

Philippine Electricity Market Corporation

SECOND METERING ARRANGEMENTS REVIEW

SUMMARY REPORT

April 2016



Executive Summary

Intelligent Energy Systems (IES) with its associates Alliance of Power and Energy Xponents (APEX) and Deloitte Philippines (Deloitte) are pleased to submit this Summary Report on the Second Metering Arrangements Review.

In broad terms, the Metering Arrangements Review covers all metering activities, data handling and processing of metering data carried out by the Metering Service Providers and the Billing Settlements and Metering Department of the Philippine Electricity Market Corporation. The Review covers:

- metering for generators and customers operating in the Wholesale Electricity Spot Market covering the period 26 December 2011 to 25 December 2013; and
- metering for contestable customers under the Retail Competition and Open Access, covering the period 1 July 2013 to 25 December 2013.

The metering operations of the following organisations are the subject of this Review.

For the WESM:

- NGCP, which is the sole Metering Services Provider for the WESM.

For RCOA:

- MERALCO, which is the largest electricity Distributor in the Philippines, covering the Metro Manila area;
- Angeles Electric Corporations (AEC), a distributor covering the Angeles City area in Pampanga; and
- San Fernando Electric Light and Power Corporation (SFELAPCO), a distributor covering the San Fernando area in Pampanga.

WESM and RCOA metering processes spans the following sites and activities

- Individual meter sites/installations;
- Processes of the MSP Maintenance and Testing Divisions which provide regionally-based facilities for installing, testing and maintaining metering installations;
- Processes and systems at meter data processing centres, which collect and store meter data, check it for integrity and estimate corrections where necessary, and transmit the data to PEMC; and
- Systems and processes undertaken by the PEMC BSMD for registration of meters, receiving, storing, validating and editing meter data, and processing it further to be ready for settlement.

EXECUTIVE SUMMARY

The table following outlines the site numbers and functions that are subject to review. The counts of metering site findings are based on classes of findings; there may be a number of metering sites with a similar finding. The numbers of sites with the findings are given in the details of the finding in the main report, and in the Appendices of this summary for Major Non-conformances.

Overview of Sites Subject to Review

Function/Responsible Organisation ¹	NGCP	MERALCO	AEC	SFELAPCO	PEMC BSMD	Totals
Meter Sites ¹	154	44	1	1	NA ²	200
MTD Functions	6	1	1	1	NA	9
Data Centers	2	1	1	1	NA	5
Meter Data Processing	NA	NA	NA	NA	1	1

¹ Some meter sites are owned by Trading Participants rather than the Responsible Organisation.

² Not applicable

Findings were classified into three categories as set out below.

Agreed Review Assessment Criteria

- MAJOR NON-CONFORMANCES (Major NCs)

Deviations from WESM or Retail Market Rules that have an impact on service performance or data accuracy, or which may result in a major system or process breakdown; for example, failure to perform maintenance that results in equipment breakdown.

- MINOR NON-CONFORMANCES (Minor NCs)

Lapses in the implementation of the WESM or Retail Market Rules and do not have any immediate impact on the service performance or data accuracy. However, if the lapse continues between one review and the next, it may, in some cases, elevate to a major non-conformance.

- OPPORTUNITIES FOR IMPROVEMENT (OFIs)

Findings that are not included in the WESM or Retail Market Rules but which may help the organization to improve its performance.

In interpreting these guidelines, the Review team observed the following:

- Security issues in violation of the Rules or Codes qualify as Major Non-conformances as data integrity could be compromised at any time; and
- Safety issues are over-riding and will be classified as Major Non-conformances.

EXECUTIVE SUMMARY

The following Table summarises the findings of the Review

Summary of Review Findings

Organisation	Task	Major NCs	Minor NCs	OFIs	Total
NGCP (WESM)	Totals	12	13	20	45
	Process and Procedures	1	3	8	12
	IT General Controls	0	4	7	11
	Meter Site Review	11	6	5	22
MERALCO (RCOA)	Totals	4	10	13	27
	Process and Procedures	0	4	2	6
	IT General Controls	0	3	4	7
	Meter Site Review	4	3	7	14
AEC (RCOA)	Totals	1	4	1	6
	Process and Procedures	0	3	0	3
	IT General Controls	0	0	1	1
	Meter Site Review	1	1		2
SFELAPCO (RCOA)	Totals	1	4	1	6
	Process and Procedures	0	2	1	3
	IT General Controls	0	0	0	0
	Meter Site Review	1	2	0	3
BSMD (PEMC)	Totals	0	4	1	5
	Process and Procedures	0	1	1	2
	IT General Controls	0	3	0	3
GENERAL	Recommendations			24	
REVIEW TOTALS		18	35	60	113

Some key points in the findings were

- For both WESM and RCOA meter sites, lapses in metering security was a significant factor in the Major Non-conformances found.
- For NGCP, there was an overall 25% improvement in the number of findings, but much variation between MTDs and with TP owned facilities a major contributor to the number of sites uncorrected from the First Review.

EXECUTIVE SUMMARY

- The two smaller RCOA MTDs, AEC and SFELAPCO, do not have well developed internal procedures. We have made a recommendation on this matter.
- The largest RCOA MTD, MERALCO, has well developed procedures in most situations, but some need adjustment and stronger enforcement to better comply with the letter and spirit of the RCOA Rules. As this is the first Review involving RCOA MTDs, there is no basis for assessing improvements in performance at this stage.
- The BSMD systems remain predominantly spreadsheet-based, which is unsatisfactory. The Centralised Registration and Settlement System should greatly improve the situation when commissioned.

The Review Team prepared Issues papers on the following topics. These were motivated by issues that merged during the review.

- Issues Paper on MTN and Meter Location with SSLA
- Issues Paper on International Practice on Backup Meters
- The Smart Grid - Opportunities and International Experiences
- Issues Paper on International Practice on the Ownership and Accountability of Meters

The Review makes recommendations in the following areas, based on the on-site findings and the Issues Papers prepared.

- Proposed Rule Changes Relating to Meter Sites
- Progressing MTN and Revenue Meter Location Improvements
- Backup Metering in WESM and RCOA
- Preparing for the Smart Grid
- Ownership and Accountability of Meters
- Requirement for Internal Business Procedures
- Clarification of Responsibilities for Retail MSP Submission of Metering Data
- Classification of Metering Audit Findings

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Glossary of Terms

Note: Common terms or terms used in references are omitted

AEC	Angeles Electric Corporation
APEX	Alliance of Power and Energy Xponents
APM	Annual Preventive Maintenance
BCT	Bushing-type Current Transformer
BSMD	Billing, Settlements and Metering Department (of PEMC)
CCTV	Closed Circuit Television
CIT	Communication and Information Technology
CRB	Central Registration Body (PEMC)
CRSS	Central Registration and Settlement System
CT	Current Transformer
dBm	Decibel milliwatts
DOE	Department of Energy
EPIRA	Electric Power Industry Reform Act
ERC	Energy Regulatory Commission
EV	Eastern Visayas
FIT	Feed In Tariff
FTP	File Transfer Protocol
GPR	Ground Potential Rise
GSM	Global System for Mobile Communications
IBP	Internal Business Procedures
IES	Intelligent Energy Systems
IP	Internet Protocol
ISC	Inter-Agency Steering Committee for the Development and Formulation of a Comprehensive and Holistic Smart Grid Policy Framework and Roadmap for the Philippine Electric Power
IT/ITD	Information Technology/Information Technology Department
ITGC	IT General Controls
kV	kilovolt
kW	kilowatt
LA	Lightning Arresters
MAR	Metering Arrangements Review
MERALCO	Manila Electric Company
MIRF	Meter Installation Registration Form
MNM	Market Network Model

GLOSSARY OF TERMS

MO	Market Operator
MPWO	Metering Point Work Order
MQ	Metered Quantity
MSP	Meter Service Provider
MTD	Maintenance and Testing Division
MTN	Market Trading Node
MTR	Meter Trouble Report
MV-90	Itron Meter Data Management System used by NGCP and other
MW	Megawatt
N.A or n.a.	Not Applicable or Not Available
NC	Non-conformance/non-compliance
NGCP	National Grid Corporation of the Philippines
NLN	North Luzon North
NLS	North Luzon South
O&M	Operations and Maintenance
OPI	Opportunity for Improvement
PAC	PEM Audit Committee
PDC	Philippine Distribution Code
PEMC	Philippine Electricity Market Corporation
BSMD	Billings, Settlements and Metering Division
TWG	Technical Working Group
PGC	Philippine Grid Code
PMT	Preventive Maintenance and Testing
PT	Potential Transformer
RCC	Rules Change Committee
RCOA	Retail Competition and Open Access
RTU	Remote Telemetry Unit
SFELAPCO	San Fernando Electric Light and Power Company
SLN	South Luzon North
SLS	South Luzon South
SSLA	Site Specific Loss Adjustment
TP	Trading Participant
TWG	Technical Working Group
VT/CT	Voltage Transformer/Current Transformer
WESM	Wholesale Electricity Spot Market
WV	Western Visayas

1 About This Report

Intelligent Energy Systems (IES) with its associates Alliance of Power and Energy Xponents (APEX) and Deloitte Philippines (Deloitte) are pleased to submit this Report on the Second Metering Arrangements Review.

In broad terms, the Metering Arrangements Review covers all metering activities, data handling and processing of metering data carried out by the Metering Service Providers (MSPs) and the Billing Settlements and Metering Department (BSMD) of Philippine Electricity Market Corporation (PEMC). The Review covers:

- metering for generators and customers operating in the Wholesale Electricity Spot Market (WESM) covering the period 26 December 2011 to 25 December 2013; and
- metering for contestable customers under the Retail Competition and Open Access (RCOA), covering the period 1 July 2013 to 25 December 2013.

The Review was carried out under the procedures laid out in Section 11 of the PEM Audit Manual Issue 2.0. This Report is intended to meet the requirements of Section 11.5.5 of the PEM Audit Manual.

2 Background

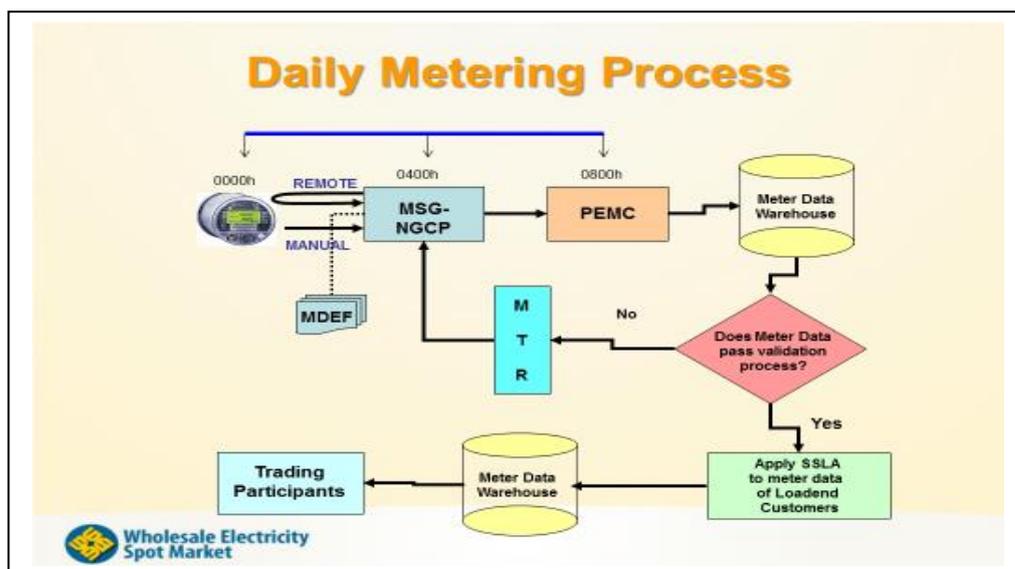
PEMC operates the WESM, which is established pursuant to the Electric Power Industry Reform Act (EPIRA) of 2001. As Market Operator (MO), PEMC is responsible for the settlement of all buy and sell transactions that take place in the market. To settle transactions, it needs clean, validated meter data for all buyers and sellers in the market over the period of settlement, which is one month in the WESM. The metering for that data is managed by one or more designated MSPs and its preparation for final use in settlement is a joint exercise between PEMC and the MSPs. Currently there is a single MSP for the WESM: National Grid Corporation of the Philippines (NGCP).

RCOA was been introduced under EPIRA in mid-2013. This is currently restricted to larger customers with loads of 1 MW or above. The idea of RCOA is to support competition, whereby a retail customer can switch to another supplier if it offers a better deal than the customer's current supplier. To achieve this, a Central Registration Body (CRB) is designated, in this case PEMC, to manage the interface between the customer's MSP and its retailer of choice.

The First Metering Arrangements Review included only WESM metering. The current Review includes both WESM and RCOA metering.

The metering arrangements and data processing around metering are broadly similar for both WESM and RCOA, apart from differences in file transfer protocols and some additional processing to allocate loss adjustments to RCOA customers. Below is a brief description of the processes carried out every day for WESM meters. This provides some context for the scope of the review.

Figure 2-1: Daily metering Process in the WESM



Source: PEMC Module 3 - Metering Processes_Final_20120629 (Presentation to Auditor-July10 2012A).ppt

The WESM metering process illustrated is conducted daily. A monthly process is conducted prior to settlement for the full month of meter readings, to confirm completeness and accuracy of the monthly data used for settlement. The process for RCOA meters is similar, but with some differences in detail.

Meters on site are interrogated daily from midnight and data downloaded to the MSP's metering database. Sometimes meter data need to be read manually if there is a communication problem.

After initial validation where potential data problems are flagged according to a set of defined criteria, the data are uploaded to PEMC and stored in PEMC's Meter Data Warehouse. PEMC then undertakes its own data validation and checks. If PEMC identifies a potential problem with a particular set of meter readings, a Meter Trouble Report (MTR) is generated and forwarded to the MSP for appropriate action. This signals either that data has not been received or that some estimation may be required for later editing. The MSP investigates the problem and provides PEMC with an estimate for substituting the poor data, or confirms the validity of the original data, giving reasons. PEMC performs the final editing if it deems the proposed data changes acceptable.

If the data are deemed satisfactory, the next step is to estimate the adjustment necessary to account for losses between the Market Trading Node (MTN) and the point of metering. This process is called Site Specific Loss Adjustment (SSLA). The accuracy of this process depends on having a complete picture of the network configuration and parameters between the MTN and metering point. Some configurations can be quite complex.

With this process completed on a daily basis, a process at the end of each month confirms the data as being ready for settlement or still requiring work. Behind the daily routine there are processes managed by each MSP to install, maintain and test the physical metering infrastructure and to register the meter so as to be properly recognised in the MSP and PEMC systems.

3 Scope of the Review

3.1 Review Objectives

The general objective of this Metering Arrangements Review is to assess the adequacy of the metering standards, security systems and processes in the Philippine WESM and RCOA markets. Further, the Metering Arrangements Review shall be conducted to confirm that the metering arrangements and installations comply with the WESM Rules and WESM Metering Manual (WMM), Retail Rules and Retail Metering Manual (RMM), associated Market Manuals, Philippine Distribution Code (PDC), and the Philippine Grid Code (PGC), and to identify and report any possible non-compliance.

The External Auditor was required to conduct the following specific tasks to meet these Review objectives.

3.2 Process and Compliance Review

- a) Assess the compliance of the WESM and RCOA MSPs with their obligations, as stated under the applicable Rules and Documents;
- b) Assess the compliance of the MSPs with its documented internal procedures;
- c) Assess the adequacy and compliance of MSPs with good utility practice of preventive maintenance performed on metering equipment, including completeness of maintenance programs, test results and sealing records;
- d) Check the timeliness of the MSP in addressing MTRs;
- e) Check the availability of information dissemination to the Market Operator during meter trouble;
- f) Assess the adequacy of metering data adjustment process and variables with respect to the metering installation's physical configuration;
- g) Review the validity and completeness of meter test results conducted during the Metering Arrangements Review period; and
- h) Review the MSPs' compliance with the testing schedules to be conducted on metering components in accordance with the applicable Rules and Manuals.

3.3 Procedures Review

- a) Review the adequacy of internal procedures/protocols of MSPs in meter data collection, including but not limited to, manual retrieval of meter data in times of remote communication failure;
- b) Check the availability of recovery plan and procedures in case of erased or corrupted metering data and of an off-site data storage location; and
- c) Assess the consistency of MSP's internal business procedures with the WESM Rules, Retail Rules and relevant Market Manuals.

3.4 Review of Systems Used by MSPs

- a) Assess the reliability of the meter communication links and interfaces to the meter data collection system of MSP;
- b) Review the availability, accuracy and reliability of software, tools and programs used by MSPs in meter data collection, processing and database (e. g. MV-90);
- c) Assess the reliability of the communication link and interfaces between MSP and the Market Operator;
- d) Check the availability of back-up systems in the event of power failures;
- e) Assess the adequacy of remote monitoring facilities of the MSP to alert the Market Operator of any failure of any components of the metering installation; and
- f) Check the adequacy of physical and logical access security of metering data held in metering installations and metering database.

3.5 Review of Metering Installations (On-site Inspections)

A total of 2 0 0 WESM and RCOA meters in Luzon and Visayas are inspected on-site.. The review of metering installations includes, but not limited to the following:

- a) Assessment of whether the design, technical specifications, operation, maintenance, safety and security of the metering installations comply with the standards set forth in the applicable Rules and Manuals;
- b) Determination of the appropriateness of the revenue metering and market trading node location;
- c) Check on the consistency of metering installation components with the corresponding Metering Installation Registration Form (MIRF), which include the following, among others-
 - i. Number of Current Transformers (CT) and Potential Transformers (PT), i.e. three CTs and three PTs as stated in the PGC 8.3.2.1;
 - ii. Nameplate ratio of the installed CTs and PTs; and
 - iii. Nameplate of the equipment installed, particularly the serial numbers and meter seals (as found during the on -site inspection and as left).
- d) Check on the availability of spare parts (e.g. meters, CTs and PTs) in case of defective metering installations that need immediate replacement;
- e) Check on the availability of check meters for main revenue meters, if deemed applicable; and
- f) Conduct thermal scanning to determine the loose and/or hotspot connection.

3.6 Applicable Rules and Manuals

The following are the applicable Rules and Manuals for the metering arrangements review as nominated in the project contract, supplemented with additional documentation that came to later notice or the Team has used to support its work:

1. WESM Manual- Metering Standards & Procedures Issue 9.0;
2. Wholesale Electricity Spot Market Rules;
3. Retail Competition Open Access Rules;
4. ERC Guidelines for the Issuance of Certificate of Authority for WESM Metering Service Providers;
5. Retail Metering Manual;
6. Philippine Grid Code;
7. Philippine Distribution Code;
8. Philippine Electrical Code;
9. Documented Internal Procedures of MSPs;
10. Relevant Circulars, Orders and other Issuances of the DOE and ERC;
11. Other applicable Rules and Regulations;
12. ANSI/IEEE C57.13 Guide for Grounding of Instrument Transformer Secondary Circuits and Cases;
13. WESM Monthly Summary Report;
14. NGCP-MSP Performance Report;
15. NGCP Meter Trouble Report Summary (MTR); and
16. Documentation on thermal scanning, including:
 - Infraspection Institute Standard for Infrared Inspection of Electrical Systems and Rotating Equipment. 2008.
 - NFPA 70B- Recommended Practice for Electrical Equipment Maintenance. 2010.
 - ASTM E-1934-99a (2005) - Standard Guide for Examining Electrical and Mechanical Equipment with Infrared Thermography. 2005
 - ANSI/NETA Standard for Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems
 - US-Occupational Safety & Health Agency Standards for General Industry 29 CFR, Part 1910

3.7 Parties and Locations Audited

The metering operations of the following organisations are the subject of this Review.

For the WESM:

- NGCP, which is the sole MSP for the WESM.

For RCOA:

- MERALCO, which is the largest electricity Distributor in the Philippines, covering the Metro Manila area;
- Angeles Electric Corporations (AEC), a distributor covering the Angeles City area in Pampanga; and
- San Fernando Electric Light and Power Corporation (SFELAPCO), a distributor covering the San Fernando area in Pampanga.

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- Processes of the MSP Maintenance and Testing Divisions (MTDs) which provide regionally-based facilities for installing, testing and maintaining metering installations;
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- Systems and processes undertaken by the PEMC BSMD for registration of meters, receiving, storing, validating and editing meter data, and processing it further to be ready for settlement.

The table following outlines the site numbers and functions that are subject to review.

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¹ Some meter sites are owned by Trading Participants rather than the Responsible Organisation.

² Not applicable

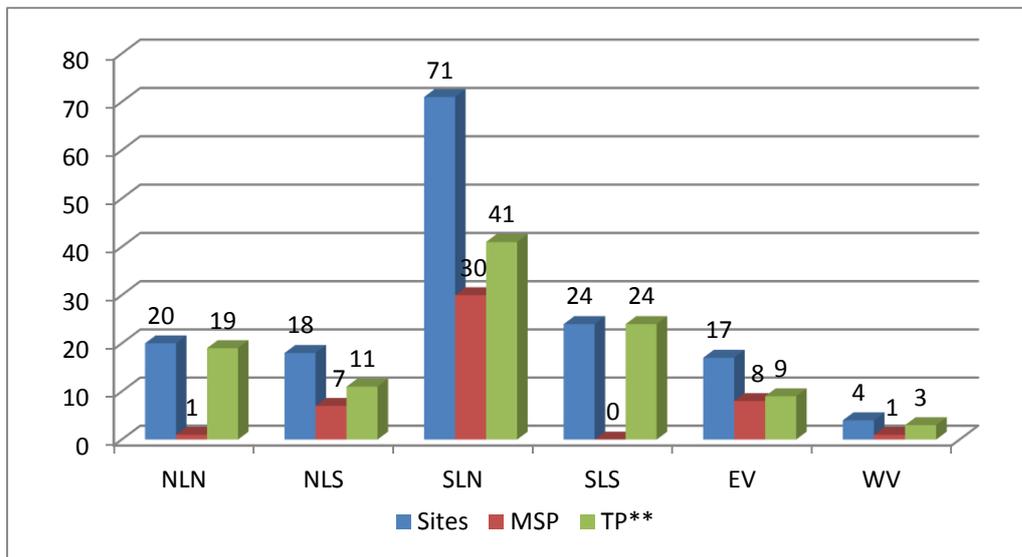
SCOPE OF THE REVIEW

Of the six MTDs operated by NGCP, four (4) are in Luzon and two (2) are in the Visayas:

- North Luzon North (NLN)
- North Luzon South (NLS)
- South Luzon North (SLN)
- South Luzon South (SLS)
- Eastern Visayas (EV)
- Western Visayas (WV)

The chart following shows the number of metering sites audited in each of the NGCP MTDs listed above. Note that in 69% of sites, the instrument transformers are owned by the Trading Participant (TP).

Figure 3-1: WESM Metering Facility Ownership



** Instrument transformers are owned by the Trading Participant (TP)

4 Review Process

4.1 Inception Report and Agreed Assessment Criteria

The Inception Report was the primary vehicle for planning the Review. As required by the project contract, this report contains the External Auditor's Review Plan, Methodology, Work Program and checklists for all the key tasks subject to audit. It confirms the Review scope and outlines the Review approach, including the Review process and a schedule of proposed client interaction for the duration of Review work. It also included the set of criteria used to classify findings which were:

- MAJOR NON-CONFORMANCES (Major NCs)

Deviations from WESM or Retail Market Rules that have an impact on service performance or data accuracy, or which may result in a major system or process breakdown; for example, failure to perform maintenance that results in equipment breakdown.

- MINOR NON-CONFORMANCES (Minor NCs)

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- OPPORTUNITIES FOR IMPROVEMENT (OFIs)

Findings that are not included in the WESM or Retail Market Rules but which may help the organization to improve its performance.

In interpreting these guidelines, the Review team observed the following:

- Security issues in violation of the Rules or Codes qualify as Major Non-conformances as data integrity could be compromised at any time; and
- Safety issues are over-riding and will be classified as Major Non-conformances.

The content of the Inception Report was agreed among the External Auditor, PAC and TWG, in consultation with PEMC and MSPs.

4.2 Review Process Workshop

Prior to actual team mobilization and execution, a Metering Arrangements Review Process Workshop was conducted to ensure that the objectives, scope and methodology of the Metering Arrangements Review project were understood clearly across the audit participants; namely PEM Audit Committee (PAC), MSPs, Energy Regulatory Commission (ERC), Department of Energy (DOE), Technical Committee and other key stakeholders.

4.3 Gather Planning Data on the Metering Sites Subject to Review

Data on the metering sites to be audited was gathered from available reports, records and documents from PEMC, MSPs and central/provincial sites. Details are contained in the project Inception Report.

- The PEMC BSMD office systems and processes subject to audit is located in PEMC Head Office, Ortigas Centre, Metro Manila
- WESM sites audited (all NGCP) were:
 - Meter data centres at Diliman (Metro Manila) and Cebu;
 - MTD Sites in Pampanga, Laguna, La Union, Albay, Bacolod and Cebu where documents (e.g. MTRs, Metering Installation Registration Forms MIRFs), maintenance schedules, etc.) are stored and maintained; and
 - WESM meter sites nominated for audit by PAC (some of these metering facilities are owned by TPs).
- RCOA sites audited were:
 - The MERALCO meter data centres and MTD operations in Ortigas Center and Metro Manila, together with 41 PAC nominated RCOA meter sites;
 - AEC data center and MTD operations, together with a single RCOA meter site, located in Angeles City, Pampanga; and
 - SFELAPCO data center and MTD operations, together with a single RCOA meter site, located in San Fernando, Pampanga.

4.4 Meter Site Field Work

Three Field Teams were created to undertake the field work, each composed of a Team Leader, a Technical Auditor (Metering/Substation), a Documentation Auditor, and an IT Auditor. PEMC and other WESM policy and regulatory staff usually accompanied the field team on its visits. A total of one hundred ninety-seven (197) sites were listed for inspection. In fact, a total of 200 sites were inspected upon the arrival of the team on-site, since three sites had two meters. The Table following shows the number of site visits scheduled, including the number of new sites and sites followed up from the First Metering Arrangements Review.

Table 4-1: Metering Sites to be Inspected

AREA	RCOA	WESM				TOTAL
		LOAD		GENERATOR		
		New	Follow-up ¹	New	Follow-up ¹	
Luzon	43	60	39	13	21	176
Visayas	0	10	6	0	5	21
Total	43	70	45	13	26	197

The following matters were reviewed:

1. Documentation and compliance with Codes
2. Equipment specifications and condition
3. Communication integrity
4. Facility security and maintenance

4.5 Process and Compliance Review

In the MTD and MSP data centers, the meter registration process was reviewed for compliance with the requirements of the WESM and Retail Market Manuals.

The following were included in the compliance and information security review:

1. Maintenance Plans and Records;
2. Calibration Plans and Records;
3. Competency of Personnel;
4. Meter Trouble Reports;
5. Metering data collection and transmission;
6. Handling of Meter data Validation, Estimation and Editing (VEE); and
7. Emergency Procedures.

In addition to the above requirements, the status of previous audit findings was checked for the effectiveness of actions taken.

4.6 Procedures Review

Presence and adequacy of the MSPs' documented procedures were reviewed for alignment with the requirements of the WESM and Retail Market Manuals.

4.7 MSP Information Security Control Review

The IT Audit was conducted in the sites of NGCP Cebu and Diliman as well as of MERALCO and PEMC in Ortigas. The IT areas covered during the audit were:

1. Information Systems Operations;
2. Information Security;
3. Application Systems Implementation and Maintenance;
4. Database Implementation and Support;
5. Network Support;
6. Hardware and Systems Software Support; and
7. Business Continuity Planning.

At the start of the fieldwork, system walkthrough of the metering system being used by NGCP and MERALCO was performed to understand how this system supports the metering business processes.

During the site visit, ocular inspection of the data centers was also performed to confirm the effectiveness of the physical and environmental controls. Observations and findings from the fieldwork were scheduled and discussed with process owners for clarification and getting the commitment to address the findings noted.

4.8 PEMC-BSMD Activities

PEMC BSMD receives and processes metering data in preparation it for use in settlement. Settlement of the WESM takes place at PEMC. In the case of RCOA, PEMC transmits settled data to the relevant retailer for their billing of the RCOA customer.

The following PEMC-BSMD systems and processes were reviewed for both WESM and RCOA:

1. Data transmission, storage and IT controls;
2. The MTR process;
3. Performance monitoring;
4. Data Validation, Estimation and Editing (VEE);
5. Site Specific Loss Adjustment (SSLA); and
6. Progress on implementing the recommendations of the first Metering Arrangements Review.

A Customer Registration and Settlement System (CRSS) has been under development by PEMC-BSMD and is due for implementation in June 2017. The development of this system is partly a response to the findings of the First Metering Arrangements Review, although plans for it were underway before that time. This system will substantially replace most of the current systems used by BSMD. For that reason, this Review did not go to the same level of detail as the first Review in this area as the BSMD meter data processing systems will soon be replaced.

4.9 Analysis and Follow-up

Upon the completion of field work and site visits, the team drafted its initial set of detailed findings which were then discussed with the responsible parties. As a result, some findings were adjusted to correct for errors or initial misunderstandings. In most other cases, the course of action to deal with each finding was agreed upon and in many cases had already been acted upon by the time of the close-out meeting. Where there was discussion about the appropriate categorisation of a finding, the Review team applied the agreed categorisation criteria at the time of the investigation. Early response to a finding, while commendable and noted in the report, did not change the finding itself or its categorisation.

Once the detailed findings had been substantially agreed or at least reviewed, the team analysed the results for general trends such as:

- Any clear differences in non-compliances among WESM MTDs;

- Any clear differences in non-compliances between NGCP-owned and TP-owned metering facilities; and
- Progress in committed action plans to address findings from the first Metering Arrangements Review and during the course of the current Review.

Review of the draft Review report by the PAC and the Technical Working Group (TWG) led to a re-consideration of some findings and their classifications.

4.10 Issues Papers

During the Review, and partly as a result of the discussions held during the Review and initial Review findings, the Review team prepared and circulated a number of Issues Papers. Some were initiated by the team and some were requested by PEMC. These papers covered the following topics:

- MTN Location, Meter Location and SSLA
- International Practice on Backup Meters
- International Developments on the Smart Grid
- Ownership and Accountability of Meters

The review Recommendations address some of the issues covered in these papers.

5 Main Findings

5.1 WESM MSP (NGCP) Findings

NGCP Process Compliance and Procedure Review

The topic of a single Major Non-conformance is summarised below, together with a reference to the relevant Rule or Procedure. Detail on this non-conformance is given in Appendix A.

Table 5-1: Major Non-conformance in Process and Procedures- NGCP

Finding	Reference
Major Non-conformance	
1. Records needed as proof of maintenance were not completely accomplished.	PGC 8.4.4.1

The topics of Minor Non-conformances and OFIs are listed below.

Table 5-2: Minor Non-conformances and OFIs in Process and Procedures - NGCP

Finding	Reference
Minor Non-conformances	
2. Polyphase Meter Testing Reports as proof of maintenance were not completely accomplished.	PGC 8.4.4.1
3. Calibration of Test Instruments is not always performed as scheduled.	WMM 2.5.5.4
4. Warehouse inventory for meter seals is not updated	NGCP Warehousing Procedure
Opportunities for Improvement	
1. Recording of MTR causes	n.a.
2. Standardization of procedure and practices between MTDs	n.a.
3. Improvement of business continuity management procedure to include disaster recovery of metering facility.	n.a.
4. Inventory management of meter spare parts	n.a.
5. Sending of calibrated meters only to MTDs to eliminate double handling / transportation of meters	n.a.
6. Compliance of contract workers with safety & technical standards	n.a.
7. Use of backup meter while testing main meter	n.a.
8. Testing meter battery before commissioning to reduce early failures	n.a.

NGCP IT General Controls Review

Procedures of NGCP data center in Diliman (Luzon) and in Cebu were reviewed. No Major Non-conformances were noted. The topics of Minor Non-conformances and OFIs are listed below, with references where relevant.

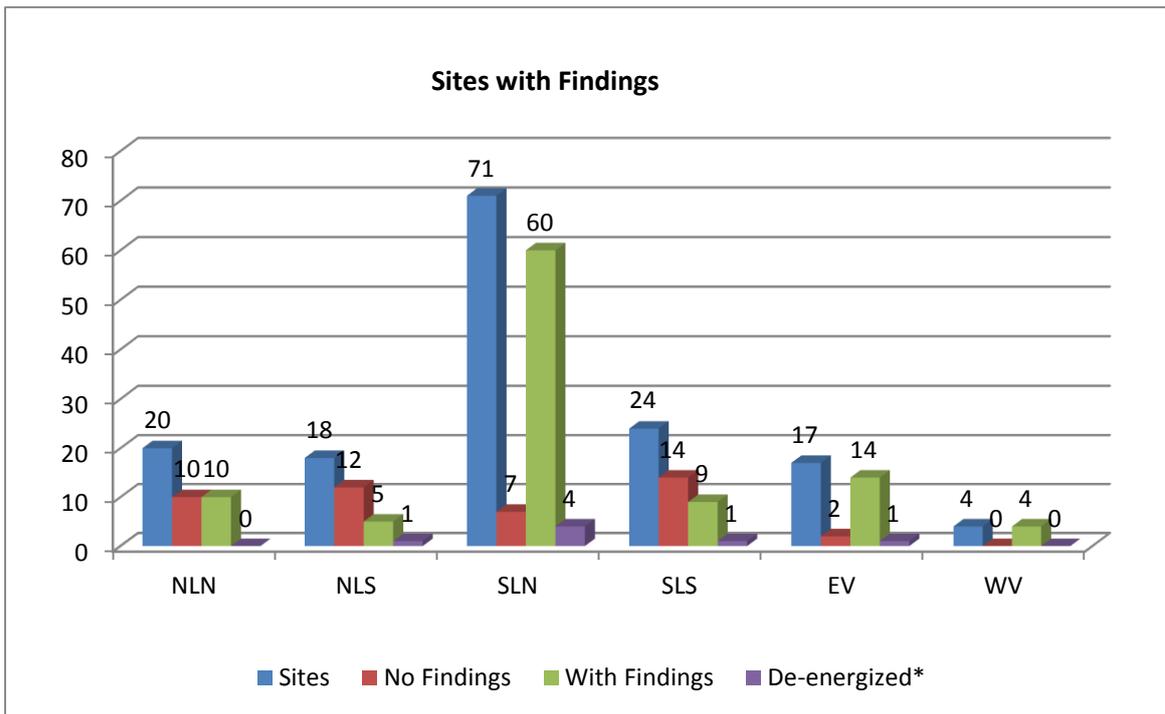
Table 5-3: Minor Non-conformances and OFIs in IT General Controls - NGCP

Finding	Reference
Minor Non-conformances	
1. Physical access control to MV-90 room is inadequate. In Diliman, the door is misaligned, while in Cebu, there is no requirement for biometric upon entrance.	WESM 2.9.2.1
2. There is no periodic review of MV-90 users' access in Diliman and Cebu	NGCP Circular 2014-0001
Opportunities for Improvement	
1. Application of complex passwords for workstation in NGCP and Diliman	NGCP Circular 2011-0023
2. Activation of the screen locking feature for MV-90 workstation	NGCP Circular 2013-0012 s5.6
3. Turn-over of unutilized desktops and CPUs of the old MV-90 to property office	NGCP Circular 2013-0012
4. Updating of internal policy on collecting, processing and forwarding meter data to PEMC from dial-up connection to File Transfer Protocol (FTP)	NGCP PM-OM-OMM-04
5. Installation and maintenance of adequate fire detection equipment for NGCP Diliman data center, such as water detector and fire suppression system	Leading practices
6. Completion of NGCP Data Recovery Site facility	NGCP Circular 2012-0019 s5.1

NGCP Meter Sites Review

The following figure and table summarise the number WESM sites with findings, classified by NGCP MTD and also by facility ownership. Some sites have multiple findings against different WESM Rules. The sites of MTDs SLN, EV and WV have findings well in excess of 50% of all their sites. MTD SLN stands out in terms of absolute numbers, with slightly less than half of the total findings. MSP and TP-owned facilities have, in total, similar proportions of sites with findings – around 70%.

Figure 5-1: Findings on WESM Metering Sites by MTD - NGCP



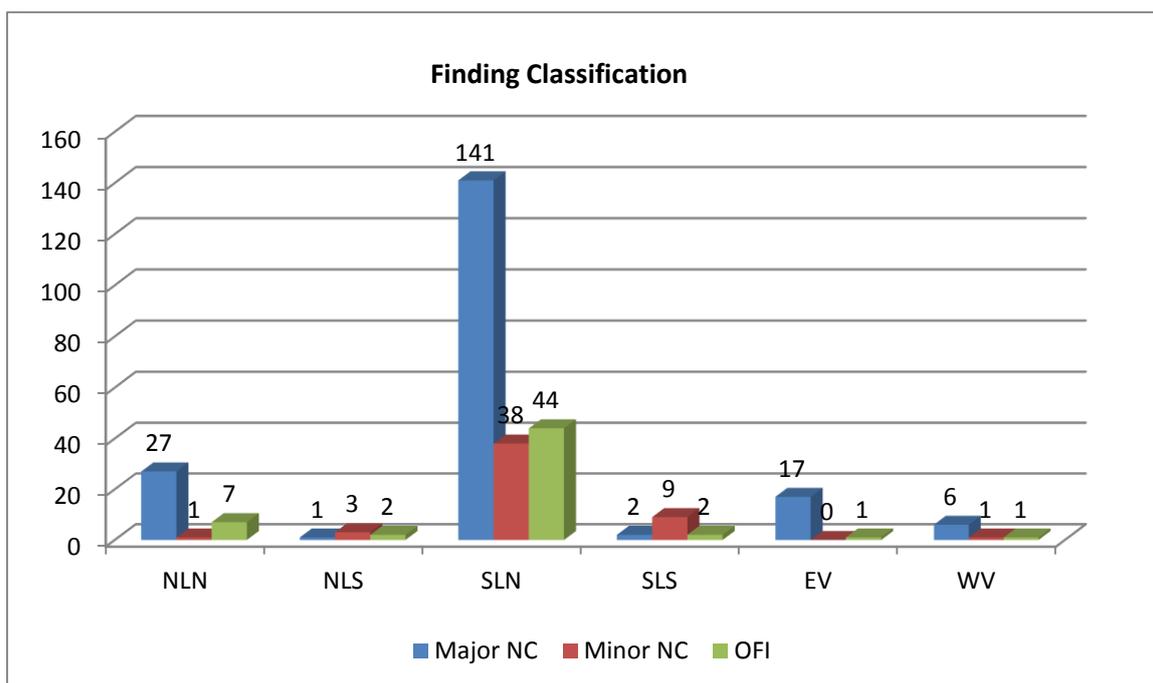
Sites with Findings	By MTD							By Ownership		
	NLN	NLS	SLN	SLS	EV	WV	TOTAL	MSP	TP	TOTAL
Count										
Sites	20	18	71	24	17	4	154	47	107	154
No Findings	10	12	7	14	2	0	45	9	36	45
With Findings	10	5	60	9	14	4	102	33	69	102
De-energized*	0	1	4	1	1	0	7	5	2	7

MAIN FINDINGS

The figure and table below summarise the findings by classification (Major NC, Minor NC and OFI). The total number of site inspected exceeds the number of sites with findings because some sites have multiple findings.

The standout observation is the high number of findings on SLN, especially in the Major category. While SLN has more meters than other MTDs, the proportion of findings at SLN is also high relative to other MTDs. This observation together with observations on process control suggests a regional management problem at SLN that NGCP management needs to correct.

Figure 5-2: Findings on WESM Metering Sites by Classification - NGCP



Classification	By MTD							By Ownership		
	NLN	NLS	SLN	SLS	EV	WV	TOTAL	MSP	TP	TOTAL
Major NC	27	1	141	2	17	6	194	69	125	194
Minor NC	1	3	38	9	0	1	52	10	42	52
OFI	7	2	44	2	1	1	57	26	31	57
Totals	35	6	223	13	18	8	303	105	198	303

The table on the following page breaks down the Major non-conformances according to the Rule violated, separated by MTD and also by facility ownership. The highest number of non-conformances relates to security issues and there is a concentration of security-related findings in SLN MTD as well as in TP-owned facilities. The review recommends a tighter compliance enforcement regime for TP-owned facilities. More detail on each Major findings is given in Appendix B.

MAIN FINDINGS

Table 5-4: Major Non-conformances on WESM Metering Sites by MTD and Facility Ownership - NGCP

No.	CODE	Brief Description	NLN	NLS	SLN	SLS	EV	WV	TOT	MSP	TP	TOT
1	PGC 8.4.1	Instrument Transformers shall be tested every 5 years	5	0	20	0	4	1	30	9	21	30
2	PGC 8.4.2	Meter Testing and Calibration Issue	2	0	28	0	0	0	30	10	20	30
3	WMM 2.5.6	Grounding Problem - High touch and step potentials	2	0	0	0	0	0	2	0	2	2
4	WMM 2.5.7	Bushing CT with 0.6% accuracy - beyond the 0.3% accuracy requirement	0	0	3	0	0	0	3	3	0	3
5	WMM 2.5.8	Voltage Transformer Requirement	4	1	8	0	4	0	17	2	15	17
6	WMM 2.6.5	Non-Standard Arrangement of VT-CT-LA	0	0	6	1	0	1	8	1	7	8
7	WMM 2.7.3	Instrument Transformer Secondary	5	0	16	0	0	0	21	10	11	21
8	WMM 2.9.1.3	Instrument Transformer secondary box without security seals	2	0	35	0	5	3	45	19	26	45
9	WMM 2.9.1.4	Meter Enclosure Issues	4	0	15	0	4	1	24	8	16	24
10	PGC 8.4.4	Maintenance Issues	3	0	7	1	0	0	11	5	6	11
11	WMM 2.4.1	Time Synchronization Error	0	0	3	0	0	0	3	2	1	3
	TOTALS		27	1	141	2	17	6	194	69	125	194

MAIN FINDINGS

The topics of Minor NCs and OFIs are as follows:

Table 5-5: Minor Non-conformances and OFIs on WESM Metering Sites - NGCP

Finding	Reference
Minor Non-conformances	
1. A total of thirty (30) metering sites have an unsecured metering perimeter	WMM 2.9.1.7
2. MIRF of six (6) metering sites in MTD-SLN was not available	WMM 2.3.3
3. Ten (10) grid revenue meters in MTD-SLN have blackened displays	WMM 2.4.1
4. Four (4) metering sites in MTD-SLN uses Bushing-type Current Transformer instead of stand alone and dedicated Current Transformer	WMM 2.5.7
5. Non-standard meter test block/switch configuration (CCCC-PPPP) is being used in Palanas Substation, Taal, Batangas instead of P-CC-P-CC-P-CC-P	WMM 2.9.1.5
6. Double-bushing VT is being used in Mataas na Bayan Substation (BATELEC I) in Batangas instead of single bushing VT	WMM 2.5.8
Opportunities for Improvement	
1. Conduct of grounding test for twenty-nine (29) metering sites with ground connection resistance exceeding 5 ohms	n.a.
2. Completeness of PMTR and MIRF records	n.a.
3. Updating of expired ERC seals	n.a.
4. Provision for maintenance records for lightning arrestors	PGC 8.4.4
5. Conduct of thermal scanning as one of the maintenance activities of the MSP	Tech. standard

NGCP Performance Relative to First Metering Arrangements Review

A comparative count of the WESM MSP findings during the First and Second Metering Arrangements Reviews (including those which were not called in the first review) is shown in the Table below. There is a 25.7 % improvement overall, but much variation between MTDs.

Table 5-6: Comparison of First MAR and Second MAR Findings

Findings	NLN	NLS	SLN	SLS	EV	WV	Total
1st Review*	56	29	54	1	22	5	167
2nd Review	29	10	57	0	22	6	124
% Improvement	48.2%	65.5%	-5.6%	100.0%	0.0%	-20.0%	25.7%

* Includes findings that were not called during the first Metering Arrangements Review

Some problem areas requiring improvement are:

- Many site non-conformance findings from the First Metering Arrangements Review were found to have persisted. In accordance with the Review assessment criteria, these non-conformances were categorised as Major.
- There is a clear difference in the compliance performance between NGCP MTDs which suggests that regional management needs to be improved in those MTDs with high levels of non-compliance.
- TP-owned facilities have a relatively high rate of non-compliance which indicates that a stronger regime to enforce compliance to the Rule is required. It is common international practice to have a formal system to enforce compliance to the Rules, irrespective of facility ownership. The Review recommends a Rule change to establish such a system.

5.2 RCOA MSP Findings

RCOA Findings Overview

On SFELAPCO and AEC, the major finding found for both sites was the absence of any test records for voltage and current transformers. This reflects inadequate documentation and procedures generally for these smaller MSPs, for which the review has made a general recommendation to drive improvement in this area.

The large number of findings for MERALCO relative to AEC and SFELAPCO reflects the much larger number of sites for which the MERALCO MSP is responsible. MERALCO’s documentation and procedures are highly developed relative to the smaller MSPs.

As shown in the Table following, there were 43 RCOA metering installations reviewed. Some sites were found to have more than some metering point; hence, 46 metering installations were reviewed in total.

Of MERALCO’s 44 reviewed sites, 34 were found to be compliant while 10 had at least one non-compliance. Each of AEC’s and SFELAPCO’s reviewed meters had a Major NC. Details are provided in Appendices D and E respectively.

Table 5-7: RCOA Metering Sites Summary

Distributor	Scheduled	Actual	Compliant	Non-Compliant
MERALCO	41	44	34	10
AEC	1	1	0	1
SFELAPCO	1	1	0	1
TOTAL	43	46	34	12

The count of findings by classification for the three MSPs whose sites were reviewed is shown in Table below. Note that the total of 17 major and minor-NCs exceeds the total of 12 sites with non-conformances because some sites have several NCs.

Table 5-8: RCOA Site Review Findings

Distributor	Major NC	Minor NC	OFI	Total Findings
MERALCO	8	4	45	57
AEC	1	1	0	2
SFELAPCO	1	2	0	3
TOTAL	10	7	45	62

The following sub-sections provide more detail on all the findings for MERALCO, AEC and SFELAPCO.

MERALCO Process Control Procedures

The following Minor NCs and OFIs were noted for MERALCO.

Table 5-9: Minor Non-conformances and OFIs in Process and Procedures - MERALCO

Finding	Reference
Minor Non-conformances	
1. Incompletely accomplished MIRF	RMM 4.1.1
2. Incompletely accomplished maintenance procedures for 34.5kV and 69kV metering facilities	PGC 8.5.3
3. Unresolved internal findings on housekeeping	RMM 2.6.1.7
4. Handling of Meter Trouble Reports is not in accordance with the rule	RMM 7.4.1
Opportunities for Improvement	
1. Delineation of responsibilities in the implementation of RCOA processes.	n.a.
2. Review frequency for testing and calibration of revenue meters	Note: The External Auditor proposes establishment of specific rule for maintenance and calibration of RCOA meters

Although classified as a Minor NC, Item 4 in the table is important to address to enhance data integrity. A specific Rule change is proposed to clarify the requirement.

MERALCO IT General Controls Review

Minor NCs and OFIs were noted for the following topics.

Table 5-10: Minor Non-conformances and OFIs in IT Controls - MERALCO

Finding	Reference
Minor Non-conformances	
1. There is an inadequate physical access control on the workstation used for extract validation as it is outside the control room	Leading practices on IT Controls
2. Personal files are saved in the workstation desktop	PL-ICIO-100 s6.6.2
3. There is lack of access and profile review for data collection application users	PL-ICIO-101 s5.10
Opportunities for Improvement	
1. Activation of screen locking feature for the workstation assigned to collect data from Command Center	PL-ICIO-100 s7.4.5 PL-ICIO-101 s5.12
2. Observance of company policy on the privileged use of FTP username and passwords	PL-ICIO-100 s7.2.1
3. Registration of personal devices upon entrance to MERALCO premises	PL-ICIO-100 s7.3.3
4. Prompt turn-over of the Command Center System to MERALCO personnel by the service provider	n.a.

MERALCO Meter Site Review

The biggest cause of Major NCs with MERALCO was problems with metering security, as set out in the following Table.

Table 5-11: Major Non-conformances – MERALCO

Category	Count
Commissioning	1
No records for Instrument Transformer commissioning tests	1
Security	7
No secondary terminal box seal	5
Primary Cable connection damaged	1
No padlock	1
Total	8

MAIN FINDINGS

Details of these Major NCs are included as Appendix C. With MERALCO and NGCP, there was some debate on the impact of the security issue in specific cases. The Review classified any security breach as Major. However, the Review also considered that there would be merit in documenting in the PEMC Audit Manual a set of metering-specific-criteria for classifying findings, especially in the areas of risk, security and safety. The review has made a recommendation on that matter.

Minor NCs and OFIs found in MERALCO metering sites are summarised in the Table following:

Table 5-12: Minor Non-conformances and OFIs on RCOA Metering Sites - MERALCO

Finding	Reference
Minor Non-conformances	
1. Two (2) out of 44 metering sites have meter time discrepancy beyond +/-60 seconds allowable demand period as compared with the system time.	PDC 8.4.4.6
2. The meter cabinet for Smart (PLDT) in Matalino St., Quezon City has broken weather seal and missing metal support. Its metering cabinet cannot be opened also due to stocked water inside the meter enclosure	RMM 2.6.1.4
3. Tree leaves are touching VT high voltage bushing in Pepsi Cola, Muntinlupa metering site.	RMM 2.6.1.7
Opportunities for Improvement	
1. Regular cleaning and maintenance of metering sites and vaults	Standard Operation and Maintenance Practice
2. Regular trimming of trees and vegetation near pole facilities	RMM 2.6.1.7
3. Use of one (1) MIRF for every meter and proper documentation of MW capacity in the MIRF	Retail Rules 4.4.1 and 4.4.2.2
4. Installation of lighting arresters and inspection of unsafe high voltage metering facility clearance from building deck in Taguig City	n.a.
5. Replacement of busted lamps in metering vaults	n.a.
6. Regular checking and maintenance of the grounding system of Asia Brewery, Solid Development Corporation and Marriott Hotel Substations	n.a.
7. Improving communication link to reduce MTRs	n.a.

AEC Findings

Findings on for AEC Process and Procedures, IT General Controls and Meter Sites are summarised below. Details of the Major NC finding are given in Appendix D.

Table 5-13: Findings for AEC

Finding	Reference
Minor Non-conformances on Process and Procedures	
1 There is no formal documentation yet of the processes in compliance with the Retail Market Rules. Some processes are documented but are still in draft.	PDC 8.22.
2 MIRFs are not completely accomplished e.g. MIRF no., signature from both RES and customer, attachment required.	RMM 4.4.1
3 The test benches are calibrated using the standard meter but results of calibration is not being recorded. Also, the attachment of calibration tag or sticker to identify the equipment status is also not being practiced both for the test bench and for the standard meter.	PDC 8.5.4
OFI on Systems	
1 The customer meter is located across the field office of AEC and data are collected manually on a daily basis using a laptop.	Retail Rules 4.4.2.1
Major Non-conformance on Metering Site	
1 The maintenance program for the metering equipment has not yet been established.	PDC 8.5.3
Minor Non-conformance on Metering Site	
1 The metering facility of North Beacon Commercial Corporation (Marquee Mall) is not provided with a remote communication link. The RMSP is retrieving the meter data from the site daily.	RMM2.2c and 2.4.3

SFELAPCO Findings

Findings on for SFELAPCO Process and Procedures, IT General Controls and Meter Sites are summarised below. Details of the Major NC finding are given in Appendix E.

Table 5-14: Findings for SFELAPCO

Finding	Reference
Minor Non-conformances on Process and Procedures	
1 There is no formal documentation yet of the processes in compliance with the Retail Market Rules. Some processes are documented but are still in draft.	PDC 8.22.
2 A Meter Installation Registration Form (MIRF) is not properly accomplished. The MIRF for Marquee Mall does not have the SEIN, customer approval and RES signature. .	RMM 4.4.1
3 The test benches are calibrated using the standard meter but results of calibration is not being recorded. Also, the attachment of calibration tag or sticker to identify the equipment status is also not being practiced both for the test bench and for the standard meter.	PDC 8.5.4
OFI on Systems	
1 Data are downloaded using the GSM modem and stored on a laptop computer, at risk of getting lost due to virus or hardware problems.	Retail Rules 4.4.2.1
Major Non-conformance on Metering Site	
1 The maintenance program for the metering equipment has not yet been established.	PDC 8.5.3
Minor Non-conformance on Metering Site	
1 Meter time is not synchronized with Philippine Standard Time. It is advanced by 15 minutes.	PDC 8.4.4.6

RCOA MSP Relative Performance

As this is the first Metering Arrangements Review covering RCOA MSPs, there is no basis for evaluating performance over time.

5.3 BSMD (WESM & RCOA) Findings

PEMC BSMD registers WESM and RCOA meters, receives and stores metering data, generates MTRs for MSP action to provide missing data or correct errors, applies SSLA and, in the case of RCOA meters, allocates loss adjustments to individual metered sites. It also performs a monitoring role by collecting data and reporting on MSP performance according to criteria set out in the WESM and Retail Metering Manual.

The First Metering Arrangements Review identified a range of specific findings in the processing of metering data by BSMD. However, an important finding of the First Review was that the spreadsheet-based system used by BSMD for processing metering data was highly prone to error and should be replaced by a more robust system. In fact, BSMD had already recognised this and had initiated a project to do that, called the Central Registration and Settlement System (CRSS).

At the time of the Second Review the CRSS was in an advanced stage of development but had not yet been commissioned. In light of the imminent replacement of the spreadsheet-based system, the auditors did not repeat the earlier work but instead reviewed the follow up action from the First Review. Specifically the auditors assessed each of the First Review Findings under the following headings:

1. Issue recognised and fixed
2. Issue always fixed by month end
3. Issue not fully fixed because BSMD is not fully in control
4. Issue will be resolved by CRSS
5. Issue would be resolved by CRSS/SSLA recommendations in this Review
6. Issue Less relevant because of backup metering policy

In summary, the finding had either been fixed in the context of the current system, would be fixed by commissioning of the CRSS, or needed additional actions which have been addressed as recommendations in this Review (Items 3, 5 and 6).

The terms of reference required the checking of the MTN location as part of the meter site review. However, in discussions with NGCP, the Retail MSPs and PEMC BSMD, a range of related issues were raised with the Review team. These suggested a closer review of the rules and procedures around revenue meter location, MTN location, RTU location and associated SSLA and settlement procedures was warranted. The broader issues raised were:

- A proposal for no SSLA for generators;
- SSLA for generators with meters far from asset boundary;
- Extending RTUs and MTNs closer to distributor connection points;
- SSLA allocation to RCOA customers; and
- SSLA for upstream off-take connections.

A general recommendation was provided on these matters, as they generally impact on the market as a whole, rather than BSMD alone.

In summary, the topics of PEMC BSMD findings are as follows.

Table 5-15: Findings for BSMD

Finding	Reference
Good Point Observation	
1. The spreadsheet-based system for BSMD data management is being replaced by the Customer Registration and Settlement System (CRSS). However, the CRSS had not been commissioned as of review time	n.a.
Minor Non-conformances on Process Control	
1. MSP Performance Reporting is not yet implemented	RMM 8.3 & 8.4
Opportunities for Improvement on Process Control	
1. Review of rules in relation to MTN Location, Revenue Meter Location and SSLA	WESM Rules; Metering and Network Manuals
Minor Non-conformances on ITGC	
1. There is no defined periodic password change process for the file being sent by the Daily MTR TP Email Program	Leading practices on IT Controls
2. Not all tabs of the Daily MTR TP Email Program is protected	As above
3. There is an inadequate supervisory review on master data changes for Daily MTR TP Email Program	As above

6 Issues Papers

6.1 Overview

The Review Team Prepared Issues papers on the following topics. These were motivated by issues that merged in the review.

- Issues Paper on MTN and Meter Location with SSLA
- Issues Paper on International Practice on Backup Meters
- The Smart Grid - Opportunities and International Experiences
- Issues Paper on International Practice on the Ownership and Accountability of Meters

6.2 MTN Location and Related Issues

The terms of reference required checking of the MTN location as part of the meter site review. However, discussions with NGCP, Retail MSPs and PEMC BSMD, raised some broader issues and proposals relating to MTN location, including:

- A proposal not to apply SSLA to generators, except for the case that follows.
- A proposal to apply SSLA for generators with meters far from the asset boundary.
- Extending Remote Telemetry Units (RTUs) and MTNs closer to distributor connection points.
- Perceived problems with SSLA allocation to RCOA customers.
- SSLA determination for upstream off-take connections.

These issues suggested merit in a closer review of the rules and procedures around revenue meter location, MTN location, RTU location and associated SSLA and settlement procedures.

An Issues Paper was prepared to review the rules and propose changes relating to these locations and related matters. It attempted to demonstrate how these changes would resolve the issues enumerated above, as well as to simplify and remove ambiguities in the WESM and Retail Rules and associated Metering and Market Network Model Manuals. The proposed Rule and Manual changes affect the market as a whole, not just PEMC BSMD.

The central proposal is that settlement should occur at asset boundaries/connection points. Adjustments to market price and to Metering Quantities (MQs), where required, should always be made to those asset boundaries. Further, revenue meters as well as MTNs should be located as close as possible to asset boundaries. MTNs should also be defined more flexibly in the Rules, so that they need not be located with RTUs.

Management comments from PEMC were receptive to some parts of the proposals but not of others, or agreed only that the matter might be studied further. Other parties, including NGCP MSP, were fully supportive in the close-out meeting with them. In view of the differing views on this matter, the Review has recommended a workshop to help resolve them.

6.3 Backup Metering in WESM and RCOA

NGCP has already implemented a backup metering policy for WESM meters down to 5MW. There is a rule change under consideration by the Rule Change Committee that would require this policy to be extended to all meters in the WESM. There is currently no requirement for backup metering for RCOA meters or any immediate intention to do so.

The Review team was asked to prepare a paper on international practice on backup metering and the team also considered those findings in the context of the Philippines WESM and RCOA arrangements. The findings and recommendations from this exercise are summarised below.

It is a common (but not universal) international practice to require full backup metering at the transmission level, or at least down to the equivalent of 1 MW average. Ideally, a cost-benefit analysis should be performed to compare the cost of backup metering with the expected benefit of reducing the cost per site of dealing with occasional failures, with an over-riding judgement on the benefit of a general improvement to market robustness. The Review team has seen backup metering costings but was not able to obtain a listing of the remaining under 5MW WESM meter sites that are still without backup metering. However, as much of the benefit in backup metering is a saving in office costs, largely independent of site size, a universal policy for WESM meters is likely to be justified.

In the case of RCOA metering, we also suggest a cost benefit analysis, but as yet there are no formal performance data to go by. This should improve when PEMC begins gathering and reporting on MSP performance statistics.

A Recommendation has been made to give effect to these conclusions.

6.4 Preparing for the Smart Grid

In March 2013, DOE established an Inter-Agency Steering Committee for the Development and Formulation of a Comprehensive and Holistic Smart Grid Policy Framework and Roadmap for the Philippine Electric Power Industry (ISC). The title expresses its function. The Review team was requested to prepare a paper on international experience that would inform the deliberations of this committee in the metering area.

The 'smart grid' is an electricity network that can intelligently integrate the actions of all users connected to it – generators, consumers and those that do both – in order to efficiently deliver economic, secure, and sustainable electricity supplies. It offers options for small-scale generation and demand management which can provide customers with more choice and control about how they meet their power needs.

The paper reviewed smart grid programs in five countries:

- United Kingdom
- Singapore
- New Zealand
- United States
- Australia

Utilities in each of these countries have initiated a range of pilot and commercial programs for both large and small customers.

To summarise, metering is a key component of the smart grid. Generally, the requirements are:

- The ability to measure energy use at interval relevant to the response time requirements of the system. In most situations this is a period of half an hour to an hour, which is the trading period used in the WESM. In other applications such as frequency control, the required monitoring interval could be much shorter, of the order of seconds.
- The ability to communicate in real time in both directions and often to control the electrical equipment remotely.

However, not all smart grid activity requires interval metering. A supplier could reach an arrangement with a customer whereby a specific load could be interrupted remotely from time to time, but within contractually prescribed limits. Such a deal may not require interval metering to support it.

Relatively large metering points such as those in the WESM and current RCOA are already required to have interval metering and so is smart grid ready although additional communication and monitoring equipment may be required on a case-by-case basis. There is no immediate requirement to amend current WESM and RCOA metering policy on smart grid grounds.

For small customers, strategic decision is whether and when to roll out smart meters depends on a range of factors which the ISC is no doubt reviewing. International practice suggests that smart meter rollout to small customers has often been associated with the contestability of those customers. In any case a cost benefit should be carried out before commitment to such a strategy.

The review has made recommendations on the smart grid consistent with this discussion.

6.5 Ownership and Accountability of Meters

This Review has highlighted difficulties with enforcing good testing and maintenance practices, especially for TP owned metering facilities. The Review team was also requested to prepare a review of international practices on this matter. This paper reviewed approaches to metering ownership and accountability at the wholesale and retail levels in the following countries:

- United Kingdom
- Australia
- California
- New Zealand

There is a wide variety of arrangements of ownership and accountability for metering. However, a common theme is that an entity is defined (which may be a monopoly or competitive Metering Service Provider) which is responsible for keeping the facility compliant. This may be facility owner or someone that they nominate.

New Zealand provides a model of how this entity id dealt with in the event of possible code breaches. The metering equipment provider (MEP) is required to comply with all of its obligations under the code. If a MEP is alleged to have failed in its metering responsibilities and breached the code, the NZ Electricity Authority’s compliance committee assesses each alleged breach for seriousness and overall impact, and then decides how it will be dealt with. The authority has identified the following possible enforcement options in relation to alleged breaches:

- a) no further action;
- b) compliance advice letter;
- c) warning letter;
- d) requirement to undertake remedial action; or
- e) prosecution

The review makes a recommendation for such an accountability and enforcement regime to be implemented.

7 General Recommendations

The Review has considered a range of metering-related issues that would require rule changes, manual updates or both. Generally, they affect the market as a whole rather than an individual entity within it. Some of these arise from the findings of the field and office audits, others from requests to the Review team to examine a topic more closely or to review international practice on a particular topic such as backup metering. A summary of the resulting recommendations follows.

7.1 Proposed Rule Changes Relating to Meter Sites

Following a review of meter site findings and consideration of good practice for both WESM and RCOA, we propose manual changes in the following areas, for both WESM and RCOA. The following is summary of areas covered.

WESM Metering Manual and Philippine Grid Code

- For Voltage Transformers
 - Double-bushing is acceptable as long as the metering complies with the Blondel's Theorem.
- Safety Requirements and Grounding System
 - Establish limits for grounding resistance

RCOA Metering Manual and Philippine Distribution Code

- Meter Testing and Calibration
 - For meters over 1MW, require 100% testing of meters every two (2) years.
- Instrument Transformer Testing
 - Implement a Rule requiring regular testing of instrument transformers after commissioning.
- Voltage Transformer
 - Double-bushing is acceptable as long as the metering complies with the Blondel's Theorem.
- Safety Requirements and Grounding System
 - Establish limits for grounding resistance
- Lightning Arresters and Fuses
 - Adjust the Rules for Lighting Arrestors depending on the class of the equipment
- Metering Installation Registration
 - Adjust the MIRF to include the facility capacity relevant to EPIRA eligibility and to require an MIRF to be submitted for each meter.

7.2 Progressing MTN and Revenue Meter Location Improvements

In view of the lack of a common view between industry participants on the feasibility and desirability of some of the recommendations of the Issues Paper in this area, the Review recommends the following approach.

1. Hold a workshop, managed by DOE, to review the locational issues addressed in the Review. As part of the current brief, Review staff would assist with the program, make a presentation on the recommendations and be prepared to field questions. The program could also support presentations by PEMC BSMD and TOD as well as NGCP System Operator (SO) and metering staff on related issues, to be organised in advance with the assistance of Review staff.
2. The output of the workshop would be a record which summarises the agreed facts and suggests a way forward for implementation of some, all or none of the Review recommendations, or any other recommendations that may emerge.

7.3 Backup Metering in WESM and RCOA

The Review recommends as follows.

1. The WESM Rules and metering manual should be amended to require backup meters for all WESM metering sites, as currently proposed to the Rule Change Committee.
2. The policy for RCOA sites be subjected to a cost benefit study based on more extensive and better performance information than was available to this Review, acknowledging that there will be a cut-off site size to be defined if backup metering is to be mandated and that the policy should apply to all meters of that size, not just those metering RCOA sites. In the meantime, sites requesting a backup meter should be provided with one, with the cost charged directly to them.

7.4 Preparing for the Smart Grid

Recommendations on preparing for the smart grid based on the Review examinations of international practices are:

1. The ISC should note that all wholesale metering as well as 1 MW and over RCOA metering already provide basic smart grid capability, including support for time-of-use pricing and scope for real time monitoring.
2. Any mandated roll-out of smart meters should be supported by cost-benefit studies that clearly identify the potential application of such meters.
3. The ISC should note that the rollout of smart meters to smaller customers is usually associated with the contestability of those customers and also with contestability in the provision of meters and metering services, as noted in the following recommendation. Such an approach is believed to encourage innovation in smart grid operations and metering services.

4. The ISC should consider the organisational structure of metering service provision in the retail sector (including the functions of ownership installation, testing, maintenance and data provision) in the context of the work on the smart grid concept.

7.5 Ownership and Accountability of Meters

The Review recommends that the following options be considered for implementation:

1. The WESM Rules and metering Codes should specify that the designated MSP (currently NGCP) is responsible for testing of all WESM meters, including TP-owned meters.
2. The Rules and Codes should require a “responsible person” to be nominated as responsible for the TP-owned installation and its maintenance, subject to the WESM Rules and manuals as well as any directions by the MSP or compliance authority consistent with those Rules and manuals.
3. The Rules and Codes should specify an enforcement regime, possibly along New Zealand lines, whereby a central compliance authority/committee can deal with specific breaches referred to it with a graduated set of enforcement options, such as:
 - a. no further action
 - b. compliance advice letter
 - c. warning letter
 - d. requirement to undertake remedial action; or
 - e. prosecution
4. The DOE should consider implementing the recommendations of the first Review, to ensure a majority of independent Directors on the PEMC Board. This should facilitate more objective consideration of a range of compliance and market design issues on the WESM and RCOA.

7.6 Requirement for Internal Business Procedures

The Review identified some gaps in internal business procedures available and followed by the larger MSPs such as NGCP and MERALCO. The smaller MSPs that were reviewed, AEC and SFELAPCO, had no documented internal business procedures for RCOA customers. These MSPs requested guidance with their development.

We therefore recommend consideration of a new Rule to require development and implementation of internal business procedures, including arrangements to provide some guidance to those MSPs that have limited resources and experience with the development and use of these documents.

7.7 Clarification of Responsibilities for Retail MSP Submission of Metering Data

An important RCOA finding was that the requirement on RCOA MSPs for the uploading of their metering data and the treatment of their MTRs should be clarified. Section 7.4 of the Retail Metering Manual should be updated to reflect the following.

- Daily data should be uploaded to CRB separately for each meter (not customer), daily on receipt and without editing, if available.
- Where data are not available at the time, the daily upload shall include a brief summary of the reason, in a format agreed with the CRB.

7.8 Classification of Metering Audit Findings

Section 5.3.2 of the PEM Audit Manual contains general guidelines on how the findings of audits should be classified. Experience over the first two metering audits suggests that guidelines more specific to metering audits would help affected MSPs and other parties to be very clear, well in advance, about how their systems, procedures and facilities will be assessed during an audit.

The Review recommends that the PEM Audit Committee consider adding metering-specific assessment guidelines to Section 11 of the Audit Manual. These would be based on those in Section 5.3.2 of the Manual but include references to matters specific to metering such as:

- what constitutes a loss of data integrity;
- the treatment of findings on facilities not owned by the MSP;
- how safety matters are to be treated;
- the treatment of findings rectified immediately after an audit visit; and
- the boundary between a localised and systemic findings.

Appendix A - Major Non-conformance on NGCP Process and Procedures

NGCP-PCP-MA-01: Maintenance Records of Equipment

APPENDIX A - MAJOR NON-CONFORMANCE ON NGCP PROCESS AND PROCEDURES

<p>NGCP-PCP-MA-01: Maintenance Records of Equipment</p> <p>Applicable Rule</p> <p>Philippine Grid Code Section 9.4.4.1 states that <i>The metering equipment at the Connection Point shall be maintained by the Meter Operator. All test results, maintenance programs, and sealing records shall be kept for the life of the Equipment. The Equipment data and test records shall be made available to authorized parties.</i></p> <p>In addition, an NGCP procedure titled Corrective Maintenance of Revenue Metering Equipment, PM-OM-OMM-07 rev 1 requires Maintenance Planning and Control Section (MPCS) to prepare a Metering Point Work Order (MPWO) to be provided to the MTD.</p> <p>Observations</p> <ul style="list-style-type: none">• The Metering Point Work Orders (MPWOs) are not available on file• The required equipment history card that aims to record all events relating to meter installation is no longer implemented• The checklist for safety precautions is not consistently filled-out. <p>Risk Implication</p> <p>Maintenance records including history cards are essential for analysing equipment performance and determining the appropriate maintenance frequency. They also serve as proof of activity completion. This was also a finding from the First Metering Arrangements Review and is therefore classified as a major non-conformance.</p> <p>Current Practice</p> <p>The implementation of this procedure is not consistently implemented across all MTDs.</p> <p>Recommended Practice</p> <p>Recommend conducting re-orientation among MTDs to ensure common understanding and effective implementation of internal procedures.</p>	<p>Management Response</p> <p>Accepted. NGCP will make appropriate corrections in the execution of procedures among MTDs.</p> <p>However, NGCP argues this should not be classified as a Major non-conformance as it files all test and calibration reports and sealing records of meters and metering instrument transformers, despite not maintain the equipment history card.</p> <p>Timeframe</p> <p>Ongoing</p>
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Appendix B - Major Non-conformances on NGCP Metering Sites

NGCP-MTD-MA-01: Instrument Transformer Testing

NGCP-MTD-MA-02: Meter Testing and Calibration

NGCP-MTD-MA-03: Voltage Transformer Requirement

NGCP-MTD-MA-04: Current Transformer Requirement

NGCP-MTD-MA-05: Safety Requirements and Grounding System

NGCP-MTD-MA-06: Physical Security of Metering Equipment

NGCP-MTD-MA-07: Meter Enclosure

NGCP-MTD-MA-08: Instrument Transformer Secondary Cabling

NGCP-MTD-MA-09: Requirements for Grid Revenue Meters – Internal Clock

NGCP-MTD-MA-10: Location/Arrangement of Instrument Transformers

NGCP-MTD-MA-11: Maintenance Issues

APPENDIX B - MAJOR NON-CONFORMANCES ON NGCP METERING SITES

<p>NGCP-MTD-MA-01: Instrument Transformer Testing</p> <p>Applicable Rule</p> <p>Philippine Grid Code (2007), Section 8.4.1.1 –<i>Test on the Instrument Transformers shall be done by the Metering Service Provider or a party authorized by the Metering Service Provider, and the concerned User during the Test and Commissioning stage and then at least once every five (5) years or as the need arises due to questions on accuracy. The tests shall be carried out in accordance with this Chapter or an agreed equivalent international standard.</i></p> <p>Observation</p> <p>Thirty (30) out of 154 or 19.5% of the WESM metering sites inspected under this Review have active instrument transformers which have not yet been tested to be compliant with the PGC requirement as per the required schedule, as verified in the PMT data record. The majority or 70% (21 out of 30) of these sites are owned by TPs.</p> <p>Risk/Implication</p> <p>The need for high accuracy meters and instrument transformers is important in revenue metering. A small error in accuracy will magnify to large metering data quantities because of the large meter multipliers as a result of using instrument transformers. Hence, the PGC requires regular testing of the revenue meters and instrument transformers to ensure their accuracy within the set limit. Regular testing of instrument transformers also includes insulation resistance to detect abnormality or impending failure.</p> <p>Recommendation</p> <p>The MSP should be responsible for ensuring that instrument transformers are tested according to the required schedule, regardless of the ownership of the equipment. The compliance to maintenance should be in the Connection Agreement between the MSP and TP and other enforcement mechanisms put in place as recommended in this report</p>	<p>Management Response</p> <p>For Metering VTs and CTs that are owned by the Customer, PGC 8.4.4.1 prescribes that the maintenance of the devices is the responsibility of the Metering Equipment Owner. This makes scheduling difficult and explains why tests could not be performed 100%.</p> <p>Timeline</p> <p>Four (4) metering sites were corrected as of May 26, 2015. The remainder of NGCP sites are ongoing.</p>
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APPENDIX B - MAJOR NON-CONFORMANCES ON NGCP METERING SITES

<p>NGCP-MTD-MA-02: Meter Testing and Calibration</p> <p>Applicable Rule</p> <p>Philippine Grid Code, Section 8.4.2. <i>The Metering Service Provider and User, through the ERC or an independent party authorized by the ERC, shall test and seal the meters at least once a year and recalibrate or replace such meters if found to be outside the acceptable accuracy stipulated in the Grid Code.</i></p> <p>Observations</p> <p>Six (6) metering sites were found with meters overdue for testing.</p> <p>Twenty four (24) meters have no ERC seals or have broken ERC seals.</p> <p>Risk/Implication</p> <p>The need for high accuracy meters and instrument transformers is important in revenue metering. A small error in accuracy will magnify to large metering data quantities because of the large meter multipliers as a result of using instrument transformers. Hence, the PGC requires regular testing of the revenue meters and instrument transformers on regular basis to ensure their accuracy is within the set limit.</p> <p>Recommendation</p> <p>The MSP should ensure the annual testing of revenue meters on the required schedule.</p> <p>Revenue meters that need ERC calibration can usually be pulled out without the need for temporary replacement. The backup meter or vice versa could be used as the billing meter. This is one of the advantages of installing back-up meters as proposed in this report.</p> <p>Pulling out of meters should be properly documented and approved.</p>	<p>Management Comment</p> <p>The findings are accepted, and the appropriate corrective measures are being implemented to ensure that the meters are ERC-tested., and tested by NGCP as well in accordance with the WESM MSP Certificate of Authority, initially at commissioning to service and periodically in accordance with the PGC.</p> <p>Timeline</p> <p>Maintenance testing and ERC calibration testing of meters are already scheduled in the Annual Preventive Maintenance (APM) program this year. Eleven (11) sites were already corrected as of May 26, 2015.</p>
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APPENDIX B - MAJOR NON-CONFORMANCES ON NGCP METERING SITES

<p>NGCP-MTD-MA-03: Voltage Transformer Requirement</p> <p>Applicable Rule</p> <p>WESM-MSDM-MM-09, Section 2.5.8 –“Voltage Transformer installed as the main metering, shall meet the minimum requirements, listed below:”</p> <ul style="list-style-type: none"> • Construction shall be single phase, inductive type , single bushing • Accuracy Class shall be IEC 6044-2 Class 0.2/ANSI C57.13 Class 0.3 or better <p>Observation</p> <p>Seventeen (17) out of 154 or 11% of the metering sites still use Capacitive-type Voltage Transformers. Most of these sites (15 out of 17 sites, or 88%) are owned by Trading Participants.</p> <p>Risk/Implication</p> <p>Use of Capacitive-type Voltage Transformer is not recommended because accuracy is affected by temperature. Also, its capacitors will deteriorate over time leading to loss of accuracy.</p> <p>Recommendation</p> <p>Although most of the Capacitive-type VTs are owned by TPs, the MSP is still responsible and should have the power to require and install equipment in accordance with the requirements of the WESM Rules and Manuals. See the general recommendation in Section 7.</p>	<p>Management Comment</p> <p>NGCP agrees that the CVT is inferior to the inductive-type VTs in terms of stability and should be replaced for better metering performance and compliance with the WMM. Legal and commercial issues have hindered replacement to compliant inductive-type VTs. For this reason NGCP argues that this finding should be classified as a Minor Non-conformance.</p> <p>Timeline</p> <p>NGCP already replaced all NGCP-owned CVTs and advised affected TPs of the need to replace the Capacitive-type VTs with Inductive-type VTs. For MSP owned Capacitor-type VTs, the replacement budget is already filed by NGCP in the 4th Regulatory Period, for ERC’s approval.</p>
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APPENDIX B - MAJOR NON-CONFORMANCES ON NGCP METERING SITES

<p>NGCP-MTD-MA-04: Current Transformer Requirement</p> <p>Applicable Rule</p> <p>WESM-MSDM-MM-09, Section 2.5.7 – <i>Current Transformer installed as the main metering shall meet the minimum requirements, listed below:</i></p> <ul style="list-style-type: none">• <i>Construction shall be single phase, wound type, free standing</i>• <i>Accuracy Class shall be IEC 44.1 Class 0.2/ANSI C57.13 Class 0.3 or better</i> <p>Observation</p> <p>Three (3) out of 154 or 1.9% of metering sites were using bushing CTs of the power circuit breaker. Per BCT nameplate, the CT accuracy is 0.6% which exceeded the required limit of 0.3%.</p> <p>Risk/Implication</p> <p>Inaccurate CT translates to erroneous energy registration.</p> <p>There is also a security issue using the BCT of the power circuit breaker. The CT secondary cabling is accessible to other users of the power circuit breaker aside from the MSP.</p> <p>Recommendation</p> <p>The MSP should refrain from using Bushing-type CTs and instead install a standalone and dedicated CTs as required by the PGC and WESM Rules. As per industry practice, bushing-type CTs are used mainly for statistical metering and protection purposes.</p>	<p>Management Comment</p> <p>These are isolated cases. For this reason NGCP argues that the finding should be considered as a Minor Non-conformance.</p> <p>Timeline</p> <p>The 3 metering sites found with such condition are temporary LV metering facilities with small loads which are destined to be retired once the Power Transformer is divested to the DU customer.</p>
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APPENDIX B - MAJOR NON-CONFORMANCES ON NGCP METERING SITES

<p>NGCP-MTD-MA-05: Safety Requirements and Grounding System</p> <p>Applicable Rule</p> <p>WESM-MSDM-MM-09, Section 2.5.6 – <i>The installation shall conform to the requirements of the Philippine Electrical Code; and the IEC or ANSI/IEEE C57.13-1983 IEEE guide for Grounding of Instrument Transformer Secondary Circuits and Cases.</i></p> <p>Observation</p> <p>The auditors experienced high touch potentials on equipment metal structures and enclosures during the site physical inspection at Sual Coal-fired Thermal Power Plant.</p> <p>Risk /Implication</p> <p>Electrical shocks could be fatal and equipment could be damaged during close-in line-to-ground faults or lightning surges.</p> <p>Recommendation</p> <p>Regular checking and maintenance of the grounding system should be performed. There are two important conditions to check on grounding system maintenance:</p> <ol style="list-style-type: none"> 1. Check that each equipment or structure is solidly connected to the grounding grid or system to ensure that all equipment and personnel are of equal potential during line-to-ground faults or surges. The test should be point-to-point to check the continuity of ground conductors. The Technical Committee study and establish a limit for connectivity resistance. This limit should be small; in the range of milliohms. 2. Check the grounding system resistance to ensure that the fault currents or surges are dissipated to earth, with Ground Potential Rise (GPR) limited so as not to cause damage to the installed equipment. The test could be done using Fall-of-Potential (FOP) measurement. The Technical Committee study and establish a limit for grounding system resistance. A limit of 5 ohms could be used in accordance with IEEE Std 142-2007 Grounding of Industrial and Commercial Power Systems, Section 4.1.3 – Recommended acceptable values. 	<p>Management Comment</p> <p>NGCP argues that this is an isolated case and should be considered as a Minor Non-conformance. Further, the deficiency affects not only the metering facility but the whole switchyard, so should not be seen as a metering non-conformance at all.</p> <p>Timeline</p> <p>The MSP already informed the TP on Oct. 20, 2014 about the grounding problem. Team Sual Corporation will conduct checking/validation of the finding.</p>
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APPENDIX B - MAJOR NON-CONFORMANCES ON NGCP METERING SITES

<p>NGCP-MTD-MA-06: Physical Security of Metering Equipment</p> <p>Applicable Rule</p> <p>WESM-MSDM-MM-09, Section 2.9.1 – <i>Metering Installation shall be secure and tamper proof and conforms to the following applicable security requirements:</i></p> <p>Section 2.9.1.3 <i>Secondary terminal boxes of the current transformers and voltage transformers shall be sealed and placed as far as practicable to ensure the detection of unauthorized access to the instrument transformer connections.</i></p> <p>Observation</p> <p>Forty-five (45) out of 154 metering sites inspected have unsealed secondary terminal boxes for instrument transformers of which, 35 were found at MTD South Luzon North (SLN). Twenty five (25) out of the 45 site findings were identical to the findings for the same sites during the First Metering Arrangements Review.</p> <p>There is a strong predominance of this finding in MTD South Luzon North (SLN), indicating a systemic problem requiring correction in that MTD. For this reason, and because a lack of security presents an immediate potential hazard to data integrity, this finding is classified as major non-conformance for the SLN MTD, but minor in the odd cases that appear in other MTDs.</p> <p>Risk/Implication</p> <p>Without the necessary security seals, tampering the meter and its data are possible, placing meter data integrity at risk.</p> <p>Recommendation</p> <p>The auditors acknowledge that some instrument transformers, usually the older ones, have no provision for the installation of security seals. However, some MTDs have resolved this problem by using security stickers or a wire conductor with a security seal. This improvised solution should be adapted across all MTDs.</p>	<p>Management Comment</p> <p>The finding is accepted.</p> <p>While NGCP agrees that that the failure to seal the secondary terminal boxes of the metering VTs and CTs using wire or sticker seals needs to be fixed, it argues that the risk to meter data integrity has not been an issue in practice because of the high voltage hazard. Meter data integrity has not been compromised. For this reason NGCP sought a Minor Non-conformance classification rather than a Major.</p> <p>Timeline</p> <p>Correction will be done during the scheduled Annual Preventive Maintenance this year.</p> <p>Three (3) sites were already corrected and one site retired as of May 26, 2015.</p>
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APPENDIX B - MAJOR NON-CONFORMANCES ON NGCP METERING SITES

<p>NGCP-MTD-MA-07: Meter Enclosure Revenue Meters Inside Control Room</p> <p>Applicable Rule</p> <p>WESM-MSDM-MM-09, Section 2.9.1 – <i>Metering Installation shall be secure and tamper proof and conform to the following applicable security requirements:</i></p> <p>Section 2.9.1.4 Meter Enclosure – <i>All meters, test links, and communication equipment shall be contained within a meter enclosure similar to Figure 5. The meter enclosure shall comply with the following requirements:</i></p> <ul style="list-style-type: none"> <i>i. The meter enclosure shall be secured by the meter service provider.</i> <i>ii. The meter service provider shall have access to the meter enclosure at all times.</i> <i>iii. Persons other than the meter service provider shall not be given access to the meter enclosure.</i> <i>iv. The meter enclosure shall be padlocked and sealed as far as practicable in the manner approved by the MO.</i> <i>v. The meter enclosure shall be weatherproof.</i> <p>Observation</p> <p>8.4% or 13 out of 154 of metering sites have revenue meters located inside control rooms that are owned and controlled by the TP. The TP has full access to the revenue meters including the meter wirings</p> <p>All 13 sites had identical findings in the First Metering Arrangements Review. Only one site (Kalayaan) was corrected as of March 2015 and the Review understands others were scheduled for correction in the first quarter of 2015. However, the MSP must also deal with ERC and the TP on this correction.</p> <ul style="list-style-type: none"> 1. Replacement of CVTs commissioned before the implementation of the WESM must be budgeted for by the TP approved by ERC. 2. The control room is owned the TP and relocation will consider civil works, house wiring, a shutdown and the availability of NGCP logistics. Replacing the CVTs can be the prime purpose of the shutdown or replacement could be done during a shutdown for plant and switchyard maintenance of the plant. 	<p>Management Comment om Meters Insider Control Room</p> <p>These installations do not pose a major security risk due to the fact that the metered quantities are always monitored by the Market Operator against the metered Generator capacities and RTU readings, and any deviation of the MQ from these values is immediately reported by the Market Operator to the MSP for verification.</p> <p>Timeline</p> <p>As part of ongoing corrections, , NGCP has already relocated the meters to secured meter enclosures on:</p> <p>5 out of 7 metering points at Kalayaan Power Plant; and</p> <p>2 out of 2 metering pints at Mal-Ban Geothermal Power Plant.</p> <p>The relocation of meters for the other power plants with this</p>
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APPENDIX B - MAJOR NON-CONFORMANCES ON NGCP METERING SITES

A scheduled shutdown can be cancelled if the overall power outlook does not permit it.

As this finding represents a breach of the Rules, creates a security risk and has persisted, it is classified as a major non-conformance.

If the meter concerned is used as a backup meter, there are as yet no specific WESM rules about their management. Backup meters should be subject to the same performance and security requirements as main revenue meters. While NGCP has undertaken a program of installing back-up metering, a requirement for WESM back-up metering is an ongoing proposal under consideration by the RCC.

Risk Implication

Tampering with the revenue meters and wirings could be done by TPs, especially where they have the full control and access of the meter enclosure. Security risk findings are classified as major non-conformances.

Recommendation on Revenue Meters inside Control Room

The revenue meters should be relocated and installed in a meter enclosure that conforms to the WESM Rule requirements i.e. at the connection point to the network, which must be outside of the TP's private facilities in accordance with 2.9.1.4 ii above. Corrective action on this should be followed up by the next Metering Review.

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No Padlock/Defective Doors

Observation

7.1% of the meter enclosures inspected (11 out of 154) were found without a padlock or were defective (e.g. doors cannot be closed). The risk is as noted above.

Recommendation on Padlocks and Doors

The MSP should secure the meter enclosure so that the MSP has the only access to it.

condition is being worked out but is constrained by contractual issues where the Plant Owner/Operator is not the Trading Participant.

On the 1 metering point for CAPELCO inside the NGCP Panit-an S/S, there is not risk for the metering circuit be tampered. As a compliance plan, the relocation to a secured meter enclosure will be undertaken along with the upgrading of the metering facility where all the Metering VTs and CTs will be replaced in 2016.

Timeline for Padlocks and Doors

Padlocks will be installed within 3 months (by end May 2016).

The 4 meter enclosures with defective doors are isolated cases and will be replaced during the forthcoming shutdowns of the metering facilities.

APPENDIX B - MAJOR NON-CONFORMANCES ON NGCP METERING SITES

<p>NGCP-MTD-MA-08: Instrument Transformer Secondary Cabling</p> <p>Applicable Rule</p> <p>WESM-MSDM-MM-09, Section 2.7.3 –“Instrument transformer secondary cabling and cabling accessories shall comply with the following codes and conditions:</p> <ul style="list-style-type: none"> 2.7.3.1 The Philippine Electrical Code; 2.7.3.2 The main meter shall be supplied from dedicated current transformers used for no other purpose; 2.7.3.3 Voltage transformers with one secondary wiring shall be dedicated to the main metering and used for no other purpose; 2.7.3.4 Voltage transformers with more than one secondary winding shall have one winding dedicated to the main metering and used for no other purpose; 2.7.3.5 Electrical connection to the instrument transformer secondary terminals shall not be possible outside the meter box; 2.7.3.6 Cabling from the instrument transformers to the meter enclosure shall be routed in dedicated conduit, and the route shall be visually traceable; and 2.7.3.7 Each secondary terminal of each instrument transformer shall be brought to the test block on a separate conductor.” <p>Observation</p> <p>Twenty one (21) metering sites violated WESM Section 2.7.3 on instrument transformer secondary cabling. Eleven (11) of these sites are owned by TPs. Violations relate to non-dedicated instrument transformers and exposed wiring.</p> <p>Risk Implication</p> <p>There is a security issue because instrument transformers are not dedicated to the revenue meter and tampering is possible.</p>	<p>Management Comment</p> <p>Correction of the Trading Participant/Plant Owner/Operator cases requires action by them. For this reason NGCP argues that this should not be a finding directed towards NGCP.</p> <p>Timeline</p> <p>On undedicated Instrument Transformers – there is an ongoing communication between the MSP and TP for the relocation and installation of permanent metering. Also, the procurement of revenue metering equipment is included in the 4th Regulatory Capital Expenditures Budget of the MSP.</p> <p>Exposed wirings are scheduled for correction in 2015. Two metering sites were corrected as of May 26, 2015.</p>
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APPENDIX B - MAJOR NON-CONFORMANCES ON NGCP METERING SITES

<p>Recommendation</p> <p>Provide dedicated instrument transformers for the revenue meters.</p> <p>Exposed wiring should be corrected by placing all wiring inside a conduit.</p> <p>Fourteen (14) out of the 21 findings are identical for the same issue at the same sites during the First Metering Arrangements Review. For this reason this finding is classified as a major non-conformance.</p> <p>The Review recognises that correction of this and some other findings requires co-operation from the Trading Participant and Plant Owner/Operator, which is not always easy to obtain. For this reason the Review has made a general recommendation to strengthen the enforcement provisions in such cases (Recommendation DOE MOA-01: Meter Ownership and Accountability).</p>	
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APPENDIX B - MAJOR NON-CONFORMANCES ON NGCP METERING SITES

<p>NGCP-MTD-MA-09: Requirements for Grid Revenue Meters – Internal Clock</p> <p>Applicable Rule</p> <p>WESM-MSDM-MM-09, Section 2.4.1 – <i>Meters installed as the main revenue meter shall meet the minimum requirements listed below:</i></p> <ul style="list-style-type: none"> • <i>Internal Clock – The meter shall have an internal clock with an allowable error of +/-1 second per demand interval.</i> <p>Observation</p> <p>Three (3) findings have back-up meter time exceeding the 5-minute time discrepancy against the system time. All these findings are in MTD South Luzon North (SLN). There is a time drift in the backup meters as it is not synchronized with MV90, and NGCP does not currently provide connection to GSM modem for backup meters.</p> <p>Risk/Implication</p> <p>A time discrepancy between meter and meter database will produce errors in the recorded electricity quantities relative to actual quantity. We note that NGCP has installed backup meters to substitute data whenever there are problems with the main meter. We note also that the installation of backup meters is not currently required under the WESM Rules. However, when backup meter data are used and time is not properly synchronised, the substituted data will in turn produce settlement errors. For this reason the finding is classified as a Major Non-conformance as data integrity is at risk.</p> <p>Recommendation</p> <p>Meter time synchronization should be performed regularly, for both main and backup meters. As backup meter can be used at any time, main and backup meters should be maintained in the same way and to the same standards, even though the time synch must be checked and corrected manually because of the lack of a GSM modem connection.</p>	<p>Management Comment</p> <p>NGCP argues that this should not be classified as a Major Non-conformance because</p> <ul style="list-style-type: none"> • The requirement for time synchronisation of backup meters is not required by the Market Rules, only the Main Meter. • The deviation occurs over a long period of time because the meter is not regularly polled by the System. • If the backup metering data are used, corrective adjustments are made before commercial settlement. <p>Timeline</p> <p>Correction of time of meters that are not synchronized is ongoing. One metering site was corrected as of May 26, 2015.</p>
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APPENDIX B - MAJOR NON-CONFORMANCES ON NGCP METERING SITES

<p>NGCP-MTD-MA-10: Location/Arrangement of Instrument Transformers</p> <p>Applicable Rule</p> <p>WESM-MSDM-MM-09, Section 2.6.5 –<i>“With respect to the physical arrangement of the instrument transformers, the current transformer shall be located at the load side based on the normal flow of current.”</i></p> <p>Observation</p> <p>Eight (8) metering sites have the CT located at the source side. Seven (7) or 88% of these CT installations are owned by Trading Participants. Six (6) instances are in MTD-SLN.</p> <p>Risk Implication</p> <p>If the CT is located at the source side, it will measure the VT losses and loads (both core loss and copper loss) during normal flow of current. These losses will then be recorded as part of the customer’s load and will therefore be charged to the customer, contrary to the intent of Section 2.6.5.</p> <p>MTD–SLN commented that the impact of this situation on the metering accuracy is very small/negligible and they requested re-classification to OFI. The Review team performed an engineering estimate of the quantum of VT losses that would be charged to the customer.</p> <p>Recommendation</p> <p>The sites that are incorrectly wired with the CT on the source side should be corrected.</p> <p>The auditors acknowledges that majority of the sites with these findings may not be easily corrected because civil foundations should be constructed and long interruptions would be needed. However, with proper planning and budget justification, the corrections could be made.</p>	<p>Management Comment</p> <p>NGCP also argues that the finding should not be directed to NGCP because the corrective action is by the Trading Participant. As noted in other findings where similar arguments have been made, the Review has made a general recommendation to address this issue.</p> <p>Timeline</p> <p>The MSP has already coordinated with the TP to correct the required VT-CT-LA physical arrangement. Correction of other sites will coincide with the replacement of the Capacitive-type with Inductive-type VTs.</p>
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APPENDIX B - MAJOR NON-CONFORMANCES ON NGCP METERING SITES

<p>NGCP-MTD-MA-11: Maintenance Issues</p> <p>Applicable Rule</p> <p>Philippines Grid Code, Section 8.4.4. - Maintenance of Metering Equipment.</p> <p><i>8.4.4.1. The Metering Equipment at the Connection Point shall be maintained by the Metering Equipment Owner. All test results, maintenance programs, and sealing records shall be kept for the life of the Equipment. The Equipment data and test records shall be made available to authorized parties.</i></p> <p><i>8.4.4.2. The Metering Equipment Owner shall repair the metering System as soon as practical and in any event within two days if a metering System malfunctions or maintenance occurs. The Metering Service Provider shall be allowed to charge the metering services provided, subject to the approval of the ERC.</i></p> <p>Observation</p> <p>7.1% (11 out of 154) of metering sites had facility component corrosion or contaminants.</p> <p>Risk/Implication</p> <p>Accumulation of contaminants, especially on high voltage bushings of equipment could lead to flashover and could cause forced interruption and equipment damage.</p> <p>Corrosion if not corrected can cause to damage to the meter and other equipment inside the enclosure.</p> <p>Recommendation</p> <p>Preventive maintenance should be performed regularly to avoid the accumulation of corrosion. The specific cases identified should be corrected as soon as possible.</p>	<p>Management Comment</p> <p>Corrosion of the meter enclosure has no direct effect on meter data integrity and accuracy, while the discoloration of the of the high voltage insulators of instrument transformers at the cement plant was not insulation failure as borne out by electrical tests. Replacement of corroded components requires costly shutdown of the Generator or Customer’s Load. The maintenance strategy is to perform corrective maintenance during the next scheduled outage of the facility. Based on the criteria for classifying findings in the Inception Report, the finding does not qualify as a Major Non-conformance.</p> <p>Timeline</p> <p>Correction is included in the MSP’s 2015 Annual Preventive Maintenance.</p> <p>Three rusty cabinets were replaced as of May 26, 2015.</p>
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Appendix C - Major Non-conformances on MERALCO Metering Sites

MERALCO-MTD-MA-01: Instrument Transformer Testing

MERALCO-MTD-MA-02: Physical Security on Secondary Terminal Box

MERALCO-MTD-MA-03: Physical Security on Meter Enclosure

MERALCO-MTD-MA-04: Quality of Materials and Workmanship

APPENDIX C - MAJOR NON-CONFORMANCES ON MERALCO METERING SITES

<p>MERALCO-MTD-MA-01: Instrument Transformer Testing</p> <p>Applicable Rule</p> <p>Philippine Distribution Code (Dec 2001) Chapter 8.5.1 – Instrument Transformer Testing states that <i>Test on the Instrument Transformers shall be done by the authorized representatives of the Distributor in the presence of the User’s representatives during the Test and Commissioning stage and as the need arises due to questions on accuracy.</i></p> <p>Observation</p> <p>MERALCO was not able to show any Commissioning Tests on the Instrument Transformers on all the metering sites audited. Only supplier’s test certificates were provided. Most of the instrument transformers were installed after the Philippine Distribution Code effectivity in December 2001.</p> <p>Risk /Implication</p> <p>Supplier’s test certificates are provided but this equipment was subjected to transport, handling, storage and other events that could affect their accuracy and quality. Most importantly, the commissioning tests are assurances to both MSP and User that the metering facility is within the accuracy limit, noting that the MSP is no longer conducting accuracy testing of instrument transformers after the commissioning.</p> <p>Recommendation</p> <p>The MSP should conduct commissioning tests of instrument transformers prior to putting the metering facility in service. The User’s representatives should be present as witness and be required to sign off the Commissioning Test Report. The test report should be made available during the life of the equipment.</p>	<p>Management Comment</p> <p>We would like to note that out of the total RCOA meters that are subject of this Review, only eighteen (18) services were installed after the effectivity of the PDC in December 2001.</p> <p>However, we do recognize that at the time of on-site audit, our MSAM Office was not able to show commissioning test records, and only supplier's test certificates were provided. This is for the reason that, as part of the normal procedure of the storage of the physical copies of metering reports, including the reports on the conduct of the Phase Angle test, reports that are more than one year old are purged from physical storage. This is done to make efficient use of storage space as there are voluminous physical records on metering alone. Nevertheless, the fact of the conduct of the tests and the results thereof are digitally kept in the MERALCO’s Customer Management System. To further support this fact, MERALCO’s Officer of the Meter Testing team has executed an Affidavit to attest to the fact that MERALCO has conducted the required tests on its metering facilities pursuant to Section 8.5.1 of the PDC.</p> <p>Thus, we are of the position that the finding of not being able to present commissioning test records has no legal basis to warrant its inclusion in the list of non-conformances. At the very least, this may be considered only as one of the Opportunities for Improvement.</p>
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APPENDIX C - MAJOR NON-CONFORMANCES ON MERALCO METERING SITES

<p>MERALCO-MTD-MA-02: Physical Security on Secondary Terminal Box</p> <p>Applicable Rule</p> <p>Retail Manual Annex D Chapter 2.6.1.3 – <i>“Secondary terminal boxes of the current transformers and voltage transformers shall be sealed to ensure the detection of unauthorized access to the instrument transformer connections.”</i></p> <p>Observation</p> <p>Five (5) out of 44 (11.4%) metering sites have instrument transformers secondary terminal boxes without security seals.</p> <p>Risk /Implication</p> <p>Tampering of the instrument transformers connections could be possible because the necessary security seals are lacking. Such security risks qualify as major non-conformances.</p> <p>Recommendation</p> <p>The MSP should install security seals for the instrument transformers secondary terminal boxes. Serial numbers of the seals should be properly recorded for security control and documentation.</p> <p>Management Comment</p> <p>MERALCO has advised that two (2) of the five (5) sites with this finding have already been installed with terminal seals. These sites are Chowking Food in Sucat and Integrated Energy Solutions Inc. in Makati City.</p> <p>The remaining three (3) sites have no provision or slot for seal installation. The re-sealing of these secondary terminal boxes would be scheduled during the customer’s preventive maintenance in co-ordination with them. This is done to avoid inconvenient service interruption. Those without terminal seals are reported by the visiting crew during routine/regular inspection of meters.</p>	<p>Management Comment</p> <p>Three (3) sites have no provision or slot for seal installation. The re-sealing of these secondary terminal boxes would be scheduled during the customer’s preventive maintenance in co-ordination with them. This is done to avoid inconvenient service interruption. Those without terminal seals are reported by the visiting crew during routine/regular inspection of meters.</p> <p>Timeline</p> <p>Two (2) of the five (5) sites with this finding have already been installed with terminal seals. These sites are Chowking Food in Sucat and Integrated Energy Solutions Inc. in Makati City.</p>
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APPENDIX C - MAJOR NON-CONFORMANCES ON MERALCO METERING SITES

<p>MERALCO-MTD-MA-03: Physical Security on Meter Enclosure</p> <p>Applicable Rule</p> <p>Retail Manual Annex D, Section 2.6.1.6.2 – Padlock Requirements</p> <p><i>The requirements for padlocks are:</i></p> <ul style="list-style-type: none"><i>a) Padlock shall be heavy duty;</i><i>b) Padlock shall have only one security key and placed on a secured area;</i><i>c) Security key shall be controlled by Retail Metering Services Provider; and</i><i>d) Use of security key shall be documented and monitored.</i> <p>Observation</p> <p>The metering vault of Philippine Integrated Energy Solutions in Ayala Ave., Makati City was found without a padlock.</p> <p>Risk /Implication</p> <p>A metering vault without a padlock will allow unauthorized entry of personnel and will subsequently expose them to high voltage hazards. Moreover, tampering of the meter wiring could be possible. Security and safety issues qualify as major non-conformances.</p> <p>Recommendation</p> <p>The metering vault should be provided with padlock for safety and security reasons.</p>	<p>Management Comment</p> <p>MERALCO considers the current arrangement to be adequate for security and should not be classified as a non-conformance, on the following grounds.</p> <ul style="list-style-type: none">• The metering vault is equipped with a Ring Main Unit which is secured with a door whose handle can only be operated with a special key. This avoids the need for a public and provides a more compact and space saving metering vault.• If a padlock is required, it may affect the warranty of the equipment.• In any case, MERALCO assures PEMC and the auditors the current arrangement prevents any risk of unauthorized access, safety hazards and tampering. <p>Timeline</p> <p>Resolution to the rest of the findings are already referred to the appropriate offices within MERALCO for resolution, in coordination by said offices with concerned customers (i.e., for appropriate scheduling, at the customers' most convenient time).</p>
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APPENDIX C - MAJOR NON-CONFORMANCES ON MERALCO METERING SITES

<p>MERALCO-MTD-MA-04: Quality of Materials and Workmanship</p> <p>Applicable Rule</p> <p>Retail Manual Annex D, Section 2.5.7.4.1. – <i>The primary cable terminations connected to the high voltage terminals of an instrument transformer shall be in good quality and acceptable workmanship.</i></p> <p>Observation</p> <p>The primary cable connection of the VT appears to be severely damaged possible due to touching of tree leaves. Please refer to the picture following.</p> <p>Risk /Implication</p> <p>The primary cable may break anytime once subjected to another fault. Absence of one VT would give an erroneous meter reading. The risk to data integrity and potentially safety is significant, which qualifies this as a major non-conformance.</p> <p>Recommendation</p> <p>MERALCO should replace the damaged primary cable immediately. Regular inspection should be done to prevent recurrence of this incident. An inspection checklist should be developed to include all essential points to consider.</p>	<p>Management Comment</p> <p>To validate the findings of the auditor, the tree leaves at the site have since been trimmed and the primary cable connection of the VT replaced. Further, there appeared to be not real damage, as evidences by no evidence of zero consumption data or tripping of the transformer where the cable is connected.</p> <p>Timeline</p> <p>Completed.</p>
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Appendix D - Major Non-conformance on AEC Metering Site

AEC-MTD-MA-01: Metering Equipment Maintenance

APPENDIX D - MAJOR NON-CONFORMANCE ON AEC METERING SITE

<p>AEC-MTD-MA-01: Metering Equipment Maintenance</p> <p>Applicable Rule</p> <p>Philippine Distribution Code (Dec 2001) Chapter 8.5.3: <i>The Distributor shall maintain all metering Equipment. Distributor shall keep all test results, maintenance programs, and sealing records. The Equipment data and test records shall be furnished by the Distributor to the User upon request.</i></p> <p>Observation</p> <p>The maintenance program for the metering equipment has not yet been established. The instrument transformers have no test records.</p> <p>Risk /Implication</p> <p>Non-maintenance of the metering facility might lead to frequent forced electric service interruptions and might lead also to early failure of equipment.</p> <p>Recommendation</p> <p>Develop and implement a maintenance program for instrument transformers including maintenance of records.</p>	<p>Management Comment:</p> <p>Accepted.</p> <p>Timeline</p> <p>Ongoing</p>
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Appendix E - Major Non-conformance on SFELAPCO Metering Site

SFELAPCO-MTD-MA-01: Metering Equipment Maintenance

APPENDIX E - MAJOR NON-CONFORMANCE ON SFELAPCO METERING SITE

<p>SFELAPCO-MTD-MA-01: Metering Equipment Maintenance</p> <p>Applicable Rule</p> <p>Philippine Distribution Code (Dec 2001) Section 8.5.3 <i>The Distributor shall maintain all metering Equipment. Distributor shall keep all test results, maintenance programs, and sealing records. The Equipment data and test records shall be furnished by the Distributor to the User upon request.</i></p> <p>Observation</p> <p>The maintenance program for the metering equipment has not yet been established. The instrument transformers have no test records.</p> <p>Risk /Implication</p> <p>Non-maintenance of the metering facility might lead to frequent forced electric service interruptions and to early failure of equipment.</p> <p>Recommendation</p> <p>Develop and implement a maintenance program for instrument transformers including maintenance of records.</p>	<p>Management Comment</p> <p>Accepted</p> <p>Timeline</p> <p>Ongoing.</p>
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