

Conclusions drafted by the WG chairmen and facilitators

SEEEM Meeting

9 April 2007 Zurich Switzerland

Zurich 4 May 2007, Conrad U. Brunner (second SEEEM Meeting 2.doc)

The SEEEM meeting of 9 June 2007 was invited as a side event to the Motor Summit 2007 10/11 April 2007 in Zurich Switzerland hosted by S.A.F.E., SwissEnergy and SEEEM. This conclusion paper, the abstracts of all speakers and presentations are available on www.seeem.org/news.

It is the second SEEEM meeting after the Launch event on 20 June 2006 in London as a side event to EEDAL'06.

The next SEEEM meeting will take place as a side event of EEMODS'07 on 13/14 June 2007 in Beijing.

Plenary Session.....	2
Working Group 1: Harmonization Issues.....	3
Working Group 2: Policy Issues Working Group 3: Stakeholder Outreach & Support	6
Conclusions	7
List of participants	9
Agenda SEEEM Meeting 9 April 2007	10

A+B International, Sustainable Energy Advisors
Gessnerallee 38a, CH 8001 Zurich Switzerland
Tel +4144 226 30 70, Fax +4144 226 30 99, Mail cub@ABinternational.ch

www.seeem.org

Plenary Session

Conrad U. Brunner welcomed as SEEEM coordinator the 25 participants from 17 countries and thanked them for being active in the field of efficient electric motor systems and for joining the SEEEM meeting. Especially the WG chairmen and facilitators were active in preparing the agenda for the plenary and the WGs.

The existing SEEEM work plan concentrates in the present phase I until EEMODS'07 in June 2007 in Beijing on technical harmonization of standards and the launch of working groups. Thereafter in phase II also motor systems (notably pumps and fans) should be considered.

In a summary presentation (www.seeem.org/news) recent technical and policy developments were presented and discussed. The major events for improved motor systems energy efficiency since the launch of SEEEM in June 2006 at EEDAL'06 in London are as follows:

1. ACEEE/NEMA announcement in March 2007 asking US congress to raise EPA Act MEPS to Premium within 3 years of enactment (Rob Boteler/NEMA and Neil Elliott/ACEEE).
2. Launch of new IEA Implementing Agreement on energy efficient equipment in March 2007 (Paul Waide). On 9 July 2007 IEA will hold a second meeting for interested countries to decide on work plan.
3. IEC development of revised and new standards to be ready by 2008: IEC 60034-2 (edition 4) "Testing Standard" and new IEC 60034-30 "Efficiency Classes" published for comments due until 20 April 2007 (WG 31 members: Brian Fletcher/UK, Szymon Liska/Poland, Conrad U. Brunner/Switzerland, Kei Konishi/Japan).
4. The European household appliance association CECED announced in March 2007 the necessity for legal action on household equipment in Europe after the voluntary labeling had low compliance and failed to move the market.
5. Technical life cycle cost studies in the framework of the European Energy using Products directive on Eco-design (Lot 11 on motors) will be ready by the end of 2007. At the MS'07 the entire crew were present: EC coordinator Ismo Grönroos-Saikkala, motors: Anibal de Almeida, pumps: Hugh Falkner, circulators: Charles Gaisford and fans: Peter Radgen. EC decisions on implementation of MEPS are planned by the end of 2008.
6. UNEP and UNDP prepare GEF project for SEEEM with focus on developing countries (Anne Arquit Niederberger, Benoît Lebot).
7. ITFSP bases its motor work on SEEEM (Charles Gaisford, Melanie Slade).
8. China, Korea (Seo Huseok), Malaysia and India (Srinavasan Ramaswamy) have moved or move towards MEPS. Switzerland will join EU effort.
9. China and Canada (Natural Resources: Dale Friesen, Pierre Angers) have started independent testing campaigns to verify the star in IEC 60034-2 (edition 4) vs. IEEE 112 B and CSA standards. Proposals for better accuracy and repeatability to IEC.
10. Positive developments under the Kyoto Protocol Clean Development Mechanism that could make it easier for efficient motor system promotion programs to leverage carbon funding (e.g., Programs of Activities, addressing methodological challenges facing energy efficiency projects).

Generally the speed and the visible convergence of the global development towards harmonized testing standards, efficiency classes and MEPS were welcomed by industry and government representatives. The renewed global attention to energy efficiency in the context of climate change policy has stimulated actions by several law makers and leading industries.

Working Group 1: Harmonization Issues

Chairman	Anibal de Almeida, University of Coimbra Portugal
Facilitator	Conrad U. Brunner, SEEEM coordinator and S.A.F.E. Switzerland
Participants	Pierre Angers, Austin Bonnett, Robert B. Boteler, Brian Fletcher, Hugh Falkner, Dale Friesen, Kei Konishi, Michel Lhenry, Paulo Renato Quintaes, Srinivasan Ramaswamy, Hans-Paul Siderius

Discussion Outcomes

Anibal de Almeida chaired the meeting and introduced an overview of existing testing methods and respective problems. The SEEEM (Standards for Energy Efficiency of Electric Motor Systems) project WG1 is directed at the harmonization of energy efficiency testing procedures, efficiency classes and marking schemes for motors, a necessary condition to achieve a global market transformation strategy to promote efficient industrial electric motor systems worldwide.

One of the major drivers of this harmonization effort is the International Electrotechnical Commission (IEC) with the development of both efficiency test standards and efficiency classification standards. These two new standards are an essential step towards having a transparent market and to promote energy savings:

IEC Efficiency Test Standards

The efficiency test standards IEC 60034-2 (ed. 4), draft approved in March 2006, with 81% majority, final draft pending 2007, implementation expected 2008. It contains three different test methods for the measurement of induction motor efficiency:

- Input-output method similar to IEEE 112 – Method B;
- Indirect method similar to IEC 61972, with stray load losses determined by an assigned variable allowance based on realistic assumptions;
- Stray load losses determined by the Eh-Star Method.

Because of its relative lower costs to test the large number of motor models already in the market, motor manufacturers see this last method as a cost-effective alternative to upgrade the efficiency tests of those motors.

Eh-Star is an inexpensive measuring method where stray load losses are calculated mathematically. Eh-star is based on an asymmetrical feeding of a three-phase induction motor. Independent comparative efficiency tests of 17 motors carried out by two Universities (Darmstadt in Germany and Nottingham in UK), between input-output and calorimetric test methods and the Eh-Star method, showed a good matching of the test results and comparative accuracy. Besides these already known results, Natural Resources Canada has funded independent comparative testing of 13 motors (see Motor Summit 2007 presentations under www.seeem.org/news). The main conclusions of the tests are:

- Accuracy and repeatability of Eh-Star have not been adequately demonstrated in laboratory. Substantial stray-load loss variations may occur due to several factors, namely the impact of temperature, the selection of the testing resistance R_{eh} and the correlation coefficient.
- Even with these limitations, the average error compared with input-output methods IEEE112-B / CSA 390 was an overestimation of the motor efficiency of only 0.3%. The Canadian experts mentioned that this small variation was due to using best practice techniques, which need to be clearly defined to leave less room for error.

Therefore there is a need to make improvements in the definition of the implementation of the Eh-Star test procedure to improve its accuracy and repeatability, which is possible and desirable, but may take some time. It is recommended that IEC tackles this issue in the shortest time frame as possible (if possible not more than 6 months).

IEC Efficiency Classes

The same sort of uncertainty characterizes motor efficiency classification around the world. Existing efficiency classification schemes (e.g. CEMEP, EPAct and NEMA Premium, Australia, China, etc.) use

different testing methods and are related to motors operating with a different supply frequency (50 Hz or 60 Hz). Two major tests methods are in use today: IEEE 112-B which is an input/output method and the IEC 60034-2 (edition 2) in which the stray load losses are assigned an unrealistically low fixed value (0.5% of full-load input power). These two test methods deliver significantly different results and therefore efficiency levels are not straightforwardly comparable. Furthermore, the measurement tolerances vary in the different test methods, and the impact of the supply frequency (50 Hz or 60 Hz) used during the test on the final test results complicates things further.

A first transitional step was taken in Australia by the adoption of a standard which presents different efficiency tables depending on the test method used (IEEE 112 B input-output or IEC 60034-2). Of course this solution makes more difficult compliance and verification.

IEC is developing the standard IEC 60034-30 Energy Efficiency Classes that will hopefully end the current confusion regarding efficiency classification schemes. The standard proposes four efficiency levels:

- Below standard efficiency (no star);
- Standard efficiency (1 Star);
- High efficiency (2 Stars);
- Premium efficiency (3 Stars).

Efficiency and losses shall be tested in accordance with IEC 60034-2 using the “summation of losses” test procedure with *stray load losses* determined either from input-output measurement or from Eh-star test.

The 50 Hz values of standard (1-Star) and high efficiency (2-Star) are similar to the existing CEMEP-EU Eff 2 and Eff 1. However the values have been adjusted to take the different test procedures into account (the CEMEP values assume that the *stray load losses* represent a flat 0.5% of input power). Since in this standard the *stray load losses* determined from input-output test or are measured by the Eh-star method the CEMEP values are adjusted down accordingly.

It is important that Standard IEC 60034-30 is not delayed by the approval of IEC 60034-2 (ed. 4).

Several strategies are possible:

- Because of their lower losses, and of the need for higher testing accuracy, the input-output measurement should be applied for high efficiency (2-Star) and Premium efficiency (3-Star) motors. Standard and lower efficiency motors could use either method.
- To use the Australian methodology with two minimum efficiency tables for each class, which is clearly more confusing.

Repair or Replace?

Because of the existing motor stock in the EU and in most countries is largely dominated by standard and lower efficiency motors, and because often the efficiency is degraded when the motors are repaired, the replacement of failed old motors with new high efficiency motors presents a golden opportunity to achieve very large savings. It was stated that in USA the repair market was 4 to 5 times larger (in number of units) than the new motor market. EASA (www.easa.com) has published several documents to provide the necessary know how for quality repair. New Zealand is proposing a method for determination if an old motor should be rewound or replaced based on age, size and running hours.

Super Premium Motors

In the low power range of electric motors significant improvements can be achieved above Premium efficiency levels. Some manufacturers have already introduced such type of products, namely permanent magnet motors. The cost-effectiveness and efficiency classification of Super Premium motors



deserves to be investigated, particularly considering that Premium motors may become mandatory in some countries.

Working Group 2: Policy Issues

Working Group 3: Stakeholder Outreach & Support

Chair: Paul Waide, International Energy Agency
Facilitator: Anne Arquit Niederberger, A+B International (Sustainable Energy Advisors)
Participants: Reinhard Albert, Bettina Bergauer-Culver, Hans De Keulenaer, Neal Elliott, Charles Gaisford, Frank Hartkamp, Yong Yun Ohk, Huseok Seo, Gianluca Ruggieri, Glenn Widerström

Discussion Outcomes

Paul Waide (IEA) chaired the meeting, which began with an overview of the SEEEM Work Program and Tasks assigned to SEEEM Working Group 2 (Policy Issues), as well as an update of the work undertaken since the SEEEM Launch in June 2006, by Anne Arquit Niederberger (A+B International).

Participants then indicated their immediate priorities for SEEEM WG 2 as follows:

- Priority 1: Recommend mandatory minimum energy performance standards (MEPS) levels and timetable for implementation
- Priority 2: (same rank)
Good practice guidance on methodologies to quantify energy savings & greenhouse gas emission reductions
- Priority 3: Exchange experience and cooperate on policies & incentives that build on standards
Input into policymaking processes (which was regarded as a crucial ongoing task, rather than a specific activity).

Hans De Keulenaer (ECI) led the brief discussion on WG 3. It was agreed that the WG 3 tasks – stakeholder outreach and support – can only be planned once WG 2 progresses and there is a better idea of resource availability. Thus it is recommended to initially merge WG 2 and WG 3 (also at the Side Event in Beijing).

A number of specific WG 2/WG 3 activities were suggested during the discussion:

- Assessment of the global availability of testing laboratories: Given that general purpose motors are largely commodity products, it is not necessary that every country have its own testing capability. In introducing MEPS in 1992, the USA, for example, relied heavily on the testing capability of its neighbor Canada. SEEEM should consider how countries might cooperate to make effective use of the existing capability and determine whether this is adequate.
- Assess which developing countries to engage as a priority in SEEEM. Full participation of major motor manufacturers, exporters and end-users are crucial.
- Roadmap for global motor MEPS introduction.

Conclusions

MEPS for energy efficient electric motors on sufficiently high levels and with a timeline for implementation that allows industry to adapt should be pushed world wide.

Subsequent SEEEM work should focus also on motor systems like pumps, fans and compressors.

The development of higher efficient motors (4-Star) should be supported especially in the smaller range (< 10 kW output) also using permanent magnet motors. Ongoing IEC work on standards for brushless DC Motor needs to be closely followed and should address two main applications:

- High performance BLDC motors, used mostly for demanding applications such as motion control, but which are very costly.
- BLDC motors for centrifugal loads in which the torque requirements are much reduced. These applications are where most of the savings potential is concentrated. These motors typically use ferrites which are much cheaper than NeFeBo magnets.

IEC TC2 secretary (Nick Bradfield) and president (Hans Otto Seinsch), as well as the chairmen of WG 28 (Manfred Stiebler) for revision of IEC 60034-2 and WG 31 (Martin Doppelbauer) for new IEC 60034-30 are informed of the Canadian test results. This might have an impact on an eventual revision of IEC 60034-1 on Tolerances (Chairman Bernd Ponick). Final approval of IEC 60034-2 (edition 4) and IEC 60034-30 should not be delayed. As an intermediary solution also the Australian two columns approach (allowing for the two different testing methods IEEE 112B and IEC 60034-2 edition 2) could be applied to provide a basis for MEPS.

The development of the IEC 60034-30 Efficiency Classes is welcomed because it clearly improves world wide communication and harmonization. The dialogue between NEMA and IEC to reach agreement on 60 Hz and 50 Hz compatibility is very important. The upcoming exchange between NEMA, DOE and IEC WG 31 on 10 May 2007 in Washington DC should clarify the compatibility of IEC for the 60 Hz world.

MEPS for 3-Star and 2-Star motors should so far only be based on test results with input/output method. Eh Star testing methods need further development but can be used as a cheaper alternative for 1-Star motors.

WG 3 work can wait until results of WG 1 and WG 2 are available as content for the subsequent outreach campaign. WG 3 therefore can be merged with WG 2: Paul Waide and Hans de Keulenaer acting as co chairs.

Electronic means of learning and communication will have to be used to reduce unnecessary and costly physical transport of people and goods to attend meetings.

Pending future support for SEEEM and necessary means the following proposals from WG 2 should be implemented:

- Provide input on the work to be done under the motor annex of the new IEA Implementing Agreement on energy efficient end-use electric equipment.
- Compile information on global motor efficiency testing capability and consider its adequacy for supporting wide scale implementation of MEPS in key countries.
- Compile information to determine which are the major motor manufacturer / exporter / end user countries (so we know which countries to target under SEEEM).
- Prepare an issue/discussion paper on the introduction of motor MEPS in key countries (incl. recommendations on levels and a schedule for implementation).



Renewed efforts have to be made by existing and new SEEEM partners and supporters to secure sustainable work for the period until and after EEMODS.

Next SEEEM meeting will be at EEMODS'07 in Beijing (www.eeemods.cn):

- 13 June 2007 afternoon an open session will be held to inform and discuss the results,
- 14 June 2007 morning the SC, TAG and WG will discuss further priorities in phase II including motors and systems.



Standards for Energy Efficiency
of Electric Motor Systems

List of participants

WG1	Name	First Name	Affiliation	Country
1	Angers	Pierre	Meridium Power Inc.	Canada
1	Bonnett	Austin	Consultant	USA
1	Boteler	Robert B.	NEMA/Emerson	USA
1	Brunner	Conrad	U. A + B International	Switzerland
1	De Almeida	Anibal	University of Coimbra	Portugal
1	Falkner	Hugh	AEA MTP	UK
1	Fletcher	Brian	Baldor	UK
1	Friesen	Dale	Meridium Power Inc.	Canada
1	Konishi	Kei	JEMA	Japan
1	Lhenry	Michel	ABB Motors	France
1	Quintaes	Paulo Renato	WEG-Industrias SA	Brasil
1	Ramaswamy	Srinivasan	Bureau of Energy Efficiency India	India
1	Siderius	Hans-Paul	Senter Novem	The Netherlands
1	Albert	Reinhard	Umweltbundesamt	Germany
1	Arquit Niederberger	Anne	A + B International	USA
1	Bergauer-Culver	Bettina	FMEL	Austria
1	De Keulenaer	Hans	ECI	Belgium
1	Elliott	Neal	ACEEE	USA
1	Gaisford	Charles	AEA MTP	UK
1	Hartkamp	Frank	Senter Novem	Netherlands
1	OHK	Yong Yun	KEMCO	Korea
1	Ruggieri	Gianluca	Università dell'Insubria	Italy
1	SEO	Huseok	KEMCO	Korea
1	Waide	Paul	IEA	France
1	Widerström	Glenn	Swedish Energy Agency	Sweden

Agenda SEEEM Meeting 9 April 2007

16 00 Plenary Session:
Welcome and orientation on recent events and SEEEM activities

17 00 Working Groups 1 and 2/3:
Orientation and new developments.

WG 1 Agenda

- Welcome & Introduction (Anibal De Almeida)
- WG1 Priorities
 - Testing Standards
 - Energy Efficiency Classes
 - Motor repair
 - Super Premium Motors
- Wrap Up and Next Steps until EEMODS'07 (Anibal de Almeida)
- End WG1 meeting

WG 2/3 Agenda

- Welcome & Introduction (Paul Waide)
- WG2 Priorities
 - Overview of Work Program and Tasks (Anne Arquit Niederberger)
 - Structured Discussion of Priorities
- WG3 Stakeholder Outreach & Support (Hans de Keulenaer, European Copper Institute, Chair SEEEM WG3)
- Wrap Up and Next Steps until EEMODS'07 (Paul Waide)
- End WG2/WG3 meeting

19 00 Joint Session:
Reports from the two Working Groups
Priorities for future work until June 2007 (EEMODS)

19 30 Reception

20 00 Dinner