Proposed Change to the Draft of the Ninth Edition of the SI Brochure

Unit of Reactive Power

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Introduction

There are three distinct quantities of interest related to measurements of sinusoidal electric power: active power, apparent power and reactive power.

Though all these quantities have the same unit expressed in terms of base units as kg m^2 s^{-3}, electrical engineers have historically named differently the units for each of those quantities to better design electrical facilities.

Electric utilities are increasingly interested in measuring and taxing separately each of these power components even for the residential costumer. This trend will continue with the advent of smart grids.

Electrical instruments should give clear indication on each of these power components so that the costumer knows what is being paid for.

NMIs use the unit symbol var when declaring the related CMC entries in Appendix C of the MRA.

Objective

To eliminate the dubiousness generated by the IEC adoption of two equal-footing units for the quantity reactive power.

Motivation

The quantity reactive power is relevant for national commerce and economics; it is part of legal legislation in developed countries; and it is expected to continue to be used in the future.

National legislations regarding the use of units are in general based on the SI. The IEC Standard 80000-6, which follows the SI Brochure, is adopted as a reference in the specific case of electrical units.

Problems have occurred when national governments adopt in their legislation only the coherent derived units listed in SI Brochure. Electrical utilities and instrument manufacturers justifiably refuse to adopt volt ampere for the unit of reactive power.

IEC 80000-6

The units are arranged in IEC Standard 80000-6 in the following way:

- The coherent SI units (i.e. the seven base units and 22 coherent derived units) are given first;
- Some non-SI units are then given, being those accepted by the CIPM, or by the OIML, or by ISO or IEC, for use with the SI (such units are separated from the SI units in the item by use of a broken line);

IEC Standard 80000-6 lists the unit of reactive power in the following way:

It regards the unit volt ampere as the coherent derived unit of reactive power and the unit var as a non-SI unit accepted by IEC for use with the SI. So first the unit volt ampere (unit symbol V A) is listed and then the unit var (unit symbol var)

IEC Standard 80000-6 asseverates that ´where two or more names or two or more symbols are given for one quantity and no special distinction is made, they are on an equal footing.´.

Justification

One could think that this problem should be left for IEC to solve. IEC could perhaps eliminate the unit volt ampere as the coherent derived unit of reactive power in IEC Standard 80000-6 and leave only the non-SI unit var as the unit of reactive power. But this means to change the arrangement of units adopted for that standard and described in the previous section. That arrangement is correct and follows the SI Brochure.

It is here proposed that the draft of the ninth edition of the SI Brochure be changed to consider var as the special name of the unit of the derived quantity reactive power to be listed in its Table 4. That table lists the SI units with special names which can be constructed directly from the seven defining constants. By doing so, IEC Standard 80000-6 would list only one unit for the quantity reactive power and the current problems caused by the listing of two units would cease.

Detailed changes to the Draft of the SI Brochure

Change Table 4 so as to include an additional entry containing:

- the quantity reactive power in its first column,
- the special name var in its second column,
- the expression var = kg m^2 s^{-3} in its third column and
- the unit V A in its fourth column.

Change the caption of this table to read ´The 23 SI units with special names and symbols´.

Revise section 2.2.4 to replace the references to ´22 SI units with special names´ by ´23 SI units with special names´ and the reference to ´the set of 29 coherent SI units´ by ´the set of 30 coherent SI units´.

Acknowledgments

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They helped us to better define the action finally proposed in CCEM/2017–04.1.

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