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C(2019) 5380 final

ANNEX

**ANNEX**

**to the**

**Commission Regulation (EU) .../...**

**amending Regulation (EU) No 548/2014 of 21 May 2014 on implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to small, medium and large power transformers**

{SWD(2019) 306 final}

## ANNEX

The Annexes to Regulation (EU) No 548/2014 are amended as follows:

(1) Annex I is amended as follows:

(a) point 1 is amended as follows:

(i) the title of Table I.1 is replaced as follows:

"Maximum load and no-load losses (in W) for three-phase **liquid-immersed** medium power transformers with one winding with  $U_m \leq 24\text{kV}$  and the other with  $U_m \leq 3,6\text{kV}$ "

(ii) the title of Table I.2 is replaced as follows:

"Maximum load and no-load losses (in W) for three-phase **dry-type** medium power transformers with one winding with  $U_m \leq 24\text{kV}$  and the other with  $U_m \leq 3,6\text{kV}$ "

(iii) the following paragraphs are added after the first paragraph:

"As of the date of application of Tier 2 requirements (1<sup>st</sup> July 2021), when the one-to-one replacement of an existing medium power transformer entails disproportionate costs associated with their installation, the replacement transformer is, exceptionally, only required to meet Tier 1 requirements for the given rated power.

In this respect, installation costs are disproportionate if the costs of the replacement of the complete substation housing the transformer and/or the acquisition or rental of additional floor space are higher than the net present value of the additional avoided electricity losses (tariffs, taxes and levies excluded) of a Tier 2 compliant replacement transformer over its normally expected service life. The net present value shall be calculated based on capitalised loss values using widely accepted social discount rates<sup>1</sup>.

In this case, the manufacturer, importer, or authorised representative shall include in the technical documentation of the replacement transformer the following information:

- Address and contact details of the commissioner of the replacement transformer
- The station where the replacement transformer is to be installed. This shall be unequivocally identified by either a specific location or a specific installation type (e.g., station or cabin model)
- The technical and/or economic justification of the disproportionate cost to install a transformer that is only Tier 1 compliant instead of a Tier 2 compliant one. If the transformers(s) were commissioned by a tendering process, all the necessary information regarding the analysis of bids and the award decision shall be provided.

In the above cases, the manufacturer, importer or authorised representative shall notify the competent national market surveillance authorities."

(iv) Table I.3 is replaced by Tables I.3a and I.3b as follows:

"Table I.3a: Correction factors to be applied to the load and no load losses indicated in Tables I.1, I.2 and I.6 for medium power transformers with special combinations of winding voltages (for rated power  $\leq 3150$  kVA)

Special combination of voltages in one winding	Load losses	No	load
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<sup>1</sup> The European Commission Better Regulation Toolbox suggest using a value of 4% for the social discount rate

[https://ec.europa.eu/info/sites/info/files/file\\_import/better-regulation-toolbox-61\\_en\\_0.pdf](https://ec.europa.eu/info/sites/info/files/file_import/better-regulation-toolbox-61_en_0.pdf)

		(P <sub>k</sub> )	losses (P <sub>o</sub> )
For both liquid immersed (Table I.1) and dry type (Table I.2)		No correction	No correction
Primary highest voltage for equipment U <sub>m</sub> ≤ 24kV	Secondary highest voltage for equipment U <sub>m</sub> > 3,6kV		
For liquid immersed (Table I.1)		10%	15%
Primary highest voltage for equipment U <sub>m</sub> = 36kV	Secondary highest voltage for equipment U <sub>m</sub> ≤ 3,6kV		
Primary highest voltage for equipment U <sub>m</sub> = 36kV	Secondary highest voltage for equipment U <sub>m</sub> > 3,6kV	10%	15%
For dry type (Table I.2)		10%	15%
Primary highest voltage for equipment U <sub>m</sub> = 36kV	Secondary highest voltage for equipment U <sub>m</sub> ≤ 3,6kV		
Primary highest voltage for equipment U <sub>m</sub> = 36kV	Secondary highest voltage for equipment U <sub>m</sub> > 3,6kV	15%	20%

Table I.3b: Correction factors to be applied to the load and no load losses indicated in Tables I.1, I.2 and I.6 for medium power transformers with dual voltage in one or both windings differing more than 10% and rated power ≤ 3150 kVA.

Type of dual voltage	Reference voltage for the application of correction factors	Load losses (P <sub>k</sub> )(*)	No load losses (P <sub>o</sub> )(*)
Dual voltage on one winding with reduced power output on the lower low-voltage winding AND maximum available power on the lower voltage of the low-voltage winding limited to 0,85 of the rated power assigned to the low-voltage winding at its higher voltage.	losses shall be calculated based on the higher voltage of the low-voltage winding	No correction	No correction
Dual voltage on one winding with reduced power output on the lower high-voltage winding AND maximum available power on the lower voltage of the high-voltage winding limited to 0,85 of the rated power assigned to the high-voltage	losses shall be calculated based on the higher voltage of the high-voltage winding	No correction	No correction

winding at its higher voltage.			
Dual voltage on one winding AND full rated power available on both windings, i.e., the full nominal power is available regardless of the combination of voltages.	The losses shall be calculated based on the higher voltage of the dual voltage winding	10%	15%
Dual voltage on both windings AND rated power available on all combinations of windings, i.e., both voltages on one winding are fully rated in combination with one of the voltages on the other winding	the losses shall be calculated based on the higher voltages of both dual voltage windings	20%	20%

(\* ) The losses shall be calculated on the base of the voltage of the winding specified in the second column and can be increased with the correction factors given in the last 2 columns. In any case, whatever the combinations of winding voltages, the losses cannot exceed the values given in Tables I.1, I.2 and I.6 corrected by the factors in this table."

(b) in point 1.4, the first paragraph is replaced as follows:

"1.4. For the one-to-one replacement of existing medium power pole-mounted transformers with power ratings between 25 kVA and 400 kVA, the applicable maximum levels of load and no-load losses are not the ones in Tables I.1 and I.2, but those in Table I.6 below. Maximum allowable losses for kVA ratings other than those explicitly mentioned in Table I.6 shall be obtained by linear interpolation or extrapolation. The correction factors for special combinations of winding voltages indicated in Tables I.3a and I.3b are also applicable.

For the one-to-one replacement of existing medium power pole-mounted transformers, the manufacturer, importer or authorised representative shall include in the technical documentation of the transformer the following information:

- the address and contact details of the commissioner of the replacement transformer;
- the station where the replacement transformer is to be installed. This shall be unequivocally identified either by a specific location or an specific installation type (e.g. technical description of the pole).

In the above cases, the manufacturer, importer or authorised representative shall notify the competent national market surveillance authorities."

With regard to the installation of new pole-mounted transformers, it is the requirements in Tables I.1 and I.2, in conjunction with Tables I.3a and I.3b where justified, which are applicable."

(c) point 2 is replaced by the following:

## **"2. Minimum energy efficiency requirements for large power transformers**

Minimum efficiency requirements for large power transformers are set out in Tables I.7, I.8 and I.9.

There may be specific instances where the replacement of an existing transformer, or the installation of a new one, meeting the applicable minimum requirements set out in Tables I.7, I.8 and I.9 would result in disproportionate costs. As general rule, costs can be considered to be disproportionate when the extra transportation and/or installation costs of a Tier 2 or Tier 1, as applicable, compliant transformer would be higher than the net present value of the additional avoided electricity losses (tariffs, taxes and levies excluded) over its normally expected service life. This net present value shall be calculated based on capitalised loss values using widely accepted social discount rates<sup>2</sup>.

In those cases, the following fall-back provisions apply:

As of the date of application of Tier 2 requirements (1st July 2021), when the one-to-one replacement of a large power transformers in an existing site entails disproportionate costs associated to its transportation and/or installation, or is technically infeasible, the replacement transformer is, exceptionally, only required to comply with Tier 1 requirements for the given rated power.

Furthermore, if the cost of installing a replacement transformer complying with Tier 1 requirements are also disproportionate, or where no technically feasible solutions exist, no minimum requirements shall apply to the replacement transformer.

As of the date of application of Tier 2 requirements (1<sup>st</sup> July 2021), when the installation of a new large power transformer in a new site entails disproportionate costs associated to their transportation and/or installation, or is technically infeasible, the new transformer is, exceptionally, only required to meet Tier 1 requirements for the given rated power.

In these cases, the manufacturer, importer or authorised representative responsible for placing on the market or putting into service the transformer shall:

include in the technical documentation of the new or replacement transformer the following information:

- address and contact details of the commissioner of the transformer;
- the specific location where the transformer is to be installed;
- the technical and/or economic justification to install a new or replacement transformer that does not comply with Tier 2 or Tier 1 requirements. If the transformer(s) were commissioned by a tendering process, all the necessary information regarding the analysis of bids and the award decision, shall also be provided;

. notify the competent national market surveillance authorities.

**Table I.7 Minimum Peak Efficiency Index requirements for liquid immersed large power transformers**

Rated Power (MVA)	Tier 1 (01.07.2015)	Tier 2 (01.07.2021)
	Minimum Peak Efficiency Index (%)	

<sup>2</sup> The European Commission Better Regulation Toolbox suggest using a value of 4% for the social discount rate

[https://ec.europa.eu/info/sites/info/files/file\\_import/better-regulation-toolbox-61\\_en\\_0.pdf](https://ec.europa.eu/info/sites/info/files/file_import/better-regulation-toolbox-61_en_0.pdf)

≤ 0,025	97,742	98,251
0,05	98,584	98,891
0,1	98,867	99,093
0,16	99,012	99,191
0,25	99,112	99,283
0,315	99,154	99,320
0,4	99,209	99,369
0,5	99,247	99,398
0,63	99,295	99,437
0,8	99,343	99,473
1	99,360	99,484
1,25	99,418	99,487
1,6	99,424	99,494
2	99,426	99,502
2,5	99,441	99,514
3,15	99,444	99,518
4	99,465	99,532
5	99,483	99,548
6,3	99,510	99,571
8	99,535	99,593
10	99,560	99,615
12,5	99,588	99,640
16	99,615	99,663
20	99,639	99,684
25	99,657	99,700
31,5	99,671	99,712
40	99,684	99,724
50	99,696	99,734
63	99,709	99,745
80	99,723	99,758
100	99,737	99,770
125	99,737	99,780
160	99,737	99,790
≥200	99,737	99,797

Minimum PEI values for MVA ratings that fall in between the ratings given in Table I.7 shall be calculated by linear interpolation

**Table I.8 Minimum Peak Efficiency Index requirements for dry-type large power transformers with  $U_m \leq 36\text{kV}$**

Rated Power (MVA)	Tier 1 (01.07.2015)	Tier 2 (01.07.2021)
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	Minimum Peak Efficiency Index (%)	
$3,15 < S_r \leq 4$	99,348	99,382
5	99,354	99,387
6,3	99,356	99,389
8	99,357	99,390
$\geq 10$	99,357	99,390

Minimum PEI values for MVA ratings that fall in between the ratings given in Table I.8 shall be calculated by linear interpolation

**Table I.9 Minimum Peak Efficiency Index requirements for dry-type large power transformers with  $U_m > 36\text{kV}$**

Rated Power (MVA)	Tier 1 (01.07.2015)	Tier 2 (01.07.2021)
	Minimum Peak Efficiency Index (%)	
$\leq 0,05$	96,174	96,590
0,1	97,514	97,790
0,16	97,792	98,016
0,25	98,155	98,345
0,4	98,334	98,570
0,63	98,494	98,619
0,8	98,677	98,745
1	98,775	98,837
1,25	98,832	98,892
1,6	98,903	98,960
2	98,942	98,996
2,5	98,933	99,045
3,15	99,048	99,097
4	99,158	99,225
5	99,200	99,265
6,3	99,242	99,303
8	99,298	99,356
10	99,330	99,385
12,5	99,370	99,422
16	99,416	99,464
20	99,468	99,513
25	99,521	99,564
31,5	99,551	99,592
40	99,567	99,607
50	99,585	99,623
$\geq 63$	99,590	99,626

Minimum PEI values for MVA ratings that fall in between the ratings given in Table I.9 shall be calculated by linear interpolation",

(d) in point 3, the last subparagraph is replaced by:

“For medium and large power transformers only, the information under a); c) and d) shall also be included on the rating plate of the transformer.”;

(e) in point 4, the last paragraph is deleted,

and a new point (d) is added as follows:

"(d) the specific reason(s) why transformers are considered to be exempted from the Regulation in accordance with Article 1.2"

(2) Annex II is replaced by the following:

## "Annex II

### Measurement methods

For the purpose of compliance with the requirements of this Regulation, measurements shall be made using a reliable, accurate and reproducible measurement procedure, which takes into account the generally recognised state of the art measurement methods, including methods set out in documents the reference numbers of which have been published for that purpose in the Official Journal of the European Union.

### Calculation methods

The methodology for calculating the Peak Efficiency Index (PEI) for medium and large power transformers referred to in Tables I.4, I.5, I.7, I.8 and I.9 of Annex I is based on the ratio of the transmitted apparent power of a transformer minus the electrical losses to the transmitted apparent power of the transformer. The calculation of PEI shall use state-of-the-art methodology available in the latest version of the relevant harmonised standards for medium and large power transformers.

The formula to be used for the Peak Efficiency Index calculation is:

$$PEI = 1 - \frac{2(P_0 + P_{c0} + P_{ck}(k_{PEI}))}{S_r \sqrt{\frac{P_0 + P_{c0} + P_{ck}(k_{PEI})}{P_k}}} = 1 - \frac{2}{S_r} \sqrt{(P_0 + P_{c0} + P_{ck}(k_{PEI}))P_k} \quad (\%)$$

Where:

$P_0$  is the no load losses measured at rated voltage and rated frequency on the rated tap

$P_{c0}$  is the electrical power required by the cooling system for no load operation, derived from the type test measurements of the power taken by the fan and liquid pump motors (for ONAN and ONAN/ONAF cooling systems  $P_{c0}$  is always zero)

$P_{ck}(k_{PEI})$  is the electrical power required by the cooling system in addition to  $P_{c0}$  to operate at  $k_{PEI}$  times the rated load.  $P_{ck}$  is a function of the load.  $P_{ck}(k_{PEI})$  is derived from the type test measurements of the power taken by the fan and liquid pump motors (for ONAN cooling systems  $P_{ck}$  is always zero).



$P_k$  is the measured load loss at rated current and rated frequency on the rated tap corrected to the reference temperature

$S_r$  is the rated power of the transformer or autotransformer on which  $P_k$  is based

$k_{PEI}$  is the load factor at which Peak Efficiency Index occurs",

(3) Annex III<sup>3</sup> is amended as follows:

the following paragraph is added after the first paragraph:

“Where a model has been designed to be able to detect it being tested (e.g. by recognizing the test conditions or test cycle), and to react specifically by automatically altering its performance during the test with the objective of reaching a more favourable level for any of the parameters specified in this Regulation or included in the technical documentation, or included in any of the documentation provided, the model and all equivalent models shall be considered not compliant.”

At the end of point (1) the following is added:

"The Member State authority can do this verification using its own testing equipment.

If Factory Acceptance Tests (FATs) are planned for such transformers, which will test parameters laid down in Annex I of this Regulation, the Member State authorities may decide to use witnessed testing during these FATs to gather test results which can be used to verify compliance of the transformer under investigation. The authorities may request a manufacturer to disclose information on any planned FATs relevant for witnessed testing.

If the result referred to in point 2 (c) is not achieved, the model and all equivalent models shall be considered not to comply with this Regulation. The Member State authorities shall provide all relevant information to the authorities of the other Member States and to the Commission without delay after a decision is taken on the non-compliance of the model."

And point (3) is replaced as follows:

"(3) If the results referred to in point 2(a), (b) or (c) are not achieved, the model and all equivalent models shall be considered not to comply with this Regulation.",

(4) in Annex IV, point (c) is amended as follows:

"(c) Medium power transformers with amorphous steel core: Ao-50%, Ak."

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<sup>3</sup> Annex III to Regulation (EU) No 548/2014 as amended by Commission Regulation (EU) 2016/2282 of 30 November 2016 amending Regulations (EC) No 1275/2008, (EC) No 107/2009, (EC) No 278/2009, (EC) No 640/2009, (EC) No 641/2009, (EC) No 642/2009, (EC) No 643/2009, (EU) No 1015/2010, (EU) No 1016/2010, (EU) No 327/2011, (EU) No 206/2012, (EU) No 547/2012, (EU) No 932/2012, (EU) No 617/2013, (EU) No 666/2013, (EU) No 813/2013, (EU) No 814/2013, (EU) No 66/2014, (EU) No 548/2014, (EU) No 1253/2014, (EU) 2015/1095, (EU) 2015/1185, (EU) 2015/1188, (EU) 2015/1189 and (EU) 2016/2281 with regard to the use of tolerances in verification procedures, OJ L 346, 20.12.2016, p. 51.