IAPWS Working Group Power Cycle Chemistry (PCC)

Minutes of IAPWS PCC WG Meetings

Berlin, Germany 7 and 9 September 2008

Chairman: Robert Svoboda
Members present See PCC Attachment A

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1. Agenda

1.1. Amendments / Adoption of Agenda

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

2. Appointment of Clerk of Minutes

Richard Harries agreed to record the minutes.

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

The minutes were agreed without any corrections or additions.

4. Progress Reports on PCC Activities 2007 / 2008

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

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

4.2. ICRN (Joint Meeting with PCAS)

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

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

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

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

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

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

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

4.3. European Standard EN 12952

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

4.4. International Collaboration on Sampling

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

5. Priority List Review

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

6. PCC Task Groups

6.1. Progress Reports

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

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

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

6.2. New Task Group – Cycle Chemistry Guidance.

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

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

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

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

7. Other Business

7.1. ISO 5667 standard on sampling.

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

7.2. PCC Mission

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

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

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

8. Proposals for International Collaboration

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

9. Changes in Membership, election of Officers

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

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

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

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

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

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

11. Preparation of PCC WG Report for Executive Meeting

12. Miscellaneous and Adjournment

There was no other business.

Those present at the PCC meeting were as follows:

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

PCC Priority List for Further Research

1. Interfacial situation in advanced ultra supercritical plants

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

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

2. Mechanism of Decomposition of Ion-exchange Resin

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

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

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

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

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

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

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

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

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

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

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

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

Detailed definition of the problem

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

7. * The quantification of risk of asset damage

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

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

8. Improved understanding of condensation mechanisms

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

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

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

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

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

10. Radiation chemistry of water

Radiolysis

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

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

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

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

12. Water cooling of copper in electrical machines

- generator stators
- accelerators

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

**** urgent priority***

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

In addition, PCC should maintain awareness of the following items

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

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

REPORTS FROM TASK GROUPS

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

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

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

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

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

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

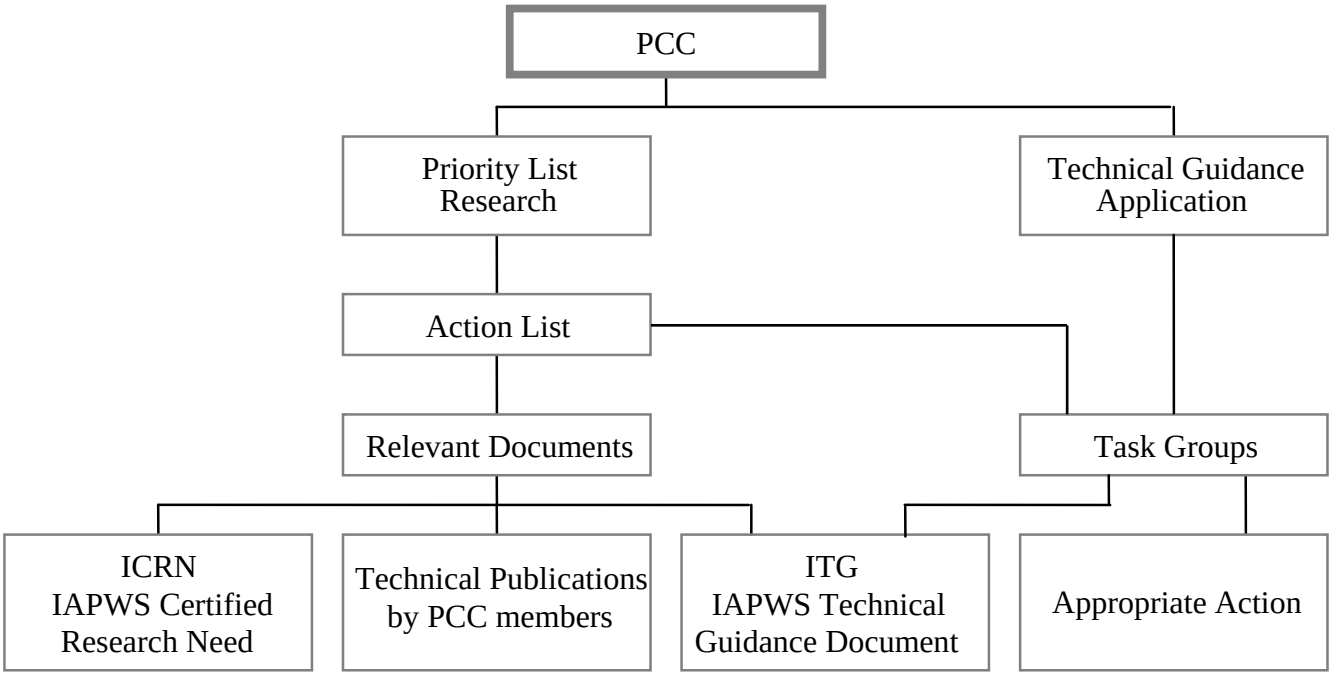
PCC MISSION (2008)

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

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

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

PCC WORKING PROCESS
Workflow



Working Tools

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