each analytical method, the student was instructed on how to accurately prepare solutions to make

method calibration curves. **Figure 1** shows the absorbance spectrum of the Fe-AHA complex used to determine the concentration of AHA in solution and the calibration curve measured by the student for AHA quantification by UV-Visible spectroscopy. In all cases, the student's calibration results agreed with our previously published and benchmarked efforts.

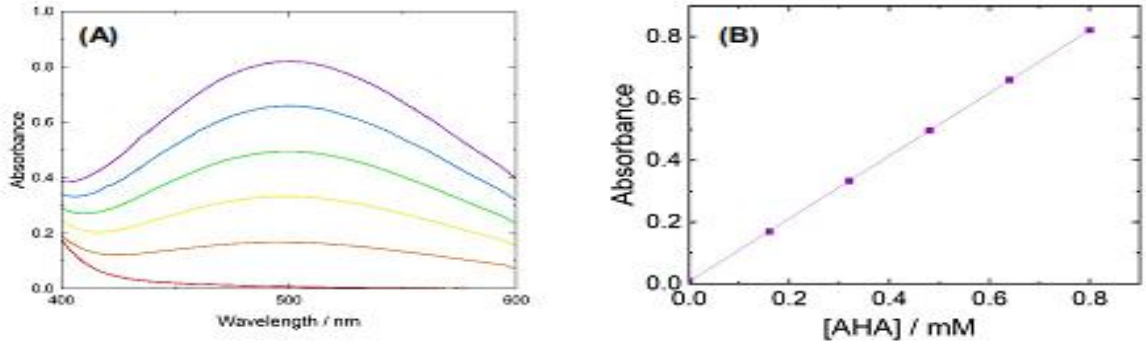

Figure 1. (A) The UV-Visible spectrum of the Fe-AHA complex used to determine the concentration of AHA in the solutions. **(B)** A Beer's Law calibration curve relating the complex's maximum absorbance at 502 nm to the concentration of AHA with measured extinction coefficient of $\varepsilon = 1017\ M^{-1}\ cm^{-1}$.

The student was also provided access to existing models for uncomplexed AHA and fully trained on building kinetic models using FACSIMILE Kinetic Modelling Software. The student expanded the model by adding published AHA complexation constants from the literature [viii8] into the existing model:

$$AHA + Fe^{3+} \rightarrow Fe(AHA)^{2+} + H_{aq}^{+} \qquad K_1 = 62.48$$

$$Fe(AHA)^{2+} + AHA \rightarrow Fe(AHA)_2^{+} + H_{aq}^{+} \qquad K_2 = 2.81$$

$$Fe(AHA)_2^{+} + AHA \rightarrow Fe(AHA)_3 + H_{aq}^{+} \qquad K_3 = 0.0158$$

The results predicted for AHA complex formation as a function of the concentration of AHA in the form of pHL or (-log[AHA]) with starting concentrations of 0.1 M HNO_3 and 2.5 mM Fe^{3+} are shown in **Figure 2**.

Using these complexation constants, the student determined that in an aqueous solution of 0.2 M HNO_3 having 0.5 M AHA and 0.5 M Fe^{3+} would maximize the $Fe(AHA)^{2+}$ concentration, and 0.5 M AHA and 0.5 mM Fe^{3+} would maximize the $Fe(AHA)_2^{+}$ concentration. Initial gamma irradiations were completed on each of these optimized solutions to absorbed doses of up to 45 kGy. The loss of AHA for each solution was determined as a function of dose as seen in **Figure 3,** using the UV-Visible spectroscopy method described.

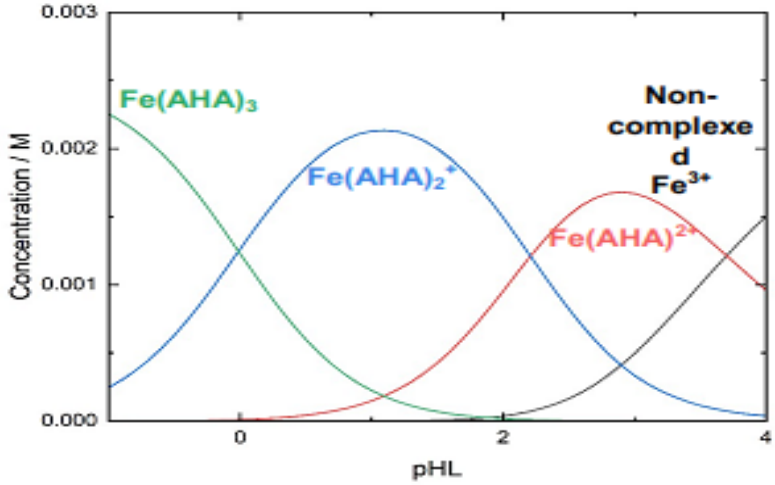

Figure 2. FACSIMILE model speciation predictions over a range of pHL (-log[AHA]) with starting concentrations of 0.1 M HNO_3 and 2.5 mM Fe^{3+}.

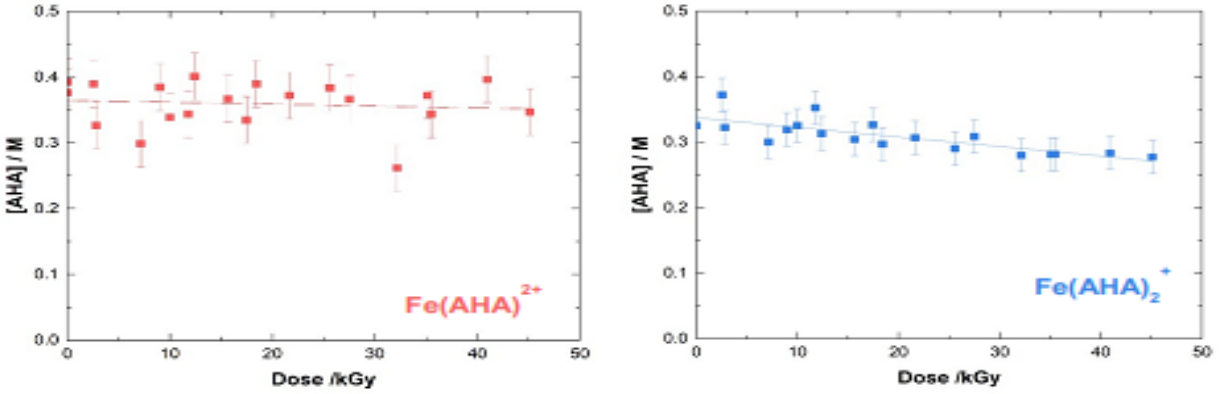

Figure 3. Measured concentrations of AHA as a function of absorbed gamma dose in kGy: with solutions optimized for **(A)** $Fe(AHA)^{2+}$ with starting concentrations of 0.5 M AHA, 0.5 M Fe^{3+}, 0.2 M $HNO_3$and **(B)** $Fe(AHA)_2^+$ with starting concentrations of 0.5 M AHA, 0.5 mM Fe^{3+}, 0.2 M HNO_3.

This preliminary work was presented as a poster at the 18th International Conference on the Properties of Water and Steam, held in conjunction with the 22nd Symposium on Thermophysical Properties in Boulder, Colorado, USA for June 23-28, 2024.

Premature End to the International Collaboration

Unfortunately, the collaboration was terminated unexpectedly after the initial three months. The visiting student discontinued their attendance at work without prior notice and did not respond to further communication attempts. The student also discontinued their doctorate work at their home university. The abrupt termination of the student placement and lack of additional funding led to the end of the research project, and the intended research objectives remain incomplete. It was determined that insufficient progress had been made to publish these results, as only three of the nine months of the placement were completed.

In an attempt to complete some of the proposed scientific objectives, the original student's supervisor, Prof. Aliaksandr Baidak, hired a new Master of Chemistry student to complete the cobalt-60 gamma irradiation experiments at the University of Manchester. This work, not funded by IAWPS, was recently completed and is intended to be published in a peer-reviewed journal in the coming months.

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(vii) R.E. Umpleby, J.K. Conrad, J.R. Wilbanks, K.D. Schaller, and G.P. Horne, Radiolytic evaluation of acetohydroxamic acid (AHA) under biphasic (n-dodecane and TBP/DEHBA/DEH*i*BA) used nuclear fuel reprocessing conditions. *Rad. Phys. Chem.*, **2023**, *207*, 110799.

(viii) F.P.L. Andrieux, C. Boxall, and R.J. Taylor, The Hydrolysis of Hydroxamic Acid Complexants in the Presence of Non-oxidizing Metal Ions 1: Ferric Ions. *J. Solut. Chem.*, **2007**, *36*, 1201–1217.

Attachment 9 PCC Minutes

Power Cycle Chemistry Working Group (PCC WG)
Helsinki , Finland, 23rd to 28th June 2025

Revision 2.00

Monday 23 June: 10:30 – 12:00 Session (PCC Meeting)

1. **Introduction to PCC 2025 WG meeting**

IAPWS 2025 PCC WG members were welcomed by David Addison who introduced quickly the work of the PCC Working Group and reviewed the schedule / agenda for the week.

PCC Deliverables and Highlights since last meeting in 2024:

- PCC is now on LinkedIn
- Corrosion Product White Paper published
- Instrumentation TGD updated in Boulder
- First PCC Webinars held
- New Website almost ready to go

2. **Adoption of Agenda and Minutes Approval**

There were 42 people officially registered for PCC with the majority attending all of the PCC meeting and others there part time. The agenda was adopted with the final version from the week attached as PCC Attachment A. Minutes from PCC 2024 were approved with no changes.

3. **Appointment of PCC WG Clerk of Minutes**

Tapio Werder (GSAPWS) was appointed as clerk.

4. **Review of Actions from last PCC WG Meeting**

See list below. The following points arising from the actions were also discussed:

- ICRN 32: In progress; should get a final vote at EC meeting on Friday.

- Webinars: first Webinar was a success; more webinars under planning.
  - **Action:** Members of PCC to provide wishes for contents until end of the week. There will be a list of webinars developed by PCC.

- Radiation chemistry and radiolysis collaboration: Status unknown Pam Yakabuskie, unable to attend IAPWS 2025.
  - **Action:** David Addison to follow up status directly with Pam.

- FFA fouling on instrumentation: ICRN on FFS in development and includes this point.

- Corrosion Product White Paper: to become a TGD in the future; waiting for input (decay map) from the world.
    - Action: PCC Members to share data with Task Group (Barry Dooley) as it becomes available, update from Task Group at IAPWS 2026

- OPAL Website: Access for members resolved. New document/file sharing platform tbd.

- ICRNs: 22 and 26: closing statement will be developed by Barry Dooley and Bobby Svoboda.
    - **Action:** Closing Statement for ICRN 22 - Bobby Svoboda
    - **Action:** Closing Statement for ICRN 26 - Bobby Svoboda and Barry Dooley
    - **Action:** Once closing statements received David Addison to advise ES and get website updated

5. International Collaborations

- **Action:** Willy Cook and Ben Loder to review with Barry Dooley and develop renewal request for ongoing IC at UNB for submission at IAPWS 2026

6. IAPWS TGD Updates

An update was provided by Barry Dooley on activities since 2024.

- **Instrumentation TGD Amendment** – published in June 2024 after Postal Ballot.

- **Monitoring Corrosion Products** – White Paper published in January 2025 on website of PCC WG.

- **Film-forming Substances (FFS) in Nuclear Plants** – delayed, but there might be the possibility to re-establish the STG.
    - **Action:** Re-establish the STG. Willy Cook new Vice-Chair of STG, gets in contact with Chair Jörg Fandrich; Wolfgang Hater confirmed to continue his membership to STG. Pam Yakabuskie to join the STG. Willy Cook to report back to Barry Dooley by end of July 2025.

- **Flue Gas Condensation** – Nordics IAPWS White Paper; Published in PPCHEM 06/24.
    - **Action:** Evaluate if this should be developed into a PCC White Paper: STG Chair is Monika Nielsen; Ludwin Daal and Ben Loder are members of STG. Report back at next year meeting 2026.

- **Geothermal** – Delayed but still in progress – aiming for 2026 approval

- **Electrode Boilers** – TGD drafting to commence – aiming for 2026 approval

- **Dew Points of Low Sulphur Exhaust Gas** – Update by IRS WG on White Paper to follow later this week (Tuesday morning session)

Monday 23 June: 1:30 pm – 4:30 pm Session (PCC and PCAS Joint Meeting)

1. Presentation "Update on FFA Research" – Ken Yoshida, Tokushima University, Japan

2. Presentation "Canada/Japan/Taiwan International Collaboration FFA Update" - Sarita Weerakul, University of New Brunswick, Canada

3. Presentation "Ongoing FFS research needs from a PCC perspective and current draft FFS ICRN status" – David Addison and Barry Dooley.
    - **Note:** ICRN draft was sent out to members on Monday morning. Potential revision of the FFS TGD will be linked to IAPWS deposit map (IAPWS TGD7-16). Potential research work in the field for universities was presented by Barry Dooley.

4. Presentation "High-resolution X-ray computerized tomography to characterize localized corrosion rates of carbon steel in contaminated steam cycles" – Derek Hall, Penn State University, USA

5. Presentation "An Electrochemical Investigation of Boiler Steel Corrosion Under Chloride and Sulphate Contamination, Summary Presentation of Doctor of Philosophy Dissertation Derived from IAPWS International Collaboration Project (also summary report for IC project)" – Ben Loder, University of New Brunswick, Canada

6. Presentation "Analysis of Film-Forming Amine Concentration in Water Solutions" – Sonja Vidojkovic, University of Belgrade, Institute of Chemistry, Technology, and Metallurgy, Serbia

Tuesday 24 June: 09:00 – 12:00 Session

1. *PCC Priority List*: 15 min of discussion in groups about priorities/needs in the respective countries.

2. Presentation "IAPWS Corrosion Product Sampling White Paper Update" – Barry Dooley
    - **Action:** PCC members to report back to Barry Dooley how they applied the new white paper in their power plant. The data will be used to develop a TGD for flexible operation.

3. PCC internal review of the new website.

- **Action:** PCC members to review the new webpage and send feedback/input to Paul McCann.

4. PCC Mission statement review: last developed and reviewed in 2010. David Addison prepared some updates and clarifications.
   - **Action:** PCC members to review once draft sent via email by David Addison

5. Benchmarking: Is it worth the development of an IAPWS PCC Benchmarking TGD?
   – Barry Dooley showed how the Benchmarking looks like in his assessments.
   - **Action**: STG started to discuss potential TGD; David Addison Chair and Barry Dooley Vice Chair of this STG. STG members are David de Vos, Paul McCann and Duncan McAllister. Report back to PCC at IAPWS 2026 on pathway forward

6. Presentation "NZ/Nordic Electrode Boilers Update" – David Addison/Monika Nielsen

Tuesday 24 June: 01:30 – 05:30 Session (PCC / PCAS / IRS Joint Meeting)

1. Presentation "Japanese spray type electrode boilers" – Yasuhiro Kawahara / Tomohiko Yoshii, Japan

2. Presentation "Data Collection on E-Boilers" – Heine Rosendal, Denmark

3. Presentation "Report on Acid Dew Point White Paper" – Nobuo Okita, Japan

4. Presentation "Two New Studies on the Properties of Film Forming Amines in Water-Steam Circuits" – Wolfgang Hater, Germany

5. Presentation "Understanding the Oxides and Deposits on Supercritical Boiler Waterwalls" – Barry Dooley

6. Presentation "Dutch IAPWS (DIAPWS) Update on Work Done During Past Year" – Ludwin Daal, Netherlands

7. Cycle Chemistry for Flexible Operation – Gaps: 20 min of discussion in groups about priorities/needs in the respective countries:
   - **Australia/Asia**
     i. Webinar on flex ops is going to happen (presented by Paul)
     ii. Webinar on CPM WP planned as well
     iii. Time influence on Preservation: How long can a system stay wet (ICRN update)
   - **Europe**
     i. New issues: Alarm Management
     ii. Guidance on Measurement for FFS
     iii. White Paper for FFA measurement
     iv. What happens to the phase transition zone?
   - **Americas**
     i. Gaps in "When do I need to clean": NDI methods for internal deposits
     ii. Power Enhancement in Flex Ops:
     iii. How to use the IAPWS documentation in Flex Ops
   - **Nordics**
     i. Impact of Flex Ops on Lifetime Calculations/Expectations
     ii. Carry Over in "Overfiring"- Operation
     iii. Sampling Probes: vgbe as the standard

8. *PCC Webinars* Discussion Update:

- 2-4 per year
- 2 month before the annual meeting to raise awareness for the annual meeting.
- twice per Topic to cover the different time zones.
- Potential Topics:
    - Introduction to WSC chemistry / 101
    - Steam purity
    - FFS
    - CPM
    - Flex Ops
    - FAC
    - Sampling and Analyses
    - Electrode Boilers
    - Geothermal
    - etc…
- Format should be the same as the first one:
    - PCC Chair doing the Intro
    - PCC Chairs doing the curating of the questions
    - **Action:** Redefine the Goals of the Webinar: What are the objectives for those? Until Thursday.

Thursday 26 June: 09:00 – 12:00 Session

1. FGC Treatment White Paper: Update.
    - **Action:** Ben Loder to restructure the current version to the current White Paper format of PCC; Monika Nielsen to provide the missing references (six month); . After that, it will be sent to the Editorial Committee of IAPWS.

2. Geothermal TGD Update: TGD in progress
    - **Action:** David Addison to prepare the TGD to go for approval process in the upcoming months. Postal Ballot is aimed for April 2026.

3. IAPWS 2004 "Blue Book" Update: Chapter 17 – Physical Properties of Water.
    - **Action:** Keep this Document in mind when writing the Benchmarking TGD; Paul McCann: Add a visible reference to this book and where to purchase on the new website in the PCC section.

4. Revisit the idea of a *IAPWS Industrial Boiler TGD* – Open PCC discussion
    - General acknowledgement within PCC of the potential value; there is members with interest in the area in PCC; no decision taken to form a new STG for writing a TGD.

- **Action**: Wolfgang Hater to give it a thought until the annual meeting 2026 and report back.

5. *PCC Workflow Charts* Revision: ICRN, TGD, and PCC working process are covered so far. They will be available to all PCC members as updated drafts for review/comment then issue by PCC as internal documents.

6. *PCC Priority List* Update Discussion/Wrap up:
    - **Action:** David Addison to send out a revised Priority List 2025 for review and comment.
    - Consider another way of collecting these inputs.
    - **Action:** Form a STG on FFS: Chair: Paul McCann, Members: Ronny Wagner, Wolfgang Hater, Sonja Vidukovic, Write up a best practices for analytics in FFS treatment. Later to decide how it will be integrated in the suit of documents.

7. Possible PCC related ICRNs;
    - **Action**: David Addison to collect/summarize initial comments on FFS ICRN
    - **Note**: Possible ICRN on Electrode Boilers; to be thought on until 2026

8. Possible PCC related to future International Collaboration Projects
    - **Action:** Willy Cook, Barry Dooley, and Ben Loder to prepare a request for new ICP to revise the values in boiler treatments in 2026/2027
    - **Action:** Paul McCann and David Addison to put together a flow chart on International Collaboration Projects

7. PCC Communications

1. LinkedIn:
    - **Action:** Monika Nielsen will draft something on TGDs
    - **Action:** Tapio Werder to draft a few posts on TGDs and share it with the PCC chairs.
    - **Action:** Members to share the postings
2. Webinars:
    - **Action:** Next one will be on **FFS** (*Barry Dooley and Wolfgang Hater*) before the end of the 2025 and one will be on **Steam Purity** (*Barry Dooley and Bobby Svoboda*) before the next annual meeting
    - **Note:** Webinars are for two things: best practices and current topics
    - **Action:** To post the first one on YouTube
3. Email Corresponding List:
    - **Action:** David Addison to set up a general mailing list; the official mailing list will be handled through MailChimp in the future
    - **Action:** Think of a short intro video for PCC work

8. *IAPWS 2026*: in Early July 2026 in Bristol/UK.

9. *IAPWS 2027*: in July 2027 in Brisbane/Australia.

10. Election of New Officers and Members:
    - **Willy Cook** was elected as new Vice Chair of PCC
    - Discussions raised in regards of rules for becoming a member of PCC; outcome:
        i. New attendees can request membership at the end of the working week:
        ii. New PCC members at 2025 annual meeting:
        - **Levie Lensun**, Business Development Director, h2o facilities SA, 8 Avenue des Grandes-Communes, CH-1213 Petit-Lancy, Switzerland, lensun@fineamin.ch
        - **Paul Honcoop**, Senior Process & Equipment Engineer Chemistry Consultant Combined Cycles, Stadhouderslaan 900, 2382 BL Zoeterwoude, The Netherlands, paul.honcoop@nem-energy.com
        - **Andre de Bache**, Senior Product Manager, Kurita Europe, Industriering 43, D-41751 Viersen, Germany, andre.debache@kurita-water.com
        - **Heine Baum Rosendal**, Associate Professor, Fredericia Maskinmesterskole, Købmagergade 86, D-7000 Fredericia, Denmark, hbr@fms.dk
        - **Lionel Barre**, Industry Technical Consultant, Power Industry, Nalco France SAS, 10, Avenue Aristide Briand, 92220 Bagneux, France, lbarre@ecolab.com
        - **David Little**, Industry Technical Consultant, Heavy Industrial Water, 8825 Mallow Drive, Knoxville, TX, 37922, USA, dlittle@ecolab.com
        - **Jørgen Peter Jensen**, Teknisk Design Specialist, Carbon Capture, , Denmark, jpej@vestfor.dk
        - **Sarita Weerakul**, PhD, Research Scientist, Department of Chemical Engineering, University of New Brunswick, Fredericton, New Brunswick, Canada, i805k@unb.ca
        - **Thomas Blank,** Dr. rer. nat., R&D Analytical Instruments, SWAN Analytische Instrumente AG, Studbachstrasse 13, CH-8340 Hinwil, Switzerland, thomas.blank@swan.ch
        - **André Frank**, E.ON Energiinfrastruktur AB, Edelsfensvägen 21, 22651 Lund, , Sweden, andre.frank@eon.se

Attachment 10 Future of ICPWS

As requested on Monday by the Executive Secretary, a small committee consisting of Allan Harvey, Jan Hruby and me met to discuss the future of the ICPWS conference series. This committee was struck considering the most recent host of the ICPWS (USA – 2024), the last past host (Czech Rep – 2018) and the potential future host (Canada – 2028 or 2029).

The following bullet points summarize our discussion:

- All agree that the ICPWS is a great mechanism for marketing and promoting the work of IAPWS and our Working Groups to a larger audience.

- There is concern about the financial viability of ICPWS
    - 2018 was challenging due to lack of expected registrations
    - 2024 was deemed a success due to integration with TPS
    - Potential future ICPWS may benefit from “piggy-backing” on other meetings

- Success of a future ICPWS would largely depend upon the marketing and promotional activities undertaken by the host
    - Necessary to start early with heavy promotion
    - Assemble a Keynote program including “superstar” speakers early and use this for promotion

- It was felt that 2029 would be the best year for the next ICPWS if we decide to proceed. This coincides with that 100th anniversary of the inaugural International Steam Conference, which may be a great promotional tool.

Respectfully submitted,

Willy
with Allan and Jan

Attachment 11 Czech Republic

Czech Society for the Properties of Water and Steam

Annual Report 2025

Submitted to IAPWS Executive Committee, June 2025

Steering board of CZPWS

Chair: Jan Hrubý (Institute of Thermomechanics of the Czech Academy of Sciences - IT CAS, hruby@it.cas.cz), Vice-Chair: Milan Sedlář (SIGMA Research and Development Institute), Secretary: Ondřej Bartoš (Czech Technical University in Prague), Member: Adam Nový (Doosan Škoda Power, s. r. o.), Member: Vladimír Majer (Technical University of Liberec).

CZPWS Meetings

Annual meeting of the CZPWS was held on June 18, 2025. The form of the meeting was hybrid. CZPWS members were informed about the activities of CZPWS Chair and approved CZPWS Financial Statements. CZPWS is a member of the Council of Scientific Societies of the Czech Republic (CSS CR). Based on this membership, CZPWS receives funding for paying CZPWS Member Dues to IAPWS.

RESEARCH

Surface tension of aqueous solutions

The team of the Institute of Thermomechanics of the Czech Aademy of Sciences (IT CAS) published new data for the surface tension of water + ethylene glycol mixtures with special focus on the low-temperature region including the supercooled metastable state. The experiments were carried out with a unique capillary-based apparatus at temperatures down to 30 °C. Based on new accurate data for the liquid density collected at 0.1 MPa with the vibrating tube densimeter, the correlations for pure ethylene glycol and for aqueous mixtures with ethylene glycol densities were developed [0]. Further aqueous binary systems under investigation include mixtures with methanol and sodium chloride. The preliminary results were presented at the ICPWS conference in June 2024 [2].

Modeling of gas hydrates – sH structure

IT CAS in collaboration with the Ruhr University Bochum and the Technical University Dresden, the van der Waals and Platteeuw model for gas hydrates combined with the multiparameter EoSs, including IAPWS-95 formulation for water, has been successfully extended to model the third most common crystal structure of sH type [3]. The modified model has been tested on

ternary systems with methylcyclohexane or 2-methylbutane as large-guest molecule substances and methane and carbon dioxide as the main hydrate forming guests.

Cavitation

Milan Sedlář (SIGMA Research and Development Institute and the Centre of Hydraulic Research) participated in activities WG PCAS.

The problems studied in the SIGMA Research and Development Institute and the Centre of Hydraulic Research in the period of June 2024 – June 2025 have been related mainly to the modelling of cavitation erosion during the hydrodynamic cavitation and to the thermal effects of cavitation and the exact description of water and water vapour properties during the cavitation flows.

In cooperation with the Institute of Physics/Czech Academy of Sciences, the tests of cavitation resistance of steel samples treated with LSP and 3D printed samples with different surface patterns have continued from the last three years. The cavitation erosion stand has been reconstructed for higher speeds and higher temperatures and equipped with the transparent lid enabling continuous monitoring by cameras. These tests have been accompanied by advanced numerical simulations. Some experimental and simulation results have been presented in the 5th International Symposium on Thermal-Fluid Dynamics (ISTFD 2024), Xi'an, China, July 26 – 29, 2024. The results also have been published [4].

Concerning the thermal effects of cavitation, a new hot water cavitation tunnel (Venturi type) is nearly finished. It is equipped with two sapphire windows which will enable to measure in the infrared spectrum. Supporting simulations of cavitating flow in the temperature range of 25 – 175 °C have been performed to confirm the functionality and design parameters.

Standard derivative properties of oxygen containing organic aqueous solutes at high temperatures and pressures

Vladimír Majer, Josef Šedlbauer and Martin Slavík (Technical University of Liberec, Czech Republic) have been engaged for a longer period of time in collecting and evaluating standard (infinite dilution) thermodynamic properties of aqueous organic solutes at superambient conditions. This activity was started on instigation of the PCAS of IAPWS about 20 years ago with focus primarily on derivative properties at high temperatures and pressures, namely volumes derived from vibrating tube density measurements and heat capacities obtained by from differential flow calorimetry experiments.

The Liberec group was joined recently in their effort by Ivan Cibulka from the University of Chemical Technology in Prague. His group was active over past 30 years or so in highly precise determination of volumetric properties for dilute aqueous solutions and produced large amount of reliable data primarily for oxygen containing organic compounds.

After a preliminary discussion with the Co-Editor of the Journal of Solution Chemistry Magdalena Bendová, an overview article for this Journal in under preparation. The publication will present the infinite dilution volumes and heat capacities for oxygen containing organic aqueous solutes derived from measurements that reach well above 100°C. The Publication will have an extensive electronic Appendix containing all data points as presented in original

literature, about 3000 for volumes and 300 for heat capacities. The substantial added value will be a qualified united assignment of error margins to each presented data point.

The oxygen containing organic compounds are in most cases well soluble in water and are stable at temperatures to 250-300°C. Their standard derivative properties obtained by extrapolation to infinite dilution as a function of temperature reflect differences in behaviour in direction to the critical point of water depending on the molecular structure of a solute. They are there-fore of interest both for theoretic studies and for obtaining the Gibbs free energies for calculations of phase and chemical equilibria at superambient conditions.

IRS-related activities

Adam Nový (Doosan-Skoda Power) participated in activities of WG IRS. In particular:

1) Working on validation procedure for different IF97 implementations.

2) Contributing to future proposal of Industrial Formulation for the Thermodynamic Properties of Water and Steam based on SBTL (Spline Based Table Lookup) method. This promising method can in future significantly speed up thermodynamic properties calculations.

References:

1. Vinš V., Součková M., Prokopová O., Čenský M., Hrubý J., Blahut A.: Density and surface tension of water + ethylene glycol mixtures as key components of heat transfer liquids, International Journal of Refrigeration 171 (2025) 191-201.

2. Vinš V., Součková M., Prokopová O., Čenský M., Blahut A., Hrubý J.: Comparison of the surface tension of aqueous binaries with methanol, ethanol, and ethylene glycol in the low temperature region including supercooled state International Conference on Properties of Water and Steam, Boulder, CO, USA, June 23-28, 2024.

3. Fiedler F., Vinš V., Nhat L. N., Jäger A., Span R.: Extension of a hydrate model for structure H applied to multiparameter equations of state. Journal of Chemical Physics (accepted for publication June 4, 2025).

4. Sedlář, M.; Koutný, A.; Krátký, T.; Komárek, M.; Fulín, M. Assessment of Cavitation Ero-sion Using Combined Numerical and Experimental Approach. Fluids 2024, 9, 259. https://doi.org/10.3390/fluids9110259.

Attachment 12 Japan

Current Status of Research Activities in Japan
Submitted to the Executive Committee Meeting, IAPWS, June, 2025

Japanese National Committee, Chaired by Professor Kenji Yasuoka
International Association for the Properties of Water and Steam
c/o The Japan Association for the Properties of Water and Steam
Chaired by Professor Kenji Yasuoka
3-14-1 Hiyoshi, Kohoku-ku,
Yokohama 223-8522, Japan

I. Overview:

The Japan National Committee of IAPWS continues to endeavor to make closer and innovative interactions between engineering and academic groups with respect to the international and domestic energy-related issues. The key points of our attention are cleaner, greener, and more sustainable energy as well as high efficiency and safety. We are discussing the science and engineering of fuels, boilers, turbines, and water-treatment. Now we take it into account the power generation from geothermal and biomass energies. Our activities in the publication are shown below.

II. Recent Publications:

Yasuoka, Kenji
Professor, Department of Mechanical Engineering, Keio University
email: yasuoka@mech.keio.ac.jp
URL: https://k-ris.keio.ac.jp/html/100011311_en.html

Coarse-Grained Model of Disordered RNA for Simulations of Biomolecular Condensates
I. Yasuda, S. Bülow, G. Tesei, E. Yamamoto, K. Yasuoka, K. Lindorff-Larsen
J. Chem. Theory Comput., 21, 2766-2779, 2025

Large-Scale FMO-MP2 Calculations of the Spike Protein Droplet Model
H. Doi, T. Nakano, K. Sakakura, K. Akisawa, K. Okuwaki, Y. Hirano, E. Yamamoto, K.Yasuoka, S. Ohshima, T. Katagiri, Y. Mochizuki
J. Comput. Chem., 46, e70052. (6 pages), 2025

FMO-based interaction analysis on DEET/Icaridin - AgamOBP1 complex
K. Akisawa, Y. Sakuma, A. Tsukamoto, H. Doi, K. Okuwaki, Y. Hirano, E. Yamamoto, K. Yasuoka, Y. Mochizuki
Chem. Lett., upaf030 (6 pages), 2025

High selectivity of CO2 capture with single- and double-walled carbon nanotubes
Winarto, L. Yuliati, Purnami, P. E. Brumby, K. Yasuoka
Environ. Sc.: Nano, 12, 1375-1383, 2024

Water structures in tip-charged carbon nanotubes
Y. Ono, E. Yamamoto, K. Yasuoka
J. Chem. Phys., 161, 054702. (13 pages), 2024

In-layer inhomogeneity of molecular dynamics in quasi-liquid layers of ice
I. Yasuda, K.Endo, N.Arai, K.Yasuoka
Commun. Chem., 7, 117. (11 pages), 2024

Hysteresis Elimination for an Anisotropic Liquid-Crystal Model via Molecule Design and Replica-Exchange Optimization
A. Kowaguchi, , P. E. Brumby, K. Yasuoka
Journal of Chemical Information and Modeling, 64, 4673-4686, 2024

Matubayasi, Nobuyuki
Professor, Graduate School of Engineering Science, Osaka University
email: nobuyuki@cheng.es.osaka-u.ac.jp
URL: http://www.cheng.es.osaka-u.ac.jp/matubayasi/english/index.html

Unifying sorption isotherms in reversed-phase liquid chromatography
W. Heamen, N. Matubayasi, H. F. Sneddon S. Shimizui
J. Chromatogr. A, in press, 465891 (10 pages), 2025, DOI: 10.1016/j.chroma.2025.465891

Development of a force field for ATP – how charge scaling controls self-association
T. M. Do, N. Matubayasi, D. Horinek
Phys. Chem. Chem. Phys., 27, 6325-6333, 2025

Investigating the hyperparameter space of deep neural network models for reaction coordinates
K. Kawashima, T. Sato, K. Okazaki, K. Kim, N. Matubayasi
APL Mach. Learn., 3, 016113 (11 pages), 2025

Solvent-Environment Dependence of the Excess Chemical Potential and Its Computation Scheme Formulated through Error Minimization
St. Hervø-Hansen, K. Okita, K. Kasahara, N. Matubayasi
J. Chem. Theory Comput., 21, 1064-1077, 2025

Atomistic analysis of nematic phase transition in 4-cyano-4'-n-alkyl biphenyl liquid crystals: Sampling for the first-order phase transition and the free-energy decomposition
S. Ogita, Y. Ishii, G. Watanabe, H. Washizu, K. Kim, N. Matubayasi
J. Chem. Phys., 162, 054905 (9 pages), 2025

Flexible framework of computing binding free energy using the energy representation theory of solution
K. Okita, Y. Maruyama, K. Kasahara, N. Matubayasi
J. Chem. Phys., 162, 034103 (12 pages), 2025

Multiplicativity in Solubility Isotherms
S. Shimizu, N. Matubayasi
Ind. Eng. Chem. Res., 64, 833-842, 2025

Gas and Liquid Isotherms: The Need for A Common Foundation
S. Shimizu, N. Matubayasi
Langmuir, 41, 2103-2110, 2025

Temperature Dependence of Hydrotropy
S. Shimizu, N. Matubayasi
J. Phys. Chem. B, 128, 10915-10924, 2024

High Antifouling Performance of Weakly Hydrophilic Polymer Brushes: A Molecular Dynamics Study,
T. Yagasaki, N. Matubayasi
Langmuir, 40, 15046-15058, 2024

A methodology of quantifying membrane permeability based on returning probability theory and molecular dynamics simulation
Y. Matsubara, R. Okabe, R. Masayama, N. Morishita Watanabe, H. Umakoshi, K. Kasahara, N. Matubayasi
J. Chem. Phys., 161, 024108 (15 pages), 2024

Influence of cholesterol on hydrogen-bond dynamics of water molecules in lipid-bilayer systems at varying temperatures
K. Shikata, K. Kasahara, N. Morishita Watanabe, H. Umakoshi, K. Kim, N. Matubayasi
J. Chem. Phys., 161, 015102 (10 pages), 2024

Synergistic Solvation as the Enhancement of Local Mixing
S. Shimizu, N. Matubayasi
J. Phys. Chem. B, 128, 5713-5726, 2024

Sorption Hysteresis: A Statistical Thermodynamic Fluctuation Theory
S. Shimizu, N. Matubayasi
Langmuir, 40, 11504-11515, 2024

Simple and complex sorption−solution isotherms for membrane polymers: A statistical thermodynamic fluctuation theory
S. Shimizu, O. Vopička, K. Friess, N. Matubayasi
Physica A, 642, 129753 (16 pages), 2024

Unveiling interatomic distances influencing the reaction coordinates in alanine dipeptide isomerization: An explainable deep learning approach
K. Okada, T. Kikutsuji, K. Okazaki, T. Mori, K. Kim, N. Matubayasi
J. Chem. Phys., 160, 174110 (8 pages), 2024

Yoshida, Ken
Associate Professor, Department of Applied Chemistry, Graduate School of Technology,

Industrial and Social Sciences, Tokushima University
email: yoshida.ken@tokushima-u.ac.jp
URL: http://pub2.db.tokushima-u.ac.jp/ERD/person/189117/work-en.html

Hydrothermal Reactions of Amines for Boiler Water Treatment: Fundamental Insights and Future Perspectives
K. Yoshida
Chem. Eng., 89, 253-256, 2025 (in Japanese)
Effect of Cage Occupancies on Molecular Vibrations of Methane in Structure H Clathrate Hydrate: Ab Initio Molecular Dynamics Simulation,
K. Yoshida, S. Suhara, N. Noguchi
J. Phys. Chem. B, 128, 23, 5727, 2024

Nakahara, Masaru
Professor Emeritus, Institute for Chemical Research, Kyoto University
Email: nakahara@scl.kyoto-u.ac.jp

Dream and Hope of Solution Chemistry
Masaru Nakahara
J. Japan Assoc. Solution Chem., 5, 1-2, 2024

Uchida, Hiroshi
Senior Researcher, Physical and Chemical Oceanography Research Group, Global Ocean Observation Research Center, Research Institute for Global Change, Japan Agency for Marine-Earth Science and Technology (JAMSTEC)
Email: huchida@jamstec.go.jp

Development of Multiparametric Standard Seawater (MSSW) for CO2 parameters, dissolved oxygen, and density of seawater
H. Uchida, A. Murata, M. Wakita, H. Mitsuda, Y. Nagasawa, T. Tanaka, Y. Kayukawa, K. Takeda, K. Ito, T. Yoshimura, D. Sasano
Springer Oceanography, 2025, doi:10.1007/978-981-96-2520-8_12

On Japanese Standard Seawater for salinity measurements used during and after World War II
H. Uchida
Springer Oceanography, 2025, doi:10.1007/978-981-96-2520-8_11

Changes in the composition of International Association for the Physical Sciences of the Ocean Standard Seawater
H. Uchida, M. Wakita, A. Makabe, A. Murata, A. Petrovic
Springer Oceanography, 2025, doi:10.1007/978-981-96-2520-8_10

History of batch-to-batch comparative studies of International Association for the Physical Sciences of the Ocean Standard Seawater
H. Uchida, M. Oe, M. Wakita
Springer Oceanography, 2025, doi:10.1007/978-981-96-2520-8_9

Sawatsubashi, Tetsuya
Manager, Research & Innovation Center, Mitsubishi Heavy Industries, Ltd.
Email: tetsuya.sawatsubashi.np@mhi.com

Report on 4th The Technical Subcommittee for Water-Steam Cycle Chemistry (8th Technical Discussion Meeting)
T. Sawatsubashi
The Thermal and Nuclear Power, 76, 62-65, 2025 (in Japanese)

Ichihara, Taro
Senior Engineer, Service Division, Mitsubishi Heavy Industries Power IDS Co., Ltd.
Email: taro.ichihara.jp@mhi.com

Report on 4th The Technical Subcommittee for Water-Steam Cycle Chemistry (8th Technical Discussion Meeting)
T. Ichihara
The Thermal and Nuclear Power, 76, 62-65, 2025 (in Japanese)

Recent Experience in Hydrogen Damage on Evaporator Tubes of Water-Tube Boilers
T. Ichihara
J. Japan Boiler Assoc., 449, 17-24, 2025 (in Japanese)

Nakatsuchi, Yuta
Senior Deputy Manager, Research & Innovation Center, Mitsubishi Heavy Industries, Ltd.
Email: yuta.nakatsuchi.mc@mhi.com

Novel Prediction Model Based on the Two-Film Theory for the Ammonia Distribution Coefficient in Heat Recovery Steam Generators of Gas Turbine Combined Cycle Power Plants
Y. Nakatsuchi, H. Kido, A. Hamasaki, S. Fujimoto
Power Plant Chem., 27(2), 102–112, 2025

Field Experience of Improving Plant Operation by Applying High-AVT(LO) at Sendai Thermal Power Station Unit 4
Y. Nakatsuchi, Y. kawahata, H. Takahashi, M. Urata, Y. Takanami, N. Urata
The thermal and Nuclear Power, 74, 253–261, 2025

Novel Identification Method for Seawater Contamination into Water-Steam Cycles
Y. Nakatsuchi, A. Hamasaki, H. Kido, T. Iwato
Power Plant Chem., 26, 112–117, 2024

Sanehiro, Muromachi
Associate Professor, Graduate School of Engineering, Yokohama National University

email: Muromachi-sanehiro-sf@ynu.ac.jp
URL: https://er-web.ynu.ac.jp/html/MUROMACHI_Sanehiro/en.html

Phase equilibrium data for semiclathrate hydrates formed with *n*-propyl, tri-*n*-butylammonium bromide and tri-*n*-butyl, *n*-pentylammonium bromide under methane, carbon dioxide and nitrogen gas pressure
S. Muromachi, S. Takeya, K. Suzuki, N. Tenma
Fluid Phase Equilibr., 587, 114213, 2025

Discovery of the final primitive Frank-Kasper phase of clathrate hydrates
S. Muromachi, S. Takeya
Sci. Adv., 10, eadp4384 (7 pages), 2024

Microstructural investigation of morphology and kinetics of methane hydrate in the presence of tetrabutylammonium bromide: Insights for preservation and inhibition
S. Takeya, S. Muromachi, M. Muraoka, K. Suzuki, N. Tenma, K. Hirano, K. Hyodo, M. Kawamoto, A. Yoneyama
J. Chem. Phys., 160, 154704, 2024

III. Presentations at JPAPWS General Meetings:

FY2025 1st General Meeting, May 13, 2025
Experience of Large-Scale Electrode-Type Electric Boilers
Yasuhiro Kawahara (Kimura Chemical Plants Co., Ltd.)

Big Data Factorial Analysis using Plant Operational Data for Dose Rate Reduction
Nobuo Ishihara（Mitsubishi Heavy Industries, Ltd.）

Hydrazine Alternatives for the Pressurized Water Reactor/Pressurized Heavy Water Reactor Secondary System: Evaluation of Hydrogen Injection
Nobuo Ishihara（Mitsubishi Heavy Industries, Ltd.）

Water Chemistry of PWR Plants Expressed with Numbers
Nobuo Ishihara（Mitsubishi Heavy Industries, Ltd.）

FY2024 4th General Meeting, March 21, 2025
How Film-Forming Amines (FFAs) Affect Flow-Accelerated Corrosion (FAC) – Laboratory Results and the Needs for Further Investigation
Sarita Weerakul（University of New Brunswick）

Evaluation of flow and heat transfer characteristics of phase-change slurries
Hiroyuki Kumano（Aoyama Gakuin University）

FY2024 3rd General Meeting & Tour, January 31, 2025
DKK-TOA Corporation, Saitama Factory (Research and Development Center (RDC), Medical Device Center (MDC), Sayama Integration Center (SIC))
Overview of DKK-TOA Corporation, explanation of the Saitama Factory, and tour of the

Saitama Factory facilities

FY2024 2nd General Meeting, December 18, 2024
Advanced control and application to green chemical processes of organic reactions in hot compressed water
Makoto Akizuki（The University of Tokyo）

Research on the roles of hot compressed water as a reaction medium in pinacol rearrangement
Shotaro Seki（The University of Tokyo）

FY2024 1st General Meeting, May 28, 2024
Development of Novel Water Quality Management method for Water-Steam Circuits of Gas Turbine Combined Cycle Power Plants
Yuta Nakatsuchi（Mitsubishi Heavy Industries, Ltd.）

Adsorption Behavior of OLDA and the Effect of Adsorbed OLDA on Contact Angle
Yuta Nakatsuchi（Mitsubishi Heavy Industries, Ltd.）

Cage Occupancy Analysis and Phase Diagram Prediction in Clathrate Hydrates through Monte Carlo Simulations
Hirotaka Kishimoto（Keio University）

IV. Presentations at JPAPWS Symposium:

The JPAPWS Symposium 2025, June 1, 2025
—Physical Chemistry of Water and Aqueous Solutions: From Molecular-Level Analysis to Water Quality Management Technology—

Water Treatment Technologies Contributing to Productivity and Energy Efficiency
Shintaro Mori (Kurita)

Chemistry of Film-forming Amines and Aqueous Solutions: Future Perspectives through Advanced Fundamental Research and Academic-Industrial Collaboration
Ken Yoshida (Tokushima University)

Structure of liquid water studied by neutron and X-ray diffraction methods
Yasuo Kameda (Yamagata University)

Research of Water Quality Management for Gas Turbine Combined Cycle Power Plant
Yuta Nakatsuchi（Mitsubishi Heavy Industries, Ltd.）

Hydrogen damage in a power boiler: Correlations between damage distribution and thermal-hydraulic properties
Taro Ishihara (Mitsubishi Heavy Industries Power IDS Co., Ltd.)

Experimental studies on water, ice and clathrate hydrates under high pressure using

diamond anvil cell
Naoki Noguchi (Tokushima University)

Temperature dependence of gas solubilities in water coexisting with hydrates
Hideki Tanaka (Okayama University)

Molecular simulation of water and machine learning
Kenji Yasuoka (Keio University)

All-Atom Energetics of Cosolvent Effects on Aggregation of Functional Molecules
Nobuyuki Matubayashi (Osaka University)

Molecular dynamics study of water and polymers —Molecular mechanism of swelling and embrittlement—
Susumu Okazaki (Yokohama City University)

Protein reaction intermediates detected by time-resolved diffusion technique in aqueous solution
Masahide Terazima (Kyoto University)

Life Devoted to Science and Engineering
Masaru Nakahara (Kyoto University)

The JPAPWS Symposium 2024, October 22, 2024
—The forefront of Japan's GX and hydrogen/ammonia utilization technologies—

Utilizing Fuel Ammonia in Thermal Power Generation for Achieving Carbon Neutrality
Miki Ichihara (IHI)

Thermodynamic Property Measurements of High-Pressure Hydrogen up to 100 MPa and Thermodynamic Modeling of the Refueling Process at Hydrogen Stations
Naoya Sakoda, Y. Tanaka, (Kyushu University)

IRS-WG in IAPWS and a domestic WG on “Basic Technologies of Power plants”
Nobuo Okita (Toshiba Energy Systems & Solutions Corporation)

Introduction of IAPWS／PCC WG Activities
Shinichi Terada (Toshiba Energy Systems & Solutions Corporation)

Hydrothermal electrochemical process for carbon circulation
Takaki Tomai (Tohoku University)

Overview of Anion Exchange Membrane Water Electrolysis
Hiroshi Ito (Aist)

Development of hydrogen production by High Temperature Gas Cooled Reactor toward a carbon neutrality

Takeshi Matsuo (Mitsubishi Heavy Industries, Ltd.)

Green Transformation Strategy for carbon neutrality toward 2050 - Domestic and International Trends in Hydrogen and Ammonia Utilization Technology for Thermal Power Generation -
Yoshio Takagi (Thermal and Nuclear Power Engineering Society)

Attachment 13 Germany/Switzerland

GSAPWS to IAPWS Executive Committee

Research Activities on the Properties of Water and Steam of the German-Swiss Association for the Properties of Water and Steam (GSAPWS) e.V. in the Period 2024/2025

https://gsapws.org

First Chair: Prof. Dr. Hans-Joachim Kretzschmar
Zittau/Goerlitz University of Applied Sciences, Zittau, Germany

Second Chair: Michael Rziha
PPCHEM AG, Hinwil, Switzerland

Deputy Chair: Prof. Dr. Karsten Meier
Helmut Schmidt University, Hamburg, Germany

Deputy Chair: Tapio Werder
PPCHEM AG, Hinwil, Switzerland

The 2025 General Meeting and the Annual Meeting of the German-Swiss Association for the Properties of Water and Steam (GSAPWS) took place at the Ruhr University Bochum on 6 and 7 March, 2025.

In the following, activities of certain members of the German-Swiss Association for the Properties of Water and Steam in the years 2024 to 2025 are summarized.

GFZ Helmholtz Centre for Geosciences
Section 4.3 - Geoenergy, Potsdam
Dr. Harald Milsch, Ulrike Hoffert

Project

Geothermal fluids display a huge variability in chemical composition and salinity. The approach that is pursued at GFZ is to fill the existing data gaps systematically by determining the properties of synthetic fluids containing the main salts only, i.e. typically NaCl, $CaCl_2$, and KCl. To evaluate the error in density, viscosity and electrical conductivity that comes with neglecting the minor constituents of natural fluids, four European geothermal sites are selected that span a huge variability in salt concentration and composition. For each site, four synthetic samples are prepared and parameterized by measurements for the abovementioned properties as a function of temperature, one containing the main salts only and the three others containing one dominant minor salt each in addition to the former base solution. In cooperation with BRGM, France, the resulting original data points are compared with predictions from numerical modelling using the PHREESCALE geochemical code in connection with PhreeqC. Preliminary results for density indicate an excellent match. This study is ongoing and the results will be published after completion.

Recent Publications

In the past, aqueous solutions of NaCl, $CaCl_2$ and defined mixtures thereof were parameterized for density and viscosity up to saturation, at temperatures between 293 K and 353 K, and ambient pressure. Two publications of these findings were submitted to and published in *Geothermal Energy* (Springer; Hoffert et al., 2024; 2025):

- Ulrike Hoffert, Laurent André, Guido Blöcher, Sylvain Guignot, Arnault Lassin, Harald Milsch, Ingo Sass (2024): Density of pure and mixed NaCl and $CaCl_2$ aqueous solutions at 293 K to 353 K and 0.1 MPa: An integrated comparison of analytical and numerical data. Geothermal Energy, 12, 39. https://doi.org/10.1186/s40517-024-00318-1
- Ulrike Hoffert, Guido Blöcher, Stefan Kranz, Harald Milsch, Ingo Sass (2025): Viscosity of pure and mixed aqueous NaCl and $CaCl_2$ solutions at 293 K to 353 K and 0.1 MPa: a simple empirical correlation parameterized with original analytical data. Geothermal Energy, 13, 15. https://doi.org/10.1186/s40517-025-00339-4

Helmut Schmidt University / University of the Federal Armed Forces Hamburg
Institute of Thermodynamics
Prof. Dr. Karsten Meier, Dr. Robert Hellmann

Project

In an ongoing project, thermophysical properties of mixtures of water vapor and simple gases are predicted from first-principles calculations. Investigated properties include second and third virial coefficients, with an important application being the enhancement factors of water and ice. Furthermore, the transport properties shear viscosity, thermal conductivity, and binary diffusion coefficient in the dilute gas limit are calculated. So far, the gases nitrogen, oxygen, argon, carbon dioxide, air, hydrogen, carbon monoxide, hydrogen sulfide, and sulfur dioxide have been investigated.

Recent Publications

- Hellmann, R.:
  Cross Second and Third Virial Coefficients and Dilute Gas Transport Properties of the (H_2O + Ar) System from First-Principles Calculations.
  J. Chem. Eng. Data 69, 942-957 (2024).

PPCHEM AG, Hinwil
Tapio Werder, Michael Rziha

The activities of the PCC Working Group were limited to a small contribution to the revision of the White Paper "Sampling, monitoring and analysis of corrosion products for flexible and fast-starting equipment" (PCC W P 24-001, published January 2025; https://www.iapws.org/wg/PCC.html).

Publications in the PPCHEM® Journal which are of Interest for PCC:

- "Water Treatment of Flue Gas Condensate – White Paper" Nordic IAPWS; PPCHEM® 2024, 26(6), 308–331.
- "IAPWS TGD2-09(2024): Instrumentation for Monitoring and Control of Cycle Chemistry for the Steam/Water Circuits of Fossil-Fired, Combined Cycle, and Industrial Power Plants" IAPWS, PPCHEM® 2024, 26(5), 250–275.

Ruhr University Bochum
Faculty of Mechanical Engineering, Chair of Thermal Turbomachines and Aeroengines
Prof. Dr. Francesca di Mare

Projects:

1. Supercritical CO_2-based power cycles require consideration of non-ideal thermodynamics and compressible turbulence. Recently, we studied the decay of homogeneous isotropic turbulence with eddy shocklets using Direct Numerical Simulation. We consider both ideal gas and use Span-Wagner reference equation of state to model supercritical CO_2. The results are explicitly filtered, allowing for evaluation of a previously untested, yet universally accepted assumption, that the computable temperature and pressure (outputs of the equation of state using the available filtered

quantities) are good approximations for the true filtered temperature and pressure. For the investigated thermodynamic state, the approximation does not result in a great error, however it does influence both the mean and the shape of PDF of both variables. The findings from this work were not only presented at the 6th conference on Non-Ideal Compressible Fluid Dynamics in Lyon but also at this year's GSAPWS meeting in Bochum (see [1]).

2. We conducted the first-of-its-kind full-crown Detached-Eddy Simulation (DES) of a radial turbine designed for the operation in a supercritical CO_2-based power cycle. The simulation domain not only models the main blade passage, but also the exhaust diffuser and the rotor disk cavities. Thermophysical properties of CO_2 are modelled with the Span-Wagner reference equation which is evaluated by a highly efficient spline-based table look-up method (created by Matthias Kunick in a similar fashion as needed for our previous wet steam computations). The hybrid RANS/LES models, using Improved Delayed Detached-Eddy Simulation approach, are validated in a flow around a circular cylinder at Re = 3900, obtaining excellent agreement with other experimental and numerical studies. A preliminary assessment of the grid quality in the context of DES is performed for the full-crown simulation, and characteristic flow features of the main passage and cavity flow are highlighted and discussed. The SBTL method proved here again superior performance and accuracy (see [2,3]).

Recent Publications:

[1] Lea, B.; Sadowski, W.; di Mare, F.:
Evaluating differences between the computable and filtered state variables in supercritical CO_2.
Proceedings of the 5th International Seminar on Non-Ideal Compressible Fluid Dynamics for Propulsion and Power. (in publication process)

[2] Lea, B.; Lo Presti, F.; Sadowski, W.; di Mare, F.:
Detached Eddy Simulation of a Radial Turbine operated with supercritical CO_2.
Proceedings of the 16th European Turbomachinery Conference (ETC16)
Turbomachinery, Fluid Dynamics and Thermodynamics. Paper No. ETC2025-273.

[3] Lea, B.; Lo Presti, F.; Sadowski, W.; di Mare, F.:
Detached Eddy Simulation of a Radial Turbine operated with supercritical CO_2.
International Journal of Turbomachinery, Propulsion and Power (in preparation).

SWAN Analytische Instrumente AG, Hinwil (Switzerland)
Mar Nogales

Contribution to the revision of the White Paper "Sampling, monitoring and analysis of corrosion products for flexible and fast-starting equipment" (PCC W P 24-001, published January 2025; https://www.iapws.org/wg/PCC.html).

Contribution to the released revision of the TGD "IAPWS TGD2-09(2024): Instrumentation for Monitoring and Control of Cycle Chemistry for the Steam/Water Circuits of Fossil-Fired, Combined Cycle, and Industrial Power Plants"

Technical University of Dresden
Institute of Power Engineering, Thermal Power Machinery and Plants
Dr. Andreas Jäger

Projects:

1. The cooperation regarding the establishment of gas hydrate models, in particular hydrogen hydrates, with colleagues from the Institute of Thermomechanics of the Czech Academy of Sciences in Prague and from Ruhr-University Bochum is continued. TU Dresden is supporting the work, which is mainly carried out within a DFG-project by Ruhr-University Bochum with Dr. Václav Vinš from the Czech Academy of Sciences being a "Mercator Fellow" of the project. An extension of the model to gas hydrates forming structure sH has been submitted to The Journal of Chemical Physics and is currently under review.

2. Within the project "Optisyskom", heat transfer coefficients in annular cavities in the casing of steam turbines are investigated experimentally and theoretically. The project is finished and the final report is currently compiled.

Recent Publications:

[1] Fiedler, F.; Vinš, V.; Nguyen Nhat, L.; Jäger, A.; Span, R.: Extension of a hydrate model for structure H applied to multiparameter equations of state. Submitted to The Journal of Chemical Physics, 2025.

Zittau/Goerlitz University of Applied Sciences, Faculty of Mechanical Engineering / KCE-ThermoFluidProperties, Amberg
Prof. Dr. Matthias Kunick, Prof. Dr. Hans-Joachim Kretzschmar,
Dr. Sebastian Herrmann

Projects

1. Development of a neu industrial formulation for steam and water using Spline-Based Table Look-Up Method (SBTL)
   - Evaluation of STBL-Property Functions based on IAPWS-IF97 and IAPWS-95 in power cycle simulations, together with Siemens Energy Erlangen, Iqony Solutions Zwingenberg and Chair of Thermal Turbomachines and Aeroengines of Ruhr University Bochum.
2. Development of fast property-calculation algorithms for gaseous mixtures of water with non-condensable gases in thermo-hydraulic process simulations:
   - Development of computationally efficient algorithms for the properties of gaseous mixtures of water vapor with Ar, CO, CO_2, He, H_2, N_2, and O_2. The mixture model combines the ideal mixing of real fluids with a residual part obtained from a virial-mixing approach or a one-fluid model.
   - Implementation and verification of the property library LibSBTL95 in ATHLET.
3. Application of the Spline-Based Table Look-Up Method (SBTL) to humid air
   - SBTL functions have been developed for water and steam as well as for dry air and the enhancement factor. These SBTL functions have been implemented into a new property library for humid air which is successfully applied at the Fraunhofer UMSICHT, Oberhausen, for the simulation of Advanced Adiabatic Compressed Air Energy Storages (AA-CAES).
   - Implementation and verification in the software KRAWAL of Siemens
4. Development of a new ASHRAE standard for calculating thermodynamic properties of moist air, ASHRAE Project SPC 213P: Method for Calculating Moist Air Thermodynamic Properties.
   - The vapor pressure and saturation temperature equations of the IAPWS-IF97 Industrial Formulation and the melting pressure equation of the IAPWS Formulation 2011 are being incorporated into the new ASHRAE Standard, Method for Calculating Moist Air Thermodynamic Properties.

Attachment 14 New Zealand

NEW ZEALAND
Association for the Properties of
WATER & STEAM

Tō AOTEAROA
Rangā mō ngā Āhuatanga o te
WAI ME TE MAMAOA

New Zealand Association for the Properties of Water and Steam (NZAPWS) Annual Report

Date: 27 June 2025

Key Achievements:

1. NZAPWS is now into its 9th year of full IAPWS membership

2. Successfully arranged and hosted a major 2024 NZAPWS Symposium on industrial steam and electrode boilers in person meeting in Queenstown, New Zealand in August 2024 which also including inviting and supporting Monika Nielson to attend as a keynote speaker to help represent IAPWS. The Symposium attracted 75 attendees. The meeting was financially successful bringing in approximately NZ$5,600 for NZAPWS after expenses have been paid.

3. NZAPWS will hold another symposium in 2026 on a biennial basis

4. NZAPWS has robust funding in place and has gained additional sponsors for the 2025/2026 year as part of the NZAPWS 2024 and is in a good financial position

5. NZAPWS has an active membership covering the following areas:
    a. Fossil power generation
    b. Industrial steam production and use for dairy product production
    c. Geothermal power generation (subsurface and surface operations)
    d. Humidity research and services
    e. Water/steam analytical services
    f. Water/steam chemical treatment and services
    g. Electrode/electrical resistance boilers

6. NZAPWS have a dedicated website – www.nzapws.org.nz to provide relevant information and to manage meetings for NZAPWS

Key Activities:

1. NZAPWS 2024 meeting very successful

2. NZAPWS supported the AUSAPWS 2025 meeting

3. Next NZAPWS meeting to be in 2026

4. David Addison of NZAPWS continues as PCC Chair

5. David Addison and Ian Richardson have continued working on geothermal related aspects for a IAPWS white paper along with Nobuo Okita (Toshiba) of Japan. Work is ongoing

6. David Addison is working on a electrode boiler TGD with Monica Nielsen

7. Jeremy Lovell-Smith has had ongoing involvement in TPWS and SCW and intends to continue to be actively involved (but unable to attend IAPWS 2025)

Publications:
None for 2025 at this stage

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NZAPWS Chairperson
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Web: www.nzapws.org.nz

NEW ZEALAND
Association for the Properties of
WATER & STEAM

Tō AOTEAROA
Ranga mō ngā Āhuatanga o te
WAI ME TE MAMAOA

Attachment 15 United States

U.S. National Committee to IAPWS
2025 Report on Activities of Potential Interest to IAPWS

Communicated from the National Institute of Standards and Technology, Boulder, CO and Gaithersburg, MD:

In collaboration with G. Garberoglio (Italy) and R. Hellmann (Germany), calculations have been performed (in the context of a review article) for the enhancement factors of ice and liquid water in various gases as a function of temperature and pressure. Special attention was given to documenting the size of the effect of truncating the virial equation for gas-phase thermodynamics after the second coefficient, to the effect on the enhancement factor of changing from one gas to another, and to calculating water–gas second virial coefficients from first principles. Reference: A.H. Harvey, G. Garberoglio, and R. Hellmann, "Vapor-phase thermodynamics of aqueous mixtures from the virial expansion," in *Molecular Thermodynamics of Aqueous Systems*, T.R. Letcher and E. Wilhelm, eds. (Royal Society of Chemistry, in press).

High-accuracy refractivity measurements have been performed on water vapor (and heavy water vapor) between 293 K and 433 K at an optical frequency, and at 303 K at a frequency in the near infrared. Comparison with the IAPWS formulation for the refractive index of ordinary water indicates that there is some room for improvement, with about a 2% discrepancy in the low-density limit. References: P.F. Egan and Y. Yang, "Optical $n(p, T_{90})$ measurement suite 2: H_2O and D_2O," *Int. J. Thermophys.* **45**, 89 (2024); P.F. Egan and Y. Yang, "Optical $n(p, T_{90})$ measurement suite 3: Results at λ = 1542 nm," *Int. J. Thermophys.* **45**, 120 (2024).

Communicated from OLI Systems Inc., Parsippany, NJ:

Aqueous chemistry of critical materials

OLI continued its work on aqueous chemistry modeling in support of the development of novel processes for the recovery and recycling of critical materials. This work is conducted under the auspices of the US Department of Energy's Critical Materials Institute. In 2024, the work was focused on thermodynamic modeling for the recovery of lithium ion battery components and on the biological effects of dissolved rare earth elements. The results of the work on the recovery of cobalt and nickel from end-of-life lithium ion battery cathodes have been published in the following paper:

> J.R. Klaehn, M. Shi, L.A. Diaz, D.E. Molina, R. Repukaiti, F. Madani Sani, M. Lencka, A. Anderko, N. Arulsamy, T.E. Lister, "Fractional Precipitation of Ni and Co Double Salts from Lithium-Ion Battery Leachates," RSC Sustainability, 2 (2024) 3298-3310.

The following review addresses the recent results and challenges in the development of rare earth separation techniques using biotechnology:

> Y. Fujita, D. Park, M. Lencka, A. Anderko, D. Reed, V. Thompson, G. Das, A. Eslamimanesh, and Y. Jiao, "Beneficiation of Rare Earth Elements: Prospects for

Biotechnology Deployment," Chapter 8 in "Rare Earth Elements: Sustainable Recovery, Processing, and Purification," edited by A.K. Karamalidis and R. Eggert, Wiley (2025), pp. 251-297.

Thermodynamic and kinetic modeling of mineral scaling

OLI worked on the development of models for predicting the formation of mineral scales using both thermodynamic and kinetic models. Recent work focused on the prediction of induction time for the precipitation of common mineral scales such as calcium carbonate and various alkaline earth sulfates. The models are designed for applications in water treatment and geothermal energy production. The results are described in the following conference paper:

G. Das, R.D. Springer, J.J. Kosinski and A. Anderko, "Scaling Risk Assessment and Remediation in Geothermal Operations Using a Novel Theoretical Approach," AMPP Annual Conference, paper no. C2024-20701, New Orleans, LA, March 3-7, 2024.

Attachment 16 Netherlands (Associate)

DIAPWS update 2025 – Finland meeting

After the Boulder USA meeting in 2024, Dutch IAPWS has increased membership with another utility based on a chemical processing facility. USG Utilities is a new member, currently 10 new members. It is anticipated that one of the members will include its group members in 2026 and this will entail almost all power production in Netherlands participating.

3 Meetings were held between Boulder meeting and Finland meeting, 2 in person (SloeCentrale in Terneuzen and at Onyx Power station in Rotterdam), 1 online meeting.

Two collective projects were completed and also presented to the working group Power Cycle Chemistry of IAPWS namely:

- a round robin on TOC measurements with 7 members participating and 1 external lab. Also a comparison with online TOC measurements were made
- Alarm management, aim to Gain insight in how operators monitor the water/steam cycle and prevent alarm overloads. Technical interviews were carried out at 2 gas fired and 2 coal fired power plants.

Budget was secured from 4 DIAPWS members (Eneco, EPZ Borsele, Uniper and Onyx) to build the DIAPWS website, LinkedIn page and organization of Dutch DIAPWS open event. The open event is planned for 3rd of March 2026 in Amersfoort. The event will be in Dutch with different technical speakers. To be invited:

- Power industry Paper mills Boiler manufacturers
- Waste2Energy Oil & Gas Suppliers (Analytical, Monitors, Chemicals)

The aim is increase the membership and gather participation funds to finance future DIAPWS activities.

Attachment 17 Israel (Associate)

Status Report to the IAPWS Executive Committee

Dear Members of the Executive Committee,
ISRAPWS (IAPWS Israel) is a non-profit association dedicated to the sharing of experience and technical knowledge among professionals in the field of water and steam properties. Our core activity is the facilitation of knowledge exchange and community engagement among members working in thermal power cycles, process industries, and related scientific applications.

Our main annual event is a one-day symposium traditionally held each November at a conference venue in Petach-Tikva. The agenda typically includes professional and technical lectures focused on water and steam chemistry, operational challenges, and relevant case studies. An open discussion session is also held to promote direct dialogue in an open and friendly environment—an atmosphere we aim to foster throughout the year among all community members.

In addition to the annual conference, other activities include webinars and personal contact among members of the community. Our most recent webinar featured **Dr. Daniel Friend (IAPWS)** and was very well received. Additional webinars are planned for the near future. The agenda of our most recent conference (2024) is attached to this report for your reference.

ISRAPWS operates entirely in the spirit of non-profit activity. All organizational work is conducted by volunteers, and funding for the annual symposium is secured through modest sponsorships from

participants. Looking ahead, we are committed to strengthening the community and increasing our influence and financial sustainability.
At the first session of the 2024 conference, a central topic was the management of operational risks and crisis situations in process factories and power plants. This included a case study from a power plant incident that occurred on October 7, 2023.

We had planned to participate in the upcoming IAPWS Annual Meeting (22–27 June 2025, Helsinki), with the intention of meeting the EC and engaging in discussions on water-steam chemistry and power plant operations. Unfortunately, due to current regional flight restrictions (no-fly zone), we have had to cancel our travel plans.
We hope to meet you at a future IAPWS event and continue our active contribution to the organization.

On behalf of ISRAPWS, I extend our sincere thanks to the Executive Committee for your continued support and for welcoming us as an Associate Member of IAPWS.

With respect and appreciation,

Yitzhak Nussbaum
Executive Secretary
ISRAPWS – IAPWS Israel
20.6.2025

Attachment 18 Argentina & Brazil (Associate)

The Argentine National Committee
International Association for the Properties of Water and Steam.

Report on IAPWS related scientific activities – 2020-2025

Submitted to the Executive Committee Meeting, IAPWS
Helsinki, June 2025

National Committee address:
CNEA, Av. Gral. Paz 1499, (1650) San Martín, Buenos Aires – Argentina.

National Representatives:
Dr. Horacio R. Corti. Tel. 5411-6772-7174, E-mail: hrcorti@integra.cnea.gob.ar

Departamento de Física de la Materia Condensada, Centro Atómico Constituyentes, Comisión Nacional de Energía Atómica

Current projects and main results (last five years)

1) Thermophysical properties of supercooled water and supercooled water solutions in bulk and confined in nanopores

Following with a research area focused on the properties of supercooled and vitrified water and aqueous solutions we completed studies on the glass transition temperature of mixtures water-glycerol and water-tetraethylene glycol mixtures in bulk and confined in mesoporous silica.
A study on the thickness of the cuasi-liquid layer in the ice-liquid water interface as a function of the supercooling degree was performed using and modified AFM technique.
In collaboration with colleagues from several groups all around the world two reviews were published on the structure and dynamics of nanoconfined water and aqueous solutions and on advances in the study of supercooled water.

2) Transport properties of aqueous solution in confined media

The electro-osmotic flow of water-methanol mixtures through Nafion membranes was studied in relation with the performance of direct methanol fuel cells. Also, we studied the effect of carbon mesoporous structure on the transport properties of confined LiCl chloride aqueous solutions.

By resorting to a neutron radiography technique, we studied the wettability, imbibition and interdiffusion of concentrated LiCl aqueous solutions in nanoporous carbon in relation to energy storage.

3) Structural, thermodynamics and transport properties of Water-in-Salt electrolytes

The superconcentrated aqueous solutions, also called Water-in-Salt electrolytes (WiS), having less than two water molecules per cation and exhibiting a wide electrochemical window, have emerged as interesting electrolytes in advanced batteries and supercapacitors.
We have studied the nanostructure of lithium-based WiS using SANS technique and determined its volumetric and transport properties.

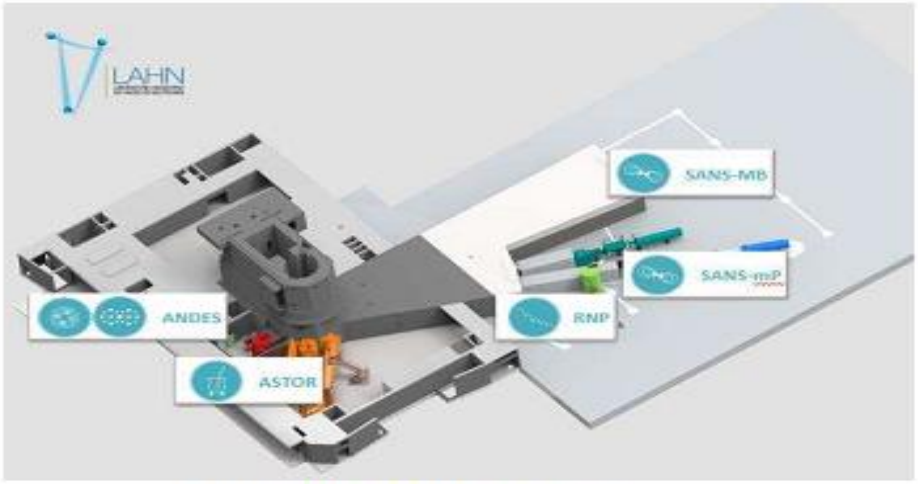
4) Volumetric properties of ^{18}O-enriched water

We developed a simple and low-cost densitometric technique to determine the ^{18}O content of ^{18}O-enriched water in relation to the production of ^{18}F-labelled radiopharmaceuticals.
An analysis of the volumetric properties of ^{18}O heavy water and ordinary water has been completed and it allowed us to determine the density and molar volume of pure ^{18}O water.

5) LAHN, a new facility for the study of water containing materials

The Argentine Neutron Beam Argentine Laboratory (LAHN) is an open and user-oriented facility that will be dedicated to the study and characterization of matter by means of state-of-the-art neutron techniques. It will use the neutron beams provided by the multipurpose nuclear reactor RA-10 currently being built by CNEA at the Ezeiza Atomic Center (Buenos Aires). LAHN, planned to start operating in 2027 aims to become a hub for interdisciplinary research providing world-class tools for that are particularly useful for in-situ or in-operando studies of materials having water. Properties like charge neutrality, spin angular momentum and range of wavelengths make thermal and cold neutrons a valuable probe for non-destructive investigations in a variety of systems and provide some unique advantages in comparison with X-rays, because their strong interactions with light element, like H.
The techniques that will be available at LAHN include:
- ANDES, a diffractometer oriented to the study of objects and materials, with the capacity of precisely defining the volume gauged by the experiment on a mm scale.

- ASTOR is an imagine instrument, capable of producing neutron radiographies and tomographies, as well as «movies» of processes.
- SANS-MB is a small angle neutron scattering optimized for soft matter experiments and small samples,
- SANS-MP is multi-purpose SANS, with polarized neutron and a wider q-range.
- RNP is a reflectometer with the possibility of polarized neutrons, specially interesting for the study of interfaces.



Scheme of the instruments at LAHN

Publications (last five years)

- Environmental chamber with controlled temperature and relative humidity for ice crystallization kinetic measurements by Atomic Force Microscopy (AFM).
M. M. Gianetti, J. Gelman Constantin, H. R. Corti, M. P. Longinotti, Rev. Sci. Instrum. 91 (2020) 023704.

- Mobility-viscosity decoupling and cation transport in super-concentrated aqueous lithium electrolytes
G. Horwitz, C. R. Rodríguez, P. Steinberg, G. Burton, H. R. Corti. Electrochim. Acta, 359 (2020) 136915.

- Volumetric and viscosity properties of water-in-salt lithium electrolytes: a comparison with ionic liquids and hydrated molten salts.
G. Horwitz, P. Steinberg, H. R. Corti. J. Chem. Termodyn. 158 (2021) 106457.

- Effect of the carbon mesoporous structure on the transport properties of confined lithium chloride aqueous solutions.
E. Fuentes Quezada, S. A. Maldonado Ochoa, R. H. Acosta, F. Vaca Chávez, M. Bruno, E. de la Llave, M. P. Longinotti, H. R. Corti, Micropor. Mesopor. Mater., 323 (2021) 111255.

- The Nanostructure of Water-in-Salt Electrolytes Revisited: Effect of the Anion Size.
G. Horwitz, E. Härk, P. Y. Steinberg, L. P. Cavalcanti, S. Risse, H. R. Corti. ACS Nano 15 (2021) 11564–11572.

- Revisiting the glass transition of water-glycerol mixtures in the bulk and confined in mesoporous silica.
I. Angarita, M. F. Mazzobre, H. R. Corti, M. P. Longinotti, Phys. Chem. Chem Phys. 23 (2021) 17018-17025.

- Structure and dynamics of nanoconfined water and aqueous solutions.
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- Advances in the study of supercooled water.
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Attachment 19 China (Associate)

Hello, President, Executive secretary and Colleagues from all countries!

We are so sorry that China electric power plant chemical standardization technical committee cannot send the representative to attend this meeting. I would like to make a brief report on the current situation of the Chinese Committee, and entrust the organizing committee to speak on our behalf.

China electric power plant chemical standardization technical committee is an academic group composed of nearly 40 experts from various research institutes in China. It mainly carries out the formulation and revision of China's standards in Power plant chemistry, and organizes some academic activities of power plant chemistry. As an academic group, China electric power plant chemical standardization technical committee focus on establishing a set of standard system which not only meet the needs of the development of power plant chemistry in China, and also conforms to the development of power plant in the world.

From June 2024, we have held six standardization working meetings, published one ISO international standard, initiated the formulation or revision of five ISO and one IEC international standards, and completed the formulation or revision of 19 Chinese standards in the field of power plant chemistry.

1）ISO：Corrosion of metals and alloys-Corrosion test method for disinfectant-Spraying method

2）ISO：Corrosion and fouling in industrial cooling water systems — Part 1: Guidelines for conducting pilot-scale evaluation of corrosion and fouling control additives for open recirculating cooling water systems

3）ISO：Corrosion and fouling in industrial cooling water systems Part 2: Evaluation of the performance of cooling water treatment programmes using a pilot-scale test rig

4）ISO：Corrosion of metals and alloys-Monitoring method for corrosion states of stainless steel in industrial cooling water

5）ISO：Petroleum and related products－Determination of anti-aging for phosphate ester turbine control fluids

6）ISO：Petroleum and related products－Determination of mineral oil content in triaryl phosphate ester fire-resistant fluids

7）IEC：Solar thermal electric plants–Biphenyl/Diphenyl oxide-based heat transfer fluids for use in line-focus concentrated solar power applications

8）Determination of crushing strength of ion exchange resin for water treatment

9）Technical guide for coal test laboratory in power plant

10）Test methods of fuel in thermal power plant Part 6: Combustible matter in fly ash and bottom ash

11）Testing method and quality of Urea and Urea hydrolysate in power plants

12）Technical requirements and performance acceptance method of intelligent sampling and sample preparation system for power generation coal

13）Technical guidelines for biochemical treatment of power plant wastewater

14）Analysis of water and steam in power plant-Determination of anions - Ion chromatography

15）Test methods of fuel in thermal power plants Part 7：Determination of sulfur in fly ash and bottom ash and calculation of combustible sulfur in coal

16）Determination of online coal analysis using laser-induced breakdown spectroscopy

17）Guidelines for performance testing of membrane water treatment equipment in power plants

18）Guideline for nitrogen filling and corrosion prevention for heat recover boiler of gas-steam combined cycle unit

19）Guideline for the acceptance of tubular membrane equipment for water treatment in power plant

Attachment 20 Greece (Associate)

From 2024 July till today, the effort for expanding interest on IAPWS activities in Greece was continued. Additional people were introduced in the mailing list of the Hellenic Association, mainly from the conventional power generation sector.

The National Committee is actively supporting IAPWS activities, establishing regular update on IAPWS activities (documents, events etc.) to HIAPWS participants. Persons participating in HIAPWS also contribute to IAPWS WGs.

The effort for regular communications/web meetings between the National Committee members has not been as regular as intendent. Still, the main obstacle for officially setting a Committee is the lack of financing.

A web symposium has been organized and implemented in Nov 2024, with presentation of colleagues mainly on water-steam instrumentation topics and with the kind participation of Mr. Dooley. A late winter web symposium is under consideration, but not yet organized.

Attachment 21 Press Release

Press Release

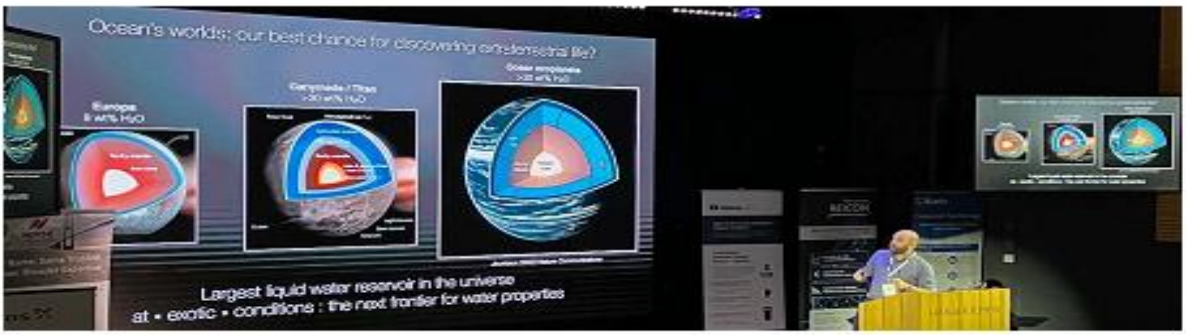
IAPWS Executive Committee and Working Group Meetings

Helsinki, Finland **22 – 27 June 2025**

Between June 22nd and 27th, 96 scientists, engineers and 10 guests representing 20 countries met at the Hanaholmen Convention Centre in Helsinki, Finland for the annual meetings of the IAPWS Executive Committee and Working Groups. This series of meetings began in 1929 in London, UK with the purpose to connect scientists and researchers with the industry operators, engineers and managers who use their work. Collaboration and engagement across these varied groups provides guidance to the researchers on topical problems within industry and provides the engineers with the latest research results for direct application in their facilities.

IAPWS produces releases and guidelines on the recommended scientific formulations for physical and chemical properties of water in its various forms as well as technical guidance documents that are the concerted opinion of IAPWS members on the best operating practices for power plant chemistry. IAPWS also documents certified research needs that represent the opinion of experts in their respective fields that a research topic is greatly needed to fill a current gap in knowledge. All this information is freely available and can be found on the IAPWS website at www.iapws.org.

On Wednesday June 25th, the 2025 IAPWS Symposium "Industrial Boilers, Flue Gas Condensate and Future Technologies" focused primarily upon new frontiers of industrial boiler systems including 11 presentations on topics ranging from flue gas condensate systems, electric boilers and future technologies of power-to-gas plants and small modular nuclear reactors. During the Symposium, the annual Helmholtz award was presented to Dr. Baptiste Journaux (University of Washinton, USA) who excited the audience with his talk "Planetary Science: The new frontier in water and aqueous solutions thermodynamic properties". Dr. Journaux's talk described the



development of new thermodynamic formulations, consistent with IAPWS releases, that describe the properties of ice phases at high pressures as may be found on moons and exo-planets within our solar system and beyond. The work culminated in the definition of a new thermodynamic point – the cenotectic – the invariant point occurring at the lowest temperature at which the liquid phase, for any value of concentration, pressure, or other thermodynamic forces acting on the system, remains in stable. Following the Symposium, the delegates were ferried for the dinner in the Banquet Hall of Tenaille von Fersen, on Suomenlinna, a World Heritage Site with a sea fortress where the annual IAPWS banquet was held. During the banquet, Dr. Andre Anderko was announced as a new IAPWS Honorary Fellow.

IAPWS, through the various working groups, produces releases and guidelines, technical guidance documents (TGD) and IAPWS certified research needs (ICRN). These can be found for free download on the IAPWS website at www.iapws.org.

IAPWS Working Group Thermophysical Properties of Water and Steam (TPWS) discussed primarily the development of a new formulation of thermodynamic properties of ordinary water, replacing in future the currently valid IAPWS-95. IAPWS-95 provides an excellent representation of experimental data in most regions and it has found immense applications in power generation, geophysics, physical chemistry, biochemistry, etc. However, new data, new theoretical knowledge, and new applications require a complete re-design of the formulation. Preliminary work, including a critical revision of existing data, was started in collaboration of the National Institute of Standards and Technology (NIST) in Boulder, USA, Institute of Thermomechanics in Prague, Czechia, and Rühr Universität Bochum, Germany. TPWS also investigated the possibility of updating IAPWS recommendations for the surface tension of ordinary water and for boundaries of liquid and solid phases of water (ices).

Within the Subcommittee for Seawater, an agreement has been reached on how to continue the work of the subcommittee within the framework of a collaboration with TPWS working group. The subcommittee will gather scopes to match the needs of industries and those of the oceanographer community and will help organize a 2026 workshop on sensors adopted in seawater applications.

The Industrial Requirements and Solutions Working Group (IRS) discussed the proposal for a new Industrial Formulation for the properties of water and steam using the Spline-Based Table Look-up method (SBTL) and reported on the evaluation of SBTL property functions based on IAPWS-IF97 and IAPWS-95. According to the presented results, the key decisions on future paths have been met. It was proposed to establish a task group aiming at the evaluating the results to support the draft release at the IAPWS meeting in 2026, leading to a new standard for industrial formulation for fast calculation. A draft of the white paper on "accurate estimation of low sulfur dew point in GTCC for efficient operation avoiding acid corrosion" has been reviewed and the formula is to be further revised to adjust the model to the data and further survey conducted to aim for new IAPWS guideline.

The Physical Chemistry of Aqueous Systems (PCAS) working group showcased significant progress in water chemistry research this year, with particularly active discussions on film forming substances (FFS). Key developments included high-resolution monitoring techniques for amine film assembly on low-roughness metal surfaces, an update on the international collaboration examining the effects of film forming amines (FFA) on flow-accelerated corrosion and their relationship to film structure, and in-situ electrochemical measurements

demonstrating the protective effects of film forming substances against corrosion. Additionally, the working group engaged in valuable discussions on advanced characterization methods using X-ray CT to assess localized corrosion rates in steels under high-temperature, high-pressure conditions, as well as modeling approaches for hydrodynamic cavitation in water at elevated temperatures. These research efforts continue to advance our fundamental understanding of aqueous system chemistry and its practical applications in industrial water treatment and corrosion mitigation.

The Power Cycle Chemistry (PCC) working group had a great week that saw an increase in attendance with detailed and robust technical discussions on emerging technologies and applications. Highlights included summary presentations of recently completed and ongoing International Collaboration Projects on the influence of contaminant concentration on boiler steel corrosion and detailed studies on surface interactions with film forming amines. New insights on oxides formed in supercritical units were presented based upon state-of-the-art electron microscopy, focused ion-beam (FIB) and STEM analyses. This year, the PCC celebrated an enhanced social media presence with updated webpages, a LinkedIn feed and the launch of PCC Webinars and starting to plan this year's activities. Finally, the PCC has updated their Priority Listing for future activities that include topics around cycling and fast-start plants, electrode boilers, training and knowledge transfer and film forming substances.

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 held in Bristol, UK in July 2026. 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. Daniel Friend, dg.friend@iapws.org. People do not need to be citizens or residents of member countries to participate.

Delegates from the IAPWS Symposium, Executive Committee and Working Groups Hanaholmen Convention Centre, Helsinki, Finland – June 25, 2025

Attachment 22 Registration List

Registrant List

First Name	Last Name	Company	Country
Adam	Novy	Doosan Skoda Power a.s.	Czech Republic
Alex	Mokki	Vantaan Energy Ltd	Finland
Allan	Harvey	National Institute of Standards and Technology	United States
André	Frank	E.ON	Sweden
Andre	De Bache	Kurita Europe	Germany
Antti	Kuosmanen	Hyxo Oy	Finland
Antti	Pasanen	Nordic Ren-Gas Oy	Finland
Antti	Nygren	KL - Lämpö Oy	Finland
Arja	Lehikoinen	Valmet Technologies Oy	Finland
Aurel	Ranniste Sachssendahl	Siemens Energy Global GmbH & Co. KG	Germany
Baptiste	Journaux	University of Washington	United States
Barry	Dooley	Structural Integrity	United Kingdom
Benedikt	Lea	Ruhr-University Bochum	Germany
Benjamin	Loder	University of New Brunswick	Canada
Daniel	Friend	IAPWS	United States
David	Addison	Thermal Chemistry Limited	New Zealand
David	De Vos	Laborelec NV/SA	Belgium
David	Little	Nalco Water	United States
Derek	Hall	Penn State University	United States
Dirk	Nyrnberg	Oleinitec Nordic AB	Sweden
Duncan	McAllister	Australian Association for the Properties of Water and Steam	Australia
Eero	Vuorenmaa	Nalco Finland Oy	Finland
Elisabeth	Dahlin	Gothenburg Energi AB	Sweden
Ellen	Sjöstrand	Stockholm Exergi AB	Sweden
Emre	Sener	PETKIM PETROKİMYA HOLDING A.Ş	Turkey

Erkka	Mäkinen	Nalco Finland Oy	Finland
Hans-Joachim	Kretzschmar	KCE-ThermoFluidProperties UG	Germany
Heine	Rosendal	Fredericia Maskinmesterskole	Denmark
Helen	Dömstedt	Adven Sverige AB	Sweden
Huyen	Dong	Waltron Bull & Roberts, LLC	United States
Jørgen Peter	Jensen	Vestforbrænding	Denmark
Jan	Hruby	Institute of Thermomechanics of the Czech Academy of Sciences	Czech Republic
Jani	Vuorinen	Teollisuuden Vesi Oy	Finland
Jari	Rissala	Endress+Hauser	Finland
Jarmo	Halonen	IP-Produkter Oy	Finland
Jenna	Oksanen	Vantaan Energy Ltd	Finland
Johan	Borjeson	Oleinitec Nordic AB	Sweden
Jonas	Bergman	Radscan AB	Sweden
Jouko	Hilden	Grundfos Water Treatment	Finland
Karsten	Meier	Helmut-Schmidt-University	Germany
Ken	Yoshida	Tokushima University	Japan
Kenji	Yasuoka	Keio University	Japan
Konsta	Sipilä	VTT Technical Research Centre of Finland Ltd	Finland
Lars	Gjedde	Norsk Analyse A/S	Denmark
Laura	Kuukkanen	Valmet	Finland
Leena	Vänskä	Helen Oy	Finland
Levie	Lensun	h2o facilities sa	Switzerland
Linda	Wiig	Linda Wiig AB	Sweden
Lionel	Barre	Nalco France	France
Ludwin	Daal	BlueXPRT bv	Netherlands
Mads	Skovbjerg	COWI	Denmark
Maria del Mar	Nogales López	SWAN Analytische Instrumente AG	Switzerland

Marjukka	Joutsimo	UPM NERC (Finland)	Finland
Martin	Ekman	NSI Mobile Water Solutions	Finland
Martti	Ikonen	Endress+Hauser	Finland
Matthias	Kunick	Zittau/Görlitz University of Applied Sciences	Germany
Matti	Ryyppö	Flootech Oy	Finland
Matti	Ryyppö	Flootech Oy	Finland
Mikko	Vepsäläinen	VTT Technical Research Centre of Finland	Finland
Milan	Sedlar	CENTRUM HYDRAULICKÉHO VÝZKUMU, spol. s r.o.	Czech Republic
Monika	Nielsen	Ørsted Bioenergy & Thermal Power	Denmark
Naravit	Leaukosol	New Brunswick Power	Canada
Nicholas	Bruno	Nalco Water, An Ecolab Company	United States
Niko	Pesonen	Vantaan Energy Ltd	Finland
Nobuo	Okita	Toshiba Technical Services International Corporation	Japan
Oscar	Kimura	Swan Analytische Instrumente AG	Switzerland
P. Alberto	Giuliano Albo	INRiM	Italy
Pål	KLOSTER	Techouse AS	Norway
Pamela	Yakabuskie	Canadian Nuclear Laboratories	Canada
Paul	Honcoop	NEM Energy	Netherlands
Paul	McCann	RWE Generation UK PLC	United Kingdom
Pirre	Perasto	Vantaan Energy Ltd	Finland
Reiner	Pawellek	Iqony Solutions GmbH	Germany
Riku	Montonen	Kontram Oy	Finland
Robert	Svoboda	Svoboda Consulting	Switzerland
Robert	Hellmann	Helmut-Schmidt-Universität	Germany
Roger	Lundberg	RL Aqua AB	Sweden
Ronny	Wagner	REICON Leipzig GmbH	Germany
Ryan	Morris	Amentum	United Kingdom

Ryo	Akasaka	Kyushu Sangyo University	Japan
Sami	Huhtiniemi	Solenis	Finland
Sarita	Weerakul	Dept. of Chemical Engineering, University of New Brunswick	Canada
Serguei	Lvov	The Pennsylvania State University	United States
Shahin	Tabandeh	VTT MIKES	Finland
SHEAU YUAN	TAN	Mettler Toledo, Thornton	Malaysia
Sonja	Vidojkovic	University of Belgrade, Institute of Chemistry, Technology and Metallurgy	Serbia
Tapio	Werder	PPCHEM AG	Switzerland
Taro	Ichihara	Mitsubishi Heavy Industries Power IDS, Ltd.	Japan
Thomas	Blank	SWAN Analytical Instruments	Switzerland
Thomas	Dalsgaard	Grundfos Water Treatment A/S	Denmark
Thor	Brønlund	NORSK ENERGI AVD OSLO	Norway
Tomohiko	Yoshii	Kimura Chemical Plants Co., Ltd.	Japan
Tomoya	Kutsumi	Toyama Prefectual University	Japan
Turgay	Ömürlü	STAR RAFİNERİ ANONİM ŞİRKETİ	Turkey
William	Cook	University of New Brunswick	Canada
Wolfgang	Hater	Training & Consultant	Germany
Yasuhiro	Kawahara	Kimura Chemical Plants Co., Ltd.	Japan
Yohei	Kayukawa	National Institute of Advanced Industrial Science and Technology	Japan

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