

## **MINUTES OF THE WORKING GROUP INDUSTRIAL CALCULATIONS MEETINGS**

**IAPWS 2000 Prague, Czech Republic  
3.-8. September 2000**

All IC meetings were jointly held with the WG TPWS.

The joint meeting was officially opened September 4, 2000, 1:30 p.m. by chairman B. Rukes.

1. The agenda was revised and adopted, see IC attachment A. Dealing with topic 6 was shifted to the beginning to be in accordance with the WG TPWS agenda.
2. I. Weber was appointed clerk of the minutes.
3. The minutes of the Toronto Meeting 1999 were accepted unchanged.
  6. (This item is referenced in the WG TPWS agenda as topic 7.)
    - a) H.-J. Kretzschmar presented the draft of the supplementary release on the  $p(h,s)$  backward equation. In his presentation he made the following points:
      - i. The draft has been sent to the members of the WG TPWS and IC prior to the Prague meeting.
      - ii. The backward equation is needed since the computational effort to calculate  $p(h,s)$  with the existing IAPWS-IF97 equations is large (two dimensional iteration).
      - iii. The consistency requirements were defined according to the IAPWS survey prior to the development of IAPWS-IF97.
      - iv. The subregions in region 2 were chosen as those of IAPWS-IF97.
      - v. The equations were developed on the basis of data determined with the IAPWS-IF97 formulation.
      - vi. All backward equations fulfill the requirements regarding numerical consistency to IAPWS-IF97 as well as along the region and subregion boundaries.
      - vii. Using these backward equations the function  $T(h,s) = T(p(h,s),s)$  can be calculated. This function also fulfils all requirements regarding numerical consistency.
      - viii. The computing time advantage was presented in comparison to the different calculation possibilities within IAPWS-IF97. A minimum factor of 11 for region 1 and 9 for the region 2 can be reached.
      - ix. The backward equations are ready to be evaluated by IAPWS.

The members of the WGs agreed to proceed with the supplementary release. The WG chairmen will express this at the EC meeting.

## Attachment 5

An evaluation task group was set up, consisting of K. Miyagawa and J. Gallagher, chaired by K. Miyagawa. The purpose of the evaluation task group is

- to evaluate the accuracy of the backward equations
- to comment on the structure and wording of the draft of the supplementary release.

The task group will present a technical evaluation report within the next 6 months. An updated draft of the supplementary release shall be distributed well before the 2001 meeting. At the 2001 meeting the task group will give a report together with a revised version of the supplementary release. A general discussion developed about the use of backward equations. The concern was expressed that backward equations might be used in improper ways. Users should be informed about the proper use of backward equations. The possibility of posting a corresponding warning at the IAPWS home page was addressed. At least the revised document on the  $p(h,s)$  equations should contain a corresponding remark. Additionally it was discussed whether the document should be called a "supplementary release" or a "guideline".

The members of both WGs expressed their thanks to H.-J. Kretzschmar and his co-workers for their effort.

- b) K. Miyagawa presented the proposal of a guideline for the Tabular Taylor Series Expansion (TTSE) Method. In his presentation he made the following points:
- i. A draft of the guideline together with additional documents on a CD has been given to the members of the WG TPWS and IC prior to the meeting.
  - ii. The technical information has been already presented at the 1999 meeting in Toronto. There are no changes to the presented material.
  - iii. The guideline is only for the TTSE method. Up to now IAPWS guidelines were formulated only for equations and data. Therefore the proposal is beyond the current range of IAPWS guidelines.
  - iv. The purpose of the guideline is to give the user easy access to the TTSE method. Therefore all required documents, source codes and executables should be available from the IAPWS home page.
  - v. The question of copyright for downloading has to be clarified in advance.

In the following an extensive discussion about the consequences on IAPWS products and on the handling of the IAPWS home page developed. The main results of these discussions were:

## Attachment 5

- i. The draft of the guideline shall be revised and discussed at the 2001 meeting.
- ii. Both WGs express their will to continue with the proposal of a TTSE method guideline. The WG chairmen will express this at the EC meeting.
- iii. A technical evaluation task group was set up consisting of I. Weber and I. Kodl, chaired by I. Weber. The task group will give a report at the 2001 meeting.
- iv. The WGs cannot decide whether for the proposed document the definition of the IAPWS guidelines is appropriate or if a new IAPWS product has to be defined. The WG chairmen will report this to the EC and request clarification.
- v. The WG chairmen will report to the EC about the proposed use of the IAPWS home page. The issue of distribution of documents through the home page and the maintenance of the home page has to be clarified. Clarification is requested from the EC.
- vi. The copyright issue in the case of downloading has to be clarified by the EC. The WG chairmen will ask the EC for advice. D. Friend agreed to be a member of the eventually set up EC task group "Copyright".

Finally both WGs expressed their thanks to K. Miyagawa and P. Hill for their efforts regarding the development of the TTSE method.

4. During the Toronto meetings there were discussions about the future of the IC WG. It was decided to conduct an international survey to define future needs of the industry. I. Weber presented the results of this survey. The following main statements were made:
  - a) A preliminary questionnaire together with a request for recipient addresses was circulated throughout the IC members and the National Committee chairmen in June.
  - b) In total 156 questionnaires were sent out in July, covering a wide range of countries.
  - c) Altogether only 16 replies were received, which might be only a weak basis for any decisions.
  - d) The main requirements contained in the replies were
    - Equations for the metastable regions
    - Additional backward equations for IAPWS-IF97  $T(p,h)$  and  $T(p,s)$  in region 3

In the following discussion, J. Sengers pointed out that it should be proposed to the EC that generally surveys should be used to formulate new requirements to IAPWS. He also mentioned that a value of 20% replies is a standard value, i.e. one cannot expect a significantly higher number of replies for the amount of questionnaires sent out. It was noted that there are no replies from some of the major companies in the

## Attachment 5

power plant industry. There was consensus in both WGs to proceed with both of the requirements mentioned in topic 4. d). For the equations in the metastable regions, it was found that further investigation is needed to define the exact requirements. B. Rukes agreed to prepare a draft document for an ICRN and to present it at the 2001 meeting. Concerning the additional backward equations H.-J. Kretzschmar expressed his willingness to develop such equations. For funding reasons he asked for a written request by the WG chairmen.

K. Watanabe remarked that one of the reasons for the survey was also the future naming of the WG IC. B. Rukes asked the WG IC members to develop suggestions until reconvening.

The meeting was closed for the day by the chairman at 5 p.m.

The meeting was reopened by the chairman at 5, September 2000, 9.am.

Several proposals for the WG IC name were discussed including "Industrial Requirements and Solutions" (IRS), "Industrial Co-ordination" (IC) and "Industrial Computation and Modelling" (ICM). The WG IC voted that the decision will not be made before the 2001 meeting and that the EC will be informed about the proposals.

5. N. Okita gave a report about the impact of the change from IFC67 to IAPWS-IF97 on HRSG design and performance calculations. He made the following points:

- a) In general the findings of earlier investigations were confirmed.
- b) The impact can reach relative values of approximately 2%, affecting the design calculation more than the performance calculation.
- c) Further investigation is needed to clarify the influence of design methods.
- d) Toshiba's design data bases have to be revised according to the new formulation.

During the following discussion it was established that it should be remembered that the reported differences are clearly smaller than the accuracy of the calculation model itself.

7. Membership was discussed by B. Rukes. No new membership was reported.

8. Two topics were discussed under "Other Business":

- a) During the meeting it was proposed to make water/steam property routines and programs available through the IAPWS home page. Problems might arise since some developers of IAPWS-IF97 software packages sell their software for money while others give them away for free. It was decided that this topic has to be clarified by the EC in conjunction with the copyright issue (see topic 6. b) vi. of these minutes).

## **Attachment 5**

- b) B. Rukes expressed his intention to step down from the position of WG chairman. He stated that being the WG chairman for 11 years is enough especially on the background of his future position as IAPWS president. He pointed out that there are two good candidates for the chairmanship, the current vice chairman W. Parry and K. Miyagawa. Traditionally the vice chairman steps into the chairman position when the chairman resigns. In this case three of the four IAPWS WGs would be chaired by members of the US National Committee (TPWS: D. Friend, PCAS: D. Palmer). In the chairman's opinion this situation would not be favourable for an international organisation. Therefore he suggested that K. Miyagawa shall assume the role of WG chairman. He informed the WG IC members that this issue has been already discussed with the US National Committee and W. Parry at the 1999 meeting in Toronto and there were no objections against a nomination of K. Miyagawa. K. Miyagawa himself expressed his willingness to serve. The members of WG IC unanimously agreed to the nomination of K. Miyagawa and that the EC should be requested to agree to the appointment of K. Miyagawa. The position of the vice chairman shall remain unchanged.

Finally the members of WGs TPWS and IC expressed their deepest thanks to B. Rukes for his continuous effort for IAPWS and especially for his work for the development of IAPWS-IF97. The wish was expressed that B. Rukes will continue his fruitful contribution to both WGs in the future.

9. Preparation of the report to the Executive Committee Meeting will be undertaken by the chairman and the clerk of minutes.
10. The WG IC meeting was adjourned by B. Rukes.

**Agenda  
of Industrial Calculations Working Group**

PRAGUE, CZECH REPUBLIC,

3. – 8. SEPTEMBER 2000

1. Opening Remarks, Adoption of Agenda
2. Appointment of Clerk of Minutes
3. Approval of Minutes of Toronto Meeting, September 1999
4. Future Activities of WG IC
  - 4 a) Report on the Survey
  - 4 b) Conclusions from the Survey Results
5. News about Implementation of IAPWS-IF97
6. Projects of interest to TPWS and IC
  - 6 a) Supplementary Release on  $p(h,s)$  Backward Equations
  - 6 b) Guideline on Tabular Taylor Series Expansion (TTSE) Method
7. Membership
8. Other Business
9. Preparation of Report to Executive Committee
10. Adjournment