Wholesale Electricity Spot Market

PUBLIC

WESM Manual

Metering Standards and Procedures Issue 11.0

Abstract	This document covers the development, validation, approval, publication and revision of the WESM Metering Manual.

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Document Change History

Issue No.	Proponent	Date of Effectivity	Reason for Amendment
1	TWGMC	28 Jan 2005	New Document, Incorporate the comments of Mother Committee TWG
2		29 Aug 2005	**(1)** Changes in SEIN **(2)** Inclusion of Metering Point Location **(3)** Additional Procedures in the Meter Data Collection/Retrieval System **(4)** Additional Procedures in the Validation, Estimation, and Editing **(5)** Inclusion of the Metering Service Agreement Pro-forma **(6)** Inclusion of Meter Security in the Metering Installation Standard
3			Changes in Section 7.3.5 Meter Value Estimation.
4			**(1)** Changes in Metering Services Provider Registration under Section 4.1 Introduction and Section 4.2 Pre-requisite for Registration. **(2)** Changes in Section 6.2 Meter Data Collection. **(3)** Inclusion of a new Section 6.9 – Emergency Procedure. **(4)** Upgrade Section 7.5 – Work Flow for Metering Data Validation, Estimation and Editing. **(5)** Changes made in Section 7.6 Procedural Steps for Validation, Estimation and Editing Process. **(6)** Inclusion of a new Section 9 – Site Specific Loss Adjustment (SSLA).
5		08 Feb 2007	Changes “Philippine Electricity Market Corportion” or “PEMC” to “Market Operator” or “MO”.
6	RCC Metering Subcommittee	12 Aug 2008 08 Feb 2010	**(1)** Addition of new Section 7.4.3.4 on the Use of Meter Register Reading Reading in VEE **(2)** Inclusion of new Section on the Metering Service Provider (MSP) Perfomance Measurement
7	RCC Metering Subcommittee	12 Aug 2008	Revision of Section 9 on the allocation of transformer losses in SSLA calculation
8	RCC/PEMC	12 Nov 2012	Correction of Section 9.8.3 by modifying the formulae that determines SSLA in the WESM, with the value/term 1000 to be incorporated in the

Issue No.	Proponent	Date of Effectivity	Reason for Amendment
			formulae for consistency with the units of real and reactive losses in the equations.
9	RCC/PEMC	20 Jun 2013	Revisions to Section 9.7 of the Metering Standards and Procedures to clarify the respective roles of the Network Service Provider, Metering Service Provider, the Market Operator as well as Trading Participants in carrying out site-specific loss adjustments.
10	RCC/PEMC	30 May 2014	Revision to Section 1.3.4 to replace 'Dispute Resolution Administrator' with 'Enforcement and Compliance Officer' as the one to undertake investigations of infractions and/or tampering of meter data and metering facilities.
11	PEMC	15 Jun 2017	Implementation of Preferential Dispatch

Document Approval

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Related Document

Document ID	Document Title
	WESM Rules
	Philippine Grid Code
	Philippine Distribution Code

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SECTION 1 WESM METERING MANUAL

1.1 INTRODUCTION

1.1.1. About this Manual

This manual consolidates the pertinent metering procedures, flowcharts, policies and standards intended generally for WESM Participants and more particularly for Metering Services Providers (MSP) to be used in the commercial operation of the WESM. These procedures are divided into topics integrated into chapters which formulate detailed guidelines, descriptions of the equipment, the steps involved with its significant periods, and tables, etc. This manual shall form part and parcel of the supplementary requirements on metering for the WESM rules.

1.1.2. Purpose

The intention of this manual is to:

1. Provide for the process for the registration of a Metering Services Provider
2. Provide for the process of registration of Metering Installation (MI) of any delivery point which will participate in the WESM.
3. Provide for the smooth interfacing of Meter Data Collection process in accordance with WESM rules.
4. Provide for the efficient Validation, Estimating and Editing of Meter-Settlement Ready Data.
5. Provide for a prompt procedural manner of reporting in cases where Meter Trouble exists.
6. Provide for the Metering Standards to augment the harmonized version of the Grid and Distribution Codes and WESM rules.
7. Provide the procedures for a unique numbering system for the Site and Equipment Identification System of the metering facilities.

1.1.3. Scope

This manual covers the procedural steps from the registration of the MSP and the Metering Installations they serve, to the meter data collection and the Validation, Estimating and Editing (VEE) processes as well as the publishing of meter data into the MO website, up to the maintenance and security aspect of the metering facilities with basis coming from the *Metering Installation Standards* and the *Site Equipment and Identification (SEIN)*.

1.1.4. Intended Audience

This manual shall be used as a guide for the Network Service Provider (NSP), the Distribution Utilities, the Metering Services Providers and their respective Trading Participants which in this case are the Generator Companies and End Customers.

1.1.5. Conventions

The standard conventions to be followed in this *manual* are as follows:

1. The word 'shall' denotes a mandatory requirement;
2. Terms and acronyms used in this *manual* including all Parts thereto that are italicized have the meanings ascribed thereto in the WESM Rules, the Grid Code, the Distribution Code and in this manual;
3. Double quotation marks are used to indicate titles of publications, legislation, forms and other documents.
4. Any procedure-specific convention(s) shall be identified within the specific document itself.

1.1.6. Background

Pursuance to Section 2.3.6.of the WESM rules, any aspiring Metering Services Provider (MSP) who wants to join the WESM shall register with the Market Operator provided it should passed the requirements of section 4.4 of the WESM. In addition, the Trading Participant/MSP should register the desired Metering Facilities to be declared as WESM participants in accordance to section 4.3.1 (c) of the WESM rules.

As stipulated under section 4.8.2 of the WESM rules, Market Operator should create and maintain a metering database which composed of energy (kilowatt) data, reactive (kilovar) energy, etc of Trading Participants that shall be used for settlement and for resolution in cases of disputes.

Likewise, said metering data shall undergo the procedural steps of Validation and substitution process as per section 4.9 of the WESM rules.

1.2 DEFINITION OF TERMS

Accuracy Class: A designation assigned to an instrument transformer the errors of which remain within specified limits under prescribed conditions of use.

Accuracy: The extent to which a given measurement agrees with the defined value.

Basic Insulation Level (BIL): A specific insulation level in kilovolts of the crest value of a standard lightning impulse.

Blondel's Theorem: In a system of N conductors, N-1 meter elements, properly connected, will measure the active power or energy taken. The connection must be such that all voltages coils have a common tie to the conductor in which there is no current coil.

Bottom-connected: Having a bottom-connected terminal assembly.

Burden: For a voltage transformer, the total volt-ampere load, with specified power factor, applied to the secondary terminals. For a current transformer, the total apparent impedance, expressed in ohms, connected to the secondary terminals.

Business Day: Any day on which is open for business, which is usually 24 hours a day and 7 days a week.

Channel: Individual input, output and intervening circuitry required to record time-tagged data.

Class Designation: The maximum specified continuous load in amperes.

Commissioning Test: Is a procedural test on a new Metering Installation (MI) prior to its operation which consists of the visual check and safety of the surroundings of the new MI; continuity test; insulation test; instrument transformer ratio-check and the recordings of the required information on the meters and instrument transformers.

Connection Point: The point of connection of the User System or Equipment to the Grid (for Users of the Grid) or to the Distribution System (for Users of the Distribution System).

Current Transformer: An instrument transformer intended to have its primary winding connected in series with the conductor carrying the current to be measured or controlled.

Customer Alert: A switching output used to indicate events or conditions.

Customer: Any person/entity supplied with electric service under a contract with a Distributor or Supplier.

Demand Interval: The specified interval of time on which a demand measurement is based.

Demand: The average power or a related quantity over a specified interval of time.

Display: A means of visually identifying and presenting measured or calculated quantities and other information.

Distribution Code: The set of rules, requirements, procedures, and standards governing Distributor Utilities and Users of Distribution System in the operation, maintenance and development of the Distribution System. It also defines and establishes the relationship of the Distribution System with the facilities or installations of the parties connected thereto.

Distributors: An Electric Cooperative, private corporation, government-owned utility or existing local government unit that has an exclusive franchise to operate a Distribution System.

Double Secondary Current Transformer (Double Core): One which has two secondary coils each on a separate magnetic circuit with both magnetic circuits excited by the same primary winding.

Double Secondary Potential Transformer (Double Core): One which has two secondary windings on the same magnetic circuit insulated from each other and the primary.

Embedded Generator: A person or entity that generates electricity using a Generating Plant that is connected to a Distribution System of any User and has no direct connection to the Grid.

Emergency Restoration Plan: Sometimes called the Emergency Instrument Transformer Restoration Plan, are plans which the Metering Services Provider must take in case of any failures on the meters or the Instrument Transformers.

End-User: A person or entity that requires the supply and delivery of electricity for its own use.

Energy: The integral of active power with respect to time.

Flicker: The impression of unsteadiness of visual sensation induced by a light stimulus whose luminance or special distribution fluctuates with time.

Frequency: The value of the frequency on which the requirements of this standard are based.

Generator: Any person or entity authorized by the ERC to operate a facility used in the Generation of Electricity

Grid Code: The set of rules, requirements, procedures, and standards to ensure the safe, reliable, secured and efficient operation, maintenance, and development of the high voltage backbone Transmission System and its related facilities.

Grid Owner: The party that owns the high voltage backbone Transmission System and is responsible for maintaining adequate Grid capacity in accordance with the provisions of the Grid Code.

Grid: The high voltage backbone System of interconnected transmission lines, substations, and related facilities for the purpose of conveyance of bulk power. Also known as the Transmission System.

Grounding: An instrument transformer which has the neutral end of the high-voltage winding connected to the case or mounting base.

Harmonics: Sinusoidal voltages and currents having frequencies that are integral multiple of the fundamental frequency.

*Interval Data:*The recorded demand data based on specified demand time interval.

Line-loss Compensation: A method that adds to or subtracts from the meter registration to compensate for predetermined energy losses of transmission/distribution lines.

Low-Voltage Winding of an Instrument Transformer: The winding that is intended to be connected to the measuring or control devices.

Philippine Electricity Market Corporation (PEMC): An independent group, with equitable representation from the electric power industry participants, whose task includes the operation and administration of the Wholesale Electricity Spot Market in accordance with the Market Rules.

Mass Memory: An electronic storage circuit where data is stored for display and/or retrieval.

Market Trading Node: Those nodes at which electricity will either be bought (Load Customer) or sold (Generator) from the spot market and at which energy bought or sold in the market is required to be measured.

Meter: A device, which measures and records the consumption or production of electricity.

Metering Installation: The meter and associated equipment and installations installed or to be installed for the collection of metering data required for settlement purposes.

Metering Point: The point of physical connection of the device measuring the current in the power conductor.

Metering Services Provider (MSP): A person or entity authorized by the ERC to provide metering services and registered with the Market Operator in that capacity in accordance with section 2.3.6 of the WESM rules.

Multi-Ratio Current Transformer: One from which more that one ratio can be obtained by the use of taps on the secondary winding.

Negative Sequence Unbalance Factor: The ratio of the magnitude of the negative sequence component of the voltages to the magnitude of the positive sequence component of the voltages, expressed in percent.

Optical Port: A communications interface on metering products which allows the transfer of information, while providing electrical isolation and metering security. The communications medium is typically infrared light transmitted and received through the meter cover.

Phasor: A complex number, associated with sinusoidally varying electrical quantities, such that the absolute value (modulus) of the complex number corresponds to either the peak amplitude or rms value of the quantity, and the phase (argument) to the phase angle at zero time. By extension, the term “phasor” can also be applied to impedance and related complex quantities that are not time-dependent.

Power Quality: The quality of the voltage, including its frequency and resulting current that are measured in the Grid, Distribution System, or any User System.

Power, Active (KW): The time average of the instantaneous power over one period of the wave.

Power, Apparent (KVA): The product of rms current and rms voltage for any wave form in a two-wire circuit. For sinusoidal quantities, apparent power is equal to the square root of the sum of the squares of the active and reactive powers in both two-wire and polyphase circuits.

Power, Reactive (KVAR): For sinusoidal quantities in a two-wire circuit, reactive power is the product of the voltage, the current, and the sine of the phase angle between them, using the current as reference.

Rated Primary Current: The current selected for the basis of performance specifications of a current transformer.

Rated Secondary Current: The rated current divided by the marked ratio.

Rated Secondary Voltage: The rated voltage divided by the marked ratio.
Rating: The nameplate voltage, current and frequency for a meter to which it is operating.

Ratio (Marked): The ratio of the rated primary value to the rated secondary value as stated on the nameplate.

Stator: An assembly of an induction watt-hour meter, which consists of a voltage circuit, one or more current circuits, so arranged that their joint effect, when energized, is to exert a driving torque on the rotor.

System Operator: The party responsible for generation Dispatch, the provision of Ancillary Services, and operation and control to ensure safety, Power Quality, Stability, Reliability, and Security of the Grid.

Test Amperes: The load current specified by the manufacturer for the main calibration adjustment.

Time-of-Use: A selected period of time during which a specified rate will apply to the energy usage or demand, typically designated as A, B, C, and D.

Totalizing: A device used to receive and sum pulses from two or more sources for proportional transmission to another totalizing relay or to a receiver.

TRANSCO: The corporation that assumed the authority and responsibility of planning, maintaining, constructing, and centrally operating the high-voltage Transmission System, including the construction of Grid interconnections and the provision of Ancillary Services.

Transformer-loss Compensation: A method that adds to or subtracts from the meter registration to compensate for predetermined iron and/or copper losses of transformers.

User: A person or entity that uses the Grid or Distribution System and related facilities. Also, a person or entity to whom the Grid Code or Distribution Code applies.

Voltage Fluctuation: The systematic variations of the voltage envelope or random amplitude changes where the RMS value of the voltage is between 90 percent and 110 percent of the nominal value.

Voltage Transformer: A device that scales down primary voltage supplied to a meter while providing electrical isolation.

WESM Participants: All Generation Companies, Distribution Utilities, Suppliers, Aggregators, End-Users, the TRANSCO or its Buyer or Concessionaire, IPP Administrators and other entities authorized by the ERC to participate in the WESM in accordance with he Act.

WESM Rules: The rules that govern the administration and operation of the Wholesale Electricity Spot Market.

Zero Sequence Unbalance Factor: The ratio of the magnitude of the zero sequence components of the voltages to the magnitude of the positive sequence component of the voltages, expressed in percent.

Note: Any other concepts herein found in this metering manual shall also adopt the definitions integrated in the WESM rules, the Grid Code and the Distribution Code.

1.3 RESPONSIBILITIES

1.3.1. The Market Operator shall be responsible for the development, validation, maintenance, publication and revision of this document in coordination with WESM Participants;

1.3.2. The Metering Services Provider/Trading Participant shall provide the necessary information and references for subsequent revisions and validation of this document;

1.3.3. The Philippine Electricity Market Board shall be responsible for the approval of this document and subsequent revisions and issuances;

1.3.4. The Enforcement and Compliance Officer shall be responsible for the investigations on any infractions of the Trading Participants/Metering Services Provider or in cases where disputes which may arise involving meter data or tampering of any metering facilities that is detrimental to the integrity of the meter data;

1.3.5. And any other responsibilities of technical or legal committees or groups as stated in the WESM rules, the Grid Code or the Distribution Code which may affect the relevant provision of this manual.

1.4 AMENDMENTS

Any amendments to this Manual shall be approved by the DOE, following the procedures for changes to Market Manual set out in the WESM Rules and in the relevant Market Manual.

1.5 PUBLICATION AND EFFECTIVITY

This Market Manual, as it may be amended from time to time, shall be published in the market information website maintained by the Market Operator.

This Market Manual or any amendments thereto shall become effective upon approval of the DOE in accordance with the WESM Rules Clause 8.6.4. The date of effectivity shall be indicated in this document.

SECTION 2 METERING INSTALLATION STANDARDS

2.1. INTRODUCTION

These standards pertain to all metering facilities, such as devices and miscellaneous equipment, etc of a Metering Installation (MI) among and between all Grid Users like the Grid Owner (TRANSCO), System Operator, Market Operator, Generators, Distributors, Suppliers, Customers and any entity who will participate in the WESM. It also describes certain electrical, dimensional and mechanical characteristics and designs and takes into consideration certain safety features of current and inductively coupled voltage transformers of types generally used in the measurement of electricity associated with revenue metering.

2.1.1. General Requirements

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

2.1.2. Applicability

This standard shall be observed by metered Trading Participants in the WESM.

2.2. LOCATION OF THE METERING POINT

The location of the Metering Point is ideally at the Market Trading Node and shall be in accordance with the WESM Rules, the Grid Code, and the Distribution Code.

If the Metering Point is not located at the Market Trading Node, an agreed Site Specific Loss Adjustment (SSLA) shall be applied to the meter data representing the energy supplied by the Generator or consumed by the Customer at that Metering Point for determining the quantities to be settled in the WESM.

2.3. METERING INSTALLATIONS

2.3.1. Applicability to Equipment

This standard applies to the following metering equipment, devices and accessories:

a. Meters

b. Instrument transformers
c. Meter Enclosure
d. Meter Test Switch/Block
e. Secondary Cabling for Instrument Transformers
f. Grounding
g. Conduit System
h. Communication Link
i. Meter Seals and Padlock
j. Metering Perimeter

The equipment is used for the settlement of Philippine WESM administered transactions.

2.3.2. Applicability to Installations

This standard applies to Metering Installation in the WESM administered market for:

a. Connection between utility control areas
b. Connection to the WESM controlled grid system
c. Points of connection between local distribution companies
d. Connection of registered Trading Participants embedded within the local distribution companies
e. Designated interties with other grid systems
f. Any other locations as required by the WESM for settlement purposes

2.3.3. Registration of Metering Installations

All WESM Metering Installations, consisting of the Revenue Meter, Metering Instrument Transformers, Meter Enclosure, and Other Metering Accessories, shall be registered with MO prior to deployment in the WESM.

2.4. METERS

2.4.1. Requirements for Grid Revenue Meters

Meters installed as the main revenue meter, shall meet the minimum requirements listed below:

ITEMS	SPECIFICATIONS	REFERENCE DOCUMENTS
Accuracy Class	IEC 687 Class 0.2 / ANSI 12.20 Class 0.3 or better	Grid Code 9.3.3.1

ITEMS	SPECIFICATIONS	REFERENCE DOCUMENTS
No. of Stator	Blondel's Theorem compliant / 3-element	
Rating	115V 1 A or 5 A 60 Hz	The rating should be suitable to the secondary rating of the instrument transformers.
No. of Quadrants (Measurement)	Active Energy/Power Measurement: Bi-directional Reactive Power Measurement: 4 Quadrant	Grid Code 9.3.3.2
Interval Data	Programmable to 1, 5, 15, 30, and 60 minute interval	Grid Code 9.3.4.1
No. of Channels	At least eight (8)	Grid Code 9.2.4.1 Grid Code 9.2.4.2
Mass Memory	Minimum 60 day recording of a 5-minute time-stamped demand interval for 8 recording channels	WESM 4.5.1 (g) Grid Code 9.3.4.3 Grid Code 9.2.5.3
Billing Function	The meter shall be capable of measuring and recording the following electrical parameters per billing interval: • Kwh (Delivered) • Kwh (Received) • Kvarh (Quadrant 1) • Kvarh (Quadrant 2) • Kvarh (Quadrant 3) • Kvarh (Quadrant 4) • Kvah (Delivered) • Kvah (Received) • Max Kw (Delivered) • Max Kw (Received) • Kvar (Quadrant 1) • Kvar (Quadrant 2) • Kvar (Quadrant 3) • Kvar (Quadrant 4) • Kva (Delivered) • Kva (Received) A. Power Factor • Frequency • Per Phase Current • Per Phase Voltage	Grid Code 9.2.4.1 Grid Code 9.2.4.2 Grid Code 9.3.3.1 Grid Code 9.3.3.2 Grid Code 9.5.4 Grid Code 9.5.5
Loss Compensation	A flexible transformer loss compensation for both copper and iron losses and transmission/ distribution line loss compensation with a simple user set-up for Site Specific adjustments. Losses can	Grid Code 9.2.3.1 WESM 4.5.2.2

ITEMS	SPECIFICATIONS	REFERENCE DOCUMENTS
	be measured and segregated separately from other billing parameters.	
Security	The meter shall have provisions for securing the meter data, meter configurations and programs by electronic means and/or passwords. It shall also be secured physically by way of security seals.	WESM 4.5.6 Grid Code 9.4.5
Communication Capability	The meter shall have at least minimum of three (3) independent communication ports that could operate independently. Each port can communicate simultaneously, with each one using a different protocol. It should be capable of a two-way communication.	WESM 4.5.7.1 WESM 4.5.1(c) Grid Code 9.3.4.2 Grid Code 9.5.1.1 Grid Code 9.5.1.4
Internal Clock	The meter shall have an internal clock with an allowable error of +/-1 second per demand interval.	WESM 4.5.8.1 Grid Code 9.3.4.4
Time Synchronization	Line frequency or crystal synchronization. The internal clock shall be capable of being reset set by the data collection software during normal collection operations.	WESM 4.5.8.1 Grid Code 9.3.4.4
Digital Display	The meter shall have a digital display with a minimum of 5 digits.	WESM 4.5.1 (c) Grid Code 9.3.3.1
Codes and Standards Compliance	The meter shall adhere to established International Standards (IEC, etc.).	Grid Code 9.3.3.1
Applicable and Compliance Tests	These tests shall include material tests and established practice and/or other approved standards. Routine tests prescribed by the applicable standards shall be performed. In particular, the following tests shall be performed for the revenue meters: a. Power frequency tests (insulation) b. Impulse voltage test (insulation). c. HF interference test d. Surge withstand and fast transient tests	Grid Code 9.3.3.3. IEC 255-1 IEC 255-A (Class III) IEC 245-4
Battery	Capable of retaining readings and time of day for at least two days without external power source	Grid Code 9.2.5.3 Grid Code 9.3.3.2 WESM 4.5.1 (g)

ITEMS	SPECIFICATIONS	REFERENCE DOCUMENTS
Enclosure	The meter shall be provided with the necessary cover to protect the internal component against the harmful elements of environment that may affect its measuring circuit and operation.	ANSI 12.1 4.3.4

2.4.2. Requirements for Distribution Revenue Meter

Meters installed as the main revenue meter, shall meet the minimum requirements listed below:

ITEMS	SPECIFICATIONS	REFERENCE DOCUMENTS
Accuracy Class	IEC 687 Class 0.2 / ANSI 12.20 Class 0.3 or better	IEC 687 4.6
No. of Stator	Corresponds to the service type and complying with Blondell's Theorem	Dist. Code 8.4.3.1 ANSI C12.1
Voltage Rating	Corresponds to the secondary voltage rating of voltage transformers used	Dist. Code 5.5.1.1
Current Rating	Corresponds to the secondary current rating of current transformers used (typically 1A or 5A)	ANSI or IEC Standard
Frequency	60 Hz	Dist. Codes 3.2.2.1 -
Measurement	Bi-directional active metering (delivered & received) and 4-quadrant reactive metering	Dist Codes 8.3.3.1 Dist. Codes 8.3.4.2 Dist. Code 8.4.3.2 .
Interval Data	Programmable to 5, 15, 30 minute interval	Dist. Code 8.4.4.1
No. of Channels	At least Six (6) Channels	This satisfies the minimum requirements as stated under: Dist. Codes 8.3.3.2 Dist. Codes 8.3.4.3
Mass Memory	At least 60 days	Dist Code 8.3.5.3
Recording Billing Quantities	Display and record TOU energy and power parameters (kWh, kVarh, max. kW & cum. kW) for all rates	Dist. Code 8.4.3.1
Loss Compensation (if applicable)	A flexible transformer loss compensation for both copper and iron losses and transmission/ distribution line loss compensation with a simple user set-up for Site Specific adjustments. Losses can be measured and	WESM 4.5.2.2

ITEMS	SPECIFICATIONS	REFERENCE DOCUMENTS
	segregated separately from other billing parameters.	
Security	The meter shall have provisions for securing the meter data, meter configurations and programs by electronic means and/or passwords. It shall also be secured physically by way of security seals.	WESM 4.5.6
Communication Capability	The meter shall be equipped with a means of communication channel capable of electronic data transfer. Either an integrated telephone modem, and/or RS-232 communication port for interface to an external communication medium are considered acceptable..	WESM 4.5.7.1 WESM 4.5.1(c) Dist. Code 8.4.4.2
Internal Clock/Battery	With long life lithium battery for clock/ calendar maintenance	WESM 4.5.8.1 Dist Code 8.4.4.6
Time Synchronization	The meter can be programmed to synchronize time without change in measured billing parameters.	
Digital Display	The meter shall have a digital display with a minimum of 5 digits.	WESM 4.5.1 (c) Dist Code 8.4.3.1
Codes and Standards Compliance	The meter shall adhere to the IEC Standards or their equivalent national standards for metering	
Enclosure	The meter shall be provided with the necessary cover to protect the internal component against the harmful elements of environment that may affect its measuring circuit and operation.	ANSI 12.1 4.3.4

2.5. INSTRUMENTS TRANSFORMERS

2.5.1. General Requirements

Metering installations shall include instrument transformers.

2.5.2. Use of Instrument Transformers

Instrument transformers supplying the revenue meter shall be used solely for the purposes of revenue metering and not for any other purposes, including, but not limited to, the attachment of other devices.

2.5.3. Instrument Transformer Ratios

2.5.3.1. Selection of Current Transformer Ratios

Current transformer ratios shall be selected according to the following factors:

a. The maximum sustained primary current in a current transformer shall not exceed the primary tap multiplied by the primary factor of the current transformer; and
b. The minimum sustained primary current during normal operation shall not be less than 10% of the primary tap.

2.5.3.2. Selection of Voltage Transformer Ratios

Voltage transformer ratios shall be selected such that operation at the minimum or maximum sustained secondary voltage shall not affect meter accuracy or meter function.

2.5.4. Accuracy Requirements

2.5.4.1. Current Transformers

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

2.5.4.2. Voltage Transformers

Voltage transformers shall conform to the IEC 6044-2 Class 0.2 or ANSI C57.13 Class 0.3 of any instrument transformer.

2.5.4.3. Proof of Accuracy Compliance

Proof of compliance with Section 4.4 shall be provided in the form of factory test cards complete with serial numbers.

2.5.4.4. Other Requirements Relating to Accuracy

Where accuracy tests are required, they shall comply with the following requirements:

a. tests shall be carried out by a third-party testing agency using equipment traceable to International Standards;

b. tests shall be conducted with the suitable burdens connected to each current transformer;
c. additional tests shall be conducted at other suitable burdens if the existing burden is expected to change in the future;
d. tests shall include ratio and phase-angle error tests;
e. ratio and phase-angle tests of current transformers shall be measured over a range of secondary current from 1% of rated primary current up to and including the maximum current as defined by the rating factor;
f. test results shall provide correction factors to be applied to both active and reactive power at each test point

2.5.5. Instrument Transformer Burdens: General Requirements

Burden shall include the following considerations:

a. every device connected to every instrument transformer;
b. the burden imposed by each device; and
c. the size of the conductors in the secondary cabling and the length of the path followed by the cabling

2.5.5.1. Burden Calculation – All Current Transformers

The burden calculation for a current transformer shall include:

a. the impedance of the secondary wiring;
b. the impedance of all devices connected to the current transformer;
c. the apparent impedance associated with the interconnection of current transformer secondaries;
d. the apparent impedance associated with the sharing of a common current path through a measuring device with another current transformer;
e. the apparent impedance associated with the sharing of an approved common-return conductor;
f. the apparent impedance associated with the impedance of any other current transformer(s) connected in parallel with subject instrument transformer;
g. burden under balanced power system conditions; and
h. worst-case unbalance, including single-phase power

2.5.5.2. Not to Exceed Nameplate Ratings

The measurement of calculation shall verify that actual burdens in service do not exceed the nameplate rated burden limits for the IEC 44-1 Class 0.2 or ANSI C57.13 Class 0.3 of any instrument transformer.

2.5.5.3. Burden Calculations – All Voltage Transformers

The burden calculation for a voltage transformer shall include the apparent power and power factor at the secondary terminals of the instrument transformer.

2.5.5.4. Not to Exceed Nameplate Ratings

The measurement of calculation shall verify that actual burdens in service do not exceed the nameplate rated burden limits for IEC 6044-2 Class 0.2 or ANSI C57.13 Class 0.3 of any instrument transformer.

2.5.6. Safety Requirements and Grounding System

The installation shall conform to the requirements of:

a. Philippine Electrical Code; and
b. The IEC or ANSI/IEEE C57.13-1983 IEEE Guide for Grounding of Instrument Transformer Secondary Circuits and Cases.

2.5.7. Current Transformer

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

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

ITEMS	SPECIFICATIONS	REFERENCE DOCUMENTS
Rated Primary Current	The thermal rating factor shall not be less than 1.0.	
Secondary Current	1A or 5A	Grid Code 9.3.2.2 IEC 4.2 Standard values of rated secondary currents
Rating Factor	Minimum of 1.0 at 30°C	
Frequency	60 Hz	
Ambient Air Temperature	-5°C and 50°C for very hot climate	IEC 3.2.1 1996
BIL	Refer to Table 2 for applicable BIL	
Creepage Distance	Refer to Table 3 for applicable creepage distance	
Number of Core	Preferably Two (2) metering core	Grid Code 9321 Grid Code 9.3.2.2
Mounting	Depend on the applications	
Grounding		Grid Code 9.3.2.2
Security	Seal holder shall be provided to the CT secondary terminal box (see Figure 1)	Grid Code 9.4.5 Meter Equipment Security .

2.5.8. Voltage Transformer

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

ITEMS	SPECIFICATIONS	REFERENCE DOCUMENTS
Type	Outdoor Type; Minimum oil filled, Dry Type or Gas-filled	
Cooling	Oil immersed, Self-cooled; Butyl, Cast resin	
Construction	Single phase, Inductive type, single bushing	
Termination	Line-to-ground	Grid Code 9.3.1.
Accuracy Class	IEC 6044-2 Class 0.2 /ANSI C57.13 Class 0.3 or better	Grid Code 9.3.1.1 .
Burden	Shall not exceed the rated burden limit for the IEC 6044-2 Class 0.2 /ANSI C57.13 Class 0.3 or better. (see Table 4)	Grid Code 9.4.1.2

ITEMS	SPECIFICATIONS	REFERENCE DOCUMENTS
Ratio	See Table 5	
Secondary Voltage	See Table 5	
Frequency	60 Hz	
Operating Temperature	55°C average ambient temperature, with max ambient temperature not exceeding 65°C	
BIL	Refer to Table 2 for applicable BIL	
Creepage distance	Refer to Table 3 for applicable creepage distance	
Number of Core	Preferably Two (2)	
Mounting	Depend on the applications	
Grounding		Grid Code 9.3.1.1
Security	Seal holder shall be provided to the CT secondary terminal box (see Figure 1)	Grid Code 9.4.5 Meter Equipment Security

2.5.9. Lightning Arrester

Lightning Arrester installed (if necessary) at the main metering, shall meet the minimum requirements listed below:

Nominal System Voltage	Max. Rated Voltage	Standard Lightning Impulse Withstand Voltage	Max. Continuous Operating Voltage	Max. Nominal Discharge Current	Maximum Line Discharge Class		Long Duration Current Impulse Withstand Capability
[KV]	[KV]	[KV]	[KV]	[KA]	IEC	ANSI	[KVA]
13.8	15	95	12	10	CL 2	Station	100
34.5	36	170	29	10	CL 2	Station	100
69	72.5	325	58	10	CL 2	Station	100
115	123	550	98	10	CL 2	Station	100
138	145	650	116	10	CL 2	Station	100
230	245	900	196	10	CL 2	Station	100
500	525	1550	420	20	CL 4	Station	100

2.6. PRIMARY CONNECTIONS

2.6.1. Location of Primary Terminals of Current Transformer

The primary terminals of each current transformer shall be located as close as practicable to the Metering Point.

2.6.2. Location of Primary Terminals of Voltage Transformer

The primary terminals of each current transformer shall be located as close as practicable to the Metering Point.

2.6.3. Requirements of Primary Terminals

The primary terminals of each voltage transformer shall be:

a. at the same potential as the current transformer; and
b. as close as practicable to the primary terminals of the current transformer of the same phase

2.6.4. Connection to Power System

With respect to any physical separation of the points at which the voltage transformer and the current transformer of each phase are connected to the power system, the installation shall:

a. minimize the voltage drop between the voltage transformer and the current transformer; and
b. minimize the leakage of current between the voltage transformer and the current transformer

2.6.5. Location/Arrangement of Instrument Transformers

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. Refer to Figure 3.

2.6.6. Distances, clearances between Instrument Transformers

The distances between instrument transformers and the prescribed clearances were shown in Table 6 and Figure 4.

2.6.7. Primary Cable

2.6.7.1. Quality of Materials and Workmanship

The primary cable terminations connecting to the high-voltage terminals of an instrument transformer shall be in good quality and of accepted workmanship.

2.6.7.2. Location of Primary Connections

Primary connections of the instrument transformer shall be located such that operation of power system equipment does not degrade the following elements:

a. accuracy of measurement;
b. data required for validation or settlement;
c. loss adjustment factors; and
d. Monitoring of metering equipment condition

2.7. SECONDARY CONNECTIONS FOR INSTRUMENT TRANSFORMERS

The requirements and applicability apply to all instrument transformers used in the Metering Installations of all metered Trading Participants of the WESM.

2.7.1. Current Transformer

2.7.1.1. Size of Secondary Cabling

The secondary cabling between the current transformers and the meter test switch/block shall be of a sufficient size that the rated burden for the IEC 0.2 or ANSI 0.3 accuracy class is not exceeded when current, equivalent to the rated current, flows in the secondary winding.

2.7.2. Voltage Transformer

2.7.2.1. Size of Secondary Cabling

The secondary cabling between the voltage transformers and the meter test switch/block shall be of correct size such that the voltage drop in each phase shall not exceed 0.2 V.

2.7.3. Codes and Conditions

Instrument transformer secondary cabling and cabling accessories shall comply with the following codes and conditions:

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 winding 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 shall be used for no other purpose;

2.7.3.5. electrical connection to the instrument transformer secondary terminals shall not be possible outside of 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

2.8. COMMUNICATION LINKS FOR THE METER

The communication link to be installed shall be a dedicated line for metering purposes (e.g. PLDT, Bayantel, Digitel lines or GSM Modem) which must be compatible with the meter and the remote meter data collection system of MO and the MSP.

2.9. SECURITY OF METERING INSTALLATIONS AND DATA

2.9.1. Physical Security of Metering Equipment

Metering Installation shall be secure and tamper proof and conforms to the following applicable security requirements:

2.9.1.1. Instrument transformers connections

Secondary cabling shall be secured, tamper proof and compliant with the WESM Rules and the Grid and Distribution Code requirements on security of registered revenue metering Installations and metering data.

2.9.1.2. Conduit Systems

All wiring from the instrument transformers' secondary terminal box to the meter installation enclosure (meter box) shall be placed in a conduit which is compliant with environmental requirements to ensure that the connections to cabling is secure, tamper proof and compliant with the MO Requirements. Conduit joints (elbow, T-connector) shall be properly sealed and secured. No secondary cabling shall be exposed and accessible to unauthorized personnel. See Figure 5.

2.9.1.3. Secondary Terminal Box

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. See Figure 1.

2.9.1.4. Meter Enclosure

All meters, test links, and communication equipment shall be contained within a meter enclosure similar to Figure 5.

a. Meter Enclosure Requirements

The meter enclosure shall comply with the following requirements:

i. The meter enclosure shall be secured by the meter service provider.
ii. The meter service provider shall have access to the meter enclosure at all times.
iii. Persons other than the meter service provider shall not be given access to the meter enclosure.
iv. The meter enclosure shall be padlocked and sealed as far as practicable in a manner approved by the MO.
v. The meter enclosure shall be weatherproof.

2.9.1.5. Meter Test Block/Switch

Test block/switch shall be installed inside the meter enclosure to allow the current and voltage from each instrument transformer and each meter to be individually determined. See Figure 6.

a. Technical Descriptions

i. Test Points: 10 points, (4 potential & 6 current Points)
ii. Pole Arrangement: P-CC-P-CC-P-CC-P
iii. Rating: 600 VAC, 20 amps
iv. Current carrying parts are made of non-tarnishing nickel silver
v. Switches are of the open knife-blade type
vi. Current switch poles are provided with an auto- shorting jaw and the other has a shunted jack which is adaptable to a test plug
vii. Base is a one piece resistant moldings.

Provided with standard cover, a one piece non-transparent/ transparent moulded high impact styrene and removable cover.

2.9.1.6. Meter Seals and Padlock

a. Meter Seal Requirements

The requirements for meter seals are:

i. Seals shall have unique serial numbers
ii. Seals shall be traceable to the MSP/ERC that installed the seals
iii. The MSP shall maintain a record of the seal serial numbers and log subsequent changes including reasons for the seal change

b. Padlock Requirements

The requirements for padlock are:

i. Padlock shall be heavy duty
ii. Padlock shall have only one security key and placed on a secured area
iii. Security key shall be controlled by MSP
iv. Use of security key shall be documented and monitored

2.9.1.7. Metering Perimeter

The Metering Installation shall be secured by a perimeter fence similar to Figure 7 if applicable and its gate properly padlock, sealed and secured. Metering perimeter shall also be well lighted and free from any unwanted materials, equipment, vegetation, etc. (refer Table 7)

2.9.2. Security of Metering Data

2.9.2.1. Each Metered Market Participants thru its MSP shall ensure that the metering data recorded in each Metering Installation is protected from direct local or remote electronic access, including during the transfer of such metering data to the communication interface of the metering database. The MSP shall implement suitable password and other security controls.

2.9.2.2. Metering data shall be protected during delivery to the MO other than electronic means, protected from access by persons other than itself regardless of the medium, including but not limited to diskette, CDs and paper, on or in which such metering data is transcribed, transferred or stored for purposes of such delivery.

2.9.2.3. Each MSP shall keep all records of passwords for electronic access to metering data confidential.

2.9.2.4. The MSP shall provide, in respect of each Metering Installation in respect of which it is the Metering Services Provider, 'read-only' passwords to the MO.

2.9.2.5. The MSP may, and at the request of the MO shall, change one or more of the passwords relating to a Metering installation in respect of which it is the Metering Services Provider.

2.10. REDUNDANT METERING INSTALLATION

A redundant Metering Installation can be achieved in one of two ways:

2.10.1. Dual metering using two independent sets of instrument transformers approved by the Market Operator, where the main instrument transformers are connected to the main meter, the alternate instrument transformers are connected to the alternate meter; or

2.10.2. Partial redundant metering using a single set of instrument transformers approved by the Market Operator where both the main and alternate meters are connected to either common or separate core.

2.11. METERING INSTALLATION - EXISTING

A Metering Installation installed and commissioned before the WESM comes into effect, and that does not comply with the requirement of this standard will be permitted by the Market Operator to remain in service subject to the following condition:

2.11.1. The meter shall have a mass memory capable of recording 15-minute demand interval and have communication ports for remote and manual data retrieval,

2.11.2. ERC has tested/verified and sealed the meter,

2.11.3. Accuracy class of the meter and instrument transformers shall be 0.5 or better, and

2.11.4. All non-compliant meters and instrument transformers shall be replaced within one-year after the WESM come into effect.

SECTION 3 SITE EQUIPMENT IDENTIFICATION (SEIN)

3.1. INTRODUCTION

This chapter describes all the Metering Installations (MI) up to the specific detail at the Connection Points between all Grid Users like The Grid Owner (TRANSCO), The System Operator, The Market Operator, Generators, Distributors, Suppliers, Customers and Any entity with a User System connected to the Grid.

The objectives of identifying Metering Installations are as follows:

a. To prescribe the manner of developing a Standard Identification Equipment Labeling Systems for Metering Installation for the entities participating in the Wholesale Electricity Spot Market as prescribed in the Grid Code and Distribution Code.

b. To ease in locating and identifying equipment and make the location symbol more reflective of the name of the Metering Installation (MI).

c. To guide and direct the Market Operator, System Operator, Trading Participants, Metering Services Provider (MSP) and Operation and Maintenance (O &M) in the operation and maintenance of Metering Installations.

d. To assist in the planning, documentation, spare management, maintenance, defect statistics, budgeting and control of Metering Installations.

e. To help in the establishment of Metering Installation database management system.

f. To ensure the safety of maintenance personnel.

3.2. GENERAL PROCEDURES

The following procedures for labeling and identification of revenue Metering Installation and its equipment, devices, auxiliaries, etc. is detailed below:

3.2.1. Revenue Metering Installation

Metering Installation shall be labeled as:

A-BBB-CCCC-XX

where:

A	Shall be a one (1) letter designation of the purpose or function of the metering. Please refer to Table 8 for the designation of the Meter Purpose.
BBB	Shall be a three (3) letter initial designation of Substation or Plant ID. Please refer to Procedure 1 and Table 9 for Standard Site ID.
CCCC	Shall be a four (4) letter initial designation of the Metered Participant ID. Please refer to Procedure 2 and Table 10 for Metered Participant ID.
NN	Shall be a two (2) digit number to designate the delivery/receiving point number

Example:

M-MEX-SFEL-01

where:
M - Main Meter
MEX - Mexico S/S
SFEL - SFELAPCO
01 - Delivery/Receiving point number 1

3.2.2. Revenue Meters

Revenue Meters shall be labeled as:

DDY-(A-BBB-CCCC-XX)

where:

DD	Shall be a two (2) letter initial designation for revenue meters. Please refer to Table 11 for the standard designation of Metering equipment, devices and auxiliaries, etc.
Y	Shall be a one (1) digit number designation for the purpose or function of the metering: ▫ 1 for Delivered (OUT) ▫ 2 for Received (IN)

	▫ 3 for Bi-directional (IN & OUT)
(A-BBB-CCCC-XX)	See identification procedure for Revenue Metering Installation.

Example:

MF3-(M-MEX-SFEL-01)

where:

MF **-** Multi-function electronic meter
3 **-** Bi-directional (IN & OUT)
M - Main Meter
MEX - Mexico S/S
SFEL - SFELAPCO
01 - Delivery/Receiving point number 1

3.2.3. Meter Box

Meter Box shall be labeled as:

DD-(A-BBB-CCCC-XX)

where:

DD	Shall be a two (2) letter initial designation for metering box. Please refer to Table 11 for the standard designation of Metering equipment, devices and auxiliaries, etc.
(A-BBB-CCCC-XX)	See identification procedure for Revenue Metering Installation.
NOTE	The above identification procedure applies to the following equipment: ▫ Modem

Example:

MB-(M-MEX-SFEL-01)

where:

MB **-** Meter Box
M - Main Meter
MEX - Mexico S/S
SFEL - SFELAPCO
01 - Delivery/Receiving point number 1

3.2.4. Meter Test Switch

Meter Test Switch shall be labeled as:

DDYY-(A-BBB-CCCC-XX)

where:

DD	Shall be a two (2) letter initial designation for meter test switch. Please refer to Table 11 for the standard designation of Metering equipment, devices and auxiliaries, etc.
YY	Shall be a two (2) digit designation for the equipment number.
(A-BBB-CCCC-XX)	See identification procedure for Revenue Metering Installation.
NOTE	The above identification procedure applies to the following equipment: ▫ Metering Structure

Example:

TS01-(M-MEX-SFEL-01)

where:
TS **-** Meter Test Switch
01 **-** Meter Box
M - Main Meter
MEX - Mexico S/S
SFEL - SFELAPCO
01 - Delivery/Receiving point number 1

3.2.5. Current Transformer

Current Transformer shall be labeled as:

DEE-(A-BBB-CCCC-XX)

where:

D	Shall be a one (1) letter initial designation for phase of the current transformer: ▫ "A" for Phase A ▫ "B" for Phase B ▫ "C" for Phase C ▫ "Z" for Three Phase (3Φ)
EE	Shall be a two (2) letter initial designation for the current transformer. Please refer to Table 11 for the standard designation of Metering equipment, devices and auxiliaries, etc.

(A-BBB-CCCC-XX)	See identification procedure for Revenue Metering Installation.
NOTE	The above identification procedure applies to the following equipment: ▫ Potential Transformer ▫ Lightning Arrester

Example:

ACT-(M-MEX-SFEL-01)

where:

A **-** Phase A
CT **-** Current Transformer
M - Main Meter
MEX - Mexico S/S
SFEL - SFELAPCO
01 - Delivery/Receiving point number 1

3.3. BASIS FOR ESTABLISHING THE SEIN

The specific details of this Standards and Procedures comprise the Site and Equipment Identification of Revenue Metering Installations of Trading Participants in the WESM as prescribed in the following provisions of the Philippine Grid Code and Distribution Code:

3.3.1. Grid Code 7.11.1.1
3.3.2. Grid Code 7.11.1.2
3.3.3. Grid Code 7.11.1.3
3.3.4. Grid Code 7.11.2.1
3.3.5. Grid Code 7.11.2.2
3.3.6. Distribution Code 7.12.1.1
3.3.7. Distribution Code 7.12.1.2
3.3.8. Distribution Code 7.12.1.3
3.3.9. Distribution Code 7.12.2.1
3.3.10. Distribution Code 7.12.2.2

SECTION 4 METERING SERVICES PROVIDER REGISTRATION

4.1. INTRODUCTION

The WESM Rules, under Section 4.4, prescribes the criteria and disqualifications for the registration of entities as WESM Metering Services Provider (MSP). This procedure details the process by which the Market Operator (MO) receives applications for MSP registration, assesses whether applicants can be registered as MSP based on the provisions of WESM Rules Section 4.4, and grants MSP registration to qualified applicants.

4.2. PRE-REQUISITE FOR REGISTRATION

To apply for registration as WESM Metering Services Provider, the applicant must:

4.2.1. Have knowledge of the relevant sections of the WESM Metering Standard and Procedures detailing the responsibilities of WESM Metering Services Provider, and the requirements and the processes for provision of WESM metering services;

4.2.2. Provide documentation that it possesses standards and procedures covering its business and technical processes to ensure the integrity of Metering Installations and the metered energy and demand data.

4.2.3. Submit documentary evidence that it has the financial and technical resources, infrastructure and organization to perform all the functions and tasks of the Metering Service Provider, which include:

a. Daily retrieval of metered data from the metering points that it is contracted to provide MSP services.

b. Daily electronic transmission of retrieved metered data to the Market Operator for billing and settlements, in a format that is compatible with the Market Operator's Metered Data Collection System.

c. Installation, testing and commissioning to service, and calibration of metering equipment in accordance with the Grid Code, the Distribution Code, the WESM Metering Manual, and the ERC Guidelines for WESM Metering Service Providers;

d. Maintenance and repairs on Metering Installations.

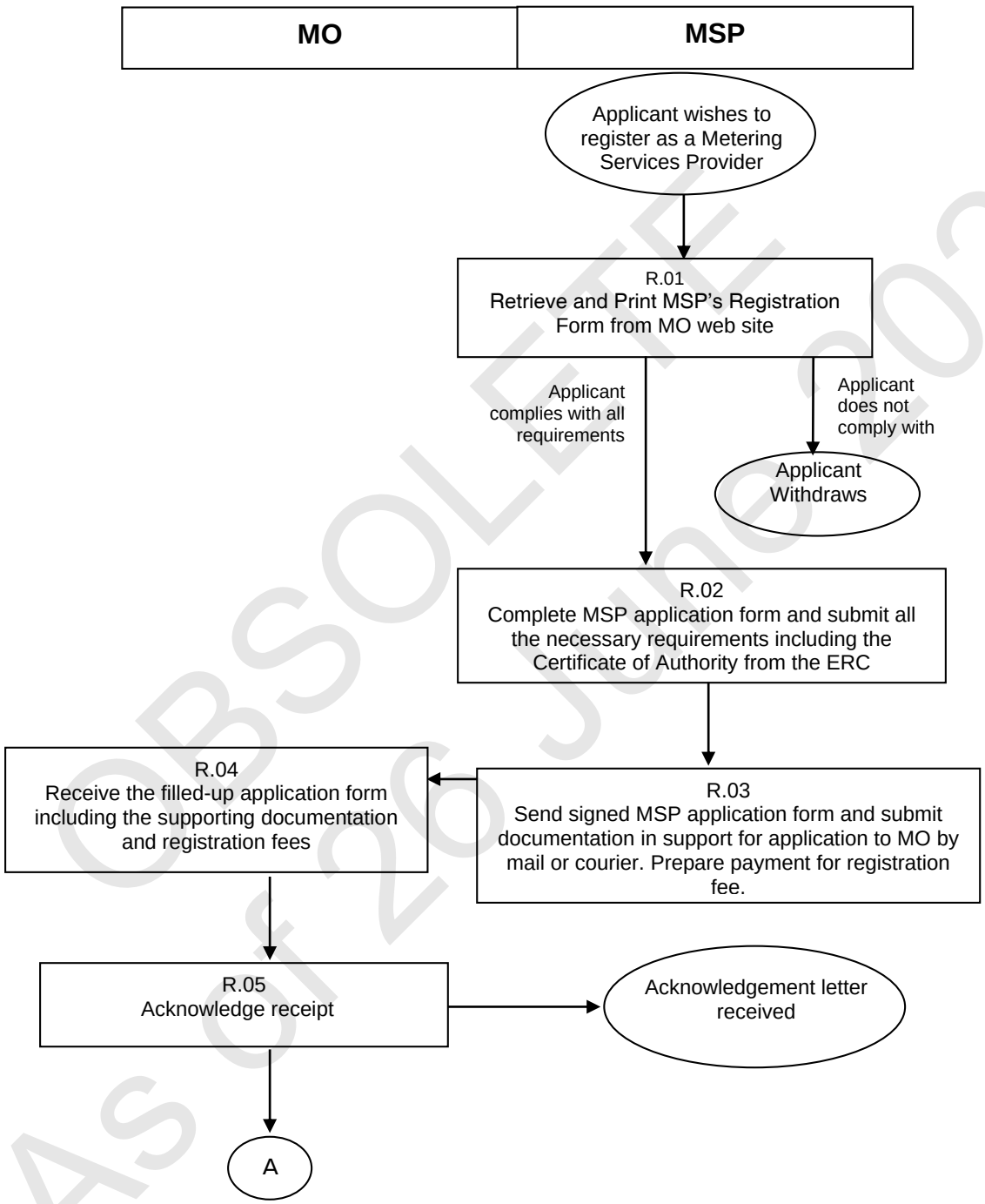
4.2.4. Submit a copy of its Certification of Authority as WESM Metering Service Provider issued by the Energy Regulatory Commission (ERC);

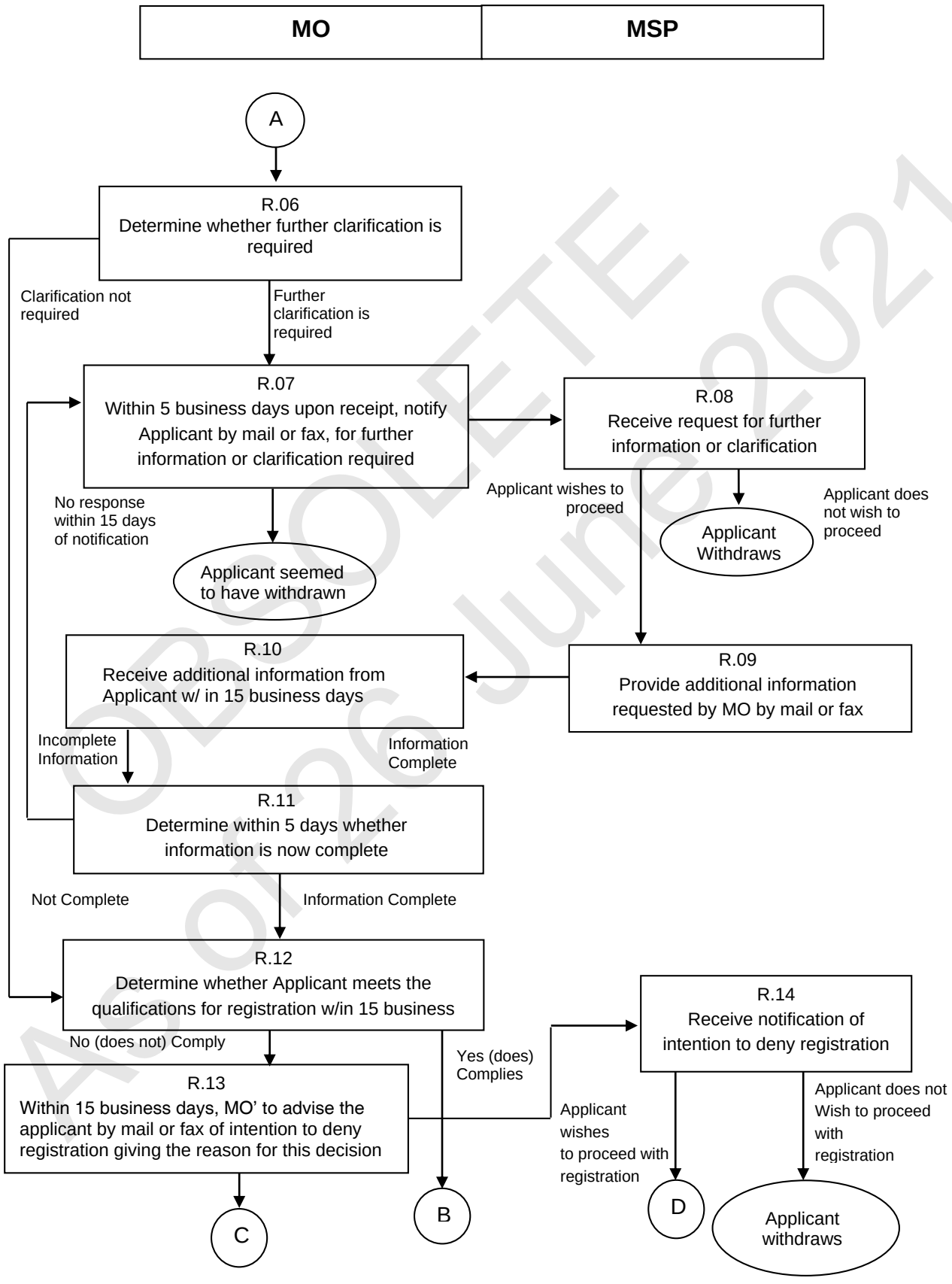
4.2.5. Accomplish the Metering Services Provider Registration Form and submit the same to the Market Operator with supporting documents, together with the registration fee.

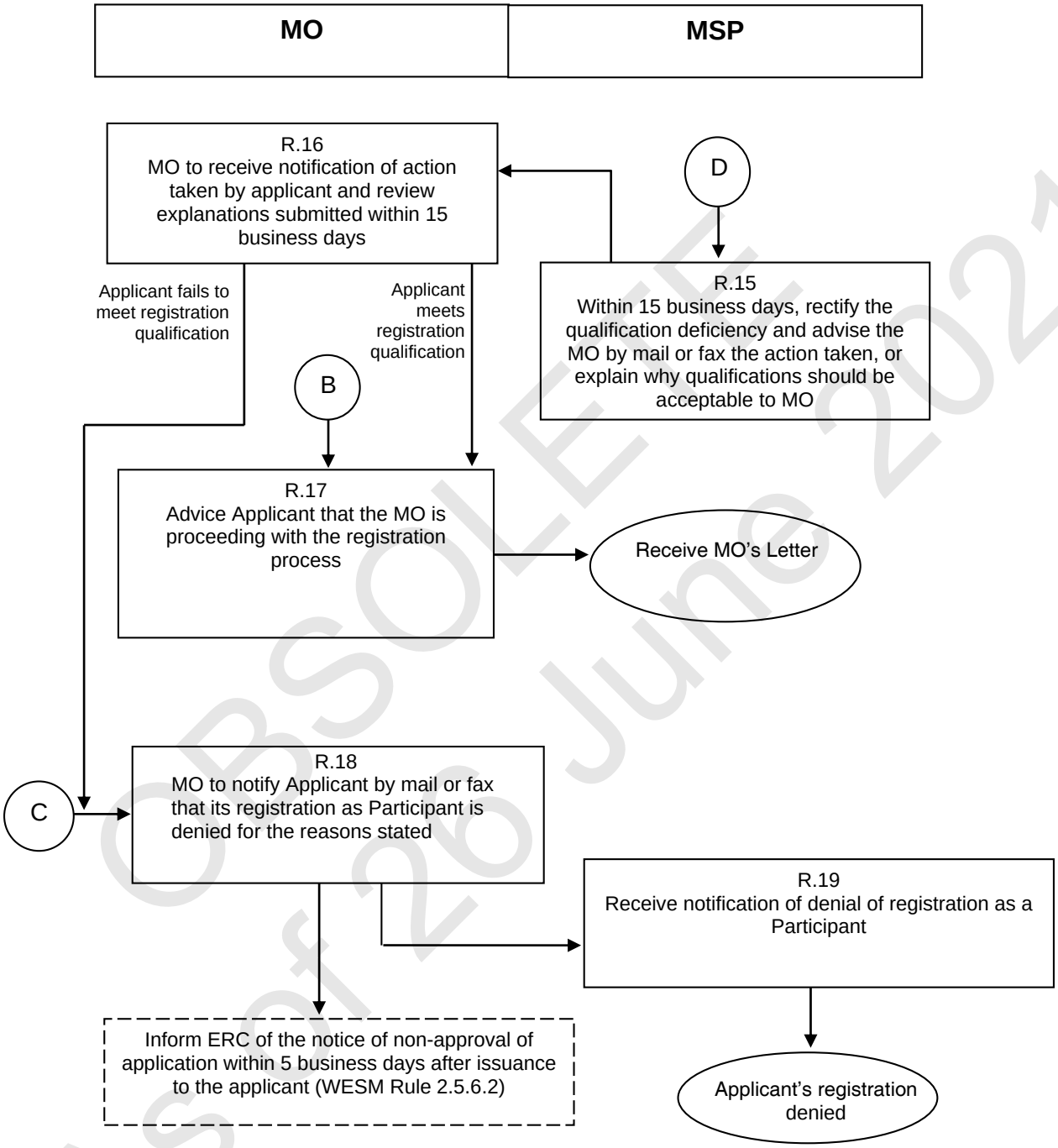
4.3. FLOWCHART AND PROCEDURAL STEPS

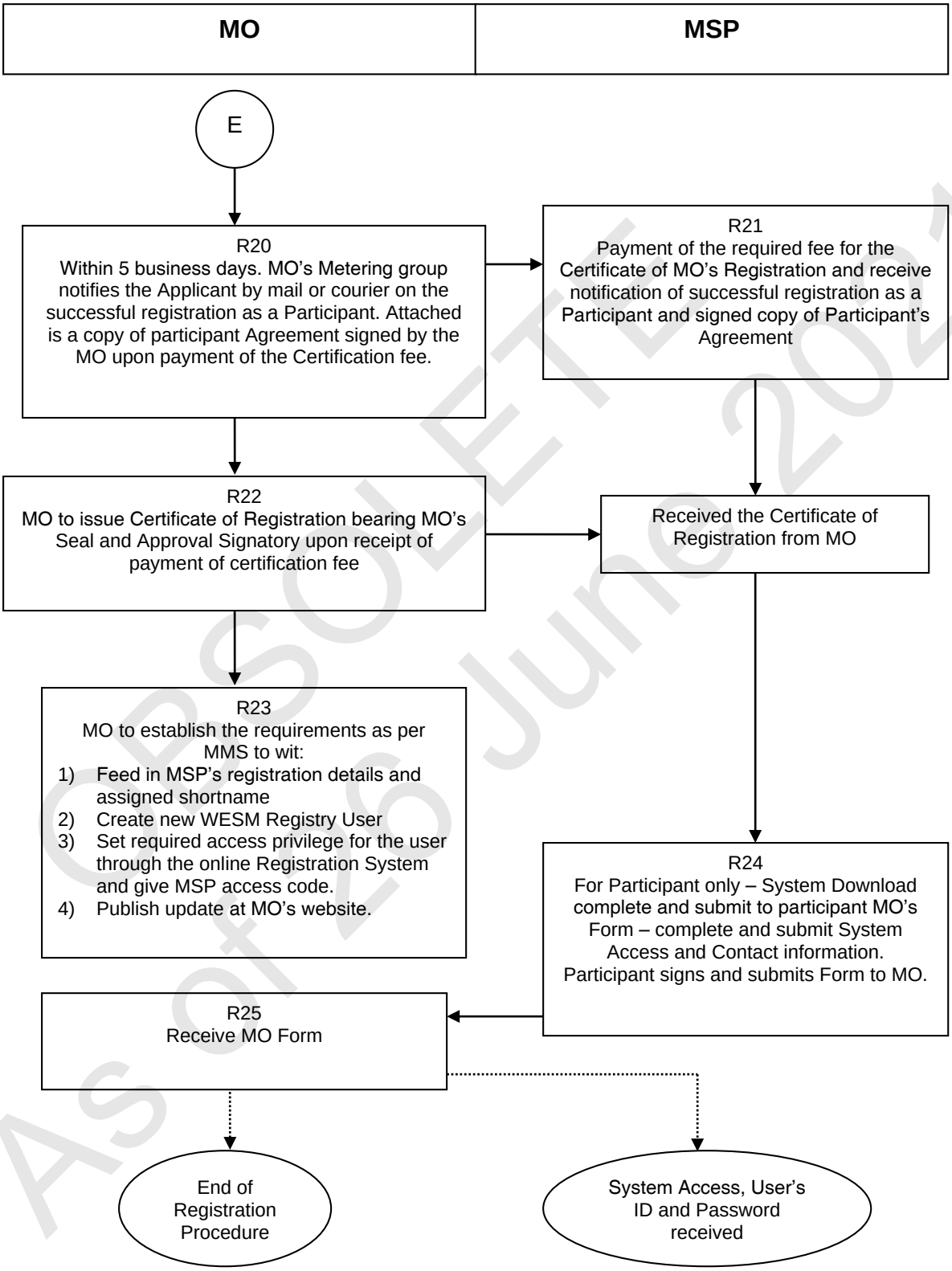
The following diagram represents the flow of work and procedural steps related to the Registration of the Metering Services Provider, to wit:

4.3.1. Procedural Workflow for Registration of Metering Services Provider









4.4. PROCEDURAL STEPS FOR METERING SERVICES PROVIDER REGISTRATION

Ref.	Task Name	Task Detail	When	Resulting Information	Method	Completion Events
R.01	Retrieve and print "MSP's Application form" from MO Web site.	Applicant downloads and prints required forms from the MO Web site.	When applicant wishes to register as a Participant		MO Web site	
R.02	Completion of Applicant forms and required documents	Applicant completes required forms and submit the application form and all required documents including ERC's Certificate of Authority	After Step R.01.	Submission of completed forms and the required documentation.	By Courier	
R.03	Transmission of MSP's Application Form and Prepare payment for Registration Fee.	Applicant to transmit the application forms and required documents to MO and pay registration fee.	After Step R.02.		Mail or courier	
R.04	Receive completed MSP's Application Form and fee	MO receives MSP's application form and all required documents and fees from the Applicant.	After Step R.03.		Mail or courier	
R.05	Acknowledge receipt of documents.	MO sends acknowledgement letter to Applicant.	After Step R.04.		Mail or courier	
R.06	Determine whether further clarification is required.	MO reviews documentation to determine whether additional information or clarification is required in order to proceed with registration.	After Step R.05.			

Ref.	Task Name	Task Detail	When	Resulting Information	Method	Completion Events
R.07	Acknowledge receipt of documents.	MO sends acknowledgement letter to Applicant.	After Step R.06.		Mail or courier	
R.08	Determine whether further clarification is required.	MO reviews documentation to determine whether additional information or clarification is required in order to proceed with registration.	After Step R.07.			
R.09	Notify Applicant, within 5-business day of receipt, of the requirement for further information or clarification.	MO sends to Applicant a letter requesting further information or clarification.	Within 5 business days after Step R.08, if further clarification required.		Mail or fax	
R.10	Receive request for further information or clarification.	Participant Applicant receives request from MO for further information or clarification.	After Step R.09.			Applicant withdraws, if it does not want to proceed.
R.11	Provide additional information or clarification, as requested by MO.	Applicant sends to Metering Group of MO the requested information.	Within 15 business days after Step R.10, if Applicant wishes to proceed.		Mail or fax	
R.12	Receive additional information from Applicant.	Applicant wishes to proceed and send the additional documents to MO.	After Step R.11. w/in 5 business days		Mail or fax	

Ref.	Task Name	Task Detail	When	Resulting Information	Method	Completion Events
R.13	Determine whether information is now complete.	MO reviews the new information and determines its completeness.	After Step R.12.	MO repeats Step R.08 if information is not complete.		
R.14	Determine whether Applicant meets the qualifications for registration. w/in 5 business days	MO reviews the Applicant's qualifications.	After Step R.13 or Step R.06, where information is complete.	MO proceeds to Step R.18 if satisfactory. Otherwise MO goes to R.13.		
R.15	Advise Applicant within 15 business days of intention to deny registration, giving reason for the decision.	If the Applicant is deemed unqualified, the MO advises Applicant of intention to deny registration, stating reasons for this decision.	Within 15 business days after Step R.14, if Applicant does not comply with requirements.		Mail or fax	
R.16	Receive notification of intention to deny registration.	Participant Applicant receives notification from MO of intention to deny registration.	After Step R.15.		Mail or fax	Applicant withdraws, if it does not wish to proceed.
R.17	Rectify the qualification deficiency or explain why qualifications should be acceptable to MO w/in 15 business days	If the Applicant wishes to proceed with registration, Applicant advises MO of actions taken or explanations as to why qualifications should be acceptable to MO.	Within 15 business days after Step R.16, if Applicant wishes to proceed with registration.		Mail or fax	

Ref.	Task Name	Task Detail	When	Resulting Information	Method	Completion Events
R.18	Receive notification of action taken by Applicant and review explanations submitted.	MO receives and reviews the Applicant's notification of action taken by Applicant or the explanations submitted.	After Step R.17.	Decision on whether the Applicant now qualifies. If not, go to Step R.33. If yes, proceed to Step R.17.		
R.19	Advise Applicant that MO is proceeding with the registration process	If the Applicant meets the registration qualifications, the MO advises Applicant of MO's intention to proceed with the registration process	After Step R.18		Mail of Fax	Applicant receives letter from the MO stating that the registration process will continue
R.20	Received Notification	Applicant had received the notification that its registration had been denied			Mail or fax	Applicant's Registration is denied – ERC to be notified by MO
R.21	Within 5 business days, notify Applicant of its successful registration as a Participant and payment of the Certification fee	Within 5 business days of the Applicant attending the Procedures Review, the MO notifies the Applicant of its successful Registration as a Participant. Upon payment of the Certification Fee,				After payment of the required fee, the Applicant shall receive notification of successful registration

Ref.	Task Name	Task Detail	When	Resulting Information	Method	Completion Events
R.22	The Participant shall receive notification of successful Registration as a new MSP, upon Payment of the Certification Fee.	After payment of certification fee, the Participant receives notification of successful Registration	After Step R.21.			
R.23	MO to establish the requirements as per MMS	These are among others: 1.) Feed in MSP's registration details & assigned short name 2.) Create new WESM Registry User Set the required access privilege for the User through online Registry System & give to MSP the access code ETC				
R.24	MO to issue Certificate of Registration with the Seal of MO	After payment of the certification fee, the participant shall receive the Certificate of Registration from the MO	After R.23			
R.25	Update register of Participant	MO updates the registry of Participant with name of Applicant and publishes updated register on the MO Web site.	After Step R.24.		Web publishing	Updated Participant Register published on the MO Web site.

Ref.	Task Name	Task Detail	When	Resulting Information	Method	Completion Events
R.26	Download, complete and submit to Participant, MO Form, Participant System Access and Contact Information.	Download from the MO Web site, complete and submit the required form to your Metered Trading Participant. Participant signed MO Forms to MO.	After Step R.25	System access for Participant Only is initiated.	Mail, courier or fax	System access requested.
R.27	Receive MO-FORM.	The MO receives the System access information. Using “MO-FORM Participant Revenue Metering System Password” sends the password for the Market Management System (MMS).	After Step R.26	System access User IDs and Passwords		Participant has access to MO Systems. End of Registration procedure.

SECTION 5 METERING INSTALLATION REGISTRATION

5.1. INTRODUCTION

All Trading Participants (Generators and Customers) who are direct WESM members, through their Metering Services Providers (MSP) are required to register their Metering Installations with the Market Operator (MO) before they will be allowed to participate in the WESM.

5.2. PREPARING FOR METERING INSTALLATION REGISTRATION

In order to qualify for the registration of potential delivery points and be allowed to participate in the WESM, the Trading Participant and/or its Metering Services Provider must be able to demonstrate the following requirements prior to registration with the Market Operator (MO):

5.2.1. Read and understand relevant sections about the "Metering Installations" detailing the requirements of the harmonized version of relevant sections of the WESM rules, the Philippine Distribution Code and the Philippine Grid Code;

5.2.2. Metering installations installed by the Trading Participant/Metering Services Provider shall consists of meters compliant with WESM rules:

5.2.3. Demonstrate to the Market Operator that the Trading Participant's MSP has successfully conducted a commissioning test for new Metering Installation. On the other hand, the Trading Participant's MSP shall submit reports of all commissioning test for existing Metering Installation.

5.2.4. An End to End Test to satisfy the MO's requirements on the successful examination of the Metering Installation and ensure the accuracy of the meter data shall be performed by the Trading Participant's MSP.

5.2.5. MSP shall demonstrate or provide proof that the metering equipment and metering data are provided with adequate security system;

5.3. REGISTRATIONS AND SUBMITTALS

5.3.1. The three types of Metering Installations to be registered are:

5.3.1.1. Main and alternate meter, of revenue quality meters, with the same accuracy class and features. The alternate meter is not mandatory;

5.3.1.2. Main and check meter, of revenue quality meters, with the same accuracy class, but the check meter has lesser features than the main meter. The check meter is not mandatory;

5.3.1.3. Main or Single meter, of revenue quality type.

5.3.2. Pertinent Documents to be submitted by the Trading Participant in coordination with its MSP:

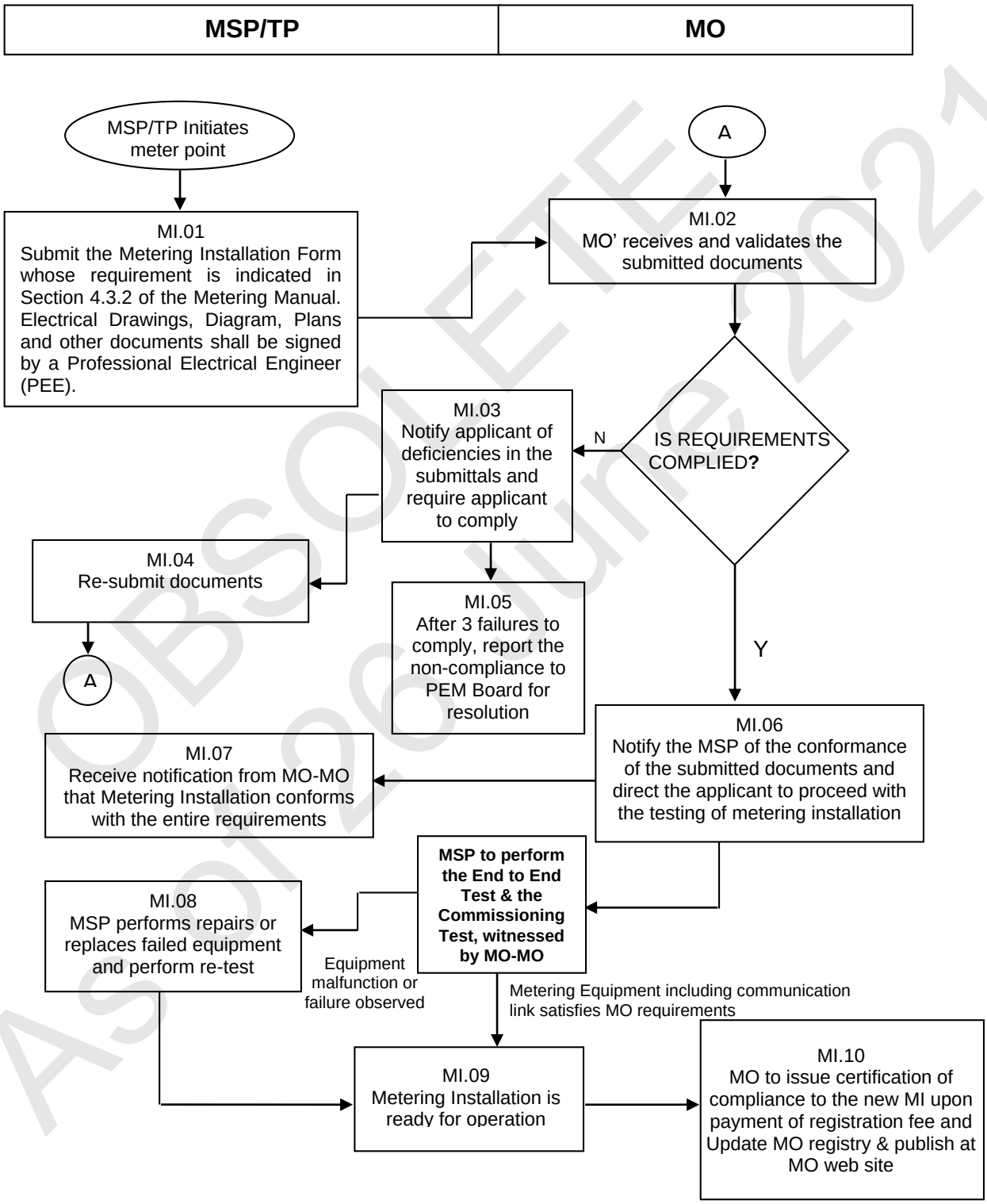
5.3.2.1. Accomplished Metering Installation Form;
5.3.2.2. Metering Installation Specifications;
5.3.2.3. Load Profile (Forecast, Historical Data, including Maximum and Minimum Hourly Demand)
5.3.2.4. Data of Connected Transformers (Core & Copper Loss)
5.3.2.5. Data of Radial Lines from the Market Trading Node to the Metering Point.
5.3.2.6. Drawing of the Location Plan of the Metering Point;
5.3.2.7. Single Line Diagrams from Grid Substation to the Metering Point
5.3.2.8. Detailed Wiring Diagram of the Metering Installation
5.3.2.9. ERC's Certification on Meter Test Results (with ERC Seal)
5.3.2.10. Test and calibration reports of Instrument Transformers and Meters;
5.3.2.11. Pro-forma Agreement between Trading Participant and its MSP; and
5.3.2.12. Other Special Features of the Meter.

Note: All drawings, plans, wiring diagrams shall be signed by a Professional Electrical Engineer (PEE).

5.4. WORKFLOW AND PROCEDURAL STEPS

The following diagram represents the work flow and information between the interfacing of the MO and the MSP in registering the Metering Installation. Also featured in this manual are the procedural steps to be followed by the Metering Services Provider in registering the Metering Installation/facilities.

5.4.1. Workflow for Registration of Metering Installation



5.5. PROCEDURAL STEPS FOR REGISTRATION OF METERING INSTALLATIONS

Ref.	Task Name	Task Detail	When	Resulting Information	Method	Completion Events
MI.01	Submission of Application Form and pertinent documents	Submit the application form with the following documents: Electrical Diagram, Metering Installation Specification and Documents, Metering Point Locations, Drawings, Load (Demand) Forecast of Metering Installation, Transformer Data, Agreement between MSP and TP (if any), Pictures of the Installation, Payment of Application Fee (submittals should be signed by a PEE)	MSP initiates the Metering Installation Registration	Application Forms with the required documents was submitted to MO	By courier	MO receives the documents.
MI.02	MO receives and validates the submitted documents	MO validates the application form and the Metering Installation documents for completeness and conformance to standards	Following receipt of Form and submittals from MSP			
MI.03	Request clarification from MSP of requirements	The MO requests the MSP to provide further clarifications about the submitted forms and documents for no-conformance to MO requirements. If the MO decides the Metering Installation is not suitable for registration, then proceed to Step MI.05.	After the initial evaluation of the MO that submitted documents were found lacking in substance (if these circumstances happened	Notification by the MO requesting to fulfill its requirements	Fax, mail, or e-mail	The MSP receives the MO notification.

Ref.	Task Name	Task Detail	When	Resulting Information	Method	Completion Events
			repeatedly, proceed to Step MI.05)			
MI.04	Resubmit needed documents with clarification.	To continue the registration process, the MSP must resubmit to MO all the needed requirements.	After receiving the clarification request from the MO.	All the required documents with clarifications	mail or courier	The MO receives the documents.
MI.05	MO-MO reports the non-compliance of the MI to the PEM Board for resolution	After 3 failures to comply with the requirements.	After MI.03	MO Board decides to reject the registration of the MI	Fax, mail or courier	MI is not included in the rolls of WESM Member
MI.06	Notify MSP the conformance of the entire requirements and request for End to End test	MO notifies the MSP that the Metering Installation described in the submitted documents conforms to MO standards and requests the MSP to perform the End to End test.	After evaluating that the submitted documents' conform to MO's requirements complete.	Notification by MO stating that the MSP's documents conform to MO requirements.	Fax, mail, or e-mail	The MSP receives notification.
MI.07	Receive notification of conformance.	MSP receives notification of conformance and should pay the necessary registration fees.	After Step MI.06.		Fax, mail, or e-mail	

Ref.	Task Name	Task Detail	When	Resulting Information	Method	Completion Events
MI.08	MSP to rectify all uncovered problems	MSP has corrected the problems/failures concerning the end to end test	After MSP performs the end to end test by and uncovers some failures or problems			MSP's Metering Installation is ready for testing
MI.09	Metering Installation is ready for operation	MSP's Metering Installation satisfactorily passed the end to end test as witnessed by MO and ready for operation,	After MI.08			
MI.10	Updating of the MO's registry and Publishing it at MO's Web site	MO to issue a certificate of compliance to the new Metering Installation upon payment of registration fee and Update its registry and published the new Metering Installation of the MSP at MO's Web site	After MI.09			End of registration process of MSP's MI

SECTION 6 METERING DATA COLLECTION

6.1. INTRODUCTION

The Metering Services Provider (MSP) is primarily responsible for and in behalf of the Trading Participant (TP) to collect and deliver Metering data to the Market Management System (MMS) of the Market Operator (MO). Revenue Meters and/or data collection system of the MSP must be capable of electronic, remote communication with the MO's meter Interrogation System to transfer Metering data. The MO will publish on its web site the metering data for the time period covered by the settlement process in accordance to section 4.8 of the WESM rules. If remote acquisition of metering data becomes unavailable, the MO will contact the Metered TP or MSP to arrange an alternate means of transferring the data.

6.2. DATA COLLECTION

The meter data collection process shall be done in the following manner:

6.2.1. The Registered MSP shall collect meter data the previous day (for the 24 hour period) from each Metering Points of their respective TPs (Generators or Customers) including meters which are remotely connected by means of their meter data retrieval systems starting at 12 midnight. Then all configured data shall be transmitted to the MMS every 4 AM the succeeding day. However, the MSP shall not make, cause or allow any alteration to the original stored meter data as retrieved in the metering installation; and

6.2.2. In case of remote communication failure, with prior notice to MO, the MSP shall manually retrieve the meter data and transmit or deliver it to the MMS.

6.2.3. However, MO may opt to perform remote data collection on the affected meters using its own MMS's data collection system with prior notice to the MSP.

All meter data delivery/transmittal shall be in accordance with established procedures.

All meter clocks shall be synchronized by the MSP with the Philippine Standard Time (PST) to ensure accuracy of settlements as per section 4.5.8 of the WESM rules.

6.3. METERING DATABASE

The Metering data recorded in the Metering database with respect to a registered wholesale meter is confidential information and will only be made available to:

6.3.1. TP whose settlement statement is determined on the basis of the Metering data recorded in that registered wholesale meter;

6.3.2. The MSP for that registered wholesale meter; and

6.3.3. Network Service Provider to whose system a TP is connected using a separate WESM Metering Installation.

The TP may query the Metering database for the purpose of reviewing the Metering data to determine its correctness.

6.4. INTERFACE AND DATA FLOW

Pursuant to Section 4.6 of the WESM Rules, the data that comes in from the Data collection system shall be subjected to Validation, Estimation and Editing (VEE) processes to ensure integrity of the metered data for settlement purposes. This MMS process involves various interfaces which comprises the following:

6.4.1. The MSP will collect daily the 24-hour metered data of the previous day and shall transmit/deliver it to the MMS of the MO within the 4th hour of the succeeding day.

6.4.2. The following contents shall be needed by the MMS from the metered data:

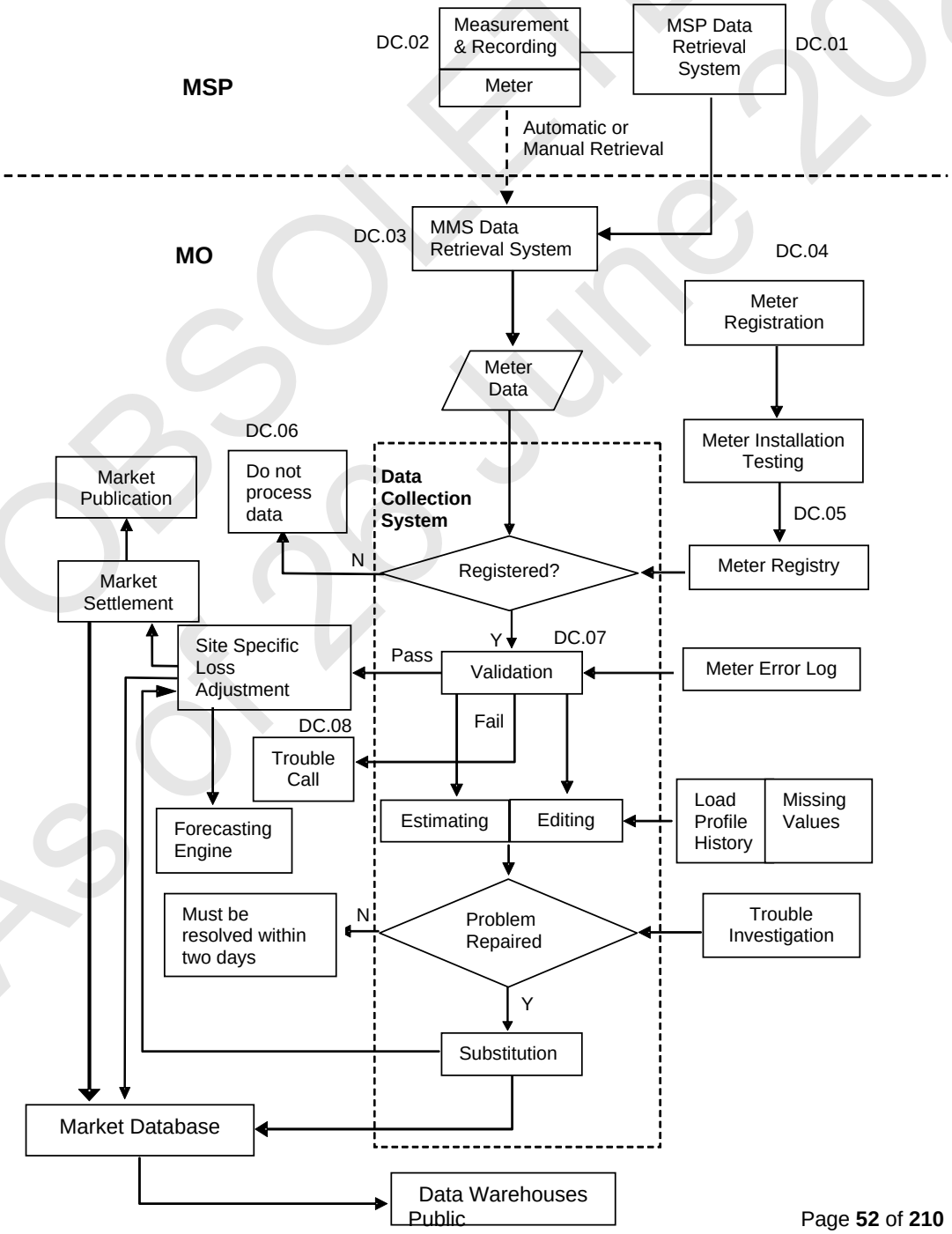
6.4.2.1. Date and time (Time Series) of meter readings received for each meter and the Meter data exchange format.
6.4.2.2. The meter data in kwh (Energy) with assigned channel number.
6.4.2.3. Site Equipment Identification Number (SEIN) or Recorder ID of Meter (RevMeterID/Meter Point).
6.4.2.4. Meter Serial Number
6.4.2.5. Substation (Market Node)
6.4.2.6. Substation Voltages
6.4.2.7. Resolution (every 15 minute)
6.4.2.8. Minimum and Maximum Value of meter data

6.4.3. The Metering Services Provider shall submit the metering data in meter data exchange format or any other secured format as required by the Market Operator.

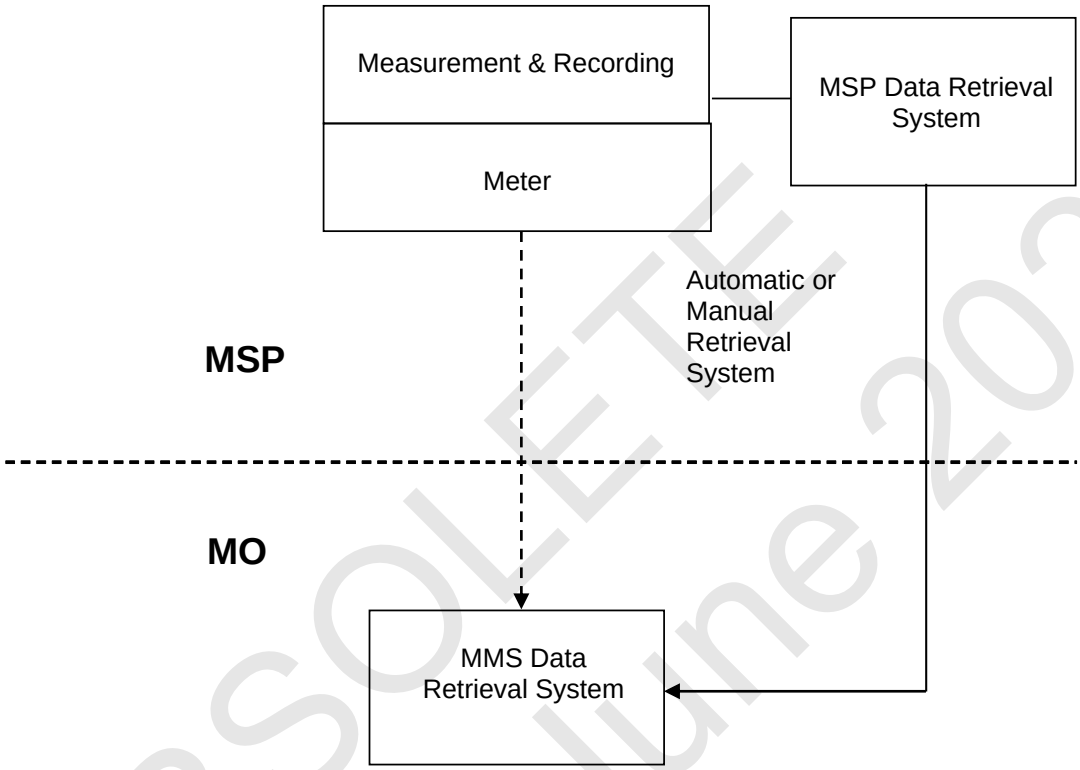
6.5. WORKFLOW AND PROCEDURAL STEPS

The following diagram represents the work flow and procedural steps regarding the interfacing of the MSP and the MO in relation to the metered data.

6.5.1. Metering Data System Workflow



6.5.2. Metering Data Collection Workflow



6.6. METERING DATA COLLECTION PROCESS

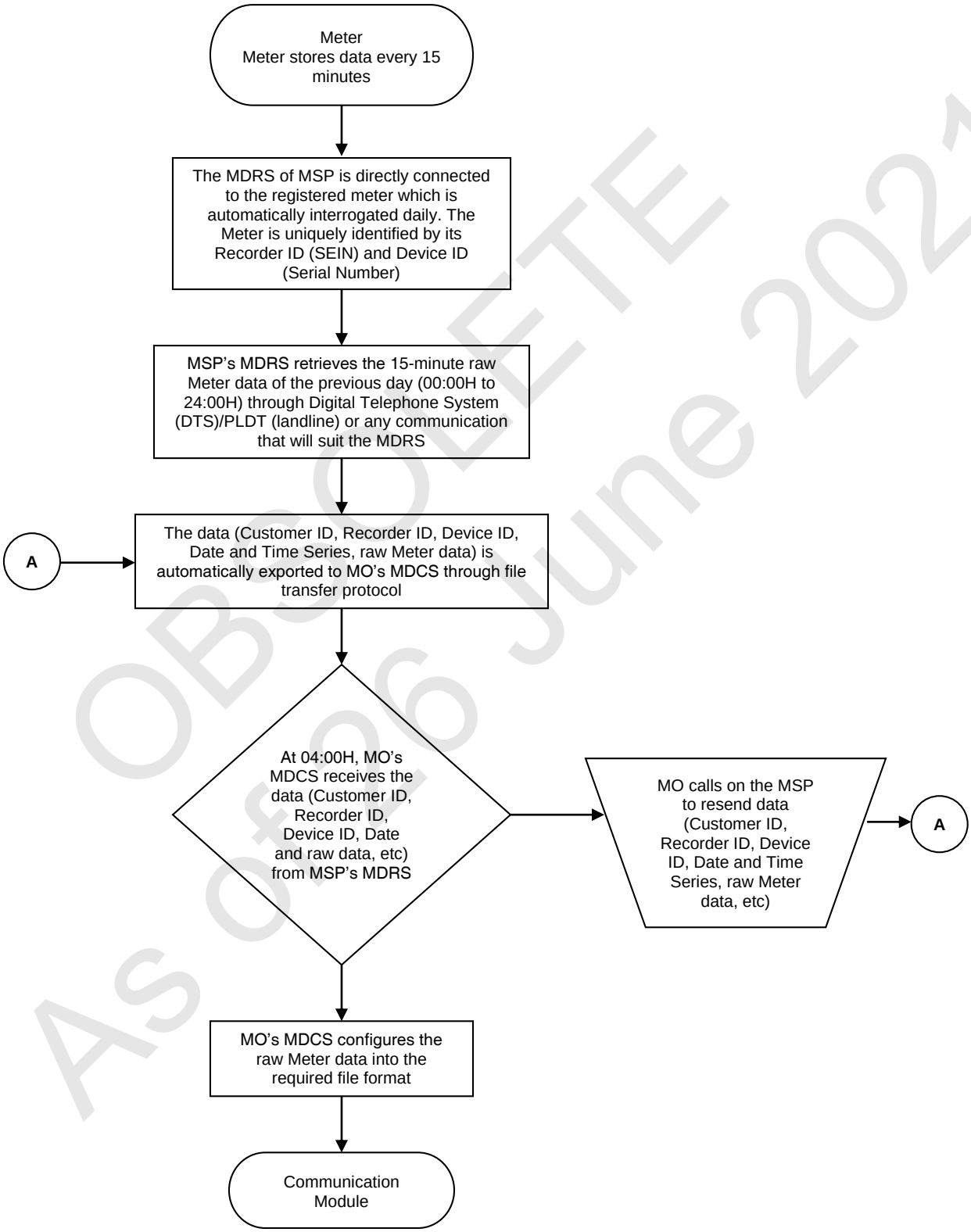
Ref	Requirement	Frequency/Method	Where/Who	From	To
DC.01	Measuring and recording of Metered data (kWh, Kw, kVArh and kVAr)	Continuous, 15-minute interval	Meter/MSP	MSP	MO
DC.02	Recording of event logs	Per occurrence	Meter/MSP	MSP	MO
DC.03a	Electronic downloading of Metered data/event log	Daily Automatic	MSP	Meter	MSP
DC.03b	Manual downloading of Metered data/event log	Daily As instructed by MO in case of meter trouble.	MSP	Meter	Temporary Collection System (e. g. laptop)
DC.03c	Uploading of Metered data/event log	Daily Automatic	MSP	MSP Temporary Collection System	MO Meter Data Collection System

6.7. METER DATA RETRIEVAL SYSTEM

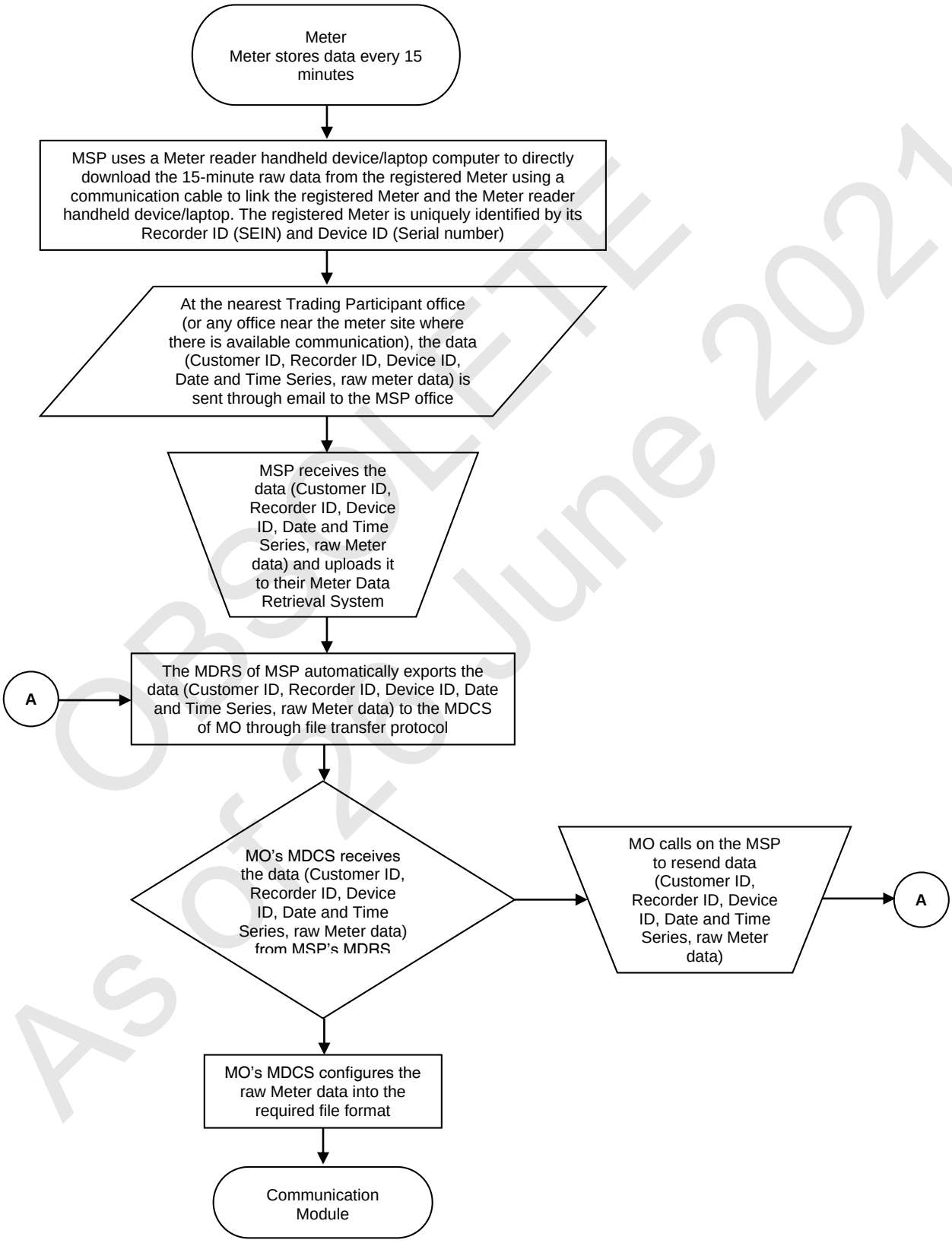
6.7.1. The MMS Data Retrieval/Collection System of the MO has three (3) different ways to communicate with the meters and communication system with MSP, to wit:

6.7.1.1. Meter Data Retrieval of MSP to Meter Data Collection System of MO
6.7.1.2. Meter Data Flat File to Meter data Collection System of MO
6.7.1.3. Meter to Meter Data Retrieval/Collection System of MO

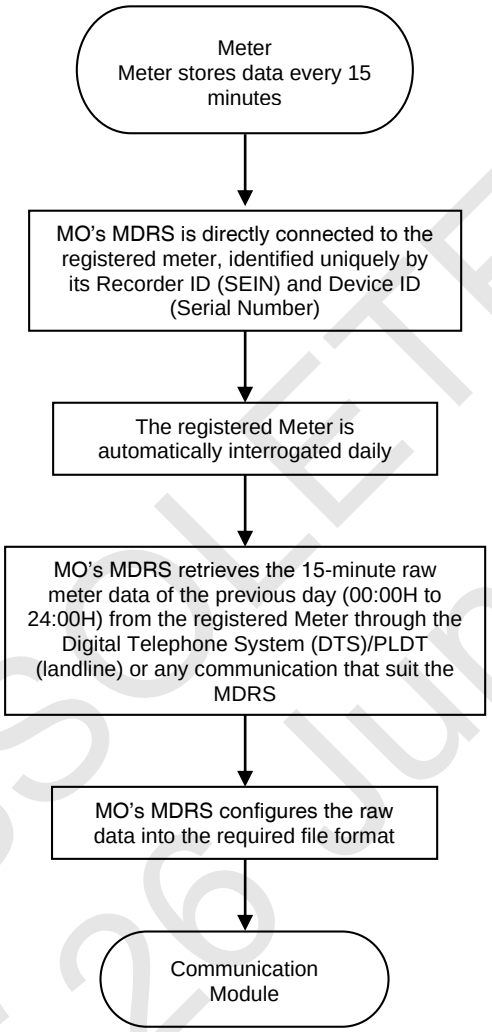
6.7.1.1 Meter Data Retrieval System (MDRS) of MSP to Meter Data Collection System (MDCS) of MO:



6.7.1.2 Meter Data Flatfile to Meter Data Collection System of MO:



6.7.1.3 Meter to Meter Data Retrieval/Collection System of MO.



6.8. METER DATA RETRIEVAL/COLLECTION PROCEDURE

6.8.1. MSP's Meter Data Retrieval System to Meter Data Collection System of MO

Ref	Requirement	Frequency/Method	Where/Who	From	To
1	Meter reads and stores data	Continuous, 15-minute interval	Meter		
2	Retrieval of raw meter data of the previous day (0000H-2400H) through DTS/PLDT or any available communication line	Daily Automatic	Meter/MSP	Meter	MSP's MDRS
3	Meter data is exported to MO (0400H) next day	Daily Automatic	MSP	MSP's MDRS	MO's MDCS
4	Meter data is received by MO	Daily Automatic	MO		
5	Configure the raw meter data to Required file format	Daily Automatic	MO		

6.8.2. Meter Data Flat File to Meter Data Collection of MO (In case of communication failure)

Ref	Requirement	Frequency/Method	Where/Who	From	To
1	Meter reads and stores data	Continuous, 15-minute interval	Meter		
2	Retrieval of raw meter data through meter reader handheld device or laptop	Daily/Weekly Manual	Meter/MSP	Meter	Meter Reader Handheld Device/Laptop
3	Meter data is e-mailed	Per occurrence	MSP	MSP (Field)	MSP (Main) where the MDRS is located
4	Meter data is received & uploaded to MDRS	Per occurrence	MSP		
5	Meter data is exported and received by MO's MDCS	Automatic	MSP	MSP's MDRS	MO's MDCS
6	Configuration of raw meter data to the required file format	Automatic	MO		

6.8.3. Meter to Meter Data Retrieval System of MO

Ref	Requirement	Frequency/Method	Where/Who	From	To
1	Meter reads and stores data	Continuous, 15-minute interval	Meter		
2	Retrieval of raw meter data of the previous day (0000H-2400H) through DTS/PLDT or any available communication line	Daily Automatic	Meter/MO	Meter	MO's MDRS
3	Configuration of raw meter data to the required file format	Daily Automatic	MO		

6.9. EMERGENCY PROCEDURES

In case of failure of MSP's Meter Data Retrieval System (MDRS) and/or emergency situations that require transfer of the MO metered data processing operation from the Main Server to the Emergency Back-up System (EBS), the procedural steps to address the situation shall be as follows:

6.9.1. Failure of the MSP Meter Data Retrieval System

6.9.1.1. MSP

6.9.1.1.1. Inform MO of the occurrence of the failure of its MDRS.

6.9.1.1.2. Perform emergency restoration of its MDRS.

6.9.1.1.3. While the MDRS is out of service, retrieve all required metered data using alternative methods of retrieval and submit it within seven (7) days to MO in a file format that is compatible with the MO system. .

6.9.1.1.4. For this purpose, the MSP may use a backup MDRS if it is available, or retrieve the metered data on-site or remotely using the proprietary meter software.

6.9.1.2. MO Upon receipt of metered data, perform VEE and process the metered data for billing and settlement.

6.9.1.3. MSP

6.9.1.3.1. Inform MO when its MDRS is ready to resume normal operation.

6.9.1.3.2. Resume normal retrieval and transmittal of metered data using the MDRS

6.9.2. In case of technical problems and emergency situations at the MO Main Server that necessitate transfer of operation to the Emergency Back-up System (EBS):

6.9.2.1. MO

6.9.2.1.1. Inform the MSPs and the TPs of the need to transfer operations from the Main Server to the EBS; and instruct MSPs to transmit the metered data to the EBS.

6.9.2.1.2. Activate the EBS, upload the metered data and perform VEE process for billing and settlement.

6.9.2.1.3. Performs emergency restoration of its Main Server

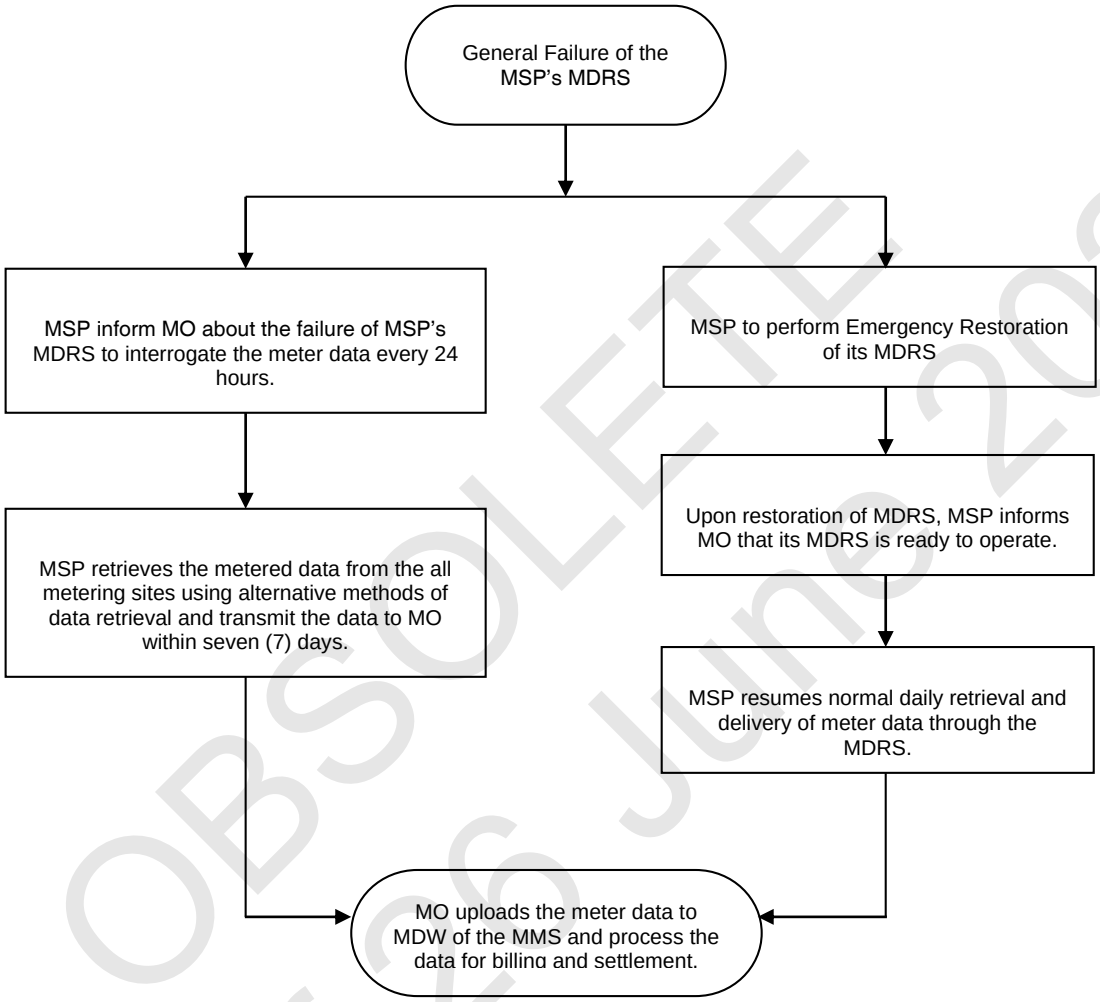
6.9.2.2. MSP Transmit the metered data to MO-EBS.

6.9.2.3. MO When the MO is ready to resume operation at the Main Server, inform the MSPs to resume metered data transmittal to the Main Server.

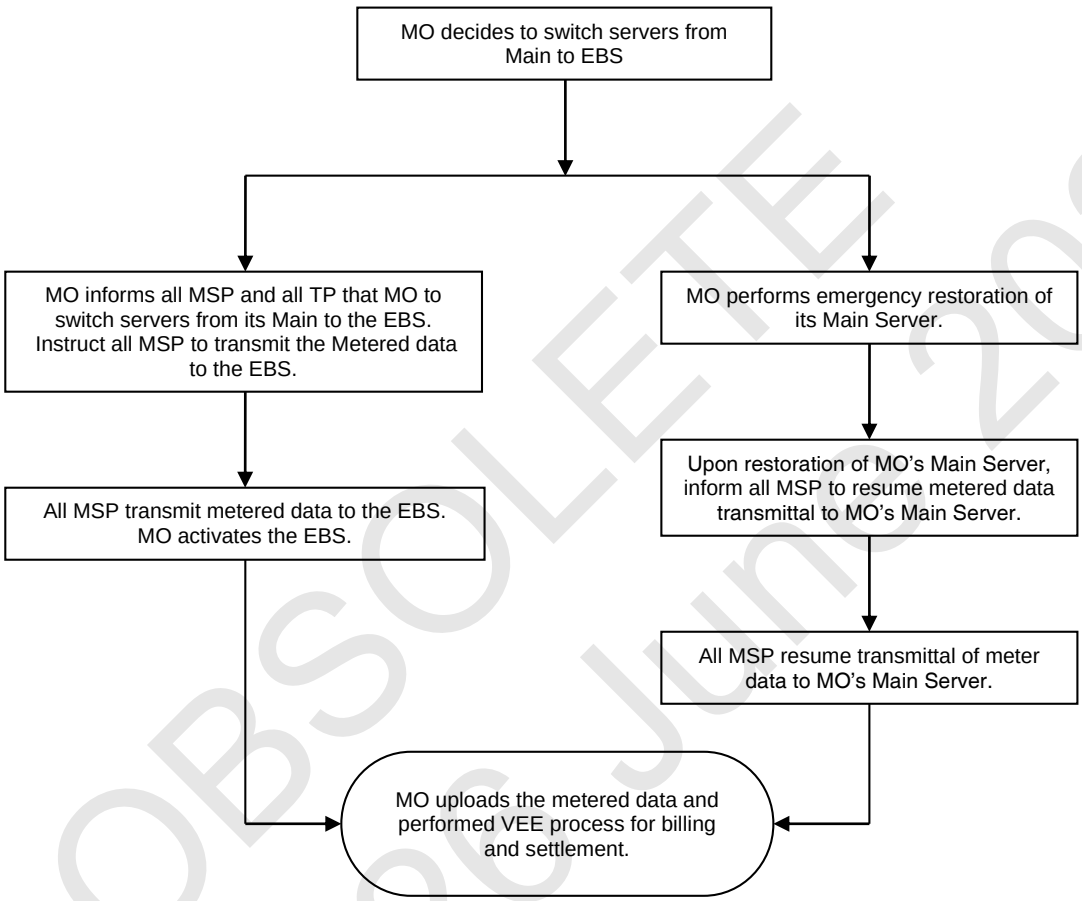
6.9.2.4. MSP Resume transmittal of metered data to the MO Main Server.

6.9.2.5. MO Resume operations at the Main Server. Upload the meter data and perform VEE process for billing and settlement.

6.9.3. Failure of MSP Meter Data Retrieval System



6.9.4. Switching of Servers from Main Site to EBS by MO



SECTION 7 DATA VALIDATION, ESTIMATION AND EDITING

7.1. INTRODUCTION

The Metering data collected by the Market Operator (MO) shall be reviewed using the Validation, Estimation, and Editing (VEE) process. The VEE process operates according to established schedule that ensures the integrity of the metered data suitable for settlement purposes as per Section 4.9 of the WESM rules.

7.2. GENERAL DESCRIPTION OF THE VEE PROCESS

7.2.1. The VEE Perspective

At the time the metered data were received by the Market Management System (MMS), it shall be evaluated using criteria as agreed among Trading Participants, Metering Services Provider (MSP) and the MO. Whether the metered data contains missing values, uncertain values or exceeds the max/min values, such data shall undergo validation, estimation and editing wherein substitutions of metered data should follow the establish policy using historical data or the best available information. In cases where metered data fails in the VEE process, MO will then issue trouble report and give instruction to the concerned MSP who should investigate the trouble and provide report to MO later.

The concerned Metering Services Provider may propose an adjustment to the edited value based on confirmed nature of failures. Once the metered data had undergone verification, all concerned parties including MO must agree to the proposed change.

7.2.2. Custodian of Metering Database

MO shall establish and maintains a database containing metered data transferred from each registered wholesale meter to the MMS in accordance with section 4.8.2 of the WESM rules. The metering database includes original energy readings, substitutions, estimations, and calculated values for all WESM complaint meters.

7.3. THE VEE PROCESS

7.3.1. Meter Value Validation

When the metered data is received by the MMS, several checks will be performed. The time series that fails the test will be reported according to four error categories:

7.3.1.1. Uncertain Value
7.3.1.2. Missing Values
7.3.1.3. Outside Min/max limits
7.3.1.4. Orphan values

7.3.2. Checks to be performed for the Meter Data

The following checks will be performed for the above values:

7.3.2.1. Evaluate the meter's maximum and minimum readings.

7.3.2.2. Verify the values of the check meter if check meter is available.

7.3.2.3. Verification for the values of the metered data whose meter is not registered in the MMS, master lists which are known as the "Orphan Values".

7.3.2.4. Review the historical meter readings which fall outside defined parameters max/min of the historical data. The historical data used for reasonability check is limited to:

a. Same value as last week
b. Same value as the same hour during the previous day of the same type (i.e. weekday or weekend)

7.3.3. Meter Values Validation Configuration

Minimum and maximum values for the metered data are recorded in the registry of the MMS' metering system. Any value that falls outside the range will be marked with status "uncertain".

7.3.3.1. Check against Historical Values

Check against historical meter data is executed by clock control or manually. This validation uses the following historical values:

a. Same value as last week

b. Same value as the previous day
c. Average of previous day

7.3.3.2. Check against Check Meter (if necessary)

The verification of values of the check meter is recorded in the MMS and the parameters to be checked should follow the same period.

7.3.4. Meter Values Validation Reporting

A special report is shown in the MMS wherein the errors in the three categories below are reflected:

7.3.4.1. Uncertain value. Values that failed the test against the check meter, the historical data check or the balance test.

7.3.4.2. Missing Values. This check is performed directly in the time series matrix.

7.3.4.3. Outside min/max limits. This check is performed directly in the time series matrix.

7.3.4.4. Comparing the check meter to another meter (main or alternate meter measuring the same power flow).

7.3.5. Meter Value Estimation

Meter values that are missing will be estimated and substituted for settlement purposes. This estimate shall be based on the following items:

7.3.5.1. Same value as last week

7.3.5.2. Same value as the same hour during the previous day of the same day type (i.e. weekday or weekend)

7.3.5.3. If the meter value for one interval is missing, estimation based on Interpolation between values

7.3.5.4. If the meter values for two or more intervals are missing, meter data from the alternate meter

7.3.5.5. In the absence of an alternate meter, historical data previously gathered from the main meter

7.3.5.6. For generators without alternate meters or historical, the real time ex-post (RTX) information

The estimated meter values shall be updated to their correct value upon submission by the Metering Services Provider (MSP) of the actual meter data obtained from the WESM compliant meters within the required period. A settlement recalculation run will be undertaken to implement the correct meter values into the settlement equation.

7.3.6. Meter Value Approval

All meter data that are received must be approved by the MO before they are used in the settlement process. These data are reviewed and verified using the methods as discussed in sections 7.1 to 7.5.

7.3.7. Meter Value Export

Settlement-ready values will be ready for transfer to the settlement process. Only approved values are transferable.

7.4. VEE – ESSENTIAL INDICATORS

7.4.1. Validation Tests for all Metering Installation

The MSP may perform its own validation of Metering Installation. The following are the validation test that maybe performed by the MSP.

7.4.1.1. Current and Voltage Check

This indicator detects the loss of voltage and/or current input to the meter due to failure of the supply from one or more instrument transformers or tampering.

7.4.1.2. Load Profile vs Meter Reading

These checks for corruption related to the meter multiplier.

7.4.1.3. Intervals Found vs. Interval Expected

Checks for missing intervals.

7.4.1.4. Time Synchronization

Checks for synchronism of meter clock to Philippine Standard Time/Data Collection System time.

7.4.1.5. Number of Power Outage Intervals

This indicator allows periods of zero primary power to be identified.

7.4.1.6. CRC/ROM RAM

CRC pertains to the hardisk, ROM is read only memory and RAM is random access memory. This is part of the internal component of the meters, which automatically flags down indicating failure of internal electronics of the meter.

7.4.1.7. Meter Clock over Flow

Flag generated by the meter indicating failure of internal electronics.

7.4.1.8. Hardware Reset

Flag generated by the meter indicating failure of internal electronics.

7.4.1.9. Time Reset

Indicates the interval in which the meter clock time has been changed creating either a shorter or longer interval.

7.4.1.10. Data Overflow on Interval

This indicates that the meter is creating more pulses than it can record in an interval or Data Collection System (DCS) can accommodate in an interval.

7.4.1.11. Number of Channels

The actual number of data channels from the meter does not match the number expected at the data collection System.

7.4.1.12. Changed Device ID

The internal device identifier does not match the value registered at the data collection System.

7.4.1.13. Watch Dog Time Out

This is the failure of the meter to return data in response to a poll within the required time frame. This is reported by some recorders when a watchdog register is tripped or activated.

7.4.1.14. Parity Error

This indicator determined by a parity error bit that is set by a recorder on a channel of data during status check or read/write function.

7.4.1.15. Event Log Check

Checks error messages and alarms recorded by the meter.

7.4.2. Main/Alternate/Check Meter Combination

Data from the alternate/check meter can be directly substituted for the main meter provided the equipment in the alternate/check meter installation is of revenue quality. However, if the main and the alternate/check meters are not installed at the same Connection Point, the alternate/check meter data must be adjusted to account for the physical losses.

7.4.2.1. Additional Tests Required for Main/Alternate/Check Meter Combination

a. Energy Comparison

For each dispatch interval (1 hour), the kWh delivered of the main meter shall be compared with the kWh delivered of the alternate/check meter. If the difference exceeds a predefined limit, Validation fails and a trouble call shall be issued. The process shall be repeated for kVArh delivered, kWh received and kVArh received of the main.

Note:

- The assignment of channel numbers in the main and alternate/check meter must be the same.
- The predefined limit shall be associated with the main meter data.

b. Demand Comparison

For each dispatch interval (1 hour), the active and reactive power demand values of the main meter shall be compared with the active and reactive power demand of to alternate/check meter.

7.4.2.2. Stand-alone Metering

a. Generally, the validation shall check the maximum/minimum energy limit and comparing it to historical data. The MO may opt to check/validate using its data collection system which is capable of performing the following test. No source of comparison data is available in stand-alone Metering; therefore, Validation must be based on the available data at hand.

i. High/Low Limit on Interval

Specifies maximum and minimum interval demand when exceeded.

ii. High/Low Limit on Energy

Specifies maximum and minimum energy when exceeded over the period being validated.

iii. Percentage Change on Interval

Flags validation failure if consecutive intervals differ by more than the specified intervals.

iv. Load Factor Tolerance

Flags Validation failure when the average load divided by the maximum load over the period being validated exceeds the prescribed level.

v. Power Factor Limit

Flags a Validation failure when the average power factor over the period being validated is less than the specified minimum.

vi. Zero Interval Tolerance

Flags a Validation failure if the total number of intervals containing zeroes over the period being validated exceeds the tolerance limit.

b. Voltage Check

i. If the values in all voltage channels is within the prescribe level, validation succeeds.
ii. If the values in one or two but not in all voltage channels are zero, a failure in the supply voltage is indicated.
iii. If the values in all voltage channels are zero and any of the current channels contain data, a failure in the supply voltage is indicated.
iv. If the values in all voltage and current channels are zero, the Validation succeeds.

c. Current Check

i. If the values in all current channels are greater than zero, Validation succeeds.
ii. If the value in one or two but not in all current channels is zero, a failure in the supply current is indicated.
iii. If all current values are zero, Validation succeeds.

7.4.3. Estimating, Editing and Substitution

When Validation indicates that the data from the main meter might be incorrect, the VEE software will automatically prepare an estimate. Data from the alternate or check meter will be substituted if these data passed Validation. If no other data is available or if data from alternate or check meter is also a suspect (fails Validation), the estimate shall be prepared based on the historical load pattern.

7.4.3.1. Main/Alternate/Check Metering

a. When energy comparison test fails, a trouble call shall be initiated to establish which meter data is incorrect. The alarms registered in the event log shall be examined to determine whether the problem is associated with the failure

of the main meter. If all tests carried out on the main meter do not indicate a problem, no Substitution from the alternate to the main shall be carried out.

b. If a test carried out on the main meter indicates a problem, data from the alternate/check meter shall be substituted for each dispatch interval where the energy comparison test fails. The data from the alternate/check meter shall pass the Validation tests before any Substitution is done.

c. If a test carried out on the main meter indicates a problem and the data from the alternate/check meter does not pass validation (or the alternate/check meter also indicates a problem), an estimated data based on historical load pattern shall be substituted.

d. The decision to use the substituted data in the settlement process shall be based on the results of the trouble call investigation.

7.4.3.2. Stand-Alone Metering

For stand-alone Metering, estimating shall be based on historical load pattern since no other data is available. Estimation Methods is in accordance with sections 3.1 to 3.5.

7.4.3.3. If there is insufficient data to implement the two methods, the method agreed between the TP and MO shall be applied automatically.

7.4.3.4. Use of Meter Register Reading Reading in VEE (As approved by PEM Board Resolution No. 2010-57 dated 25 August 2010)

Meter Register Readings (Present Index & Previous Index corresponding to the start and end of the period to be settled) may be used for the VEE process under the following circumstances:

a. Non availability of load profile capable meter
b. Failure of both main and alternate meters
c. Load profile data of the main/alternate meters is corrupted

The trading participant through its MSP is required to submit the meter register readings from an installed Statistical or Revenue-

class meter subject to the review and acceptance of the MO for use in the VEE process, based on the following criteria:

a. The meter where the register readings are taken measures the energy at the same metering point as the main meter. If the meter is not measuring at the same metering point as the main meter, corresponding adjustments for line and transformer losses shall be applied to the register readings.

b. The meter where the register readings are taken is certified by the MSP to have been tested and the error is quantified in a test report.

c. The register readings are adjusted for the meter error.

The meter register readings shall be treated by the MO in the following manner:

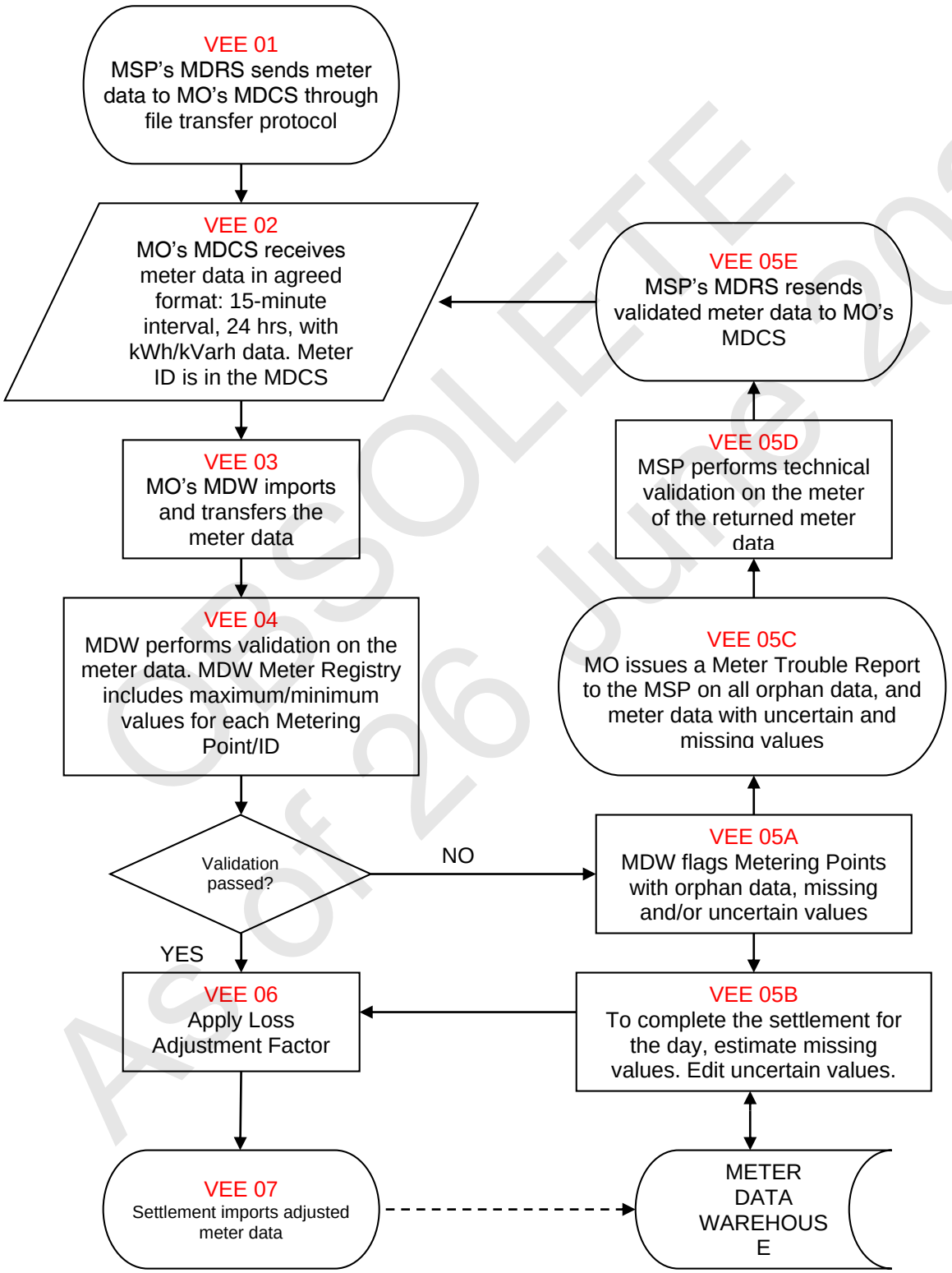
a. The hourly equivalent meter data shall be computed proportionately according to the load shape obtained from available RTU data corresponding to metering point for the time covered by the register readings, or to the load shape obtained from the historical load profile data for a similar day and time.

b. The hourly equivalent meter data shall undergo site – specific loss adjustment for any equipment between the market trading node and the meter.

c. Register readings for succeeding settlement periods shall be submitted by the trading participant through its MSP and shall be used by the MO until a load profile meter data is available.

7.4.3.5. The decision to use the substituted data in the **settlement** process shall be based on results of the trouble call investigation.

7.5. WORK FLOW FOR METERING DATA VALIDATION, ESTIMATION AND EDITING



7.6. PROCEDURAL STEPS FOR VALIDATION, ESTIMATION AND EDITING PROCESS

Ref.	Task Name	Task Detail	When	Resulting Information	Method
VEE 01	Sending the meter data	MSP's MDRS sends meter data to MO's MDCS	0745 H daily	Meter data is in the shared folder for file transfer protocol in the MDCS terminal	File transfer protocol
VEE 02	Receiving the meter data	MO's MDCS receives meter data in agreed format	After meter data has been sent by the MSP	Meter data is in 15min interval by 24 hours with kWh and kVarh data. Meter ID is recognized by MDCS Masterfile	None
VEE 03	Importing the meter data	Meter data is imported by MDW and the files are transferred	After meter data has been recognized by MDCS Masterfile	Meter data is recognized by MDW Masterfile	File import/transferred
VEE 04	MDW validation	MDW validates the meter data for good, orphan, uncertain, and missing values. MDW Meter Registry includes maximum/minimum values for each Metering Point.	After meter data has been imported by the MDW.	Meter data with orphan, missing and/or uncertain values are indicated in the MDW interface	Automatic validation
VEE 05A	Marking the validated meter data with flags	MDW flags meter data as orphan data, and meter data with missing and/or uncertain values	After meter data has been validated for maximum and minimum values limit.	Meter data values with flags	Automatic marking of flags
VEE 05B	MDW Estimation and Editing for daily settlement.	Manual estimation and editing of meter data with missing and/or uncertain data.	After meter data with flags are indicated in the MDW interface	Estimated missing values and edited uncertain values	Manual estimation and editing based on historical values
VEE 05C	Returning the orphan meter data and meter data with uncertain and missing values	MO issues a Meter Trouble Report to the MSP on all orphan data and meter data with uncertain and missing values	After meter data has been validated for maximum and minimum values limit	Returned orphan data and meter data with uncertain and missing values in the Meter Trouble Report	File transfer
VEE 05D	MSP validation	MSP performs technical validation on the meter of the returned meter data	Upon receipt of the returned meter data	Re-validated meter data	Per occurrence automatic validation
VEE 05E	Resending the meter data	MSP's MDRS resends re-validated meter data to MO's MDCS	After the MSP validation on the meter of the returned meter data	Re-validated meter data	File transfer
VEE 06	Application of Loss Adjustment factor	The site specific loss adjustment factor is computed for each metering point and is applied.	After validation, estimation and editing of meter data	Adjusted metering data	Manual computation for loss adjustment factor.
VEE 07	Settlement Import	Settlement imports corrected meter data for preliminary settlement	After application of loss adjustment factor	Meter data is stored in the MDW	--

SECTION 8 METER TROUBLE REPORT

8.1. INTRODUCTION

This chapter provides for instructions to the Trading Participants (TP) and their Metering Services Provider (MSPs) for the processing of Meter Trouble Reports (MTRs) to investigate potential problems with revenue Metering Installations.

The Metering Services Provider of TP should review the entries in the metering database in a timely manner so that discrepancies can be addressed before the preliminary settlement statement is issued by the MO. The MO will issue an MTR to the MSP for the affected meter to investigate the problem, perform repairs as required, and provide substitute metering data in accordance with this procedure.

8.2. METER TROUBLE REPORT (MTR)

The MO issues an MTR to the MSP for each meter for which it is responsible with data that fail the validation process, including missing data. MTRs are initiated by the said Metering Group, MSPs and/or TPs who experience difficulties communicating with a Metering Installation or validation of meter data. An MSP and/or TP may inform and request that the MO to issue an MTR. Where the MO determines that an MTR is not required, it notifies the TP and/or MSP of its decision.

The market rules contain strict timelines with respect to MTR processing. These timelines are required to ensure prompt resolution of all MTRs and maintain the integrity of the settlements process. MSPs are expected to meet these timelines and all exceptions are tracked by the MO. MTRs that are not resolved within timelines specified in the Metering standard can trigger sanctions and data estimates for the Metering Installation of the TP.

The MO is required to issue a MTR within 24 hours after its detection, to the associated MSP and promptly notify the TP when it becomes aware of a potential defect or malfunction at a Metering Installation. After notification and within two (2) business days, the MSP is required to implement the Emergency Restoration Plan and shall also inform the MO of such plan. If the MTR is still unresolved after seven (7) business day, the MO shall implement estimates (historical loading) for the resolution of the preliminary settlement of the Trading Participant. The MSP is also allowed up to twelve (12) business weeks to rectify the instrument transformer malfunction.

8.2.1. Improving Efficiency in Resolving MTRs

In case of outages, a TP and/or its MSP shall notify MO within 24 hours after its occurrence. All *TPs* may use the Metering Outages Form to notify their *MSP* and *MO* of any *outages* that may affect the metering data. The *MSP* will use this information to resolve MTRs that have been issued. Appendix A shows a sample of the form and instructions for completion.

To access the MTR system, individuals in a TP or MSP organization, require a User ID and password. To obtain a User ID, download the following form from the MO Web site and complete it as directed including the appropriate signatures. Return the completed form to the MO. The Information Systems Group of MO will notify the user of the User ID and password.

8.2.2. Unresolved MTRs

As described in Section 2.0 of this document, the MO can implement the VEE of metering data, when MTRs are not resolved within specific periods. These estimates remain in place until the MTR is rectified to the MO's satisfaction.

If the MSP resolves the MTR and subsequently provides metering data acceptable to the MO for the period in which the estimates were created, the MO replaces those estimates with that metering data. The TP/MSP must make the metering data available to MO within three (3) to seven (7) business days before the final statement date(s) for the trading day(s) affected. If the TP/MSP does not make the metering data available to the MO by this deadline, the MO estimates will appear on the final statement.

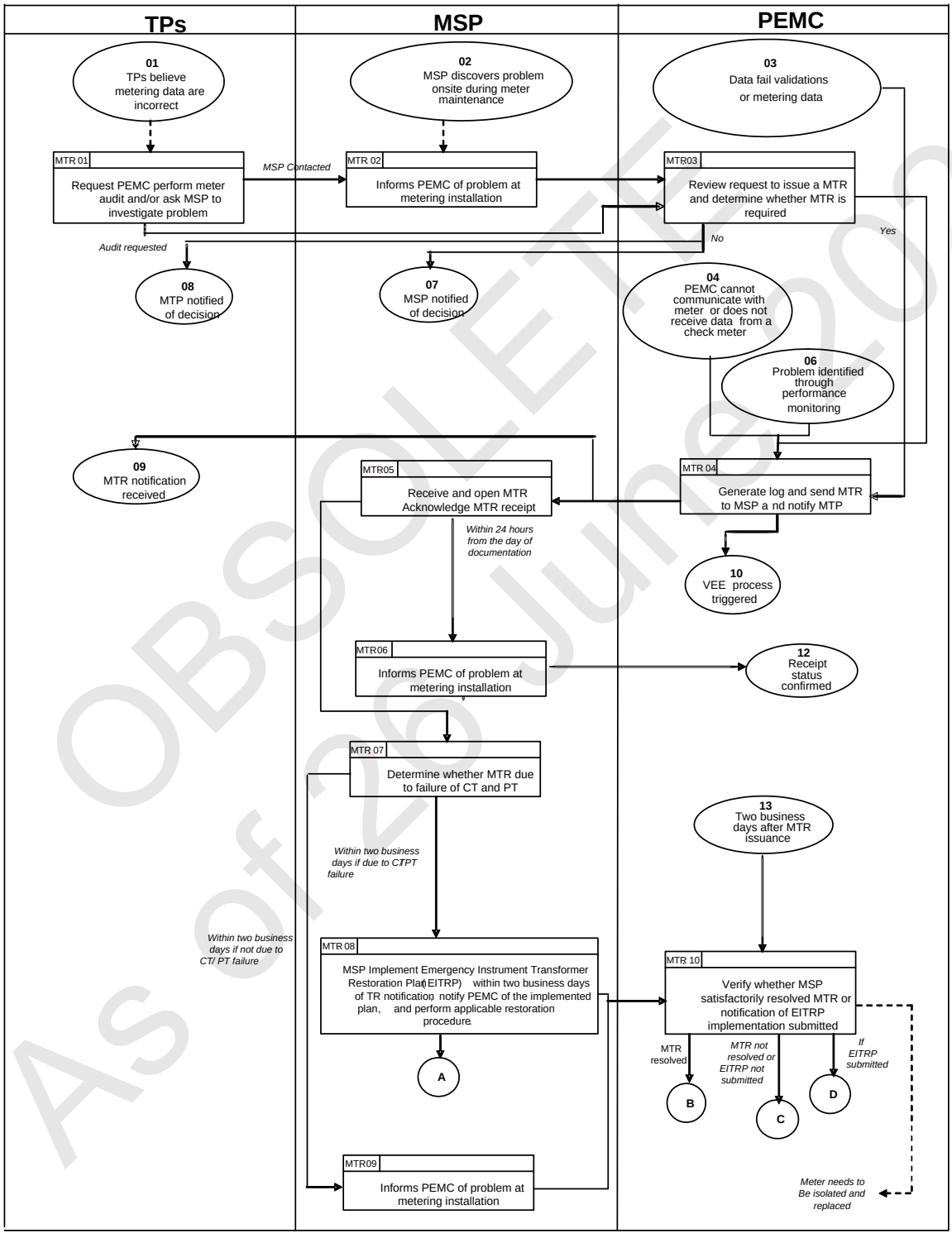
If the MSP submitted the report after the final settlement period, the said adjustment will be reflected on the following billing period.

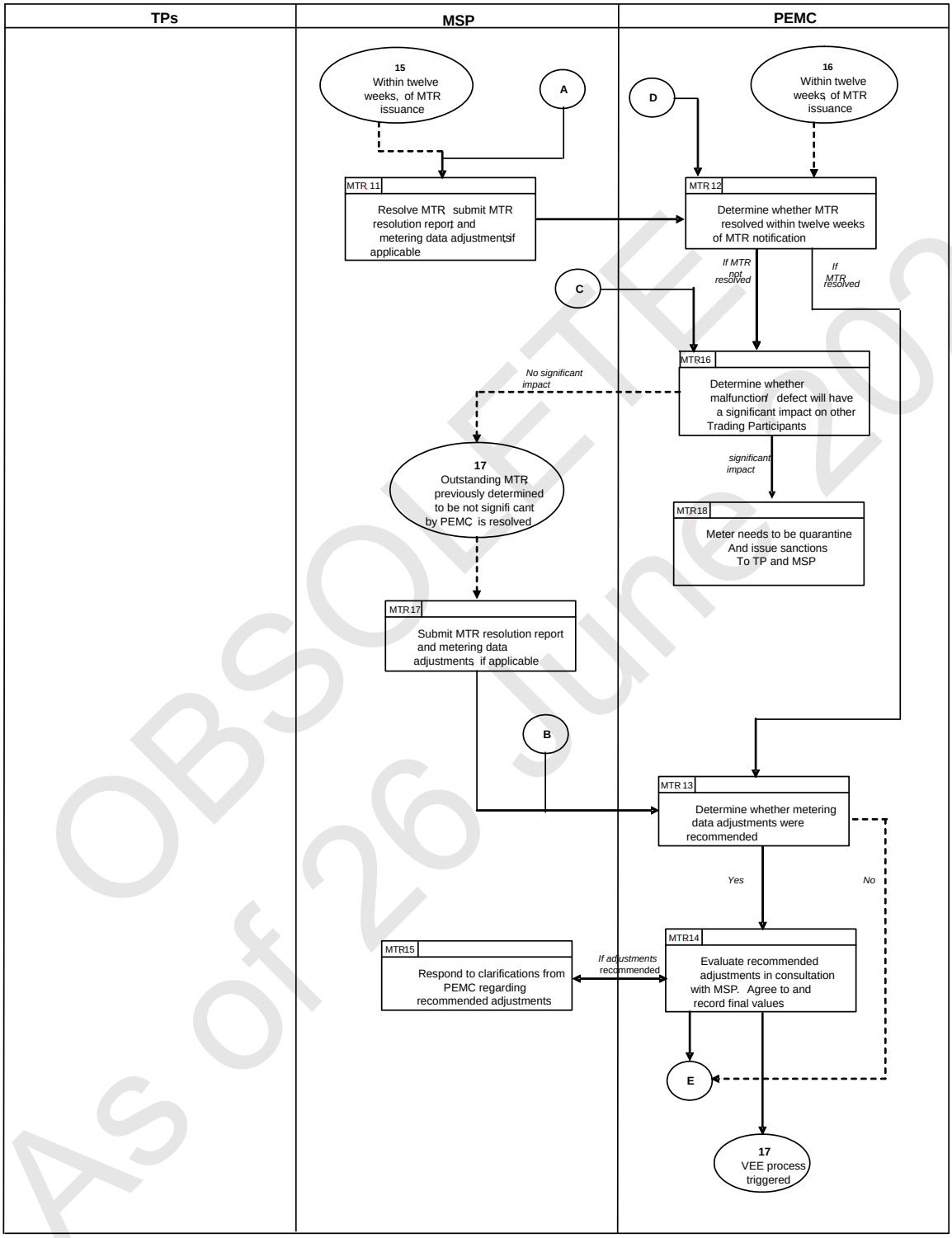
In cases where there is unintentional meter error (e.g. meter multiplier) that causes meter malfunction occurred in the process, a prescribe period of one year is allowed for reconciliation from the date of discovery of such error.

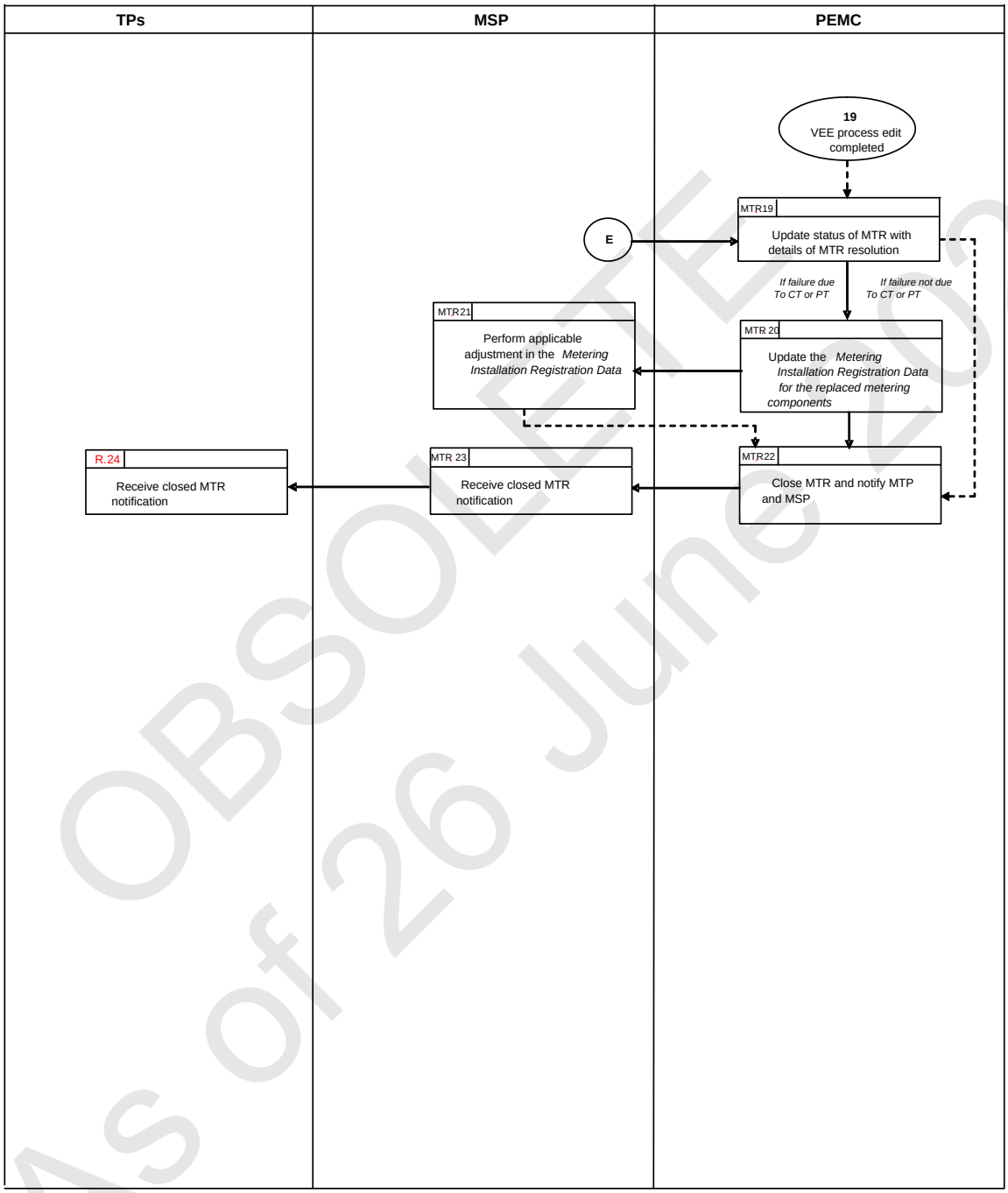
8.3. PROCEDURAL WORK FLOW

The procedural work flow contains graphical representations of the steps and flow of information related to MTR procedure between the *MO*, the primary external participant, the TP and its MSP involved in the procedure, and any other parties.

8.4. WORKFLOW FOR METER TROUBLE REPORT







8.5. PROCEDURAL STEPS FOR METER TROUBLE REPORTS

Ref.	Task Name	Task Detail	When	Resulting Information	Method	Completion Events
MTR.01	Request *MO to* perform *meter* audit (Conformance monitoring") and/or ask *MSP* to investigate problem.	The *TP* either requests that the Metering Group of *MO* perform an audit of the *Metering Installation and/*or instructs its *MSP* to investigate the problem.	Upon suspicion by the TP that the *metering data* are incorrect.	If audit required: *Request for Meter Audit. MSP* instructed to investigate	As cited in Conformance monitoring	• Audit requested of *MO* or *MSP* instructed to investigate problem. • Audit report produced
MTR.02	Inform *MO* of problem at *Metering Installation*	The *MSP* informs the *MO* of a problem discovered at a *Metering Installation*. *MSPs* may discover problems at M*etering Installations* during normal service activities, such as maintenance or seal changes, or be informed of a problem by a *TP*.	Within one *business day* of a discovery by (or notification to) the *MSP* of a problem at a *Metering Installation*	Request for *MTR*.	If urgent, the *MSP* phones the *MO* to report the problem. In all cases the *MSP* sends an email giving details of the problem at the *Metering Installation.*	Request for *MTR* submitted to the *MO*.
MTR.03	Review request to issue an MTR and determine whether *MTR* is required.	*MO* reviews the results of the *metering data* audit submitted by the *MTP* or the problem at the *Metering Installation* reported by the *MSP* and determines whether an MTR is warranted. If an MTR is warranted, the *MO* proceeds to Step MTR.04. If an MTR is not warranted, the *MO* logs the actions taken to address the reported problem and the reasons for not issuing an MTR and notifies the *MSP* and *TP* of its decision.	Upon receipt of a request for an MTR from a *MTP* or *MSP*; or, upon identification of an error in the *metering data* during the Commercial Reconciliation process.	Details for *MTR* or arguments to justify why it will not be issued.	*MO* staff exercise their judgment re: the results of the Data Audit Report or details of the problem at the *Metering Installation*	Decision as to whether *MTR* is warranted and actions logged.
MTR.04	Generate, log and send *MTR* to *MSP* and notify *TP*.	The *MO* generates, logs, and sends the *MTR* to the *MSP* and notifies the *MTP* of the *MTR*.	Upon a determination in Step V.03 that an MTR is warranted. Upon failing *Validation, Editing and Estimation of Data (VEE) process* validations. Upon failure of the *metering data* collection application to communicate with a	Data required to complete the fields of an MTR form, issue it to the *MSP* for resolution, and notify the *TP*.	Automatic completion and issue via Internet of an MTR form for a selection of Communication or Validation Failures; Or Automatic completion and manual issue via	*MTR* generated, logged, and sent to the *MSP* and the *TP is* notified.

Ref.	Task Name	Task Detail	When	Resulting Information	Method	Completion Events
			Metering Installation; or, upon failure to receive *metering data* from a *check meter*. Upon identification of a problem at a *Metering Installation* through performance monitoring. Upon failure of an audit by a *Metering Installation* or Upon determination that a *meter* is not compliant with requirements.		Internet of the *MTR* form for a selection of Communication or Validation Failures 2.6.1.1.1.1. Or Manual completion and issue via Internet of the *MTR* form for reports of failed Data Audits, problems at a *Metering Installation*, non compliant *meters*, CR Data discrepancies	
MTR.05	Receive and open *MTR*. Acknowledge *MTR* receipt.	The *MSP* receives and opens the *MTR*, sends to *MO* an acknowledgement of *MTR* receipt within 24 hours following *MTR* issue.	Following Step MTR.04.	Acknowledgement of *MTR* Receipt	The *MSP* • receives *MTR* form via Internet, • checks the box "Acknowledge Receipt"	*MTR* received and opened by *MSP*. Acknowledgement of *MTR* Receipt checked.
MTR.06	Verify whether *MSP* received and opened the *MTR*.	The *MO* verifies whether the *MSP* received and opened the *MTR*, and records result for Performance monitoring.	Following Step MTR.05	Late acknowledgement, if applicable	If applicable, *Late Acknowledgement* message displayed on *MO* system	Receipt status confirmed by *MO*
MTR.07	Determine whether *MTR* due to failure of CT or PT.	The *MSP* determines whether the *MTR* is due to the failure of a current transformer (CT) or a potential transformer (PT). If the *MTR* is due to the failure of a CT or PT, the *MSP* proceeds to Step 5A.08. If the *MTR* is not due to the failure of a CT or PT, the *MSP* proceeds to Step 5A.09.	Following Step MTR.05.	None	The *MSP* conducts its own investigation.	Determination rendered as to whether *MTR* is due to failure of CT or PT.
MTR.08	Implement Emergency *Instrument Transformer* Restoration Plan (EITRP) within two *business days* of	The *MSP* implements an EITRP to remedy the *MTR* within two *business days* of *MTR* notification, notifies the *MO* of the implemented plan, and	Within two days of determining in Step V.07 that *MTR* is due to the failure of a CT or PT.	Notification of Implementation of EITRP.	• The *MSP* selects "Yes" in boxes "Failure Type is PT or CT?" & "EITRP Implemented" attaches pertinent information	EITRP implemented and applicable registration procedure performed by the *MSP*.

Ref.	Task Name	Task Detail	When	Resulting Information	Method	Completion Events
	MTR notification, notify *MO* of the implemented plan, and perform applicable registration procedure.	performs the applicable registration procedure. The EITRP must remain in place until the CT or PT is replaced.			if required and returns the *MTR* form to the *MO* via Internet. ●The *MSP* phones the *MO* Metering Group, then sends an email with pertinent registration details	
MTR.09	Resolve *MTR*, submit *MTR* resolution report, and *metering data* adjustments, if applicable.	The *MSP* resolves the *MTR* and submits the actions taken to resolve the *MTR* to the *MO* The *MSP* may also submit *metering data* adjustments to the *MO*, if applicable.	Within two days of determining in Step MTR.07 that *MTR* is not due to the failure of a CT or PT.	*MTR* resolution report and *metering data* adjustments, if applicable.	• The *MSP*: • Completes the "MTR Resolution Report*"* in the *Meter* Trouble Report form, attaches pertinent information • If applicable, selects "Yes" in the box "*Metering Data* Adjustments" submits proposed data adjustments and justification, • Returns MTR form to the *MO* via Internet	*MTR* resolved and *MTR* resolution report and, if required, applicable *metering data* adjustments submitted to the *MO*
MTR.10	Verify whether *MSP* satisfactorily resolved *MTR* or notification of EITRP implementation submitted.	The *MO* verifies whether the *MSP* satisfactorily resolved the *MTR* or whether the *MSP* submitted a notification to the *MO* of the implemented EITRP. If the *MTR* is resolved, the *MO* proceeds to Step 5A.13. If the *MTR* is not resolved (and an EITRP notification has not been submitted), the *MO* proceeds to Step 5A.16. If the *MSP* submitted an EITRP, the *MO* proceeds to Step 5A.12. If the *MTR* requires that the *meter* be quarantined, the Quarantine *Meter* process is followed.	Following Steps V.08 or MTR.09, and within two days following issuance of *MTR*.	None	*MO* check *MSP's* "MTR Resolution Report" in *M*TR form: • If *MSP* reports that problem has been fixed, *MO* verifies that the original cause of problem does not persist and *MSP* has provided accurate, accessible, complete information, **or** • If *MSP* has selected "Yes" in boxes "Failure Type is PT or CT?" and "EITRP Implemented" of the *M*TR form, *MO* verifies that *meter* Quarantine (meter	Verification of *MTR* resolution or EITRP submission completed.

Ref.	Task Name	Task Detail	When	Resulting Information	Method	Completion Events
					isolation and needs to be replaced) and re-registration have processes have been initiated.	
MTR.11	Resolve *MTR*, submit *MTR* resolution report, and *metering data* adjustments, if applicable.	The *MSP* resolves the *MTR* and submits a report documenting the actions taken to resolve the *MTR* to the *MO*. The *MSP* may also submit *metering data* adjustments to the *MO*, if applicable.	Following Step MTR.08, within twelve weeks of *MTR* notification.	*MTR* resolution report, and *metering data* adjustments, if applicable, duly justified by the *MSP*.	The *MSP* • Completes the "MTR Resolution Report*"* in the *M*TR form, attaches pertinent information • If applicable, selects *"Yes"* in the box *"Metering Data* Adjustments*"* submits proposed data adjustments and justification, • Returns *M*TR form to the *MO* via Internet	*MTR* resolved and *M*TR resolution report and applicable *metering data* adjustments submitted to the *MO*.
MTR.12	Determine whether *MTR* resolved within twelve weeks of *MTR* notification.	The *MO* determines whether the *MTR* was resolved within twelve weeks of *MTR* notification. If the *MTR* was resolved, the *MO* proceeds to Step MTR.13. If the *MTR* was not resolved, the *MO* proceeds to Step MTR.16.	Following Step MTR.10 and within twelve weeks of determining in Step MTR.07 that *MTR* is due to the failure of a CT or PT.	None	*MO* check *MSP's* "MTR Resolution Report" in *M*TR form: • If *MSP* reports that problem has been fixed, *MO* verifies that the original cause of problem does not persist and *MSP* has provided accurate, accessible, complete information and • Re-registration process has been initiated	Determination rendered as to whether MTR was resolved within twelve weeks of notification.

Ref.	Task Name	Task Detail	When	Resulting Information	Method	Completion Events
MTR.13	Determine whether *metering data* adjustments were recommended.	The *MO* determines whether the *MSP* recommended any adjustments to the *metering data*. If *metering data* adjustments were recommended, the *MO* proceeds to Step MTR.14. If *metering data* adjustments were not recommended, the *MO* proceeds to the *VEE process.*	Upon determination in Step V.10 that *MTR* was resolved; or upon determination in Step MTR.12 that *MTR* was resolved; or following resolution of *MTR* in Step MTR.17;	None	*MO* checks "MTR Resolution Report" submitted by *MSP* in the *MTR* form, and verifies "Yes/No" selection by *MSP* in "*Metering Data* Adjustments" box.	Determination rendered as to whether the *MSP* recommended *metering data* adjustments.
MTR.14	Evaluate recommended adjustments in consultation with *MSP*. Agree to and record final values.	The *MO* evaluates the recommended adjustments submitted by the *MSP* and, if clarifications are required, consults the *MSP*, and records final values.	Upon determination in Step MTR.13 that the *MSP* submitted *metering data* adjustments.	Proposed adjustments and final values.	*MO* staff assess proposed adjustments and justifications, verify that • Adjusted data are comparable to data collected before and after failure and to previous load patterns • Values are within nameplate rating of power transformers • Adjustments are supported by operations data, "as found" and "as left" readings.	Final adjustment values agreed to and recorded by the *MO*.
MTR.15	Respond to clarifications from the *MO* regarding recommended adjustments.	The *MSP* responds to clarifications from the *MO* regarding the recommended adjustments.	Following Step MTR.14	Clarifications regarding recommended adjustments.	Telephone conversations, followed by emails to record exchanges and agreed adjustment values.	Clarifications responded to by the *MSP*.

Ref.	Task Name	Task Detail	When	Resulting Information	Method	Completion Events
MTR.16	Determine whether malfunction/defect will have a significant impact on other *Trading Participant*s.	Where an *MSP* does not: • resolve an MTR within two *business day*s; • implement an Emergency Restoration Plan within two *business day*s of notification of a CT/PT failure; or • install and register a new PT or CT, as required, within twelve weeks of *MTR* notification, the *MO* assesses the potential impacts/risks for other *Trading Participant*s. The *MO* assumes that the unresolved malfunction/defect has a significant impact on other *Trading Participant*s unless it is determined that the *metering data* affected are not significant. If the unresolved *MTR* does not have a significant impact on other *Trading Participant*s, the *MO* awaits resolution of the *MTR* by the *MSP* (Step V.17).	Upon determination in Step V.12 that the *MSP* has not satisfactorily resolved the *MTR*; or, upon determination in Step V.10 that the *MSP* has not satisfactorily resolved the *MTR*.	None	By default, late *MTR*s have a significant impact on other *Trading Participant*s. Exceptions are determined by the *MO*.	Determination rendered as to whether malfunction/defect will have a significant impact on other *Trading Participant*s.

Ref.	Task Name	Task Detail	When	Resulting Information	Method	Completion Events
MTR.17	Submit *MTR* resolution report, and *metering data* adjustments, if applicable.	The *MSP* resolves the *MTR* and submits a report documenting the actions taken to resolve the *MTR* to the *MO*. The *MSP* may also submit *metering data* adjustments to the *MO*, if applicable.	Following resolution of outstanding *MTR*, previously assessed to not impact other *Trading Participant*s	*MTR* resolution report and *metering data* adjustments, if applicable.	The *MSP* • Completes the "MTR Resolution Report" in the *M*TR form, attaches pertinent information • If applicable, selects *"Yes"* in the box *"Metering Data* Adjustments*"* submits proposed data adjustments and justification, • Returns *MTR* form to the *MO* via Internet	*MTR* resolved and *M*TR resolution report and applicable *metering data* adjustments submitted to the *MO*.
MTR.18	Meter needs to be quarantine and issue sanctions on the TP and MSP	The *MO* sends a notification that the meter needs to be quarantined and likewise issue sanctions against the TP and MSP involved.	After checking out that the result on the malfunctioned meter have resulted in significant impact on other Trading Participant	Meter to be Quarantine and sanctions have been issued	Email to concerned TP *and/or MSP*	Instructions sent to the T*P and/or MSP*.
MTR.19	Update status of *MTR* with details of resolution.	The *MO* logs the status of the *MTR* and the details of its resolution. If the failure was due to a CT or PT, the *MO* proceeds to Step MTR.20. If the failure was not due to a CT or PT, the *MO* closes the *MTR*.	Following Steps MTR.14; or upon completion of *VEE process* edit (ovals 10 and 17).	None	Entries in *M*TR form	*MTR* status updated.
MTR.20	Request *Metering Services Provider* to perform applicable procedure(s).	The *MO* requests the *MSP* to perform the applicable procedure(s).	Following Step MTR.19, where the problem was a result of a failure of a CT or PT.	Request to *MSP*.	Notification by *MTR*.	Request sent to *MSP*.

Ref.	Task Name	Task Detail	When	Resulting Information	Method	Completion Events
MTR.21	Perform applicable procedure(s) and submit required registration files.	The *MSP* performs the applicable procedure(s) in and submits the required registration files to the *MO*	Following Step MTR.20.	Required registration files.	As cited in "Metering Standard"	Applicable "Changes to *Metering Installation* Registration" sub procedure conducted and required registration files submitted to the *MO*
MTR.22	Close *MTR* and notify *TP* and *MSP*.	The *MO* sends a notification to the *TP* and the *MSP* once it is satisfied that the *MTR* has been successfully closed.	Following Step MTR.21			*TP* and *MSP* receive notification from *MO* that *MTR* is formally closed

SECTION 9 SITE – SPECIFIC LOSS ADJUSTMENT

9.1. INTRODUCTION

The WESM Rules states that the ideal location of the Metering Point should be at the Market Trading Node (MTN). The Trading Participant, the Network Service Provider, and the Market Operator, as mandated by the WESM Rules, shall use their best endeavor to adjust the meter registration to account for electrical losses when the Metering Point is not physically located at the MTN.

9.2. DEFINITION

The Site – Specific Loss Adjustment (SSLA) is a procedure developed for determining the amount of electrical losses between the Metering Point and the MTN.

9.3. PURPOSE

This Procedure shall be used to adjust Trading Participant's meter data to compensate for the electrical losses in the components that come between the Metering Point and the MTN. The power and energy registered at the Metering Point shall be adjusted to reflect meter readings that would have been obtained if the revenue meter is physically located at the MTN.

This procedure is also intended to provide Market Participants with a summary of the steps and interfaces for performing Site - Specific Loss Adjustment.

9.4. LOSS FACTOR

There shall be a Site – Specific Loss Factor (SSLF) distinct for every Metering Point, and dynamic for every Trading Interval, which represents the adjusted meter data of a Metering Point.

The SSLF is a unit-less number that shall be multiplied to the original meter data of its corresponding Trading Interval. The end-product of the SSLF and the original meter data is the adjusted power or energy of the Trading Participant as seen from the MTN.

9.5. SCOPE

This Procedure applies to all Revenue Metering Installations of Trading Participants in the WESM, where the Metering Point is not physically located at the MTN.

9.6. WESM MEMBERS INVOLVED IN PERFORMING SSLA

9.6.1. Network Service Provider in coordination with Trading Participants
9.6.2. Metering Services Provider (MSP)
9.6.3. Market Operator (MO)

9.7. ROLES AND RESPONSIBILITIES

Responsibility for carrying out site-specific loss adjustments is shared among:

9.7.1. Network Service Provider:

9.7.1.1. The *Network Service Provider* shall submit to the *Market Operator* every six months all significant conductor and power transformer data between the metering point and the market trading node and as often as it implements significant changes in the actual physical configuration of the conductor and power transformer between the metering point and the market trading node.

9.7.1.1.1. Conductor Data
- a. Conductor size
- b. Number of conductors per circuit
- c. Line Length (km)
- d. Line Voltage

9.7.1.1.2. Power Transformer Data
- a. Rated kVA
- b. Core Loss (Open Circuit Test result)
- c. Full-load Copper Loss (Short-Circuit Test result)
- d. Percent Impedance (% Z)
- e. Equivalent Transformer Resistance (R_e)
- f. Equivalent Transformer Reactance (X_e)
- g. Equivalent Transformer Impedance (Z_e)
- h. Transformer's Full-Load Output Active Power (kW)

i. Transformer's Efficiency (%) at Full-Load Output Active Power
j. Transformer's Maximum Efficiency (%)
k. Transformer's Output Active Power (kW) at Maximum Efficiency

9.7.1.2. In coordination with the *Metering Services Provider*, grid single-line diagrams that show the significant changes in the actual physical configuration of the conductor and power transformer shall also be submitted by the *Network Service Provider* to the *Market Operator*.

9.7.2. Metering Services Provider:

9.7.2.1. The *Metering Services Provider* shall collect and deliver to the *Market Operator* the meter data containing the daily energy consumption or delivery of all *Trading Participants*.

9.7.3. Trading Participant:

9.7.3.1. The *Trading Participant*, in coordination with the *Network Service Provider*, shall submit to the *Market Operator* all significant conductor and power transformer data between its metering point and the market trading node upon its registration in the WESM, and as often as it notices significant changes in the actual physical configuration of the conductor and power transformer between its metering point and the market trading node. The *Trading Participant* shall submit the same type of data stated in Sub-sections 9.7.1.1.1 and 9.7.1.1.2.

9.7.4. Market Operator:

9.7.4.1. The *Market Operator* shall reconcile the data submitted by the *Network Service Provider* and the *Trading Participant*. The reconciled data shall be agreed by the *Market Operator, Network Service Provider* and the *Trading Participants*. The *Market Operator* shall use the reconciled data starting on the current billing month only, then progressively for the succeeding billing months until a new conductor and power transformer data is submitted.

9.7.4.2. Calculate the loss adjustment in accordance with this procedure using Microsoft Excel.

9.7.4.3. Develop in consultation with the WESM Participants, a standard table of reference, containing data for power transformers and conductors.

9.8. LOSS CALCULATION

9.8.1. Load Customer Cases:

9.8.1.1. **Case 1: Single Market Trading Node:** A metering point is connected to only one MTN.

a. **Case 1 – A**: only one metering point is presently connected to the MTN (figure 1).

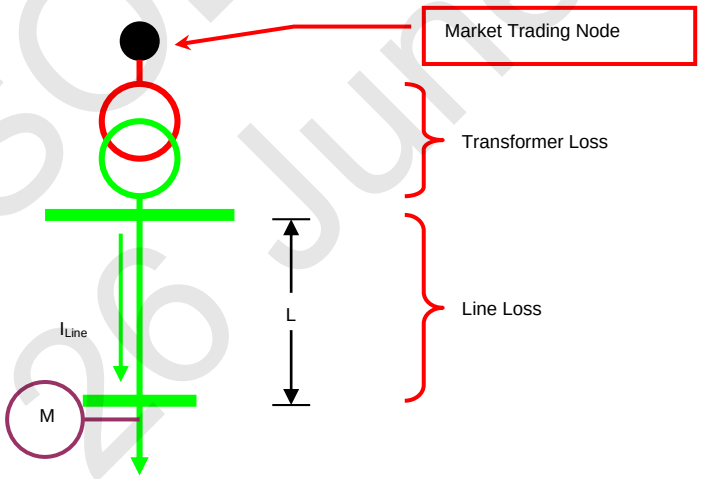


Figure 1

b. Case 1 – B: numerous metering points connected to, or are sharing the same MTN (figure 2).

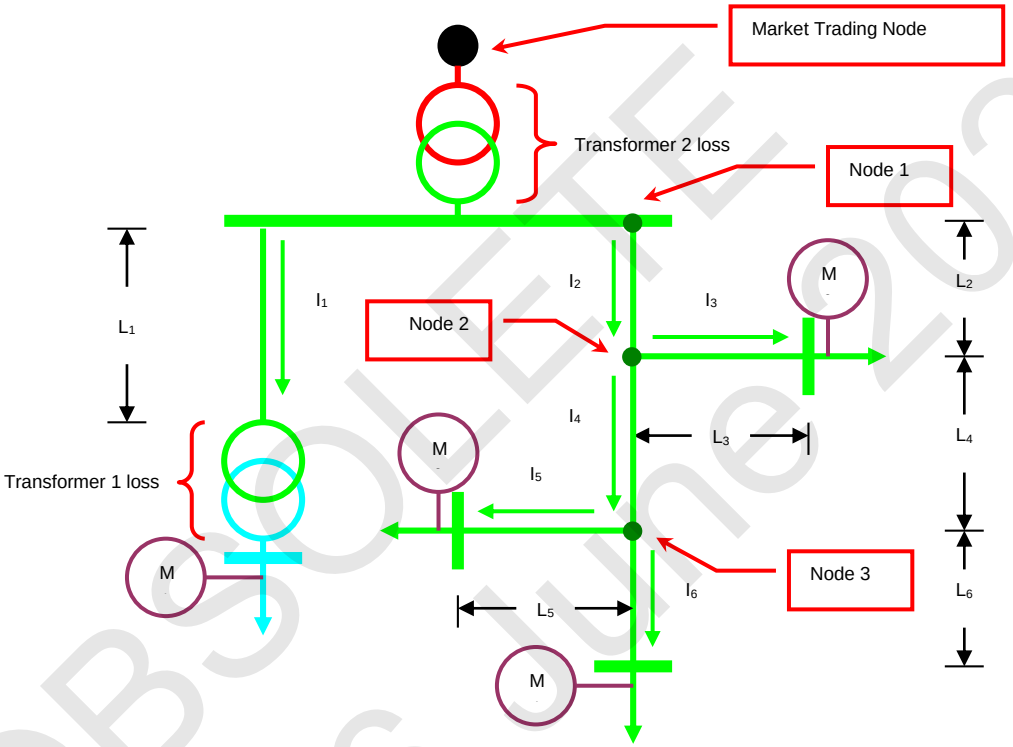


Figure 2

9.8.1.2. Case 2: Multiple Market Trading Nodes: A metering point is connected to two or more MTNs during normal condition (figure 3).

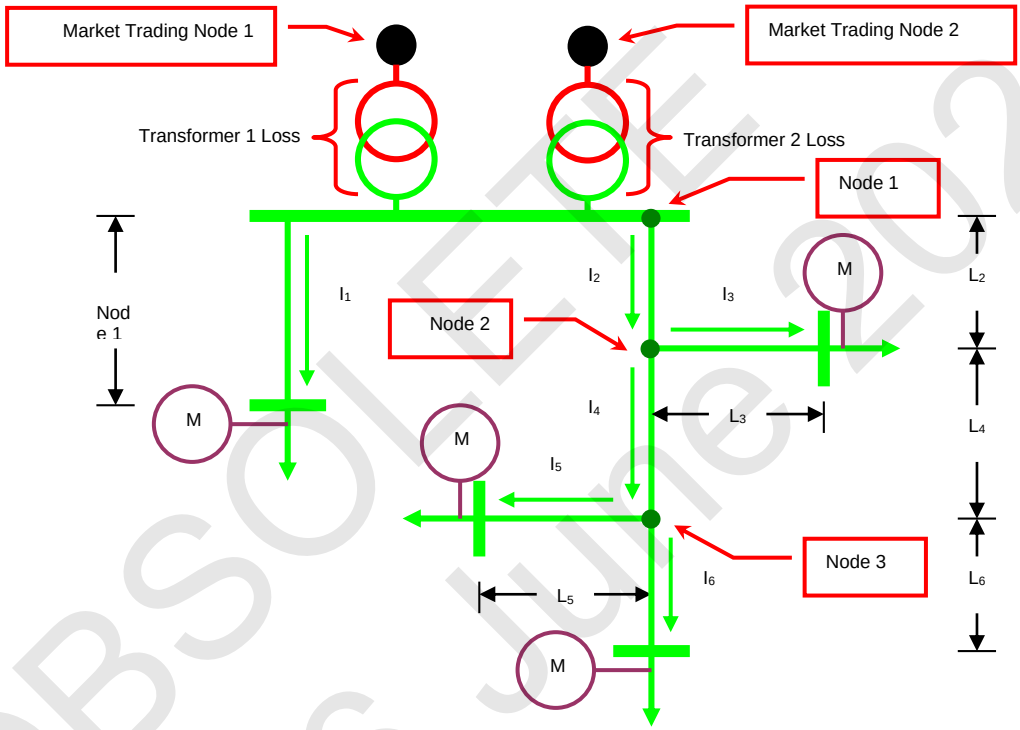


Figure 3

9.8.1.3. **Case 3: Alternate Market Trading Node:** A metering point is connected to another MTN for alternate source of power during emergency condition or pre-arranged shutdown.

a. **Case 3 – A:** a metering point is connected to another transformer for alternate source of power during emergency or pre-arranged shutdown. Usual setting for alternate source of power from the same substation (figure 4).

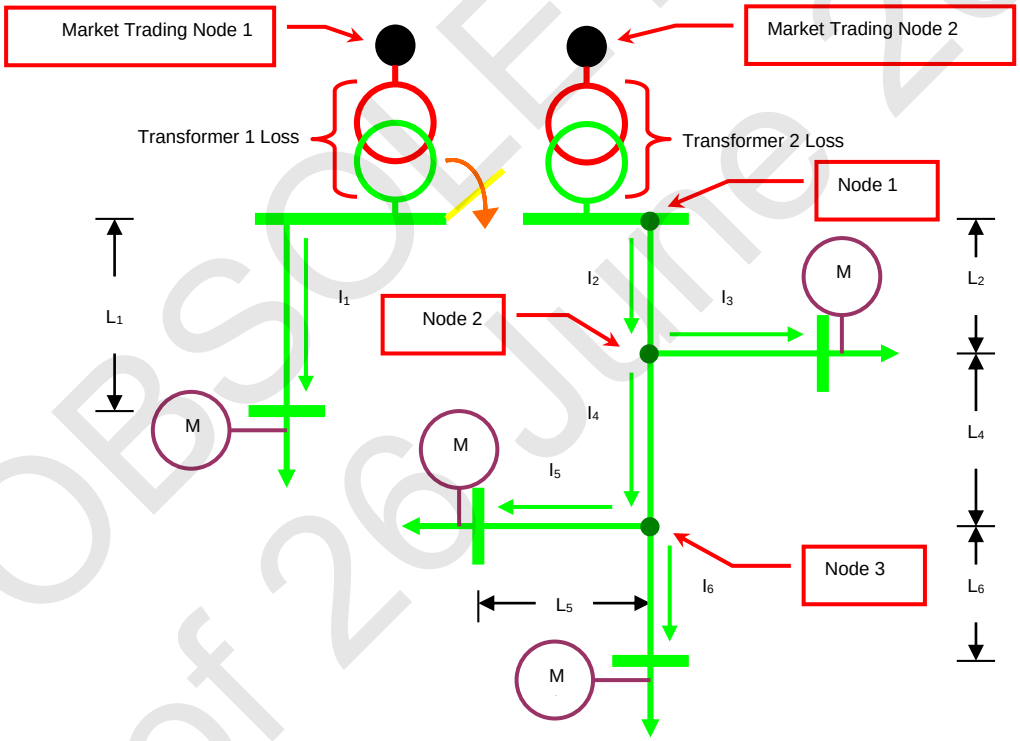


Figure 4

b. **Case 3 – B:** a metering point is connected to another line for alternate source of power during emergency or pre-arranged shutdown. This is the usual setting for alternate source of power from another substation (figure 5).

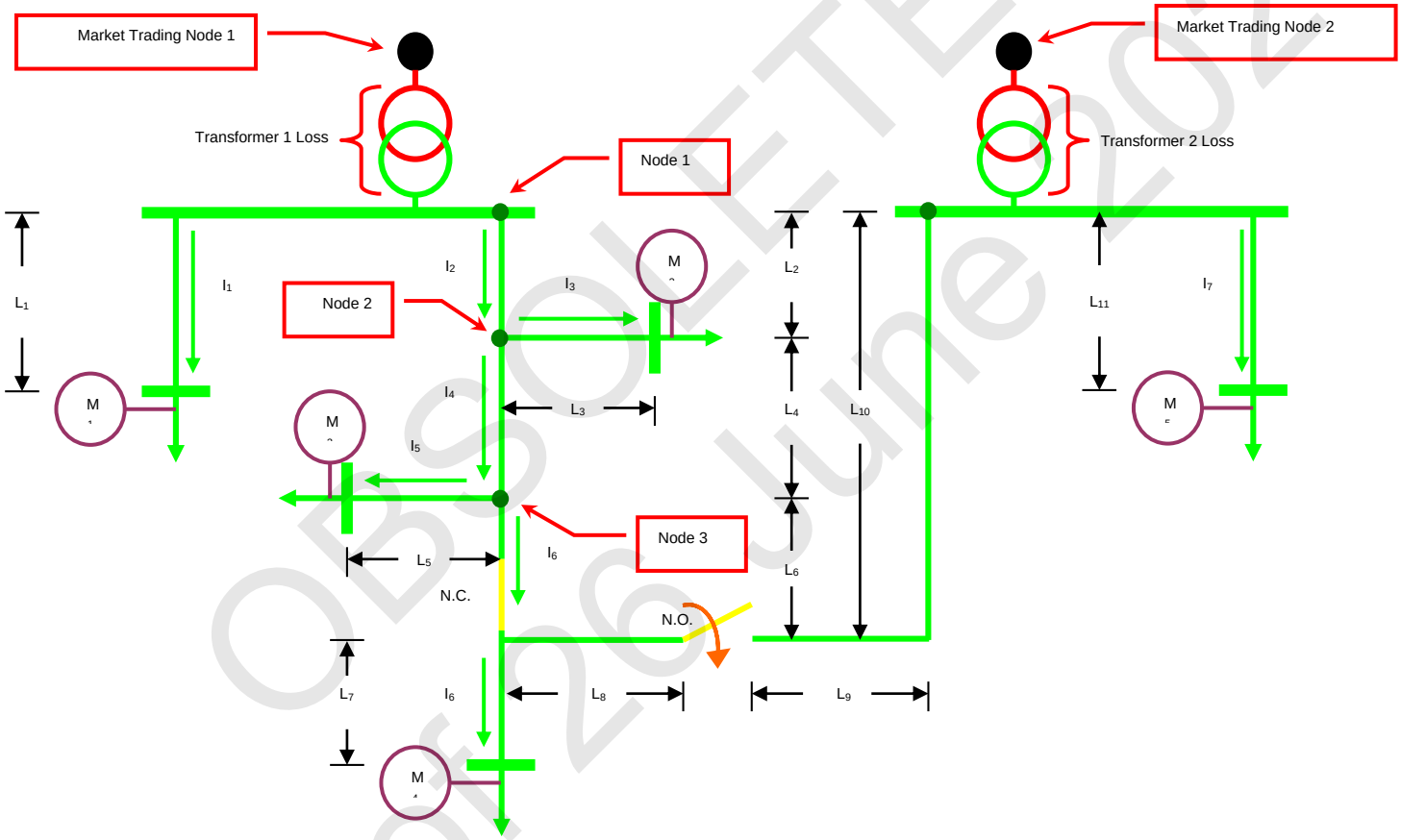


Figure 5

9.8.1.4. **Case 4: Lagging MTN:** A metering point is located before the MTN. The meter is installed at a voltage level higher or equal to the voltage level of the MTN (figure 6).

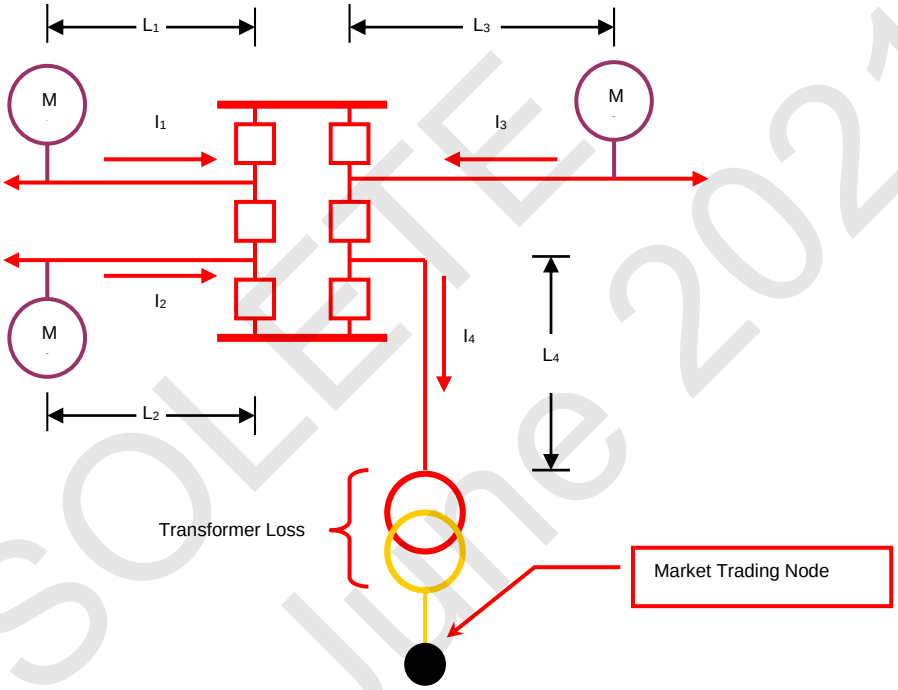


Figure 6

9.8.2. Generator Cases:

9.8.2.1. Case 1: One Metering Point – One Market Trading Node: A metering point measures the dispatch of only one generating unit (figure 7).

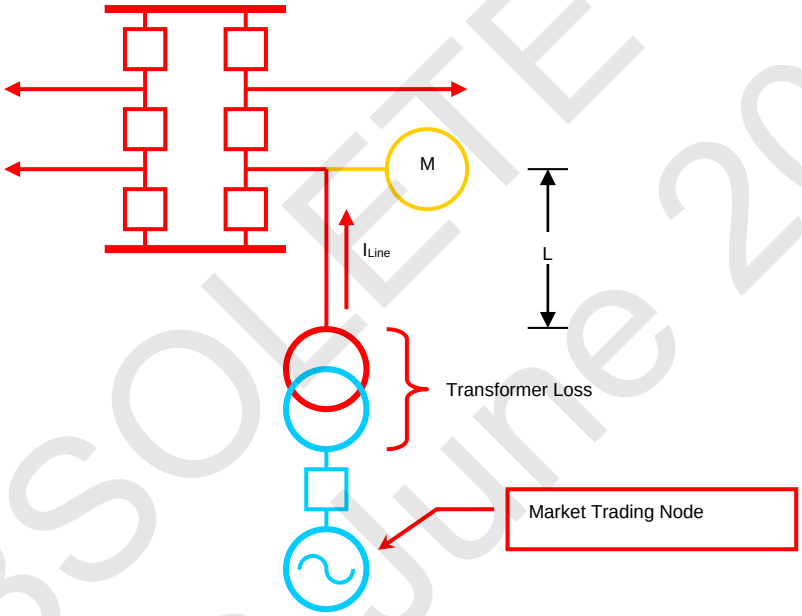


Figure 7

9.8.2.2. Case 2: One Metering Point – Multiple Market Trading Nodes: A metering point measures the aggregate dispatch of a group or block of generating units (figure 8).

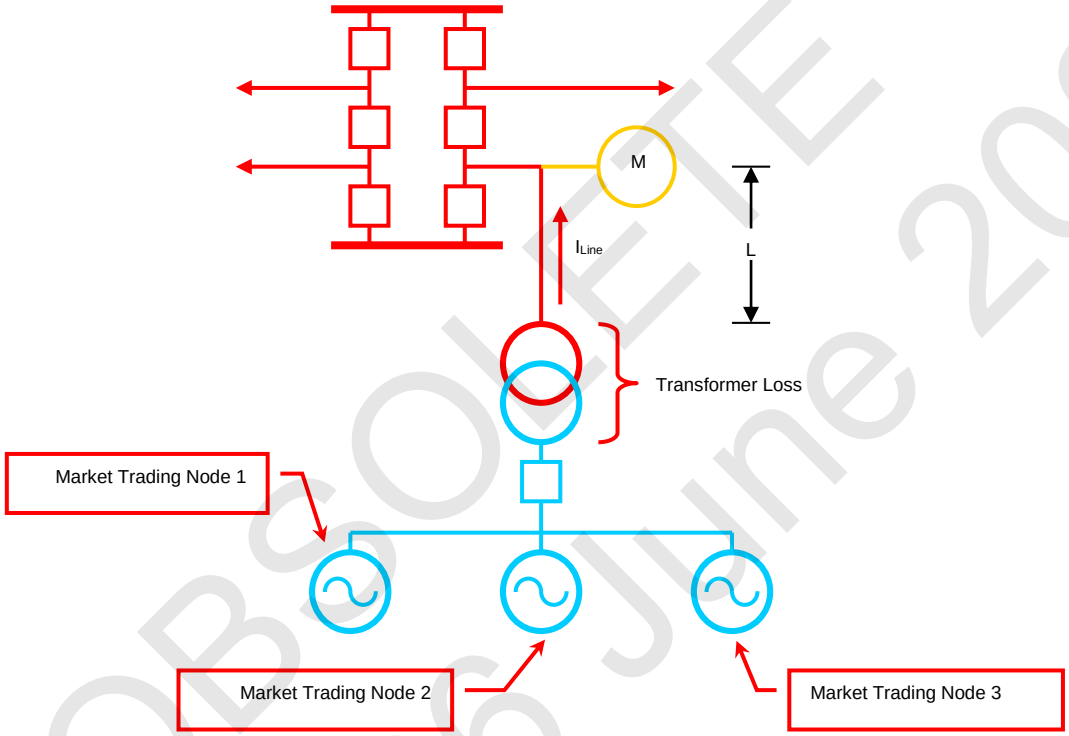


Figure 8

9.8.2.3. Case 3: Multiple Metering Points – Multiple Market Trading Nodes: A group of metering points measures the aggregate dispatch of a group or block of generating units (figure 9).

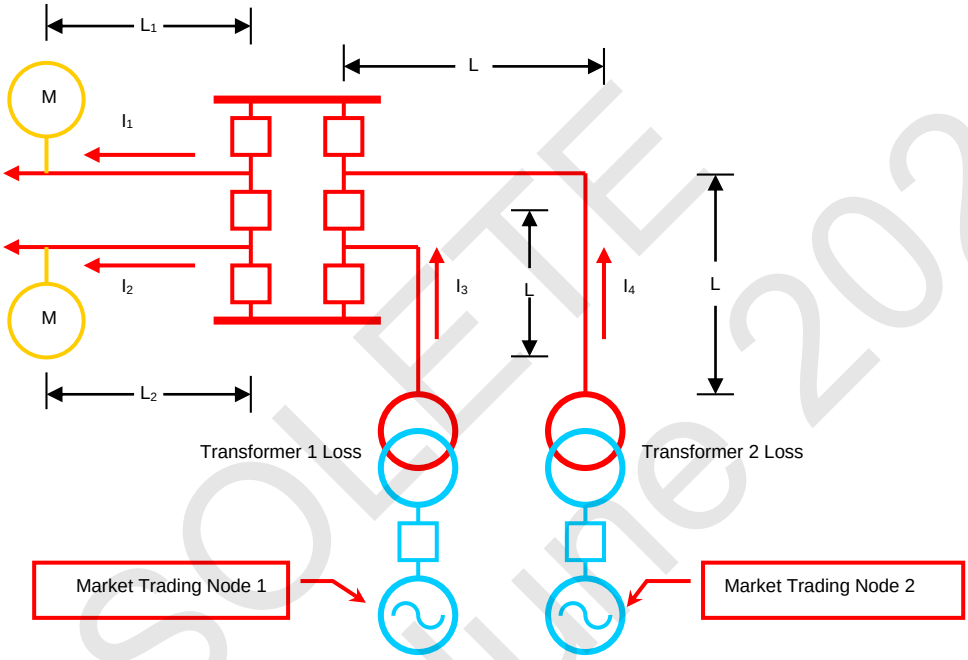


Figure 9

9.8.3. General Equations:

The following are the equations to be used for calculating the SSLF

kW_{Meter} = $(kWh_{Meter\text{-}15min} + kWh_{Meter\text{-}30min} + kWh_{Meter\text{-}45min} + kWh_{Meter\text{-}00min}) \div 1h$

$kVar_{Meter}$ = $(kVarh_{Meter\text{-}15min} + kVarh_{Meter\text{-}30min} + kVarh_{Meter\text{-}45min} + kVarh_{Meter\text{-}00min}) \div 1h$

I_{Line} = $kW_{Meter} \div ((\sqrt{3}) * V * pf_{Meter})$

pf_{Meter} = $\cos(\tan^{-1}(kVar_{Meter} \div kW_{Meter}))$

$Line_{kW\text{-}Loss}$ = $(I_{Line})^2 * R_{Line} \div 1000$

R_{Line} = $r_a * L$

$Line_{kVar\text{-}Loss} = (I_{Line})^2 * X_{Line} \div 1000$

$X_{Line} = X_I * L$

$Transformer_{Loss} = TCore_{Loss} + TCopper_{Loss}$

$TCore_{Loss}$ = constant loss from the open-circuit test

$TCopper_{Loss}$ = full-load copper loss from the short-circuit test or $P_{Short\text{-}Circuit}$

$Core_{Loss\text{-}Meter} = TCore_{Loss} * kW_{M1} \div \sum kW_{Meters}$ (Formula to be used if all meters register consumption, core loss being shared by all meters proportional to its consumption) (As approved by PEM Board Resolution No. 2010-76 dated 22 November 2010)

$Core_{Loss\text{-}Meter} = TCore_{Loss} * kW_{M1} * HLS_{M1}$ (Formula to be used if one or more or all of the meter/s register/s zero, core loss being shared according to the historical load factor of each metering point) (As approved by PEM Board Resolution No. 2010-76 dated 22 November 2010)

$Copper_{Loss\text{-}Meter} = ((kW_{Meter} \div pf_{Meter}) \div T_{kVA\text{-}Rating})^2 * P_{Short\text{-}Circuit}$

$Total_{kW\text{-}Loss} = Line_{kW\text{-}Loss} + Core_{Loss\text{-}Meter} + Copper_{Loss\text{-}Meter}$

$SSLF = 1 + (Total_{kW\text{-}Loss} \div kW_{Meter})$

$Adjusted_{kW} = SSLF * kW_{Meter} = Total_{kW\text{-}Loss} + kW_{Meter}$

Where:

$kWh_{Meter\text{-}XXMin}$: 15-minute interval active energy meter registration

$kVarh_{Meter\text{-}XXMin}$: 15-minute interval reactive energy meter registration

kW_{Meter} : active power derived from the meter registration

I_{Line} : current (Ampere) along the line

V : voltage (kV) level of the line

pf_{Meter} : power factor from the derived active and reactive power

$kVar_{Meter}$: reactive power derived from the meter registration

$Line_{kW\text{-}Loss}$	: the active loss (kW) along the line
$Line_{kVar\text{-}Loss}$	: the reactive loss (kVar) along the line
R_{Line}	: total resistance (ohm) of the line
X_{Line}	: total inductive reactance (ohm) of the line
r_a	: resistance per unit length (ohm/km) of the line
X_l	: total inductive reactance per unit length (ohm/km) of the line
L	: total line length (km)
$Transformer_{Loss}$	: total loss (kW) in the transformer
$TCore_{Loss}$	: constant loss (kW) from the open-circuit test
$TCopper_{Loss}$	: full-load copper loss (kW) from the short-circuit test
$P_{Short\text{-}Circuit}$	: same meaning as the $TCopper_{Loss}$
$Core_{Loss\text{-}Meter}$	: meter's equivalent share (kW) of the $TCore_{Loss}$
$Copper_{Loss\text{-}Meter}$	: meter's equivalent share (kW) of the $TCopper_{Loss}$
$\sum kW_{Meters}$	: summation of active power derived from the meter readings of all metering points under the same transformer (As approved by PEM Board Resolution No. 2010-76 dated 22 November 2010)
HLS	: Historical Load Share; the fraction or ratio of a metering point's total energy, against the total energy of all metering points under the same transformer. The HLS for the current billing month shall be based on the energy of the last twelve (12) billing months. (As approved by PEM Board Resolution No. 2010-76 dated 22 November 2010)
M_1	: pertains to the first meter, and so on
$T_{kVA\text{-}Rating}$	: transformer rating (kVA)
$Total_{kW\text{-}Loss}$	: total active loss (kW) for a metering point

$Adjusted_{kW}$: adjusted (kW) active power

SSLF : Site – Specific Loss Factor

9.8.4. Detailed Loss Calculation:

The detailed example loss calculations for every case are included in the Appendix of this Manual under "Site – Specific Loss Adjustment".

9.9. PROCEDURAL STEPS FOR SSLA

Ref.	Task Name	Task Detail	When	Resulting Information	Method	Completion Events
S.01	Determination of Metering Point location	MO to determine the exact location of the Metering Points for each MTN	After the registration of the Metering Installations			
S.02	Metering Point located at the MTN	MO shall declare that there is no need for meter data to be adjusted for Metering Points located at the MTN	After MO verifies the location of the Metering Point	SSLF equal to 1		
S.03	Metering Point not located at the MTN	MO shall request the Network Service Provider and the Trading Participant to submit power transformer and line data	After MO verifies the location of the Metering Point	Letter for the submission of requested data	By mail of fax	
S.04	Receive Request	Network Service Provider and Trading Participant to acknowledge the receipt of the request	Upon receipt of the request		By phone or e-mail	
S.05	Preparation of the data	Network Service Provider in coordination with the Trading Participant to prepare the data requested	Upon acknowledge of the request	Preliminary transformer and line data		
S.06	Submission of the Requested Data	Network Service Provider and Trading Participant to submit the data requested	Upon completion of the data	Accurate and valid transformer and line data	By mail of fax	
S.07	Receive Information	MO to acknowledge the receipt of the submitted data	Upon receipt of the data		By phone or e-mail	
S.08	Preparation of Loss Calculation	MO to prepare the Loss Calculation for each MTN or group of MTNs using the data submitted by the Network Service Provider and the Trading Participant	Upon acknowledge of the data	Loss Network Models of the MTNs		
S.09	Send Meter Data	Metering Services Provider(s) to send the Meter Data of the previous Trading Day to MO	Every trading day	Meter Data	MSP's Meter Data Retreival System	
S.10	Initial Calculation of SSLF	MO to initially calculate the SSLF of all Trading Participants to test the procedure		Preliminary SSLF		
S.11	Presents initial calculation of SSLF	MO to present to the Trading Participants and MSP the initial SSLF values computed for the agreement of the process	After completion of initial calculation			

SECTION 10 PERFORMANCE MEASUREMENT-METERING SERVICE PROVIDER

(As approved by PEM Board Resolution No. 2010-58 dated 25 August 2010)

10.1. INTRODUCTION

The integrity of meter data and timeliness of submission/delivery of meter data to the Philippine Electricity Market Corporation (PEMC) by the Meter Service Provider/s (MSP) are the objectives of the WESM to produce and transmit the settlement ready data to the trading participant/s (TP). Erroneous meter data and/or a delay in submission/delivery of meter data may affect the billing and settlement of WESM generators, customers and other entities.

10.2. PURPOSE

This section provides the Trading Participant/s, Meter Service Provider/s and PEMC steps required for the review, evaluation and measurement of the performance of a Meter Service Provider (MSP). The measurement process monitors the conformance of an MSP to the WESM Rule Section 4.3.3 – MSP Obligation and as discussed in this section.

10.3. SCOPE

This procedure is intended to provide the Trading Participant/s, Meter Service Provider/s and PEMC information and/or steps in rating the performance of the Metering Service Provider/s. The procedural work flows described in this section serve as reference for the trading participant/s, metering service provider/s and PEMC in reflecting the requirement in the WESM Rules.

The scope of an MSP Performance Measurement includes the following:

10.3.1. The integrity of meter data provided by the Meter Service Provider/s to PEMC and the Trading Participant/s.

10.3.2. The daily and monthly meter data delivery by the Meter Service Provider/s in accordance with the WESM Rules.

10.3.3. The timely resolution to the daily and monthly meter trouble report by the Meter Service Provider/s.

10.3.4. The Customer Satisfaction Rating/s.

10.4. PERFORMANCE MEASURES

The performance of a Metering Services Provider/s shall be rated against the standards set forth in this procedure. The MSP shall abide and comply with the measures as detailed below for successful and efficient operation of the WESM.

10.4.1. Service Delivery

10.4.1.1. Data Meter Data Delivery

Daily Meter Data Delivery or Meter Retrieval Success is the ratio of number of metering installation successfully communicated to the total number of registered metering installations. Required average daily result shall be greater than or equal to 95% as reported.

10.4.1.2. Integrity of Metering Data

Integrity of Metering Data is the valid meter data that passed the validation process as set forth by WESM. This measures the ratio of the number of metering installations for which the data passes the validation process to the total number of metering installation successfully retrieved (communicated). Required average daily result shall be greater than or equal to 95% as reported.

10.4.1.3. Timeliness and Percentage Resolution to the Daily Meter Trouble Report

This measure the percentage of the total number of metering installation for which a daily meter trouble reports (MTR) is issued, that has been resolved or corrected in 10 calendar days. Required average daily result shall be greater than or equal to 90% as reported.

10.4.1.4. Timeliness and Percentage Resolution to the Monthly Meter Trouble Report

The MTR issued (for each metering installation) based on the submitted monthly compact disc containing all meter data for the billing period shall be resolved and corrected within 2 business days. Required result shall be greater than or equal to 90% as reported.

10.4.1.5. Timeliness of Monthly Meter Data Delivery

This involves the delivery/review/compilation/part retrieval of meter data for all the metering installations by the meter service provider. The

standard shall be rated 100% for the complete delivery of meter data for all metering installations within 3 calendar days after the billing period.

Incomplete Metering Data shall be rated based on the ratio of the number of metering points with meter data submitted to total metering installations as registered in the WESM.

10.4.2. Customer Satisfaction

Customer Satisfaction is a measurement of the Meter Service Provider corporate image, its responsiveness to emergency situation and on call meeting/s, the safety/behavior of its personnel and its compliance to the requirement of the metering facilities.

A Meter Service Provider Customer Satisfaction Rating Sheet shall be issued to measure the service satisfaction provided by a Meter Service Provider as rated by the WESM trading participant/s. Required annual average result shall be greater than or equal to 90%.

10.5. PERFORMANCE STANDARDS

The Performance Standard as set by the WESM is the following:

Performance Indicator	Category	Performance Measures	Percent Weight	Percent Passing
Service Delivery	Daily Meter Data Delivery	Number of metering installations successfully retrieved	25	95
	Integrity of Meter Data	Meter Data that passed the validation processes	25	95
	Timeliness and Percentage Resolution to the Daily Meter Trouble Report	Resolution to the Meter Trouble Report within 10 calendar days	15	90
	Timeliness and Percentage Resolution to the	Resolution to the Meter Trouble	10	90

Performance Indicator	Category	Performance Measures	Percent Weight	Percent Passing
	Monthly Meter Trouble Report	Report within 2 business days		
	Timeliness of Monthly Meter Data Delivery	Complete delivery of all meter data within 3 calendar days after the billing period.	15	100
Customer Satisfaction	Customer Satisfaction Rating	Meter Service Provider Performance Appraisal by the Trading Participant/s.	10	90

10.6. OVERALL PASSING PERCENTAGE

The following is the overall passing percentage of a meter service provider rated annually.

	% Weight	Passing	Equivalent %
Daily Meter Data Delivery	25 %	95 %	23.75 %
Integrity of Meter Data	25 %	95 %	23.75 %
Timely Resolution (Daily MTR)	15 %	90 %	13.5 %
Timely Resolution (Monthly MTR)	10 %	90 %	9 %
Timely Delivery Monthly Meter Data	15 %	100 %	15 %
Customer Satisfaction	10 %	90 %	9 %
		Overall Passing	**94 %**

10.7. PERFORMANCE RATING

10.7.1. Monthly Performance Rating

After every billing period, the Philippine Electricity Market Corporation shall issue or release to the trading participant/s and meter service provider/s the actual generated performance rating of the MSP measured under Section 10.4.1 – Service Delivery. The result of the MSP performance ratings shall be discussed with the MSP by the PEMC if so requested by the concerned MSP and its trading participant/s. The generated performance rating of the MSP shall be published in the website.

10.7.2. Semi-Annual Customer Satisfaction Rating

Every six (6) months, the PEMC Metering & Settlement Department shall conduct a CSR on the MSP performance through the issuance of the CSR form to all the WESM trading participants to be accomplished and submitted back to PEMC. The CSR forms are to be accomplished every first week of July of the current year and January of the following year. The July rating comprises the MSP performance from January to June of the current year and the January rating correspond to the second half of the previous year (July to December).

10.7.3. Annual Performance Rating

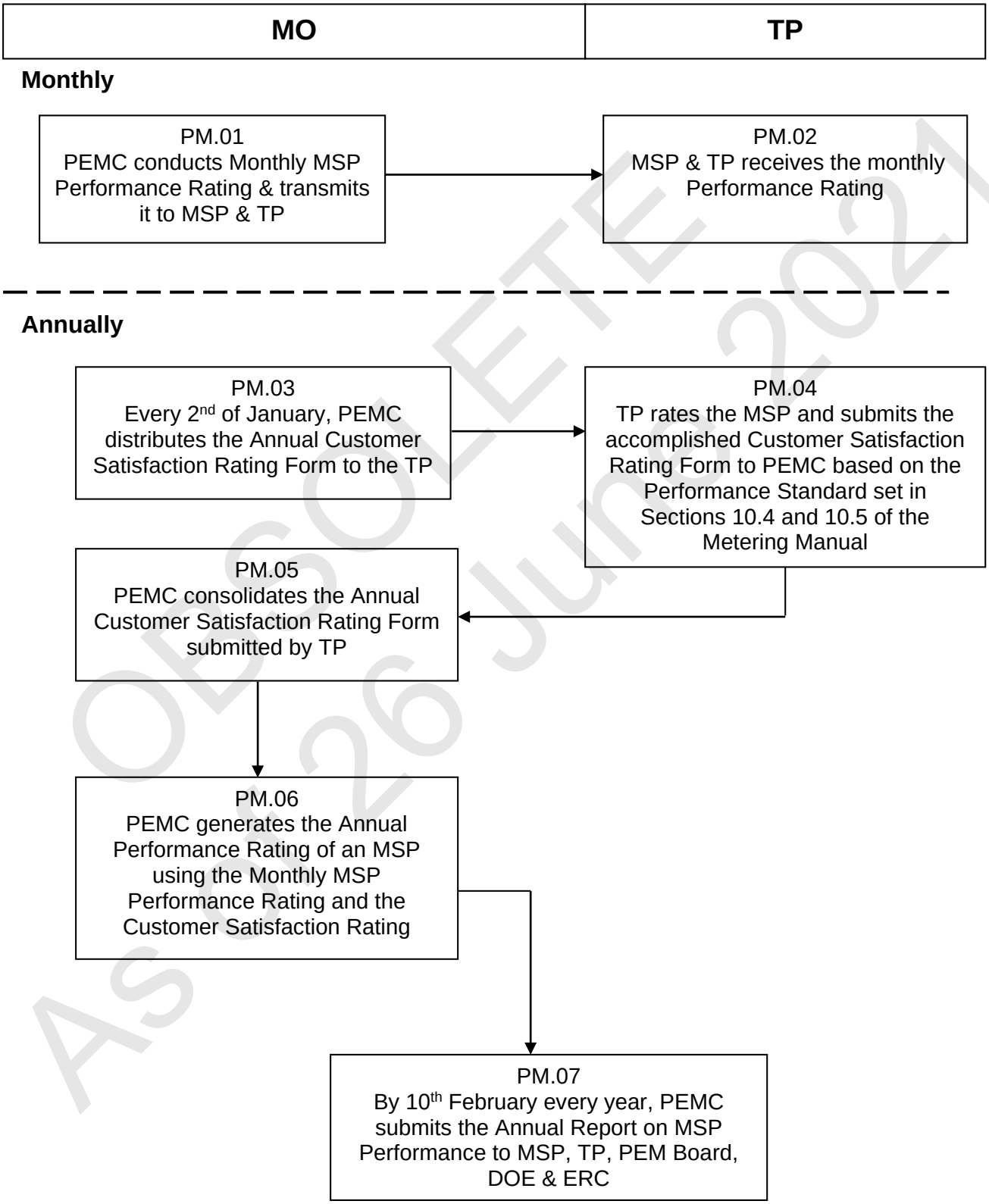
Annual Performance Rating covers the billing periods January to December of each year. It shall consist of:

1. The annual Performance Measures under Sub- section 10.4.1 – Service Delivery (Average of the 12 months billing).

2. The Customer Satisfaction Rating under Sub-sections 10.4.2 and 10.7.2.

The annual MSP Performance Rating shall be submitted by the PEMC Metering & Settlement Department to PEMC Management.

Work Flow for MSP Performance Rating



Customer Satisfaction Measurement

Meter Service Provider Customer Satisfaction Rating Sheet:		***LEVELS OF SATISFACTION**			
		Below 90%	Above 90%	Above 95%	Above 99%
A. Corporate Image: Does the MSP's Company/Employee maintain good representation at all times?	Wearing ID at all times Tidy and neat appearance/attire of personnel General appearance of service vehicle Upkeep of tools and equipment				
B. Punctuality/Responsiveness: Do they arrive/act on time?	Emergency breakdown				
	On time during appointment/meeting				
Do they submit report/s on time?	Metering Information Registration Form				
	Notice of Metering Installation Changes				
	Metering Equipment Test/Calibration Report/s				
C. Safety: Do they observe safety at all times?	Wearing safety helmet Wearing safety shoes Wearing gloves when needed				
	Secure clearance during metering activities				
D. Behavioral/ General Impression Do they conduct themselves in a professional manner?	Courteous Accommodating Knowledgeable/Competent				
* MSP Rating in numerical percentage					

APPENDIX

METERING SERVICES PROVIDER REGISTRATION FORM

A. General Information

1. Name

Name of Organization to be Registered: _____

Short Name: _____

2. Business/ Office Address

No. Street	City:	Province:	Postal/Zip Code:
Phone Number:	FAX Number:	E-mail Address:	

3. Primary Contact for this Application

Mr. Mrs. Last Name: Full Name: Middle Initial:

Mr. /Ms. _____

Position Held _____

Other: _____

Local Address, if the address in item 2 is located outside the country:

Street City: Province Country Postal/Zip Code:

Phone Number: FAX Number: E-mail Address:

Assistant's Name:
_____

4. Head of Business Organization (chief executive officer, president or other person that has authority over and responsibility for the operations of the organization)

Mr. Mrs. Last Name: Full Name: Middle Initial:

Miss. Ms. _____

Position Held _____

Other: _____

Phone Number: FAX Number: E-mail Address:

B. Details of Mo's Requirements

1. **Nature and Details of Form of Applicant's Business Organization**

   Form (i.e., corporation, partnership, etc.): _____

   Date of Information: _____

2. **How long is your organization been involved in the metering services? _____Please submit additional documents as detailed below in support to the registration.**

   A. Provide proof that it has relevant experience (technical and financial capability) based on previous work and company's profile on Technical Capability;

      a. Submit a detailed list of the company's employees resume, which contains years of experience and their respective field of expertise;

      b. Demonstrate and submit documents that an appropriate infrastructure exists to communicate with the MO for Metering processes;

      c. Demonstrate and Submit documents an ability to service meter trouble calls to MO standards; and

      d. Demonstrate and Submit documents that emergency restoration plans for Metering Installation failure are in place.

   B. Certificate of Authority from the ERC and all relevant documents as approved by ERC.

3. For further clarification, please don't hesitate to call us at Tel No. 631-87-34 local ____ or e-mail your inquiry at_____

Submitted by:

_____
President or Representative
Meter Service Provider

PHILIPPINE ELECTRICITY MARKET CORPORATION
9th Floor, Robinsons-Equitable Tower, ADB Ave. cor. Poveda St., Ortigas Center 1600, Pasig City
Tel. No. (632) 631-8734 Telefax: (632) 636-0802
Website: www.wesm.ph

METERING INSTALLATION FORM

Region		Resource ID (***for MO use only***)	
District		Market Trading Node (***for MO use only***)	

PARTICIPANT'S INFORMATION

Participant's Name:				Type :	Generator ○ Customer ○
Delivery Pt No./Address	Substation Name/Capacity/Loc/Prov.	Voltage Level	Classification	Type of Meter:	
				Electronic ○	
				Electro-Mechanical ○	
Contact Person				Tel. No.	
Metering Services Provider				Tel. No.	

METERING INFORMATION

Scheme		MAIN Meter	Multiplier:			
Metering Line Voltage			Internal		External	
Service		ALT/BACK-UP Meter	Multiplier:			
Frequency			Internal		External	

METER DEVICE INFORMATION

Particulars	MAIN Meter	ALTERNATE/BACK-UP Meter
METERING INSTALLATION (MI) SEIN		
Serial Number		
Make/Brand		
Model/Type		
Time Base Used		

METER COMMUNICATION INFORMATION

Communication Port/s Available	BAUD Rate	Telephone No./Communication Provider Available

Additional Documents to be submitted	***Remarks (for MO Used Only)***
1.) Metering Installation Specifications	
2.) Load Profile (Forecast, Historical Data, including Maximum and Minimum Hourly Demand)	

3.) Data of Connected Power Transformers (Core & Copper Loss)	
4.) Data of Lines from Metering Point to Market Trading Node	
5.) Drawing of the Location Plan of the Metering Point	
6.) Single Line Diagrams from Grid Substation to the Metering Point	
7.) Detailed Wiring Diagram of the Metering Installation	
8.) ERC's Certification on Meter Test Results (w/ ERC Seal)	
9.) Test & Calibration reports of Instrument Transformers and Meters	
10.) Pro-forma Agreement between Trading Participant & its MSP	
11.) Other Special Features of the Meter	
Submitted by:	Approved by:
(Signature above Printed Name)	
Note: The Trading Participant shall accomplished this form in coordination with its MSP ***All drawings, plans, wiring diagrams shall be signed by a Professional Electrical Engineer.***	

GOVERNING PROVISIONS OF THE WESM RULES

The following pertinent provision in the WESM rules that served as requirements for potential candidates for being Trading Participants and Metering Services Providers are detailed below, to wit:

Section 4.3.2 Election of a Metering Services Provider by a Trading Participant

Section 4.3.2.1 A *Trading Participant* who is a *Direct WESM Member* shall:

a. Elect a Metering Services Provider who will have responsibility for arranging for the provision, installation, testing, calibration and maintenance of each Metering Installation for which that Trading Participant is financially responsible;

Sections 4.3.3 Metering Services Provider Obligations

The *Metering Services Provider* shall:

a. Ensure that its *Metering Installations* are provided, installed, tested, calibrated and maintained in accordance with this chapter 4, the *Grid Code* and *Distribution Code* and all applicable laws, rules and regulations.

b. Ensure that the accuracy of each of its *Metering Installations* complies with the requirements of chapter 4 and the *Grid Code* and *Distribution Code*; and

c. The *Metering Services Provider* shall provide for remote monitoring facilities to alert the *Market Operator* of any failure of any components of the Metering Installation which might affect the accuracy of the metering data derived from that Metering Installation.

Section 4.4.2 Subject to clause 4.3.3.3, a *Generation Company* or *Customer* which is involved in the trading of *energy* shall not be registered as a *Metering Services Provider* for any *Connection Point* in respect of which the *metering data* relates to its own use of *energy*.

Section 4.4.3 If a *Trading Participant* is a *Customer* and also a *Network Service Provider*, the *Trading Participant* may register as a *Metering Services Provider* only for Connection Points that it does not own.

Section 4.5 METERING INSTALLATION

Section 4.5.1 Metering Installation Components

A *Metering Installation* shall:

a. Be accurate in accordance with this chapter 4 and the *Grid Code* and *Distribution Code*;

b. Have facilities to enable *metering data* to be transmitted from the *metering installation* to the *metering database*, and be capable of communication with the *metering database*; This requirement may be relaxed during the operation of the *interim WESM*.

c. Contain a device which has a visible or an equivalently accessible display of *metering data* or which allows the *metering data* to be accessed and read at the same time by portable computer or other equipment of a type or specification reasonably acceptable to all entities who are entitled to have access to that *metering data*;

d. Be secure;

e. Have electronic data recording facilities such that all *metering data* can be measured and recorded in *trading intervals*;

f. Be capable of separately registering and recording flows in each direction where bi-directional *active energy* flows occur;

g. Have a *meter* having an internal or external *data logger* capable of storing the *metering data* for at least 60 days and have a back up storage facility enabling *metering data* to be stored for 48 hours in the event of external power failure; and

h. Have an *active energy meter*, and if required in accordance with the Grid *Code* and *Distribution Code*, a *reactive energy meter*, having both an internal or external *data logger*.

Section 4.5.6 Security of Metering Data Held in a Metering Installation

The *Metering Services Provider* shall ensure that *metering data* held in a *Metering Installation* is protected from local or remote electronic access or manipulation of data by the installation of suitable security

electronic access controls (including, if required by the *Market Operator*, passwords).

Section 4.5.7 Performance of Metering Installations

Section 4.5.7.1 The *Metering Services Provider* shall use all reasonable endeavors to ensure that *metering data* is capable of being transmitted to the *metering database* from its *Metering Installations*:

a. Within the applicable accuracy parameters described in the *Grid Code* and *Distribution Code*; and

b. Within the time required for *settlement*, at a level of availability of at least 99% per annum, or as otherwise agreed between the *Market Operator* and the *Metering Services Provider*.

Section 4.5.7.2 If a *Metering Installation* malfunction or defect occurs, the *Metering Services Provider* shall ensure that repairs shall be made as soon as practicable and in any event within two *business days*, unless extended by the *Market Operator*.

Section 4.5.8 Meter Time

Section 4.5.8.1 The *Metering Services Provider* shall ensure that all *Metering Installation* and *data logger* clocks are referenced to Philippines Standard Time.

Section 4.6 METERING DATA

Section 4.6.1 Changes to Metering Data

The *Metering Services Provider* shall not make, cause or allow any alteration to the original stored data in a Metering Installation. It shall also use reasonable endeavors to ensure that no other person or entity does the same.

Section 4.6.2.3 The *Metering Services Provider* shall, at its own cost, ensure that *metering data* derived from a *Metering Installation* for which it is responsible shows the time and date at which it is recorded and is capable of being transmitted from the *metering installation* to the *metering database* in accordance with the *Market Operator's* reasonable requirements.

Section 4.6.2.5 Without prejudice to the generality of this clause 4.5, the *Metering Services Provider* shall ensure that each of its *Metering Installations* have adequate communication facility that will enable the *Market Operator* to obtain remote access to the *metering data* from the *metering database*. This requirement, however, may be relaxed during the initial operation of the *WESM*.

Section 4.8.1 Installation Databases

Section 4.8.1.1 The *Metering Services Provider* shall create, maintain and administer an *installation database* in relation to all its *Metering Installations*.

Section 4.8.1.2 The *Metering Services Provider* shall ensure that each *affected Participant* and the *Market Operator* is given access to the information in its *installation database* at all reasonable times and:

a. In the case of data sixteen months old or less, within seven *business days* of receiving written notice from the person or entity seeking access; and

b. In the case of data more than sixteen months old, within thirty days of receiving written notice from the person or entity seeking access.

Section 4.8.1.3 The *Metering Services Provider* shall ensure that its *installation database* contains the information specified in Appendix B2.

Section 4.8.4 Confidentiality

Subject to clause 4.7.3, *metering data* is confidential and each *WESM Member* and *Metering Services Provider* shall ensure that such data is treated as *confidential information* in accordance with the *WESM Rules*.

METERING SERVICE AGREEMENT

This **METERING SERVICE AGREEMENT** (hereinafter referred to as "Agreement," for brevity) entered into this _____ day of _____, 2005, by and between: _____(individual/ corporation/ business organization)_____ duly incorporated/formed/registered] and organized under the laws of _____(country/state) _____, having its registered address at_____ __, hereinafter referred to as the Metered Trading Participant (MTP).

Metered Trading Participant (MTP):
MTP Representative:
Title:
Signature

- and -

_____, a (form of business organization) organized under the laws of the Republic of the Philippines, and having received Authorization from the Philippine Energy Regulatory Commission (ERC) to operate as a Metering Services Provider for WESM Trading Participants, and having its registered address at _____, hereinafter referred to as the Metering Service Provider (MSP)

WITNESSETH:

WHEREAS, The provision of metering equipment and services to the entities involved in the generation, transmission, distribution, and wholesale trading of electricity in the restructured Philippine electricity industry is governed by the Wholesale Electricity Spot Market (WESM) Rules, the Philippine Grid Code, and the Philippine Distribution Code;

WHEREAS, Clause 4.3.2 of the WESM Rules requires a Trading Participant who is a Direct WESM Member to:

Metering Services Provider (MSP):
MSP Representative:
Title:
Signature:

(a) Elect a Metering Services Provider who will provide, install, test, calibrate and maintain each metering installation for which the Trading Participant is financially responsible;

(b) Enter into an Agreement with the Metering Services Provider which includes the terms and conditions for the provision, installation and maintenance of the relevant metering installation by the Metering Services Provider, and

(c) Provide the Market Operator with the relevant details of the metering installation in accordance with Appendix B2 within ten (10) business days of entering into an Agreement with the Metering Services Provider(s) under clause 4.3.4(b);

WHEREAS, the WESM Rules requires the Metering Services Provider to:

(a) Ensure that its metering installations are provided, installed, tested, calibrated and maintained in accordance with Chapter 4 of this, the Grid Code and Distribution Code and all applicable laws, rules and regulations. (Clause 4.3.3)

(b) Ensure the accuracy of each of its metering installations in compliance with the requirements of Chapter 4 and the Grid Code and Distribution Code.(Clause 4.3.3)

(c) Protect the metering installation from any form of unauthorized interference, by providing secure housing for metering equipment or by ensuring that security at the metering point is adequate to protect against such interference. (Clause 4.5.5.1)

(d) Ensure that metering data held in a metering installation are duly-protected from local or remote electronic access or manipulation of data by the installation of suitable security electronic access controls (including, if required by the Market Operator, passwords). (Clause 4.5.6)

(e) Undertake all reasonable measures to ensure that the metering data are capable of being transmitted to the metering database from their metering installations (Clause 4.5.6):

(f) Perform repairs on failed metering installations as soon as practicable and in any event within two (2) business days, unless extended by the Market Operator (Clause 4.5.7.2);

Metered Trading Participant (MTP):
MTP Representative: Signature
Title:

WHEREAS, The (Name of MSP) has been issued Authorization by the Energy Regulatory Commission ("ERC") and registered by the Market Operator ("MO") as a Metering Service Provider of the WESM, and the (Name of Metered Trading Participant) has been registered by the Market Operator as a WESM Trading Participant;

WHEREAS, The provision and maintenance of revenue metering equipment, and the delivery of services as Meter Service Provider to the Metered Trading Participants shall be covered in a Supplemental Agreement to this Metering Service Agreement;

Signature:

WHEREAS, This Agreement is entered into for the purpose of establishing the terms and conditions between the Parties, as well as their respective rights and obligations pursuant to this Agreement, the WESM Rules, the Grid Code, and the Distribution Code;

NOW, THEREFORE, for and in consideration of the mutual covenants herein set forth, for valuable and adequate consideration, the receipt of which is hereby acknowledged, the Parties agree as follows:

Metering Services Provider (MSP):
MSP Representative:
Title:

Signature
Metered Trading Participant (MTP):
MTP Representative:
Title:

ARTICLE I

INTERPRETATION

1.1. WESM Rules Definitions: Subject to Section 1.2, italicized expressions used in this Page 2 of 12 Agreement have the meanings ascribed thereto in Chapter 11 of the WESM Rules.

1.2. Supplementary Definitions: The following words shall have the meanings set out below, unless the context requires otherwise:

"Agreement" means this Agreement, including any Schedules hereto attached;

"Metered Trading Participant" (MTP) means a WESM Trading Participant which has contracted the services of a Metering Service Provider (MSP) under this Agreement.

"Applicable Laws" are laws, regulations, rules, codes, guidelines, market manuals and such other documents as are applicable to the provision of metering services, and all orders of the government and its instrumentalities and agencies exercising jurisdiction over such activities;

"Confidential Information" means (i) information which has been supplied by the disclosing person in confidence implicitly or explicitly, where disclosure can reasonably be expected to (a) prejudice significantly the competitive position of the disclosing person, (b) interfere significantly with the contractual or other negotiations of the disclosing person or another person; (c) result in undue loss or gain to the disclosing person or to another person, (d) compromise the efficiency of the WESM, or (e) result in the disclosing person's being in breach of a bona fide arm's length confidentiality agreement to which the information is subject; or (ii) information that, pursuant to the WESM Rules or such other applicable laws, the Parties cannot disclose or make available to one or more persons;

"Effectivity Date" is the date of signing of this Agreement by the representatives of the Metering Service Provider (MSP) and the Metered Trading Participant (MTP);

"Party" means a party to this Agreement;

Signature
Metered Trading Participant (MTP):
MTP Representative:
Title:

"Market Operator" means the Philippine Electricity Market Operator or any other successor entity duly formed for the purpose of operating the spot market;

"Supplemental Agreement" is an agreement which is intended to supplement and form part of this Agreement, for the purpose of defining the specific scope of supply and services, the agreed rates for the service charges, and other commercial terms not covered in this Agreement.

1.3. Interpretation: Unless the context otherwise requires, it is understood that:

1.3.1. Words importing the singular include the plural and vice versa;
1.3.2. Words importing a gender include all genders;
1.3.3. When italicized, the parts of speech and grammatical forms of a word or phrase defined in this Agreement have a corresponding meaning;
1.3.4. "Person" includes a natural or juridical person;
1.3.5. A reference to a thing includes a part of that thing;
1.3.6. A reference to an article, section, provision or schedule is understood to mean that which is contained in this Agreement;
1.3.7. A reference to any statute, regulation, proclamation or any similar directive includes all statutes, regulations, proclamations, orders or directives varying, consolidating, re-enacting, extending or replacing it;
1.3.8. A reference to a document or provision of a document, including this Agreement and the WESM Rules, includes an amendment or supplement to, or replacement or notation of, that document, as well as any exhibit, schedule, appendix or other attachments thereto;
1.3.9. A reference to a person includes that person's heirs, executors, administrators, successors and permitted assigns;
1.3.10. A reference to sections of this Agreement or of the WESM Rules separated by the word "to" (i.e., "sections 1.1 to 1.4") shall be a reference to the sections inclusively;
1.3.11. The expressions "including," "includes" and "included" mean including, without limitation; and
1.3.12. A reference in this Agreement to the WESM Rules includes a reference to any forms and market manuals pertaining to the WESM and to any policies, guidelines or other documents adopted by the PEM Board;

1.4. Headings: The division of this Agreement into articles and sections and the insertion of headings are for convenience of reference only and shall not affect the interpretation of this Agreement, nor shall they be construed

Metered Trading Participant (MTP):
MTP Representative:
Title:
Signature

Metering Services Provider (MSP):
MSP Representative:
Title:
Signature:

as indicating that all of the provisions of this Agreement relating to any particular topic are to be found in any particular article, section, sub-section, clause, provision, part or schedule.

ARTICLE 2

WESM RULES

2.1. WESM Rules Governs: In the event of any inconsistency between this Agreement and the WESM Rules, the WESM Rules shall prevail.

ARTICLE 3

MSP RIGHTS AND OBLIGATIONS

3.1 Compliance with WESM Rules: The MSP is bound by the provisions of the WESM Rules, the Grid Code and the Distribution Code insofar far as they are applicable to metering service providers in the same manner as if such provisions formed part of this Agreement.

3.2 Provision of Metering Equipment: The MSP shall provide the equipment that shall form part of the Metering Installation in accordance with the agreed scope of supply under the Supplemental Agreement between the Metering Service Provider and the Metered Trading Participant.

3.3 Provision of Metering Services: The MSP shall provide the following metering services:

3.3.1 Metering installation and commissioning services for new metering installations or upgrading, relocation or such other services for the purpose of providing WESM compliant meters;

3.3.2 Metering installation operation and preventive maintenance, covering the following activities:

a. Meter reading;
b. Periodic inspections;
c. Metering security;
d. Meter data communications service, including commercial telephone subscription;
e. Annual calibration and testing of meters;
f. Testing of instrument transformers as may be provided under the WESM Rules, furnishing the Metered Trading Participant

Metered Trading Participant (MTP):
MTP Representative:
Title:
Signature

Metering Services Provider (MSP):
MSP Representative:
Title:
Signature:

with metered demand and energy consumption data, metering installation data and such other data as may be required by the MO;

3.3.3 Off-schedule work requested by the Market Operator or the Metered Trading Participant;

3.4 Performance Standards: The MSP shall meet the performance standards pertaining to its obligations set forth in the ERC Guidelines for MSPs, the WESM Rules, Grid Code & Distribution Code.

3.5 Staffing Requirements: The MSP shall at all times maintain an adequate number of qualified personnel so as to permit it to perform all of its functions and obligations under this Agreement, and as a Metering Service Provider under the WESM Rules, and to meet the performance standards referred to in Section 3.4.

3.6 Rights Relating to Metering Installations: The Metered Trading Participant shall, in respect to a metering installation covered under the Supplemental Agreement, provide the MSP with access to, and procure any rights necessary, for the MSP to access such metering installation and to access all metering data in such metering installation to the extent of enabling the MSP to perform its obligations and exercise its rights under the WESM Rules and this Agreement.

3.7 Information on Metering Installation: The MSP shall disclose or provide to the Metered Trading Participant all information on the metering installation for which it is the Metering Service Provider where such information is required by the Metered Trading Participant in order to be able to perform its obligations and exercise its rights under the WESM Rules and this Agreement with respect to such metering installation. Where no time is specified as regards the disclosure or provision of specific information, the said information shall be disclosed or provided within a reasonable time.

3.8 Accuracy of Information: The MSP shall ensure the accuracy of information it has obtained from its metering installations.

3.9 Correction of Information: Where the MSP discovers that any information previously disclosed by it pursuant to Section 3.7 was untrue or inaccurate, or subsequently becomes untrue, incorrect, incomplete, misleading or deceptive, the MSP shall immediately rectify the situation by disclosing or providing the true, correct, complete and accurate information to the person to whom the erroneous information was disclosed or provided.

Metered Trading Participant (MTP):
MTP Representative:
Title:
Signature

Metering Services Provider (MSP):
MSP Representative:
Title:
Signature:

3.10 Record Retention: The MSP shall retain all records which it is mandated to maintain as per the provisions of Chapter 4 of the WESM Rules, or as per the order of the Metered Trading Participant under this Agreement for a period of sixteen (16) months in accessible format, and ten (10) years in archive, or for such other period of time as may be specified in the WESM Rules or designated by the MO in respect of any record or class of records.

3.11 Permits and Licenses: The MSP shall at all times maintain in good standing all permits, licenses and other authorizations that may be necessary to enable it to carry on the business, and perform the functions and obligations of a Metering Service Provider as described in the WESM Rules and in this Agreement.

3.12 Notification of Significant Events: The MSP shall notify the Metered Trading Participant of any of the circumstances which may give rise to the following, either at the time of the occurrence thereof, or immediately upon becoming aware thereof:

3.12.1 The MSP ceases to satisfy any of the qualifications of an MSP.

3.12.2 It becomes unlawful for the MSP to comply with any of the obligations imposed on Metering Service Providers under the WESM Rules or under this Agreement by reason of the fact that its license, permit or other authorization has been suspended or revoked.

3.12.3 The MSP ceases, or is in danger of terminating, the conduct of its business or a substantial part thereof;

3.12.4 The MSP is wound up or dissolved, unless the notice of winding up or dissolution is discharged;

3.12.5 The MSP is insolvent or unable to pay its debts under any applicable legislation;

3.12.6 An event has triggered, or is likely to trigger, the revocation or expiration of the registration of any metering installation with respect to which it acts as a metering service provider; and

3.12.7 Any other event arises which materially affects or is likely to materially affect:

a. the performance by the MSP of any of the obligations imposed on Metering Service Providers under the WESM Rules or this Agreement;

b. the performance by the MSP of its obligations relating to metering installations or metering data under the WESM Rules or this Agreement; or

c. the performance, accuracy or security of any metering installation with respect to which it acts as a Metering Service

Metered Trading Participant (MTP):
MTP Representative:
Title:
Signature

Metering Services Provider (MSP):
MSP Representative:
Title:
Signature:

Provider or of any metering data contained in, or are being made available from such metering installation.

3.13 No Adjustments to Metering Data: Except as expressly permitted by the WESM Rules or this Agreement, the MSP shall not adjust any metering data or other information contained in a metering installation with respect to which it is the Metering Service Provider, in the metering registry or in the metering database.

3.14 Insurance: The MSP shall at all times maintain general contractual liability insurance coverage and such other insurance coverage upon such terms and in such amounts as would be maintained by a prudent person conducting business activities identical to, or similar in nature, to those of the MSP's.

3.15 The MSP as a Third-Party Beneficiary. The MSP shall be a third-party beneficiary to any future agreement between the Metered Trading Participant and any other party relating to the metering installation of the Metered Trading Participant for the purpose of granting the MSP access to any relevant information, records and facilities as needed by the MSP to fulfill its obligations under the WESM Rules, the Grid Code, Distribution Code, and this Agreement.

Metered Trading Participant (MTP):
MTP Representative:
Title:
Signature

ARTICLE 4

RIGHTS AND OBLIGATIONS OF METERED TRADING PARTICIPANTS

4.1 Compliance with WESM Rules: The Metered Trading Participant is bound by the provisions of the WESM Rules insofar as they are applicable to the subject matter of this Agreement as though such provisions formed part of this Agreement.

4.2 Provision of Metering Equipment. The Metered Trading Participant shall provide the metering equipment to be installed as part of the Metering Installation;

4.3 Payment for Metering Charges. The Metered Trading Participant shall pay to the Metering Services Provider the metering charges as stipulated in the Supplemental Agreement, to cover the following items of supply and services:

4.3.1 Metering Installation and Commissioning Services, as one-time charge.

Metering Services Provider (MSP):
MSP Representative:
Title:
Signature:

4.3.2 Metering Installation Operation and Preventive Maintenance, as regular monthly charge, covering the costs of:

- **a.** Meter reading;
- **b.** Periodic inspections;
- **c.** Metering security;
- **d.** Meter data communications service, including commercial telephone subscription;
- **e.** Annual calibration and testing of meters;
- **f.** Testing of instrument transformers as may be provided under the Grid Code.

4.3.3 Capital Cost Recovery for metering equipment provided by the Metering Service Provider, as part of its scope of supply under the Supplemental Agreement, to be paid as part of the monthly metering charges.

4.3.4 Off-schedule work rendered as per request of the Trading Participant, to be paid as part of the monthly metering charges.

4.3.5 Miscellaneous expenditures including replacement of metering equipment, and costs arising from any compliance to regulatory requirements under the WESM Rules, Grid Code, Distribution Code and other applicable laws.

The rates covering these charges and the manner in which the amounts shall be computed shall be covered by the Supplemental Agreement.

4.4 Disclosure of Information: The Metered Trading Participant shall disclose or provide to the MSP such information as is required to be disclosed or provided to the MSP pursuant to the WESM Rules and this Agreement. Such information shall be so disclosed within the time specified in, and in the form and manner required by the WESM Rules or this Agreement. Where no time is specified in relation to the disclosure or provision of specific information, the same shall be disclosed or provided within a reasonable time.

4.5 Accuracy of Information: Information disclosed or provided by the Metered Trading Participant pursuant to Section 4.3 shall be true, accurate and complete, to the best of the Metered Trading Participant's knowledge, at the time when such disclosure or provision is made. The Metered Trading Participant shall not knowingly or recklessly disclose or provide information pursuant to Section 4.3 that, at the time and in light of the circumstances in which such disclosure or provision is made, is misleading or deceptive or does not state a fact that is required to be stated.

Metered Trading Participant (MTP):
MTP Representative:
Title:
Signature

Metering Services Provider (MSP):
MSP Representative:
Title:
Signature:

4.6 Correction of Information: Where the Metered Trading Participant discovers that any information previously disclosed or provided by it to the MSP pursuant to Section 4.3 was, at the time of disclosure or subsequently thereafter, becomes untrue, incorrect, incomplete, misleading or deceptive, the Metered Trading Participant shall immediately rectify the situation and disclose or provide the true, correct, complete information to the person to whom the original or currently untrue, incorrect, incomplete, misleading or deceptive information had been disclosed or provided.

4.7 Use of Information: Except as otherwise prohibited by the WESM Rules or this Agreement, the Metered Trading Participant is entitled to use any data or information obtained from the MSP in pursuance of its duties under the WESM Rules or under this Agreement.

4.8 Rights of the MSP to Access Metering Facilities. The Metered Trading Participant shall, with respect to a metering installation, provide the MSP with access to, and procure any rights necessary for the MSP to access, such metering installation and to access all metering data in such metering installation so as to enable the MSP to perform its obligations and exercise its rights under the WESM Rules and this Agreement. The MSP shall not be prevented from fulfilling its obligations under the WESM Rules and the Grid Code or this Agreement by reason of the fact that it is provided with escorted access to the Metering Facilities of the Metered Trading Participant.

4.9 Notification of Significant Events: The Metered Trading Participant shall notify the MSP of the occurrence of any circumstance which would most likely give rise to any of the following events, upon the occurrence thereof, or upon becoming aware thereof:

4.9.1 The Metered Trading Participant ceases to satisfy any of the qualifications of a WESM Trading Participant.

4.9.2 Its registration as a Metered Trading Participant is suspended or revoked, or is threatened to be suspended or revoked because of violation of the WESM Rules.

4.9.3 The Metered Trading Participant enters into, or intends to enter into an arrangement or compromise with, or an assignment for the benefit of, all or any class of its creditors or members or a moratorium involving any of them;

4.9.4 A receiver, manager or person having a similar function under the laws of any relevant jurisdiction is appointed with respect to any property of the Metered Trading Participant which is used in or relevant to the performance by the MTP of any of the obligations to

Metered Trading Participant (MTP):
MTP Representative:
Title:
Signature

Metering Services Provider (MSP):
MSP Representative:
Title:
Signature:

metering service providers under the WESM Rules or under this Agreement;

4.9.5 An administrator, liquidator, trustee in bankruptcy or person having a similar or analogous function under the laws of any relevant jurisdiction is appointed in respect of the MTP, or any action is taken to appoint such person;

4.9.6 An application is made, or a resolution is passed, for the winding up or dissolution of the MTP;

4.9.7 The MTP is wound up or dissolved, unless the notice of winding up or dissolution is discharged;

4.9.8 The MTP is taken to be insolvent or unable to pay its debts under any applicable legislation;

4.10 The MSP as Third-Party Beneficiary. The Metered Trading Participant shall ensure that the MSP is given third-party beneficiary rights in any future agreement between the Metered Trading Participant and any other party relating to the metering installations for which it is the MSP, for the purpose of granting the MSP access to any relevant information, records and facilities as needed by the MSP to fulfill its obligations under the WESM Rules, the Grid Code, the Distribution Code, and this Agreement.

Metered Trading Participant (MTP):
MTP Representative:
Title:
Signature

ARTICLE 5

REPRESENTATIONS AND WARRANTIES

5.1 Representations and Warranties of the Parties: The Parties to this Agreement hereby represent and warrant as follows :

5.1.1 This Agreement constitutes a legal, binding and enforceable obligation of the Parties;

5.1.2 The Parties have all the qualifications and none of the disqualifications to enter into this Agreement;

5.1.3 Each Party has the necessary corporate power to enter into, and perform its obligations under, this Agreement;

5.1.4 5.1.4 The execution, delivery and performance of this Agreement has been duly authorized by the government;

5.1.5 The individuals executing this Agreement and any document in connection herewith have been duly authorized to execute this Agreement and have the full power and authority to bind the Parties;

5.1.6 The activities undertaken by the Parties prior to the effectivity date in respect of any metering installation, have been carried out in accordance with the WESM Rules

Metering Services Provider (MSP):
MSP Representative:
Title:
Signature:

ARTICLE 6

CONFIDENTIALITY

6.1 Confidentiality: Section 4.8.4 of Chapter 4, and Sections 5.2 - 5.3 of Chapter 5 of the WESM Rules apply to this Agreement, and all references in those Sections to a trading participant are deemed to be references to the MSP and all references in those sections to the WESM Rules are deemed to include references to this Agreement.

6.2 Other Confidentiality Obligations: The MSP shall:

6.2.1 Comply with the obligations referred to in Article 6.1 of this agreement with respect to any historical metering data pertaining to any metering installation that was created prior to the commencement by the MSP of its activities as a metering service provider; and

6.2.2 Respect the confidentiality classification and all associated restrictions on disclosure, assigned or applicable to any confidential information that the MSP may prepare or have in its possession or control as a result of activities undertaken by the MSP under the WESM Rules or this Agreement.

6.3 Other Confidentiality Provisions: Nothing in this Agreement shall require a Party to disclose information that it is strictly classified or considered to be highly-confidential by applicable laws or the WESM Rules.

Metered Trading Participant (MTP):
MTP Representative:
Title:
Signature

ARTICLE 7

TERM AND TERMINATION

7.1 Term: This Agreement shall be a binding obligation on its date of effectivity and shall remain in full force and effect until terminated in accordance with Sections 7.02 and 7.3 of Article 7.

7.2 Termination upon Revocation of Registration: This Agreement shall be automatically terminated upon the revocation by the Market Operator of the registration of the Metering Service Provider (MSP) or the Metered Trading Participant (MTP), in accordance with the WESM Rules.

Metering Services Provider (MSP):
MSP Representative:
Title:
Signature:

7.3 Termination by any of the Parties: Any of the Parties may terminate this Agreement with or without cause, within thirty (30) days from written notice to the other party.

7.4 Termination by the MTP Without Cause. Upon termination by the MTP without cause, the MTP shall pay MSP a termination fee in the amount provided for under the Supplemental Agreement.

7.5 Ongoing Liability: Notwithstanding the termination of this Agreement for any reason, both the Metering Service Provider and Trading Participant shall remain subject to the liabilities and financial obligations that were incurred or which arose under the WESM Rules or this Agreement prior to the date of termination of this Agreement, regardless of the date on which any claim relating thereto may be made.

7.6 Survival: The provisions of Articles 7.4, 6 and 8 of this Agreement shall survive the termination of this Agreement for any reason.

Metered Trading Participant (MTP):
MTP Representative:
Title:
Signature

ARTICLE 8

LIABILITY

8.1 Liability: The provisions of Clauses 2.8 and 4.7 of the WESM Rules or such other applicable laws are incorporated in this Agreement, such that any reference in such Section to metering service providers and trading participants is deemed to be a references to the parties to this Agreement.

ARTICLE 9

DISPUTE RESOLUTION

9.1 Dispute Resolution: In the event of any dispute between the Parties arising pursuant to this Agreement, the Parties shall use the dispute resolution process set forth in Chapter 7 of the WESM Rules. For this purpose, references in Chapter 7 of the WESM Rules to a trading participant shall be deemed to be in reference to the Parties.

9.2 No Other Proceedings: Subject to Section 9.3 of this Agreement, no Party shall commence a civil action or other proceeding in relation to a dispute referred to in Section 9.1 until such time that the dispute resolution process has been completed.

Metering Services Provider (MSP):
MSP Representative:
Title:
Signature:

9.3 No Prejudice to Sanctions: Nothing in this Agreement shall prejudice the right of the MO to take any enforcement actions referred to in the WESM Rules.

ARTICLE 10

MISCELLANEOUS

10.1 Amendment: No amendment of this Agreement shall be effective unless made in writing and signed by the Parties.

10.2 Assignment: Either Party may assign or transfer any or all of its rights and/or obligations under this Agreement subject to the other Party's prior written consent. Such consent shall not be unreasonably withheld. Any such transfer or assignment shall be conditioned upon the successor-in-interest's being pre-qualified to discharge the functions and obligations of the original Party, and its/his full and unconditional acceptance of the rights and obligations under this Agreement, as though said successor-in-interest was an original Party to this Agreement.

10.3 Successors and Assigns: This Agreement shall inure to the benefit of, and be binding upon, the Parties and their respective heirs, administrators, executors, successors and permitted assigns.

10.4 Further Assurances: Each Party shall promptly execute and deliver or cause to be executed and delivered all further documents in connection with this Agreement that the other Party may reasonably require for purposes of giving effect to this Agreement.

10.5 Waiver: A waiver of any default, breach or non-compliance under this Agreement shall not take effect, unless in writing and signed by the Party to be bound by the waiver. No waiver shall be inferred or implied from any Party's failure to act, or delay in acting with respect to the other Party's default, breach, omission or non-observance of duties and obligations set forth in this Agreement.

10.6 Applicable Laws: The Parties to this Agreement shall ensure compliance with existing laws, rules, regulations, administrative orders and policies. Any amendments thereto shall be deemed incorporated herein. Should any provision of this Agreement be later on adjudged as unconstitutional, invalid or unenforceable, the same shall be deemed severed here from, without affecting the validity or enforceability of the remaining provisions.

Metered Trading Participant (MTP):
MTP Representative: Signature
Title:

Metering Services Provider (MSP):
MSP Representative: Signature:
Title:

10.7 Prior Agreements: Subject to Article 10.9, this Agreement supersedes any prior agreement between the Parties.

10.8 Ongoing Liability: Nothing in this Agreement shall extinguish any liabilities or financial obligations that either Party may owe to the other under the terms of any prior written agreement between them of like intent.

10.9 Notices: Any notice, demand, consent, request or other communication required or permitted to be given or made under this Agreement shall:

10.9.1 Be given or made in the manner set forth in Clause 9.6 of the WESM Rules;

10.9.2 Be, pursuant to Article 3.11 hereof, addressed to the other Party in accordance with the information set forth in Part A of Schedule 1; and

10.9.3 Be treated as having been duly given or made in accordance with the provisions of Clause 9.6 of the WESM Rules.

Either Party may change its address and representative as set forth in Part A of Schedule 1 by written notice to the other Party. Such change, however, shall not constitute an amendment of this Agreement for the purposes of the application of Section 10.2.

10.10 Governing Law: This Agreement shall be governed by, and construed in accordance with, applicable Philippine laws and jurisprudence.

10.11 Counterparts: This Agreement may be executed in any number of counterparts, each of which shall be deemed to be an original and all of which, when taken together, shall be deemed to constitute one and the same instrument. Counterparts may be executed either in original or faxed form and the Parties adopt any signatures received by a receiving facsimile machine as original signatures of the Parties; provided, however, that any Party providing its signature in such manner shall promptly forward to the other Party an original signed copy of this Agreement which was so faxed.

IN WITNESS WHEREOF, the Parties have hereto executed this Agreement, through their duly authorized representatives.

Metering Service Provider (MSP)	**Metered Trading Participant (MTP)**
By:	By:
Name:	Name:
Title:	MTP Representative:
MSP Representative:	Title:
Signature:	Signature

Title:

Date:

_____
Signature

Title:

Date:

_____
Signature

METERING OUTAGE FORM

Metering Outage Reporting Form	
Form Completion Date:	
MTP Name:	
MTP ID:	
MTP Primary Contact Person/Phone#:	
MTP Alternate Contact Person/Phone#:	
Facility Name:	
Meter Point ID's Affected:	
Power System Outage Yes/No:	
Metering Outage Yes/No:	
Actual Outage Start Date:	
Actual Outage Start Time:	
Actual Outage End Date:	
Actual Outage End Time:	
Temporary Metering Required:	
Outage Verification	
MTR Numbers:	
Remarks: Initial Findings within 24 hours	
What causes the problem?	
Remedial Action Taken	
Note: Detailed Report for submission within 48 Hours to MO.	
MTR Closed:	
MTR Close Date:	

Meter Service Provider of TP

_____

Signature above printed name

Instructions to MTPs for completion of Metering Outage Form

This form will be used by your *MSPs* to resolve issued MTRs. This will reduce the time spent by your *MSPs* in confirming metering *outages* and the associated costs.

1) *MTPs* should complete the top portion only (*MSP* Metering Outage Reporting Form - Notification). This form should be completed on the start day of the metering *outage*. Please ensure all *meter points* affected are included.
2) If the *outage* is complete enter the end time.
3) Submit the form to your *MSPs* with a copy to the *MO* for reference purposes.
4) If the *outage* is ongoing, complete the end time on day of completion and resubmit form to your *MSPs*.
5) The Outage Verification section is for the *MSPs* only.

METER TROUBLE REPORT FORM

Meter Trouble Report	
Form Completion Date (mm/dd/yyyy):	
SEIN:	
MDEF File Number:	
Substation:	
Initial Findings (Gap/Overlap/Uncertain):	
Actual Start Date (mm/dd/yyyy):	
Actual Start Time (hh:mm):	
Actual End Date (mm/dd/yyyy):	
Actual End Time (hh:mm):	
Initial Action Taken(Edit/Estimation):	
MSP Verification	
Remarks (Findings and Action Taken):	
Proposed Adjustment (Estimated Value):	
Report Close Date (mm/dd/yyyy):	
Note: Detailed Completion Report for submission within 48 Hours to MO.	

Market Operator
(Signature over Printed Name)

Meter Service Provider
(Signature over Printed Name)

METERING INSTALLATION STANDARDS

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

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

Table 2 – Basic Impulse Insulation Levels (BIL)

Nominal System Voltage (kV)	BIL and full-wave crest (kV)
15	110
25	150
34.5	200
69	350
115	550
138	650
230	1050
500	1675

Table 3 – Creepage Distance

Pollution Level	Minimum Nominal Specific Creepage Distance Between Phase and Earth (mm/kV)
Light	16
Medium	20
Heavy	25
Very Heavy	31

Table 4 – Standard Burdens for Voltage Transformers

Characteristics on Standard Burdens			Characteristics on 120 V Basis			Characteristics on 69.3 V Basis		
Designa-Tion	VA	Power Factor	Resis-tance	Induc-tance	Impe-dance	Resis-tance	Induc-tance	Impe-dance
W	12.5	0.10	115.2	3.0400	1152	38.4	1.0100	384
X	25.0	0.70	403.2	1.0900	576	134.4	0.3640	192
M	35.0	0.20	82.3	1.0700	411	27.4	0.3560	137
Y	75.0	0.85	163.2	0.2680	192	54.4	0.0894	64
Z	200.0	0.85	61.2	0.1010	72	20.4	0.0335	24
ZZ	400.0	0.85	30.6	0.0503	36	10.2	0.0168	12

Table 5 – Ratios and Ratings of Voltage Transformers

Rated Voltage (V)	Marked Ratio	Secondary Voltage
14,400 Grd Y/8,400	70/120:1	120V/69V
24,940 Grd Y/14,400	120/200:1	120V/69V
34,500 Grd Y/20,125	175/300:1	120V/69V
69,000 Grd Y/40,250	350/600:1	115V/67V
115,000 Grd Y/69,000	600/1000:1	115V/67V
138,000 Grd Y/80,500	700/1200:1	115V/67V
230,000 Grd Y/138,000	1200/2000:1	115V/67V
500,000 Grd Y/287,500	2500/4500:1	115V/67V

Table 6 – Minimum Clearances and Distances

CLEARANCES OF ENERGIZED METAL PARTS ARE SUMMARIZED IN THE FOLLOWING TABLE FOR THE DIFFERENT SYSTEMS:

Nominal System Voltage	d1 (mm)	d2 (mm)	D (mm)	H (mm)
13.8	300	350	900	3500
34.5	500	610	1500	3600

Nominal System Voltage	d1 (mm)	d2 (mm)	D (mm)	H (mm)
69	800	900	2000	3750
115	1100	1360	2500	4000
138	1300	1800	3000	4000
230	1850	3200	4000	5000
500	3250	5200	8000	9000

Where:

d1 = minimum clearance between live metal parts and ground
d2 = minimum clearance between live metal parts of two phases
D = practical distance phase center lines
H = minimum height of live conductors above ground.
However, the upper edge of an earthed insulator support must, for all voltage series, beat a height of at least 2300mm above the ground level.

Table 7 – Minimum Height and Protective Barrier Clearance in Outdoor Installation

Rated Voltage	Maximum Voltage for Eqpt	Minimum Clearances		Minimum Height		Protective Clearance Between Barriers and Live Parts Inside the Installation						At The Perimeter Fence			
				H		A		B		C		D		E	
				Minimum Clearances		Minimum Clearances		Minimum Clearances		Minimum Clearances		Minimum Clearances		Minimum Clearances	
Un (kV)	Um (kV)	N (mm)	S(mm)	N(mm)	S(mm)	N(mm)	S(mm)	N(mm)	S(mm)	N(mm)	S(mm)	N(mm)	S(mm)	N(mm)	S(mm)
3	3.6	150	150	2600	2600	150	150	250	250	600	600	1150	1150	1650	1650
6	7.2	150	150	2600	2600	150	150	250	250	600	600	1150	1150	1650	1650
10	12	150	150	2600	2600	150	150	250	250	600	600	1150	1150	1650	1650
20	24	215	160	2600	2600	215	160	315		600	600	1215	1160	1720	1660
30	36	325	270	2625	2600	325	270	425		625	600	1325	1270	1825	1770
45	52	520		2820		520		620		820		1520		2020	
60	72.5	700		3000		700		800		1000		1700		2200	
110	123	1100	950	3400	3250	1100	950	1200		1450	1250	2100	1950	2600	2450
150	170	1550	1350	3850	3650	1550	1350	1650		1850	1650	2550	2350	3050	2850
220	245	2200	1850	4500	4150	2200	1850	2300		2500	2150	3200	2850	3700	3350
330	362		2400	4700		2400		2500		2700		3400		3900	
380	420		2900	5200		2900		3000		3200		3900		4400	
500	525		4100	6400		4100		4200		4400		5100		5600	

DRAWINGS, FIGURES & PERTINENT SKETCHES

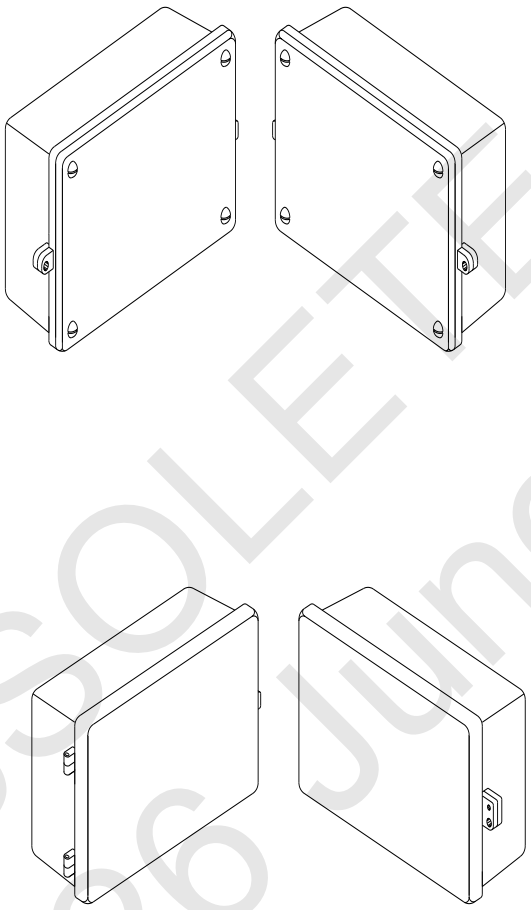


Figure 1 – CT/VT Secondary Terminal Box

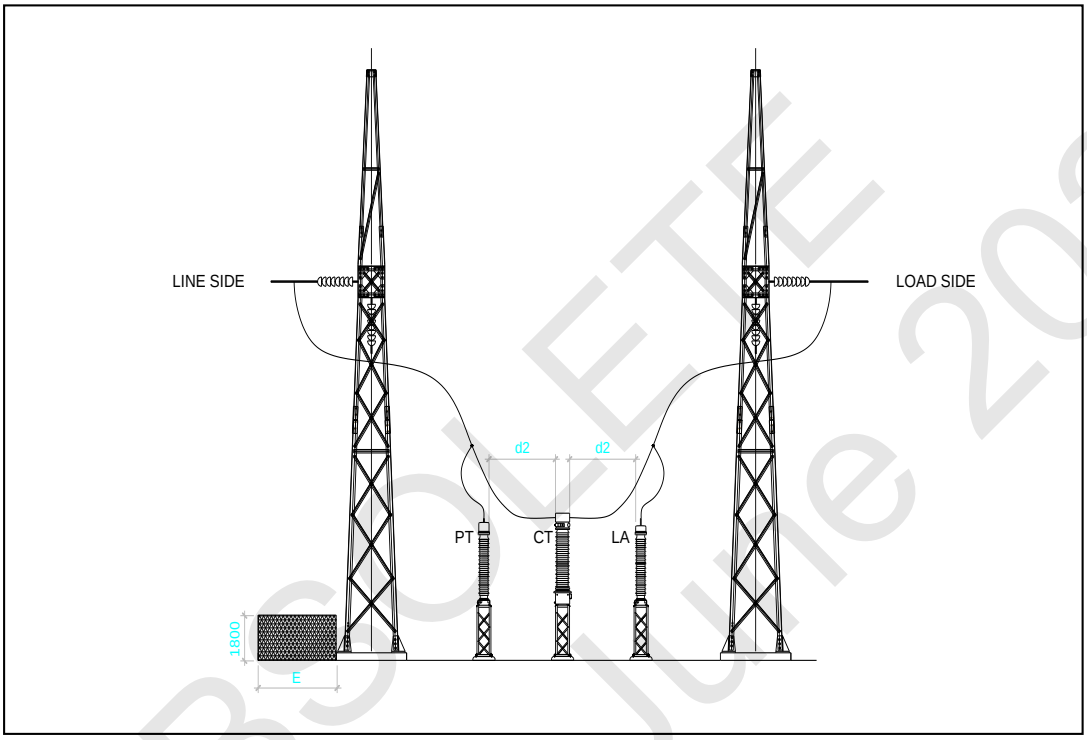
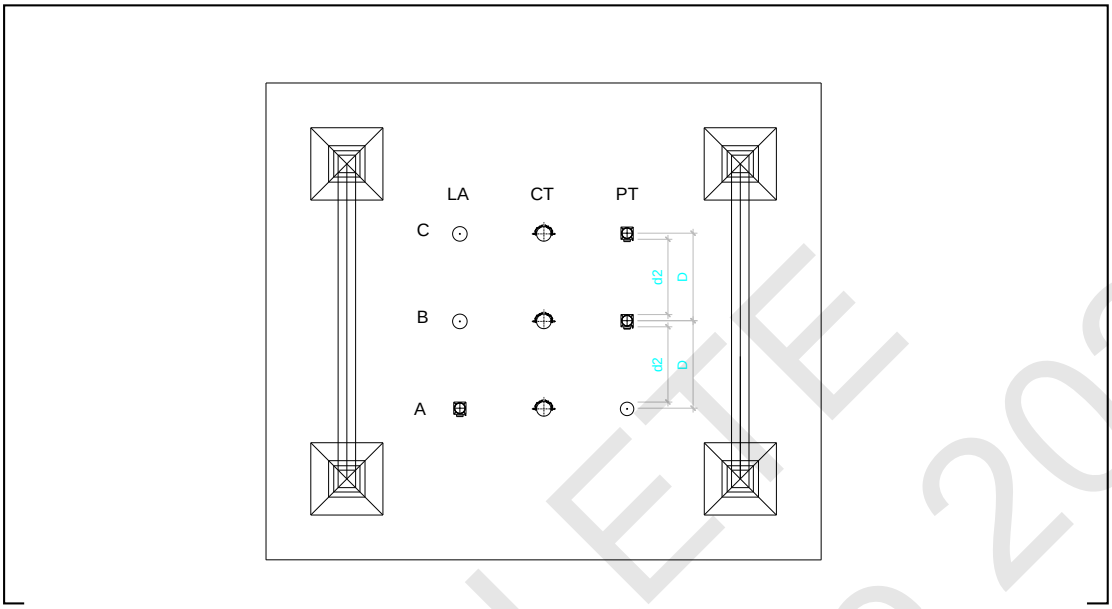
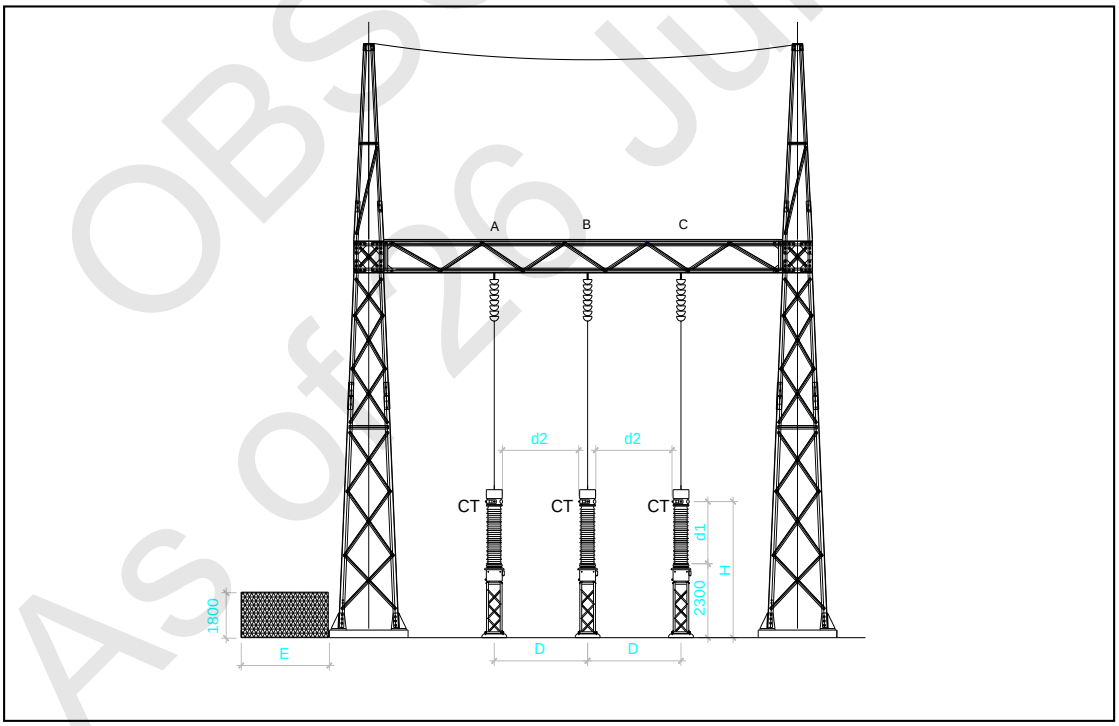


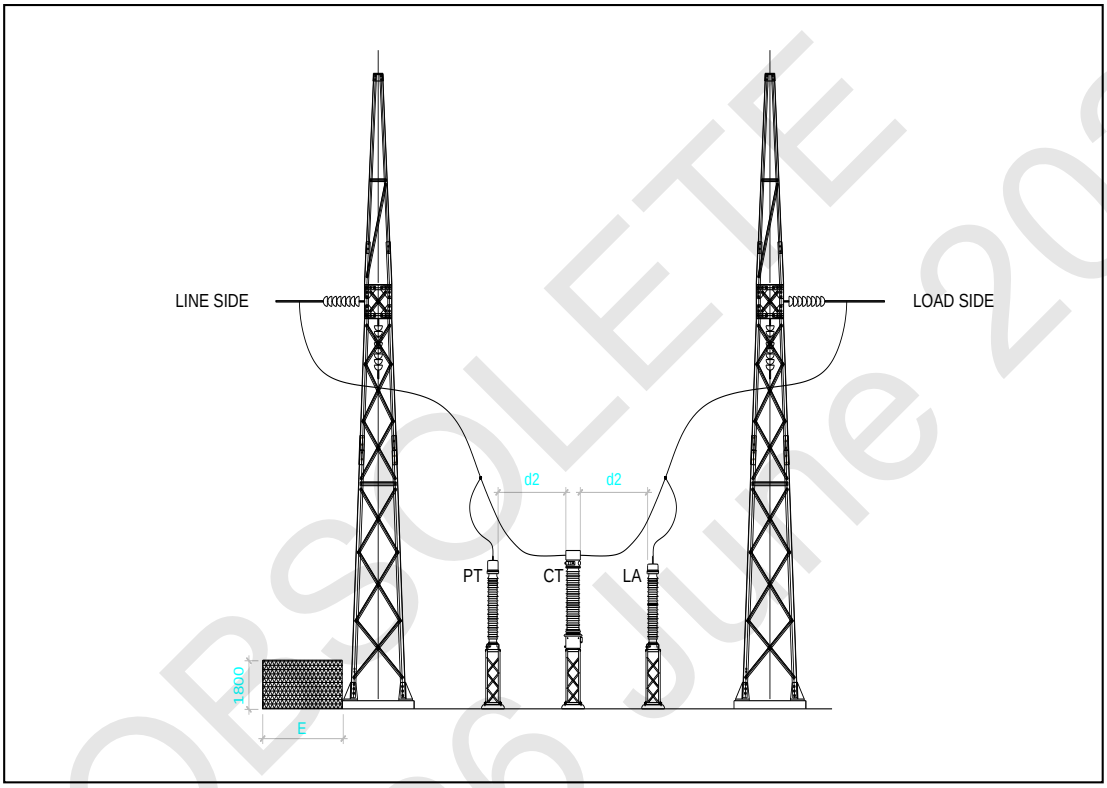
Figure 2 - Location/Arrangement of Instrument Transformers



A – TOWER PLAN (TOP VIEW)



B – TOWER PLAN (DISTANCE BETWEEN PHASES)



C – TOWER PLAN (DISTANCE BETWEEN INSTRUMENT TRANSFORMERS)

Figure 3 – Distance and Clearance between Instrument Transformers

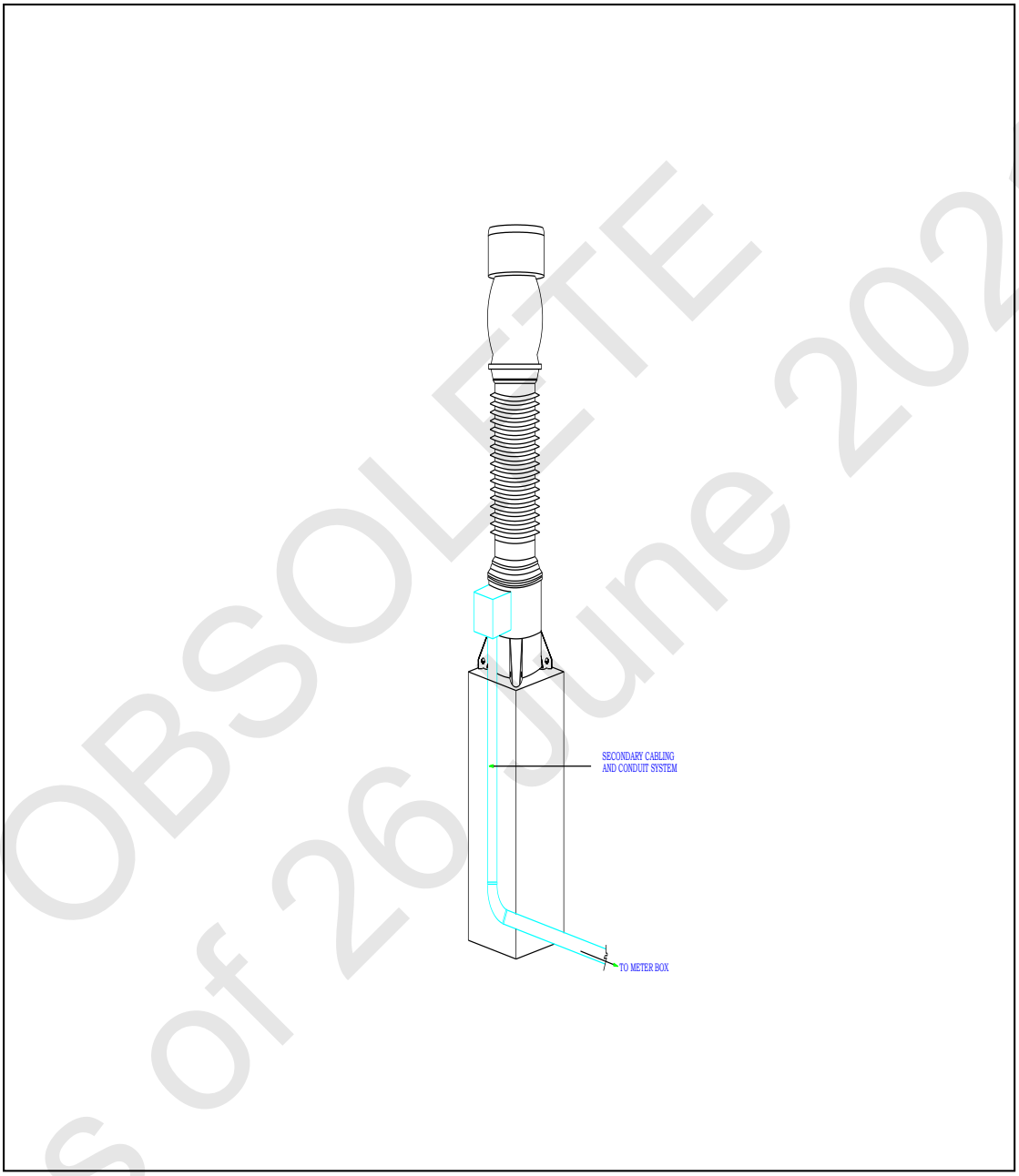


Figure 4 – Conduit System

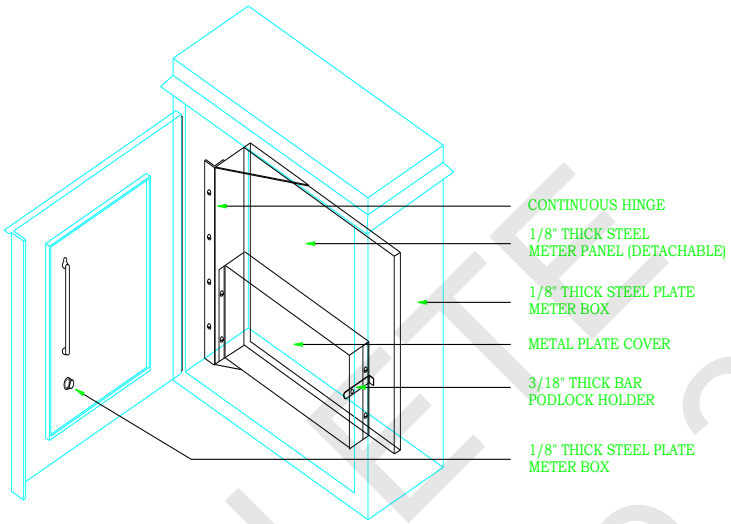


Figure 5 – Meter Enclosure

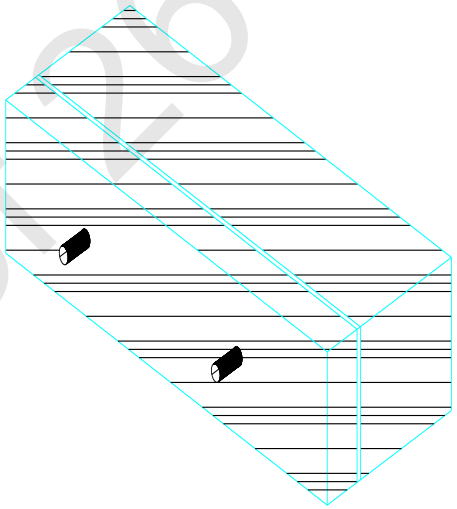


Figure 6 – Switch Box

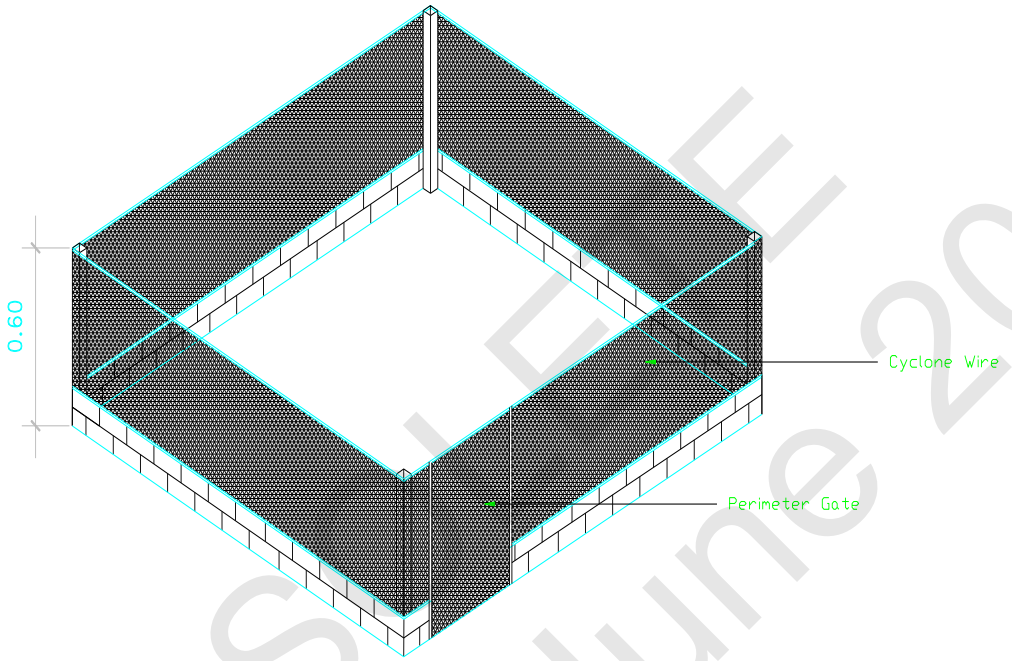


Figure 7 – Perimeter Fence

SITE EQUIPMENT IDENTIFICATION (SEIN)

RELEVANT TABLES

Table 8 – Meter Purpose Designation

Designation	Meter Purpose
M	Main Meter
A	Alternate Meter (Partial Redundant Metering)
B	Alternate Meter (Full Redundant Metering)
C	Check Meter

Table 9 – Site Initials

Generating Stations/ Sub-Stations	Proposed Site ID	Generating Stations/ Sub-Stations	Proposed Site ID
ABAGA	ABA	ATOK	ATO
ABUBOT	ABU	AURORA	AUR
ABUCAY	ABC	BABATNGON	BAB
ABUYOG	ABY	BACMAN	BAC
AGOO	AGO	BACNOTAN	BCN
AGUS	AGU	BACOLOD	BCL
AGUSAN	AGS	BADOC	BAD
AHEP	AHE	BAGAC	BAG
AKLE	AKL	BAGANGA	BGN
ALCEM	ALC	BAGO	BGZ
ALCOY	ALY	BAIS	BAI
ALICIA	ALI	BAKUN	BAK
ALIJIS	ALJ	BALANGA	BAL
ALLEN	ALL	BALAOAN	BLN
ALSONS	ALS	BALASAN	BLS
AMBAGO	AMB	BALATOC	BLT
AMBUKLAO	AMK	BALDOZA	BLD
AMLAN	AML	BALER	BLR
AMPAYON	AMP	BALIBAGO	BLB
AMPUCAO	AMC	BALIGATANHEP	BLG
ANGAT	ANG	BALINGOAN	BNG
ANGELES	ANL	BALINTAWAK	BLK

Generating Stations/ Sub-Stations	Proposed Site ID	Generating Stations/ Sub-Stations	Proposed Site ID
ANISLAGAN	ANI	BALIWAG	BLW
APALIT	APA	BALIWASAN	BWS
API	API	BALOC	BLC
APLAYA	APL	BALOIAIRPORT	BLP
ARANETA	ARA	BANGUED	BAN
ARHEP	ARH	BANI	BNI
ASTURIAS	AST	BANILAD	BNL
ATIMONAN	ATI	BANTAY	BNT
BANTIGUE	BTG	BUSECO	BUS
BARIT	BAR	BUTUAN	BUT
BAROBO	BRB	CABACUNGAN	CAB
BATAAN	BAT	CABADBARAN	CBD
BATANGAS	BTN	CABAGAN	CBG
BATOBALANI	BTB	CABANATUAN	CBN
BAUANG	BAU	CABARROGUIS	CBR
BAYBAY	BAY	CADIZ	CAD
BAYOMBONG	BYM	CAGELCO	CAG
BAYUGAN	BYG	CAGWAIT	CGW
BCC	BCC	CALAANAN	CAL
BCI	BCI	CALABANGAN	CLB
BDPP	BDP	CALACA	CLC
BECKEL	BEC	CALAMBA	CLM
BEI	BEI	CALASIAO	CLS
BENECO	BEN	CALATAGAN	CLT
BENQUET	BNQ	CALAUAN	CLN
BHEP	BHE	CALINOG	CLG
BHEPP	BHP	CALIRAYA	CLR
BILIRAN	BIL	CAMILING	CAM
BINALBAGAN	BIN	CANDON	CAN
BINAN	BNN	CAPCOM	CAP
BINGA	BNZ	CARMEN	CAR
BINGCUNGAN	BNC	CASECNAN	CAS
BISLIG	BIS	CASTILLEJOS	CST

Generating Stations/ Sub-Stations	Proposed Site ID	Generating Stations/ Sub-Stations	Proposed Site ID
BITIN	BIT	CAT	CAT
BMMRC	BMM	CATARMAN	CTR
BOKOD	BOK	CATBALOGAN	CTB
BOHOL DIESEL	BOH	CATEEL	CTL
BOLBOK	BOL	CATIGBI-AN	CTG
BONGABON	BON	CATUBIG	CBX
BONTOC	BTC	CAUAYAN	CAU
BORONGAN	BOR	CAWAYAN	CAW
BOTOCAN	BOT	CCP	CCP
BOTOLAN	BTL	CELCOR	CEL
BPC	BPC	CHEPP	CHE
BPPC	BPP	CIGI	CIG
BPPMI	BPM	CIP	CIP
BRC	BRC	CLARK	CLA
BSP	BSP	CND	CND
BTPP	BTP	COMPOSTELA	COM
BUGALLON	BUG	CONCEPCION	CON
BULUALTO	BUL	CONSOLACION	CNS
BUNAWAN	BUN	CORTES	COR
BURGOS	BUR	FCVC	FCV
CLARK	CLA	FEI	FEI
CND	CND	FERROCHEM	FER
COMPOSTELA	COM	FORCEM	FOR
CONCEPCION	CON	FORI	FOI
CONSOLACION	CNS	GADGARAN	GAD
CORTES	COR	GARCIA LOAD END	GAR
COTOBATO	COT	GATEWAY	GAT
CPC	CPC	GENERAL SANTOS	GEN
CPPC	CPP	GINGOOG	GIN
CRUZNADAAN	CRU	GLAN	GLA
CUENCA	CUE	GMA	GMA
CUEVAS	CVS	GSCAIRPORT	GSC
CULASI	CUL	GSDP	GSD

Generating Stations/ Sub-Stations	Proposed Site ID	Generating Stations/ Sub-Stations	Proposed Site ID
CURRIMAO	CUR	GUADALUPE	GUA
DANAO	DAN	GUAGUA	GGA
DAOTAP	DAO	GUBAT	GUB
DAPITAN	DAP	GUIMBA	GUI
DARAGA	DAR	GUIMELCO	GML
DASMARINAS	DAS	GUMACA	GUM
DATAG	DAT	HCC	HCC
DAUIS	DAU	HEDCOR	HED
DAVAO	DAV	HERMOSA	HER
DECORP	DEC	HERNANDEZ	HRN
DIGOS	DIG	HINIGDAAN	HIN
DINALUPIHAN	DIN	HONDAGUA	HON
DINAS	DNS	HOPEWELL	HOP
DINGLE	DNG	HOUSING	HOU
DOLEPHIL	DOL	IBAAN	IBA
DOLORES	DLR	ICC	ICC
DUHAT	DUH	IFELCO	IFE
DUMAGUETE	DUM	ILAGAN	ILA
DUMANGAS	DMN	ILECO	ILE
DUMANJUG	DMJ	ILIJAN	ILI
DURACOM	DUR	IMUS	IMU
EAUC	EAU	INCHROME	INC
ECI	ECI	INDOPHIL	IND
EDISON	EDI	INEC	INE
ELECTRODESTA	ELE	INFANTA	INF
ELEGANT	ELG	INGASCO	ING
ENRON	ENR	INGORE	INR
EPZA	EPZ	IPIL	IPI
ESTANCIA	EST	IRIGA	IRI
EXEMPLAR	EXE	IROSIN	IRO
FAMY	FAM	KIELCO	KIE
FATIMA	FAT	KPSPP	KPS
FCIE	FCI	LEYTE GPP	LEY

Generating Stations/ Sub-Stations	Proposed Site ID	Generating Stations/ Sub-Stations	Proposed Site ID
FGPC	FGP	LUCBAN	LUC
IRRI	IRR	LUGAIT	LUG
ISABEL	ISA	LUGO	LUO
ISABELA	ISB	LUMBOCAN	LUM
ISELCO	ISE	LUZON	LUZ
ITOGON	ITO	MAASIM	MAA
JANOPOL HEP	JAN	MAASIN	MSN
KABACAN	KAB	MABINAY	MAB
KABANKALAN	KBN	MABINI	MBN
KADAMPAT	KAD	MABITAK	MBT
KALAYAAN	KAL	MABITANG	MBG
KALIBO	KLB	MABUHAY	MBH
KALUMPANG	KLM	MACO	MAC
KAMUNING	KAM	MACTAN	MCT
KANAGKA-AN	KAN	MADAUM	MAD
KAPATAGAN	KAP	MADRID	MDR
KAUSWAGAN	KAU	MAGPP	MPP
KEPHILCO	KEP	MAGANOY	MAG
KIAMBA	KIA	MAGAT	MGT
KIAS	KIS	MAGELLAN	MGL
KIBAWE	KIB	MAGIPIT	MGP
KIDAPAWAN	KID	MAKBAN A	MKA
KIWALAN	KIW	MAKBAN B	MKB
KLINAN	KLI	MAKBAN C	MKC
KORONADAL	KOR	MAKBAN D	MKD
LA TORRE	LTO	MAKBAN E	MKE
LA TRINIDAD	LTR	MAKBAN O	MKO
LABO	LAB	MALABANG	MAL
LABRADOR	LBR	MALAMANG	MLM
LAGAWE	LAG	MALAPATAN	MLP
LAGONOY	LGN	MALAYA	MLY
LAKEVIEW	LAK	MALINAO	MLN
LAOAG	LAO	MALITA	MLT

Generating Stations/ Sub-Stations	Proposed Site ID	Generating Stations/ Sub-Stations	Proposed Site ID
LEGASPI	LEG	MALITBOG	MLB
LEMON	LEM	MALOLOS	MLL
LEPANTOMINES	LEP	MANDAUE	MAN
LIBMANAN	LIB	MANGALDAN	MNG
LIGAO	LIG	MANSILANGAN	MNS
LIMALAND	LIM	MAPALAD	MAP
LIMAY	LMY	MAPASO	MPS
LINGAYEN	LIN	MARAMAG	MAR
LIPA	LIP	MARAWI	MRW
LOBOC	LOB	MARIBOJOC	MRB
LOS BANOS	LBA	MARICALUM	MRC
MARIVELES	MRV	NULING	NUL
MASINLOC	MAS	NUVELCO	NUV
MASIWAY	MSW	OBRERO	OBR
MATANO	MAT	OKOY	OKO
MATI	MAI	OLDBANTAY	OLD
MAWAB	MAW	OLONGAPO	OLO
MCARTHUR	MCA	ONGON	ONG
MCCI	MCC	OPOL	OPO
MCI	MCI	ORIONTAP	ORI
MECO	MEC	ORMAT	ORM
MEDELLIN	MED	ORMOC	ORC
MEPZ	MEP	OROQUIETA	ORO
MEXICO	MEX	OVERTON	OVE
MIC	MIC	OZAMIS	OZA
MIDSAYAP	MID	PACEMCO	PAC
MILAGRO	MIL	PAF	PAF
MIRANT	MIR	PAGADIAN	PAG
MOBILE	MOB	PAGBILAO	PGB
MOLAVE	MOL	PAGUDPOD	PGD
MOPRECO	MOP	PALAPALA	PAL
MORONG	MOR	PALINPINON	PLN
MPCC	MPC	PALO	PAO

Generating Stations/ Sub-Stations	Proposed Site ID	Generating Stations/ Sub-Stations	Proposed Site ID
MRO	MRO	PAMPLONA	PAM
MRSQ	MRS	PANAS	PAN
MT VIEW	MVI	PANAY DIESEL	PNY
MULANAY	MUL	PANELCO	PNL
MUNOZ	MUN	PANIQUI	PNQ
NABAS	NAB	PANITAN	PNT
NABUNTURAN	NBN	PANTABANGAN	PNB
NAGA LUZON	NLU	PARACALE	PAR
NAGUILIAN	NAG	PASAR	PAS
NAPOT	NAP	PATAG	PAT
NARVACAN	NAR	PAYOCPOC	PAY
NASIPIT	NAS	PELCO	PEL
NASUGBU	NSG	PETRON	PET
NASUJI	NSJ	PEZA	PEZ
NDMC	NDM	PFC	PFC
NEGROS GPP	NEG	PFM	PFM
NENENG	NEN	PGI	PGI
NEWBANTAY	NEW	PHILPHOS	PHL
NEWLOON	NWL	PHILSECO	PHS
NEWTECH	NWT	PHIVIDEC	PHV
NIA	NIA	PICOP	PIC
NMPC	NMP	PPC	PPC
NOVALICHES	NOV	SANTIAGO	SNT
NSC	NSC	SARA	SAR
PILOT	PIL	SARI	SAI
PINAMUCAN	PIN	SBMA	SBM
PITOGO	PIT	SEMI	SEM
PMA	PMA	SFELAPCO	SFL
PMSC	PMS	SIBALOM	SIB
PNOC	PNO	SIBONGA	SBN
PNOC-EDC CEBU C1	PC1	SIGPIT	SIG
PNOC-EDC CEBU C2	PC2	SIGUEL	SGL
PNOC-EDC LUZON C1	PL1	SILAY	SIL

Generating Stations/ Sub-Stations	Proposed Site ID	Generating Stations/ Sub-Stations	Proposed Site ID
PNOC-EDC LUZON C2	PL2	SIMUAY	SIM
PNOC-EDC M1GP	PN1	SIOM	SIO
PNOC-EDC M2GP	PN2	SIPALAY	SIP
PNPP	PNP	SIRAWAY	SIR
POLANCO	POL	SKK	SKK
POLLOC	PLL	SMC	SMC
PONDOL	PON	SN CARLOS	SCA
POPOO	POP	SN ENRIQUE	SEN
POTOTAN	POT	SN ESTEBAN	SES
PPA	PPA	SN FABIAN	SFA
PPUD	PPU	SN FERNANDO	SFE
PRESCO	PRE	SN FRANCISCO	SFR
PSC	PSC	SN ISIDRO	SIS
PUD	PUD	SN JOSE	SJO
PUERTO	PUE	SN JUAN	SJU
PULANGI	PUL	SN JUANICO	SJN
PUTIAO	PUT	SN LORENZO	SLO
PUTIK	PTK	SN LUIS	SLU
QPPL	QPP	SN MANUEL	SMA
QUEZONPOWER	QUE	SN MIGUEL	SMI
RABON	RAB	SN PEDRO	SPE
RECODO	REC	SN ROQUE	SRO
RMTC	RMT	SOGOD	SOG
ROCKWELL	ROC	SOLANA	SOL
ROROG	ROR	SORSOGON	SOR
ROSARIO	ROS	SPPC	SPP
ROXAS	ROX	ST BERNARD	SBE
SADUC	SAD	STA ANA	SAA
SALCON	SAL	STA BARBARA	SBA
SALUG	SLG	STA CLARA	SCL
SAMANGAN	SAM	STA CRUZ	SCR
SAMELCO	SML	STA MESA	SME
SANGALI	SAN	STATION SERVICE	STA

Generating Stations/ Sub-Stations	Proposed Site ID	Generating Stations/ Sub-Stations	Proposed Site ID
SANGILO	SNG	TALOMO	TLM
SCFTPP	SCF	TIGBAUAN	TIG
STA RITA	SRI	TINAMBAC	TIN
STA ROSA	SRS	TINDALO	TND
STEELCORP	STE	TIPCO	TIP
SUAL	SUA	TIWI A	TWA
SUBA	SUB	TIWI B	TWB
SUBIC	SBC	TIWI C	TWC
SUCAT	SUC	TOLOSA	TOL
SUKELCO	SUK	TOMONTON	TOM
SUNVALLEY	SUN	TONGONAN	TON
SURALLAH	SUR	TPC	TPC
SURICON	SRC	TPS	TPS
SURIGAO	SRG	TRANSASIA	TRA
TAAL	TAA	TRENTO	TRE
TABANGO	TAB	TRINIDAD	TRI
TABUK	TBK	TUBIGON	TUB
TACLOBAN	TAC	TUGAS	TUG
TACURONG	TCR	TUGUEGARAO	TGG
TAFT	TAF	TUNGA	TUN
TAGAYTAY	TAG	TUNGAWAN	TNG
TAGBILARAN	TGB	UBAY	UBA
TAGKAWAYAN	TGK	UCC	UCC
TAGOLOAN	TGL	UMIRAY	UMI
TAGUM	TGM	UPPC	UPP
TALAKAG	TAL	URDANETA	URD
TALAVERA	TLV	VALLADOLID	VAL
TALISAY	TLS	VECO	VEC
TANAUAN	TAN	VMC	VMC
TAPG	TAP	VOA	VOA
TARELCO	TAR	WMPC	WMP
TAYABAS	TAY	ZAMBALESBASE	ZAM
TAYUG	TYG	ZAMBOANGA	ZMB

Generating Stations/ Sub-Stations	Proposed Site ID	Generating Stations/ Sub-Stations	Proposed Site ID
TEI	TEI	ZAPOTE	ZAP
TERNATE	TER		

TABLE 10 – METERED PARTICIPANT ID

Metered Participant	Proposed ID	Metered Participant	Proposed ID
ABRECO	ABRE	BACNOTAN STEEL	BCNT
ACC	ACCZ	BALOI	BALO
ADC	ADCZ	BARIT	BARI
AEC	AECZ	BATAAN REFINING	BATA
AFP	AFPZ	BATELEC I	BAT1
AGP	AGPZ	BATELEC II	BAT2
AGGREKO	AGGR	BBTI	BBTI
AGUS	AGUS	BCC	BCCZ
AGUSAN	AGSN	BCI	BCIZ
AHEP	AHEP	BCM	BCMZ
AKELCO	AKEL	BCWD	BCWD
ALECO	ALEC	BEI	BEIZ
ALTURAS	ALTU	BENECO	BENE
AMLAN	AMLA	BEPZ	BEPZ
ANECO	ANEC	BHEP	BHEP
ANGAT	ANGA	BHEPP	BHPP
ANTECO	ANTE	BHPI	BHPI
APEX	APEX	BILECO	BILE
API	APIZ	BLCI	BLCI
ASELCO	ASEL	BOHECO I	BOH1
AURELCO	AURE	BOHECO II	BOH2
BAB (PAF)	BABP	BOHOL DIESEL	BOHO
BACMAN	BACM	CPC	CPCZ
BPPMI	BPPM	BPPC	BPPC
BSP	BSPZ	CPPC	CPPC
BTPI	BTPI	DANECO	DANE
BUSCO	BUSC	DASURECO	DASU

Metered Participant	Proposed ID	Metered Participant	Proposed ID
BUSECO	BUSE	DECORP	DECO
CABCOM	CABC	DISTILLERIA DE BAGO	DIST
CAGELCO I	CAG1	DLPC	DLPC
CAGELCO II	CAG2	DMPI	DMPI
CALACA	CALA	DND	DNDZ
CAMELCO	CAME	DOLEPHIL	DOLE
CANLUBANG SUGAR	CANL	DORECO	DORE
CANORECO	CANO	DORELCO	DRLC
CAPELCO	CAPE	DOW	DOWZ
CASECNAN	CASE	DUCC	DUCC
CASURECO I	CAS1	DUCOMI	DUCO
CASURECO II	CAS2	DURACOM	DURA
CASURECO II	CAS3	E.B. MENDOZA	EBME
CASURECO IV	CAS4	EAUC	EAUC
CAT	CATZ	ECOSIP	ECOS
CEBECO I	CEB1	EDISON COGEN	EDIS
CEBECO II	CEB2	EEI	EEIZ
CEDC	CEDC	ELEGANT STEEL	ELEG
CELCOR	CELC	ENRON	ENRO
CENECO	CENE	ERDB-FORI	ERDB
CENPELCO	CENP	ESAMELCO	ESAM
CENTRAL ENG'G	CENT	FAB	FABZ
CEPALCO	CEPA	FCC	FCCZ
CEPZA	CEPZ	FCVC	FCVC
CEZA	CEZA	FGPC	FGPC
CHEPP	CHEP	FIBECO	FIBE
CORDERO	CORD	FLECO	FLEC
CLSU	CLSU	FPIC	FPIC
COC	COCZ	FPRDI	FPRD
COCOCHEM	COCO	GENSAN HSG	GENS
COLIGHT	COLI	GIPCS	GIPC
COTELCO	COTE	GMC	GMCZ
COTO MINES	COTO	GPM	GPMZ
GUIMELCO	GUIM	LIMAO	LMZY

Metered Participant	Proposed ID	Metered Participant	Proposed ID
HCC	HCCZ	LIPA ICE PLANT	LIPA
HEDCOR	HEDC	LMG CHEMICALS	LMGC
HOPEWELL	HOPE	LOBOC	LOBO
ICC	ICCZ	LUECO	LUEC
IEEC	IEEC	LUELCO	LUEL
IFELCO	IFEL	LUZON HYDRO	LUZO
ILECO I	ILE1	MAGAT	MAGA
ILECO II	ILE2	MAGELCO	MAGE
ILECO III	ILE3	MAGPP	MAGP
ILIJAN	ILIJ	MAKBAN A	MAKA
ILPI	ILPI	MAKBAN B	MAKB
INDOPHIL	INDO	MAKBAN C	MAKC
INEC	INEC	MANSONS	MANS
INGASCO	INGA	MARCELA	MARC
INNOVE	INNO	MASINLOC	MASI
IRRI	IRRI	MASIWAY	MSWY
ISECO	ISEC	MCCI	MCCI
ISELCO I	ISE1	MCI	MCIZ
ISELCO II	ISE2	MECO	MECO
ITC	ITCZ	MECO	MZYX
ITOGON MINES	ITOG	MEGAPACK	MEGA
JANOPOL	JANO	MENDECO	MEND
KAELCO	KAEL	MENZI-AGRI CORP	MENZ
KALAYAAN	KALA	MEPZA	MEPZ
KIBAWE HSG	KIBA	MGN	MGNZ
KIELCO	KIEL	MIC	MICZ
KPSPP	KPSP	MIRANT	MIRA
KSP	KSPZ	MMC	MMCZ
LANECO	LANE	MOELCI I	MOE1
LASURECO	LASU	MOELCI II	MOE2
LEPANTO MINES	LEPA	MOPRECO	MOPR
LEYECO II	LEY2	MORESCO I	MOR1
LEYECO III	LEY3	MORESCO II	MOR2
LEYECO IV	LEY4	MSMC	MSMC

Metered Participant	Proposed ID	Metered Participant	Proposed ID
LEYECO V	LEY5	MSU	MSUZ
LEYTE GPP	LEYT	MUNICIPAL OF BAUAN	MUNI
LIMALAND	LIMA	MVC	MVCZ
MWSI	MWSI	PCC	PCCZ
MWSS	MWSS	PELCO I	PEL1
NALCO	NALC	PELCO II	PEL2
NCC	NCCZ	PELCO III	PEL3
NEECO I	NEE1	PENELCO	PENE
NEECO II	NEE2	PFM	PFMZ
NEGROS GPP	NEGR	PGI	PGIZ
NEWTECH INDUSTRIES	NEWT	PHILPOS	PHLP
NIA-AMPUCAO	NIAA	PHILTOWN	PHLT
NIA-AMRIS	NMLN	PHIVIDEC	PHIV
NIA-AMULUNG	NMLG	PICOP	PICO
NIA-BALIGATAN	NIAB	PICOP NEWTECH	PCPN
NIA-BUTUAN	NBTN	PILIPINAS SHELL	PILI
NIA-CAUAYAN	NIAC	PILMICO	PILM
NIA-PANTABANGAN	NIAP	PLANTERS	PLAN
NIA-SOLANA	NIAS	PMA	PMAZ
NMPC	NMPC	PMC	PMCZ
NMT	NMTZ	PMSC-BOHOL	PMSC
NOBEL	NOBE	PMSC-CEBU	PMSB
NOCECO	NOCE	PNOC-CAMARINES SUR	PNOC
NORECO I	NOR1	PNOC-IPP	PNCP
NORECO II	NOR2	PNOC-LAGUNA	PNCL
NORSAMELCO	NORS	PNOC-LEYTE	PNCY
NPC	NPCZ	PNOC-NEGROS	PNCN
NPC HSG	NPCH	PNOC-SWMI	PNCS
NSC	NSCZ	PNPP	PNPP
NUVELCO	NUVE	PPC	PPCZ
ORICA	ORIC	PRESCO	PRES
ORMAT	ORMA	PSC	PSCZ
PACEMCO	PACE	PSIC	PSIC
PAF	PAFZ	PSWR	PSWR

Metered Participant	Proposed ID	Metered Participant	Proposed ID
PANAY DIESEL	PANA	PUD-OLONGAPO	PUDO
PANELCO I	PAN1	PULANGI	PULA
PANELCO III	PAN3	PUYAT STEEL	PUYA
PANTABANGAN	PANT	PUYAT VINYL	PYTV
PANTAO RAGAT	PNTR	QPPL	QPPL
PANTAR	PNTZ	QUEZELCO I	QUE1
PASAR	PASA	QUEZELCO II	QUE2
QUIRELCO	QUIR	SUNRISE	SUNR
RCC	RCCZ	SURNECO	SURN
RGS ICE PLANT	RGSI	SURSECO I	SUR1
RMTC	RMTC	SURSECO II	SUR2
RVA	RVAZ	TAIHEIYO	TAIH
SAJELCO	SAJE	TALOMO	TALO
SALCON POWER	SALC	TAPG	TAPG
SAMELCO I	SAM1	TARELCO I	TAR1
SAMELCO II	SAM2	TARELCO II	TAR2
SAN ROQUE	SROQ	TEI	TEIZ
SBMA	SBMA	TIPCO	TIPC
SCFTPP	SCFT	TIWI A	TIWA
SDC-MIRANT	SDCM	TIWI B	TIWB
SFELAPCO	SFEL	TIWI C	TIWC
SIARELCO	SIAR	TPC	TPCZ
SIOM	SIOM	TPS	TPSZ
SKK STEEL	SKKS	UCC	UCCZ
SMC	SMCZ	ULPI	ULPI
SOCOTECO I	SOC1	UPLB	UPLB
SOCOTECO II	SOC2	UPPC	UPPC
SOLECO	SOLE	VECO	VECO
SORECO I	SOR1	VOMI	VOMI
SORECO II	SOR2	VRESCO	VRES
SPC	SPCZ	WAHC	WAHC
SPMI	SPMI	WESCOR	WESC
SPPC	SPPC	WMPC	WMPC
SPUG	SPUG	ZAMCELCO	ZAMC

Metered Participant	Proposed ID	Metered Participant	Proposed ID
SRA	SRAZ	ZAMECO I	ZAM1
STATION SERVICE	STAT	ZAMECO II	ZAM2
STEEL CORP	STEE	ZAMSURECO I	ZMS1
STEPHAN	STEP	ZAMSURECO II	ZMS2
SUBIC SHIPYARD	SUBI	ZANECO	ZANE
SUKELCO	SUKE		

Table 11 – Metering Equipment, Devices and Auxiliaries

Designation	Description
CT	Current Transformer
LA	Lightning Arrester
MB	Meter Box
MD	Modem
MF	Multi-function Electronic Meter (Smart Meter)
PT	Potential Transformer
ST	Metering Structure
TS	Meter Test Switch

PROCEDURES OF SITE EQUIPMENT AND IDENTIFICATION

Procedure No. 1

1. The Site ID for all generating stations and substations connected to the grid shall be identified by its first three letters of the station's name;

   Note: The Site ID for generating stations or substations whose name is consisting of only three letters, the Site ID will be its name itself.

Stations	Site ID
ABAGA	ABA
BABATNGON	BAB
BCI	BCI
CADIZ	CAD
CIP	CIP
EDISON	EDI
FATIMA	FAT

2. Any generating stations or substations that will appear to have identical Site IDs, the first three letters of the stations name (item 1) shall be replaced by the first three/ next consonant letters of the station's name.

   Note: - If the first letter of the station's name is not a consonant, the first letter (a vowel) shall be carried followed by the succeeding two/ next consonant letters of the station's name.

   - Among the identical Site IDs, the one to come first will have the first three letters/ consonant of the stations name and the rest will apply the procedure on item 2.

   - Adding of "Z", "Y" or "X" to the first two consonants of the stations name is applied when all possible site IDs were used and duplication still exists.

Stations	ITEM 1 (Identical Site ID)	ITEM 2 (Identical Site ID)				Site ID
AMBAGO	AMB	**AMB**				AMB
AMBUKLAO	AMB	**AMK**				AMK
BAIS	**BAI**					BAI
BALANGA	BAL	**BAL**				BAL
BALAOAN	BAL	**BLN**		**BLN**		BLN
BALASAN	BAL	**BLS**				BLS
BALATOC	BAL	**BLT**				BLT
BALDOZA	BAL	**BLD**				BLD
BALER	BAL	**BLR**				BLR

Stations	ITEM 1 (Identical Site ID)	ITEM 2 (Identical Site ID)				Site ID
BALIBAGO	BAL	**BLB**				BLB
BALIGATANHEP	BAL	**BLG**	**BLG**			BLG
BALINGOAN	BAL	BLN	BLG	BLN	**BNG**	BNG
BALINTAWAK	BAL	BLN	BLT	BLW	**BLK**	BLK
BALIWAG	BAL	**BLW**		**BLW**		BLW
BALIWASAN	BAL	BLW	BLS	BLN	**BWS**	BWS
BALOC	BAL	**BLC**				BLC
BALOIAIRPORT	BAL	BLR	**BLP**			BLP
BANGUED	**BAN**	**BAN**				BAN
BANI	BAN	**BNZ**				BNZ
CABACUNGAN	**CAB**	**CAB**				CAB
CABADBARAN	CAB	**CBD**				CBD
CABAGAN	CAB	**CBG**		**CBG**		CBG
CABANATUAN	CAB	**CBN**				CBN
CABARROGUIS	CAB	**CBR**				CBR
CAT	**CAT**	**CAT**				CAT
CATARMAN	CAT	**CTR**				CTR
CATBALOGAN	CAT	**CTB**				CTB
CATEEL	CAT	**CTL**				CTL
CATIGBI-AN	CAT	**CTG**	**CTG**			CTG
CATUBIG	CAT	CTB	CTG	CBG	**CTZ**	CTZ

3. For generating stations like Makban and Tiwi Complex, the Site IDs shall be the first two consonants of the stations name and the letter A, B, C, D, E…

   Note: - For Metered Participants like Makban and Tiwi Complex that will appear to have identical Site IDs, replace the 2nd consonants with its next consonant and add the letter A, B, C, D, E...

Stations	Site ID
MAKBAN PLANT A	MKA
MAKBAN PLANT B	MKB
MAKBAN PLANT ORMAT	MKO
TIWI PLANT A	TWA
TIWI PLANT B	TWB

4. For generating stations and substations whose station name begins with La, Mt, San or Sta, the Site IDs shall be the first letter of the words La, Mt, San or Sta and the first two letters after the words La, Mt, San or Sta.

Note: - For Metered Participants below that will appear to have identical site IDs, replace the last two letters of the Site IDs with the first two/next consonants of the station's name after the words La, Mt, San or Sta.

Stations	ITEM 4 (Identical Site ID)	ITEM 2 (Identical Site ID)	Site ID
LA TORRE	**LTO**		LTO
LA TRINIDAD	**LTR**		LTR
MT APO	**MAP**		MAP
MT VIEW	**MVI**		MVI
SAN CARLOS	**SCA**		SCA
SAN JUAN	SJU	**SJU**	SJU
SAN JUANICO	SJU	SJN	SJN
SAN ROQUE	SRO	**SRO**	SRO
STA ROSA	SRO	SRS	SRS
STA CLARA	**SCL**		SCL

Procedure No. 2

1. The ID for all participating Metered Participants shall be identified by the first four letters of the Metered Participant's name;

   Note: The ID for participating Metered Participants whose name is consisting of only four letters, the Metered Participant ID will be its name itself.

   Adding "Z", "Y", or "X" to the Metered Participant's name is used when the number of the Metered Participant's name is less than four.

Metered Participant	Metered Participant ID
ABRECO	ABRE
BACMAN	BACM
CABC	CABC
DANECO	DANE
EDISONCOGEN	EDIS
FDRDI	FDRD
GMC	GMCZ

2. Any Metered Participant that will appear to have identical ID, the first four letters of the Metered Participant's name (item 1) shall be replaced by the first four/ next consonant letters of the Metered Participant's name.

   Note: - If the first letter of the Metered Participant's name is not a consonant, the first letter (a vowel) shall be carried followed by the succeeding three/ next consonant letters of the Metered Participant's name.

- AMOng the identical Metered Participant IDs, the one to come first will have the first four letters/ consonant of the Metered Participant's name and the rest will apply the procedure on item 2.

- Adding of "Z", "Y" or "X" to the first three/remaining consonants of the Metered Participant's name is applied when all possible IDs were used and duplication still exists.

Metered Participant	ITEM 1 (ID)	ITEM 2 (ID)	(Identical ID)	Metered Participant ID
BACNOTANCEMENT	BACN	BACN		BACN
BACNOTANSTEEL	BACN	**BCNT**		BCNT
DORECO	DORE	DORE		DORE
DORELCO	DORE	**DRLC**		DRLC
LIMALAD	LIMA	LIMA		LIMA
LIMAO	LIMA	**LMZY**		LMZY
PANTABANGAN	PANT	PANT		PANT
PANTAORAGAT	PANT	**PNTR**	PNTR	PNTR
PANTAR	PANT	**PNTR**	**PNTZ**	PNTZ

3. For Metered Participants like Makban and Tiwi Complex, the IDs shall be the first three letters of the Metered Participant's name and the letter A, B, C, D, E…

   Note: - For Metered Participants like Makban and Tiwi Complex that will appear to have identical IDs, replace the first three letters of the Metered Participant's name with its first three/remaining consonants or apply item 2.

Metered Participant	Metered Participant ID
MAKBAN PLANT A	MAKA
MAKBAN PLANT B	MAKB
TIWI PLANT A	TIWA
TIWI PLANT B	TIWB

4. For Metered Participants whose names begin with La, Mt, San or Sta, the IDs shall be the first letter of the words La, Mt, San or Sta and the first three letters after the words La, Mt, San or Sta.

   Note: - For Metered Participants below that will appear to have identical IDs, replace the last three letters of the Metered Participant's ID with its first three/remaining consonant after the words La, Mt, San or Sta or just simply apply item 2.

Metered Participant	Metered Participant ID
SAN JOSE	SJOS
SAN ROQUE	SROQ

5. For Metered Participants like Pelco and Zameco Complex, the IDs shall be the first three letters of the customer's name and the equivalent decimal of the given Roman Numerals.

   Note: - For Metered Participants below that will appear to have identical IDs, replace the first three letters of the Metered Participant's name with its first three consonants (Item 2) plus the equivalent decimal of the given Roman Numerals.

Metered Participant	ITEM 1 (ID)	ITEM 2 (ID)	Metered Participant ID
PELCO I	**PEL1**		PEL1
PELCO II	**PEL2**		PEL2
PELCO III	**PEL3**		PEL3
ZAMECO I	ZAM1	**ZAM1**	ZAM1
ZAMELCO II	ZAM2	**ZAM2**	ZAM2
ZAMSURECO I	ZAM1	ZMS1	ZMS1
ZAMSURECO II	ZAM2	ZMS2	ZMS2

SITE – SPECIFIC LOSS ADJUSTMENT

Customer

Case 1: Single Settlement Point

A metering point is connected to only one MTN:

a. **Case 1 – A**: only one metering point is presently connected to the MTN (figure 1)

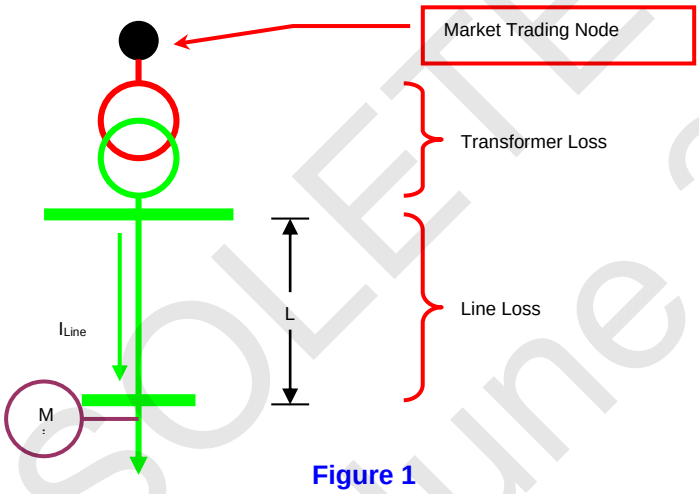


Figure 1

kW_{Mi} = $(kWh_{Mi\text{-}15min} + kWh_{Mi\text{-}30min} + kWh_{Mi\text{-}45min} + kWh_{Mi\text{-}00min}) \div 1h$

$kVar_{Mi}$ = $(kVarh_{Mi\text{-}15min} + kVarh_{Mi\text{-}30min} + kVarh_{Mi\text{-}45min} + kVarh_{Mi\text{-}00min}) \div 1h$

I_{Line} = $kW_{Mi} \div ((\sqrt{3}) * V * pf_{Mi})$

pf_{Mi} = $\cos(\tan^{-1}(kVar_{Mi} \div kW_{Mi}))$

$Line_{kW\text{-}Loss}$ = $(I_{Line})^2 * R_{Line}$

R_{Line} = $r_a * L$

$Line_{kVar\text{-}Loss}$ = $(I_{Line})^2 * X_{Line}$

X_{Line} = $X_l * L$

$Core_{Loss\text{-}Mi}$ = $TCore_{Loss} * (kW_{Mi} \div \sum_{i=1}^{n} kW_{Mi}) = T_1Core_{Loss} \div 1$

$Copper_{Loss\text{-}Mi}$ = $((kW_{Mi} \div pf_{Mi}) \div T_{kVA\text{-}Rating})^2 * P_{Short\text{-}Circuit}$

$Total_{kW\text{-}Loss}$ = $Line_{kW\text{-}Loss} + Core_{Loss\text{-}Mi} + Copper_{Loss\text{-}Mi}$

SSLF = $1 + (Total_{kW\text{-}Loss} + kW_{Mi})$

$Adjusted_{kW}$ = $Total_{kWLoss} + kW_{Mi}$ = $SSLF * kW_{Mi}$

b. **Case 1 – B**: numerous metering points connected to, or are sharing the same MTN (figure 2)

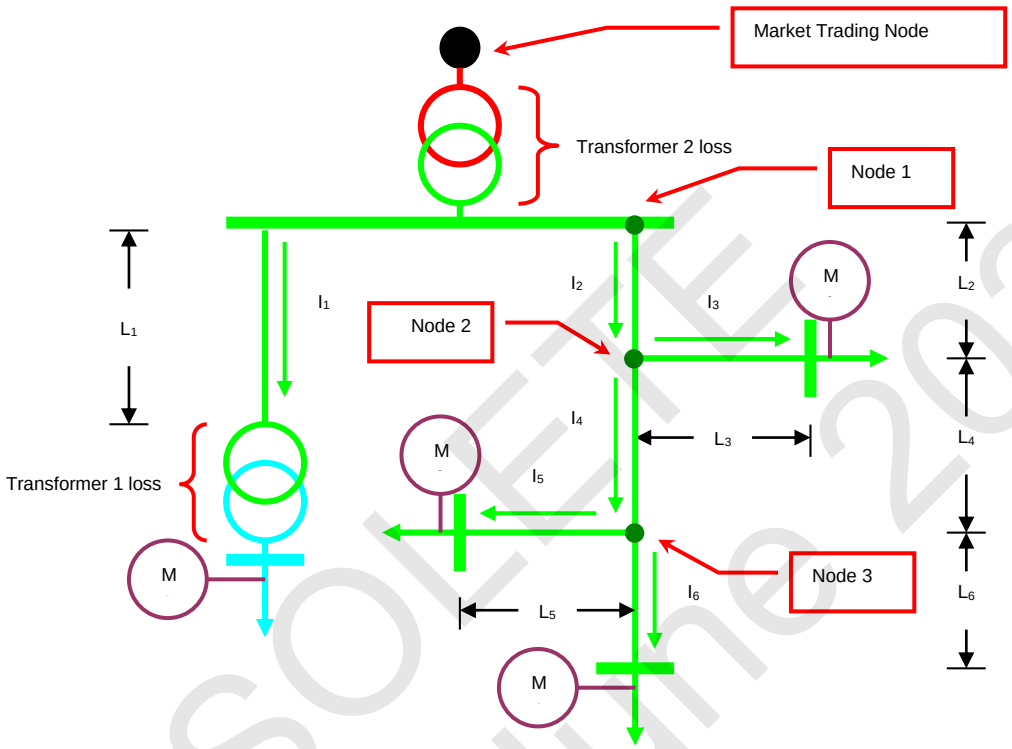


Figure 2

Active and Reactive Power:

kW_{M1} = $(kWh_{M1\text{-}15min} + kWh_{M1\text{-}30min} + kWh_{M1\text{-}45min} + kWh_{M1\text{-}00min}) \div 1h$

$kVar_{M1}$ = $(kVarh_{M1\text{-}15min} + kVarh_{M1\text{-}30min} + kVarh_{M1\text{-}45min} + kVarh_{M1\text{-}00min}) \div 1h$

kW_{M2} = $(kWh_{M2\text{-}15min} + kWh_{M2\text{-}30min} + kWh_{M2\text{-}45min} + kWh_{M2\text{-}00min}) \div 1h$

$kVar_{M2}$ = $(kVarh_{M2\text{-}15min} + kVarh_{M2\text{-}30min} + kVarh_{M2\text{-}45min} + kVarh_{M2\text{-}00min}) \div 1h$

kW_{M3} = $(kWh_{M3\text{-}15min} + kWh_{M3\text{-}30min} + kWh_{M3\text{-}45min} + kWh_{M3\text{-}00min}) \div 1h$

$kVar_{M3}$ = $(kVarh_{M3\text{-}15min} + kVarh_{M3\text{-}30min} + kVarh_{M3\text{-}45min} + kVarh_{M3\text{-}00min}) \div 1h$

kW_{M4} = $(kWh_{M4\text{-}15min} + kWh_{M4\text{-}30min} + kWh_{M4\text{-}45min} + kWh_{M4\text{-}00min}) \div 1h$

$kVar_{M4}$ = $(kVarh_{M4\text{-}15min} + kVarh_{M4\text{-}30min} + kVarh_{M4\text{-}45min} + kVarh_{M4\text{-}00min}) \div 1h$

Line Currents and Line Losses:

I_1 = $kW_{M1} \div ((\sqrt{3}) * V_1 * pf_1)$ = $kW_{M1} \div ((\sqrt{3}) * V_1 * \cos(\tan^{-1}(kVar_{M1} \div kW_{M1})))$

$I_3 = kW_{M2} \div ((\sqrt{3}) * V_2 * pf_2) = kW_{M2} \div ((\sqrt{3}) * V_2 * \cos(\tan^{-1}(kVar_{M2} \div kW_{M2})))$

$I_5 = kW_{M3} \div ((\sqrt{3}) * V_3 * pf_3) = kW_{M3} \div ((\sqrt{3}) * V_3 * \cos(\tan^{-1}(kVar_{M3} \div kW_{M3})))$

$I_6 = kW_{M4} \div ((\sqrt{3}) * V_4 * pf_4) = kW_{M4} \div ((\sqrt{3}) * V_4 * \cos(\tan^{-1}(kVar_{M4} \div kW_{M4})))$

$Line_{5\text{-}kW\text{-}Loss} = (I_5)^2 * R_5 = (I_5)^2 * (r_{a\text{-}5} * L_5)$

$Line_{5\text{-}kVar\text{-}Loss} = (I_5)^2 * X_5 = (I_5)^2 * (X_{l\text{-}5} * L_5)$

$Line_{6\text{-}kW\text{-}Loss} = (I_6)^2 * R_6 = (I_6)^2 * (r_{a\text{-}6} * L_6)$

$Line_{6\text{-}kVar\text{-}Loss} = (I_6)^2 * X_6 = (I_6)^2 * (X_{l\text{-}6} * L_6)$

Total Active Power at Node 3 ($kW_{N\text{-}3}$) $= kW_{M3} + kW_{M4} + Line_{5\text{-}kW\text{-}Loss} + Line_{6\text{-}kW\text{-}Loss}$

Total Reactive Power at Node 3 ($kVar_{N\text{-}3}$) $= kVar_{M3} + kVar_{M4} + Line_{5\text{-}kVar\text{-}Loss} + Line_{6\text{-}kVar\text{-}Loss}$

$I_4 = kW_{N\text{-}3} \div ((\sqrt{3}) * V_{N\text{-}3} * pf_{N\text{-}3}) = kW_{N\text{-}3} \div ((\sqrt{3}) * V_{N\text{-}3} * \cos(\tan^{-1}(kVar_{N\text{-}3} \div kW_{N\text{-}3})))$

$Line_{4\text{-}kW\text{-}Loss} = (I_4)^2 * R_4 = (I_4)^2 * (r_{a\text{-}4} * L_4)$

$Line_{4\text{-}kVar\text{-}Loss} = (I_4)^2 * X_4 = (I_4)^2 * (X_{l\text{-}4} * L_4)$

$Line_{3\text{-}kW\text{-}Loss} = (I_3)^2 * R_3 = (I_3)^2 * (r_{a\text{-}3} * L_3)$

$Line_{3\text{-}kVar\text{-}Loss} = (I_3)^2 * X_3 = (I_3)^2 * (X_{l\text{-}3} * L_3)$

Total Active Power at Node 2 ($kW_{N\text{-}2}$) $= kW_{M2} + kW_{M3} + kW_{M4} + Line_{3\text{-}kW\text{-}Loss} + Line_{4\text{-}kW\text{-}Loss} + Line_{5\text{-}kW\text{-}Loss} + Line_{6\text{-}kW\text{-}Loss}$

Total Reactive Power at Node 2 ($kVar_{N\text{-}2}$) $= kVar_{M2} + kVar_{M3} + kVar_{M4} + Line_{3\text{-}kVar\text{-}Loss} + Line_{4\text{-}kVar\text{-}Loss} + Line_{5\text{-}kVar\text{-}Loss} + Line_{6\text{-}kVar\text{-}Loss}$

$I_2 = kW_{N\text{-}2} \div ((\sqrt{3}) * V_{N\text{-}2} * pf_{N\text{-}2}) = kW_{N\text{-}2} \div ((\sqrt{3}) * V_{N\text{-}2} * \cos(\tan^{-1}(kVar_{N\text{-}2} \div kW_{N\text{-}2})))$

$Line_{2\text{-}kW\text{-}Loss} = (I_2)^2 * R_2 = (I_2)^2 * (r_{a\text{-}2} * L_2)$

$Line_{2\text{-}kVar\text{-}Loss} = (I_2)^2 * X_2 = (I_2)^2 * (X_{l\text{-}2} * L_2)$

$Line_{1\text{-}kW\text{-}Loss} = (I_1)^2 * R_1 = (I_1)^2 * (r_{a\text{-}1} * L_1)$

$Line_{1\text{-}kVar\text{-}Loss} = (I_1)^2 * X_1 = (I_1)^2 * (X_{l\text{-}1} * L_1)$

Distributing $Line_{4\text{-}kW\text{-}Loss}$

For M_3, $Line_{4\text{-}kW\text{-}Loss\text{-}M3} = (Line_{4\text{-}kW\text{-}Loss} * (kW_{M3} + Line_{5\text{-}kW\text{-}Loss})) \div kW_{N\text{-}3}$

For M_4, $Line_{4\text{-}kW\text{-}Loss\text{-}M4} = (Line_{4\text{-}kW\text{-}Loss} * (kW_{M4} + Line_{6\text{-}kW\text{-}Loss})) \div kW_{N\text{-}3}$

Distributing $Line_{2\text{-}kW\text{-}Loss}$

For M_2, $Line_{2\text{-}kW\text{-}Loss\text{-}M2} = (Line_{2\text{-}kW\text{-}Loss} * (kW_{M2} + Line_{3\text{-}kW\text{-}Loss})) \div kW_{N\text{-}2}$

For M_3, $Line_{2\text{-kW-Loss-M3}} = (Line_{2\text{-kW-Loss}} * (kW_{M3} + Line_{5\text{-kW-Loss}} + Line_{4\text{-kW-Loss-M3}})) \div kW_{N\text{-}2}$

For M_4, $Line_{2\text{-kW-Loss-M4}} = (Line_{2\text{-kW-Loss}} * (kW_{M4} + Line_{6\text{-kW-Loss}} + Line_{4\text{-kW-Loss-M4}})) \div kW_{N\text{-}2}$

Transformer Losses:

$T_1Core_{Loss\text{-}M1} = T_1Core_{Loss} * (kW_{M1} \div \sum_{i=1}^{n} kW_{Mi}) = T_1Core_{Loss} \div 1$

$T_1Copper_{Loss\text{-}M1} = ((kW_{M1} \div pf_1) \div T_{1kVA\text{-}Rating})^2 * P_{Short\text{-}Circuit\text{-}T1}$

$T_2Core_{Loss\text{-}M1} = T_2Core_{Loss} * (kW_{M1} \div \sum_{i=1}^{n} kW_{Mi})$

$T_2Core_{Loss\text{-}M2} = T_2Core_{Loss} * (kW_{M2} \div \sum_{i=1}^{n} kW_{Mi})$

$T_2Core_{Loss\text{-}M3} = T_2Core_{Loss} * (kW_{M3} \div \sum_{i=1}^{n} kW_{Mi})$

$T_2Core_{Loss\text{-}M4} = T_2Core_{Loss} * (kW_{M4} \div \sum_{i=1}^{n} kW_{Mi})$

$T_2Copper_{Loss} = ((kW_{N\text{-}1} \div pf_{N\text{-}1}) \div T_{2kVA\text{-}Rating})^2 * P_{Short\text{-}Circuit\text{-}T2}$

$T_2Copper_{Loss\text{-}M1} = T_2Copper_{Loss} * (kW_{M1} + Line_{1\text{-kW-Loss}}) \div kW_{N\text{-}1}$

$T_2Copper_{Loss\text{-}M2} = T_2Copper_{Loss} * (kW_{M2} + Line_{3\text{-kW-Loss}} + Line_{2\text{-kW-Loss-M2}}) \div kW_{N\text{-}1}$

$T_2Copper_{Loss\text{-}M3} = T_2Copper_{Loss} * (kW_{M3} + Line_{5\text{-kW-Loss}} + Line_{4\text{-kW-Loss-M3}} + Line_{2\text{-kW-Loss-M3}}) \div kW_{N\text{-}1}$

$T_2Copper_{Loss\text{-}M4} = T_2Copper_{Loss} * (kW_{M4} + Line_{6\text{-kW-Loss}} + Line_{4\text{-kW-Loss-M4}} + Line_{2\text{-kW-Loss-M4}}) \div kW_{N\text{-}1}$

Total Active Loss for each Meter:

$Total_{kW\text{-Loss-M1}} = Line_{1\text{-kW-Loss}} + T_1Core_{Loss} + T_1Copper_{Loss\text{-}M1} + T_2Core_{Loss\text{-}M1} + T_2Copper_{Loss\text{-}M1}$

$Total_{kW\text{-Loss-M2}} = Line_{3\text{-kW-Loss}} + Line_{2\text{-kW-Loss-M2}} + T_2Core_{Loss\text{-}M2} + T_2Copper_{Loss\text{-}M2}$

$Total_{kW\text{-Loss-M3}} = Line_{5\text{-kW-Loss}} + Line_{4\text{-kW-Loss-M3}} + Line_{2\text{-kW-Loss-M3}} + T_2Core_{Loss\text{-}M3} + T_2Copper_{Loss\text{-}M3}$

$Total_{kW\text{-Loss-M4}} = Line_{6\text{-kW-Loss}} + Line_{4\text{-kW-Loss-M4}} + Line_{2\text{-kW-Loss-M4}} + T_2Core_{Loss\text{-}M4} + T_2Copper_{Loss\text{-}M4}$

SSLF:

$SSLF_{M1} = 1 + (Total_{kW\text{-Loss-M1}} \div kW_{M1})$

$SSLF_{M2} = 1 + (Total_{kW\text{-Loss-M2}} \div kW_{M2})$

$SSLF_{M3} = 1 + (Total_{kW\text{-Loss-M3}} \div kW_{M3})$

$SSLF_{M4} = 1 + (Total_{kW\text{-Loss-M4}} \div kW_{M4})$

Adjusted Active Power:

$Adjusted_{kW\text{-}M1} = Total_{kW\text{-}Loss\text{-}M1} + kW_{M1}$

$Adjusted_{kW\text{-}M2} = Total_{kW\text{-}Loss\text{-}M2} + kW_{M2}$

$Adjusted_{kW\text{-}M3} = Total_{kW\text{-}Loss\text{-}M3} + kW_{M3}$

$Adjusted_{kW\text{-}M4} = Total_{kW\text{-}Loss\text{-}M4} + kW_{M4}$

In the event that Meter 4 reading becomes zero (0), see figure 3:

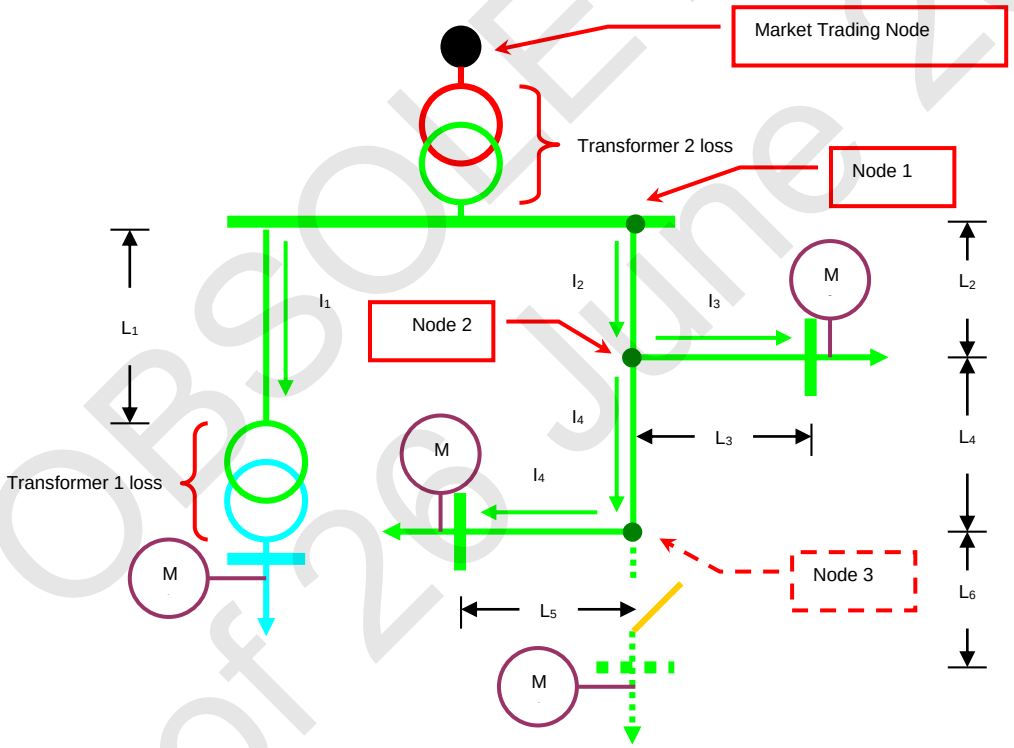


Figure 3

Active and Reactive Power:

$kW_{M1} = (kWh_{M1\text{-}15min} + kWh_{M1\text{-}30min} + kWh_{M1\text{-}45min} + kWh_{M1\text{-}00min}) \div 1h$

$kVar_{M1} = (kVarh_{M1\text{-}15min} + kVarh_{M1\text{-}30min} + kVarh_{M1\text{-}45min} + kVarh_{M1\text{-}00min}) \div 1h$

$kW_{M2} = (kWh_{M2\text{-}15min} + kWh_{M2\text{-}30min} + kWh_{M2\text{-}45min} + kWh_{M2\text{-}00min}) \div 1h$

$kVar_{M2} = (kVarh_{M2\text{-}15min} + kVarh_{M2\text{-}30min} + kVarh_{M2\text{-}45min} + kVarh_{M2\text{-}00min}) \div 1h$

kW_{M3} = $(kWh_{M3\text{-}15min} + kWh_{M3\text{-}30min} + kWh_{M3\text{-}45min} + kWh_{M3\text{-}00min}) \div 1h$

$kVar_{M3}$ = $(kVarh_{M3\text{-}15min} + kVarh_{M3\text{-}30min} + kVarh_{M3\text{-}45min} + kVarh_{M3\text{-}00min}) \div 1h$

Line Currents and Line Losses:

I_1 = $kW_{M1} \div ((\sqrt{3}) * V_1 * pf_1)$ = $kW_{M1} \div ((\sqrt{3}) * V_1 * \cos(\tan^{-1}(kVar_{M1} \div kW_{M1})))$

I_3 = $kW_{M2} \div ((\sqrt{3}) * V_2 * pf_2)$ = $kW_{M2} \div ((\sqrt{3}) * V_2 * \cos(\tan^{-1}(kVar_{M2} \div kW_{M2})))$

I_4 = $kW_{M3} \div ((\sqrt{3}) * V_3 * pf_3)$ = $kW_{M3} \div ((\sqrt{3}) * V_3 * \cos(\tan^{-1}(kVar_{M3} \div kW_{M3})))$

$Line_{5\text{-}kW\text{-}Loss}$ = $(I_4)^2 * R_5$ = $(I_4)^2 * (r_{a\text{-}5} * L_5)$

$Line_{5\text{-}kVar\text{-}Loss}$ = $(I_4)^2 * X_5$ = $(I_4)^2 * (X_{l\text{-}5} * L_5)$

$Line_{4\text{-}kW\text{-}Loss}$ = $(I_4)^2 * R_4$ = $(I_4)^2 * (r_{a\text{-}4} * L_4)$

$Line_{4\text{-}kVar\text{-}Loss}$ = $(I_4)^2 * X_4$ = $(I_4)^2 * (X_{l\text{-}4} * L_4)$

$Line_{3\text{-}kW\text{-}Loss}$ = $(I_3)^2 * R_3$ = $(I_3)^2 * (r_{a\text{-}3} * L_3)$

$Line_{3\text{-}kVar\text{-}Loss}$ = $(I_3)^2 * X_3$ = $(I_3)^2 * (X_{l\text{-}3} * L_3)$

Total Active Power at Node 2 ($kW_{N\text{-}2}$) = $kW_{M2} + kW_{M3} + Line_{3\text{-}kW\text{-}Loss} + Line_{4\text{-}kW\text{-}Loss} + Line_{5\text{-}kW\text{-}Loss}$

Total Reactive Power at Node 2 ($kVar_{N\text{-}2}$) = $kVar_{M2} + kVar_{M3} + Line_{3\text{-}kVar\text{-}Loss} + Line_{4\text{-}kVar\text{-}Loss} + Line_{5\text{-}kVar\text{-}Loss}$

$I_2 = kW_{N\text{-}2} \div ((\sqrt{3}) * V_{N\text{-}2} * pf_{N\text{-}2})$ = $kW_{N\text{-}2} \div ((\sqrt{3}) * V_{N\text{-}2} * \cos(\tan^{-1}(kVar_{N\text{-}2} \div kW_{N\text{-}2})))$

$Line_{2\text{-}kW\text{-}Loss}$ = $(I_2)^2 * R_2$ = $(I_2)^2 * (r_{a\text{-}2} * L_2)$

$Line_{2\text{-}kVar\text{-}Loss}$ = $(I_2)^2 * X_2$ = $(I_2)^2 * (X_{l\text{-}2} * L_2)$

$Line_{1\text{-}kW\text{-}Loss}$ = $(I_1)^2 * R_1$ = $(I_1)^2 * (r_{a\text{-}1} * L_1)$

$Line_{1\text{-}kVar\text{-}Loss}$ = $(I_1)^2 * X_1$ = $(I_1)^2 * (X_{l\text{-}1} * L_1)$

Distributing $Line_{2\text{-}kW\text{-}Loss}$

For M_2, $Line_{2\text{-}kW\text{-}Loss\text{-}M2}$ = $(Line_{2\text{-}kW\text{-}Loss} * (kW_{M2} + Line_{3\text{-}kW\text{-}Loss})) \div kW_{N\text{-}2}$

For M_3, $Line_{2\text{-}kW\text{-}Loss\text{-}M3}$ = $(Line_{2\text{-}kW\text{-}Loss} * (kW_{M3} + Line_{5\text{-}kW\text{-}Loss} + Line_{4\text{-}kW\text{-}Loss})) \div kW_{N\text{-}2}$

Transformer Losses:

$T_1Core_{Loss\text{-}M1} = T_1Core_{Loss} * (kW_{M1} \div \sum_{i=1}^{n} kW_{Mi}) = T_1Core_{Loss} \div 1$

$T_1Copper_{Loss\text{-}M1} = ((kW_{M1} \div pf_1) \div T_{1kVA\text{-}Rating})^2 * P_{Short\text{-}Circuit\text{-}T1}$

$T_2Core_{Loss\text{-}M4} = T_2Core_{Loss} * HLS_{M4}$

$T_2Core_{Loss\text{-}M1} = T_2Core_{Loss} * HLS_{M1}$

$T_2Core_{Loss\text{-}M2} = T_2Core_{Loss} * HLS_{M2}$

$T_2Core_{Loss\text{-}M3} = T_2Core_{Loss} * HLS_{M3}$

$T_2Copper_{Loss} = ((kW_{N\text{-}1} \div pf_{N\text{-}1}) \div T_{2kVA\text{-}Rating})^2 * P_{Short\text{-}Circuit\text{-}T2}$

$T_2Copper_{Loss\text{-}M1} = T_2Copper_{Loss} * (kW_{M1} + Line_{1\text{-}kW\text{-}Loss}) \div kW_{N\text{-}1}$

$T_2Copper_{Loss\text{-}M2} = T_2Copper_{Loss} * (kW_{M2} + Line_{3\text{-}kW\text{-}Loss} + Line_{2\text{-}kW\text{-}Loss\text{-}M2}) \div kW_{N\text{-}1}$

$T_2Copper_{Loss\text{-}M3} = T_2Copper_{Loss} * (kW_{M3} + Line_{5\text{-}kW\text{-}Loss} + Line_{4\text{-}kW\text{-}Loss} + Line_{2\text{-}kW\text{-}Loss\text{-}M3}) \div kW_{N\text{-}1}$

Total Active Loss for each Meter:

$Total_{kW\text{-}Loss\text{-}M1} = Line_{1\text{-}kW\text{-}Loss} + T_1Core_{Loss} + T_1Copper_{Loss\text{-}M1} + T_2Core_{Loss\text{-}M1} + T_2Copper_{Loss\text{-}M1}$

$Total_{kW\text{-}Loss\text{-}M2} = Line_{3\text{-}kW\text{-}Loss} + Line_{2\text{-}kW\text{-}Loss\text{-}M2} + T_2Core_{Loss\text{-}M2} + T_2Copper_{Loss\text{-}M2}$

$Total_{kW\text{-}Loss\text{-}M3} = Line_{5\text{-}kW\text{-}Loss} + Line_{4\text{-}kW\text{-}Loss} + Line_{2\text{-}kW\text{-}Loss\text{-}M3} + T_2Core_{Loss\text{-}M3} + T_2Copper_{Loss\text{-}M3}$

$Total_{kW\text{-}Loss\text{-}M4} = T_2Core_{Loss\text{-}M4}$

Adjusted Active Power:

$Adjusted_{kW\text{-}M1} = Total_{kW\text{-}Loss\text{-}M1} + kW_{M1}$

$Adjusted_{kW\text{-}M2} = Total_{kW\text{-}Loss\text{-}M2} + kW_{M2}$

$Adjusted_{kW\text{-}M3} = Total_{kW\text{-}Loss\text{-}M3} + kW_{M3}$

$Adjusted_{kW\text{-}M4} = Total_{kW\text{-}Loss\text{-}M4} + kW_{M4}$ → 0

SSLF:

$SSLF_{M1} = 1 + (Total_{kW\text{-}Loss\text{-}M1} \div kW_{M1})$

$SSLF_{M2} = 1 + (Total_{kW\text{-}Loss\text{-}M2} \div kW_{M2})$

$SSLF_{M3} = 1 + (Total_{kW\text{-}Loss\text{-}M3} \div kW_{M3})$

$SSLF_{M4} = 1 + (Total_{kW\text{-}Loss\text{-}M4} \div kW_{M4})$ → 0 $= \infty$

Case 2: Multiple Settlement Points

A metering point is connected to two or more MTNs during normal condition (figure 4)

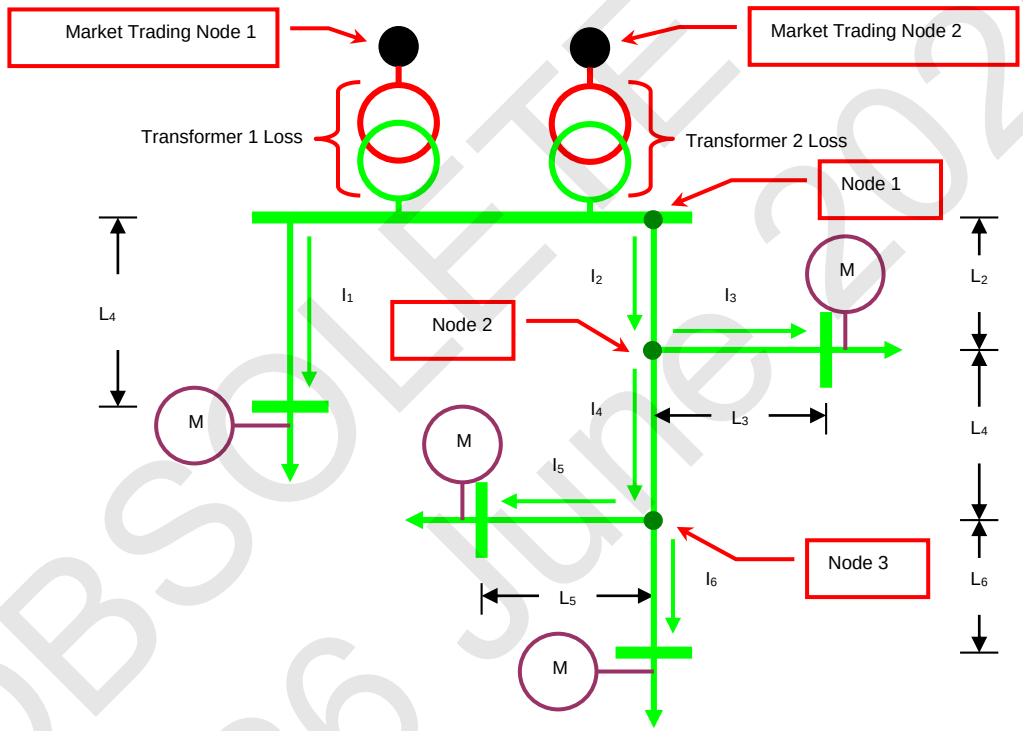


Figure 4

Active and Reactive Power:

kW_{M1} = ($kWh_{M1\text{-}15min}$ + $kWh_{M1\text{-}30min}$ + $kWh_{M1\text{-}45min}$ + $kWh_{M1\text{-}00min}$) ÷ 1h

$kVar_{M1}$ = ($kVarh_{M1\text{-}15min}$ + $kVarh_{M1\text{-}30min}$ + $kVarh_{M1\text{-}45min}$ + $kVarh_{M1\text{-}00min}$) ÷ 1h

kW_{M2} = ($kWh_{M2\text{-}15min}$ + $kWh_{M2\text{-}30min}$ + $kWh_{M2\text{-}45min}$ + $kWh_{M2\text{-}00min}$) ÷ 1h

$kVar_{M2}$ = ($kVarh_{M2\text{-}15min}$ + $kVarh_{M2\text{-}30min}$ + $kVarh_{M2\text{-}45min}$ + $kVarh_{M2\text{-}00min}$) ÷ 1h

kW_{M3} = ($kWh_{M3\text{-}15min}$ + $kWh_{M3\text{-}30min}$ + $kWh_{M3\text{-}45min}$ + $kWh_{M3\text{-}00min}$) ÷ 1h

$kVar_{M3}$ = ($kVarh_{M3\text{-}15min}$ + $kVarh_{M3\text{-}30min}$ + $kVarh_{M3\text{-}45min}$ + $kVarh_{M3\text{-}00min}$) ÷ 1h

kW_{M4} = ($kWh_{M4\text{-}15min}$ + $kWh_{M4\text{-}30min}$ + $kWh_{M4\text{-}45min}$ + $kWh_{M4\text{-}00min}$) ÷ 1h

$kVar_{M4}$ = $(kVarh_{M4\text{-}15min} + kVarh_{M4\text{-}30min} + kVarh_{M4\text{-}45min} + kVarh_{M4\text{-}00min}) \div 1h$

Line Currents and Line Losses:

I_1 = $kW_{M1} \div ((\sqrt{3}) * V_1 * pf_1)$ = $kW_{M1} \div ((\sqrt{3}) * V_1 * \cos(\tan^{-1}(kVar_{M1} \div kW_{M1})))$

I_3 = $kW_{M2} \div ((\sqrt{3}) * V_2 * pf_2)$ = $kW_{M2} \div ((\sqrt{3}) * V_2 * \cos(\tan^{-1}(kVar_{M2} \div kW_{M2})))$

I_5 = $kW_{M3} \div ((\sqrt{3}) * V_3 * pf_3)$ = $kW_{M3} \div ((\sqrt{3}) * V_3 * \cos(\tan^{-1}(kVar_{M3} \div kW_{M3})))$

I_6 = $kW_{M4} \div ((\sqrt{3}) * V_4 * pf_4)$ = $kW_{M4} \div ((\sqrt{3}) * V_4 * \cos(\tan^{-1}(kVar_{M4} \div kW_{M4})))$

$Line_{5\text{-}kW\text{-}Loss}$ = $(I_5)^2 * R_5$ = $(I_5)^2 * (r_{a\text{-}5} * L_5)$

$Line_{5\text{-}kVar\text{-}Loss}$ = $(I_5)^2 * X_5$ = $(I_5)^2 * (X_{l\text{-}5} * L_5)$

$Line_{6\text{-}kW\text{-}Loss}$ = $(I_6)^2 * R_6$ = $(I_6)^2 * (r_{a\text{-}6} * L_6)$

$Line_{6\text{-}kVar\text{-}Loss}$ = $(I_6)^2 * X_6$ = $(I_6)^2 * (X_{l\text{-}6} * L_6)$

Total Active Power at Node 3 ($kW_{N\text{-}3}$) = $kW_{M3} + kW_{M4} + Line_{5\text{-}kW\text{-}Loss} + Line_{6\text{-}kW\text{-}Loss}$

Total Reactive Power at Node 3 ($kVar_{N\text{-}3}$) = $kVar_{M3} + kVar_{M4} + Line_{5\text{-}kVar\text{-}Loss} + Line_{6\text{-}kVar\text{-}Loss}$

$I_4 = kW_{N\text{-}3} \div ((\sqrt{3}) * V_{N\text{-}3} * pf_{N\text{-}3})$ = $kW_{N\text{-}3} \div ((\sqrt{3}) * V_{N\text{-}3} * \cos(\tan^{-1}(kVar_{N\text{-}3} \div kW_{N\text{-}3})))$

$Line_{4\text{-}kW\text{-}Loss}$ = $(I_4)^2 * R_4$ = $(I_4)^2 * (r_{a\text{-}4} * L_4)$

$Line_{4\text{-}kVar\text{-}Loss}$ = $(I_4)^2 * X_4$ = $(I_4)^2 * (X_{l\text{-}4} * L_4)$

$Line_{3\text{-}kW\text{-}Loss}$ = $(I_3)^2 * R_3$ = $(I_3)^2 * (r_{a\text{-}3} * L_3)$

$Line_{3\text{-}kVar\text{-}Loss}$ = $(I_3)^2 * X_3$ = $(I_3)^2 * (X_{l\text{-}3} * L_3)$

Total Active Power at Node 2 ($kW_{N\text{-}2}$) = $kW_{M2} + kW_{M3} + kW_{M4} + Line_{3\text{-}kW\text{-}Loss} + Line_{4\text{-}kW\text{-}Loss} + Line_{5\text{-}kW\text{-}Loss} + Line_{6\text{-}kW\text{-}Loss}$

Total Reactive Power at Node 2 ($kVar_{N\text{-}2}$) = $kVar_{M2} + kVar_{M3} + kVar_{M4} + Line_{3\text{-}kVar\text{-}Loss} + Line_{4\text{-}kVar\text{-}Loss} + Line_{5\text{-}kVar\text{-}Loss} + Line_{6\text{-}kVar\text{-}Loss}$

$I_2 = kW_{N\text{-}2} \div ((\sqrt{3}) * V_{N\text{-}2} * pf_{N\text{-}2})$ = $kW_{N\text{-}2} \div ((\sqrt{3}) * V_{N\text{-}2} * \cos(\tan^{-1}(kVar_{N\text{-}2} \div kW_{N\text{-}2})))$

$Line_{2\text{-}kW\text{-}Loss}$ = $(I_2)^2 * R_2$ = $(I_2)^2 * (r_{a\text{-}2} * L_2)$

$Line_{2\text{-}kVar\text{-}Loss}$ = $(I_2)^2 * X_2$ = $(I_2)^2 * (X_{l\text{-}2} * L_2)$

$Line_{1\text{-}kW\text{-}Loss}$ = $(I_1)^2 * R_1$ = $(I_1)^2 * (r_{a\text{-}1} * L_1)$

$Line_{1\text{-}kVar\text{-}Loss}$ = $(I_1)^2 * X_1$ = $(I_1)^2 * (X_{l\text{-}1} * L_1)$

Distributing $Line_{4\text{-}kW\text{-}Loss}$

For M_3, $Line_{4\text{-}kW\text{-}Loss\text{-}M3}$ = $(Line_{4\text{-}kW\text{-}Loss} * (kW_{M3} + Line_{5\text{-}kW\text{-}Loss})) \div kW_{N\text{-}3}$

For M_4, $Line_{4\text{-kW-Loss-M4}}$ $= (Line_{4\text{-kW-Loss}} * (kW_{M4} + Line_{6\text{-kW-Loss}})) \div kW_{N-3}$

Distributing $Line_{2\text{-kW-Loss}}$

For M_2, $Line_{2\text{-kW-Loss-M2}}$ $= (Line_{2\text{-kW-Loss}} * (kW_{M2} + Line_{3\text{-kW-Loss}})) \div kW_{N-2}$

For M_3, $Line_{2\text{-kW-Loss-M3}}$ $= (Line_{2\text{-kW-Loss}} * (kW_{M3} + Line_{5\text{-kW-Loss}} + Line_{4\text{-kW-Loss-M3}})) \div kW_{N-2}$

For M_4, $Line_{2\text{-kW-Loss-M4}}$ $= (Line_{2\text{-kW-Loss}} * (kW_{M4} + Line_{6\text{-kW-Loss}} + Line_{4\text{-kW-Loss-M4}})) \div kW_{N-2}$

Transformer Losses:

$T_1Core_{Loss\text{-}M1} = T_1Core_{Loss} * (kW_{M1} \div \sum_{i=1}^{n} kW_{Mi})$

$T_1Core_{Loss\text{-}M2} = T_1Core_{Loss} * (kW_{M2} \div \sum_{i=1}^{n} kW_{Mi})$

$T_1Core_{Loss\text{-}M3} = T_1Core_{Loss} * (kW_{M3} \div \sum_{i=1}^{n} kW_{Mi})$

$T_1Core_{Loss\text{-}M4} = T_1Core_{Loss} * (kW_{M4} \div \sum_{i=1}^{n} kW_{Mi})$

$T_1Copper_{Loss} = (((kW_{N-1} \div 2) \div pf_{N-1}) \div T_{1kVA\text{-}Rating}))^2 * P_{Short\text{-}Circuit\text{-}T1}$

$T_1Copper_{Loss\text{-}M1} = T_1Copper_{Loss} * (kW_{M1} + Line_{1\text{-kW-Loss}}) \div kW_{N-1}$

$T_1Copper_{Loss\text{-}M2} = T_1Copper_{Loss} * (kW_{M2} + Line_{3\text{-kW-Loss}} + Line_{2\text{-kW-Loss-M2}}) \div kW_{N-1}$

$T_1Copper_{Loss\text{-}M3} = T_1Copper_{Loss} * (kW_{M3} + Line_{5\text{-kW-Loss}} + Line_{4\text{-kW-Loss-M3}} + Line_{4\text{-kW-Loss-M3}}) \div kW_{N-1}$

$T_1Copper_{Loss\text{-}M4} = T_1Copper_{Loss} * (kW_{M4} + Line_{5\text{-kW-Loss}} + Line_{4\text{-kW-Loss-M4}} + Line_{4\text{-kW-Loss-M4}}) \div kW_{N-1}$

$T_2Core_{Loss\text{-}M1} = T_2Core_{Loss} * (kW_{M1} \div \sum_{i=1}^{n} kW_{Mi})$

$T_2Core_{Loss\text{-}M2} = T_2Core_{Loss} * (kW_{M2} \div \sum_{i=1}^{n} kW_{Mi})$

$T_2Core_{Loss\text{-}M3} = T_2Core_{Loss} * (kW_{M3} \div \sum_{i=1}^{n} kW_{Mi})$

$T_2Core_{Loss\text{-}M4} = T_2Core_{Loss} * (kW_{M4} \div \sum_{i=1}^{n} kW_{Mi})$

$T_2Copper_{Loss} = (((kW_{N-1} \div 2) \div pf_{N-1}) \div T_{2kVA\text{-}Rating}))^2 * P_{Short\text{-}Circuit\text{-}T2}$

$T_2Copper_{Loss\text{-}M1} = T_2Copper_{Loss} * (kW_{M1} + Line_{1\text{-kW-Loss}}) \div kW_{N-1}$

$T_2Copper_{Loss\text{-}M2} = T_2Copper_{Loss} * (kW_{M2} + Line_{3\text{-kW-Loss}} + Line_{2\text{-kW-Loss-M2}}) \div kW_{N-1}$

$T_2Copper_{Loss\text{-}M3} = T_2Copper_{Loss} * (kW_{M3} + Line_{5\text{-kW-Loss}} + Line_{4\text{-kW-Loss-M3}} + Line_{4\text{-kW-Loss-M3}}) \div kW_{N-1}$

$T_2Copper_{Loss\text{-}M4} = T_2Copper_{Loss} * (kW_{M4} + Line_{5\text{-kW-Loss}} + Line_{4\text{-kW-Loss-M4}} + Line_{4\text{-kW-Loss-M4}}) \div kW_{N-1}$

Total Active Loss for each Meter:

$Total_{kW\text{-}Loss\text{-}M1}$ = $Line_{1\text{-}kW\text{-}Loss}$ + $T_1Core_{Loss\text{-}M1}$ + $T_1Copper_{Loss\text{-}M1}$ + $T_2Core_{Loss\text{-}M1}$ + $T_2Copper_{Loss\text{-}M1}$

$Total_{kW\text{-}Loss\text{-}M2}$ = $Line_{3\text{-}kW\text{-}Loss}$ + $Line_{2\text{-}kW\text{-}Loss\text{-}M2}$ + $T_1Core_{Loss\text{-}M2}$ + $T_1Copper_{Loss\text{-}M2}$ + $T_2Core_{Loss\text{-}M2}$ + $T_2Copper_{Loss\text{-}M2}$

$Total_{kW\text{-}Loss\text{-}M3}$ = $Line_{5\text{-}kW\text{-}Loss}$ + $Line_{4\text{-}kW\text{-}Loss\text{-}M3}$ + $Line_{2\text{-}kW\text{-}Loss\text{-}M3}$ + $T_1Core_{Loss\text{-}M3}$ + $T_1Copper_{Loss\text{-}M3}$ + $T_2Core_{Loss\text{-}M3}$ + $T_2Copper_{Loss\text{-}M3}$

$Total_{kW\text{-}Loss\text{-}M4}$ = $Line_{6\text{-}kW\text{-}Loss}$ + $Line_{4\text{-}kW\text{-}Loss\text{-}M4}$ + $Line_{2\text{-}kW\text{-}Loss\text{-}M4}$ + $T_1Core_{Loss\text{-}M4}$ + $T_1Copper_{Loss\text{-}M4}$ + $T_2Core_{Loss\text{-}M4}$ + $T_2Copper_{Loss\text{-}M4}$

SSLF:

$SSLF_{M1}$ = $1 + (Total_{kW\text{-}Loss\text{-}M1} \div kW_{M1})$

$SSLF_{M2}$ = $1 + (Total_{kW\text{-}Loss\text{-}M2} \div kW_{M2})$

$SSLF_{M3}$ = $1 + (Total_{kW\text{-}Loss\text{-}M3} \div kW_{M3})$

$SSLF_{M4}$ = $1 + (Total_{kW\text{-}Loss\text{-}M4} \div kW_{M4})$

Adjusted Active Power:

$Adjusted_{kW\text{-}M1}$ = $Total_{kW\text{-}Loss\text{-}M1} + kW_{M1}$

$Adjusted_{kW\text{-}M2}$ = $Total_{kW\text{-}Loss\text{-}M2} + kW_{M2}$

$Adjusted_{KW\text{-}M3}$ = $Total_{kW\text{-}Loss\text{-}M3} + kW_{M3}$

$Adjusted_{kW\text{-}M4}$ = $Total_{kW\text{-}Loss\text{-}M4} + kW_{M4}$

Case 3: Alternate Settlement Points:

A metering point is connected to another MTN for alternate source of power during emergency condition or pre-arranged shutdown

a. **Case 3 – A:** a metering point is connected to another transformer for alternate source of power during emergency or pre-arranged shutdown. Usual setting for alternate source of power from the same substation (figure 5).

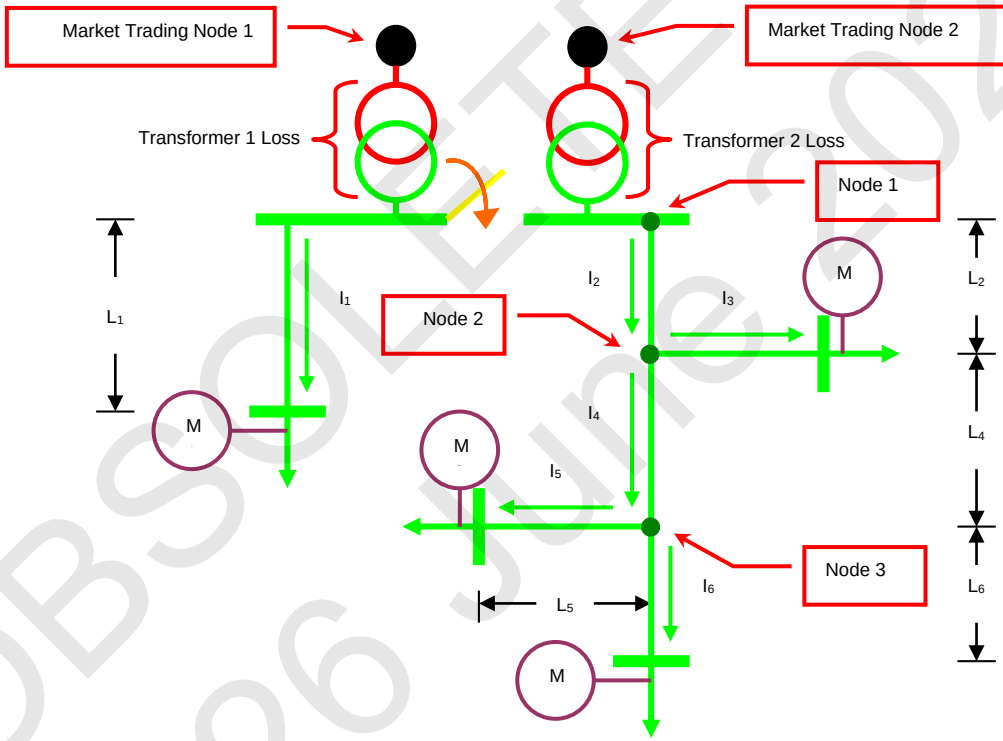


Figure 5

At normal condition (figure 5), SSLF of the meters connected to each defined point of sale can be computed separately treated the same as Case 1 – A (for T_1) and Case 1 – B (for T_2).

At Normal Condition for T_1:

Active and Reactive Power:

kW_{M1} = $(kWh_{M1\text{-}15min} + kWh_{M1\text{-}30min} + kWh_{M1\text{-}45min} + kWh_{M1\text{-}00min}) \div 1h$

$kVar_{M1}$ = $(kVarh_{M1\text{-}15min} + kVarh_{M1\text{-}30min} + kVarh_{M1\text{-}45min} + kVarh_{M1\text{-}00min}) \div 1h$

Line Current and Line Loss

I_1 $= kW_{M1} \div ((\sqrt{3}) * V_1 * pf_1)$

$Line_{1\text{-}kW\text{-}Loss}$ $= (I_1)^2 * R_1$ $= (I_1)^2 * (r_{a\text{-}1} * L_1)$

Transformer Losses

$T_1Core_{Loss\text{-}M1}$ $= T_1Core_{Loss} \div 1$

$T_1Copper_{Loss\text{-}M1}$ $= ((kW_{M1} \div pf_1) \div T_{1kVA\text{-}Rating})^2 * P_{Short\text{-}Circuit\text{-}T1}$

Total Active Loss

$Total_{kW\text{-}Loss\text{-}M1}$ $= Line_{1\text{-}kW\text{-}Loss} + T_1Core_{Loss\text{-}M1} + T_1Copper_{Loss\text{-}M1}$

SSLF

$SSLF_{M1}$ $= 1 + (Total_{kW\text{-}Loss\text{-}M1} \div kW_{M1})$

Adjusted Active Power:

$Adjusted_{kW\text{-}M1}$ $= Total_{kW\text{-}Loss\text{-}M1} + kW_{M1}$

At Normal Condition for T_2:

Active and Reactive Power:

kW_{M2} $= (kWh_{M2\text{-}15min} + kWh_{M2\text{-}30min} + kWh_{M2\text{-}45min} + kWh_{M2\text{-}00min}) \div 1h$

$kVar_{M2}$ $= (kVarh_{M2\text{-}15min} + kVarh_{M2\text{-}30min} + kVarh_{M2\text{-}45min} + kVarh_{M2\text{-}00min}) \div 1h$

kW_{M3} $= (kWh_{M3\text{-}15min} + kWh_{M3\text{-}30min} + kWh_{M3\text{-}45min} + kWh_{M3\text{-}00min}) \div 1h$

$kVar_{M3}$ $= (kVarh_{M3\text{-}15min} + kVarh_{M3\text{-}30min} + kVarh_{M3\text{-}45min} + kVarh_{M3\text{-}00min}) \div 1h$

kW_{M4} $= (kWh_{M4\text{-}15min} + kWh_{M4\text{-}30min} + kWh_{M4\text{-}45min} + kWh_{M4\text{-}00min}) \div 1h$

$kVar_{M4}$ $= (kVarh_{M4\text{-}15min} + kVarh_{M4\text{-}30min} + kVarh_{M4\text{-}45min} + kVarh_{M4\text{-}00min}) \div 1h$

Line Currents and Line Losses:

I_3 $= kW_{M2} \div ((\sqrt{3}) * V_2 * pf_2)$ $= kW_{M2} \div ((\sqrt{3}) * V_2 * \cos(\tan^{-1}(kVar_{M2} \div kW_{M2})))$

I_5 $= kW_{M3} \div ((\sqrt{3}) * V_3 * pf_3)$ $= kW_{M3} \div ((\sqrt{3}) * V_3 * \cos(\tan^{-1}(kVar_{M3} \div kW_{M3})))$

$I_6 = kW_{M4} \div ((\sqrt{3}) * V_4 * pf_4) = kW_{M4} \div ((\sqrt{3}) * V_4 * \cos(\tan^{-1}(kVar_{M4} \div kW_{M4})))$

$Line_{5\text{-}kW\text{-}Loss} = (I_5)^2 * R_5 = (I_5)^2 * (r_{a\text{-}5} * L_5)$

$Line_{5\text{-}kVar\text{-}Loss} = (I_5)^2 * X_5 = (I_5)^2 * (X_{l\text{-}5} * L_5)$

$Line_{6\text{-}kW\text{-}Loss} = (I_6)^2 * R_6 = (I_6)^2 * (r_{a\text{-}6} * L_6)$

$Line_{6\text{-}kVar\text{-}Loss} = (I_6)^2 * X_6 = (I_6)^2 * (X_{l\text{-}6} * L_6)$

Total Active Power at Node 3 ($kW_{N\text{-}3}$) = $kW_{M3} + kW_{M4} + Line_{5\text{-}kW\text{-}Loss} + Line_{6\text{-}kW\text{-}Loss}$

Total Reactive Power at Node 3 ($kVar_{N\text{-}3}$) = $kVar_{M3} + kVar_{M4} + Line_{5\text{-}kVar\text{-}Loss} + Line_{6\text{-}kVar\text{-}Loss}$

$I_4 = kW_{N\text{-}3} \div ((\sqrt{3}) * V_{N\text{-}3} * pf_{N\text{-}3}) = kW_{N\text{-}3} \div ((\sqrt{3}) * V_{N\text{-}3} * \cos(\tan^{-1}(kVar_{N\text{-}3} \div kW_{N\text{-}3})))$

$Line_{4\text{-}kW\text{-}Loss} = (I_4)^2 * R_4 = (I_4)^2 * (r_{a\text{-}4} * L_4)$

$Line_{4\text{-}kVar\text{-}Loss} = (I_4)^2 * X_4 = (I_4)^2 * (X_{l\text{-}4} * L_4)$

$Line_{3\text{-}kW\text{-}Loss} = (I_3)^2 * R_3 = (I_3)^2 * (r_{a\text{-}3} * L_3)$

$Line_{3\text{-}kVar\text{-}Loss} = (I_3)^2 * X_3 = (I_3)^2 * (X_{l\text{-}3} * L_3)$

Total Active Power at Node 2 ($kW_{N\text{-}2}$) = $kW_{M2} + kW_{M3} + kW_{M4} + Line_{3\text{-}kWLoss} + Line_{4\text{-}kW\text{-}Loss} + Line_{5\text{-}kW\text{-}Loss} + Line_{6\text{-}kW\text{-}Loss}$

Total Reactive Power at Node 2 ($kVar_{N\text{-}2}$) = $kVar_{M2} + kVar_{M3} + kVar_{M4} + Line_{3\text{-}kVar\text{-}Loss} + Line_{4\text{-}kVar\text{-}Loss} + Line_{5\text{-}kVar\text{-}Loss} + Line_{6\text{-}kVar\text{-}Loss}$

$I_2 = kW_{N\text{-}2} \div ((\sqrt{3}) * V_{N\text{-}2} * pf_{N\text{-}2}) = kW_{N\text{-}2} \div ((\sqrt{3}) * V_{N\text{-}2} * \cos(\tan^{-1}(kVar_{N\text{-}2} \div kW_{N\text{-}2})))$

$Line_{2\text{-}kW\text{-}Loss} = (I_2)^2 * R_2 = (I_2)^2 * (r_{a\text{-}2} * L_2)$

$Line_{2\text{-}kVar\text{-}Loss} = (I_2)^2 * X_2 = (I_2)^2 * (x_{l\text{-}2} * L_2)$

Distributing $Line_{4\text{-}kWLoss}$

For M_3, $Line_{4\text{-}kW\text{-}Loss\text{-}M3} = (Line_{4\text{-}kW\text{-}Loss} * (kW_{M3} + Line_{5\text{-}kW\text{-}Loss})) \div kW_{N\text{-}3}$

For M_4, $Line_{4\text{-}kW\text{-}Loss\text{-}M4} = (Line_{4\text{-}kW\text{-}Loss} * (kW_{M4} + Line_{6\text{-}kW\text{-}Loss})) \div kW_{N\text{-}3}$

Distributing $Line_{2\text{-}kW\text{-}Loss}$

For M_2, $Line_{2\text{-}kW\text{-}Loss\text{-}M2} = (Line_{2\text{-}kW\text{-}Loss} * (kW_{M2} + Line_{3\text{-}kW\text{-}Loss})) \div kW_{N\text{-}2}$

For M_3, $Line_{2\text{-}kW\text{-}Loss\text{-}M3} = (Line_{2\text{-}kW\text{-}Loss} * (kW_{M3} + Line_{5\text{-}kW\text{-}Loss} + Line_{4\text{-}kW\text{-}Loss\text{-}M3})) \div kW_{N\text{-}2}$

For M_4, $Line_{2\text{-}kW\text{-}Loss\text{-}M4} = (Line_{2\text{-}kW\text{-}Loss} * (kW_{M4} + Line_{6\text{-}kW\text{-}Loss} + Line_{4\text{-}kW\text{-}Loss\text{-}M4})) \div kW_{N\text{-}2}$

Transformer Losses:

$T_2Core_{Loss-M2} = T_2Core_{Loss} * (kW_{M2} \div \sum_{i=1}^{n} kW_{Mi})$

$T_2Core_{Loss-M3} = T_2Core_{Loss} * (kW_{M3} \div \sum_{i=1}^{n} kW_{Mi})$

$T_2Core_{Loss-M4} = T_2Core_{Loss} * (kW_{M4} \div \sum_{i=1}^{n} kW_{Mi})$

$T_2Copper_{Loss} = ((kW_{N-1}) \div pf_{N-1}) \div T_{2kVA-Rating})^2 * P_{Short-Circuit-T2}$

$T_2Copper_{Loss-M2} = T_2Copper_{Loss} * (kW_{M2} + Line_{3-kW-Loss} + Line_{2-kW-Loss-M2}) \div kW_{N-1}$

$T_2Copper_{Loss-M3} = T_2Copper_{Loss} * (kW_{M3} + Line_{5-kW-Loss} + Line_{4-kW-Loss-M3} + Line_{4-kW-Loss-M3}) \div kW_{N-1}$

$T_2Copper_{Loss-M4} = T_2Copper_{Loss} * (kW_{M4} + Line_{5-kW-Loss} + Line_{4-kW-Loss-M4} + Line_{4-kW-Loss-M4}) \div kW_{N-1}$

Total Active Loss for each Meter:

$Total_{kW-Loss-M2} = Line_{3-kW-Loss} + Line_{2-kW-Loss-M2} + T_2Core_{Loss-M2} + T_2Copper_{Loss-M2}$

$Total_{kW-Loss-M3} = Line_{5-kW-Loss} + Line_{4-kW-Loss-M3} + Line_{2-kW-Loss-M3} + T_2Core_{Loss-M3} + T_2Copper_{Loss-M3}$

$Total_{kWLoss-M4} = Line_{6-kW-Loss} + Line_{4-kW-Loss-M4} + Line_{2-kW-Loss-M4} + T_2Core_{Loss-M4} + T_2Copper_{Loss-M4}$

SSLF:

$SSLF_{M2} = 1 + (Total_{kW-Loss-M2} \div kW_{M2})$

$SSLF_{M3} = 1 + (Total_{kW-Loss-M3} \div kW_{M3})$

$SSLF_{M4} = 1 + (Total_{kW-Loss-M4} \div kW_{M4})$

Adjusted Active Power:

$Adjusted_{kW-M2} = Total_{kW-Loss-M2} + kW_{M2}$

$Adjusted_{KW-M3} = Total_{kW-Loss-M3} + kW_{M3}$

$Adjusted_{kW-M4} = Total_{kW-Loss-M4} + kW_{M4}$

Maintenance or emergency on one of the transformers would close the Normally Open switch to deliver continuous power supply to the load of the transformer that went off. If Transformer 1 remains on-line while Transformer 2 is shutdown (figure 6):

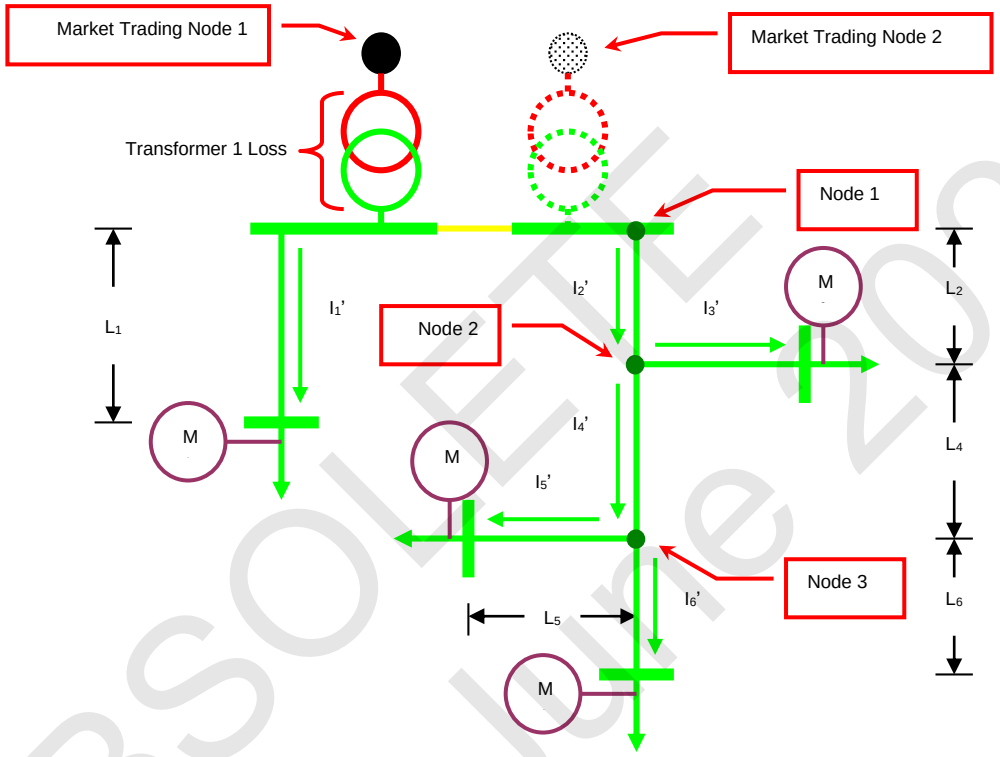


Figure 6

Active and Reactive Power:

kW_{M1} = ($kWh_{M1\text{-}15min}$ + $kWh_{M1\text{-}30min}$ + $kWh_{M1\text{-}45min}$ + $kWh_{M1\text{-}00min}$) ÷ 1h

$kVar_{M1}$ = ($kVarh_{M1\text{-}15min}$ + $kVarh_{M1\text{-}30min}$ + $kVarh_{M1\text{-}45min}$ + $kVarh_{M1\text{-}00min}$) ÷ 1h

kW_{M2} = ($kWh_{M2\text{-}15min}$ + $kWh_{M2\text{-}30min}$ + $kWh_{M2\text{-}45min}$ + $kWh_{M2\text{-}00min}$) ÷ 1h

$kVar_{M2}$ = ($kVarh_{M2\text{-}15min}$ + $kVarh_{M2\text{-}30min}$ + $kVarh_{M2\text{-}45min}$ + $kVarh_{M2\text{-}00min}$) ÷ 1h

kW_{M3} = ($kWh_{M3\text{-}15min}$ + $kWh_{M3\text{-}30min}$ + $kWh_{M3\text{-}45min}$ + $kWh_{M3\text{-}00min}$) ÷ 1h

$kVar_{M3}$ = ($kVarh_{M3\text{-}15min}$ + $kVarh_{M3\text{-}30min}$ + $kVarh_{M3\text{-}45min}$ + $kVarh_{M3\text{-}00min}$) ÷ 1h

kW_{M4} = ($kWh_{M4\text{-}15min}$ + $kWh_{M4\text{-}30min}$ + $kWh_{M4\text{-}45min}$ + $kWh_{M4\text{-}00min}$) ÷ 1h

$kVar_{M4}$ = ($kVarh_{M4\text{-}15min}$ + $kVarh_{M4\text{-}30min}$ + $kVarh_{M4\text{-}45min}$ + $kVarh_{M4\text{-}00min}$) ÷ 1h

Line Currents and Line Losses:

$I_1 = kW_{M1} \div ((\sqrt{3}) * V_1 * pf_1) = kW_{M1} \div ((\sqrt{3}) * V_1 * \cos(\tan^{-1}(kVar_{M1} \div kW_{M1})))$

$I_3 = kW_{M2} \div ((\sqrt{3}) * V_2 * pf_2) = kW_{M2} \div ((\sqrt{3}) * V_2 * \cos(\tan^{-1}(kVar_{M2} \div kW_{M2})))$

$I_5 = kW_{M3} \div ((\sqrt{3}) * V_3 * pf_3) = kW_{M3} \div ((\sqrt{3}) * V_3 * \cos(\tan^{-1}(kVar_{M3} \div kW_{M3})))$

$I_6 = kW_{M4} \div ((\sqrt{3}) * V_4 * pf_4) = kW_{M4} \div ((\sqrt{3}) * V_4 * \cos(\tan^{-1}(kVar_{M4} \div kW_{M4})))$

$Line_{5\text{-}kW\text{-}Loss} = (I_5)^2 * R_5 = (I_5)^2 * (r_{a\text{-}5} * L_5)$

$Line_{5\text{-}kVa\text{-}rLoss} = (I_5)^2 * X_5 = (I_5)^2 * (X_{l\text{-}5} * L_5)$

$Line_{6\text{-}kW\text{-}Loss} = (I_6)^2 * R_6 = (I_6)^2 * (r_{a\text{-}6} * L_6)$

$Line_{6\text{-}kVar\text{-}Loss} = (I_6)^2 * X_6 = (I_6)^2 * (X_{l\text{-}6} * L_6)$

Total Active Power at Node 3 ($kW_{N\text{-}3}$) = $kW_{M3} + kW_{M4} + Line_{5\text{-}kW\text{-}Loss} + Line_{6\text{-}kW\text{-}Loss}$

Total Reactive Power at Node 3 ($kVar_{N\text{-}3}$) = $kVar_{M3} + kVar_{M4} + Line_{5\text{-}kVar\text{-}Loss} + Line_{6\text{-}kVar\text{-}Loss}$

$I_4 = kW_{N\text{-}3} \div ((\sqrt{3}) * V_{N\text{-}3} * pf_{N\text{-}3}) = kW_{N\text{-}3} \div ((\sqrt{3}) * V_{N\text{-}3} * \cos(\tan^{-1}(kVar_{N\text{-}3} \div kW_{N\text{-}3})))$

$Line_{4\text{-}kW\text{-}Loss} = (I_4)^2 * R_4 = (I_4)^2 * (r_{a\text{-}4} * L_4)$

$Line_{4\text{-}kVar\text{-}Loss} = (I_4)^2 * X_4 = (I_4)^2 * (X_{l\text{-}4} * L_4)$

$Line_{3\text{-}kW\text{-}Loss} = (I_3)^2 * R_3 = (I_3)^2 * (r_{a\text{-}3} * L_3)$

$Line_{3\text{-}kVar\text{-}Loss} = (I_3)^2 * X_3 = (I_3)^2 * (X_{l\text{-}3} * L_3)$

Total Active Power at Node 2 ($kW_{N\text{-}2}$) = $kW_{M2} + kW_{M3} + kW_{M4} + Line_{3\text{-}kW\text{-}Loss} + Line_{4\text{-}kW\text{-}Loss} + Line_{5\text{-}kW\text{-}Loss} + Line_{6\text{-}kW\text{-}Loss}$

Total Reactive Power at Node 2 ($kVar_{N\text{-}2}$) = $kVar_{M2} + kVar_{M3} + kVar_{M4} + Line_{3\text{-}kVar\text{-}Loss} + Line_{4\text{-}kVar\text{-}Loss} + Line_{5\text{-}kVar\text{-}Loss} + Line_{6\text{-}kVar\text{-}Loss}$

$I_2 = kW_{N\text{-}2} \div ((\sqrt{3}) * V_{N\text{-}2} * pf_{N\text{-}2}) = kW_{N\text{-}2} \div ((\sqrt{3}) * V_{N\text{-}2} * \cos(\tan^{-1}(kVar_{N\text{-}2} \div kW_{N\text{-}2})))$

$Line_{2\text{-}kW\text{-}Loss} = (I_2)^2 * R_2 = (I_2)^2 * (r_{a\text{-}2} * L_2)$

$Line_{2\text{-}kVar\text{-}Loss} = (I_2)^2 * X_2 = (I_2)^2 * (X_{l\text{-}2} * L_2)$

$Line_{1\text{-}kW\text{-}Loss} = (I_1)^2 * R_2 = (I_1)^2 * (r_{a\text{-}2} * L_2)$

$Line_{1\text{-}kVar\text{-}Loss} = (I_1)^2 * X_2 = (I_1)^2 * (X_{l\text{-}2} * L_2)$

Distributing $Line_{4\text{-}kW\text{-}Loss}$

For M_3, $Line_{4\text{-}kW\text{-}Loss\text{-}M3} = (Line_{4\text{-}kW\text{-}Loss} * (kW_{M3} + Line_{5\text{-}kW\text{-}Loss})) \div kW_{N\text{-}3}$

For M_4, $Line_{4\text{-}kW\text{-}Loss\text{-}M4} = (Line_{4\text{-}kW\text{-}Loss} * (kW_{M4} + Line_{6\text{-}kW\text{-}Loss})) \div kW_{N\text{-}3}$

Distributing $Line_{2\text{-}kW\text{-}Loss}$

For M_2, $Line_{2\text{-}kW\text{-}Loss\text{-}M2} = (Line_{2\text{-}kW\text{-}Loss} * (kW_{M2} + Line_{3\text{-}kW\text{-}Loss})) \div kW_{N\text{-}2}$

For M_3, $Line_{2\text{-}kW\text{-}Loss\text{-}M3} = (Line_{2\text{-}kW\text{-}Loss} * (kW_{M3} + Line_{5\text{-}kW\text{-}Loss} + Line_{4\text{-}kW\text{-}LossM3})) \div kW_{N\text{-}2}$

For M_4, $Line_{2\text{-}kW\text{-}Loss\text{-}M4} = (Line_{2\text{-}kW\text{-}Loss} * (kW_{M4} + Line_{6\text{-}kW\text{-}Loss} + Line_{4\text{-}kW\text{-}LossM4})) \div kW_{N\text{-}2}$

Transformer Losses:

$T_1Core_{Loss\text{-}M1} = T_1Core_{Loss} * (kW_{M1} \div \sum_{i=1}^{n} kW_{Mi})$

$T_1Core_{Loss\text{-}M2} = T_1Core_{Loss} * (kW_{M2} \div \sum_{i=1}^{n} kW_{Mi})$

$T_1Core_{Loss\text{-}M3} = T_1Core_{Loss} * (kW_{M3} \div \sum_{i=1}^{n} kW_{Mi})$

$T_1Core_{Loss\text{-}M4} = T_1Core_{Loss} * (kW_{M4} \div \sum_{i=1}^{n} kW_{Mi})$

$T_1Copper_{Loss} = ((kW_{N\text{-}1}) \div pf_{N\text{-}1}) \div T_{1kVA\text{-}Rating})^2 * P_{Short\text{-}Circuit\text{-}T1}$

$T_1Copper_{Loss\text{-}M1} = T_1Copper_{Loss} * (kW_{M1} + Line_{1\text{-}kW\text{-}Loss}) \div kW_{N\text{-}1}$

$T_1Copper_{Loss\text{-}M2} = T_1Copper_{Loss} * (kW_{M2} + Line_{3\text{-}kW\text{-}Loss} + Line_{2\text{-}kW\text{-}Loss\text{-}M2}) \div kW_{N\text{-}1}$

$T_1Copper_{Loss\text{-}M3} = T_1Copper_{Loss} * (kW_{M3} + Line_{5\text{-}kW\text{-}Loss} + Line_{4\text{-}kW\text{-}Loss\text{-}M3} + Line_{2\text{-}kW\text{-}Loss\text{-}M3}) \div kW_{N\text{-}1}$

$T_1Copper_{Loss\text{-}M4} = T_1Copper_{Loss} * (kW_{M4} + Line_{6\text{-}kW\text{-}Loss} + Line_{4\text{-}kW\text{-}Loss\text{-}M4} + Line_{2\text{-}kW\text{-}Loss\text{-}M4}) \div kW_{N\text{-}1}$

Total Active Loss for each Meter:

$Total_{kW\text{-}Loss\text{-}M1} = Line_{1\text{-}kW\text{-}Loss} + T_1Core_{Loss\text{-}M1} + T_1Copper_{Loss\text{-}M1}$

$Total_{kW\text{-}Loss\text{-}M2} = Line_{3\text{-}kW\text{-}Loss} + Line_{2\text{-}kWLoss\text{-}M2} + T_1Core_{Loss\text{-}M2} + T_1Copper_{Loss\text{-}M2}$

$Total_{kW\text{-}Loss\text{-}M3} = Line_{5\text{-}kW\text{-}Loss} + Line_{4\text{-}kW\text{-}Loss\text{-}M3} + Line_{2\text{-}kW\text{-}Loss\text{-}M3} + T_1Core_{Loss\text{-}M3} + T_1Copper_{Loss\text{-}M3}$

$Total_{kW\text{-}Loss\text{-}M4} = Line_{6\text{-}kW\text{-}Loss} + Line_{4\text{-}kW\text{-}Loss\text{-}M4} + Line_{2\text{-}kW\text{-}Loss\text{-}M4} + T_1Core_{Loss\text{-}M4} + T_1Copper_{Loss\text{-}M4}$

SSLF:

$SSLF_{M1} = 1 + (Total_{kW\text{-}Loss\text{-}M1} \div kW_{M1})$

$SSLF_{M2} = 1 + (Total_{kW\text{-}Loss\text{-}M2} \div kW_{M2})$

$SSLF_{M3} = 1 + (Total_{kW\text{-}Loss\text{-}M3} \div kW_{M3})$

$SSLF_{M4}$ = 1 + ($Total_{kW\text{-}Loss\text{-}M4}$ ÷ kW_{M4})

Adjusted Active Power:

$Adjusted_{kW\text{-}M1}$ = $Total_{kW\text{-}Loss\text{-}M1}$ + kW_{M1}

$Adjusted_{kW\text{-}M2}$ = $Total_{kW\text{-}Loss\text{-}M2}$ + kW_{M2}

$Adjusted_{KW\text{-}M3}$ = $Total_{kW\text{-}Loss\text{-}M3}$ + kW_{M3}

$Adjusted_{kW\text{-}M4}$ = $Total_{kW\text{-}Loss\text{-}M4}$ + kW_{M4}

If Transformer 1 is shutdown while Transformer 2 remains on-line (figure 7), the manner of computation is the same, only, it is the core loss and full-load copper loss of Transformer 2 that would be distributed.

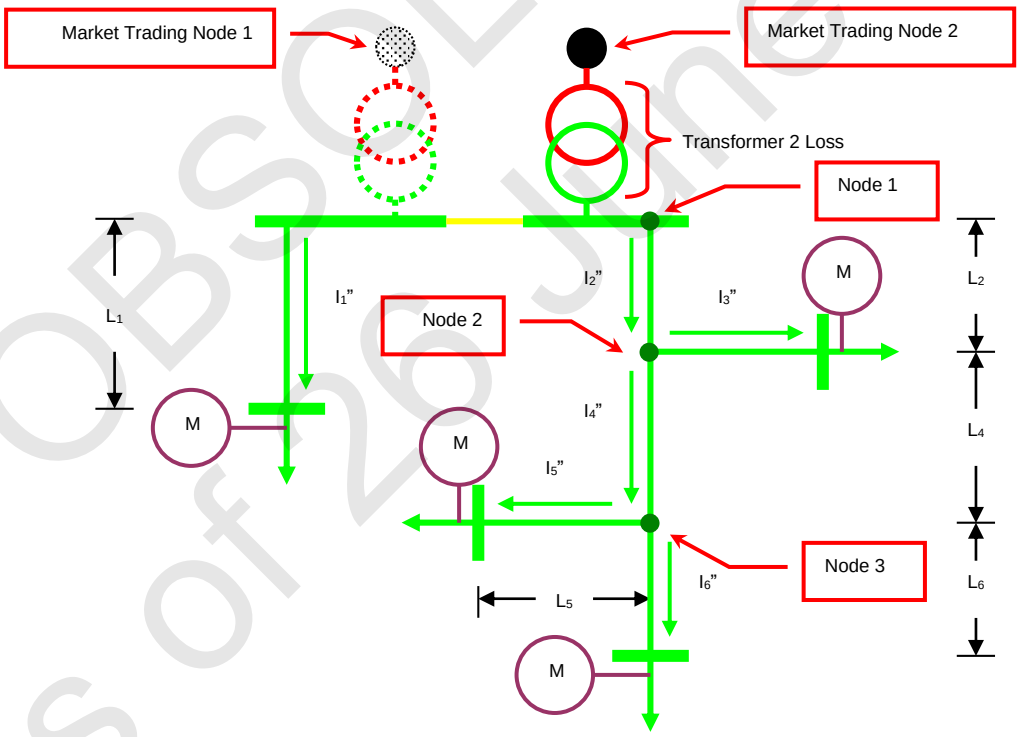


Figure 7

b. Case 3 – B: a metering point is connected to another line for alternate source of power during emergency or pre-arranged shutdown. This is the usual setting for alternate source of power from another substation (figure 8).

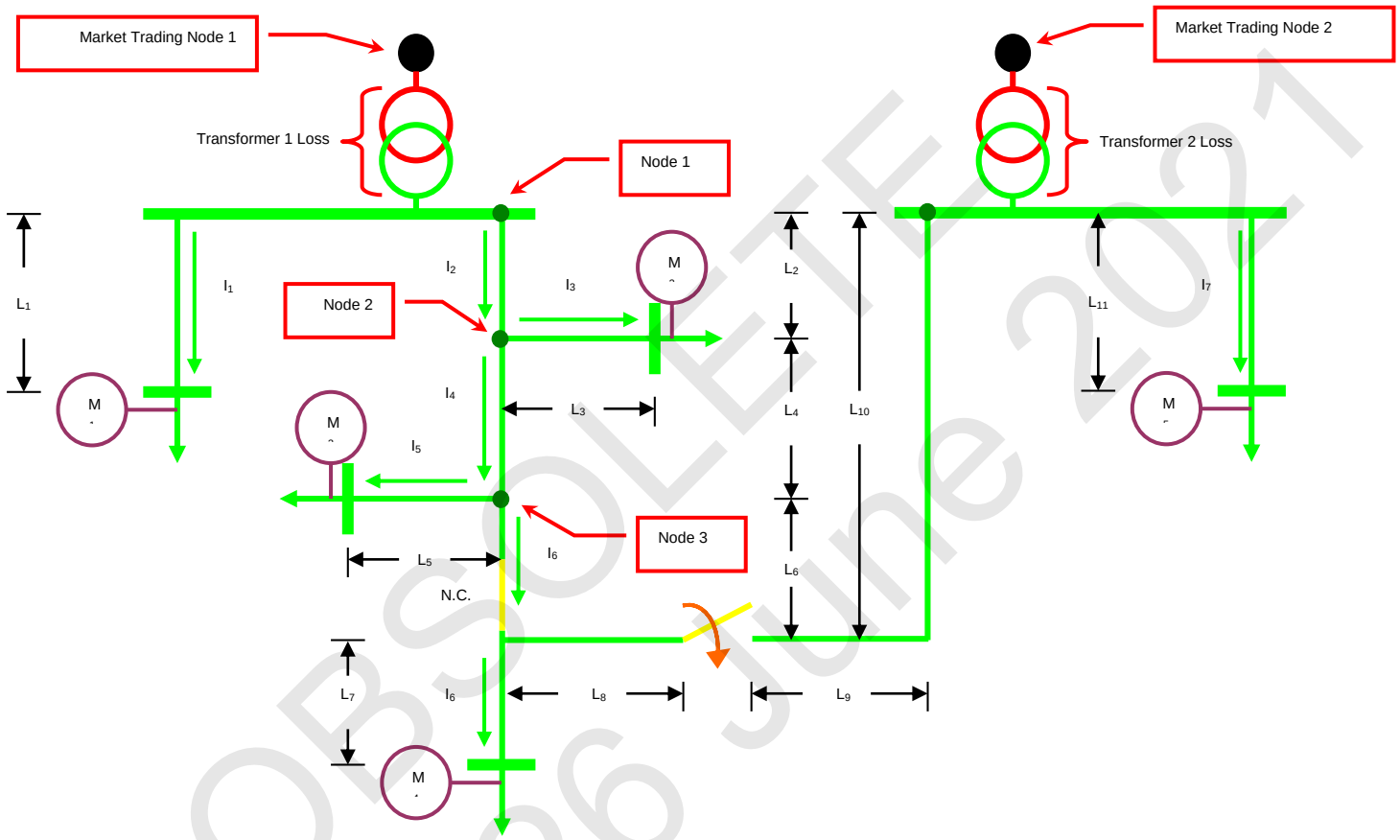


Figure 8

At normal condition (figure 8), SSLF of the meters connected to each MTN can be computed separately treated the same as in Case 1 – A (for T_2) and Case 1 – B (for T_1).

At Normal Condition for T_1:

Active and Reactive Power:

kW_{M1} = $(kWh_{M1\text{-}15min} + kWh_{M1\text{-}30min} + kWh_{M1\text{-}45min} + kWh_{M1\text{-}00min}) \div 1h$

$kVar_{M1}$ = $(kVarh_{M1\text{-}15min} + kVarh_{M1\text{-}30min} + kVarh_{M1\text{-}45min} + kVarh_{M1\text{-}00min}) \div 1h$

kW_{M2} = $(kWh_{M2\text{-}15min} + kWh_{M2\text{-}30min} + kWh_{M2\text{-}45min} + kWh_{M2\text{-}00min}) \div 1h$

$kVar_{M2}$ = $(kVarh_{M2\text{-}15min} + kVarh_{M2\text{-}30min} + kVarh_{M2\text{-}45min} + kVarh_{M2\text{-}00min}) \div 1h$

kW_{M3} = $(kWh_{M3\text{-}15min} + kWh_{M3\text{-}30min} + kWh_{M3\text{-}45min} + kWh_{M3\text{-}00min}) \div 1h$

$kVar_{M3}$ = $(kVarh_{M3\text{-}15min} + kVarh_{M3\text{-}30min} + kVarh_{M3\text{-}45min} + kVarh_{M3\text{-}00min}) \div 1h$

kW_{M4} = $(kWh_{M4\text{-}15min} + kWh_{M4\text{-}30min} + kWh_{M4\text{-}45min} + kWh_{M4\text{-}00min}) \div 1h$

$kVar_{M4}$ = $(kVarh_{M4\text{-}15min} + kVarh_{M4\text{-}30min} + kVarh_{M4\text{-}45min} + kVarh_{M4\text{-}00min}) \div 1h$

Line Currents and Line Losses:

I_1 = $kW_{M1} \div ((\sqrt{3}) * V_1 * pf_1)$ = $kW_{M1} \div ((\sqrt{3}) * V_1 * \cos(\tan^{-1}(kVar_{M1} \div kW_{M1})))$

I_3 = $kW_{M2} \div ((\sqrt{3}) * V_2 * pf_2)$ = $kW_{M2} \div ((\sqrt{3}) * V_2 * \cos(\tan^{-1}(kVar_{M2} \div kW_{M2})))$

I_5 = $kW_{M3} \div ((\sqrt{3}) * V_3 * pf_3)$ = $kW_{M3} \div ((\sqrt{3}) * V_3 * \cos(\tan^{-1}(kVar_{M3} \div kW_{M3})))$

I_6 = $kW_{M4} \div ((\sqrt{3}) * V_4 * pf_4)$ = $kW_{M4} \div ((\sqrt{3}) * V_4 * \cos(\tan^{-1}(kVar_{M4} \div kW_{M4})))$

$Line_{5\text{-}kW\text{-}Loss}$ = $(I_5)^2 * R_5$ = $(I_5)^2 * (r_{a\text{-}5} * L_5)$

$Line_{5\text{-}kVar\text{-}Loss}$ = $(I_5)^2 * X_5$ = $(I_5)^2 * (X_{l\text{-}5} * L_5)$

$Line_{6\text{-}kW\text{-}Loss}$ = $(I_6)^2 * R_6$ = $(I_6)^2 * (r_{a\text{-}6} * L_6)$

$Line_{6\text{-}kVar\text{-}Loss}$ = $(I_6)^2 * X_6$ = $(I_6)^2 * (X_{l\text{-}6} * L_6)$

$Line_{7\text{-}kW\text{-}Loss}$ = $(I_6)^2 * R_7$ = $(I_6)^2 * (r_{a\text{-}7} * L_7)$

$Line_{7\text{-}kVar\text{-}Loss}$ = $(I_6)^2 * X_7$ = $(I_6)^2 * (X_{l\text{-}7} * L_7)$

Total Active Power at Node 3 ($kW_{N\text{-}3}$) = $kW_{M3} + kW_{M4} + Line_{5\text{-}kW\text{-}Loss} + Line_{6\text{-}kW\text{-}Loss} + Line_{7\text{-}kW\text{-}Loss}$

Total Reactive Power at Node 3 ($kVar_{N\text{-}3}$) = $kVar_{M3} + kVar_{M4} + Line_{5\text{-}kVar\text{-}Loss} + Line_{6\text{-}kVar\text{-}Loss} + Line_{7\text{-}kVar\text{-}Loss}$

$I_4 = kW_{N\text{-}3} \div ((\sqrt{3}) * V_{N\text{-}3} * pf_{N\text{-}3})$ = $kW_{N\text{-}3} \div ((\sqrt{3}) * V_{N\text{-}3} * \cos(\tan^{-1}(kVar_{N\text{-}3} \div kW_{N\text{-}3})))$

$Line_{4\text{-}kW\text{-}Loss}$ = $(I_4)^2 * R_4$ = $(I_4)^2 * (r_{a\text{-}4} * L_4)$

$Line_{4\text{-}kVar\text{-}Loss}$ = $(I_4)^2 * X_4$ = $(I_4)^2 * (X_{l\text{-}4} * L_4)$

$Line_{3\text{-}kW\text{-}Loss}$ = $(I_3)^2 * R_3$ = $(I_3)^2 * (r_{a\text{-}3} * L_3)$

$Line_{3\text{-}kVar\text{-}Loss}$ = $(I_3)^2 * X_3$ = $(I_3)^2 * (X_{l\text{-}3} * L_3)$

Total Active Power at Node 2 ($kW_{N\text{-}2}$) = $kW_{M2} + kW_{M3} + kW_{M4} + Line_{3\text{-}kW\text{-}Loss} + Line_{4\text{-}kW\text{-}Loss} + Line_{5\text{-}kW\text{-}Loss} + Line_{6\text{-}kW\text{-}Loss} + Line_{7\text{-}kW\text{-}Loss}$

Total Reactive Power at Node 2 ($kVar_{N\text{-}2}$) = $kVar_{M2} + kVar_{M3} + kVar_{M4} + Line_{3\text{-}kVar\text{-}Loss} + Line_{4\text{-}kVar\text{-}Loss} + Line_{5\text{-}kVar\text{-}Loss} + Line_{6\text{-}kVar\text{-}Loss} + Line_{7\text{-}kVar\text{-}Loss}$

$I_2 = kW_{N\text{-}2} \div ((\sqrt{3}) * V_{N\text{-}2} * pf_{N\text{-}2})$ = $kW_{N\text{-}2} \div ((\sqrt{3}) * V_{N\text{-}2} * \cos(\tan^{-1}(kVar_{N\text{-}2} \div kW_{N\text{-}2})))$

$Line_{2\text{-}kW\text{-}Loss} = (I_2)^2 * R_2 = (I_2)^2 * (r_{a\text{-}2} * L_2)$

$Line_{2\text{-}kVar\text{-}Loss} = (I_2)^2 * X_2 = (I_2)^2 * (X_{l\text{-}2} * L_2)$

$Line_{1\text{-}kW\text{-}Loss} = (I_1)^2 * R_2 = (I_1)^2 * (r_{a\text{-}2} * L_2)$

$Line_{1\text{-}kVar\text{-}Loss} = (I_1)^2 * X_2 = (I_1)^2 * (X_{l\text{-}2} * L_2)$

Distributing $Line_{4\text{-}kW\text{-}Loss}$

For M_3, $Line_{4\text{-}kW\text{-}Loss\text{-}M3} = (Line_{4\text{-}kW\text{-}Loss} * (kW_{M3} + Line_{5\text{-}kW\text{-}Loss})) \div kW_{N\text{-}3}$

For M_4, $Line_{4\text{-}kW\text{-}Loss\text{-}M4} = (Line_{4\text{-}kW\text{-}Loss} * (kW_{M4} + Line_{6\text{-}kW\text{-}Loss} + Line_{7\text{-}kW\text{-}Loss})) \div kW_{N\text{-}3}$

Distributing $Line_{2\text{-}kW\text{-}Loss}$

For M_2, $Line_{2\text{-}kW\text{-}Loss\text{-}M2} = (Line_{2\text{-}kW\text{-}Loss} * (kW_{M2} + Line_{3\text{-}kW\text{-}Loss})) \div kW_{N\text{-}2}$

For M_3, $Line_{2\text{-}kW\text{-}Loss\text{-}M3} = (Line_{2\text{-}kW\text{-}Loss} * (kW_{M3} + Line_{5\text{-}kW\text{-}Loss} + Line_{4\text{-}kW\text{-}Loss\text{-}M3})) \div kW_{N\text{-}2}$

For M_4, $Line_{2\text{-}kW\text{-}Loss\text{-}M4} = (Line_{2\text{-}kW\text{-}Loss} * (kW_{M4} + Line_{6\text{-}kW\text{-}Loss} + Line_{7\text{-}kW\text{-}Loss} + Line_{4\text{-}kW\text{-}Loss\text{-}M4})) \div kW_{N\text{-}2}$

Transformer Losses:

$T_1Core_{Loss\text{-}M1} = T_1Core_{Loss} * (kW_{M1} \div \sum_{i=1}^{n} kW_{Mi})$

$T_1Core_{Loss\text{-}M2} = T_1Core_{Loss} * (kW_{M2} \div \sum_{i=1}^{n} kW_{Mi})$

$T_1Core_{Loss\text{-}M3} = T_1Core_{Loss} * (kW_{M3} \div \sum_{i=1}^{n} kW_{Mi})$

$T_1Core_{Loss\text{-}M4} = T_1Core_{Loss} * (kW_{M4} \div \sum_{i=1}^{n} kW_{Mi})$

$T_1Copper_{Loss} = (((kW_{N\text{-}1} \div 2) \div pf_{N\text{-}1}) \div T_{1kVA\text{-}Rating})^2 * P_{Short\text{-}Circuit\text{-}T1}$

$T_1Copper_{Loss\text{-}M1} = T_1Copper_{Loss} * (kW_{M1} + Line_{1\text{-}kW\text{-}Loss}) \div kW_{N\text{-}1}$

$T_1Copper_{Loss\text{-}M2} = T_1Copper_{Loss} * (kW_{M2} + Line_{3\text{-}kW\text{-}Loss} + Line_{2\text{-}kW\text{-}Loss\text{-}M2}) \div kW_{N\text{-}1}$

$T_1Copper_{Loss\text{-}M3} = T_1Copper_{Loss} * (kW_{M3} + Line_{5\text{-}kW\text{-}Loss} + Line_{4\text{-}kW\text{-}Loss\text{-}M3} + Line_{2\text{-}kW\text{-}Loss\text{-}M3}) \div kW_{N\text{-}1}$

$T_1Copper_{Loss\text{-}M4} = T_1Copper_{Loss} * (kW_{M4} + Line_{6\text{-}kW\text{-}Loss} + Line_{7\text{-}kW\text{-}Loss} + Line_{4\text{-}kW\text{-}Loss\text{-}M4} + Line_{2\text{-}kW\text{-}Loss\text{-}M4}) \div kW_{N\text{-}1}$

Total Loss for each Meter:

$Total_{kW\text{-}Loss\text{-}M1} = Line_{1\text{-}kW\text{-}Loss} + T_1Core_{Loss\text{-}M1} + T_1Copper_{Loss\text{-}M1}$

$Total_{kW\text{-}Loss\text{-}M2} = Line_{3\text{-}kW\text{-}Loss} + Line_{2\text{-}kWLoss\text{-}M2} + T_1Core_{Loss\text{-}M2} + T_1Copper_{Loss\text{-}M2}$

$Total_{kW\text{-}Loss\text{-}M3} = Line_{5\text{-}kW\text{-}Loss} + Line_{4\text{-}kW\text{-}Loss\text{-}M3} + Line_{2\text{-}kW\text{-}Loss\text{-}M3} + T_1Core_{Loss\text{-}M3} + T_1Copper_{Loss\text{-}M3}$

$Total_{kW\text{-}Loss\text{-}M4} = Line_{6\text{-}kW\text{-}Loss} + Line_{7\text{-}kW\text{-}Loss} + Line_{4\text{-}kW\text{-}Loss\text{-}M4} + Line_{2\text{-}kW\text{-}Loss\text{-}M4} + T_1Core_{Loss\text{-}M4} + T_1Copper_{Loss\text{-}M4}$

SSLF

$SSLF_{M1} = 1 + (Total_{kW\text{-}Loss\text{-}M1} \div kW_{M1})$

$SSLF_{M2} = 1 + (Total_{kW\text{-}Loss\text{-}M2} \div kW_{M2})$

$SSLF_{M3} = 1 + (Total_{kW\text{-}Loss\text{-}M3} \div kW_{M3})$

$SSLF_{M4} = 1 + (Total_{kW\text{-}Loss\text{-}M4} \div kW_{M4})$

Adjusted Active Power:

$Adjusted_{kW\text{-}M1} = Total_{kW\text{-}Loss\text{-}M1} + kW_{M1}$

$Adjusted_{kW\text{-}M2} = Total_{kW\text{-}Loss\text{-}M2} + kW_{M2}$

$Adjusted_{KW\text{-}M3} = Total_{kW\text{-}Loss\text{-}M3} + kW_{M3}$

$Adjusted_{kW\text{-}M4} = Total_{kW\text{-}Loss\text{-}M4} + kW_{M4}$

At Normal Condition for T_2:

Active and Reactive Power:

$kW_{M5} = (kWh_{M5\text{-}15min} + kWh_{M5\text{-}30min} + kWh_{M5\text{-}45min} + kWh_{M5\text{-}00min}) \div 1h$

$kVar_{M5} = (kVarh_{M5\text{-}15min} + kVarh_{M5\text{-}30min} + kVarh_{M5\text{-}45min} + kVarh_{M5\text{-}00min}) \div 1h$

Line Current and Line Loss

$I_7 = kW_{M5} \div ((\sqrt{3}) * V_5 * pf_5)$

$Line_{11\text{-}kW\text{-}Loss} = (I_7)^2 * R_{11} = (I_7)^2 * (r_{a\text{-}11} * L_{11})$

Transformer Losses

$T_2Core_{Loss\text{-}M5} = T_2Core_{Loss} \div 1$

$T_2Copper_{Loss\text{-}M5} = ((kW_{M5} \div pf_5) \div T_{2kVA\text{-}Rating})^2 * P_{Short\text{-}Circuit\text{-}T2}$

Total Active Loss for the Meter

$Total_{kW\text{-}Loss\text{-}M5} = Line_{11\text{-}kW\text{-}Loss} + T_2Core_{Loss} + T_2Copper_{Loss\text{-}M5}$

SSLF

$SSLF_{M5} = 1 + (Total_{kW\text{-}Loss\text{-}M5} \div kW_{M5})$

Adjusted Active Power:

$Adjusted_{kW\text{-}M5} = Total_{kW\text{-}Loss\text{-}M5} + kW_{M5}$

Maintenance or emergency on the line would close the Normally Open switch to deliver continuous power supply to the load of the line that went off. If Transformer 1 remains on-line while Transformer 2 is shutdown (figure 9):

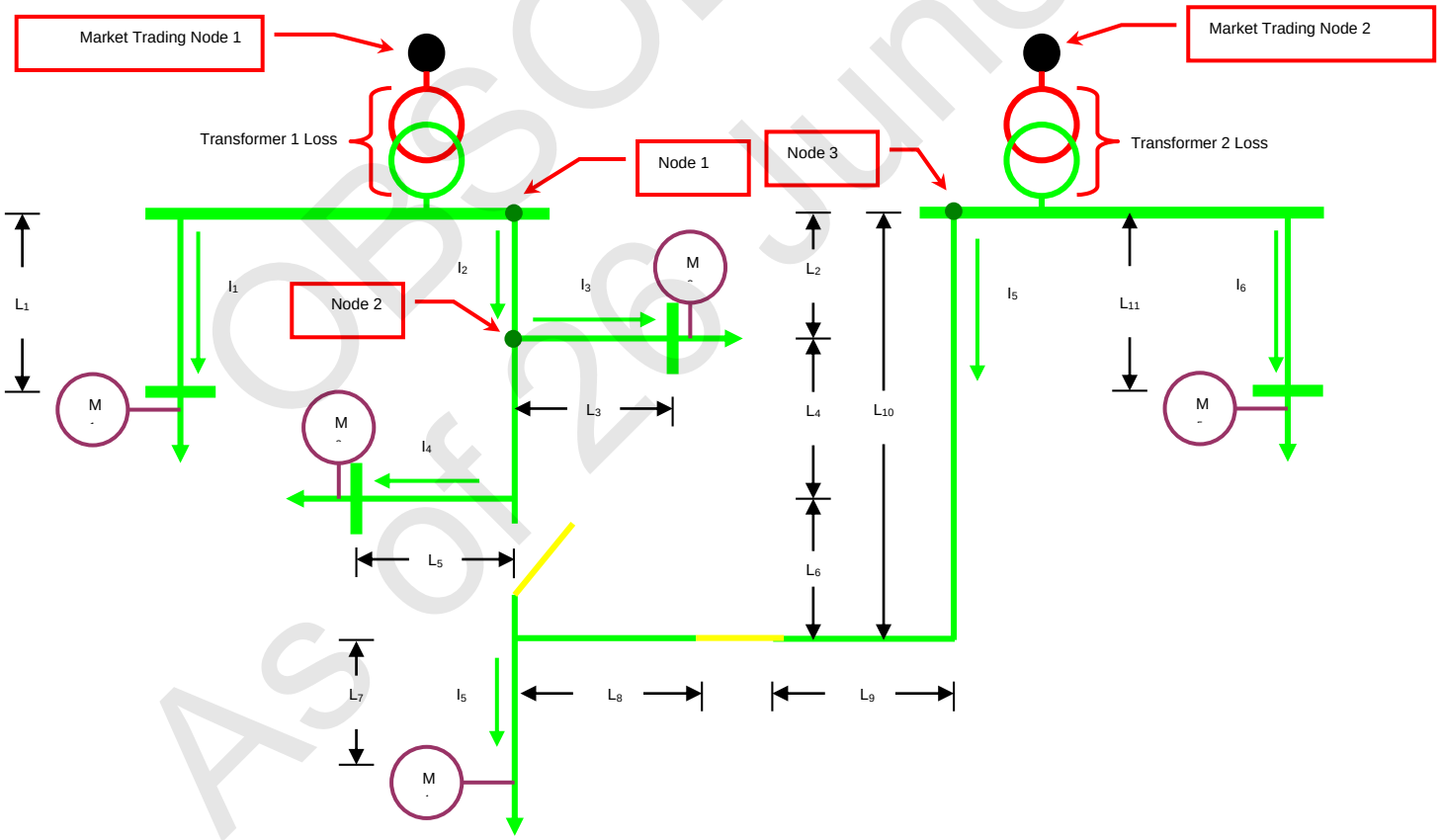


Figure 9

Active and Reactive Power:

kW_{M1} = $(kWh_{M1\text{-}15min} + kWh_{M1\text{-}30min} + kWh_{M1\text{-}45min} + kWh_{M1\text{-}00min}) \div 1h$

$kVar_{M1}$ = $(kVarh_{M1\text{-}15min} + kVarh_{M1\text{-}30min} + kVarh_{M1\text{-}45min} + kVarh_{M1\text{-}00min}) \div 1h$

kW_{M2} = $(kWh_{M2\text{-}15min} + kWh_{M2\text{-}30min} + kWh_{M2\text{-}45min} + kWh_{M2\text{-}00min}) \div 1h$

$kVar_{M2}$ = $(kVarh_{M2\text{-}15min} + kVarh_{M2\text{-}30min} + kVarh_{M2\text{-}45min} + kVarh_{M2\text{-}00min}) \div 1h$

kW_{M3} = $(kWh_{M3\text{-}15min} + kWh_{M3\text{-}30min} + kWh_{M3\text{-}45min} + kWh_{M3\text{-}00min}) \div 1h$

$kVar_{M3}$ = $(kVarh_{M3\text{-}15min} + kVarh_{M3\text{-}30min} + kVarh_{M3\text{-}45min} + kVarh_{M3\text{-}00min}) \div 1h$

kW_{M4} = $(kWh_{M4\text{-}15min} + kWh_{M4\text{-}30min} + kWh_{M4\text{-}45min} + kWh_{M4\text{-}00min}) \div 1h$

$kVar_{M4}$ = $(kVarh_{M4\text{-}15min} + kVarh_{M4\text{-}30min} + kVarh_{M4\text{-}45min} + kVarh_{M4\text{-}00min}) \div 1h$

kW_{M5} = $(kWh_{M5\text{-}15min} + kWh_{M5\text{-}30min} + kWh_{M5\text{-}45min} + kWh_{M5\text{-}00min}) \div 1h$

$kVar_{M5}$ = $(kVarh_{M5\text{-}15min} + kVarh_{M5\text{-}30min} + kVarh_{M5\text{-}45min} + kVarh_{M5\text{-}00min}) \div 1h$

Line Currents and Line Losses:

$I_1 = kW_{M1} \div ((\sqrt{3}) * V_1 * pf_1)$ = $kW_{M1} \div ((\sqrt{3}) * V_1 * \cos(\tan^{-1}(kVar_{M1} \div kW_{M1})))$

$I_3 = kW_{M2} \div ((\sqrt{3}) * V_2 * pf_2)$ = $kW_{M2} \div ((\sqrt{3}) * V_2 * \cos(\tan^{-1}(kVar_{M2} \div kW_{M2})))$

$I_4 = kW_{M3} \div ((\sqrt{3}) * V_5 * pf_3)$ = $kW_{M3} \div ((\sqrt{3}) * V_5 * \cos(\tan^{-1}(kVar_{M3} \div kW_{M3})))$

$Line_{5\text{-}kW\text{-}Loss}$ = $(I_4)^2 * R_5$ = $(I_4)^2 * (r_{a\text{-}5} * L_5)$

$Line_{5\text{-}kVar\text{-}Loss}$ = $(I_4)^2 * X_5$ = $(I_4)^2 * (X_{l\text{-}5} * L_5)$

$Line_{4\text{-}kW\text{-}Loss}$ = $(I_4)^2 * R_4$ = $(I_4)^2 * (r_{a\text{-}4} * L_4)$

$Line_{4\text{-}kVar\text{-}Loss}$ = $(I_4)^2 * X_4$ = $(I_4)^2 * (X_{l\text{-}4} * L_4)$

$Line_{3\text{-}kW\text{-}Loss}$ = $(I_3)^2 * R_3$ = $(I_3)^2 * (r_{a\text{-}3} * L_3)$

$Line_{3\text{-}kVar\text{-}Loss}$ = $(I_3)^2 * X_3$ = $(I_3)^2 * (X_{l\text{-}3} * L_3)$

Total Active Power at Node 2 ($kW_{N\text{-}2}$) = $kW_{M2} + kW_{M3} + Line_{3\text{-}kW\text{-}Loss} + Line_{4\text{-}kW\text{-}Loss} + Line_{5\text{-}kW\text{-}Loss}$

Total Reactive Power at Node 2 ($kVar_{N\text{-}2}$) = $kVar_{M2} + kVar_{M3} + Line_{3\text{-}kVar\text{-}Loss} + Line_{4\text{-}kVar\text{-}Loss} + Line_{5\text{-}kVar\text{-}Loss}$

I_2 = $kW_{N\text{-}2} \div ((\sqrt{3}) * V_{N\text{-}2} * pf_{N\text{-}2})$ = $kW_{N\text{-}2} \div ((\sqrt{3}) * V_{N\text{-}2} * \cos(\tan^{-1}(kVar_{N\text{-}2} \div kW_{N\text{-}2})))$

$Line_{2\text{-}kW\text{-}Loss}$ = $(I_2)^2 * R_2$ = $(I_2)^2 * (r_{a\text{-}2} * L_2)$

$Line_{2\text{-}kVar\text{-}Loss}$ = $(I_2)^2 * X_2$ = $(I_2)^2 * (X_{l\text{-}2} * L_2)$

$Line_{1\text{-}kW\text{-}Loss} = (I_1)^2 * R_1 = (I_1)^2 * (r_{a\text{-}1} * L_1)$

$Line_{1\text{-}kVar\text{-}Loss} = (I_1)^2 * X_1 = (I_1)^2 * (X_{l\text{-}1} * L_1)$

$I_5 = kW_{M4} \div ((\sqrt{3}) * V_7 * pf_4) = kW_{M4} \div ((\sqrt{3}) * V_7 * \cos(\tan^{-1}(kVar_{M4} \div kW_{M4})))$

$Line_{7\text{-}kW\text{-}Loss} = (I_5)^2 * R_7 = (I_5)^2 * (r_{a\text{-}7} * L_7)$

$Line_{7\text{-}kVar\text{-}Loss} = (I_5)^2 * X_7 = (I_5)^2 * (X_{l\text{-}7} * L_7)$

$Line_{8\text{-}kW\text{-}Loss} = (I_5)^2 * R_8 = (I_5)^2 * (r_{a\text{-}8} * L_8)$

$Line_{8\text{-}kVar\text{-}Loss} = (I_5)^2 * X_8 = (I_5)^2 * (X_{l\text{-}8} * L_8)$

$Line_{9\text{-}kW\text{-}Loss} = (I_5)^2 * R_9 = (I_5)^2 * (r_{a\text{-}9} * L_9)$

$Line_{9\text{-}kVar\text{-}Loss} = (I_5)^2 * X_9 = (I_5)^2 * (X_{l\text{-}9} * L_9)$

$Line_{10\text{-}kW\text{-}Loss} = (I_5)^2 * R_{10} = (I_5)^2 * (r_{a\text{-}10} * L_{10})$

$Line_{10\text{-}kVar\text{-}Loss} = (I_5)^2 * X_{10} = (I_5)^2 * (X_{l\text{-}10} * L_{10})$

$I_6 = kW_{M5} \div ((\sqrt{3}) * V_{11} * pf_5) = kW_{M5} \div ((\sqrt{3}) * V_{11} * \cos(\tan^{-1}(kVar_{M5} \div kW_{M5})))$

$Line_{11\text{-}kW\text{-}Loss} = (I_6)^2 * R_{11} = (I_6)^2 * (r_{a\text{-}11} * L_{11})$

$Line_{11\text{-}kVar\text{-}Loss} = (I_6)^2 * X_{11} = (I_6)^2 * (x_{l\text{-}11} * L_{11})$

Distributing $Line_{2\text{-}kW\text{-}Loss}$

For M_3, $Line_{2\text{-}kW\text{-}Loss\text{-}M3} = (Line_{2\text{-}kW\text{-}Loss} * (kW_{M3} + Line_{4\text{-}kW\text{-}Loss} + Line_{5\text{-}kW\text{-}Loss})) \div kW_{N\text{-}4}$

For M_2, $Line_{2\text{-}kW\text{-}Loss\text{-}M2} = (Line_{2\text{-}kW\text{-}Loss} * (kW_{M2} + Line_{3\text{-}kWLoss})) \div kW_{N\text{-}4}$

Transformer Losses:

$T_1Core_{Loss\text{-}M1} = T_1Core_{Loss} * (kW_{M1} \div \sum_{i=1}^{n} kW_{Mi})$

$T_1Core_{Loss\text{-}M2} = T_1Core_{Loss} * (kW_{M2} \div \sum_{i=1}^{n} kW_{Mi})$

$T_1Core_{Loss\text{-}M3} = T_1Core_{Loss} * (kW_{M3} \div \sum_{i=1}^{n} kW_{Mi})$

$T_1Copper_{Loss} = ((kW_{N\text{-}1} \div pf_{N\text{-}1}) \div T_{1kVA\text{-}Rating})^2 * P_{Short\text{-}Circuit\text{-}T1}$

$T_1Copper_{Loss\text{-}M1} = T_1Copper_{Loss} * (kW_{M1} + Line_{1\text{-}kW\text{-}Loss}) \div kW_{N\text{-}1}$

$T_1Copper_{Loss\text{-}M2} = T_1Copper_{Loss} * (kW_{M2} + Line_{3\text{-}kW\text{-}Loss} + Line_{2\text{-}kW\text{-}Loss\text{-}M2}) \div kW_{N\text{-}1}$

$T_1Copper_{Loss\text{-}M3} = T_1Copper_{Loss} * (kW_{M3} + Line_{5\text{-}kW\text{-}Loss} + Line_{4\text{-}kW\text{-}Loss} + Line_{2\text{-}kW\text{-}Loss\text{-}M3}) \div kW_{N\text{-}1}$

$T_2Core_{Loss\text{-}M4} = T_2Core_{Loss} * (kW_{M4} \div \sum_{i=1}^{n} kW_{Mi})$

$T_2Core_{Loss\text{-}M5} = T_2Core_{Loss} * (kW_{M5} \div \sum_{i=1}^{n} kW_{Mi})$

$T_2Copper_{Loss} = ((kW_{N\text{-}3} \div pf_{N\text{-}3}) \div T_{2kVA\text{-}Rating}))^2 * P_{Short\text{-}Circuit\text{-}T2}$

$T_2Copper_{Loss\text{-}M5} = T_2Copper_{Loss} * (kW_{M5} + Line_{11\text{-}kW\text{-}Loss}) \div kW_{N\text{-}3}$

$T_2Copper_{Loss\text{-}M4} = T_2Copper_{Loss} * (kW_{M4} + Line_{7\text{-}kW\text{-}Loss} + Line_{8\text{-}kW\text{-}Loss} + Line_{9\text{-}kW\text{-}Loss} + Line_{10\text{-}kW\text{-}Loss}) \div kW_{N\text{-}3}$

Total Active Loss for each Meter:

$Total_{Loss\text{-}M1} = Line_{1\text{-}Loss} + T_1Core_{Loss\text{-}M1} + T_1Copper_{Loss\text{-}M1}$

$Total_{Loss\text{-}M2} = Line_{3\text{-}Loss} + Line_{2\text{-}Loss\text{-}M2} + T_1Core_{Loss\text{-}M2} + T_1Copper_{Loss\text{-}M2}$

$Total_{Loss\text{-}M3} = Line_{4\text{-}Loss} + Line_{5\text{-}Loss} + Line_{2\text{-}Loss\text{-}M3} + T_1Core_{Loss\text{-}M3} + T_1Copper_{Loss\text{-}M3}$

$Total_{Loss\text{-}M4} = Line_{7\text{-}Loss} + Line_{8\text{-}Loss} + Line_{9\text{-}Loss} + Line_{10\text{-}Loss} + T_2Core_{Loss\text{-}M4} + T_2Copper_{Loss\text{-}M4}$

$Total_{Loss\text{-}M5} = Line_{11\text{-}Loss} + T_2Core_{Loss\text{-}M5} + T_2Copper_{Loss\text{-}M5}$

SSLF

$SSLF_{M1} = 1 + (Total_{kW\text{-}Loss\text{-}M1} \div kW_{M1})$

$SSLF_{M2} = 1 + (Total_{kW\text{-}Loss\text{-}M2} \div kW_{M2})$

$SSLF_{M3} = 1 + (Total_{kW\text{-}Loss\text{-}M3} \div kW_{M3})$

$SSLF_{M4} = 1 + (Total_{kW\text{-}Loss\text{-}M4} \div kW_{M4})$

$SSLF_{M5} = 1 + (Total_{kWLoss\text{-}M5} \div kW_{M5})$

Adjusted Active Power:

$Adjusted_{kW\text{-}M1} = Total_{kW\text{-}Loss\text{-}M1} + kW_{M1}$

$Adjusted_{kW\text{-}M2} = Total_{kW\text{-}Loss\text{-}M2} + kW_{M2}$

$Adjusted_{kW\text{-}M3} = Total_{kW\text{-}Loss\text{-}M3} + kW_{M3}$

$Adjusted_{kW\text{-}M4} = Total_{kW\text{-}Loss\text{-}M4} + kW_{M4}$

$Adjusted_{kW\text{-}M5} = Total_{kW\text{-}Loss\text{-}M5} + kW_{M5}$

Case 4: Lagging MTN: A metering point is located before the MTN. The meter is installed at a voltage level higher or equal to the voltage level of the MTN (figure 10).

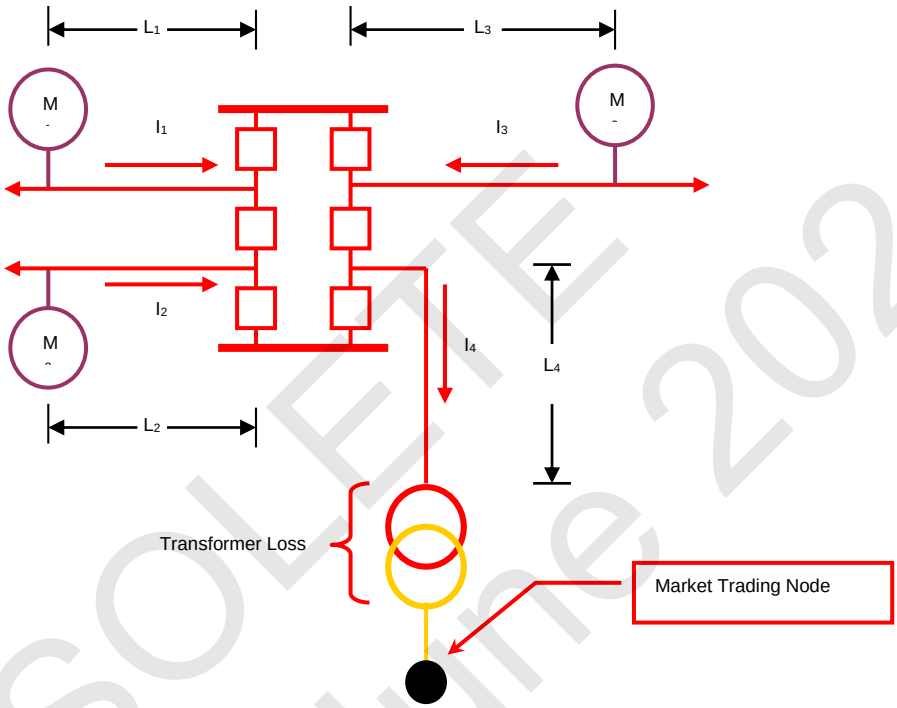


Figure 10

Simplifying Figure 10:

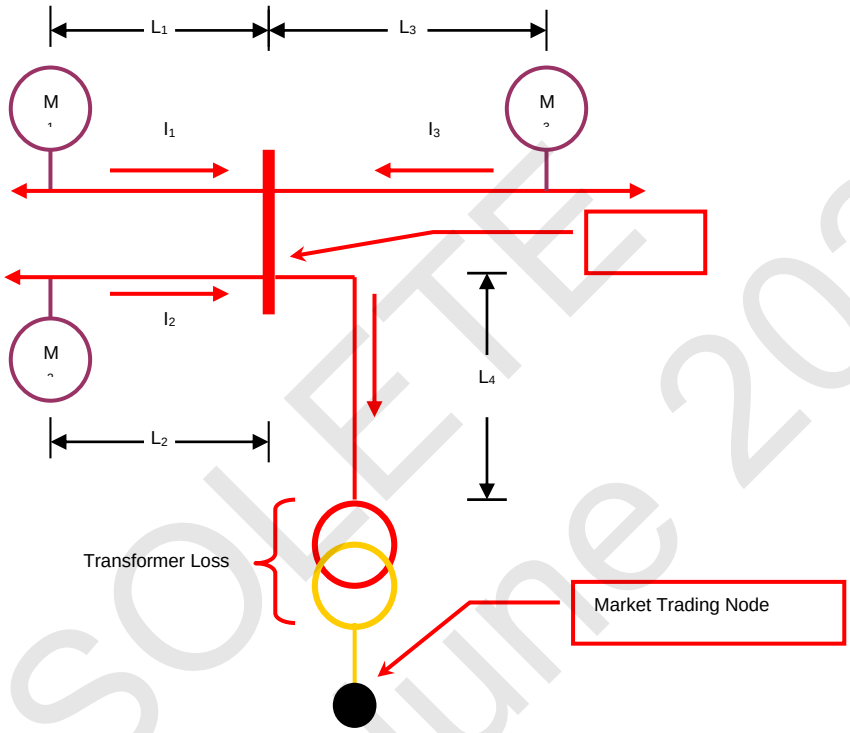


Figure 11

Active and Reactive Power:

kW_{M1} = ($kWh_{M1\text{-}15min}$ + $kWh_{M1\text{-}30min}$ + $kWh_{M1\text{-}45min}$ + $kWh_{M1\text{-}00min}$) ÷ 1h

$kVar_{M1}$ = ($kVarh_{M1\text{-}15min}$ + $kVarh_{M1\text{-}30min}$ + $kVarh_{M1\text{-}45min}$ + $kVarh_{M1\text{-}00min}$) ÷ 1h

kW_{M2} = ($kWh_{M2\text{-}15min}$ + $kWh_{M2\text{-}30min}$ + $kWh_{M2\text{-}45min}$ + $kWh_{M2\text{-}00min}$) ÷ 1h

$kVar_{M2}$ = ($kVarh_{M2\text{-}15min}$ + $kVarh_{M2\text{-}30min}$ + $kVarh_{M2\text{-}45min}$ + $kVarh_{M2\text{-}00min}$) ÷ 1h

kW_{M3} = ($kWh_{M3\text{-}15min}$ + $kWh_{M3\text{-}30min}$ + $kWh_{M3\text{-}45min}$ + $kWh_{M3\text{-}00min}$) ÷ 1h

$kVar_{M3}$ = ($kVarh_{M3\text{-}15min}$ + $kVarh_{M3\text{-}30min}$ + $kVarh_{M3\text{-}45min}$ + $kVarh_{M3\text{-}00min}$) ÷ 1h

Line Currents and Line Losses:

I_1 = kW_{M1} ÷ (($\sqrt{3}$) * V_1 * pf_1) = kW_{M1} ÷ (($\sqrt{3}$) * V_1 * cos ($\tan^{-1}$ ($kVar_{M1}$ ÷ kW_{M1})))

I_2 = kW_{M2} ÷ (($\sqrt{3}$) * V_2 * pf_2) = kW_{M2} ÷ (($\sqrt{3}$) * V_2 * cos ($\tan^{-1}$ ($kVar_{M2}$ ÷ kW_{M2})))

I_3 = kW_{M3} ÷ (($\sqrt{3}$) * V_3 * pf_3) = kW_{M3} ÷ (($\sqrt{3}$) * V_3 * cos ($\tan^{-1}$ ($kVar_{M3}$ ÷ kW_{M3})))

$Line_{1\text{-}kW\text{-}Loss} = (I_1)^2 * R_1 = (I_1)^2 * (r_{a\text{-}1} * L_1)$

$Line_{1\text{-}kVar\text{-}Loss} = (I_1)^2 * X_1 = (I_1)^2 * (X_{l\text{-}1} * L_1)$

$Line_{2\text{-}kW\text{-}Loss} = (I_2)^2 * R_2 = (I_2)^2 * (r_{a\text{-}2} * L_2)$

$Line_{2\text{-}kVar\text{-}Loss} = (I_2)^2 * X_2 = (I_2)^2 * (X_{l\text{-}2} * L_2)$

$Line_{3\text{-}kW\text{-}Loss} = (I_3)^2 * R_3 = (I_3)^2 * (r_{a\text{-}3} * L_3)$

$Line_{3\text{-}kVar\text{-}Loss} = (I_3)^2 * X_3 = (I_3)^2 * (X_{l\text{-}3} * L_3)$

Total Active Power at Node 1 ($kW_{N\text{-}1}$) $= kW_{M1} + kW_{M2} + kW_{M3} + Line_{1\text{-}kW\text{-}Loss} + Line_{2\text{-}kW\text{-}Loss} + Line_{3\text{-}kW\text{-}Loss}$

Total Reactive Power at Node 1 ($kVar_{N\text{-}1}$) $= kVar_{M1} + kVar_{M2} + kVar_{M3} + Line_{1\text{-}kVar\text{-}Loss} + Line_{2\text{-}kVar\text{-}Loss} + Line_{3\text{-}kVar\text{-}Loss}$

$I_4 = kW_{N\text{-}1} \div ((\sqrt{3}) * V_{N\text{-}1} * pf_{N\text{-}1}) = kW_{N\text{-}1} \div ((\sqrt{3}) * V_{N\text{-}1} * \cos(\tan^{-1}(kVar_{N\text{-}1} \div kW_{N\text{-}1})))$

$Line_{4\text{-}kW\text{-}Loss} = (I_4)^2 * R_4 = (I_4)^2 * (r_{a\text{-}4} * L_4)$

$Line_{4\text{-}kVar\text{-}Loss} = (I_4)^2 * X_4 = (I_4)^2 * (x_{l\text{-}4} * L_4)$

Distributing $Line_{4\text{-}kW\text{-}Loss}$

For M_1, $Line_{4\text{-}kW\text{-}Loss\text{-}M1} = (Line_{4\text{-}kW\text{-}Loss} * (kW_{M1} + Line_{1\text{-}kW\text{-}Loss})) \div kW_{N\text{-}1}$

For M_2, $Line_{4\text{-}kW\text{-}Loss\text{-}M2} = (Line_{4\text{-}kW\text{-}Loss} * (kW_{M2} + Line_{2\text{-}kW\text{-}Loss})) \div kW_{N\text{-}1}$

For M_3, $Line_{4\text{-}kW\text{-}Loss\text{-}M3} = (Line_{4\text{-}kW\text{-}Loss} * (kW_{M3} + Line_{3\text{-}kW\text{-}Loss})) \div kW_{N\text{-}1}$

Transformer Losses:

$T_1Core_{Loss\text{-}M1} = T_1Core_{Loss} * (kW_{M1} \div \sum_{i=1}^{n} kW_{Mi})$

$T_1Core_{Loss\text{-}M2} = T_1Core_{Loss} * (kW_{M2} \div \sum_{i=1}^{n} kW_{Mi})$

$T_1Core_{Loss\text{-}M3} = T_1Core_{Loss} * (kW_{M3} \div \sum_{i=1}^{n} kW_{Mi})$

$T_1Copper_{Loss} = ((kW_{N\text{-}1} \div pf_{N\text{-}1}) \div T_{1kVA\text{-}Rating})^2 * P_{Short\text{-}Circuit\text{-}T1}$

$T_1Copper_{Loss\text{-}M1} = T_1Copper_{Loss} * (kW_{M1} + Line_{1\text{-}kW\text{-}Loss} + Line_{4\text{-}kW\text{-}Loss\text{-}M1}) \div kW_{N\text{-}1}$

$T_1Copper_{Loss\text{-}M2} = T_1Copper_{Loss} * (kW_{M2} + Line_{2\text{-}kW\text{-}Loss} + Line_{4\text{-}kW\text{-}Loss\text{-}M2}) \div kW_{N\text{-}1}$

$T_1Copper_{Loss\text{-}M3} = T_1Copper_{Loss} * (kW_{M3} + Line_{3\text{-}kW\text{-}Loss} + Line_{4\text{-}kW\text{-}Loss\text{-}M3}') \div kW_{N\text{-}1}$

Total Loss for each Meter:

$Total_{kW\text{-}Loss\text{-}M1} = Line_{1\text{-}kW\text{-}Loss} + Line_{4\text{-}kWLoss\text{-}M1} + T_1Core_{Loss\text{-}M1} + T_1Copper_{Loss\text{-}M1}$

$Total_{kW\text{-}Loss\text{-}M2} = Line_{2\text{-}kW\text{-}Loss} + Line_{4\text{-}kWLoss\text{-}M2} + T_1Core_{Loss\text{-}M2} + T_1Copper_{Loss\text{-}M2}$

$Total_{kW\text{-}Loss\text{-}M3} = Line_{3\text{-}kW\text{-}Loss} + Line_{4\text{-}kW\text{-}Loss\text{-}M3} + T_1Core_{Loss\text{-}M3} + T_1Copper_{Loss\text{-}M3}$

SSLF

$SSLF_{M1} = 1 - (Total_{kW\text{-}Loss\text{-}M1} \div kW_{M1})$

$SSLF_{M2} = 1 - (Total_{kW\text{-}Loss\text{-}M2} \div kW_{M2})$

$SSLF_{M3} = 1 - (Total_{kW\text{-}Loss\text{-}M3} \div kW_{M3})$

Adjusted Meter Data:

$Adjusted_{kW\text{-}M1} = kW_{M1} - Total_{kW\text{-}Loss\text{-}M1}$

$Adjusted_{kW\text{-}M2} = kW_{M2} - Total_{kW\text{-}Loss\text{-}M2}$

$Adjusted_{KW\text{-}M3} = kW_{M3} - Total_{kW\text{-}Loss\text{-}M3}$

Generators

Case 1: One Metering Point – One Market Trading Node: A metering point measures the dispatch of only one generating unit (figure 12).

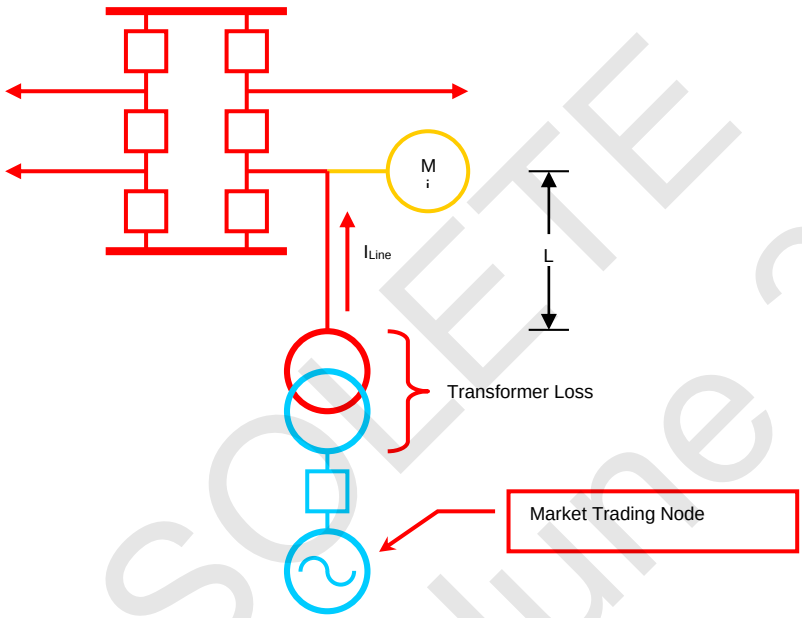


Figure 12

kW_{Mi} = $(kWh_{Mi\text{-}15min} + kWh_{Mi\text{-}30min} + kWh_{Mi\text{-}45min} + kWh_{Mi\text{-}00min}) \div 1h$

$kVar_{Mi}$ = $(kVarh_{Mi\text{-}15min} + kVarh_{Mi\text{-}30min} + kVarh_{Mi\text{-}45min} + kVarh_{Mi\text{-}00min}) \div 1h$

I_{Line} = $kW_{Mi} \div ((\sqrt{3}) * V * pf_{Mi})$, $pf_{Mi} = \cos(\tan^{-1}(kVar_{Mi} \div kW_{Mi}))$

$Line_{kW\text{-}Loss}$ = $(I_{Line})^2 * R_{Line}$, $R_{Line} = r_a * L$

$Line_{kVar\text{-}Loss}$ = $(I_{Line})^2 * X_{Line}$, $X_{Line} = x_l * L$

$Core_{Loss\text{-}Mi}$ = $T_1Core_{Loss} \div 1$

$Copper_{Loss\text{-}Mi}$ = $((kW_{Mi} \div pf_{Mi}) \div T_{kVA\text{-}Rating})^2 * P_{Short\text{-}Circuit}$

$Total_{kW\text{-}Loss}$ = $Line_{kW\text{-}Loss} + Core_{Loss\text{-}Mi} + Copper_{Loss\text{-}Mi}$

SSLF = $1 + (Total_{kW\text{-}Loss} \div kW_{Mi})$

$Adjusted_{kW}$ = $SSLF * kW_{Mi}$ = $Total_{kW\text{-}Loss} + kW_{Mi}$

Case 2: One Metering Point – Multiple Market Trading Nodes: A metering point measures the aggregate dispatch of a group or block of generating units (figure 13)

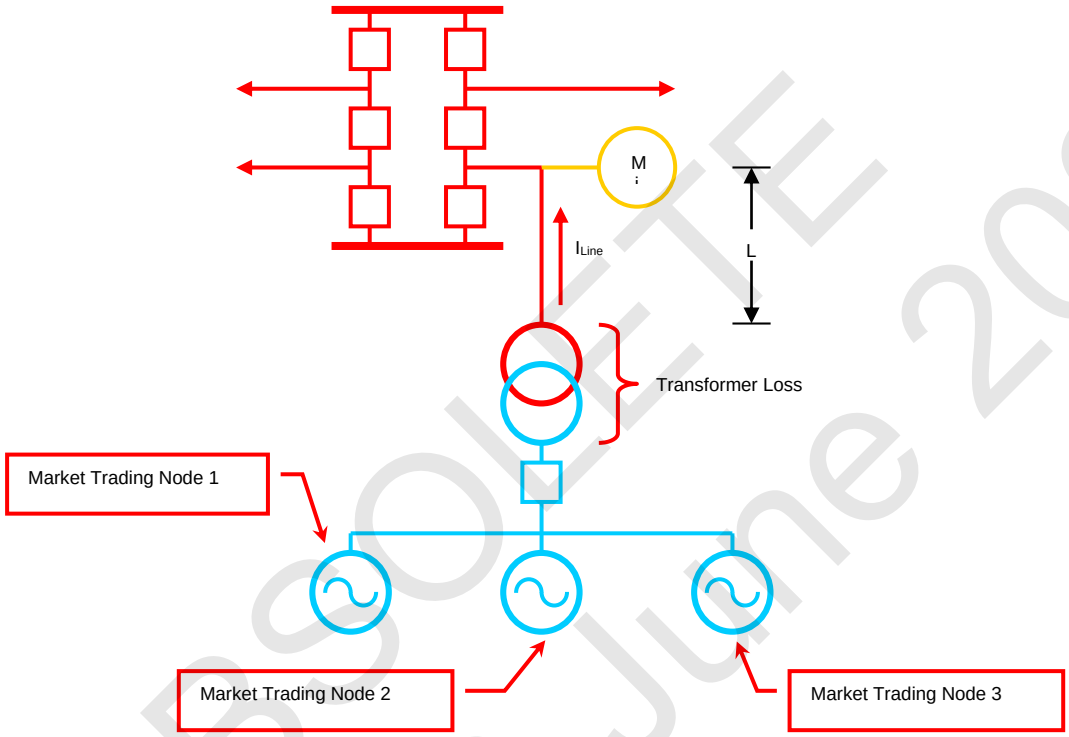


Figure 13

kW_{Mi} = $(kWh_{Mi\text{-}15min} + kWh_{Mi\text{-}30min} + kWh_{Mi\text{-}45min} + kWh_{Mi\text{-}00min}) \div 1h$

$kVar_{Mi}$ = $(kVarh_{Mi\text{-}15min} + kVarh_{Mi\text{-}30min} + kVarh_{Mi\text{-}45min} + kVarh_{Mi\text{-}00min}) \div 1h$

I_{Line} = $kW_{Mi} \div ((\sqrt{3}) * V * pf_{Mi})$

pf_{Mi} = $\cos(\tan^{-1}(kVar_{Mi} \div kW_{Mi}))$

$Line_{kW\text{-}Loss}$ = $(I_{Line})^2 * R_{Line}$, $R_{Line} = r_a * L$

$Line_{kVar\text{-}Loss}$ = $(I_{Line})^2 * X_{Line}$, $X_{Line} = x_l * L$

$Core_{Loss\text{-}Mi}$ = $T_1Core_{Loss} * kW_{M1} \div kW_{M1} = T_1Core_{Loss} * 1$

$Copper_{Loss\text{-}Mi}$ = $((kW_{Mi} \div pf) \div T_{kVA\text{-}Rating})^2 * P_{Short\text{-}Circuit}$

$Total_{kW\text{-}Loss}$ = $Line_{kW\text{-}Loss} + Core_{Loss\text{-}Mi} + Copper_{Loss\text{-}Mi}$

SSLF = $1 + (Total_{kWLoss} \div kW_{Mi})$

$Adjusted_{kW}$ = $Total_{kWLoss}$ + kW_{Mi} = SSLF * kW_{Mi}

Disaggregation of Adjusted Active Power:

$MTN_{1\text{-Meter-Equivalent}} = Adjusted_{kW} * (EPQ_{MTN1} \div \sum_{i=1}^{n} EPQ_{MTNi})$

$MTN_{2\text{-Meter-Equivalent}} = Adjusted_{kW} * (EPQ_{MTN2} \div \sum_{i=1}^{n} EPQ_{MTNi})$

$MTN_{3\text{-Meter-Equivalent}} = Adjusted_{kW} * (EPQ_{MTN3} \div \sum_{i=1}^{n} EPQ_{MTNi})$

Where:

EPQ_{MTN} = Real Time Ex-Post Quantity of the generator

Case 3: Multiple Metering Points – Multiple Market Trading Nodes: A group of metering points measures the aggregate dispatch of a group or block of generating units (figure 14).

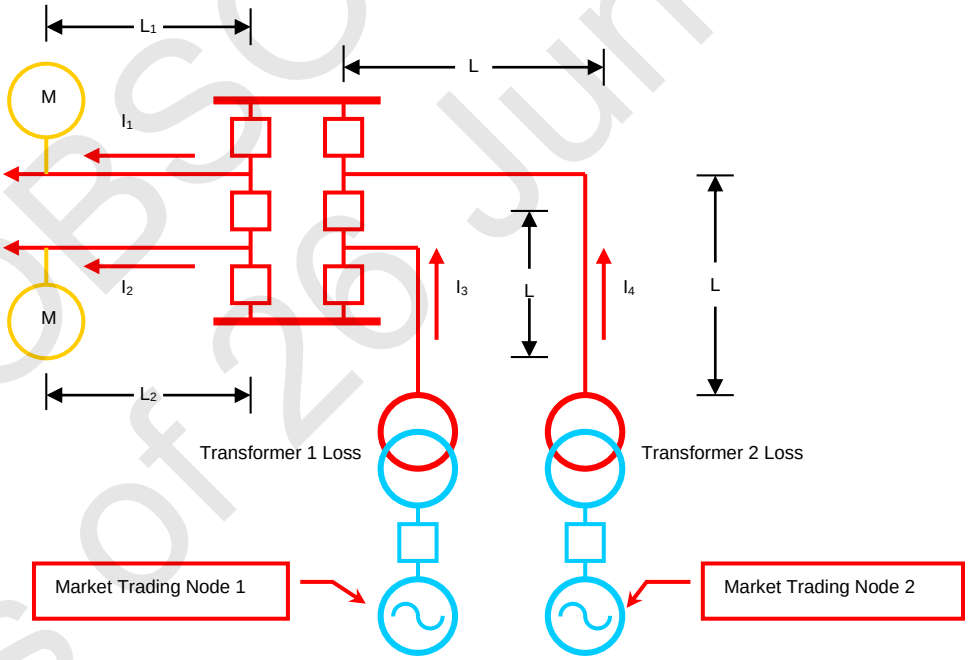


Figure 14

Simplifying Figure 14:

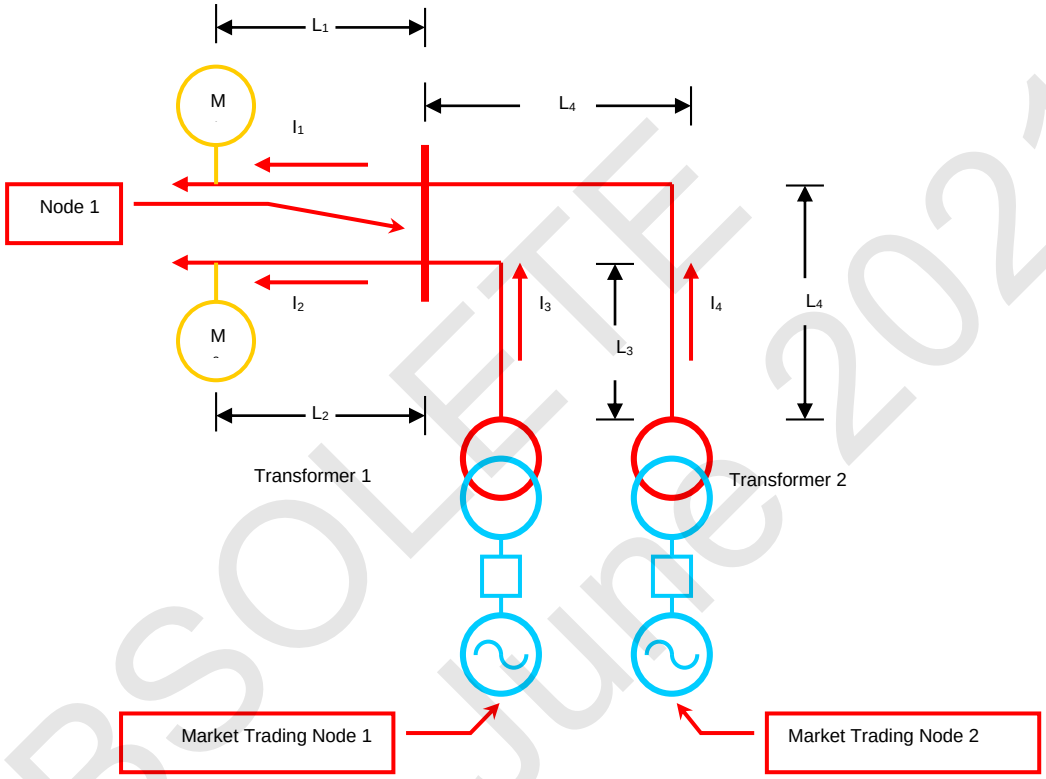


Figure 15

Active and Reactive Power:

kW_{M1} = $(kWh_{M1\text{-}15min} + kWh_{M1\text{-}30min} + kWh_{M1\text{-}45min} + kWh_{M1\text{-}00min}) \div 1h$

$kVar_{M1}$ = $(kVarh_{M1\text{-}15min} + kVarh_{M1\text{-}30min} + kVarh_{M1\text{-}45min} + kVarh_{M1\text{-}00min}) \div 1h$

kW_{M2} = $(kWh_{M2\text{-}15min} + kWh_{M2\text{-}30min} + kWh_{M2\text{-}45min} + kWh_{M2\text{-}00min}) \div 1h$

$kVar_{M2}$ = $(kVarh_{M2\text{-}15min} + kVarh_{M2\text{-}30min} + kVarh_{M2\text{-}45min} + kVarh_{M2\text{-}00min}) \div 1h$

Line Currents and Line Losses:

I_1 = $kW_{M1} \div ((\sqrt{3}) * V_1 * pf_1)$ = $kW_{M1} \div ((\sqrt{3}) * V_1 * \cos(\tan^{-1}(kVar_{M1} \div kW_{M1})))$

I_2 = $kW_{M2} \div ((\sqrt{3}) * V_2 * pf_2)$ = $kW_{M2} \div ((\sqrt{3}) * V_2 * \cos(\tan^{-1}(kVar_{M2} \div kW_{M2})))$

$Line_{1\text{-}kWLoss}$ = $(I_1)^2 * R_1$ = $(I_1)^2 * (r_{a\text{-}1} * L_1)$

$Line_{1\text{-}kVarLoss} = (I_1)^2 * X_1 = (I_1)^2 * (X_{l\text{-}1} * L_1)$

$Line_{2\text{-}kWLoss} = (I_2)^2 * R_2 = (I_2)^2 * (r_{a\text{-}2} * L_2)$

$Line_{2\text{-}kVarLoss} = (I_2)^2 * X_2 = (I_2)^2 * (X_{l\text{-}2} * L_2)$

Total Active Power at Node 1 ($kW_{N\text{-}1}$) = $kW_{M1} + kW_{M2} + Line_{1\text{-}kW\text{-}Loss} + Line_{2\text{-}kW\text{-}Loss}$

Total Reactive Power at Node 1 ($kVar_{N\text{-}1}$) = $kVar_{M1} + kVar_{M2} + Line_{1\text{-}kVar\text{-}Loss} + Line_{2\text{-}kVar\text{-}Loss}$

$I_1 + I_2 = I_3 + I_4$

Since current (I) is inversely proportional to resistance (R), $I = 1 \div R$

$I_3 = (I_1 + I_2) * R_4 \div (R_3 + R_4)$, $I_4 = (I_1 + I_2) * R_3 \div (R_3 + R_4)$

$Line_{3\text{-}kW\text{-}Loss} = (I_3)^2 * R_3 = (I_3)^2 * (r_{a\text{-}3} * L_3)$

$Line_{3\text{-}kVar\text{-}Loss} = (I_3)^2 * X_3 = (I_3)^2 * (X_{l\text{-}3} * L_3)$

$Line_{4\text{-}kW\text{-}Loss} = (I_4)^2 * R_4 = (I_4)^2 * (r_{a\text{-}4} * L_4)$

$Line_{4\text{-}kVar\text{-}Loss} = (I_4)^2 * X_4 = (I_4)^2 * (X_{l\text{-}4} * L_4)$

Distributing $Line_{3\text{-}kW\text{-}Loss}$

For M_1, $Line_{3\text{-}kW\text{-}Loss\text{-}M1} = (Line_{3\text{-}kW\text{-}Loss} * (kW_{M1} + Line_{1\text{-}kW\text{-}Loss})) \div kW_{N\text{-}1}$

For M_2, $Line_{3\text{-}kW\text{-}Loss\text{-}M2} = (Line_{3\text{-}kW\text{-}Loss} * (kW_{M2} + Line_{2\text{-}kW\text{-}Loss})) \div kW_{N\text{-}1}$

Distributing $Line_{4\text{-}kW\text{-}Loss}$

For M_1, $Line_{4\text{-}kW\text{-}Loss\text{-}M1} = (Line_{4\text{-}kW\text{-}Loss} * (kW_{M1} + Line_{1\text{-}kW\text{-}Loss})) \div kW_{N\text{-}1}$

For M_2, $Line_{4\text{-}kW\text{-}Loss\text{-}M2} = (Line_{4\text{-}kW\text{-}Loss} * (kW_{M2} + Line_{2\text{-}kW\text{-}Loss})) \div kW_{N\text{-}1}$

Transformer Losses:

$T_1Core_{Loss\text{-}M1} = T_1Core_{Loss} * (kW_{M1} \div \sum_{i=1}^{n} kW_{Mi})$

$T_1Core_{Loss\text{-}M2} = T_1Core_{Loss} * (kW_{M2} \div \sum_{i=1}^{n} kW_{Mi})$

$T_2Core_{Loss\text{-}M1} = T_2Core_{Loss} * (kW_{M1} \div \sum_{i=1}^{n} kW_{Mi})$

$T_2Core_{Loss\text{-}M2} = T_2Core_{Loss} * (kW_{M2} \div \sum_{i=1}^{n} kW_{Mi})$

$T_1Copper_{Loss} = (((kW_{N\text{-}1} \div 2) \div pf_{N\text{-}1}) \div T_{1kVA\text{-}Rating}))^2 * P_{Short\text{-}Circuit\text{-}T1}$

$T_1Copper_{Loss\text{-}M1} = T_1Copper_{Loss} * (kW_{M1} + Line_{1\text{-}kW\text{-}Loss}) \div kW_{N\text{-}1}$

$T_1Copper_{Loss\text{-}M2} = T_1Copper_{Loss} * (kW_{M2} + Line_{2\text{-}kW\text{-}Loss}) \div kW_{N\text{-}1}$

$T_2Copper_{Loss} = (((kW_{N-1} \div 2) \div pf_{N-1}) \div T_{2kVA\text{-}Rating}))^2 * P_{Short\text{-}Circuit\text{-}T2}$

$T_2Copper_{Loss\text{-}M1} = T_2Copper_{Loss} * (kW_{M1} + Line_{1\text{-}kW\text{-}Loss}) \div kW_{N-1}$

$T_2Copper_{Loss\text{-}M2} = T_2Copper_{Loss} * (kW_{M2} + Line_{2\text{-}kW\text{-}Loss}) \div kW_{N-1}$

$T_1Copper_{Loss\text{-}M1} = ((kW_{M1} \div pf_1) \div T_{1kVA\text{-}Rating})^2 * P_{Short\text{-}Circuit\text{-}T1}$

Total Loss for each Meter:

$Total_{kW\text{-}Loss\text{-}M1} = Line_{1\text{-}kW\text{-}Loss} + Line_{3\text{-}kW\text{-}Loss\text{-}M1} + Line_{4\text{-}kW\text{-}Loss\text{-}M1} + T_1Core_{Loss\text{-}M1} + T_2Core_{Loss\text{-}M1} + T_1Copper_{Loss\text{-}M1} + T_2Copper_{Loss\text{-}M1}$

$Total_{kW\text{-}Loss\text{-}M2} = Line_{2\text{-}kW\text{-}Loss} + Line_{3\text{-}kW\text{-}Loss\text{-}M2} + Line_{4\text{-}kW\text{-}Loss\text{-}M2} + T_1Core_{Loss\text{-}M2} + T_2Core_{Loss\text{-}M2} + T_1Copper_{Loss\text{-}M2} + T_2Copper_{Loss\text{-}M2}$

SSLF

$SSLF_{M1} = 1 + (Total_{kW\text{-}Loss\text{-}M1} \div kW_{M1})$

$SSLF_{M2} = 1 + (Total_{kW\text{-}Loss\text{-}M2} \div kW_{M2})$

$SSLF_{M3} = 1 + (Total_{kW\text{-}Loss\text{-}M3} \div kW_{M3})$

$SSLF_{M4} = 1 + (Total_{kW\text{-}Loss\text{-}M4} \div kW_{M4})$

Adjusted Active Power:

$Adjusted_{kW\text{-}M1} = Total_{kW\text{-}Loss\text{-}M1} + kW_{M1}$

$Adjusted_{kW\text{-}M2} = Total_{kW\text{-}Loss\text{-}M2} + kW_{M2}$

Disaggregation of Adjusted Meter Data:

$$MTN_{1\text{-}Meter\text{-}Equivalent} = Adjusted_{kW\text{-}M1} * EPQ_{MTN1} \div \sum_{i=1}^{n} EPQ_{MTNi} + Adjusted_{kW\text{-}M2} * EPQ_{MTN1} \div \sum_{i=1}^{n} EPQ_{MTNi} = Adjusted_{kW\text{-}M1} + Adjusted_{kW\text{-}M2} * (EPQ_{MTN1} \div \sum_{i=1}^{n} EPQ_{MTNi})$$

$$MTN_{2\text{-}Meter\text{-}Equivalent} = Adjusted_{kW\text{-}M1} * EPQ_{MTN2} \div \sum_{i=1}^{n} EPQ_{MTNi} + Adjusted_{kW\text{-}M2} * EPQ_{MTN2} \div \sum_{i=1}^{n} EPQ_{MTNi} = Adjusted_{kW\text{-}M1} + Adjusted_{kW\text{-}M2} * (EPQ_{MTN2} \div \sum_{i=1}^{n} EPQ_{MTNi})$$

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