IAPWS Working Group Power Cycle Chemistry (PCC)

Minutes of IAPWS PCC WG Meetings
Boulder, Colorado 30. Sept – 05 Oct 2012

Chairman: Michael Rziha
Members present See PCC Attachment A

1. Agenda

1.1. Amendments / Adoption of Agenda

There were no amendments to the drafted agenda.

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

M. Rziha summarized the schedule.

2. Appointment of Clerk of Minutes

F.U. Leidich agreed to act as Clerk of Minutes.

3. Approval of Minutes of PCC WG in Plzen, Czech Republic, 2011

The minutes were approved without any corrections.

4. Progress Reports on PCC Activities 2011 / 2012

4.1. International Collaboration

D. Lister reported on progress with the collaboration on sampling and the CFD results gained so far with his presentation given during the PCC meeting.

4.2. ICRN

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

ICRN#13 on Surface tension
Closed already, can be looked at on the IAPWS webpage

ICRN#17 on Amines
Draft agreed, expiry date Sept. 13 needs some attention.
J. Bellows will finish the draft and send it to EPRI for their comments. Afterwards it will be sent-out to the PCC group for further comments and then by M. Rziha in post-carriage for approval by EC

Action: J. Bellows
M. Rziha

ICRN#19 on Sampling of corrosion products
Closing statement on the IRCN will be prepared

Action: D. Lister

ICRN #20 on Sensors for use at elevated temperatures
Work is ongoing. Presentation on the current results is in preparation

Action: S. Uchida
D. Lister

ICRN#25 on Corrosion mechanism that are related to the presence of contaminants in steam/water circuits, particularly in boiler-water.
PCC WG agreed to submit the revised draft to EC for approval.

Action: M. Rziha

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

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

4.3. PCC Task Groups

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

Future document proposals presented by B. Dooley are:

- Amendments to the document on instrumentation
- Steam purity
- Sampling QA/QC
- Amendment to the document on carry-over
- Amines
- Others?

A discussion followed on how these document proposals shall be treated by PCC TGs.
The following persons volunteered for it in a first step:
K. Thomson, M. Rziha, D. Lister, F. Gabrielli, F.U. Leidich, D. Addison, G. Joy, J. McKinney, P. Gotovtsev, S.Marais, R. Turner, H. Takaku
Others are cordially invited to join.

Action: K. Thomson

PCC accepted the revised Sampling guidance document for approval by the EC

Action: M. Rziha

B. Dooley reported on the progress on proofing elevated importance within IAPWS and by operators (users of the guidance documents)

- The proposed change of the bylaws as per last year's meeting is done
- IAPWS to notify manufacturers needs to be completed.
  The question arose, how it can be achieved and ensured that this letter reaches the relevant persons in the manufacturers' organisations.

Action: B. Dooley

B. Dooley presented the current status of the steam purity guideline as a starting point for the discussion to follow.
The following topics were highlighted in particular:

- Industrial steam turbines: J. Tavast as TG lead needs support from others to add this to the guideline. The following members committed to contribute: T. Petrova, F.U. Leidich, J. Bellows, F. Gabrielli

Action: J. Tavast

- Geothermal turbines: D. Addison will lead the TG. He will be supported by T. Petrova, F.U. Leidich, H. Ishihara

Action: D. Addison

- Elevated CO2-Levels: M. Rziha will act as TG lead, supported by R. Turner, J. McKinney

Action: M. Rziha

A voting on the philosophy of the steam purity guideline followed ended with the following results:

- One table for all systems independent from treatment philosophy of the feedwater
- No separate tables for the kind of steam generation

4.4. European Standard EN 12952

The status of the activities on this field remains the same as per last year. It remains a challenge to push the national committees within the CEN organisation to vote for the need of a revision of the a.m. document, which is due latest by after-next year. During the last voting, the need for a revision was missed by only one vote.
All national IAPWS organisations should check whether they have contact through members to the national CEN committees. For a number of countries this can be done by the ETC (European technical committee) on power plant chemistry run by VGB. The next meeting of this group is on Oct. 22nd in Hamburg. M. Rziha, F.U. Leidich, and K. Thomson are members in this group and committed to act accordingly

Action: M. Rziha
F.U. Leidich
K. Thomson

4.5. PCC Public Relations

M. Rziha informed the audience about the growing links to national and international organisations and bodies as well as conferences.
In 2013 there will be a conference on FAC in Nuclear Power Station in Paris.
Organizer will be EdF. A link to this conference will be organized by B. Dooley

Action: B. Dooley

M. Rziha expressed the PCC's gratitude to R. Svoboda for publication of information about PCC meeting in Plzen in the PowerPlant Chemistry magazine. He declared his will to write an article about this year's conference also in PPChem. This was gratefully appreciated by the audience.

Action: M. Rziha

Another FAC conference on fossil Power Plants will happen in March 2013 in Washington DC. The link to IAPWS already exist on this conference (see webpage, was action from last year)

To increase recognition and lever profile of IAPWS PCC by manufacturers of power plant equipment, a letter shall be send to all relevant companies. F. Gabrielli and M. Rziha volunteered to draft such a letter.

Action: M. Rziha
F. Gabrielli

4.6. Other Action List Items

There were no other items not covered on the agenda.

5. Priority List Review

The priority list was discussed and updated on a point by point basis. The outcome is attached (attachment C).

6. Other Business

nil

7. Changes in Membership, election of Officers

News of the recent death of G. Bignold was greeted with great sadness.

M. Rziha proposed , seconded by B. Dooley, that K. Thomson shall be asked to stand as new vice-chairman.
PCC WG supported the proposal. K. Thomson expressed to be pleased to take over the role.

Action M. Rziha

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

New Member	**Proposed by:**	**Seconded by:**
Anders Fredrikson	K. Daucik	M. Rziha
Mats Hellman	K. Daucik	M. Rziha
Taro Ichihara	S. Uchida	F.U. Leidich
Hideo Hirano	S. Uchida	F.U. Leidich
Paul McCann	B. Dooley	M. Rziha
David Addison	B. Dooley	M. Rziha
Stephanie Marais	B. Dooley	M. Rziha
Randy Turner	B. Dooley	M. Rziha
David Moed	B. Dooley	M. Rziha
Andrew Witney	B. Dooley	M. Rziha
Kirk Buecher	B. Dooley	M. Rziha

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

Action: M. Rziha

8. Preparation of Action List 2010 / 2011, Task Distribution, Next Year's Agenda

9. Preparation of PCC WG Report for Executive Meeting

Action: M. Rziha

10. Miscellaneous and Adjournment

PCC website will go live soon. M. Rziha will send the link to all PCC members when done

Action: M. Rziha

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Those present at the PCC WG meeting were as follows:

M. Rziha	Germany
D. Moed	Netherlands
S. Uchida	Japan
H. Hirano	Japan
T. Ichihara	Japan
K. Buecher	USA
K. Thomsen	Denmark
A. Fredrikson	Sweden
A. Witney	USA
F.-U. Leidich	Germany
J. Bellows	USA
D. Lister	Canada
W. Cook	Canada
R. Turner	USA
S. Marais	South Africa
J. McKinney	USA
G. Joy	Australia
B. Dooley	USA
T. Petrova	Russia
P. Gotovtsev	Russia
P. Mc Cann	UK
M. Hellman	Sweden
K. Daucik	Denmark
P. Safaŕik	Czech Republic
F. Gabrielli	USA
D. Addison	New Zealand
M. Rziha	Germany
H. Takaku	Japan
R. German	Switzerland
H. Maurer	Switzerland

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PCAS / PCC workshop (Tuesday 08:30 - 12:00)

1.	David Addison	Presentation of NZAPWS - Areas of key interest to NZ
2.	Frantisek Marsik	Thermodynamical Analysis of the Enhancement of Hydrogen Fuel Cell Efficiency by the Water Surface Tension Control
3.	Hiroshi Takaku / Lin-Bin Nin	Characteristics of Oxide Films Formed on Welded Surfaces of Carbon Steel for Boiler Tubes
4.	Andre Anderko	Modeling the effects of solution chemistry on the localized corrosion of engineering alloys
5.	David Addison	Chemistry Aspects of Geothermal Power Plants
6.	Masaru Nakahara	Conversion of carbon dioxide and hydrogen into formic acid for CCS: In ambient water without catalyst

PCC workshop (Tuesday 13:30-17:00 and Thursday 08:30-10:00)
Update on Power Cycle Chemistry Research and Experience

1.	Frank-Udo Leidich	The New VGB-Standard on Sampling and Instrumentation for Steam Water Cycles
2.	Paul McCann	Update on the Revision of ISO 5667-7 on Sampling of Water and Steam
3.	Derek Lister	Sampling in Steam Water Systems
4.	Derek Lister / Shunsuke Ushida	Improved Sampling Technique: IAPWS International Collaboration
5.	Ken Ogan	A new approach to on-line monitoring of chloride and sulfate
6.	Gary Joy	CS Energy ACC and Solar Boost Experience – Chemical Aspects
7.	Hideo Hirano / Noburo Kawai	Status of Water Conditioning for Once Through Boiler in Japanese Fossil Plants
8.	Shunsuke Ushida	Determination of Wall Thinning Rates and High Risk Zones for Local Wall Thinning due to FAC
9.	Shunsuke Ushida	A Consideration of Design Procedures Related to Water Chemistry of BWR Power Plants

10.	Heini Maurer	Influence of Temperature on Electrical Conductivity of Diluted Aqueous Solutions
11.	William Cook	Restart chemistry control at the Point Lepreau nuclear generating station after an extended refurbishment outage
12.	Karsten Thomson	Sea water contamination of a once-through boiler
13.	Taro Ichihara / Takatoshi Satou	Practice of Amine Treatment on Industrial Power Plants in Japan

PCC Minutes, Niagara Falls July 2010
updated at Plzen, September 2011
updated at Boulder, October 2012

PCC Priority List for Further Research

1. Interfacial situation in advanced ultra supercritical plants

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

Status 2011: Joint PCC/PCAS ICRN #21 is on the IAPWS website
Status 2012 : no change

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

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

Status 2010: ICRN #20 has been issued in 2006, some activities known in 2009 (Balashov, Petkin, Lvov), re-formulation in 2010 related to the needs from nuclear industry (Uchida), 2011: still on-going
Status 2012: ICRN # 20 is approved until Sept. 2014

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

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

Status 2011: Geoff Bignold drafted ICRN #25 which should be finalized in 2011 (Bignold, Cook)
Status 2012: ICRN # 25 : Draft for EC

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

Main scope will be the minimum requirements for sampling specifically for Fe, Cu, Co, Oxygen, etc.

Status 2011: ICRN #19 on sampling has been extended to 2012. International collaboration 2006/7 2010/2012. (Uchida, Lister, Daucik, Svoboda). 4 papers by Piti et al. IAPWS Guidance Document on sampling under consideration

Status 2012: Papers by Lister, Uchida, et al. had been presented focussing on Fe-oxides. Paper is distributed to relevant PCC members for the preparation of the final report. Investigations on other parameters e. g. Oxygen are still of high interest.

5. * The quantification of risk of asset damage

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

PCC task group has been set up (chair: K.Daucik)
Status 2011: available information has been compiled, although insufficient for being basis of an IAPWS document, a publication on the existing results will be made (Daucik, 2012)
Status 2012: ongoing until next meeting in London 2013.

6. Improved understanding of condensation mechanisms

- dropwise vs filmwise condensation in condensers (improve heat transfer)
- heterogenous – homogeneous nucleation models for prediction of condensation in steam turbines (chemistry, electrostatic,...)
- chemistry of the phase transition zone in nuclear turbine systems
- development of liquid films on surfaces in saturated steam environments (especially with regard to Flow Accelerated Corrosion)

ICRN #22 is on the IAPWS website;

Status 2012: ongoing

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

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

Status 2011: wide range of information available and research ongoing, opportunity for several ICRN

Status 2012: Topic is actually partly covered by ICRN #22 and ICRN #26
Paper by Uchida and Lister et al. had been presented on transport and deposition of Fe-oxides.

8. Radiation chemistry of water

Radiolysis, main importance for nuclear generation

2007 PCAS/PCC presentations have been made

Status 2011: major issue for supercritical water reactors. Workshops held regularly in connection to the bi-annual International Conference on Water Chemistry in Nuclear Reactor Systems
Status 2012: update will presented at the 16th ICPWS in London 2013 – considering moving to watch list.

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

- Al release under various water treatment regimes
- volatile carry-over and deposition in the turbine
- depsoition on boiler tubes,
- solubility in water and steam
- behaviour in condensate purification
- interaction of Al with boiler chemistry
- specfication values for Al in feedwater, boilerwater, steam
- impact of the use of Al on materials and cycle chemistry of the rest of the cycle

Status 2011: ICRN #26 in processing, final draft is available (Rziha, Svoboda)
Status 2012: additional input to ICRN #26 by Gary Joy. Draft to EC

10. Water cooling of copper in electrical machines

- generator stators
- accelerators

Status 2011: paper at ICPWS 2008;EPRI guideline 2008, CIGRE guidance document to be published (draft document approved), new investigations Palmer/Svoboda considered
Status 2012: remains of interest. Update during 16th ICPWS

11. Water use outside the steam / water cycle

- cooling water
- waste water
- external process
- recycling for use as make-up
- etc.

For further consideration for 2012, possibly new IAPWS sub-committee.
PCC does not have the resources to take leadership on these items.

*Status 2012: ongoing. Positionpaper in preparation (task group: **Stephanie Marais**, Andy Howell, David Moed, Gary Joy, Pavel, et. Al)*

12. Chemistry in geothermal and oil / sand cycles

Behaviour of water constituents, effects on system materials, geochemical and waste water issues, including behaviour of radionuclides in these waters.

Status 2011: ICRN to be considered for 2012 (Leidich, Rziha, Myszczyszyn)
Status 2012: ICRN still to be drafted. (Leidich, Rziha, Myszczyszyn, Addison)

13. Chemistry aspects in solar thermal generation

Status 2012: ICRN is under preparation (Gary Joy)

14. Chemistry of Desalination Systems

Status 2012: "White paper" by Stephanie Marais, David Moed, Pavel Gotovtsev, Gary Joy, Andrew Howell, Paul McCann, describing the needs and recommendation is available. ICRN will be prepared until 2013. Elaboration of TGD is proposed and accepted by WG. Task Group for TGD will be set up at annual meeting 2013.

15. Chemistry of Filming Amines

Status 2012: A "white paper" by Stephanie Marais, David Moed, James Bellows and Tamara Petrova, describing the needs is available. It is recommended to create a separate ICRN beside ICRN #17. The draft will be prepared in advance to the annual meeting 2013.

**** urgent priority***

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

In addition, PCC should maintain awareness of the following items

- Chemistry and corrosion related items to future nuclear generation systems (6-best-design-reactor concepts, Generation IV reactor plants, ITER)

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