



Philippine Electricity  
Market Corporation

## MINUTES OF MEETING

### Rules Change Committee and Technical Committee Coordination Meeting (No. 2020-01)

05 May 2020, 9:00 AM – 12:03 PM

Via Microsoft Teams

Agenda	Action Required
I. <b>Call to Order</b>	<ul style="list-style-type: none"> <li>The special meeting was conducted via Microsoft Teams and was called to order at 09:02 AM. The meeting was chaired by Dr. Allan C. Nerves (RCC-Independent member).</li> </ul>
Attendance List	
In-attendance	Not In-attendance
<b><u>Rules Change Committee Representatives</u></b> <ol style="list-style-type: none"> <li><b>Allan C. Nerves</b> – Independent</li> <li><b>Carlito C. Claudio</b> – Generation</li> <li><b>Ryan S. Morales</b> – Distribution</li> <li><b>Lorreto H. Rivera</b> – Supply</li> <li><b>Ambrocio R. Rosales</b> – System Operator</li> <li><b>Isidro E. Cacho</b> – Market Operator</li> </ol> <b><u>Technical Committee</u></b> <ol style="list-style-type: none"> <li><b>Jordan Rel C. Orillaza</b> – Chairman</li> <li><b>Fortunato C. Leynes</b> – Independent</li> <li><b>Jaime V. Mendoza</b> – DMC Representative</li> <li><b>Ermelindo R. Bugaoisan, Jr.</b> – System Operator Representative</li> </ol>	
<b><u>PEMC – MAG</u></b> Karen A. Varquez Divine Gayle C. Cruz Dianne L. De Guzman  <b><u>PEMC – CPC</u></b> Dece Marwil B. Falar Kevin John Y. Dela Cuesta  <b><u>PEMC – Legal</u></b> Monica M. Martin  <b><u>DOE Representatives</u></b> Ferdinand B. Binondo	

Ryan Jaspher M. Villadiego  
 Lex Magtalas  
 Mari Josephine Enriquez  
 Karen Anne H. Siruma  
 Justin A. Lumbres  
 Kevin Lloyd C. de los Santos

**MERALCO Representatives**

Melchor Mateo L. Luber  
 Marvin G. Gonsalves  
 Eric T. Equiz  
 Justin E. Mendiola  
 Joebet Isaac V. Del Rosario  
 Katherine Ann C. Perez

**NGCP Representatives**

Armando C. Nicdao  
 Honorio F. Estravez, Jr.  
 Jayson J. Abraham  
 Francis Albert S. Vicencio

Agenda	Agreements/Action Plans
<b>II. Background and objective of the Meeting</b>	Information provided by the Secretariat were noted by the attendees.

1

2 Ms. Dianne L. De Guzman (PEMC) presented the background and objective<sup>1</sup> of the  
 3 meeting, which is to clarify the interpretation and implementation of Section GRM  
 4 9.2.3.2 of the 2016 Philippine Grid Code (PGC). The timeline of events as provided in  
 5 the presentation is summarized below:

6

Date	Details
29 Nov 2019	MERALCO submitted the proposed amendments to the WESM Metering Manual
06 Dec 2019	RCC approved the publication
21 Jan 2020	RCC deliberated on the proposal with comments & response from the proponent
13 Mar 2020	RCC approved the proposal, as amended
25 Mar 2020	PEM Board approved the proposal and directed RCC and TC to clarify the interpretation and implementation of Section GRM 9.2.3.2 of the 2016 Philippine Grid Code (PGC)

7

8

<sup>1</sup> Annex A – Presentation Material on Background and Objective of the Meeting



Agenda	Agreements/Action Plans
3.1 Presentation of Meralco	The body noted MERALCO's presentation and agreed to discuss issues/queries after all presentations.

9

10 Mr. Ryan S. Morales (RCC/MERALCO), introduced Mr. Justin E. Mendiola the  
11 presenter for Meralco from their Metering Group.

12

13 Mr. Mendiola gave the background<sup>2</sup> on the discussion of proposal, stating that the  
14 WESM Metering Manual prescribes using Current Transformers (CT) with rated  
15 burden of 5VA only. He cited that Mactan Electric Corp. intended using CT with higher  
16 rated burden and raised this matter to the Technical Committee (TC), who responded  
17 through a letter<sup>3</sup> informing that the said CT is compliant to the accuracy requirement  
18 and is of better performance. He added that an installation of CT with 12.5VA rated  
19 was considered non-compliant by the IEMOP and NGCP, which delayed the  
20 energization of bank. He also added that the proposal intended to refer the Metering  
21 Manual to the latest international standards, i.e. IEEE and IEC.

22

23 He elaborated the interpretation of IEEE Standards, wherein, rated burden higher than  
24 what is specified may be considered as long as with accurate performance. He cited  
25 as example a CT with 45VA rating and 2.5VA secondary circuit, the accuracy  
26 performance is compliant based on the international standards. He showed some  
27 samples wherein all CTs passed the load tests and accuracy consistent with 0.15, thus  
28 may be deemed compliant with the Metering Manual.

29

30 He also discussed some reasons on using higher rated burden CTs, as listed:

- 31 • Based on theoretical and actual measurement, the total connected burden  
32 exceeds the 50% of 5VA limit; and
- 33 • Load of the CT is dependent on the length of wire, longer wire higher rated  
34 burden.

35

36 He added that one of the reasons for acquiring 12.5VA CT is the site condition. Some  
37 meters are far which requires longer wires, thus, installing CTs with higher burden  
38 requirement gives allowance to greater burden loads.

39

40 With the proposal, MERALCO highlighted the following:

- 41 • Instrument Transformer with higher burden rating usually performs better and  
42 covers a wider range of application;
- 43 • The purpose of the PGC is to set minimum standard, thus recommending using  
44 CT with higher rated burden than 5VA; and

<sup>2</sup> Annex B – Presentation Material from MERALCO

<sup>3</sup> Annex C – Letter of TC to Meralco dated 29 April 2019

- Removal of Table 1 from Metering Manual and referring it to international standards will give us the freedom in acquiring CT with higher rated burden, in consideration of different situations in the sites.

Agenda	Agreements/Action Plans
3.2 Presentation of NGCP	The body noted NGCP's presentation and agreed to discuss issues/queries after all presentations.

Mr. Ermelindo R. Bugaoisan, Jr. (TC/NGCP) introduced the presenter for NGCP which is Mr. Francis Albert S. Vicencio from their Metering Group.

Mr. Vicencio discussed NGCP's presentation<sup>4</sup>, starting with MERALCO's proposal. Based on the existing requirement of Metering Manual 11.0 and 12.0, the rated burden shall not exceed the rating of 12.5VA and Meralco's proposal is to allow all requirements for CT based on the international standards.

He also discussed that PGC 2007 had no specific requirements for rated burden of CTs. It only required that the total connected burden of secondary circuit does not exceed the rated burden of CT. Also, the PGC 2007 Edition required that CT shall be certified within ANSI accuracy class of 0.3 or better.

On the other hand, the 2016 Edition of PGC provides specific burden rating for CT in Appendix 2 and requires that connected loads shall not exceed 50% of the rated burden as specified in Appendix 2. Also, the Appendix 2 provides the accuracy class requirements.

NGCP's interpretation on Appendix 2 is that, for other users except Generation Companies, it shall comply with the Accuracy Class of 0.3 or 0.15 which is better, for IEEE Standards. And 0.2 or 0.2S for IEC Standards.

Mr. Vicencio informed the body that they agreed on the rationale of MERALCO that installation of higher accuracy is supported by WESM Metering Manual. NGCP noted that the opinion of TC — *rated burden of B-1 (25VA), which is higher and therefore better*, is under Table 13: *Standard of relaying burdens for current transformers with 5A Secondary Windings of the IEEE Standards*. At this point, Mr. Fortunato C. Leynes (TC/Independent) corrected that MECO's installed CT has an accuracy class of 0.3, not relaying CT. He also pointed out that each burden designation has corresponding accuracy class.

<sup>4</sup> Annex D – Presentation Material of NGCP

Mr. Vicencio also discussed that allowing Meralco's proposal will open different selection of all rated burden requirements as stated in the international standards. Mr. Leynes pointed out the importance of accuracy class rather than focusing on the rated burden.

Mr. Vicencio then cited the IEC standard which states that the ratio error at rated frequency shall not exceed values given where burden can assume any value from 25% to 100% of the rated output. In this regard, for NGCP, a CT with a rated burden of 5VA is guaranteed by the manufacturer an accuracy class of 0.2S if the actual connected burden is between 1.25 and 5 ( $1.25 < ACB < 5$ ).

He also stated that NGCP's interpretation is that 30VA CT Burden rating is not better than 5VA CT Burden rating, even if they have same accuracy class error. But NGCP acknowledges that there are different functions and uses for higher rated burden CTs. However, both IEC and IEEE, does not guarantee the same ratio error if the actual connected burden is less than 2.5VA.

NGCP's opinion is that PGC 2016 provides specific burden requirement, and the limitation as stated in GRM 9.2.3.2 (c) of PGC 2016 intends to locate revenue meters as close as practicable to CTs. Thus, using CT higher than 5VA will result to non-compliance with the PGC 2016 unless it is guaranteed by IEC/IEE or the Manufacturer to have the same ratio error if the connected burden is less than 2.5VA.

For clarity, NGCP as MSP neither approves nor recommends to the Market Operator the approval of any metering installation or energization application which conflicts with the requirements of PGC.

Agenda	Agreements/Action Plans
IV. Question and Answer	All questions raised were entertained during the Open Forum.

Below are the questions/comments raised during the open forum:

Question/Comment	Discussions
Mr. Jaime V. Mendoza (TC): What is the basis of 50% as stated in the PGC?	Mr. Vicencio responded that NGCP cannot confirm the rationale of 50% since they were not present during the crafting of PGC 2016.
Mr. Mendoza (TC) What is the possible effect if the burden is more than 2.5VA?	Mr. Vicencio (NGCP): The international standards guarantee the accuracy class or ratio error if the burden is between 25%-100% of CT burden rating. Mr.

Question/Comment	Discussions
	<p>Mendoza commented that it will be non-compliant if the burden will be more than 2.5VA. Dr. Allan Nerves (RCC/Independent) also added that the rules allow rated burden of 1VA to 2.5VA.</p> <p>On the other hand, Mr. Leynes expounded the question raised by Mr. Mendoza on the effect of having more than 2.5VA rated burden considering that Appendix 2 limits to only 50% of the rated burden. Dr. Nerves cited an example on the possible effect if the rated burden is 3VA or 4VA, in which it will not be compliant to the 50% requirement of the PGC. Mr. Vicencio responded that even if the value is within the accuracy class and below 5VA, it will still be non-compliant to the 50% requirement of PGC. Further, Mr. Ambrocio R. Rosales (RCC/NGCP) opined that, technically there will be no effect since it is guaranteed by the manufacturer that the ratio error is within the limit and rated burden is below 5VA. He cited that the PGC, however, introduced a qualifier — GRM 9.2.3.2 (b), in which the sample stated will be considered non-compliant.</p> <p>Mr. Leynes raised his opinion on allowing CTs with higher burden rating provided that the accuracy is attained.</p>
Mr. Marvin G. Gonzalves (MERALCO) asked for the status of NGCP's actual installation of CTs having less than 2.5VA, and Mr. Morales asked NGCP if all their installed CTs are compliant with the rule.	Mr. Vicencio (NGCP): All CTs installed prior to the 2016 version of PGC are not compliant, but the newly purchased CTs are compliant with the requirement. He added that a possible technical solution to attain a lower burden is to relocate the meters or metering box.

112

113



Agenda	Agreements/Action Plans
V. Summary of Issues, Recommendations, and Next Steps	The Secretariat shall send the draft resolution for RCC and TC's review and approval.

After the presentation and open forum, the RCC and TC thanked the presenters and proceeded with their discussion without the MERALCO and NGCP representatives.

Dr. Nerves initially commented that there are conflicts between the interpretations: (1) the interpretation on how the code was written; and (2) the engineering interpretation which is sticking to accuracy class, such that any load greater than 5VA and compliant with the accuracy is considered compliant. On the other hand, the code does not allow any burden more than 50% of the rated capacity. Thus, Dr. Nerves asked the body for any suggestions in resolving this.

Prof. Jordan Rel C. Orillaza (TC) asked the wisdom behind the specific provision of PGC GRM 9.2.3.2 from Mr. Carlito C. Claudio (RCC/MEI/PANASIA), who was a member of the Grid Management Committee (GMC). Mr. Claudio clarified that the specifications stated in both PGC 2007 and 2016 are minimum requirements that shall be complied by the users. Using CTs with higher rated burden still complies with the PGC.

Dr. Nerves said that he was fortunate to discuss this matter with Mr. Arthur Evangelista, former GMC Chairman, who mentioned that there is a possible error on the specific clause of PGC. He added that the accuracy class is not guaranteed if the connected burden is lower than 25% of its burden rating. Thus, for him, a CT may violate the accuracy classes as classified by IEC/IEEE Standards.

Prof. Orillaza suggested to seek assistance from the Legal on the direction of the agreements made during the joint meeting.

Mr. Leynes asked clarification if the provisions on the amendments of the WESM Manual will be abided by NGCP.

Mr. Rosales said that based on the presentations presented by MERALCO and NGCP, there are still different interpretations. He also raised that if there are contradictions between WESM Rules and Manuals and PGC, the PGC will prevail. He also added that some conflicts will be raised considering that there are different compliances to both Market Manuals and PGC. He informed the body that NGCP has action plans on the non-compliances with the PGC. He suggested to also consider seeking clarification from the ERC to further interpret the PGC.

Mr. Mendoza cited other standards like the Philippine Electrical Code (PEC) and Metering Audit Manual specifying minimum requirements to be used. He added that



the PGC and PDC specifies minimum technical standards, thus the users may have more specific standards if it complies with the minimum requirements as set by the PGC and PDC.

Dr. Nerves clarified with Mr. Mendoza if the requirements in PGC are stricter than the proposed amendment of the MERALCO. Mr. Mendoza responded that his opinion on the 5VA is it will be the ideal value if the meters are connected on the same connection point. He also added that there are certain conditions needed in the actual operation, thus, adjustments are made like installing meters far from the prescribe connection point.

Mr. Ferdinand B. Binondo (DOE) suggested that the body agree that the WESM Metering Manual is inconsistent with the PGC. He also suggested that the WESM Metering Manual can be further amended to refer all specifications to the PGC, and to seek clarification with the ERC.

Prof. Orillaza asked the following:

1. Can we now agree that anything that is consistent with the international standards in terms of accuracy will be allowed?
2. Can we clarify as a body what is meant by "minimum standards", as far as accuracy and burden requirement is concerned?
3. Can we craft a statement on possible intent of PGC GRM 9.2.3.2

Atty. Monica M. Martin (PEMC) explained that what is written in PGC should be complied by the users and that non-compliance to the provisions may lead to violation. She verified if there will be effects to operations if GRM 9.2.3.2 (c) is not complied. Dr. Nerves answered that as per international standards, there will no effect if it is within the accuracy. She commented that there must be a reason behind adding another qualifier from the 2007 PGC to 2016 PGC, to which, Dr. Nerves said that as he understood from Mr. Art Evangelista's statement, the GMC is leading to more accurate instruments so that metering installations will be forced to use electronic meters.

Dr. Nerves suggested an option that any modification to the PGC must be addressed by the ERC. Further, Mr. Rosales suggested to seek clarification with the ERC with regards to the provision, or the committee will propose an amendment to PGC 2016 to return the qualifications stated in PGC 2007.

Mr. Claudio explained that PEM Board's instruction is to discuss the matter and come up with a common position. He added that it is not appropriate for the RCC and TC to be the ones seeking clarification or proposing modifications to the PGC. He suggested that the party with concerns to the provision will be the ones doing so.

Mr. Morales said that MERALCO's proposal is consistent with the PGC, thus, no reason for further revision. Further, the different interpretations lie on the PGC 2016, not in the proposed amendment.



Mr. Binondo said that the proposal was endorsed to DOE for Public Consultation. He also said that DOE will also invite ERC and other stakeholders to raise concerns. He agreed that the Metering Manual is not conflict with the PGC 2016, but based on the PGC, an additional provision must be satisfied. He asked if the reference numbers of international standards are subject for changing in the future. Dr. Nerves answered that international standards adopts in the technology, but the reference number is fixed. The revisions of the international is based on the year it was revised.

Furthermore, Mr. Claudio said that the ERC can clarify the issue during the Public Consultation to be conducted by DOE.

Prof. Orillaza reminded the body on the PEM Broad's directive. He suggested to include in the resolution the wisdom of the GMC members on the matter raised.

Mr. Claudio said that it is clear in PGC Section GM 2.4.2 that queries involving the interpretation and/or application of any of the provisions of the Philippine Grid Code may be referred to the GMC for clarification or comment. Considering that GMC is dissolved, it is appropriate that the party with query will directly submit its concerns to ERC.

The body agreed to submit Joint Resolution with main points as follows:

1. The RCC and TC did not have a unanimous decision on the interpretation of Section GRM 9.2.3.2 of the 2016 Philippine Grid Code (PGC);
2. The RCC and TC agreed that the WESM Metering Standards and Procedures should be consistent with the PGC, and the PGC shall prevail when there are any inconsistencies between the two. Any enhancements to both PGC and Metering Manual may be introduced during the public consultation to be conducted by the DOE on the proposed amendments to the said Metering Manual to ensure consistency and to support the interest of the industry; and
3. The RCC and TC agreed that the authority to interpret the PGC is with the ERC. Thus, the entities who are not favorable with any PGC provision, or its implementation, should seek clarification with the ERC.

Closing, the Secretariat shall send the draft resolution for RCC and TC's review and approval.

Agenda	Agreements/Action Plans
<b>VI. Adjournment</b>	The meeting was adjourned at 12:10 PM.

**Prepared by:**

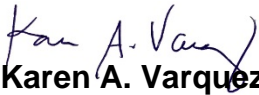


**Dianne L. De Guzman**

Specialist

Market Assessment Group – Rules Review Division

**Reviewed by:**



**Karen A. Varquez**

Manager

Market Assessment Group – Rules Review Division



**Dece Marwil B. Falar**

Manager

Corporate Planning & Communications – Strategy & Innovation Division

**Noted by:**



**John Mark S. Catriz**

OIC - Head

Market Assessment Group




**Clares Loren C. Jalocon**

Head

Corporate Planning & Communications

Approved by:	
Rules Change Sub-Committee	
 <b>Allan C. Nerves</b> RCC Representative, Independent	 <b>Carlito C. Claudio</b> RCC Representative, Generation Sector
 <b>Ryan S. Morales</b> RCC Representative, Distribution Sector	 <b>Lorreto H. Rivera</b> RCC Representative, Supply Sector
 <b>Ambrocio R. Rosales</b> RCC Representative, System Operator	 <b>Isidro E. Cacho, Jr.</b> RCC Representative, Market Operator
Technical Committee	
 <b>Jordan Rel C. Orillaza</b> Chairperson	 <b>Fortunato C. Leynes</b> Independent
 <b>Jaime V. Mendoza</b> Representative, Distribution Management Committee	 <b>Ermelindo R. Bugaoisan, Jr.</b> Representative, System Operator


## Annex A – Presentation Material on Background and Objective of the Meeting



# RCC-TC Coordination Meeting

(Interpretation of Philippine Grid Code GRM 9.2.3.2)

05 May 2020





**PEMCO**  
A Premier Electricity Market & Champion of Governance

## Outline

---

- Meeting Objectives
- Background



Interpretations on Philippine Grid Code (GRM 9.2.3.2 & Appendix 2) | 2

## Meeting Agenda

Provisional Agenda	Presenter	Action Required
I. Call to Order		
II. Background and objective of the Meeting	Secretariat	For information
III. Presentation of Sectors	Meralco & NGCP	For information
3.1 Meralco		
3.2 NGCP		
IV. Question and Answer		
V. Summary of Issues, Recommendations, and Next Steps	RCC and TC Representatives	For discussion
VI. Adjournment		



PEMC  
Go

Interpretations on Philippine Grid Code (GRM 9.2.3.2 & Appendix 2) | 3

## Meeting Objective

- To discuss the interpretation and implementation of Section GRM 9.2.3.2 of the 2016 Philippine Grid Code (PGC)



PEMC  
Go

Interpretations on Philippine Grid Code (GRM 9.2.3.2 & Appendix 2) | 4



## Background

### PEM Board Directive

RCC & TC to clarify the interpretation of GRM 9.2.3.2 of the PGC

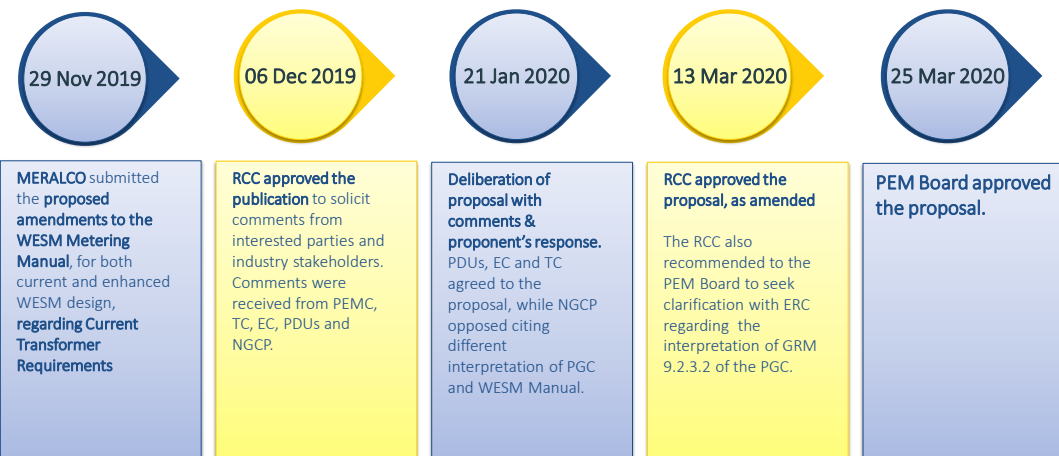


PEMCO

Interpretations on Philippine Grid Code (GRM 9.2.3.2 & Appendix 2) | 5

## Background

### Timeline of Events



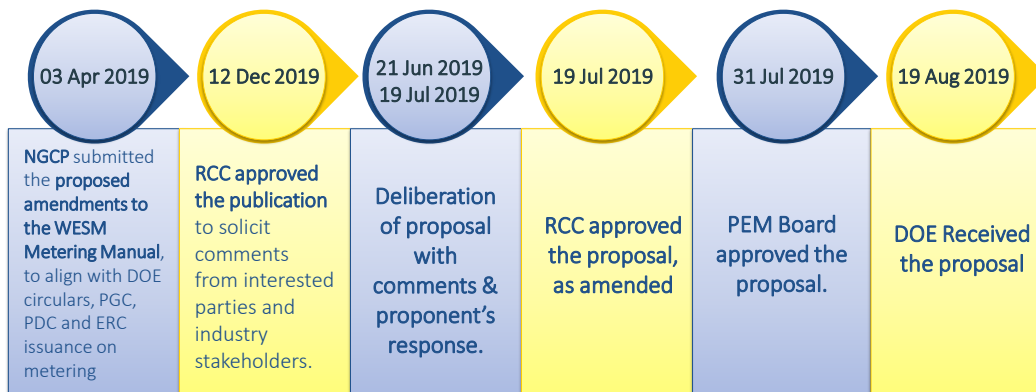
PEMCO

Interpretations on Philippine Grid Code (GRM 9.2.3.2 & Appendix 2) | 6



## Background

### Timeline of Events for NGCP's Proposal



PEMCO

Interpretations on Philippine Grid Code (GRM 9.2.3.2 & Appendix 2) | 7

## Background

### NGCP-Meralco-RCC Comparison

WESM Manual on Metering Standards and Procedures Issue 11.0			
Title / Clause	Meralco's Proposal	NGCP's Proposal	RCC's Agreement
Current Transformer Burden Clause 2.5.7	Shall not exceed the rated burden limit of 12.5 VA for the IEC 44-1 Class 0.2 /ANSI C57.13 Class 0.3 (see Table 1)	No proposal for current manual	Shall be based on the standard rated burden as specified in the latest revision of IEC 61869-2 or ANSI/IEEE C57.13, or their latest equivalent standards.

WESM Manual on Metering Standards and Procedures Issue 12.0 (for enhanced market design)			
Title / Clause	Meralco's Proposal	NGCP's Proposal	RCC's Agreement
SPECIFICATIONS FOR CURRENT TRANSFORMERS Burden Appendix N	Shall not exceed the rated burden limit of 12.5 VA for the IEC 44-1 Class 0.2 /ANSI C57.13 Class 0.3 (see Table 1)	See section 2.5.4.1 2.5.4.1. Current Transformers  Current transformers shall adhere to the requirements of the prevailing PGC IEC 44-1 Class 0.2 or ANSI C57.13 Class 0.3 or better of any instrument transformer. In addition, the accuracy of the current transformers shall be guaranteed from 0-100% of the rated burden.	Shall be based on the standard rated burden as specified in the latest revision of IEC 61869-2 or ANSI/IEEE C57.13, or their latest equivalent standards.



PEMCO

Interpretations on Philippine Grid Code (GRM 9.2.3.2 & Appendix 2) | 8





## Different Interpretations of PGC Provisions

### Requirements of Revenue Metering Equipment

GRM 9.2.3.2 The Current Transformers shall be compliant to the IEC 61869-2 or ANSI C57.13 Standard (or the latest version/s), with the following qualifications:

- (a) The Current Transformer ratio to be used shall be such that the expected minimum and maximum operating currents fall within the range where the ratio and phase accuracies are certified in accordance with the applicable ANSI or IEC Standard;
- (b) The Accuracy Class for Load metering service shall be in accordance to the **Appendix 2** or better. For Generation Company metering service, the Accuracy Class of the Current Transformers shall be such that the ratio and phase accuracies are certified by factory test reports over the entire operating current range when the Generation Company is both generating and consuming electricity;
- (c) The total burden of the metering circuit, consisting of the burdens coming from all the connected devices and the secondary cable shall not exceed fifty percent (50%) of the specified burden of the Current Transformer in **Appendix 2**;
- (d) The Current Transformer may be equipped with an additional secondary core and winding that shall be used exclusively for a redundant revenue metering circuit; and
- (e) A Type Test Report that documents compliance of the Current Transformers to the IEC 61869-2 or ANSI C57.13 Standard (or the latest version/s), to which the Current Transformers are claimed to be designed and manufactured, shall be on file with the MSP. The Type Test Report shall be by a testing entity that is accredited by ILAC-MRA or its equivalent.

This can be interpreted that the PGC will follow the international standards, as indicated.



PEMC

Interpretations on Philippine Grid Code (GRM 9.2.3.2 & Appendix 2) | 9

## Different Interpretations of PGC Provisions (cont'd)

### Appendix 2

#### APPENDIX 2

##### Table of ANSI/IEEE Ratings

For Generation Company:

	Metering Accuracy Class	Burden Designation	VA
CT	0.15	E-0.2	5
VT	0.15	Y	75

The values indicated can be interpreted as the **only ratings** accepted by the PGC

For Other Users:

	Metering Accuracy Class	Burden Designation	VA
CT	0.3	B-0.2	5
VT	0.3	Y	75



PEMC

Interpretations on Philippine Grid Code (GRM 9.2.3.2 & Appendix 2) | 10



## Different Interpretations of PGC Provisions (cont'd)

### TC's Letter to MECO

11 April 2019

ENGR. GILBERT A. PAGOBO  
General Manager  
Mactan Electric Company (MECO)  
MECO Bldg., Sangi Road, Pajo  
Lapu-lapu City, Philippines

Dear GM Pagobo:

We write in response to your email to the Technical Committee on 29 March 2019 requesting our opinion on the interpretation of the provisions of the metering requirements under the Philippine Grid Code (PGC) relative to MECO's application for energization of its mobile-3 substation to the National Grid Corporation of the Philippines (NGCP).

The TC reviewed the specifications of the subject unit based on the information you submitted to us versus the requirements under the PGC GM 9.2.3.2 (b), to wit:

*"The Current Transformers shall be compliant to the IEC 61869-2 or ANSI C57.13 Standard (or the latest version/s), with the following qualifications:*

*(b) The Accuracy Class for Load metering service shall be in accordance to the Appendix 2 or better."*

The TC likewise looked into IEEE Std C57.13-2016 provision for metering burdens and relaying burdens for current transformer.

In view of the above requirements, the TC is of the opinion that the specifications of MECO's current transformer comply with the metering accuracy class of 0.3 as well as the rated burden of B-1 (25VA), which is higher and therefore better than the burden B-0.2 (5VA) specified in PGC Appendix 2.

We hope you find our response in order.

Very truly yours,

JORDAN REYES ORILLAZA  
Chairperson, Technical Committee



Interpretations on Philippine Grid Code (GRM 9.2.3.2 &amp; Appendix 2) | 11

Higher burden requirement is better than the burden as specified in PGC Appendix 2.

## TC Resolution on MECO's Metering Requirement

- On 29 March 2019, MECO requested the TC's opinion on MECO's pending application for energization of its mobile-3 substation with a CT rated burden of B-1 (25VA) versus the required rated burden in the PGC GM 9.2.3.2.
- GRM 9.2.3.2 of the PGC states that:  
 "The Current Transformers shall be compliant to the IEC 61869-2 or ANSI C57.13 Standard (or the latest version/s), with the following qualifications:  
 (b) The Accuracy Class for Load metering service shall be in accordance to the Appendix 2 or better."

PGC Appendix 2:

	Metering Accuracy Class	Burden Designation	VA
CT	0.3	B-0.2	5
VT	0.3	Y	75



Interpretations on Philippine Grid Code (GRM 9.2.3.2 &amp; Appendix 2) | 12



## TC Resolution on MECO's Metering Requirement

- Based on the TC's review on the provisions of PGC and IEEE Std C57.13-2016 on metering burden requirements for current transformer, the TC opined that the specifications of MECO's current transformer comply with the metering accuracy class of 0.3 as well as the rated burden of B-1 (25VA), which is higher and therefore better than the burden B-0.2 (5VA) specified in PGC Appendix 2.
- In May 2019, IEMOP informed the TC that they approved, on an interim agreement, the registration of the mobile-3 substation since the three CTs passed the "transformation ratio accuracy test" of at least 0.3 as required by the Grid Code.
- NGCP and MECO agreed to totalize mobile-3 substation and another MECO substation into a single metering installation with CTs compliant to the 5 VA limit by the Grid Code. The target for this compliance plan is within the next two years.



Interpretations on Philippine Grid Code (GRM 9.2.3.2 &amp; Appendix 2) | 13

## Comparison of Provisions

2016 PHILIPPINE GRID CODE	CURRENT WESM METERING MANUAL	PROPOSED AMENDMENTS TO WESM METERING MANUAL
<p><b>GRM 9.2.3.2</b></p> <p>The Current Transformers shall be compliant to the IEC 61869-2 or ANSI C57.13 Standard (or the latest version/s), with the following qualifications:</p> <p>xxx</p>	<p><b>For Issue 11.0</b> Current Transformer Burden Clause 2.5.7</p> <p>Shall not exceed the rated burden limit of 12.5 VA for the IEC 44-1 Class 0.2 /ANSI C57.13 Class 0.3 (see Table 1)</p> <p><b>For Issue 12.0 (for Enhanced Market Design)</b> SPECIFICATIONS FOR CURRENT TRANSFORMERS Burden Appendix N</p> <p>Shall not exceed the rated burden limit of 12.5 VA for the IEC 44-1 Class 0.2 /ANSI C57.13 Class 0.3 (see Table 1)</p>	<p><u>Shall be based on the standard rated burden as specified in the latest revision of IEC 61869-2 or ANSI/IEEE C57.13, or their latest equivalent standards.</u></p> <p><u>Shall be based on the standard rated burden as specified in the latest revision of IEC 61869-2 or ANSI/IEEE C57.13, or their latest equivalent standards.</u></p>



Interpretations on Philippine Grid Code (GRM 9.2.3.2 &amp; Appendix 2) | 14



## Suggestions

- Reflect the full table of international standards to **minimize other interpretations; or**
- Delete Appendix 2 since it ~~was~~ already stated the compliance to international standards.



PEMC  
Go

Interpretations on Philippine Grid Code (GRM 9.2.3.2 & Appendix 2) | 15

## Requested Action

The PEM Board tasked the Rules Change Committee and Technical Committee to work on the different interpretations of Philippine Grid Code.



PEMC  
Go

Interpretations on Philippine Grid Code (GRM 9.2.3.2 & Appendix 2) | 16





## A Premier Electricity Market & Champion of Governance


18F Robinsons Equitable Tower, ADB Avenue, Ortigas Center, Pasig City 1600, Philippines

☎ (632) 631-8734

☎ (632) 636-0802

🌐 [www.wesm.ph](http://www.wesm.ph)

Annex B – Presentation Material from MERALCO



**Proposed Amendments to Market Rules - WESM Manual on Metering Standards and Procedures Issues 11.0 and 12.0**

May 5, 2020

**BACKGROUND:**

1. WESM Metering Manual (WMM) is prescribing to use Current Transformer with rated burden of **5VA** only.
2. Mactan Electric Corp. used a higher burden (25VA). This issue was referred to PEMC-TC and responded last April 2019 saying that it is compliant to the accuracy requirement and in fact performs better.
3. Last September 2019 MERALCO was supposed to install a 12.5VA CT at Malolos Bank 2 but was considered non-compliant by both the IEMOP and NGCP, and was hence put on hold resulting in the delay in the replacement and energization.



## COMMENTS FROM OTHERS....

**Technical Committee:**

To avoid any possible confusion, since the manual is referring to two separate standards, we suggest that we **do not affix Table 1** in this WESM manual. Likewise, any revision in either standard will be automatically adopted in this manual, without the need to revise the specific section.

**CEBECO III:**

Totally agree with the arguments presented by MECO and MERALCO because as trading participant in the market and as MSP, the costs of replacing all the existing instrument transformers which are on line are huge. Besides, **why change standards** (or specifications) to a more stringent in the Philippine setting which are **already compliant to international standards** in terms of accuracy and burden. Amenable to the proposed amendment.


**CEDC:**

Agree with the proposal that the burden of current transformers **should be based on the rated burden as specified in the latest revision of IEC 61869-2 or IEEE C57.13**. Our primary concern is the accuracy of the CTs and since the proposed amendment maintains the CT accuracy within specified limits, we fully support the proposed amendment.

**Tarlac Electric, Inc.**

The proposed amendment is agreeable to DUs with installed current transformers having the standard rated burden greater than 5 VA.

**IEC 61869 should be adapted in the latest WESM Metering Standards and Procedure.**



## WHAT THE STANDARD SAYS....

**IEEE STANDARD:**

Table 10 —Standard metering burdens for current transformers with 5 A secondary windings<sup>a</sup>

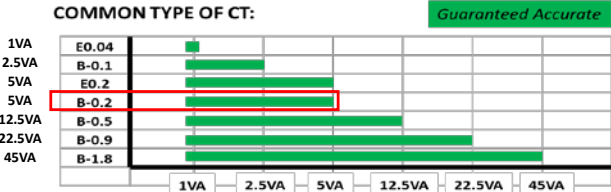
Burdens	Burden designation <sup>b</sup>	Resistance (Ω)	Inductance (mH)	Impedance (Ω) <sup>c</sup>	Total Power (VA at 5 A)	Total Power (VA at 1 A)	Power factor
Electronic burdens	E0.04	0.04	0	0.04	1.0	0.04	1.0
	E0.2	0.2	0	0.2	5.0	0.2	
Metering burdens	B-0.1	0.09	0.116	0.1	2.5	0.1	0.9
	B-0.2	0.18	0.232	0.2	5.0	0.2	
	B-0.5	0.45	0.580	0.5	12.5	0.5	
	B-0.9	0.81	1.040	0.9	22.5	0.9	
	B-1.8	1.62	2.080	1.8	45.0	1.8	

<sup>a</sup> If a current transformer secondary winding is rated at other than 5 A, the impedance, the power factor, and the burden designation remain the same while the VA at rated current shall be adjusted by  $[S/(ampere\ rating)]^2$ .


<sup>b</sup> These standard burden designations have no significance at frequencies other than 60 Hz.

<sup>c</sup> The impedance tolerance is +5% and -0%.

COMMON TYPE OF CT:



"A Current Transformer for metering shall be given an accuracy rating for each standard burden for which it is rated. **The accuracy class may be stated for the maximum burden for which it is rated and will imply that all other lower burdens shall also be in that class**; e.g., 0.3 B-1.8 would imply 0.3 B-0.1, B-0.2, B-0.5, B-0.9, and B-1.8. If the accuracy class given is specific only to that burden it is assigned, e.g., 0.3 @ B-0.5, or a range of burdens, e.g., 0.3 @ B0.5-B0.9, then the accuracy class is not guaranteed for other burdens unless specifically stated."





## EXAMPLE CT #1

### AT MERALCO-ABUBOT DELIVERY POINT

Picture of a 115kV CT Nameplate (CT installed at MERALCO-Abubot Delivery Point)



Accuracy Class 0.15 B-1.8 (45VA).

Having no "B" written before the letter "B" implies that its 0.15 accuracy is true rated VA and lower.

CT OWNERSHIP: MERALCO

**FACTORY TESTING: PASSED** 0.15 accuracy at from 1VA – 45VA burden.

X1-X2	200	V	Y1-Y2	200	V		V		V		V
DETERMINATION OF ERRORS											
5	X1 - X2			I			X1 - X2				
	S(VA)	p(%)	δ(min)	In	S(VA)	p(%)	δ(min)				
	I	0.01	-0.01	+0.7	0.01	45	-0.10	+4.5			
		0.05	-0.01	+0.7	0.05		-0.10	+4.3			
		1	+0.01	+0.6	1		-0.04	+1.2			
		1.5	+0.04	+0.5	1.5		-0.01	+0.8			
	Y1 - Y2			I			Y1 - Y2				
	S(VA)	p(%)	δ(min)	In	S(VA)	p(%)	δ(min)				
	I	0.01	-0.01	+0.7	0.01	45	-0.10	+3.9			
		0.05	-0.01	+0.7	0.05		-0.09	+3.5			
		1	+0.01	+0.7	1		-0.04	+0.8			
		1.5	+0.04	+0.5	1.5		-0.02	+0.7			

EQUIPMENT: 1. BRUNNEN; 2. BRUNNEN; 3. BRUNNEN; 4. BRUNNEN; 5. BRUNNEN; 6. BRUNNEN; 7. BRUNNEN; 8. BRUNNEN; 9. BRUNNEN; 10. BRUNNEN; 11. BRUNNEN; 12. BRUNNEN; 13. BRUNNEN; 14. BRUNNEN; 15. BRUNNEN; 16. BRUNNEN; 17. BRUNNEN; 18. BRUNNEN; 19. BRUNNEN; 20. BRUNNEN; 21. BRUNNEN; 22. BRUNNEN; 23. BRUNNEN; 24. BRUNNEN; 25. BRUNNEN; 26. BRUNNEN; 27. BRUNNEN; 28. BRUNNEN; 29. BRUNNEN; 30. BRUNNEN; 31. BRUNNEN; 32. BRUNNEN; 33. BRUNNEN; 34. BRUNNEN; 35. BRUNNEN; 36. BRUNNEN; 37. BRUNNEN; 38. BRUNNEN; 39. BRUNNEN; 40. BRUNNEN; 41. BRUNNEN; 42. BRUNNEN; 43. BRUNNEN; 44. BRUNNEN; 45. BRUNNEN; 46. BRUNNEN; 47. BRUNNEN; 48. BRUNNEN; 49. BRUNNEN; 50. BRUNNEN; 51. BRUNNEN; 52. BRUNNEN; 53. BRUNNEN; 54. BRUNNEN; 55. BRUNNEN; 56. BRUNNEN; 57. BRUNNEN; 58. BRUNNEN; 59. BRUNNEN; 60. BRUNNEN; 61. BRUNNEN; 62. BRUNNEN; 63. BRUNNEN; 64. BRUNNEN; 65. BRUNNEN; 66. BRUNNEN; 67. BRUNNEN; 68. BRUNNEN; 69. BRUNNEN; 70. BRUNNEN; 71. BRUNNEN; 72. BRUNNEN; 73. BRUNNEN; 74. BRUNNEN; 75. BRUNNEN; 76. BRUNNEN; 77. BRUNNEN; 78. BRUNNEN; 79. BRUNNEN; 80. BRUNNEN; 81. BRUNNEN; 82. BRUNNEN; 83. BRUNNEN; 84. BRUNNEN; 85. BRUNNEN; 86. BRUNNEN; 87. BRUNNEN; 88. BRUNNEN; 89. BRUNNEN; 90. BRUNNEN; 91. BRUNNEN; 92. BRUNNEN; 93. BRUNNEN; 94. BRUNNEN; 95. BRUNNEN; 96. BRUNNEN; 97. BRUNNEN; 98. BRUNNEN; 99. BRUNNEN; 100. BRUNNEN; 101. BRUNNEN; 102. BRUNNEN; 103. BRUNNEN; 104. BRUNNEN; 105. BRUNNEN; 106. BRUNNEN; 107. BRUNNEN; 108. BRUNNEN; 109. BRUNNEN; 110. BRUNNEN; 111. BRUNNEN; 112. BRUNNEN; 113. BRUNNEN; 114. BRUNNEN; 115. BRUNNEN; 116. BRUNNEN; 117. BRUNNEN; 118. BRUNNEN; 119. BRUNNEN; 120. BRUNNEN; 121. BRUNNEN; 122. BRUNNEN; 123. BRUNNEN; 124. BRUNNEN; 125. BRUNNEN; 126. BRUNNEN; 127. BRUNNEN; 128. BRUNNEN; 129. BRUNNEN; 130. BRUNNEN; 131. BRUNNEN; 132. BRUNNEN; 133. BRUNNEN; 134. BRUNNEN; 135. BRUNNEN; 136. BRUNNEN; 137. BRUNNEN; 138. BRUNNEN; 139. BRUNNEN; 140. BRUNNEN; 141. BRUNNEN; 142. BRUNNEN; 143. BRUNNEN; 144. BRUNNEN; 145. BRUNNEN; 146. BRUNNEN; 147. BRUNNEN; 148. BRUNNEN; 149. BRUNNEN; 150. BRUNNEN; 151. BRUNNEN; 152. BRUNNEN; 153. BRUNNEN; 154. BRUNNEN; 155. BRUNNEN; 156. BRUNNEN; 157. BRUNNEN; 158. BRUNNEN; 159. BRUNNEN; 160. BRUNNEN; 161. BRUNNEN; 162. BRUNNEN; 163. BRUNNEN; 164. BRUNNEN; 165. BRUNNEN; 166. BRUNNEN; 167. BRUNNEN; 168. BRUNNEN; 169. BRUNNEN; 170. BRUNNEN; 171. BRUNNEN; 172. BRUNNEN; 173. BRUNNEN; 174. BRUNNEN; 175. BRUNNEN; 176. BRUNNEN; 177. BRUNNEN; 178. BRUNNEN; 179. BRUNNEN; 180. BRUNNEN; 181. BRUNNEN; 182. BRUNNEN; 183. BRUNNEN; 184. BRUNNEN; 185. BRUNNEN; 186. BRUNNEN; 187. BRUNNEN; 188. BRUNNEN; 189. BRUNNEN; 190. BRUNNEN; 191. BRUNNEN; 192. BRUNNEN; 193. BRUNNEN; 194. BRUNNEN; 195. BRUNNEN; 196. BRUNNEN; 197. BRUNNEN; 198. BRUNNEN; 199. BRUNNEN; 200. BRUNNEN; 201. BRUNNEN; 202. BRUNNEN; 203. BRUNNEN; 204. BRUNNEN; 205. BRUNNEN; 206. BRUNNEN; 207. BRUNNEN; 208. BRUNNEN; 209. BRUNNEN; 210. BRUNNEN; 211. BRUNNEN; 212. BRUNNEN; 213. BRUNNEN; 214. BRUNNEN; 215. BRUNNEN; 216. BRUNNEN; 217. BRUNNEN; 218. BRUNNEN; 219. BRUNNEN; 220. BRUNNEN; 221. BRUNNEN; 222. BRUNNEN; 223. BRUNNEN; 224. BRUNNEN; 225. BRUNNEN; 226. BRUNNEN; 227. BRUNNEN; 228. BRUNNEN; 229. BRUNNEN; 230. BRUNNEN; 231. BRUNNEN; 232. BRUNNEN; 233. BRUNNEN; 234. BRUNNEN; 235. BRUNNEN; 236. BRUNNEN; 237. BRUNNEN; 238. BRUNNEN; 239. BRUNNEN; 240. BRUNNEN; 241. BRUNNEN; 242. BRUNNEN; 243. BRUNNEN; 244. BRUNNEN; 245. BRUNNEN; 246. BRUNNEN; 247. BRUNNEN; 248. BRUNNEN; 249. BRUNNEN; 250. BRUNNEN; 251. BRUNNEN; 252. BRUNNEN; 253. BRUNNEN; 254. BRUNNEN; 255. BRUNNEN; 256. BRUNNEN; 257. BRUNNEN; 258. BRUNNEN; 259. BRUNNEN; 260. BRUNNEN; 261. BRUNNEN; 262. BRUNNEN; 263. BRUNNEN; 264. BRUNNEN; 265. BRUNNEN; 266. BRUNNEN; 267. BRUNNEN; 268. BRUNNEN; 269. BRUNNEN; 270. BRUNNEN; 271. BRUNNEN; 272. BRUNNEN; 273. BRUNNEN; 274. BRUNNEN; 275. BRUNNEN; 276. BRUNNEN; 277. BRUNNEN; 278. BRUNNEN; 279. BRUNNEN; 280. BRUNNEN; 281. BRUNNEN; 282. BRUNNEN; 283. BRUNNEN; 284. BRUNNEN; 285. BRUNNEN; 286. BRUNNEN; 287. BRUNNEN; 288. BRUNNEN; 289. BRUNNEN; 290. BRUNNEN; 291. BRUNNEN; 292. BRUNNEN; 293. BRUNNEN; 294. BRUNNEN; 295. BRUNNEN; 296. BRUNNEN; 297. BRUNNEN; 298. BRUNNEN; 299. BRUNNEN; 300. BRUNNEN; 301. BRUNNEN; 302. BRUNNEN; 303. BRUNNEN; 304. BRUNNEN; 305. BRUNNEN; 306. BRUNNEN; 307. BRUNNEN; 308. BRUNNEN; 309. BRUNNEN; 310. BRUNNEN; 311. BRUNNEN; 312. BRUNNEN; 313. BRUNNEN; 314. BRUNNEN; 315. BRUNNEN; 316. BRUNNEN; 317. BRUNNEN; 318. BRUNNEN; 319. BRUNNEN; 320. BRUNNEN; 321. BRUNNEN; 322. BRUNNEN; 323. BRUNNEN; 324. BRUNNEN; 325. BRUNNEN; 326. BRUNNEN; 327. BRUNNEN; 328. BRUNNEN; 329. BRUNNEN; 330. BRUNNEN; 331. BRUNNEN; 332. BRUNNEN; 333. BRUNNEN; 334. BRUNNEN; 335. BRUNNEN; 336. BRUNNEN; 337. BRUNNEN; 338. BRUNNEN; 339. BRUNNEN; 340. BRUNNEN; 341. BRUNNEN; 342. BRUNNEN; 343. BRUNNEN; 344. BRUNNEN; 345. BRUNNEN; 346. BRUNNEN; 347. BRUNNEN; 348. BRUNNEN; 349. BRUNNEN; 350. BRUNNEN; 351. BRUNNEN; 352. BRUNNEN; 353. BRUNNEN; 354. BRUNNEN; 355. BRUNNEN; 356. BRUNNEN; 357. BRUNNEN; 358. BRUNNEN; 359. BRUNNEN; 360. BRUNNEN; 361. BRUNNEN; 362. BRUNNEN; 363. BRUNNEN; 364. BRUNNEN; 365. BRUNNEN; 366. BRUNNEN; 367. BRUNNEN; 368. BRUNNEN; 369. BRUNNEN; 370. BRUNNEN; 371. BRUNNEN; 372. BRUNNEN; 373. BRUNNEN; 374. BRUNNEN; 375. BRUNNEN; 376. BRUNNEN; 377. BRUNNEN; 378. BRUNNEN; 379. BRUNNEN; 380. BRUNNEN; 381. BRUNNEN; 382. BRUNNEN; 383. BRUNNEN; 384. BRUNNEN; 385. BRUNNEN; 386. BRUNNEN; 387. BRUNNEN; 388. BRUNNEN; 389. BRUNNEN; 390. BRUNNEN; 391. BRUNNEN; 392. BRUNNEN; 393. BRUNNEN; 394. BRUNNEN; 395. BRUNNEN; 396. BRUNNEN; 397. BRUNNEN; 398. BRUNNEN; 399. BRUNNEN; 400. BRUNNEN; 401. BRUNNEN; 402. BRUNNEN; 403. BRUNNEN; 404. BRUNNEN; 405. BRUNNEN; 406. BRUNNEN; 407. BRUNNEN; 408. BRUNNEN; 409. BRUNNEN; 410. BRUNNEN; 411. BRUNNEN; 412. BRUNNEN; 413. BRUNNEN; 414. BRUNNEN; 415. BRUNNEN; 416. BRUNNEN; 417. BRUNNEN; 418. BRUNNEN; 419. BRUNNEN; 420. BRUNNEN; 421. BRUNNEN; 422. BRUNNEN; 423. BRUNNEN; 424. BRUNNEN; 425. BRUNNEN; 426. BRUNNEN; 427. BRUNNEN; 428. BRUNNEN; 429. BRUNNEN; 430. BRUNNEN; 431. BRUNNEN; 432. BRUNNEN; 433. BRUNNEN; 434. BRUNNEN; 435. BRUNNEN; 436. BRUNNEN; 437. BRUNNEN; 438. BRUNNEN; 439. BRUNNEN; 440. BRUNNEN; 441. BRUNNEN; 442. BRUNNEN; 443. BRUNNEN; 444. BRUNNEN; 445. BRUNNEN; 446. BRUNNEN; 447. BRUNNEN; 448. BRUNNEN; 449. BRUNNEN; 450. BRUNNEN; 451. BRUNNEN; 452. BRUNNEN; 453. BRUNNEN; 454. BRUNNEN; 455. BRUNNEN; 456. BRUNNEN; 457. BRUNNEN; 458. BRUNNEN; 459. BRUNNEN; 460. BRUNNEN; 461. BRUNNEN; 462. BRUNNEN; 463. BRUNNEN; 464. BRUNNEN; 465. BRUNNEN; 466. BRUNNEN; 467. BRUNNEN; 468. BRUNNEN; 469. BRUNNEN; 470. BRUNNEN; 471. BRUNNEN; 472. BRUNNEN; 473. BRUNNEN; 474. BRUNNEN; 475. BRUNNEN; 476. BRUNNEN; 477. BRUNNEN; 478. BRUNNEN; 479. BRUNNEN; 480. BRUNNEN; 481. BRUNNEN; 482. BRUNNEN; 483. BRUNNEN; 484. BRUNNEN; 485. BRUNNEN; 486. BRUNNEN; 487. BRUNNEN; 488. BRUNNEN; 489. BRUNNEN; 490. BRUNNEN; 491. BRUNNEN; 492. BRUNNEN; 493. BRUNNEN; 494. BRUNNEN; 495. BRUNNEN; 496. BRUNNEN; 497. BRUNNEN; 498. BRUNNEN; 499. BRUNNEN; 500. BRUNNEN; 501. BRUNNEN; 502. BRUNNEN; 503. BRUNNEN; 504. BRUNNEN; 505. BRUNNEN; 506. BRUNNEN; 507. BRUNNEN; 508. BRUNNEN; 509. BRUNNEN; 510. BRUNNEN; 511. BRUNNEN; 512. BRUNNEN; 513. BRUNNEN; 514. BRUNNEN; 515. BRUNNEN; 516. BRUNNEN; 517. BRUNNEN; 518. BRUNNEN; 519. BRUNNEN; 520. BRUNNEN; 521. BRUNNEN; 522. BRUNNEN; 523. BRUNNEN; 524. BRUNNEN; 525. BRUNNEN; 526. BRUNNEN; 527. BRUNNEN; 528. BRUNNEN; 529. BRUNNEN; 530. BRUNNEN; 531. BRUNNEN; 532. BRUNNEN; 533. BRUNNEN; 534. BRUNNEN; 535. BRUNNEN; 536. BRUNNEN; 537. BRUNNEN; 538. BRUNNEN; 539. BRUNNEN; 540. BRUNNEN; 541. BRUNNEN; 542. BRUNNEN; 543. BRUNNEN; 544. BRUNNEN; 545. BRUNNEN; 546. BRUNNEN; 547. BRUNNEN; 548. BRUNNEN; 549. BRUNNEN; 550. BRUNNEN; 551. BRUNNEN; 552. BRUNNEN; 553. BRUNNEN; 554. BRUNNEN; 555. BRUNNEN; 556. BRUNNEN; 557. BRUNNEN; 558. BRUNNEN; 559. BRUNNEN; 560. BRUNNEN; 561. BRUNNEN; 562. BRUNNEN; 563. BRUNNEN; 564. BRUNNEN; 565. BRUNNEN; 566. BRUNNEN; 567. BRUNNEN; 568. BRUNNEN; 569. BRUNNEN; 570. BRUNNEN; 571. BRUNNEN; 572. BRUNNEN; 573. BRUNNEN; 574. BRUNNEN; 575. BRUNNEN; 576. BRUNNEN; 577. BRUNNEN; 578. BRUNNEN; 579. BRUNNEN; 580. BRUNNEN; 581. BRUNNEN; 582. BRUNNEN; 583. BRUNNEN; 584. BRUNNEN; 585. BRUNNEN; 586. BRUNNEN; 587. BRUNNEN; 588. BRUNNEN; 589. BRUNNEN; 590. BRUNNEN; 591. BRUNNEN; 592. BRUNNEN; 593. BRUNNEN; 594. BRUNNEN; 595. BRUNNEN; 596. BRUNNEN; 597. BRUNNEN; 598. BRUNNEN; 599. BRUNNEN; 600. BRUNNEN; 601. BRUNNEN; 602. BRUNNEN; 603. BRUNNEN; 604. BRUNNEN; 605. BRUNNEN; 606. BRUNNEN; 607. BRUNNEN; 608. BRUNNEN; 609. BRUNNEN; 610. BRUNNEN; 611. BRUNNEN; 612. BRUNNEN; 613. BRUNNEN; 614. BRUNNEN; 615. BRUNNEN; 616. BRUNNEN; 617. BRUNNEN; 618. BRUNNEN; 619. BRUNNEN; 620. BRUNNEN; 621. BRUNNEN; 622. BRUNNEN; 623. BRUNNEN; 624. BRUNNEN; 625. BRUNNEN; 626. BRUNNEN; 627. BRUNNEN; 628. BRUNNEN; 629. BRUNNEN; 630. BRUNNEN; 631. BRUNNEN; 632. BRUNNEN; 633. BRUNNEN; 634. BRUNNEN; 635. BRUNNEN; 636. BRUNNEN; 637. BRUNNEN; 638. BRUNNEN; 639. BRUNNEN; 640. BRUNNEN; 641. BRUNNEN; 642. BRUNNEN; 643. BRUNNEN; 644. BRUNNEN; 645. BRUNNEN; 646. BRUNNEN; 647. BRUNNEN; 648. BRUNNEN; 649. BRUNNEN; 650. BRUNNEN; 651. BRUNNEN; 652. BRUNNEN; 653. BRUNNEN; 654. BRUNNEN; 655. BRUNNEN; 656. BRUNNEN; 657. BRUNNEN; 658. BRUNNEN; 659. BRUNNEN; 660. BRUNNEN; 661. BRUNNEN; 662. BRUNNEN; 663. BRUNNEN; 664. BRUNNEN; 665. BRUNNEN; 666. BRUNNEN; 667. BRUNNEN; 668. BRUNNEN; 669. BRUNNEN; 670. BRUNNEN; 671. BRUNNEN; 672. BRUNNEN; 673. BRUNNEN; 674. BRUNNEN; 675. BRUNNEN; 676. BRUNNEN; 677. BRUNNEN; 678. BRUNNEN; 679. BRUNNEN; 680. BRUNNEN; 681. BRUNNEN; 682. BRUNNEN; 683. BRUNNEN; 684. BRUNNEN; 685. BRUNNEN; 686. BRUNNEN; 687. BRUNNEN; 688. BRUNNEN; 689. BRUNNEN; 690. BRUNNEN; 691. BRUNNEN; 692. BRUNNEN; 693. BRUNNEN; 694. BRUNNEN; 695. BRUNNEN; 696. BRUNNEN; 697. BRUNNEN; 698. BRUNNEN; 699. BRUNNEN; 700. BRUNNEN; 701. BRUNNEN; 702. BRUNNEN; 703. BRUNNEN; 704. BRUNNEN; 705. BRUNNEN; 706. BRUNNEN; 707. BRUNNEN; 708. BRUNNEN; 709. BRUNNEN; 710. BRUNNEN; 711. BRUNNEN; 712. BRUNNEN; 713. BRUNNEN; 714. BRUNNEN; 715. BRUNNEN; 716. BRUNNEN; 717. BRUNNEN; 718. BRUNNEN; 719. BRUNNEN; 720. BRUNNEN; 721. BRUNNEN; 722. BRUNNEN; 723. BRUNNEN; 724. BRUNNEN; 725. BRUNNEN; 726. BRUNNEN; 727. BRUNNEN; 728. BRUNNEN; 729. BRUNNEN; 730. BRUNNEN; 731. BRUNNEN; 732. BRUNNEN; 733. BRUNNEN; 734. BRUNNEN; 735. BRUNNEN; 736. BRUNNEN; 737. BRUNNEN; 738. BRUNNEN; 739. BRUNNEN; 740. BRUNNEN; 741. BRUNNEN; 742. BRUNNEN; 743. BRUNNEN; 744. BRUNNEN; 745. BRUNNEN; 746. BRUNNEN; 747. BRUNNEN; 748. BRUNNEN; 749. BRUNNEN; 750. BRUNNEN; 751. BRUNNEN; 752. BRUNNEN; 753. BRUNNEN; 754. BRUNNEN; 755. BRUNNEN; 756. BRUNNEN; 757. BRUNNEN; 758. BRUNNEN; 759. BRUNNEN; 760. BRUNNEN; 761. BRUNNEN; 762. BRUNNEN; 763. BRUNNEN; 764. BRUNNEN; 765. BRUNNEN; 766. BRUNNEN; 767. BRUNNEN; 768. BRUNNEN; 769. BRUNNEN; 770. BRUNNEN; 771. BRUNNEN; 772. BRUNNEN; 773. BRUNNEN; 774. BRUNNEN; 775. BRUNNEN; 776. BRUNNEN; 777. BRUNNEN; 778. BRUNNEN; 779. BRUNNEN; 780. BRUNNEN; 781. BRUNNEN; 782. BRUNNEN; 783. BRUNNEN; 784. BRUNNEN; 785. BRUNNEN; 786. BRUNNEN; 787. BRUNNEN; 788. BRUNNEN; 789. BRUNNEN; 790. BRUNNEN; 791. BRUNNEN; 792. BRUNNEN; 793. BRUNNEN; 794. BRUNNEN; 795. BRUNNEN; 796. BRUNNEN; 797. BRUNNEN; 798. BRUNNEN; 799. BRUNNEN; 800. BRUNNEN; 801. BRUNNEN; 802. BRUNNEN; 803. BRUNNEN; 804. BRUNNEN; 805. BRUNNEN; 806. BRUNNEN; 807. BRUNNEN; 808. BRUNNEN; 809. BRUNNEN; 810. BRUNNEN; 811. BRUNNEN; 812. BRUNNEN; 813. BRUNNEN; 814. BRUNNEN; 815. BRUNNEN; 816. BRUNNEN; 817. BRUNNEN; 818. BRUNNEN; 819. BRUNNEN; 820. BRUNNEN; 821. BRUNNEN; 822. BRUNNEN; 823. BRUNNEN; 824. BRUNNEN; 825. BRUNNEN; 826. BRUNNEN; 827. BRUNNEN; 828. BRUNNEN; 829. BRUNNEN; 830. BRUNNEN; 831. BRUNNEN; 832. BRUNNEN; 833. BRUNNEN; 834. BRUNNEN; 835. BRUNNEN; 836. BRUNNEN; 837. BRUNNEN; 838. BRUNNEN; 839. BRUNNEN; 840. BRUNNEN; 841. BRUNNEN; 842. BRUNNEN; 843. BRUNNEN; 844. BRUNNEN; 845. BRUNNEN; 846. BRUNNEN; 847. BRUNNEN; 848. BRUNNEN; 849. BRUNNEN; 850. BRUNNEN; 851. BRUNNEN; 852. BRUNNEN; 853. BRUNNEN; 854. BRUNNEN; 855. BRUNNEN; 856. BRUNNEN; 857. BRUNNEN; 858. BRUNNEN; 859. BRUNNEN; 860. BRUNNEN; 861. BRUNNEN; 862. BRUNNEN; 863. BRUNNEN; 864. BRUNNEN; 865. BRUNNEN; 866. BRUNNEN; 867. BRUNNEN; 868. BRUNNEN; 869. BRUNNEN; 870. BRUNNEN; 871. BRUNNEN; 872. BRUNNEN; 873. BRUNNEN; 874. BRUNNEN; 875. BRUNNEN; 876. BRUNNEN; 877. BRUNNEN; 878. BRUNNEN; 879. BRUNNEN; 880. BRUNNEN; 881. BRUNNEN; 882. BRUNNEN; 883. BRUNNEN; 884. BRUNNEN; 885. BRUNNEN; 886. BRUNNEN; 887. BRUNNEN; 888. BRUNNEN; 889. BRUNNEN; 890. BRUNNEN; 891. BRUNNEN; 892. BRUNNEN; 893. BRUNNEN; 894. BRUNNEN; 895. BRUNNEN; 896. BRUNNEN; 897. BRUNNEN; 898. BRUNNEN; 899. BRUNNEN; 900. BRUNNEN; 901. BRUNNEN; 902. BRUNNEN; 903. BRUNNEN; 904. BRUNNEN; 905. BRUNNEN; 906. BRUNNEN; 907. BRUNNEN; 908. BRUNNEN; 909. BRUNNEN; 910. BRUNNEN; 911. BRUNNEN; 912. BRUNNEN; 913. BRUNNEN; 914. BRUNNEN; 915. BRUNNEN; 916. BRUNNEN; 917. BRUNNEN; 918. BRUNNEN; 919. BRUNNEN; 920. BRUNNEN; 921. BRUNNEN; 922. BRUNNEN; 923. BRUNNEN; 924. BRUNNEN; 925. BRUNNEN; 926. BRUNNEN; 927. BRUNNEN; 928. BRUNNEN; 929. BRUNNEN; 930. BRUNNEN; 931. BRUNNEN; 932. BRUNNEN; 933. BRUNNEN; 934. BRUNNEN; 935. BRUNNEN; 936. BRUNNEN; 937. BRUNNEN; 938. BRUNNEN; 939. BRUNNEN; 940. BRUNNEN; 941. BRUNNEN; 942. BRUNNEN; 943. BRUNNEN; 944. BRUNNEN; 945. BRUNNEN; 946. BRUNNEN; 947. BRUNNEN; 948. BRUNNEN; 949. BRUNNEN; 950. BRUNNEN; 951. BRUNNEN; 952. BRUNNEN; 953. BRUNNEN; 954. BRUNNEN; 955. BRUNNEN; 956. BRUNNEN; 957. BRUNNEN; 958. BRUNNEN; 959. BRUNNEN; 960. BRUNNEN; 961. BRUNNEN; 962. BRUNNEN; 963. BRUNNEN; 964. BRUNNEN; 965. BRUNNEN; 966. BRUNNEN; 967. BRUNNEN; 968. BRUNNEN; 969. BRUNNEN; 970. BRUNNEN; 971. BRUNNEN; 972. BRUNNEN; 973. BRUNNEN; 974. BRUNNEN; 975. BRUNNEN; 976. BRUNNEN; 977. BRUNNEN; 978. BRUNNEN; 979. BRUNNEN; 980. BRUNNEN; 981. BRUNNEN; 982. BRUNNEN; 983. BRUNNEN; 984. BRUNNEN; 985. BRUNNEN; 986. BRUNNEN; 987. BRUNNEN; 988. BRUNNEN; 989. BRUNNEN; 990. BRUNNEN; 991. BRUNNEN; 992. BRUNNEN; 993. BRUNNEN; 994. BRUNNEN; 995. BRUNNEN; 996. BRUNNEN; 997. BRUNNEN; 998. BRUNNEN; 999. BRUNNEN; 1000. BRUNNEN; 1001. BRUNNEN; 1002. BRUNNEN; 1003. BRUNNEN; 1004. BRUNNEN; 1005. BRUNNEN; 1006. BRUNNEN; 1007. BRUNNEN; 1008. BRUNNEN; 1009. BRUNNEN; 1010. BRUNNEN; 1011. BRUNNEN; 1012. BRUNNEN; 1013. BRUNNEN; 1014. BRUNNEN; 1015. BRUNNEN; 1016. BRUNNEN; 1017. BRUNNEN; 1018. BRUNNEN; 1019. BRUNNEN; 1020. BRUNNEN; 1021. BRUNNEN; 1022. BRUNNEN; 1023. BRUNNEN; 1024. BRUNNEN; 1025. BRUNNEN; 1026. BRUNNEN; 1027. BRUNNEN; 1028. BRUNNEN; 1029. BRUNNEN; 1030. BRUNNEN; 1031. BRUNNEN; 1032. BRUNNEN; 1033. BRUNNEN; 1034. BRUNNEN; 1035. BRUNNEN; 1036. BRUNNEN; 1037. BRUNNEN; 1038. BRUNNEN; 1039. BRUNNEN; 1040. BRUNNEN; 1041. BRUNNEN; 1042. BRUNNEN; 1043. BRUNNEN; 1044. BRUNNEN; 1045. BRUNNEN; 1046. BRUNNEN; 1047. BRUNNEN; 1048. BRUNNEN; 1049. BRUNNEN; 1050. BRUNNEN; 1051. BRUNNEN; 1052. BRUNNEN; 1053. BRUNNEN; 1054. BRUNNEN; 1055. BRUNNEN; 1056. BRUNNEN; 1057. BRUNNEN; 1058. BRUNNEN; 1059. BRUNNEN; 1060. BRUNNEN; 1061. BRUNNEN; 1062. BRUNNEN; 1063. BRUNNEN; 1064. BRUNNEN; 1065. BRUNNEN; 1066. BRUNNEN; 1067. BRUNNEN; 1068. BRUNNEN; 1069. BRUNNEN; 1070. BRUNNEN; 1071. BRUNNEN; 1072. BRUNNEN; 1073. BRUNNEN; 1074. BRUNNEN; 1075. BRUNNEN; 1076. BRUNNEN; 1077. BRUNNEN; 1078. BRUNNEN; 1079. BRUNNEN; 1080. BRUNNEN; 1081. BRUNNEN; 1082. BRUNNEN; 1083. BRUNNEN; 1084. BRUNNEN; 1085. BRUNNEN; 1086. BRUNNEN; 1087. BRUNNEN; 1088. BRUNNEN; 1089. BRUNNEN; 1090. BRUNNEN; 1091. BRUNNEN; 1092. BRUNNEN; 1093. BRUNNEN; 1094. BRUNNEN; 1095. BRUNNEN; 1096. BRUNNEN; 1097. BRUNNEN; 1098. BRUNNEN; 1099. BRUNNEN; 1100. BRUNNEN; 1101. BRUNNEN; 1102. BRUNNEN; 1103. BRUNNEN; 1104. BRUNNEN; 1105. BRUNNEN; 1106. BRUNNEN; 1107. BRUNNEN; 1108. BRUNNEN; 1109. BRUNNEN; 1110. BRUNNEN; 1111. BRUNNEN; 1112. BRUNNEN; 1113. BRUNNEN; 1114. BRUNNEN; 1115. BRUNNEN; 1116. BRUNNEN; 1117. BRUNNEN; 1118. BRUNNEN; 1119. BRUNNEN; 1120. BRUNNEN; 1121. BRUNNEN; 1122. BRUNNEN; 1123. BRUNNEN; 1124. BRUNNEN; 1125. BRUNNEN; 1126. BRUNNEN; 1127. BRUNNEN; 1128. BRUNNEN; 1129. BRUNNEN; 1130. BRUNNEN; 1131. BRUNNEN; 1132. BRUNNEN; 1133. BRUNNEN; 1134. BRUNNEN; 1135. BRUNNEN; 1136. BRUNNEN; 1137. BRUNNEN; 1138. BRUNNEN; 1139. BRUNNEN; 1140. BRUNNEN; 1141. BRUNNEN; 1142. BRUNNEN; 1143. BRUNNEN; 1144. BRUNNEN; 1145. BRUNNEN; 1146. BRUNNEN; 1147. BRUNNEN; 1148. BRUNNEN; 1149. BRUNNEN; 1150. BRUNNEN; 1151. BRUNNEN; 1152. BRUNNEN; 1153. BRUNNEN; 1154. BRUNNEN; 1155. BRUNNEN; 1156. BRUNNEN; 1157. BRUNNEN

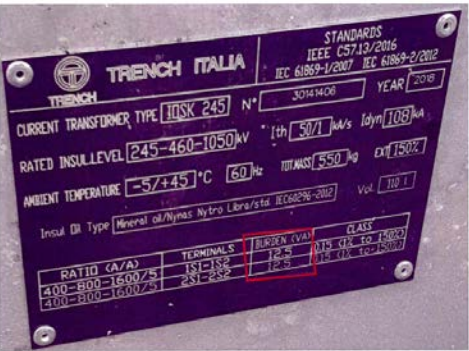
**MERALCO TESTING: PASSED** 0.15 accuracy at from 1VA – 45VA burden.

Ratio Accuracy Class Test									
Sec.	Conn.	Burden VA	10% Load				100% Load		
			RCF cos[Phi]	Phase Angle	Acc. Class	RCF	Phase Angle	Acc. Class	
X1-X2 (400/5A)		45.0/0.9	1.00041	3.02	0.04	1.00037	1.26	0.04	
		22.5/0.9	1.00015	2.34	0.02	1.00018	1.11	0.02	
		12.5/0.9	1.00003	1.70	0.00	1.00000	0.89	0.01	
		5.1	0.99989	1.22	0.01	0.99994	0.88	0.01	
		5.0/0.9	0.99994	1.17	0.01	0.99997	0.83	0.00	
		2.5/0.9	0.99992	0.99	0.01	0.99994	0.74	0.01	
Y1-Y2 (400/5A)		45.0/0.9	0.99999	0.89	0.01	0.99991	0.69	0.01	
		22.5/0.9	1.00013	2.17	0.01	1.00016	1.07	0.02	
		12.5/0.9	1.00002	1.54	0.00	1.00005	0.94	0.01	
		5.1	0.99992	1.07	0.01	0.99992	0.80	0.01	
		5.0/0.9	0.99994	1.02	0.01	0.99996	0.74	0.00	
		2.5/0.9	0.99991	0.84	0.01	0.99993	0.65	0.01	
	1.1	0.99988	0.74	0.01	0.99990	0.59	0.01		

## EXAMPLE CT #2

### AT MERALCO MALOLOS BANK #2 DELIVERY POINT

Picture of 230kV CT Nameplate (For installation at MERALCO Malolos Bank #2 Delivery Point)



CT OWNERSHIP: MERALCO

**FACTORY TESTING: PASSED** 0.15 accuracy at from 2.5VA – 12.5VA burden.

Serial Number	Terminal Markings	Ratio	Phase Angle (min)	ACCURACY TEST (Standard IEC)										ACCURACY TEST (Standard IEC or IEEE)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
				100 %					20 %					5 %					1 %					100 %					20 %					5 %					1 %																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
				100 %	100 %	100 %	100 %	100 %	20 %	20 %	20 %	20 %	20 %	5 %	5 %	5 %	5 %	5 %	1 %	1 %	1 %	1 %	1 %	100 %	100 %	100 %	100 %	100 %	20 %	20 %	20 %	20 %	20 %	5 %	5 %	5 %	5 %	5 %	1 %	1 %	1 %	1 %	1 %																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
20141000	111-152	0.000/0.000/0.000	15.1	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9	0.98	0.9</

**MERALCO TESTING: PASSED** 0.15 accuracy at from 1VA – 12.5VA burden.

RATIO ACCURACY CLASS TEST									
Secondary Connection	Ratio	Burden (VA/%)	10%			100%			
			RCF	Phase Angle	%Error	RCF	Phase Angle	%Error	
161-162	400/5	12.5 VA/0.9	0.99994	2.685	-0.036	0.99998	0.845	-0.032	
		5 VA/1	1.00003	1.904	0.003	0.99995	1.252	-0.005	
		2.5 VA/0.9	0.99991	1.769	-0.009	0.99999	0.857	-0.011	
		1 VA/1	1.00001	1.416	0.001	0.99998	0.804	-0.002	
261-262	400/5	12.5 VA/0.9	0.99994	2.777	-0.036	0.99998	0.874	-0.032	
		5 VA/1	1.00004	2.750	0.004	0.99995	1.088	-0.004	
		2.5 VA/0.9	0.99992	1.841	-0.008	0.99999	0.891	-0.010	
		1 VA/1	1.00002	1.479	0.002	0.99998	0.835	-0.002	

Remarks:  
ACCURACY TEST OK.

# WHY USE HIGHER BURDEN?

## Example Case 1: Gardner Taguig Line Delivery Point

**CT ownership:** NGCP-owned  
**Date Installed:** September 1, 2013  
**Rated Burden:** B-0.1 (2.5VA) to B0.5 (12.5VA)

**Calculated Connected Burden:**

Equiv. VA burden of wire = 3.46 VA (rated)  
Equiv. VA burden of Meter & Conn. = 0.3 VA (rated)

**Total Connected Burden = 3.76 VA (rated)**

- **92% of the connected burden accounts for the wire leads**
- **only 8% of the connected burden accounts for the meter and connection resistance**

**Note:** Based on estimates, the total connected burden exceeds the 50% of 5VA limit.

# WHY USE HIGHER BURDEN?

## Example Case 2: San Jose – Camarin Line Delivery Point

**Date of Test:** February 10, 2020  
**CT Ownership:** NGCP  
**Rated Burden:** 5VA  
**Tested by:** NGCP

MEASURED CONNECTED BURDEN (at rated current)			
CURRENT TRANSFORMER	CT CORE	MEASURED BURDEN	REMARKS
PHASE A	Core 1	1.7560 VA	Less than 50% of 5VA
	Core 2	1.7520 VA	Less than 50% of 5VA
PHASE B	Core 1	2.4550 VA	Less than 50% of 5VA
	Core 2	2.3940 VA	Less than 50% of 5VA
PHASE C	Core 1	3.2900 VA	Greater than 50% of 5VA
	Core 2	3.2020 VA	Greater than 50% of 5VA

Picture of a 115kV CT Nameplate of San Jose - Camarin Line Delivery Point

**Note:** Based on actual measurement, the total connected burden exceeds the 50% of 5VA limit.

**SUMMARY & RECOMMENDATION:**

1. Instrument transformers that have higher burden rating usually **performs better** and **covers a wider range** of application.
2. Since the purpose of the code is to **set the minimum specification** and allow use of equipment that exceeds or performs better than the required, we recommend to allow the use of CT with rated burden **higher than 5VA** as long as it is within standard and **meets required accuracy performance**.
3. Remove Table 1 in the WMM and refer only to standard IEC, IEEE or their latest equivalent.

**SUMMARY & RECOMMENDATION:****WESM METERING MANUAL ISSUE 11.0**

<b>Provision</b>	<b>Proposed Amendment</b>
Shall not exceed the rated burden limit of 12.5 VA for the IEC 44-1 Class 0.2 /ANSI C57.13 Class 0.3 (see Table 1)	Shall be based on the standard rated burden as specified in the latest revision of IEC 61869-2 or ANSI/IEEE C57.13, or their latest equivalent standards.



# THANK YOU!

- END OF PRESENTATION -





Annex C – Letter of TC to Meralco dated 29 April 2019



COF-EXT-TC-2019-01

11 April 2019

ENGR. GILBERT A. PAGOBO  
General Manager  
Mactan Electric Company (MECO)  
MECO Bldg., Sangi Road, Pajo  
Lapu-lapu City, Philippines

Dear GM Pagobo:

We write in response to your email to the Technical Committee on 29 March 2019 requesting our opinion on the interpretation of the provisions of the metering requirements under the Philippine Grid Code (PGC) relative to MECO's application for energization of its mobile-3 substation to the National Grid Corporation of the Philippines (NGCP).

The TC reviewed the specifications of the subject unit based on the information you submitted to us versus the requirements under the PGC GM 9.2.3.2 (b), to wit:

*"The Current Transformers shall be compliant to the IEC 61869-2 or ANSI C57.13 Standard (or the latest version/s), with the following qualifications:*

*(b) The Accuracy Class for Load metering service shall be in accordance to the Appendix 2 or better."*

The TC likewise looked into IEEE Std C57.13-2016 provision for metering burdens and relaying burdens for current transformer.

In view of the above requirements, the TC is of the opinion that the specifications of MECO's current transformer comply with the metering accuracy class of 0.3 as well as the rated burden of B-1 (25VA), which is higher and therefore better than the burden B-0.2 (5VA) specified in PGC Appendix 2.

We hope you find our response in order.

Very truly yours,

  
JORDAN REL ORILLAZA  
Chairperson, Technical Committee

Cc: Oscar E. Ala, President-PEMC  
Rauf A. Tan, Chief Governance Officer-PEMC

18F Robinsons Equitable Tower, ADB Avenue, Ortigas Center, Pasig City 1600, Philippines  
☎ (832) 631-8734 ☎ (832) 636-0802 🌐 [www.wesm.ph](http://www.wesm.ph)

Annex D – Presentation Material of NGCP



Power Center, Quezon Ave cor. Agham Road, Diliman, Quezon City 1100

+632.981.2118

TIPNGCP@ngcp.ph

www.ngcp.ph



RM-RPM-RRA-2020-207

19 May 2020

**ATTY. OSCAR E. ALA**

President

Philippine Electricity Market Corporation

18th Floor Robinsons Equitable Tower

ADB Avenue, Ortigas Center, Pasig City

**ATTENTION: ATTY. MAILA LOURDES G. DE CASTRO**

Chairperson, Rules Change Committee

**SUBJECT: NGCP PRESENTATION MATERIAL FOR THE JOINT RULES CHANGE COMMITTEE AND TECHNICAL COMMITTEE COORDINATION MEETING**

Dear President Ala:

NGCP would like to provide the attached material entitled, *"MERALCO's proposed amendment to the WESM Manual on Metering Standards and Procedures regarding Current Transformer Requirements"* as presented during the 05 May 2020 Joint PEMC's Rules Change Committee (RCC) and Technical Committee (TC) Coordination Meeting<sup>1</sup>.

Thank you.

Sincerely,

**MA. CYNTHIA Y. MANRIQUE**

VP and Head of Revenue and Regulatory Affairs

Enc: as stated

## **MERALCO's Proposed Amendment on the WESM Manual on Metering Standards and Procedures regarding Current Transformer Requirements**



### **Outline**

- MERALCO's Proposed Amendments
- PGC Amendment No.1 – 2007 & 2016ed.
- Rationale of MERALCO's Proposed Amendments
- Implications of MERALCO's Proposed Amendments





# MERALCO's Proposed Amendment

## WESM Metering Standards and Procedures Issue 11.0

### 2.5.7. Current Transformer

Current Transformer installed as the main metering, shall meet the minimum requirements listed below:

ITEMS	SPECIFICATIONS	REFERENCE DOCUMENTS
Type	Outdoor Type; Minimum oil filled, Dry Type or Gas-filled	
Cooling	Oil immersed, Self-cooled; Butyl, Cast resin	
Construction	Single phase, wound type, free standing	
Accuracy Class	IEC 44-1 Class 0.2 /ANSI C57.13 Class 0.3 or better	Grid Code 9.3.2.1
Burden	Shall not exceed the rated burden limit of 12.5 VA for the IEC 44-1 Class 0.2 /ANSI C57.13 Class 0.3 (see Table 1)	Grid Code 9.3.2.2 Grid Code 9.4.1.2
Rated Primary Current	The thermal rating factor shall not be	

### Existing Requirement:

Shall *not exceed the rated burden limit of 12.5VA* for the IEC 44-1 class 0.2 / ANSI C57.13 class 0.3 (see Table 1)

≤ 12.5VA – **Ok**

22.5VA – **Not Ok**

45VA – **Not Ok**

### Proposed Amendment:

Shall be based on the standard rated burden as specified in the latest revision of IEC 61869-2 or IEEE C57.13 (see Table 1)

Table 1 – Standard Burdens for Current Transformers with 5 A Secondary Windings

\*ANSI/IEEE

Designation	Resistance (ohms)	Inductance (mH)	Impedance (ohms)	Voltamperes (at 5 A)	Power Factor
B-0.1	0.09	0.116	0.1	2.5	0.9
B-0.2	0.18	0.232	0.2	5.0	0.9
B-0.5	0.45	0.580	0.5	12.5	0.9
B-0.9	0.81	1.040	0.9	22.5	0.9
B-1.8	1.62	2.080	1.8	45.0	0.9



# MERALCO's Proposed Amendment

## WESM Metering Standards and Procedures Issue 12.0

APPENDIX N

### SPECIFICATIONS FOR CURRENT TRANSFORMERS

ITEMS	SPECIFICATIONS	REFERENCE DOCUMENTS
Type	Outdoor Type; Minimum oil filled, Dry Type or Gas-filled	
Cooling	Oil immersed, Self-cooled; Butyl, Cast resin	
Construction	Single phase, wound type, free standing	
Accuracy Class	IEC 44-1 Class 0.2 /ANSI C57.13 Class 0.3 or better	Grid Code 9.2.3.2 Grid Code Appendix 2
Burden	Shall not exceed the rated burden limit of 12.5 VA for the IEC 44-1 Class 0.2 /ANSI C57.13 Class 0.3 (see Table 1)	Grid Code 9.2.3.2 Grid Code Appendix 2

### Existing Requirement:

Shall *not exceed the rated burden limit of 12.5VA* for the IEC 44-1 class 0.2 / ANSI C57.13 class 0.3 (see Table 1)

≤ 12.5VA – **Ok**

22.5VA – **Not Ok**

45VA – **Not Ok**

### Proposed Amendment:

Shall be based on the standard rated burden as specified in the latest revision of IEC 61869-2 or IEEE C57.13 (see Table 1)

APPENDIX G

### METERING INSTALLATION STANDARDS

Table 1 – Standard Burdens for Current Transformers with 5 A Secondary Windings

\*ANSI/IEEE

Designation	Resistance (ohms)	Inductance (mH)	Impedance (ohms)	Voltamperes (at 5 A)	Power Factor
B-0.1	0.09	0.116	0.1	2.5	0.9
B-0.2	0.18	0.232	0.2	5.0	0.9
B-0.5	0.45	0.580	0.5	12.5	0.9
B-0.9	0.81	1.040	0.9	22.5	0.9
B-1.8	1.62	2.080	1.8	45.0	0.9



## PGC Amendment No.1 - 2007

### 8.3.2. Current Transformers

8.3.2.1. The current transformers shall comprise three units for a three-set, Each current transformer shall be certified to have been tested for ratio and phase deviation to be within the ANSI accuracy class of 0.3 or better over the entire measuring range of the metering facility.

8.3.2.2. Provisions shall be made for another secondary winding if a check metering current supply is requested by the User. The current transformer's rated secondary current shall be either 1 or 5 amperes. The neutral conductor shall be effectively grounded at a single point. The total burden of each secondary circuit of the current not exceed the rated burden of the current transformer.

- No specific requirements on the rated burden of the CT (i.e. Any VA is Ok)
- It only required that the total burden of each secondary circuit to not exceed the rated burden of the current transformer (i.e. Actual Connected Burden (ACB) < VA of CT)
- CT shall be certified to be within ANSI accuracy class of 0.3 or better (applicable for Generating Plants & other Users)



## PGC 2016

GRM 9.2.3.2 The Current Transformers shall be compliant to the IEC 61869-2 or ANSI C57.13 Standard (or the latest version/s), with the following qualifications:

- (a) The Current Transformer ratio to be used shall be such that the expected minimum and maximum operating currents fall within the range where the ratio and phase accuracies are certified in accordance with the applicable ANSI or IEC Standard;
- (b) The Accuracy Class for Load metering service shall be in accordance to the Appendix 2 or better. For Generation Company metering service, the Accuracy Class of the Current Transformers shall be such that the ratio and phase accuracies are certified by factory test reports over the entire operating current range when the Generation Company is both generating and consuming electricity;
- (c) The total burden of the metering circuit, consisting of the burdens coming from all the connected devices and the secondary cable shall not exceed fifty percent (50%) of the specified burden of the Current Transformer in Appendix 2;
- (d) The Current Transformer may be equipped with an additional secondary core and winding that shall be used exclusively for a redundant revenue metering circuit; and

- ① Unlike in PGC 2007 Amd.No.1, PGC 2016 had provided its specified burden rating for Current Transformer in its Appendix 2
- ② Unlike in PGC 2007 Amd.No.1, PGC 2016 requires that the connected burdens shall not exceed fifty percent (50%) of the specified burden of CT in Appendix 2
- ③ PGC 2016 provides accuracy class requirements for Generators and Other Users in Appendix 2



# PGC 2016

**APPENDIX 2**

**Table of ANSI/IEEE Ratings**

For Generation Company:

	Metering Accuracy Class	Burden Designation	VA
CT	0.15	E-0.2	5
VT	0.15	Y	75

For Other Users:

	Metering Accuracy Class	Burden Designation	VA
CT	0.3	B-0.2	5
VT	0.3	Y	75

**Table of IEC Ratings**

For Generation Company:

	Metering Accuracy Class	Burden Designation	VA
CT	0.2S	-	5
VT	0.2	-	75

For Other Users:

	Metering Accuracy Class	Burden Designation	VA
CT	0.2	-	5
VT	0.2	-	75

## GRM 9.2.3.2.

(b) The **accuracy class for Load metering service** shall be in accordance to the **Appendix 2 or better.**

(c) The total burden of the metering circuit, consisting of the burdens coming from all the connected devices and the secondary cable shall not exceed fifty percent (50%) of the **specified burden of the Current Transformer in Appendix 2.**



# MERALCO's Rationale to their Proposal

**APPENDIX 2**

**Table of ANSI/IEEE Ratings**

For Generation Company:

	Metering Accuracy Class	Burden Designation	VA
CT	0.15	E-0.2	5
VT	0.15	Y	75

For Other Users:

	Metering Accuracy Class	Burden Designation	VA
CT	0.3	B-0.2	5
VT	0.3	Y	75

**Table of IEC Ratings**

For Generation Company:

	Metering Accuracy Class	Burden Designation	VA
CT	0.2S	-	5
VT	0.2	-	75

For Other Users:

	Metering Accuracy Class	Burden Designation	VA
CT	0.2	-	5
VT	0.2	-	75

## GRM 9.2.3.2. of PGC 2016ed.

(b) The **accuracy class for Load metering service** shall be in accordance to the **Appendix 2 or better.**

### MERALCO's Rationale:

Installation of a higher accuracy and functionality than the standards set by the PGC and WESM and its conformance to IEC and IEEE standards are supported by Sections 2.1.1 and 2.5.4.1 of WESM Metering Standards and Procedures which is also consistent with PEMC-TC's opinion issued last April 2019 to Mactan Electric Corp. in which "the TC is of the opinion that the specifications of MECO's current transformer comply with the metering accuracy class of 0.3 as well as the rated burden of B-1 (25VA), which is higher and therefore better than the burden B-0.2 (5VA) specified in PGC Appendix 2."

**Note:** If you would refer to IEEE C57.13-2016, B-1 (25VA) is under Table 13 **Standard Relaying Burdens** for Current Transformers with 5A secondary windings

### 2.1.1. General Requirements

This standard supplements the minimum requirements of the harmonized standards on the WESM rules, PGC and PDC for the Grid and Distribution Metering Installations for the WESM. Any Metering Installation of a higher level accuracy or functionality than that by this standard may also be installed.

### 2.5.4. Accuracy Requirements

#### 2.5.4.1. Current Transformers

Current transformers shall conform to the IEC 44-1 Class 0.2 or ANSI C57.13 Class 0.3 or better of any instrument transformer.





## Table 10 & 13 of IEEE C57.13-2016

**Table 10 — Standard metering burdens for current transformers with 5 A secondary windings<sup>a</sup>**

Burdens	Burden designation <sup>b</sup>	Resistance ( $\Omega$ )	Inductance (mH)	Impedance ( $\Omega$ ) <sup>c</sup>	Total Power (VA at 5 A)	Total Power (VA at 1 A)	Power factor
Electronic burdens	E0.04	0.04	0	0.04	1.0	0.04	1.0
	E0.2	0.2	0	0.2	5.0	0.2	
Metering burdens	B-0.1	0.09	0.116	0.1	2.5	0.1	0.9
	B-0.2	0.18	0.232	0.2	5.0	0.2	
	B-0.5	0.45	0.580	0.5	12.5	0.5	
	B-0.9	0.81	1.040	0.9	22.5	0.9	
	B-1.8	1.62	2.080	1.8	45.0	1.8	

<sup>a</sup> If a current transformer is used in a circuit in which the secondary current is not 5 A, the burden should be divided by the square of the ratio of the actual secondary current to 5 A.

**Table 13 — Standard relaying burdens for current transformers with 5 A secondary windings**

Burdens	Burden designation <sup>b</sup>	Resistance ( $\Omega$ )	Inductance (mH)	Impedance ( $\Omega$ ) <sup>c</sup>	Total Power (VA at 5 A)	Power Factor	Terminal Voltage
Relaying burdens:	B-0.1	0.09	0.116	0.1	2.5	0.9	10
	B-0.2	0.18	0.232	0.2	5.0	0.9	20
	B-0.5	0.45	0.580	0.5	12.5	0.9	50
	B-1.0	0.90	1.160	1.0	25.0	0.5	100
	B-2.0	1.80	2.320	2.0	50.0	0.5	200
	B-4.0	3.60	4.640	4.0	100.0	0.5	400
	B-8.0	7.20	9.280	8.0	200.0	0.5	800

## Implications of MERALCO's Proposal

### IEC 61869-2 (Ed 1.0 2012-09)

#### 5.5 Rated output

##### 5.5.201 Rated output values

The standard values of rated output for measuring classes, class P and class PR are:

2.5 – 5.0 – 10 – 15 and 30 VA.

Values above 30 VA may be selected to suit the application.

2.5/5/10VA – Ok  
15VA – Ok  
30VA – Ok

### IEEE Std C57.13-2016 (Revision of IEEE Std C57.13-2008)

**Table 10 — Standard metering burdens for current transformers with 5 A secondary windings<sup>a</sup>**

Burdens	Burden designation <sup>b</sup>	Resistance ( $\Omega$ )	Inductance (mH)	Impedance ( $\Omega$ ) <sup>c</sup>	Total Power (VA at 5 A)	Total Power (VA at 1 A)	Power factor
Electronic burdens	E0.04	0.04	0	0.04	1.0	0.04	1.0
	E0.2	0.2	0	0.2	5.0	0.2	
Metering burdens	B-0.1	0.09	0.116	0.1	2.5	0.1	0.9
	B-0.2	0.18	0.232	0.2	5.0	0.2	
	B-0.5	0.45	0.580	0.5	12.5	0.5	
	B-0.9	0.81	1.040	0.9	22.5	0.9	
	B-1.8	1.62	2.080	1.8	45.0	1.8	

<sup>a</sup> If a current transformer is used in a circuit in which the secondary current is not 5 A, the burden should be divided by the square of the ratio of the actual secondary current to 5 A.

12.5VA – Ok  
22.5VA – Ok  
45VA – Ok



# Implications of MERALCO's Proposal

## IEC 61869-2 (Ed 1.0 2012-09)

2.5 / 5VA - **Ok**

10VA - **Ok**

15VA - **Ok**

30VA - **Ok**

### 5.6.201.3 Limits of ratio error ( $\epsilon$ ) and phase displacement for measuring current transformers

For classes 0,1 – 0,2 – 0,5 and 1, the ratio error and phase displacement at rated frequency shall not exceed the values given in Table 201 where the burden can assume any value from 25 % to 100 % of the rated output

For classes 0,2S and 0,5S the ratio error and phase displacement at the rated frequency shall not exceed the values given in Table 202 where the burden can assume any value from 25 % and 100 % of the rated output

Accuracy Class	CT Burden Rating	25% of Burden Rating	Actual Connected Burden (ACB)	100% of Burden Rating
0.2S 0.2	5VA	1.25	$1.25 < ACB < 5$	5
0.2S 0.2	10VA	2.5	$2.5 < ACB < 10VA$	10
0.2S 0.2	15VA	3.75	$3.75 < ACB < 15VA$	15
0.2S 0.2	30VA	7.5	$7.5 < ACB < 30VA$	30

*\*refer to TC's opinion on MECO; Similarly, is a 0.2 30VA CT better than 0.2 5VA rated CT?*

*\*What happens if your ACB is  $\leq 2.5VA$ ?*



# Implications of MERALCO's Proposal

## IEEE Std C57.13-2016 (Revision of IEEE Std C57.13-2008)

2.5 / 5VA - **Ok**

12.5VA - **Ok**

22.5VA - **Ok**

45VA - **Ok**

Table 10 —Standard metering burdens for current transformers with 5 A secondary windings\*

Burdens	Burden designation <sup>a</sup>	Resistance ( $\Omega$ )	Inductance (mH)	Impedance ( $\Omega$ ) <sup>b</sup>	Total Power (VA at 5 A)	Total Power (VA at 1 A)	Power factor
Electronic burdens	E0.04	0.04	0	0.04	1.0	0.04	1.0
	E0.2	0.2	0	0.2	5.0	0.2	
Metering burdens	B-0.1	0.09	0.116	0.1	2.5	0.1	0.9
	B-0.2	0.18	0.232	0.2	5.0	0.2	
	B-0.5	0.45	0.580	0.5	12.5	0.5	
	B-0.9	0.81	1.040	0.9	22.5	0.9	
	B-1.8	1.62	2.080	1.8	45.0	1.8	

Accuracy Class	Burden Designation	CT Burden Rating	Actual Connected Burden (ACB)	100% of Burden Rating
0.15 0.3	B - 0.1	2.5VA	$ACB = 2.5VA$	2.5
0.15 0.3	B - 0.2	5VA	$2.5 < ACB < 5VA$	5
0.15 0.3	B - 0.5	12.5VA	$2.5 < ACB < 12.5VA$	12.5
0.15 0.3	B - 0.9	22.5VA	$2.5 < ACB < 22.5VA$	22.5
0.15 0.3	B - 1.8	45VA	$2.5 < ACB < 45VA$	45

### 5.1 Basis for accuracy classes

(a) For current transformers, at the specified standard burden (see 6.2 for standard burdens)

### 6.3 Accuracy ratings for metering

A CT for metering shall be given an accuracy rating for each standard burden for which it is rated (see clause 5). The accuracy class may be stated for the maximum burden for which it is rated and will imply that all other lower burdens shall also be in that class. (e.g. 0.3 B-1.8 would imply 0.3 B-0.1, B-0.2, B-0.5, B-0.9 and B-1.8)

*What happens if your ACB is  $< 2.5VA$ ?*



## NGCP's Interpretation / Opinion

- PGC 2016 provides **specific burden rating** requirement (i.e. 5VA) for Current Transformers in its Appendix 2
- *GRM 9.2.3.2.c*, by limiting the total connected burden requirement to the CT to 2.5VA (50% of 5VA), intends to locate the revenue meter as close as practicable to the CTs.



## NGCP's Interpretation / Opinion

- The use of CTs with higher burden rating than 5VA will result to a direct non-compliance to the requirements of PGC 2016 unless such CT is guaranteed by IEEE/IEC or the Manufacturer to have the same ratio error if the actual connected burden is  $\leq 2.5\text{VA}$



