

Minutes of the IAPWS working group IRS, Torino, Italy, Sep. 3 - 8, 2023

(Numbering of the topics follows IRS agenda)

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

N. Okita (on behalf of IRS Chair F. di Mare) opened the IRS (joint with TPWS) at 10:35 am, 4. September 2023 meeting for IRS. Agenda was adopted without changes.

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 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 calculation and informed about expected progress in Doosan Škoda wet steam measurement nozzle. The complete readiness for measurements is to be reported by September 2023. K. Meier reported that he is personally in touch with Prof. Schatz, who is also willing to restart measuring at Helmut-Schmidt-Universität.

The following discussion:

D. Friend and A. Harvey discussed and explained the possibilities of IAPWS funding forms and that IAPWS can support only smaller measurements like students exchanges stays. For larger project the funding is about to be found on the base of EU and/or national grants. There was also discussed possibility to form ICRN with specified regions and properties to be measured (for example: speed of sound in range of wet steam, where steam turbines operate). A. Albo asked for the typical wet steam parameters in the steam turbines. From the general debate emerged, that it would be helpful to consider creating ICRN to support/encourage wet steam measurements.

TODO:

A. Nový should report the status of test rig in Doosan Škoda. Specify the typical operational envelope in wet steam for steam turbines. K. Meier to suggest to Prof. Schatz join in Boulder 2024.

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

A. Nový introduced and explained new problem raised by R. Harwood. This new topic is about helping those users of IF97 with transition from Fortran routines to other languages to support validation of newly created IF97 libraries.

The following discussion

D. Friend mentioned the “Nifbench”, which was used for measuring speed and also mentioned, that there was in the past done comparison between IF97 and IAPWS95 for both precision and speed. D. Friend and H.J. Kretzschmar also commented, that there should exist former Fortran routines for IF97 but it will be hard to find. H.J.Kretzschmar suggested, that there are summarised test within the Wagners Steam tables book and that also extensive test were done when creating SBTL. A. Nový mentioned, that existing checkpoints available in the IF97 releases are only for checking specific functions not the library as a complex and that in real usage are the functions combined between each other. H.J.Kretzschmar also suggested to contact K.Miyagawa, as he was also doing the IF97 tests. After the discussion there has been agreed to create new TG “Translation of IF-97 Fortran routines into other programming languages” which should at first gather and summarize all existing validation mechanisms and then continue to enhance the basic tests and also add some real more complex calculation tests (for example whole power plant cycle calculation). The TG setup was unanimously accepted at separate IRS meeting. Members of TG are A. Nový, F.di Mare,R.Harwood, A. R. Sachssendahl,

TODO:

Gather existing validation mechanisms. Suggest the validation scheme.

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

N. Okita reported updates on the ongoing topic. Described the connection among deposits, exhaust temperature and wall surface temperature. The actual expected output is to form Whitepaper for reliable GTCC operation and shutdowns and revised Mueller’s curve. Some details regarding SO₂ and SO₃ concentrations should be included in the white paper.

The following discussion:

D.F. commented thermodynamical aspects. K. Meier asked about ASPEN regarding the data used K. Meier asked about the whitepaper meaning and it was answered, that it is intended as document until final TGD

TODO:

Prepare whitepaper draft until the next meeting.

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

N. Okita reported status and new updates/directions. Also reported that presence at ASME 2023 was good but not as effective because of not much time for preparation. New topic Metal Ion Complexation, close to PCC, has been added to the list. The H₂ combustion and atmospheric micro/macro physics is the most hot topic for future aviation propulsions to be focused next year.

The following discussion:

S. Senoo commented the presence at ASME 2023 on Power Generation panel discussion. K. Maier and A. Harvey mentioned that the mixtures problem and geothermal steam is most close to TPWS. Regarding the mixtures P. A. Albo suggested to check the “EOS-CG” (Combustion Gases). K. Meier commented that there is TPWS mixtures TG.

TODO:

ASME 2024 with stronger presence and preparation, attract industry around H₂ aviation propulsions and other hot topics like different H₂O mixtures respectively.

Check the “EOS-CG”.

Find way to effectively share categories with other WGs.

6.5 Discussion on 6.4 how to exploit it to outputs

D. Friend mentioned that everything, that is about to be published needs EC approval. H. J. Kretschmar reported that OPAL is still operational but not “actively” maintained and its future is uncertain. A. Harvey answered, that for sharing the outputs it would be good to use the renewed webpages of IAPWS but actually nobody within IAPWS is able to extend webpages and funding is limited.

7.1 Dew Point of Low Sulphur Exhaust Gas (N. Okita, same as 6.3 but joint PCC/PCAS/IRS)

The same topic as 6.3 but presented within PCC/PCAS by N. Okita (See PCC minutes)

8. International cooperations/projects/challenges for IRS (Francesca di Mare, N. Okita)

No international cooperations/projects/challenges to be reported.

Instead, next step and future direction of IRS-WG was discussed and summarized for EC report.

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 6.4

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

A. Nový reported no progress in theory and progress in testing rig to be reported during end of September. Also it has been confirmed contact with Dr Schatz provided by K. Meier.

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 reported the need of measurements to adjust models for droplets-condensation. Reported, that were collected measurements available within Japan and the next step will be to collect published measurements worldwide.

9.4 Report of the joint Task Group on ICRN for acid gas dew points (N. Okita, S. Senoo, T. Němec) [Joint with PCAS]

Task group on “A white paper for acid gas dew points” was setup. Members of TG are N. Okita, D. Addison, K. Yoshida and one more PCC member (McCann).

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]

N. Okita reported limited progress since the last meeting in Rotorua, 2nd draft is waiting for PCC input regarding the concentrations limits for IRS review.

9.6 Translation of IF-97 Fortran routines into other programming languages (A. Nový, jointly with TPWS)

The issue was presented by A. Nový at the joint session, here just the basic motivation for such a activity was reminded. There was unanimously agreed to setup new TG “Translation of IF-97 Fortran routines into other programming languages (A. Nový, F. di.Mare, R. Harwood, A. R. Sachssendahl).

9.7 Calculation of mixture properties of steam and non-condensable gases (N. Okita)

Two simple approaches, to use just IF97 or use IF97 with partial pressure at equilibrium.

R. Pawellek commented, that Ebsilon uses functions prepared by Zittau functions“ and/or REFPROP for mixtures and also added that customers nowadays require methanol as medium.

10. Other Business

No other business

11. Membership

It has been unanimously confirmed to propose new IRS member, Aurel Ranniste Sachssendahl from Siemens Energy.

12. Preparation of the Formal Motion to the EC

Report new TG: “Translation of IF97 Fortran routines into other programming languages“

Report new TG: „A white paper for acid gas dew points“

Report new IRS member: Aurel Ranniste Sachssendahl

Report: „Next steps“ of each TG/WG

13. Adjournment

Adjourned at about 16:45 September 4, 2023