CIGRE Study Committee A1

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP (1)

WG* N° A1. 47	**Name of Convenor : DOHYUN KANG** (Rep. of Korea) **E-mail address**: dhkang@keri.re.kr
Technical Issues # (2): 5	**Strategic Directions # (3): 2**
The WG applies to distribution networks (4): Yes	
Title of the Group: Technological Feasibility Studies for Super and Ultra Premium Efficient Motors	

Scope, deliverables and proposed time schedule of the Group:

Background

In general, over 60% of the global electric energy demand is used by electric motor systems. They are used to drive pumps, fans, compressors, traction systems and industrial handling & processing equipment in the various fields such as industry, large buildings and home appliances. Energy efficient electric motors represent one of the largest opportunities for cost-effective electric savings and the action plans for the reduction of greenhouse gas emissions. In order to gain fast and efficient access to the energy efficiency improvements of electric motor systems, regulations mandating the energy labelling of products for minimum energy performance standards (MEPS) have been widely applied to three-phase electric motors and the MEPS efficiency has resulted in higher efficiency levels such as IE3, premium efficiency. The world would save about 160 nuclear reactors (160 GW) on power plants by improving 5% of motor efficiency.

The IEC 60034-30-1, published in March 2014, widens the product range covered in the first edition of IEC 60034-30 significantly. The power range has been expanded (starting at 0.12kW and ending at 1MW). All technical constructions of electric motors are covered as long as they are rated for on-line operation and not just three-phase, cage-induction motors. The Super Premium efficiency class motors (defined as IE4 in IEC 60034-30-1) are newly included and Ultra-Premium efficiency class motors (defined as IE5 in IEC 60034-30-1) are envisaged to reduce the losses of IE4 motors further by some 20%.

This WG shall focus on the technological feasibility studies for IE4 / IE5 efficient line operated AC motors. There are three main technical areas where efficiency gains can be accomplished in IE4 / IE5 motors: the materials that make up the motor, product manufacturing, and improvements in motor design. As for the motor materials, there are core materials, magnetic materials, conductors, bearings and casing materials. For example, use of coils coated with nano graphene (carbon) enable us to improve electric conductivity sharply and decrease the copper losses simultaneously. With respect to product manufacturing, there are die-casting for conductor, heat treatment of motor core and improvement of the coil fill factor, etc. Motor designs based on optimization can provide high

performance combined with cost reduction. By using best available and future new technologies, the energy efficiency of motor can be easily improved to IE4 / IE5 class.

Scope

■ Definition and classification of line operated AC motors.

■ Selection of surveyed motor power range (small, medium and large)

■ Investigation of efficiency limits in IE4 / IE5 motors

■ Methodology of efficiency improvement

- Materials: lower loss core steels, amorphous metals, coil with nano-material insulation, coil coated with nano graphene for high electric conductivity, new permanent magnets (PM) without rare earth material (for example, Mn-Al alloy with nano core-shell)
- Design: new motor topologies (for example, permanent magnet geometric line-start motor), optimization (slot and teeth in stator and rotor, air-gap length)
- Product manufacturing: die-casting, improvement of fill factor
- Others

■ Making provisional milestones for IE4/IE5 Efficient Motors

Deliverables : Technical Brochure with summary in Electra

Main Tasks and Time Schedule: Start: December 2014 **Final report:** July 2017

- TOR approval – October 2014
- Forming of team – December 2014
- Draft questionnaire 1 – First Version – January 2015 (to be sent to WG members)
- Additional comments by members and experts – March 2015
- Draft questionnaire 2 – Second Version - May 2015
- Comments by members and experts – up to July 2015
- Final questionnaire – August 2015 (to be presented at Madrid meeting)
- Survey – answers – December 2015
- Draft report 1 – March 2016
- Comments by members and experts - June 2016
- Draft report 2 – August 2016 (to be presented at Paris meeting)
- Additional comments by members and experts – December 2016
- Final report approval – March 2017
- Document approval (Technical Guideline and summary for Electra) – July 2017

Comments from Chairmen of SCs concerned :

Approval by Technical Committee Chairman : M. Wald
Date : 03/11/2014

(1) Joint Working Group (JWG) - (2) See attached table 1 – (3) See attached table 2

(4) Delete as appropriate

Table 1: Technical Issues of the TC project "Network of the Future" (cf. Electra 256 June 2011)

1	Active Distribution Networks resulting in bidirectional flows within distribution level and to the upstream network.
2	The application of advanced metering and resulting massive need for exchange of information.
3	The growth in the application of HVDC and power electronics at all voltage levels and its impact on power quality, system control, and system security, and standardisation.
4	The need for the development and massive installation of energy storage systems, and the impact this can have on the power system development and operation.
5	New concepts for system operation and control to take account of active customer interactions and different generation types.
6	New concepts for protection to respond to the developing grid and different characteristics of generation.
7	New concepts in planning to take into account increasing environmental constraints, and new technology solutions for active and reactive power flow control.
8	New tools for system technical performance assessment, because of new Customer, Generator and Network characteristics.
9	Increase of right of way capacity and use of overhead, underground and subsea infrastructure, and its consequence on the technical performance and reliability of the network.
10	An increasing need for keeping Stakeholders aware of the technical and commercial consequences and keeping them engaged during the development of the network of the future.

Table 2: Strategic directions of the TC (cf. Electra 249 April 2010)

1	The electrical power system of the future
2	Making the best use of the existing system
3	Focus on the environment and sustainability
4	Preparation of material readable for non technical audience