Finnish Recovery Boiler Committee

SKYREC STEERING COMMITTEE MEETING X

TIME June 15th, 2010 10.00 – 16.00

PLACE Pöyry Finland Oy, Vantaa

PARTICIPANTS

Lasse Koivisto	Andritz Oy, Varkaus (during items 1 – 6.3)
Timo Peltola	Sandvik, Helsinki (during items 1 – 6.4)
Keijo Salmenoja	Oy Metsä-Botnia Ab, Rauma (during items 5.5 – 9)
Timo-Pekka Veijonen	Stora Enso Oyj
Hiroshi Matsuo	Sumitomometal Industries,Ltd. (during items 1 – 5.10)
Mika Paju	Oy Metsä-Botnia Ab, Joutseno
Matti Tikka	UPM-Kymmene Oyj, Kymi, chairman (items 1 – 5.13)
Kalle Salmi	Metso Power Oy, Tampere

Group members without a right to vote:

Esa Vakkilainen	LUT, project coordinator
Markus Nieminen	Finnish Recovery Boiler Association, secretary
Reijo Hukkanen	Stora Enso Oyj, Oulu (during items 1 – 6.3)

Other:

Mikko Vepsäläinen	VTT, during item 5.10

APPENDICES

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II	Project schedule 15.6.2010
III	LUT: Once-through and reheater recovery boiler – reheating report 15.6.2010
IV	ÅA: Laboratory tests of superheater materials – final report 4.6.2010.
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Steering committee and their substitutes
Durability Sub Committee, Black Liquor Sub Committee
Board of the FRBC
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1 CALLING MEETING TO ORDER

1.1 Abcences

Kaj Nordbäck	Chairman of Finnish Recovery Boiler Association
Martti Korkiakoski	Tekes
Olli Talaslahti	Oy Metsä-Botnia Ab, Rauma

2 MEMO OF THE PREVIOUS MEETING (2/2010)

The memo of the previous meeting was accepted.

3 BUDGET

Budget (situation 15.6.2010) is presented in APPENDIX I.

All participation fees are now collected, total sum 455 000 eur.

Ordered work sum is 576 064 eur and reservations 114 000 eur, totally 690 064 eur. TEKES will participiate maximum 50 % from 700 000 eur (350 000 eur), so budget looks ok if all reservations are materialized.

We have extra funding (no refund from TEKES) 105 000 eur, which can be utilizied also after 30.6.2011.

4 TIME SCHEDULE

Schedule (situation 15.6.2010) is presented in APPENDIX II.

Projects should be completed by the end of June 2011 and the final report written by the end of October 2011.

Both field test projects (furnace and superheater material) are behind schedule. Furnace material tests (Boildec Oy) are going on, but superheater materials tests (VTT) are not started yet.

5 ONGOING PROJECTS

5.1 LUT, Once-through and reheater recovery boiler - concept studies (WP1, S3)

Preliminary report was sent to the project participants for comments at the beginning of December 2009 and the final report in February 2010. Results were presented in the previous steering committee meeting December 16th. Final report was accepted in meeting March 17th, but Vakkilainen promised to prepare an extra report on reheating profitability.

Vakkilainen has prepared an extra report about reheating, APPENDIX III.

The extra report was accepted and the project is completed.

5.2 LUT, Pulp mill optimal steam pressure levels (WP1, S2)

Background:
When modernizing the existing pulp mill the question is how to show what is the economical pressure level. Should the mill keep the old level or decrease it?

Objective:

Work has three parts:
Part 1. Collect data steam pressure levels in use and reasons for those levels
Part 2. Calculate the annual averege steam balances for both modern and traditional pulp mill of about 600 000 ADt/a. Evaluate investments costs between different pressure levels and affect of various electricity price to the chosen pressure levels. Calculations with/without power boiler and with fine paper integrate.
Part 3. Find out means to increase power to heat ratio in existing pulp mills during mill modernization.

Status:
Aapo Hiltunen, LUT will carry out the work as his master's thesis. Project is completed by the end of November 2010. Black liquor sub-committee will supervise the project. Work will be done in English but reported also in Finnish.

Part 1. Collect data from the mills: steam pressure levels in use and reasons for those levels – question list to the mills was made in black liquor sub-committee meeting 17th February. Question list has been sent to the mills and 10/15 answers have been received. LUT will contact mills if more information is needed.

Part 2. Aapo has started to calculate investment cost of different cases, for example:
- install 3.5 bar pressure level alongside with existing 5 bar.
- decrease sootblowing steam pressure
- increase low pressure steam pipe

Calculate annual averege steam balances for both modern and traditional pulp mill of about 600 000 ADt/a. Evaluate investments costs between different pressure levels and affect of various electricity price to the chosen pressure levels. Calculations with/without power boiler and with fine paper integrate.
- modern about 600 000 ADt/a pulp mill
- traditional about 600 000 ADt/a pulp mill
- modern pulp mill + bark boiler
- traditional pulp mill + bark boiler

– modern pulp mill + fine paper mill
– traditional pulp mill + fine paper mill
– modern pulp mill + bark boiler + fine paper mill
– traditional pulp mill + bark boiler + fine paper mill

5.3 Åbo Akademi, Co-firing of black liquor and biomass – laboratory combustion tests, part 2

Objective:
Project consists of two separate works: One consists of droplet combustion tests with wood and lean BL. Second will focus on better understanding of the behaviour of nitrogen in biosludge. Project was ordered at the steering group in an e-mail meeting 29.1 – 2.2.2010. Project is started and will be completed by September 2010.

Status:
The combustion and gasification tests are completed, but the data has not been processed. We have set up the system for concentrating the biosludge + BL mixtures so that we can measure ammonia released during devolatilization. Once the heat treated and concentrated samples are prepared we will be run the combustion tests.

Nikolai DeMartini will ask if Metso or Innventia is able to supply lignin lean black liquor or if ÅA will prepare it in a laboratory. Biosludge is coming from Kymi.

5.4 Åbo Akademi, Laboratory tests of superheater materials (WP2, T3)

Objective:
Corrosion tests with 10CrMo, T91, Sanicro 28, HR11N were made under alkali sulfates and chlorides containing synthetic ashes in reducing (5% CO + 95% N2 – 2 l/min) atmosphere. Results are compared to previous project (SOTU II) where similar tests were made in oxidising atmosphere.

Status:
Test results and preliminary conclusions were presented in the steering committee meeting December 16th 2009. Preliminary report was received on 5th January, 2010 and commented in meeting March 17th. Final report (APPENDIX IV) received from ÅA June 4th.

Project report was accepted and project is completed.

Further research to be discussed.

5.5 VTT, Mill tests of superheater materials, (WP2, T3)

Objective:
Corrosion field tests of superheater tube materials are made with VTT's cooled deposit/corrosion probe in Joutseno recovery boiler. Materials (table below) were chosen in meeting IV, 8th Semtember 2009.

AISI 347	San 67	Alloy 28 (HR21, San 28)	TP310	HR11N	Super 625*

* 50 Ni – 21.5 Cr – 17.5 Fe – 9 Mo

Status:
Everything is ready, only manpower is missing from VTT to perform the test (1000 h) with two probes, opposite sites of furnace. VTT has confirmed that test will start at beginning of August (after summer holiday).

Probe's material temperature set points were verified: first probe 530 °C and second probe 570 °C.

Secretary will confirm that 530 °C is the lowest temperature and 570 °C the highest.

Comments:
- Are we interested in testing materials on present steam temperatures or future steam temperatures?
- Material temperature 510 °C means steam temperature ca. 460-480 °C
- If our target steam temperature is 540 °C, material temperatures should be 570 °C and 590 °C
- In material temperatures 550 °C and 570 °C, there is a certain percentage molten phase in the deposits
- Probes will be mounted through a manhole located on 10.5 floor, nearest sootblower is about 1 m away, no protection is desinged againts it.

5.6 FRBC's Material recommendation (WP3, P1)

Durability committee suggests updating existing recommendation "Suojaussuositus" from 1997, table of contents: APPENDIX V (in finnish).

Following chapters to be updated (possible author):
- Recovery boiler materials and weldings (Sandvik?)
- Recovery boiler coatings (VTT)
- Pressure vessel repairs(Metso?)
- Recovery boiler inspections (Inspecta)

Comments:
– Coatings chapter should include also welding

5.7 Oulun Yliopisto, Ceramic structural materials (WP3, P2)

Objective:
Project will be executed in two phases in the Oulu mill. Quick (duration two weeks) test with all materials will be done first. Longer test with 3-4 best materials after that and then will be decided which samples microstructure are studied. Microstructure study extra cost 1025 € / sample.

Status:
Quick test was started 16.2.2010 and ended 2.3.2010 and results have been received. All materials have suffered damages, ZrO_2 and spinel samples broke when frame was taken out. Some materials have absorbed smelt chemicals by diffusion.

Project is completed tentatively by the end of May 2010, it is now behind the schedule. Test number 1 (quick test) will be done again, to verify the results in week 35 due to Oulu mill has currently no free liquor gun openings to perform the test before that.

Comments from steering committee meeting March 17th:
– what is the total material lost, now only the height is measured
  - OY: all has same surface 50x50mm
– Has hardness changed?
  - OY: only with ZrO2, which broke when probe was taken out
– what is the effective material lost, colour change area included if hardness is changed.
  - OY: to be calculated
– frame has probably hindered the penetration and protected the samples
  - OY: probably, but is the same situation for all materials

Comments from durability committee meeting May 6th:
– probes uppermost and lowest material should be the same material
– quality of selfmade materials = industrial quality?
– could the reference material be MgO-ironmass.

5.8 Boildec Oy, Field testing of furnace materials (WP3, P3)

Objective:
Corrosion field tests of furnace materials are made with Boildec's probe in the Joutseno recovery boiler.

Current schedule and materials:

Test 1: Mar 2 - Apr 15, 2010	Test 2: May 15 - Jun 20, 2010	Test 3: Jul - Aug, 2010	Test 4: Nov - Dec, 2010
AISI 304L (reference material)	AISI 304L (reference material)	AISI 304L (reference material)	AISI 304L (reference material)
AISI 310S	Sandvik 67	Super 625 (Sumitomo "N")	?
Sanicro 38	HR11N = (Sumitomo "R")	HR11N (Sumitomo "R")	?
Sanicro 28	Sandvik 4C54	Sanicro 38	?

Status:
Test are about a year behind the original schedule due to problems with probe temperature control. Now problems have been solved and tests are going on.

Fourth attempt of test 1 was started on 2.3.2010 and finished successfully on 15.4.2010, summary report, APPENDIX VI (in Finnish). Tentative results from test number 1 are received from VTT, APPENDIX VII.

Report summary:
- probes pressure was close to target value (equals temperature 440 °C) about 900 hours, total test time 1006 h.
- according to temperature measurements (inside the material), average temperature was 407 - 412°C, but both measurements broke down (8.3 and 21.3) during test.
- average calculated surface temperature 432 - 435°C.
- according to temperature measurements, material temperatures during the test were below 530°C.
- total time when test material temperatures were in area 450- 530 °C was only 2 hours of 1006 hours
- probe pressure was whole time in control, so material temperatures were also because earlier tests have showed that when probes pressure is over 3 bar, temperature is below 530 °C

Test number 2 was started 17.5 and is going on.

Test 3 materials were verified, so that they are ready when the Joutseno boiler starts after Midsommer shutdown: AISI 304L (reference), Super 625, HR11N and Sanicro 38.

Test number 4 is planned to be reference run.

5.9 VTT, Analysis of the furnace test materials (WP3, P3)

Tentative results from test number 1 are received from VTT, APPENDIX VII. According to results, "best" materials were Sanicro 28, AISI 310S, then AISI 304L and last Sanicro 38.

We should wait for final results before making conclusions.

Comments:
- Sanicro 38 has constant corrosion (same min/max), measurement error?
- Corrosion rates between Sanicro 28 and Sanicro 38 are not logical, should not be much difference between them.

5.10 VTT, Effect of water quality and different chemicals on magnetite layer properties (WP4, V3)

Objective:
Increase of recovery boiler steam temperature and pressure will have effect on water chemical decradation and magnetite layer properties. Degradation of alkaline chemicals in over 300 °C has not been studied and effect on magnetite layer in 340 °C is not known.

Chosen amines to be tested:
- cyclohexylamine
- 2-amino-2-methyl-1-propanol
- morpholine
- ammonium as reference

Status:
Challenges in tuning of the equipment have delayed the project about 6 months, for example problem with the lead-in insulation. Now the tests are done and Mikko Vepsäläinen gave a presentation about the project results. Presentation APPENDIX VIII, tentative report APPENDIX IX.

Conclusions:
- Rate of thermal degradation in 340 °C: morpholine< cyclohexylamine<2-amino-2-methyl-1-propanol
- After 12 hours the magnetite layer had been developed on the surface of polished samples
- Alkaline amines had effect on magnetite layer properties of polished and pre-oxidated samples.
- According to mass tranfer resistance there was no significant difference in corrosion rate between the tested amines.
- Ammonium and morpholine had more large oxide particles on the sample surface.

Comments:

- Magnetite layer's elemental composition should be checked, now only thickness was measured
- How magnetite layer has developed, large particles in the surface
- Degradation products not measured, should be possible with gas chromatograph
- SEM image from pure metal samples
- Flow inside the autoclave unknown, how well does the boiler tube simulate?

5.11 Teollisuuden Vesi Oy, TOC removal methods and their applicability in make-up water treatment (WP4, V1)

Objective

Work consist of two parts: "Ion exchange and organic load" (part A) and "TOC removal methods" (part B). Part A is done with resins from Kotka and Rauma. Part B is literature work.

Status:

Final report for comments was sent to the steering group and durability sub-committee January 22nd. Report was accepted in meeting March 17th. Maija Vidqvist will write a more detailed summary by the end June 2010, it will be an article in a scientific journal.

5.12 Oulun Yliopisto, Reduction of TOC from recovery boiler make-up water (WP4, V1)

Objective:

TOC-measurements have been made in four different water supply plants (Stora Enso, Kemira, Oulun vesi (Veitsiluoto and Kurkelanranta)). Also the affect of ion exchange resin lifetime to TOC-removal is studied and made pilot tests with activated carbon. Cost of the master's thesis is 10 000 eur.

Status:

Presentation and final report was sent to the steering committee March 12th 2010 for comments. Both are in Finnish.

Final report was accepted and project is completed.

5.13 FRBC's Water quality recommendation, (WP4, V1)

Durability committee is preparing the table of contents for water quality recommendation. Reijo Hukkanen has made an suggestion of table of contents, APPENDIX X.

Secretary will ask comments from the steering committee on the suggestion by June 18th, and then send it to below listed companies for tendering:

- Boildec
- Teollisuuden Vesi
- Pöyry
- VTT
- Vesi-Pauli

Comments:

- Water quality recommendation should include practices what to analyse and how often and also operating instructions what to do when a value exceeds the limit.

6 PROPOSALS

6.1 OY, TOC removal methods – field tests of activated carbon and UV-treatment

Proposal for TOC further research is received from Oulu University (APPENDIX XI). The idea is to carry out field tests with actived carbon and UV-treatment. Also investment costs and operating costs of actived carbon and UV-treatment is evaluated.

Tentative schedule is June – September 2010 and cost is 15 500 €.

Decicion:
The work was ordered.

Project is done in co-operation with CEWIC (Centre of Expertise in the Water Industry Cluster) which is located in Oulu. Secretary will contact CEWIC and discuss the contract details.

6.2 Teollisuuden Vesi, TOC-removal methods – investment and operation cost calculations

Teollisuuden Vesi Oy offers a work (APPENDIX XII) where the investment costs and operating costs of different TOC removal methods (reverse osmosis, UV-treatment, nano filtering, active carbon filterin) are calculated. Calculations are made for new and existing pulp mills. Also some information regarding the selection of the method and designing are studied. Total price 17 600 eur.

Secretary has also asked an offer from Teollisuuden Vesi Oy for investment costs and operating costs of different TOC removal methods.

Decicion:
Ordering of the work postponed to autumn meeting, when the results of Oulu's project are available.

6.3 ÅA, Utilization of pyrolysis gases from the recovery boiler

Åbo Akademi offer, APPENDIX XIII.

Objective:
Extracting pyrolysis gas from the lower part of the recovery boiler could possibly be used to replace fossil fuels in the lime kiln. This study will use mass balance and energy balance calculations to study possibilities for extracting pyrolysis gases from the lower part of a recovery boiler. The extracted amount will be assumed to be such that it would cover the need of the lime kiln. In addition to the mass and energy balances, existing CFD calculations of two Kraft recovery boilers will be investigated. The aim of this latter part is to establish typical variation in the gas composition in the lower part of existing boilers as well as to discuss the amount and role of the particulate matter in the lower gas atmosphere.

Work will be finished by 31.12.2010 and reported at a common meeting and as a presentation handout. Total price 8 500 €.

Decision:
The work was ordered.

6.4 International co-operation

6.4.1 Sweden

Nikolai DeMartini, ÅA has spoken with Niclas Berglin and Rikard Wadsborn from Innventia and Mikael from ÅF about a project they are applying for funding for.

“They are considering blowing powdered wood, bark, etc. into a recovery boiler and the project is to look at the fate of non-process elements. They are not going to do any work on the combustion side (will do some modeling of heat input and steam production if I understand correctly). They were suggesting that we could share results. They are looking to the Swedish recovery boiler committee for funding. Would this be something SKY would be interesting in?”

Decision:
Steering committee supports the idea of exchanging project results. Secretary will contact Niko.

6.4.2 Northern America

Jim Keiser, ORNL is coming to Turku, Finland to have a discussion about collaboration opprotunities between the SKYREC and ORNL project "improving heat recovery in biomass-fired boilers". Keijo Salmenoja will participate in the meeting.

6.5 Others proposals

No other proposals.

7 PROJECT IDEAS

No new project ideas.

8 OTHER ISSUES

8.1 Translating project reports into English

Secretary has found translator which shloud be qualified to translate SOTU reports. The rate is 1,7 – 2,0 € per translated line.

9 NEXT MEETINGS (MEETING CALENDAR FOR 2010)

2010 meeting calendar:

- Meeting V: September 14th at 10.00 a.m, Pöyry Finland Oy, Vantaa
- Meeting VI: December 15th