



September, 2006

**The
International
Association for the
Properties of Water
and Steam**

<http://www.iapws.org>

**Working group Power Cycle Chemistry (PCC)
MINUTES OF IAPWS PCC WG MEETINGS**
Witney, United Kingdom 3-8 September, 2006

Chairman: Andre Zeijseink
Members present See addendum 1

Members attended 3 data presentation sessions covering topics set out under the agenda.

1. Amendments/Adoption of Agenda

Andre Zeijseink welcomed new attendees.
There were no amendments to the main Agenda. Additional presentations and revisions to the order of presentation were agreed – see addendum 2.

Members were asked to consider a nomination to sit on the Gibbs Award Committee.
Jim Bellows was nominated and agreed to undertake this task.

2. ELECTION OF CLERK OF MINUTES

Geoff Bignold agreed to record the minutes.

3. Approval of Minutes of 2005 Meeting in Santorini, Greece,

The minutes were agreed without any corrections or additions.

4. International Collaborations

A proposal for a Project on “Improved analysis of low concentrations of particulate oxides in water/steam cycles” had been prepared by Derek Lister, Karol Daucik and Robert Svoboda and circulated for consideration. (Related to priority list item IV.)

The proposal was described by Derek Lister. It covers aspects of a number of items on the priority list, and is directly relevant to a proposed IRCN. It was agreed that the objectives

needed to be more closely defined, so that it would be clear what systems are being considered (steam sampling, water sampling, particulate oxides, iron corrosion products, etc.). The authors discussed this and subsequently provided a more specific set of objectives which received the support of the PCC. The proposal for International Collaboration was agreed upon by PCC; the Executive Secretary was asked for further processing.

5. Priority List Review - postponed pending discussion of status of committee work.

6. Status report on progress on committee work:

6.1 Priority list item #1. To develop an ICRN on “Interfacial situation in advanced ultra supercritical plants” in collaboration with PCAS: Barry Dooley/Don Palmer

The action to provide a draft ICRN had been completed and Robert Svoboda advocated its adoption.

Barry Dooley indicated that EPRI are sponsoring work on chemistry implications of operation up to 760°C. The EPRI programme is more wide ranging, including work on oxide growth and exfoliation (not currently considered as a chemistry issue).

It was agreed that PCC support for the draft ICRN should be confirmed provisional on the agreement of PCAS. The Executive Secretary was asked for further processing.

6.2 Priority list item #2. To develop an ICRN on “Mechanism of Decomposition of Ion-exchange Resin”: Karol Daucik

The draft ICRN had been circulated and Karol Daucik presented it for consideration.

In answer to the question of whether this is a suitable topic for IAPWS, Jim Bellows stated that, if the PCC WG regarded it as important then it is *de facto* suitable. In view of the increasing use of air cooled condensers in hot climates and the need for condensate polishing on these plants, it was agreed that the need for work in this area patently exists.

PCC support for the draft ICRN was confirmed. The Executive Secretary was asked for further processing.

6.3 Priority list item #3. To develop a joint PCAS/PCC ICRN on “Development / Application of Sensors (Ambient and High Temperature Sensors)” : Eric Maughan, Derek Lister, Sunshuke Uchida, Serguei Lvov)

- 6.4** The difficulty of producing a sufficiently well defined ICRN in this general area caused lack of current agreement on how best to take this issue forward. It was acknowledged that progress had been made on ECP measurements in CANDU sampling systems, and BWR primary circuits.

Barry Dooley's view was that the ICRN in this area could be relatively simple and broad ranging. The aim is to interest researchers to work in this area.

The draft joint PCC / PCAS ICRN (E.Maughan, S.N.Lvov) was reviewed and then accepted by PCC. The Executive Secretary was asked for further processing.

There is also the question on the interpretation of such data. It is suggested that this should be subject for another ICRN ("Database for the interpretation of electrochemical sensors data"). Will be done by the same task group for 2007 (Eric Maughan, Jan 2007)

- 6.5** Priority list item #4. To develop an ICRN on "Improved analysis of low concentration of metals (Fe, Cu, Co, etc)": Derek Lister, Karol Daucik.

A draft ICRN, as well as a draft for International Collaboration was sent to the PCC members, discussed, updated and agreed upon. The Executive Secretary was asked for further processing.

It was also agreed that the objectives for the International Collaboration (see item 4) can be narrower than the ICRN and should be corresponding to the proposed resources (PhD student working for ca. 3 months).

- 6.6** Priority list items #5 and #6. It should be considered to make an ICRN covering the priorities of both topics (Task group Bellows, Maughan, Hughes, Bignold, Jan 2007).

- 6.7** Priority list item #8. A draft document by Frank Gabrielli had been circulated and was introduced by Robert Svoboda. For IAPWS this will be a new type of document. Barry Dooley confirmed that such an initiative could be made by PCC WG (comparable to Advisory Notes from TPWS).

General discussion on the draft was favourable: the approach represents good common sense and is a step forward from earlier over simplistic guidance. There are a number of points of detail requiring clarification and amplification and so an *ad hoc* subcommittee (Team/task group: Frank Gabrielli, Jim Bellows, Sven ErikTherkildsen, Marc DeWispelaere, R.Svoboda and G Bignold) is to be convened and further e-mail discussion is expected to follow before agreement of a final text. #8 "Method to determine the mechanical carry-over". The draft will be presented to the PCC members for review by Dec 2006. Target is to send it to the Executive Secretary for review within IAPWS by end February 2007.

6.8 Potential New Activity on behaviour of Amines:

Jim Bellows announced that ASME is planning research and seeking funding to address the question "Do decomposition products of amines discount the benefits of their use?". The chosen system will be ethanolamine with contamination from acetic acid, hydrochloric acid, etc. Work to be done under Digby MacDonald's supervision at Penn State University using ellipsometry and electrochemical noise. Expressions of interest were invited.

Barry Dooley indicated that this would have represented an opportunity for IAPWS| involvement via an international collaboration, although the current need is for project funding rather than provision of a suitable student.

The existing ICRN #5 shall be closed. The closing document has been prepared by E.Maughan and will be transferred to the Executive Secretary for further processing. A follow-up draft ICRN "Research on Amines for the Power Industry" was prepared by E.Maughan and finalized following discussions within PCC. The Executive Secretary was asked for further processing of the closing document as well as of the new ICRN.

7. Priority List Review

7.1 IAPWS Certified Research Needs, Closing statements

#13 "Surface Tension"

The ICRN was originally started by PCC. As there have been no activities in recent years, a recommendation was made by F.Gabrielli to close this ICRN. The 2006 meeting however revealed a new interest of TPWS, who will take over further processing of this ICRN.

7.2 PRIORITY LIST - OTHER PENDING ISSUES

5 "Corrosion mechanisms that are related to the presence of contaminants..."

and

#6 "The relationship between the chemistry of the contaminants and their concentration at point of measurement"

Consideration is to be given to making a single ICRN covering the priorities of both topics (Task group Bellows, Maughan, Hughes, Bignold, Jan 2007).

7.3 PRIORITY LIST - OTHER ITEMS

#7 "The quantification of risk of asset damage"

A session on this item will be considered for the 2007 meeting. E. Maughan (coordinator) K. Daucik, J. Bellows, A. Rudge, B. Hughes, M. Rziha, A. Zeijseink,

#9 "Improved understanding of condensation mechanisms"

As part of this item, an ICRN on "Improvement of steam turbine efficiency by chemical additives" shall be developed for 2007. (M. Stastny, Jan 2007)

#10 "Deposition of contaminants and corrosion products in steam and water circuits"

This topic should be kept, although there was no PCC activity this year. It is proposed to be reviewed at the 2007 meeting.

#11 "High pressure/high temperature steam and humid air (24MPa and up to 2000°C), thermo-physical properties and chemistry formulation"

To be coordinated with TPWS. Joint workshop PCC / TPWS in 2007 to exchange information on requirements (PCC chairman). Jim Bellows agreed to define needs from the chemical side and to present it at the workshop.

#12 "Radiation chemistry of water"

To be coordinated with PCAS. Joint workshop PCC / PCAS in 2007 to exchange requirements (PCC chairman). Dr Uchida agreed to define requirements from the PCC side for presentation at the workshop.

Derek Lister contacted Peter Tremaine regarding PCAS contacts for radiolysis issues.

7.4 New Items

PCC had considered the draft PCAS ICRN on dew point quantification in flue gas. It was agreed that this is an important topic and should be supported by PCC.

Andy Rudge indicated that there remain open questions on the possible effect of oxygen on two-phase FAC. This, together with other potential items will be reviewed in 2007.

7.5 OLD ICRNS

#5 "Organics"

Discussed under item 7 above.

8. Nuclear Chemistry Session

Copies of the presentations are available.

9. Tasks Distribution - Planning for 15th ICPWS – 2008

PCC discussed the title and session organisation proposals for the 2008 conference. A number of suggestions for the detailed organisation of the conference and for convenors of sessions relevant to PCC activities were put forwards and noted for consideration by the IAPWS executive. The PCC chairman undertook to present the consensus suggestions to the Executive for consideration.

10. News from other international groups, and new developments

PCC noted relevant conferences on organic materials (Stuttgart – 2005) and power plant chemistry (ESKOM 2005) and forthcoming conference on chemical instrumentation (Zurich Sep 2006).

VGB plan to update their chemistry guideline but had not yet sought to convene a group of appropriate experts. Michael Rziha and Robert Svoboda will ensure that VGB are fully aware of IAPWS interest.

The European Standard, EN12952: Part 12, remains in place and is regarded as mandatory in some countries. Richard Harries reported that BIAPWS were actively seeking to have it updated. BIAPWS is now represented on the relevant British Standards Institute committee and is actively lobbying for reconsideration of this standard by the appropriate CEN committee.

11. Membership

PCC unanimously recommended membership of Dr Andy Rudge and Dr Hideki Takiguchi.

12. Preparation of next year's agenda

In addition to progress on ICRN and priority list items covered above, PCC will plan short joint workshops on radiation chemistry, dew point issues and assessment of risks of damage.

13. Election of Officers

Andre Zeijseink is now standing down as chairman.

Robert Svoboda was unanimously elected to be proposed to the EC as new PCC chairman.

14. Preparation of the Report to EC

Report to be based on these minutes.

15. Miscellaneous and Adjournment

Jim Bellows requested input for the IAPWS Press Release.

Derek Lister proposed the thanks of the membership to Andre Zeijseink for his chairmanship over the last five years.

Robert Svoboda proposed to perform work on PCC action list earlier in the year as has been done in 2006, so the technical discussion will take place to a good part by E-mail, and more time at the annual meeting is left for new issues.

It is to be noted that last year's meeting was followed up by publications on 5 PCC presentations, and 1 further still pending. Acknowledgement is given to the authors.

ADDENDUM 1 – Attendees

Malcolm Ball	U.K.
James Bellows	USA
Geoff Bignold	U.K.
Karol Daucik	Denmark
Barry Dooley	USA
Andreas Drexler	Germany
Roy Fyfield	U.K.
Fionn Griffin	Ireland
Richard Harries	U.K.
Alex Hörig	Germany
Eric Huff	U.K.
J. Barry Hughes	U.K.
Derek Lister	Canada
Eric Maughan	Germany
Han Pflug	Germany
Michael Rziha	Germany
Andy Rudge	U.K.
Michael Sparrey	U.K.
Miroslav Štastný	Czech Republic
Robert Svoboda	Switzerland
Hideki Takiguchi	Japan
Svend-Erik Therkildsen	Denmark
Shunseke Uchida	Japan
Sonia Vidoikovich	Serbia
Andre Zeijseink	Netherlands

ADDENDUM 2 - Agenda

1. Amendments/Adoption of Agenda
2. ELECTION OF CLERK OF MINUTES
3. Approval of Minutes of 2005 Meeting in Santorini, Greece, action points (see also point 6)
4. International Collaborations
5. Priority List Review
6. Status report on progress on committee work:
 - 1 To develop an ICRN on "Interfacial situation in advanced ultra supercritical plants" in collaboration with PCAS: Barry Dooley/Don Palmer
 - 2 To develop an ICRN on "Mechanism of Decomposition of Ion-exchange Resin": Karol Daucik
 - 3 To develop a joint PCAS/PCC ICRN on "Development / Application of Sensors (Ambient and High Temperature Sensors)": Eric Maughan, Derek Lister, Sunshuke Uchida, Serguei Lvov
 - 4 To develop an ICRN on "Improved analysis of low concentration of metals (Fe, Cu, Co, etc)": Derek Lister, Karol Daucik
 - 5 To formulate a brief description of the problem of the relationships between the chemistry of the contaminants and their concentration at point of measurement, for presentation to IAPWS executive with the aim of potential introduction of a new ICRN proposal in 2006: Task group: Jim Bellows, Eric Maughan, Barry Hughes, and Geoff Bignold (Draft prepared and presented to PCC on 7 July 2005)
 - 6 To progress the work on a method to quantify mechanical carry-over by the establishment of a guidance document. Robert Svoboda will propose two alternative approaches to the IAPWS executive: Development of a PCC guidance document or Preparation of a paper for publication in the open literature (e.g. PowerPlant Chemistry) under IAPWS PPC team membership: Team/task group: Frank Gabrielli, Jim Bellows, Sven Erik Therkildsen, Marc DeWispelaere and R. Svoboda
- 7 New tasks distribution list

Intermezzo 1: joint workshop with PCAS

- Research Presentations on Physical Chemistry for Power Generation
 - **S.N. Lvov**, Z. Zhou, E. Chalkova, V.N. Balashov, and P. Chou, "Development of Hydrothermal Coating Technology to Mitigate Intergranular Stress Corrosion Cracking in BWRs"
 - **G. Bignold**: Chemical Properties Issues arising in recent Power Cycle Chemistry Studies
 - **Stastny M.**, Blahova O., Jiricek I., Lorenc B. " Effects of Steam Chemistry on the Turbine Blades in Transition Zone".
 - **Vidoikovitch, S.**, " Influence of Water Chemistry on the Economizer Inner Wall Condition"

- **P. Tremaine:** "Phosphate titanium interactions under boiler conditions"
 - **A. Rudge:** "Chemistry issues related to control of rippled magnetite development"
6. Progress on committee work (continued)
 7. IAPWS Certified Research Needs, Closing statements and new proposals (joint ICRN of PCC / PCAS on "Development/Application of Sensors (Ambient and High Temperature Sensors))
 8. Nuclear Chemistry Session:
 - **D. Lister:** Flow Accelerated Corrosion in Nuclear Reactor Primary Coolants
 - **A. Drexler:** Experiences with FAC in German PWRs
 - **S. Uchida:** Deposition and Release of Crud and Metallic Ions on Boiling Surfaces and Change in their Chemical Form
 - **H. Takiguchi:** Development of Environmental Remedies against FAC in Secondary System of Tsugura-2 PWR
 - **G. Bignold:** Erosion-corrosion or 'FAC' as it is now known
 - **S. Uchida:** Evaluation Method for Flow Accelerated Corrosion of Components by Corrosion Analysis Coupled with Flow Dynamics Analysis

Intermezzo 2: joint workshop with TPWS, IRS, PCAS:

Properties of Seawater (**R. Feistel**),

- A brief history and current activities of the International Association for the Physical Science of the Oceans (IAPSO)
 - Liaison with IAPSO, Letters between the IAPWS President and the President of IAPSO
 - Oceanographic Seawater Standards
 - Unit for the Salinity of Seawater, Conflict with ISO
 - Development of an Extended Formulation of the Thermodynamic Properties of Seawater
 - Physical Chemistry of Vents, Critical Properties
 - Request for Measurements/Instruments
9. Tasks distribution
 10. News from other international groups, and new developments
 11. Membership
 12. Preparation of next year's agenda
 13. Election of Officers
 14. Preparation of the Report to EC
 15. Miscellaneous and Adjournment

APPENDIX
Working group Power Cycle Chemistry (PCC)
Action List for IAPWS PCC WG Meetings

Participant(s)	Action	Deadline
J. Bellows	To represent PCC on the IAPWS Gibbs Award Committee.	
B. Dooley	To progress the PCC following proposals for approval by IAPWS: 1) draft ICRN Priority List topic #1 2) draft ICRN Priority List topic #2 3) draft ICRN Priority List topic #3 4) draft ICRN and International Collaboration Priority List topic #4 5) closure document for ICRN #5 and the draft follow-up ICRN ("Amines")	8 Sept 2006
<u>E. Maughan</u> , D. Lister, S. Uchida, S. Lvov	To develop an ICRN covering the generation of a database for the interpretation of electrochemical sensors data.	Jan 2007
<u>J. Bellows</u> , <u>E. Maughan</u> , J.B. Hughes, G. Bignold,	To develop an ICRN combining the topics: Corrosion mechanisms that are related to the presence of contaminants in steam/water circuits, particularly in boiler-water and The relationships between the chemistry of the contaminants and their concentration at point of measurement	Jan 2007
<u>F. Gabrielli</u> , J. Bellows, S-E. Therkildsen, M. deWispelaere, R. Svoboda, G. Bignold	To develop further the draft guidance note on method for the determination of mechanical carry-over in boiler drums.	Draft to PCC members for review by Dec 2006.
E. Maughan	To co-ordinate a session at the 2007 IAPWS PCC meeting on the quantification of risk of asset damage.	2007 meeting
M. Stastny	To develop an ICRN on improvement of steam turbine efficiency by chemical additives.	May 2007
PCC chairman	To coordinate with TPWS arrangements for a Joint PCC / TPWS workshop on requirements related to high pressure/high temperature steam and humid air (24MPa and up to 2000°C).	2007 meeting
J. Bellows	To define needs from the chemical side and to present it at the workshop.	
PCC chairman	To coordinate with PCAS arrangements for a joint PCC/ PCAS workshop on radiation chemistry of water	2007 meeting
S. Uchida	Dr Uchida agreed to define requirements from the PCC side for presentation at the workshop.	

Participant(s)	Action	Deadline
A. Zeijseink	To propose that IAPWS Executive approve PCC membership of Dr Andy Rudge and Dr Hideki Takiguchi.	8 Sept 2006
A. Zeijseink	To present to IAPWS Executive a summary of PCC recommendations with regard to the ICPWS to be held in 2008.	8 Sept 2006
PCC Chairman	To approach contributors to PCC workshops 2006 to consider making a manuscript to be published in a technical or engineering magazine to be selected	30 Sep 2006