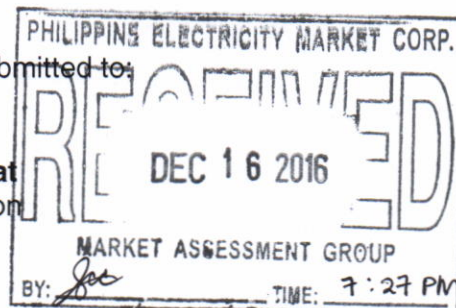# Wholesale Electricity Spot Market

REQUEST FOR AMENDMENTS OR CHANGES TO THE WESM MANUALS

Proposals made only under this prescribed form shall be accepted and considered as submitted:

This request for amendments to the WESM Rules can be submitted to:

PEM Board
Attention: **PEM Committee Secretariat**
Philippine Electricity Market Corporation
18/F Robinsons Equitable Tower
ADB Avenue, Ortigas Center
Pasig City, 1605 Philippines
Email address: rcc@wesm.ph
Fax Number: (+632) 395-2704

PHILIPPINE ELECTRICITY MARKET CORP.
RECEIVED
DEC 1 6 2016
MARKET ASSESSMENT GROUP
BY: _____   TIME: 7:27 PM

I. Proposer's Information

Name	**Melinda L. Ocampo**
Designation	President
Company	Philippine Electricity Market Corporation
Company Address	18/F Robinsons Equitable Tower, ADB Avenue
	Ortigas Center, Pasig City 1600
Telephone No.	631-8734
Fax. No.	636-0802
Email Address	mlocampo@wesm.ph

II. WESM Manual Amendments Information

Title of WESM Manual being commented:
Load Forecasting

Nature of Request (please indicate with **x**)
☒ Addition   ☒ Alteration   ☒ Deletion   ☒ Clarification   ☒ Clerical Correction
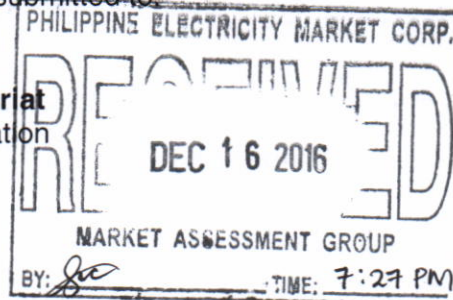

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III.   Proposed Amendment

Title	Section	Provision	Proposed Amendment	Rationale
Introduction	1			
Background	1.1	1.1.1. Load forecasts are necessary inputs to the optimization runs in the Wholesale Electricity Spot Market (WESM), particularly the week-ahead projection, day-ahead projection and ex-ante or real time dispatch market runs. The responsibility to prepare load forecasts rests in the Market Operator although Customers are also permitted to perform their own customer forecasts under certain conditions.	1.1.1. Load forecasts are necessary inputs to the optimization runs in the Wholesale Electricity Spot Market (WESM), particularly the week-ahead projection, day-ahead projection**, hour-ahead projection,** and **the** ~~ex-ante or~~ real time dispatch market runs. The responsibility to prepare load forecasts rests in the Market Operator although Customers are also permitted to perform their own customer forecasts under certain conditions.	Included hour-ahead projection as new market projection, and removed term ex-ante for consistent use of *real-time dispatch* only
Background		1.1.2. The WESM Rules provide for the responsibilities of the Market Operator in performing its load forecasts. a. WESM Rules Clause 3.7.3.1 (c) requires that each market projection shall take into account the forecast demand information prepared by the Market Operator in accordance with WESM Rules Clause 3.5.4. b. WESM Rules Clause 3.7.3.2 further requires that prior to the preparation of each set of market projections, the Market Operator shall, in consultation with the System Operator, prepare an expected unrestrained net load forecast in accordance with the procedures developed under Clause 3.5.4, and such number of other load scenarios as may be determined in consultation with WESM Participants and approved by the PEM Board. c. For the ex-ante market runs, WESM Rules Clause 3.8.1 (b) and (c) directs that at the beginning of each interval, the Market Operator shall prepare a forecast of the unrestrained net load expected at	1.1.2. The WESM Rules provide for the responsibilities of the Market Operator in performing its load forecasts. a. WESM Rules Clause ~~3.7.3.1 (c)~~ **3.7.4.1 (c)** requires that each market projection shall take into account the forecast demand information prepared by the Market Operator in accordance with WESM Rules Clause 3.5.4. b. WESM Rules Clause ~~3.7.3.2~~ **3.7.4.2** further requires that prior to the preparation of each set of market projections, the Market Operator shall, in consultation with the System Operator, prepare an expected unrestrained net load forecast in accordance with the procedures developed under Clause 3.5.4, and such number of other load scenarios as may be determined in consultation with WESM Participants and approved by the PEM Board. c. For the ~~ex-ante~~ **real-time dispatch** market runs, WESM Rules Clause 3.8.1 (b) and (c) directs that at the beginning of each interval, the Market Operator shall prepare a forecast of the	• Due to renumbered WESM Rules Clauses

Title	Section	Provision	Proposed Amendment	Rationale
		each market trading node for the end of that trading interval", and "adjust that unrestrained net load forecast to account for load shedding, if required, in accordance with WESM Rules clause 3.9.5.	unrestrained net load expected at each market trading node for the end of that trading interval", and "adjust that unrestrained net load forecast to account for load shedding, if required, in accordance with WESM Rules clause 3.9.5.	• Removed term ex-ante for consistent use of *real-time dispatch* only
		d. Furthermore, WESM Rules Clause 3.5.4.2 states that each net load forecast shall be prepared in such a way as to represent the net load to be met by scheduled generation, including losses occurring outside the system represented by the market network model, but excluding any scheduled load, and less non-scheduled generation, and generation from new and renewable energy (NRE) generating units with intermittent energy resource.	d. Furthermore, WESM Rules Clause 3.5.4.2 states that each net load forecast shall be prepared in such a way as to represent the net load to be met by ~~scheduled~~ generation~~,~~ **from scheduled generating units, must-dispatch generating units, priority dispatch generating units, and non-scheduled generating units** including losses occurring outside the system represented by the market network model, but excluding any scheduled load~~, and less non-scheduled generation, and generation from new and renewable energy (NRE) generating units with intermittent energy resource~~.	• Based on revisions from the WESM Rules for consistency
		e. WESM Rules Clause 3.5.4.3 state that the unrestrained net load forecast for any trading interval shall be prepared so as to represent the net load as it would be, or would have been, in the absence of load shedding.	e. WESM Rules Clause 3.5.4.3 state that the unrestrained net load forecast ~~for any trading interval~~ shall be prepared so as to represent the net load as it would be, or would have been, in the absence of load shedding.	• Removed use of trading interval per WESM Rules, as amended by DOE DC 2016-10-0014
		f. WESM Rules Clause 3.5.4.4 state that if load shedding is expected to occur in any trading interval, a restrained net load forecast for that trading interval shall be prepared on the same basis, but accounting for load shedding to the extent that it is expected to occur.	f. WESM Rules Clause 3.5.4.4 state that if load shedding is expected to occur in any trading interval, a restrained net load forecast for that ~~trading~~ interval shall be prepared on the same basis, but accounting for load shedding to the extent that it is expected to occur.	
Background	1.1.3	a. Each Customer may submit a forecast in respect of each trading interval for each of its registered load facilities for each trading day of week in accordance with the WESM timetable. The	a. Each Customer may submit a forecast in respect of each ~~trading~~ **dispatch** interval for each of its registered load facilities for each trading day of week in accordance with the WESM timetable. The	• Removed use of trading interval. Revised reference to Section of Dispatch Protocol on the WESM Timetable

Title	Section	Provision	Proposed Amendment	Rationale
		timetable is set out in Section 5 of the WESM Dispatch Protocol. b. The forecasted load shall be used by the Market Operator in the preparation of the net load forecast. c. If the Customer fails to submit a forecast for his load facility in accordance with the WESM timetable, or if the Customer forecast submitted is not within the published forecast tolerance range, the forecast prepared by the Market Operator at the relevant node shall be used.	timetable is set out in Section ~~5~~ **4** of the WESM Dispatch Protocol. b. The forecasted load shall be used by the Market Operator in the preparation of the net load forecast. c. If the Customer fails to submit a forecast for his load facility in accordance with the WESM timetable, ~~or if the Customer forecast submitted is not within the published forecast tolerance range,~~ **then** the forecast prepared by the Market Operator at the relevant node shall be used.	• There is no more customer forecast tolerance range to enable TPs to provide Customer Forecasts with no prohibition from the Market Operator. However, Customer Forecasts are only for Qualified Customers.

Purpose	1.2	This Market Manual establishes the following:
		
		1.2.1. The requirements in determining the load forecasts for the following market runs in the WESM:
		
		a. Market Projections
		  i. Week-Ahead Projection (WAP)
		  ii. Day-Ahead Projection (DAP)
		b. Ex-ante or real time dispatch market runs
		
		1.2.2. The customer forecast tolerance range; and
		
		1.2.3. The forecast methodology to be employed by the Market Operator for preparing load forecasts.
			This Market Manual establishes the following:
			
			1.2.1. The requirements in determining the load forecasts for the following market runs in the WESM:
			
			a. Market Projections
			  i. Week-Ahead Projection (WAP)
			  ii. Day-Ahead Projection (DAP)
			  iii. Hour-ahead Projection (HAP)
			b. ~~Ex-ante or real~~ **Real-**time dispatch ~~market runs~~
			
			1.2.2. ~~The customer forecast tolerance range; and~~
			
			~~1.2.3.~~ The forecast methodology to be employed by the Market Operator for preparing load forecasts.
				• Included hour-ahead projection
				
				• Removed customer forecast tolerance range

Scope	1.3	This Market Manual applies to the Market Operator, the System Operator and, the Trading Participants in the WESM. The systems, processes and procedures set out in this Manual shall be used in the preparation	~~This Market Manual applies to the Market Operator, the System Operator and, the Trading Participants in the WESM.~~ The systems, processes and procedures set out in this **Market** Manual shall be used in the	Revised for clarity

Title	Section	Provision	Proposed Amendment	Rationale
		of load forecasts to be used for the week-ahead projections (WAP), day-ahead projections (DAP), and ex-ante market runs in the WESM.	preparation of load forecasts to be used for the week-ahead projections (WAP), day-ahead projections (DAP), **hour-ahead projections (HAP),** and ~~ex-ante~~ **real-time dispatch** market runs in the WESM.	
Definitions, References, and Interpretation	2			
Definitions	2.1	Unless otherwise defined or the context implies otherwise, the italicized terms used in this Manual that are defined in the WESM Rules shall bear the same meaning as defined in the WESM Rules. In addition, the following words and phrases as used in this Manual shall have the following meaning -	**2.1.1** Unless otherwise defined **in this section** or the context implies otherwise, the italicized terms used in this **Market** Manual ~~that are defined in the WESM Rules~~ shall bear the same meaning as defined in the WESM Rules. **2.1.2** In addition, the following words and phrases as used in this **Market** Manual shall have the following meaning -	Revised for clarity
Definitions	2.1	2.1.1. Demand refers to the total power consumed in a Power System or Grid inclusive of the relevant losses produced during the delivery of power. It is also the total power generated in the grid.	~~2.1.1~~ **a**. Demand~~. refers to the total~~ **Total** power consumed in a Power System or Grid inclusive of the relevant losses produced during the delivery of power. It is also the total power generated in the grid.	Clerical revision
Definitions	2.1	2.1.2. Demand Forecast refers to the Demand projection for a particular Forecast Area.	~~2.1.2~~ **b**. Demand Forecast~~. refers to the~~ Demand projection for a particular Forecast Area.	Clerical revision
Definitions	2.1	2.1.3. Final Demand Forecast refers to the sum of the Net Load Forecasts plus the losses in a Forecast Area	~~2.1.3~~ **c**. Final Demand Forecast~~.~~ **Sum** ~~refers to the sum~~ of the Net Load Forecasts plus the losses in a Forecast Area	Clerical revision
Definitions	2.1	2.1.4. Forecast Area refers to a grid in the Philippine Power System where Demand Forecast will be applied. Currently, each grid in the Philippines is designated as a Forecast Area, namely the Luzon, the Visayas, and the Mindanao grids.	~~2.1.4~~ **d**. Forecast Area~~.~~ **A** ~~refers to a~~ grid in the Philippine Power System where Demand Forecast will be applied. Currently, each grid in the Philippines is designated as a Forecast Area, namely the Luzon, the Visayas, and the Mindanao grids.	Clerical revision
Definitions	2.1	2.1.5. Input Demand Forecast refers to the initially assumed Demand Forecast that shall be used as the off-take for determining the Unrestrained Net Load Forecast.	~~2.1.5~~ **e**. Input Demand Forecast~~.~~ **Initially** ~~refers to the initially~~ assumed Demand Forecast that shall be used as the off-take for determining the Unrestrained Net Load Forecast.	Clerical revision

Title	Section	Provision	Proposed Amendment	Rationale
Definitions	2.1	2.1.6. Load Predictor (LDP) refers to the functionality in the Market Management System which is used to determine the total energy requirement of a certain Forecast Area for the next trading interval, which shall be used in the ex-ante market run.	~~2.1.6. Load Predictor (LDP) refers to the functionality in the Market Management System which is used to determine the total energy requirement of a certain Forecast Area for the next trading interval, which shall be used in the ex-ante market run.~~	Removed because of the new system
Definitions	2.1	2.1.7. Load Profile or Load Pattern (interchangeably) refers to the time series representation of Demand.	~~2.1.7 . Load Profile or Load Pattern (interchangeably) refers to the time series representation of Demand.~~	Removed since application does not exist in the new MMS
Definitions	2.1	NEW	**f. Load Distribution Factor (LDF). Factor used in allocating the total projected load to individual loads in the market network model.**	Defined based on new approach in load forecasting
Definitions	2.1	2.1.8. Market Management System (MMS)refers to the infrastructure that supports the operations of the WESM and which includes functionalities that support the processes set out in this Manual.	~~2.1.8~~ **g**. Market Management System (MMS)**.** **Infrastructure** ~~refers to the infrastructure~~ that supports the operations of the WESM and which includes functionalities that support the processes set out in this **Market** Manual.	Revised for clarity
Definitions	2.1	NEW	**h. Real-time Dispatch. Otherwise known as RTD. It is the dispatch schedule which determines the target loading of facilities at the end of the dispatch interval. The RTD calculates the ex-ante nodal energy dispatch prices.**	Same definition as provided in the Dispatch Protocol.
Definitions	2.1	2.1.9. Short-Term Forecast refers to the Demand Forecast pertaining to the next trading interval up to seven days ahead and shall be applied to the calculation of market projections and real-time dispatch schedules.	~~2.1.9~~ **i**. Short-Term **Load** Forecast**. Hourly demand forecasts** ~~refers to the Demand Forecast pertaining to the next trading interval~~ **starting at the next hour** up to seven days ahead**. It** ~~and~~ shall be applied to the calculation of **the** ~~market projections and real-time dispatch schedules~~ **week-ahead projection and day-ahead projection**.	Revised for clarity in use for hourly forecasts only (DAP and WAP)
Definitions	2.1	NEW	**j. Unrestrained net load forecast. Also refers to unrestrained load.**	Added previously existing term in the Market Manual
Definitions	2.1	2.1.10. Similar Day Load Forecast (SDLF) refers to the MMS functionality that is used to derive the Demand Forecasts to be used for the Day-Ahead and Week-Ahead market projections.	~~2.1.10. Similar Day Load Forecast (SDLF) refers to the MMS functionality that is used to derive the Demand Forecasts to be used for the Day-Ahead and Week-Ahead market projections.~~	Removed since application does not exist in the new MMS
Definitions	2.1	NEW	**k. Very Short-Term Load Forecast. Demand forecasts for each dispatch interval starting at**	This refers to 5-minute forecasts for HAP and RTD

Title	Section	Provision	Proposed Amendment	Rationale
			the next dispatch interval up to the next two hours. It shall be applied to the calculation of the hour-ahead projection and real-time dispatch.	
References	2.2	This Manual shall be read in association with the following – a) WESM Rules, as amended b) WESM Manual Dispatch Protocol c) Price Determination Methodology d) Philippine Grid Code (PGC)	This **Market** Manual shall be read in association with the ~~following~~ – ~~a)~~ WESM Rules~~, as amended~~ ~~b) WESM Manual Dispatch Protocol~~ ~~c) Price Determination Methodology~~ ~~d) Philippine Grid Code (PGC)~~ **and other relevant Market Manuals**.	Revised for clarity since the WESM Rules is the primary reference for this Market Manual
Interpretation	2.3	2.3.1. Any reference to a clause in any section of this Market Manual shall refer to the particular clause of the same section in which the reference is made, unless otherwise specified or the context provides otherwise. 2.3.2. Where there is a discrepancy or conflict between this Manual and the WESM Rules, the WESM Rules shall prevail. 2.3.3. Standards and policies appended to, or referenced in, this Manual shall provide a supporting framework.	2.3.1. Any reference to a clause in any section of this Market Manual shall refer to the particular clause of the same section in which the reference is made, unless otherwise specified or the context provides otherwise. 2.3.2. Where there is a discrepancy or conflict between this **Market** Manual and the WESM Rules, the WESM Rules shall prevail. 2.3.3. Standards and policies appended to, or referenced in, this **Market** Manual shall provide a supporting framework.	Clerical revisions
Responsibilities	3			
Market Operator	3.1.	3.1.1. The Market Operator shall prepare net load forecasts for each customer node for each Trading Interval in accordance with the methodology set out in this Market Manual. 3.1.2. The Market Operator shall be primarily responsible for the development and review of the load forecasting methodology documented in this Market Manual.	3.1.1. The Market Operator shall prepare net load forecasts for each customer **market trading** node ~~for each Trading Interval~~ in accordance with the methodology set out in this Market Manual. 3.1.2. The Market Operator shall be primarily responsible for the development and review of the load forecasting methodology documented in this Market Manual.	• Removed use of trading interval per WESM Rules, as amended by DOE DC 2016-10-0014 • Clerical revisions
System Operator	3.2.	3.2.1. The System Operator shall provide the information required from them to the Market	3.2.1. The System Operator shall provide the information required ~~from them to~~ **by** the Market	Clerical revisions

Title	Section	Provision	Proposed Amendment	Rationale
		Operator in accordance with this Manual, and ensure such information's accuracy. 3.2.2. The System Operator shall assist the Market Operator in improving the load forecasting methodology set out in this Manual.	Operator in accordance with this **Market** Manual, and ensure such information's accuracy. 3.2.2. The System Operator shall assist the Market Operator in improving the load forecasting methodology set out in this **Market** Manual.	
Trading Participants	3.3.	3.3.1. The Trading Participants shall carry out the responsibilities provided for in this Manual. 3.3.2. Customer Trading Participants that opted to provide net load forecasts for their respective facilities shall be responsible for the timely submission and accuracy of their forecast information.	3.3.1. The Trading Participants shall carry out the responsibilities provided for in this **Market** Manual. 3.3.2. Customer Trading Participants that opted to provide net load forecasts for their respective facilities shall be responsible for the timely submission and accuracy of their forecast information.	Clerical revisions
Demand Forecast for Market Projections	4	Demand Forecast for Market Projections	**Short-Term** ~~Demand~~ **Load** Forecast ~~for Market Projections~~	Revised section to focus on hourly forecasts for WAP and DAP. HAP shall be covered under the Very Short Term Load Forecast, which is for 5-minute forecasts.
Week-Ahead and Day-Ahead Demand Forecasts	4	Week-Ahead and Day-Ahead Demand Forecasts	~~Week-Ahead and Day-Ahead Demand Forecasts~~ **Background**	Revised heading
Week-Ahead and Day-Ahead Demand Forecasts	4.1.1.	Hourly demand forecasts for each forecast area from the current day to the next seven (7) days shall be determined by the Market Operator using the Similar Day Load Forecast (SDLF) module of the Market Management System.	Hourly demand forecasts for each forecast area from the current day to the next seven (7) days shall be determined by the Market Operator using the ~~Similar Day Load Forecast (SDLF) module of the~~ Market Management ~~System~~ **System's Short-Term Load Forecast (STLF) application**.	Revised for clarity in the use of specific application in the New MMS
Week-Ahead and Day-Ahead Demand Forecasts	4.1.2.	The demand forecasts obtained in Section 4.1.1 of this Market Manual shall be used as input demand forecasts to obtain the unrestrained net load forecasts for the week-ahead projection (WAP) and the day-ahead projection (DAP).	The **aforementioned hourly** demand forecasts ~~obtained in Section 4.1.1 of this Market Manual~~ shall be used as input demand forecasts to obtain the **hourly** unrestrained net load forecasts for the week-ahead projection (WAP) and the day-ahead projection (DAP).	Revised for clarity

Title	Section	Provision	Proposed Amendment	Rationale
Week-Ahead and Day-Ahead Demand Forecasts	4.1.4.	The procedures for obtaining the net load forecasts from the demand forecasts are discussed further in Section 6 of this Market Manual.	The procedures for obtaining the net load forecasts from the demand forecasts **using load distribution factors** are discussed further in Section 6 of this Market Manual.	Revised for clarity of use in determining nodal load forecasts
Similar Day Load Forecast	4.2	Similar Day Load Forecast	~~Similar Day Load Forecast~~ **Determination of Hourly Demand Forecasts**	Removed to focus on determination of hourly forecasts, which may use a variety of forecasting methodologies
Similar Day Load Forecast	4.2.1	The Similar Day Load Forecast (SDLF) produces hourly demand forecasts for the current day and the next seven days.	The ~~Similar Day Load Forecast (SDLF) produces~~ **process of determining** hourly demand forecasts ~~for the current day and the next seven days~~ **involve various input data such as historical demand, historical weather measurements, and weather forecast data**.	Same as above
Similar Day Load Forecast	4.2.2	The SDLF calculates Demand Forecasts based on historical demand and weather data. Weather data used is forecasted daily. The demand profile consists of actual Hourly Average Loads, type of day (normal day and/or holiday), and actual weather data for the day (which has been previously saved in the Market Management System's database). SDLF extracts the historical data that is deemed to be the curve of best fit[1], and then applies customer provided factors to produce the Demand Forecasts for each Forecast Area.

Footnote 1: Curves of best fit are identified through statistical curve fitting | **Each forecast area is mapped to a Weather Area, which has its own distinct** ~~The SDLF calculates Demand Forecasts based on~~ historical ~~demand and~~ weather **and forecasted weather information** ~~data~~. ~~Weather data used is forecasted daily. The demand profile consists of actual Hourly Average Loads, type of day (normal day and/or holiday), and actual weather data for the day (which has been previously saved in the Market Management System's database). SDLF extracts the historical data that is deemed to be the curve of best fit[1], and then applies customer provided factors to produce the Demand Forecasts for each Forecast Area.~~

~~Footnote 1: Curves of best fit are identified through statistical curve fitting~~ | Revised for clarity and consistency in the use of weather data, both historical and forecasted. |
| Similar Day Load Forecast | 4.2.3 | Procedure for Day-Ahead Forecast

a) Through the Market Management System's Similar Day Load Forecast (SDLF) module, the Market | ~~Procedure for Day-Ahead Forecast~~

~~a) Through the Market Management System's Similar Day Load Forecast (SDLF) module, the Market~~ | Moved details of the different forecasting methodologies in the Appendix section. |

Title	Section	Provision	Proposed Amendment	Rationale
		Operator shall select a set of Daily Demand Profiles based on the following conditions: i. Similar Day load profile pattern (Sun, Mon, Tue-Wed-Thurs, Fri, Sat, and holiday) ii. Special Events, (e.g. earth hour) iii. Temperature iv. Humidity v. Other Weather conditions vi. Other Factors as deemed appropriate by the Market Operator b) The SDLF module shall initially prepare a set of Demand Forecasts by averaging the Daily Demand Profiles selected in item a) i. c) The SDLF module has a facility to override Demand Forecasts should the Market Operator see the need to adjust the initially defined Demand Forecast from the SDLF. d) The Market Operator shall maintain the information provided in the SDLF on load growth and all-time peak load value, to help improve the accuracy of the Daily Demand Forecasts determined by the SDLF.	~~Operator shall select a set of Daily Demand Profiles based on the following conditions:~~ ~~i. Similar Day load profile pattern (Sun, Mon, Tue-Wed-Thurs, Fri, Sat, and holiday)~~ ~~ii. Special Events, (e.g. earth hour)~~ ~~iii. Temperature~~ ~~iv. Humidity~~ ~~v. Other Weather conditions~~ ~~vi. Other Factors as deemed appropriate by the Market Operator~~ ~~b) The SDLF module shall initially prepare a set of Demand Forecasts by averaging the Daily Demand Profiles selected in item a) i.~~ ~~c) The SDLF module has a facility to override Demand Forecasts should the Market Operator see the need to adjust the initially defined Demand Forecast from the SDLF.~~ ~~d) The Market Operator shall maintain the information provided in the SDLF on load growth and all-time peak load value, to help improve the accuracy of the Daily Demand Forecasts determined by the SDLF.~~ **Hourly demand forecasts are determined using the MMS' STLF application's weather adaptive, similar day, and pattern matching algorithms as shown in the illustration below. The methodology behind these forecasting algorithms are further discussed in Section 12**. **Figure 1. Process Overview for Determining Hourly Demand Forecasts via MMS-STLF** (See Attachment 1)	

Title	Section	Provision	Proposed Amendment	Rationale
		NEW	**4.2.4. The Market Operator may use other forecasting algorithms to determine hourly demand forecasts for each forecast area.** **4.2.5. The demand forecast determined by the Market Operator outside of the MMS' forecasting algorithm shall be treated as an external demand forecast.** **4.2.6. If an external demand forecast is provided by the Market Operator in a relevant hourly interval, then the external demand forecast shall be considered as the input demand forecast regardless of any existing demand forecast determined by the MMS.**	Revised based on proposed new process for implementing hourly forecasts, which includes the ability for the Market Operator to introduce his own forecast (called external forecast)
Similar Day Load Forecast	4.2.4 4.2.5	4.2.4 Pursuant to WESM Rules Clause 3.7.3.2 and Clause 3.7.3.3, the Market Operator shall prepare a market projection corresponding to each load scenario as may be determined in consultation with WESM Participants and approved by the PEM Board. 4.2.5. Each projected load scenario shall be saved onto different cases by the Market Operator through the available forecasting facility.	~~4.2.4~~ **4.2.7** Pursuant to WESM Rules ~~Clause~~ **Clauses 3.7.4.2** ~~3.7.3.2~~ and ~~Clause 3.7.3.3~~ **3.7.4.3**, the Market Operator shall prepare a market projection corresponding to each load scenario as may be determined in consultation with WESM Participants and approved by the PEM Board. ~~4.2.5. Each projected load scenario shall be saved onto different cases by the Market Operator through the available forecasting facility.~~	Revised based on renumbering in WESM Rules.
			4.2.8. Load scenarios shall be provided for each day-ahead projection using the following sensitivities (increments/decrements) with respect to the input demand forecast provided: **Table 1. DAP Load Scenarios** <table><tr><td>**DAP Load Scenario**</td><td>**Increment (+) / Decrement (-), %**</td></tr><tr><td>**Load Scenario 1**</td><td>**− 5 %**</td></tr><tr><td>**Load Scenario 2**</td><td>**− 3 %**</td></tr><tr><td>**Load Scenario 3**</td><td>**+ 3 %**</td></tr></table>	Defined details of the load scenarios to be used for DAP as required in the WESM Rules.

Title	Section	Provision	Proposed Amendment	Rationale
			<u>Load Scenario 4</u> <u>+ 5 %</u>	
Demand Forecast for the Real Time Dispatch Runs	5	Demand Forecast for the Real Time Dispatch Runs	~~Demand Forecast for the Real Time Dispatch Runs~~ **Very Short Term Load Forecasts**	Revised to specify forecasts for HAP and RTD. VSTLF is in a 5-minute resolution
Hour-Ahead Demand Forecasts	5.1	Hour-Ahead Demand Forecasts	~~Hour-Ahead Demand Forecasts~~ **Background**	
Hour-Ahead Demand Forecasts	5.1.1.	Demand forecasts for the next hour in each forecast area shall be determined by the Market Operator using the Load Predictor (LDP) module of the Market Management System.	Demand forecasts for ~~the next~~ **each 5-minute interval in the next two (2)** ~~hour~~ **hours** in each forecast area shall be determined by the Market Operator using the ~~Load Predictor (LDP) module of the~~ Market Management ~~System~~ **System's Very Short-Term Load Forecast (VSTLF) application**.	Revised for clarity in applying 5-minute forecasts in the New MMS
Hour-Ahead Demand Forecasts	5.1.2.	The demand forecasts obtained in Section 5.1.1 of this Market Manual shall be used as input demand forecasts to obtain the unrestrained net load forecasts for the real-time dispatch (RTD).	The demand forecasts **for each 5-minute interval in the next two (2) hours** ~~obtained in Section 5.1.1 of this Market Manual~~ shall be used as input demand forecasts to obtain the unrestrained net load forecasts for the **hour-ahead projection (HAP) and the** real-time dispatch (RTD).	Revised for clarity in applying 5-minute forecasts in the New MMS. Added hour-ahead projection as well.
Hour-Ahead Demand Forecasts	5.1.3.	The summation of the net load forecast plus the losses computed for a forecast area after the optimization process in the relevant RTD run constitutes the final demand forecast for that forecast area.	The summation of the net load forecast plus the losses computed for a forecast area after the optimization process in the relevant **HAP or** RTD run constitutes the final demand forecast for that forecast area.	Included hour-ahead projection
Hour-Ahead Demand Forecasts	5.1.4.	The procedures for obtaining the net load forecasts from the demand forecasts are discussed further in Section 6 of this Market Manual.	xxx	
Load Predictor	5.2.	Load Predictor	~~Load Predictor~~ **Determination of Demand Forecasts for Each Dispatch Interval**	Removed LDP since it does not exist in the New MMS. Revised instead to indicate how 5-minute demand forecasts are determined

Title	Section	Provision	Proposed Amendment	Rationale
Load Predictor	5.2.1.	5.2.1. The Load Predictor is a facility in the Market Management System (MMS) for managing hour-ahead Demand Forecasts that shall be used as an input to the RTD.	~~5.2.1. The Load Predictor is a facility in the Market Management System (MMS) for managing hour-ahead Demand Forecasts that shall be used as an input to the RTD.~~	No more LDP in New MMS
Load Predictor	5.2.2.	5.2.2. The Load Predictor (LDP) is a stand-alone application in the Market Management System (MMS) that produces system energy demands in the near-term (24 intervals, every 5 minutes covering the next 2 hours). Its resulting demand forecast shall then be used by the Real-Time Dispatch (RTD).	~~5.2.2. The Load Predictor (LDP) is a stand-alone application in the Market Management System (MMS) that produces system energy demands in the near-term (24 intervals, every 5 minutes covering the next 2 hours). Its resulting demand forecast shall then be used by the Real-Time Dispatch (RTD).~~	No more LDP in New MMS
Load Predictor	5.2.3.	5.2.3. The LDP uses a time-series method utilizing the actual system demand, which is derived from the total generation of the EMSI system snapshot, to forecast the total system load for each succeeding 5-minute interval. Figure (See Attachment 2)	~~5.2.3.~~ **5.2.1** The ~~LDP~~ **VSTLF** uses **historical demand data and shall be represented in** a time-series ~~method utilizing the actual system demand, which is derived from the total generation of the EMSI system snapshot, to forecast the total system load for each succeeding 5-minute interval.~~	Revised to discuss use of new methodology for 5-minute forecasts
		NEW	**5.2.2. From the demand time-series data, demand forecast shall be determined using the Cubic-Spline Interpolation Method, which details are discussed in Appendix D.**	Additional provision that indicates methodology for 5-minute forecasts shall be discussed in the Appendix part of the Manual
Load Predictor	5.2.4	5.2.4 The LDP provides Input Demand Forecasts for each Forecast Area. It also has a feature that allows users to manually intervene with the initially computed forecast, and be able to place their own load forecast for the relevant region and interval. Figure 1. LDP Screenshot 1 (See Attachment 2)	~~5.2.4 The LDP provides Input Demand Forecasts for each Forecast Area. It also has a feature that allows users to manually intervene with the initially computed forecast, and be able to place their own load forecast for the relevant region and interval.~~ ~~Figure 1. LDP Screenshot 1 and Figure 2. LDP Screenshot 2~~	No more LDP in new NMMS
Load Predictor	5.2.5	5.2.5 LDP Algorithm xxx	~~5.2.5 LDP Algorithm~~ ~~xxx~~	No more LDP in new NMMS
Net Load Forecasts	6			
		Pursuant to WESM Rules Clause 3.5.4.1, the Market Operator shall prepare a net load forecast, which are	**6.1 Scope**	Clerical revisions.

Title	Section	Provision	Proposed Amendment	Rationale
		either unrestrained or restrained. Both shall be provided by the Market Operator in the market projections (WAP and DAP) and the real-time dispatch (RTD).	Pursuant to WESM Rules Clause 3.5.4.1, **this section provides** the Market ~~Operator~~ **Operator's preparation of** ~~shall prepare a~~ net load ~~forecast~~ **forecasts**, which are either unrestrained or restrained**, for** ~~. Both shall be provided by the Market Operator in the~~ market projections ~~(WAP and DAP)~~ and the real-time dispatch ~~(RTD)~~ **market runs**.	
Unrestrained Net Load Forecast	6.1.	6.1. Unrestrained Net Load Forecast	~~6.1.~~ **6.2** Unrestrained Net Load Forecast	
Unrestrained Net Load Forecast	6.1.	6.1.1. The unrestrained net load forecast is prepared by the Market Operator by pro-rating the input demand forecast net of an initial loss percentage to the base load values.	~~6.1.1~~ **6.2.1**. The unrestrained net load forecast is prepared by the Market Operator by ~~pro-rating~~ **allocating** the input demand forecast net of an initial loss percentage ~~to the base load values~~ **with respect to the LDF set for each customer market trading node**. **6.2.2 LDFs are defined for each customer market trading node that belongs to a specific forecast area, for each day and hour.**	Defined the use of Load Distribution Factors based on the proposed methodology of allocating demand forecasts to nodes using these allocation factors.
Unrestrained Net Load Forecast	6.1.	6.1.2. Unrestrained Net Load Forecasts shall exclude scheduled loads.	~~6.1.2. Unrestrained Net Load Forecasts shall exclude scheduled loads.~~	Removed because of new definition of Unrestrained Net Load Forecasts in the WESM Rules
Unrestrained Net Load Forecast	6.1.	6.1.3. The base load values shall consider the contributions from non-scheduled generation and generation from NRE generating units with intermittent energy resource.	~~6.1.3. The base load values shall consider the contributions from non-scheduled generation and generation from NRE generating units with intermittent energy resource.~~	Removed because of new definition of Unrestrained Net Load Forecasts in the WESM Rules
Unrestrained Net Load Forecast	6.1.	6.1.4. For the RTD, the base load value is the latest actual system snapshot prior to the execution of this workflow. For the market projections of the WAP and DAP, it shall use the Load Pattern prepared by the Market Operator, which covers loads for each Customer Node for the next seven days. The Market Operator shall develop relevant procedures in the preparation of the load Pattern.	~~6.1.4~~ **6.2.3**. ~~For the RTD, the base load value is the latest actual system snapshot prior to the execution of this workflow. For the market projections of the WAP and DAP, it shall use the Load Pattern prepared by the Market Operator, which covers loads for each Customer Node for the next seven days.~~ The Market Operator shall develop relevant	LDFs are used instead of the latest system snapshot in the proposed methodology of determining nodal forecasts.

Title	Section	Provision	Proposed Amendment	Rationale
		Figure 3. High-Level Diagram to obtain the Unrestrained Net Load Forecast (See Attachment 3)	procedures in the preparation of the ~~load Pattern~~ **LDFs**. ~~Figure 3. High-Level Diagram to obtain the Unrestrained Net Load Forecast~~ **6.2.4. The following figure shows the process of how unrestrained net load forecasts are determined from input demand forecasts using LDFs.** **Figure 2. Determination of Unrestrained Net Load Forecasts for each Customer Market Trading Node** (See Attachment 3)	
		6.1.5. The total unrestrained net load forecast can be interpreted in the following equation: Total UNLF = Demand Forecast x $(1 -$ Initial Loss Percentage$_{FA})$ Where: UNLF unrestrained net load forecast Initial Loss Percentage$_{FA}$ initial loss percentage in FA FA forecast area	~~6.1.5~~ **6.2.5**. The total unrestrained net load forecast can be interpreted in the following equation: Total UNLF = Demand Forecast x $(1 -$ Initial Loss Percentage$_{FA})$ Where: UNLF **refers to** unrestrained net load forecast Initial Loss Percentage$_{FA}$ **refers to** initial loss percentage in FA FA **refers to** forecast area	Clerical revisions
		6.1.6. The unrestrained net load forecast of each customer node shall be obtained by pro-rating the total unrestrained net load forecast to the actual load of each customer node based on the latest actual system snapshot from the System Operator.	6.1.6. The unrestrained net load forecast of each customer **market trading** node shall be obtained by pro-rating the total unrestrained net load forecast to the actual load of each customer **market trading** node based on the latest actual system snapshot from the System Operator. **This is provided in the following equation:**	Clerical revisions including use of Load Distribution Factors

Title	Section	Provision	Proposed Amendment	Rationale
		$$UNLF_b = \frac{Total\ UNLF}{Total\ Actual\ Load_{FA;LATEST}}\ x$$ Actual Load$_{i,\ FA,\ LATEST}$ Where: UNLF$_i$ unrestrained net load forecast of customer node i Total Actual Load$_{FA,\ LATEST}$ sum of actual loads in a forecast area where customer node I belongs based on the latest system snapshot Actual Load$_{i,\ FA,\ LATEST}$ actual load of customer node i based on the latest system snapshot	$$UNLF_b = \frac{Total\ UNLF}{Total\ LDF_{h,\ FA}}\ *\ LDF_{b,\ h,\ FA}$$ Where: UNLF$_b$ **refers to** unrestrained net load forecast of customer **market trading** node ~~i~~ **b** Total LDF Load$_{h,\ FA}$ **refers to the** sum of ~~actual loads~~ **load distribution factors for hour h in a forecast area FA** where customer **market trading** node ~~i~~ **b** belongs ~~based on the latest system snapshot~~ LDF$_{b,\ h,\ FA}$ **refers to the** ~~actual~~ load **distribution factor** of customer **market trading** node ~~i~~ **b for hour h in forecast area FA** ~~based on the latest system snapshot~~	
		6.1.7. A Trading Participant may submit his own unrestrained net load forecast as long as the value is within the prescribed value from the Market Operator. Further details on customer forecasts are available in Section 7 of this Market Manual.	~~6.1.7~~ **6.2.7**. A Trading Participant may submit his own unrestrained net load forecast ~~as long as the value is within the prescribed value from the Market Operator~~. Further details on customer forecasts are available in Section 7 ~~of this Market Manual~~.	Removed customer forecast tolerance range
Restrained Net Load Forecast	6.2	6.2. Restrained Net Load Forecast	~~6.2~~ **6.3**. Restrained Net Load Forecast	
Restrained Net Load Forecast	6.2	6.2.1. The restrained net load forecast of each customer node is achieved after the optimization process of the market dispatch optimization model (MDOM).	~~6.2.1~~ **6.3.1**. The restrained net load forecast of each customer **market trading** node is achieved after the optimization process of the market dispatch optimization model (MDOM).	Clerical revisions
Restrained Net Load Forecast	6.2	6.2.2. A customer node's projected load will be shed should its price reach the level of the VoLL price.	~~6.2.2~~ **6.3.2**. A customer **market trading** node's projected load will be shed should its price reach the level of the **Nodal** VoLL price.	Clerical revisions
Restrained Net Load Forecast	6.2	6.2.3. The restrained net load forecast shall then be obtained after the MDOM determines a solution reflective of load shedding. The following equation shows the value of the restrained net load forecast:	~~6.2.3~~ **6.3.3**. The restrained net load forecast shall then be obtained after the MDOM determines a solution reflective of load shedding. The following	Clerical revisions

Title	Section	Provision	Proposed Amendment	Rationale
		$RNLF_i = UNLF_i - \text{Load Shed}_i$ Where: $RNLF_i$ restrained net load forecast of customer node i $UNLF_i$ unrestrained net load forecast of customer node i Load Shed$_i$ amount of load to be shed at customer node i	equation shows the value of the restrained net load forecast: $RNLF_b = UNLF_b - \text{Load Shed}_b$ Where: $RNLF_b$ **refers to the** restrained net load forecast of customer **market trading** node ~~i~~ **b** $UNLF_b$ **refers to the** unrestrained net load forecast of customer **market trading** node ~~i~~ **b** Load Shed$_b$ **refers to the** amount of load to be shed at customer **market trading** node ~~i~~ **b**	
Initial Loss Percentage	6.3	6.3. Initial Loss Percentage	~~6.3~~ **6.4**. Initial Loss Percentage	
		6.3.1. The initial loss percentage is the percentage of the demand forecast initially assumed to be the loss. It shall be netted out of the demand forecast in order to achieve the total unrestrained net load forecast, which shall then be used to obtain the unrestrained net load forecast of each customer node.	~~6.3.1~~ **6.4.1**. The initial loss percentage is the percentage of the demand forecast initially assumed to be the loss. It shall be netted out of the demand forecast in order to achieve the total unrestrained net load forecast, which shall then be used to obtain the unrestrained net load forecast of each customer **market trading** node.	Clerical revisions
		6.3.2. Each forecast area has its own initial loss percentage, and it shall be reviewed on an annual basis by the Market Operator. The initial loss percentage per forecast area shall be published by the Market Operator in the Market Information Website[2]. *Footnote 2*: www.wesm.ph	~~6.3.2~~ **6.4.2**. Each forecast area has its own initial loss percentage, and it shall be reviewed on an annual basis by the Market Operator. The initial loss percentage per forecast area shall be published by the Market Operator in the Market Information Website[2]. *Footnote 2*: www.wesm.ph	Re-numbered item
Customer Forecasts	7			

Title	Section	Provision	Proposed Amendment	Rationale
Customer Forecast Submission	7.1.1.	Customer forecasts are made available to Trading Participants in the WESM through the Market Management System's Market Participant Interface (MPI).	**Each qualified customer, except those that are required by the Market Operator based on Section 7.1.6, may at its option, submit forecasts for its respective market trading node for each hourly or dispatch interval.** ~~Customer forecasts are made available to Trading Participants in the WESM through the Market Management System's Market Participant Interface (MPI).~~	Provision on the option of customers to submit forecasts. Deleted provision is moved to Section 7.1.7, as proposed to be amended.
	7.1.3.	7.1.3. Each Customer may, at its option, submit forecasts for its respective market trading node.	~~7.1.3. Each Customer may, at its option, submit forecasts for its respective market trading node.~~	Already provided in Section 7.1.1, as proposed to be amended.
	7.1.4.	7.1.4. Each Customer that intends to participate in this optional program shall require approval from the Market Operator for accounting and validation purposes.	~~7.1.4. Each Customer that intends to participate in this optional program shall require approval from the Market Operator for accounting and validation purposes.~~	
	7.1.5.	7.1.5. Each Customer that submits load forecasts for the market projections (Week-Ahead and Day-Ahead) and the real-time dispatch shall upload the relevant forecast in accordance with the WESM timetable.	~~7.1.5.~~**7.1.3** Each Customer that submits load forecasts for the market projections ~~(Week-Ahead and Day-Ahead)~~ and the real-time dispatch shall upload the relevant forecast in accordance with the WESM timetable.	Revision to include all market projections (WAP,DAP & HAP)
	7.1.6. 7.1.7	7.1.6 The Customer forecast shall represent the estimated aggregate demand at the market trading node.

7.1.7. Customer forecasts for the market projections and the real-time dispatch shall be in real-power quantities (MW) | ~~7.1.6~~ **7.1.4** The Customer forecast shall represent the estimated aggregate demand at the market trading node **and shall** ~~.~~

~~7.1.7. Customer forecasts for the market projections and the real-time dispatch shall~~ be in real-power quantities (MW) | Consolidate provisions |
| | 7.1.8. | 7.1.8. Customer forecasts shall be considered as the official schedule of the Real-Time Dispatch. | ~~7.1.8~~ **7.1.5**. Customer forecasts **submitted by Trading Participants shall replace the Unrestrained Net Load Forecast determined in Section 6.2 of this Market Manual** ~~shall be considered as the official schedule of the Real-Time Dispatch.~~ | Revised for clarity |
| | | NEW | **7.1.6. Should a customer market trading node have a definite MW loading that can a materially affect WESM's pricing and scheduling, then the Market Operator require the relevant Trading** | Provision to require certain loads to submit their own forecasts in the WESM, which include pump-storage |

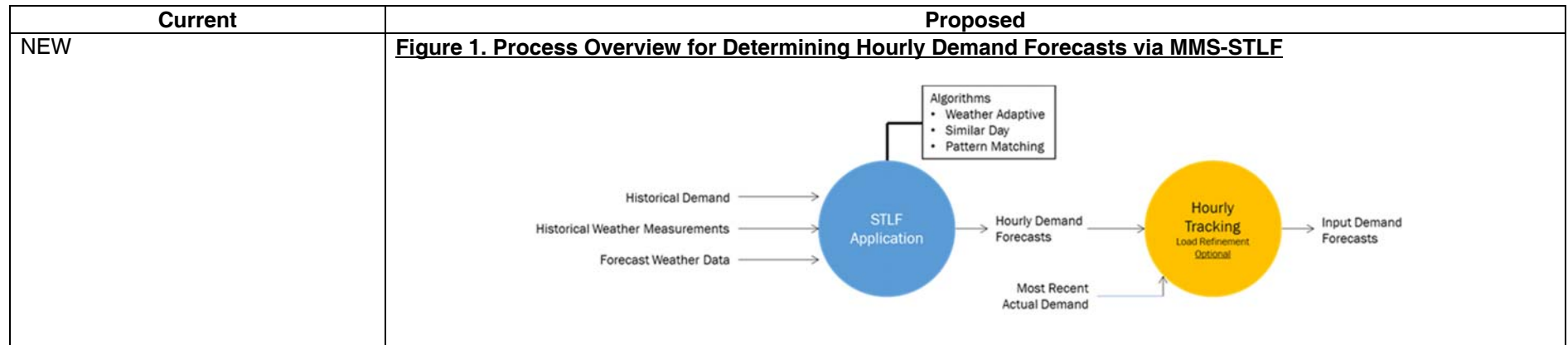| Title	Section	Provision	Proposed Amendment	Rationale
			Participant to submit Customer forecasts for the identified market trading node for each interval in accordance with the timetable.	hydro plants that operate as pump during specific periods
			7.1.7. Submission of Customer Forecasts in the WESM shall be made via the Market Management System's Market Participant Interface (MPI).	From section 7.1.1
Customer Forecast Validation	7.2	7.2. Customer Forecast Validation xxx	~~7.2. Customer Forecast Validation~~ ~~xxx~~	Removed customer forecast tolerance range
		NEW	**7.2. CUSTOMER LOAD FORECAST CONSIDERATIONS** **Trading Participants submitting customer load forecasts shall consider the following when determining Net Load Forecasts for their relevant market trading nodes.** **1. Customer Forecast Methodology. In preparing the load forecast, the customers may select the methodology that they believe is most appropriate for each individual market trading node.** **2. Customer Load Forecast Adjustment. Load adjustment factors shall be established by the Customer and his Meter Service Provider. The adjustment factors shall consider site-specific losses and other factors deemed necessary to reflect accurate customer load forecast at his market trading node.** **3. Customer Forecast Timeline. Customers may be able to provide their own load forecast based on the Open Market Window defined in the WESM Dispatch Protocol.**	From Section 8. Contents of section 8 will not provide parameters for the MO's load forecasting.

Title	Section	Provision	Proposed Amendment	Rationale
Submission of Trading Participant Load Information	7.3.	7.3. Submission of Trading Participant Load Information xxx	~~7.3. Submission of Trading Participant Load Information~~ ~~xxx~~	
Load Forecasting Considerations	8	8 Load Forecasting Considerations	8 Load Forecasting ~~Considerations~~ **Parameters**	
Weather Data	8.1.1	Historical and forecast weather data shall be made available to the Market Management System's database on a regular interval in accordance with the WESM timetable. The weather data shall be based on the major load center located in the forecast area. Weather parameters shall include, but not limited to the following. • Temperature • Humidity • Wind direction • Wind speed • Sky cover (0 = clear, 10 = maximum overcast) • Precipitation	Historical and forecast weather data shall be made available to the Market Management System's database on a regular interval in accordance with the WESM timetable. The weather data shall be based on the major load center located in the forecast area. Weather parameters shall include, but not limited to the following. • Temperature • Humidity • ~~Wind direction~~ • ~~Wind speed~~ • ~~Sky cover (0 = clear, 10 = maximum overcast)~~ • ~~Precipitation~~	Revised to reflect actual data used in proposed load forecasting methodologies
Weather Data	8.1.2.	Such weather information shall be obtained from a reliable source deemed appropriate by the Market Operator. Prospective weather data providers are listed in of this Market Manual.	Such weather information shall be obtained from a reliable source deemed appropriate by the Market Operator. Prospective weather data providers are listed in **Appendix E** ~~of this Market Manual~~.	Revised for clarity
Weather Data	8.1.3.	The Market Operator shall maintain a repository of the historical weather-related information.	xxx	
Load Demand	8.2.	Load Demand	~~Load~~ Demand	Revised for clarity
Load Demand	8.2.1.	Demand and generation data shall be obtained from the Network Service Providers' SCADA system, and it shall be incorporated in the data provided by the System Operator. Network Service Providers shall ensure that they provide the most reliable and accurate real-time information to the Market Operator.	Demand ~~and generation data~~ shall be obtained from the Network Service Providers' SCADA system, and it shall be incorporated in the data provided by the System Operator **to the Market Operator**. ~~Network Service Providers shall ensure that they provide the most reliable and accurate real-time information to the Market Operator.~~	
Load Demand	8.2.2.	Real-time information shall include telemetered data with provisions for state-estimation for higher	Real-time information shall include **at the nodal levels shall also be retrieved by the Market**	No state-estimation yet

Title	Section	Provision	Proposed Amendment	Rationale
		reliability and accuracy. Such information shall form part of the demand forecast and the net load forecast prepared by the Market Operator.	**Operator from the System Operator** ~~telemetered data with provisions for state-estimation for higher reliability and accuracy~~. Such information shall ~~form~~ **be used by the Market Operator in preparing** ~~part of~~ the demand forecast and the net load forecast ~~prepared by the Market Operator~~.	
Load Demand	8.2.3.	In the absence or failure to provide reliable real-time information, the Market Operator shall utilize the latest snapshot information provided. It shall be provided on a regular interval that is agreed upon between the Market Operator and System Operator.	In the absence or failure to provide reliable real-time information, the Market Operator shall utilize the latest ~~snapshot~~ information provided. ~~It shall be provided on a regular interval that is agreed upon between the Market Operator and System Operator.~~	Revised for clarity
Load Demand	8.2.4.	Historical hourly load information shall be used by the Market Operator in providing historical load profile for the Week-Ahead and Day-Ahead projections.	**Demand obtained over time shall be form part of the historical** ~~Historical~~ hourly load information **that** shall be used by the Market Operator **as inputs to the load forecasting algorithms used for market projections and real-time dispatch** ~~in providing historical load profile for the Week-Ahead and Day-Ahead projections~~.	Clerical revisions
Trading Participant Demand	8.2.5.	Trading Participant Demand xxx	~~8.2.5 Trading Participant Demand~~ ~~Xxx~~ **Customer Demand Forecasts based on the provisions of Section 7.**	Moved to section on Customer Load Forecasts
Load Forecast Audit and Performance Measures	9			
Load Forecast Audit and Performance Measures	9.2.	The Market Operator shall monitor the actual and forecasted load demand for each relevant market trading node.	The Market Operator shall monitor the actual and forecasted **nodal** load ~~demand~~ for each relevant market trading node.	For clarity
Amendments, Publication and Effectivity	10			
Amendments to this Manual	10.1.	10.1 Amendments to this Manual	10.1 ~~Amendments to this Manual~~**,** **Review and Update**	

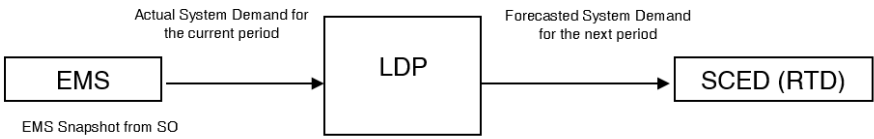| Title	Section	Provision	Proposed Amendment	Rationale
		Any amendment to, or revision to this Manual shall be approved by the PEM Board.	**10.1.1. Pursuant to WESM Rules Clause 3.5.4.6, the Market Operator shall periodically review the methodologies for performing nodal load forecasts and update this Market Manual, as necessary.** **10.1.2** Any **amendments** ~~amendment to~~ or revision to this **Market** Manual shall be approved ~~by the PEM Board~~ **in accordance with Chapter 8 of the WESM Rules and corresponding Market Manual on rules change process**.	
Publication and Effectivity	10.2	Upon approval of the PEM Board, this Manual shall take effect fifteen (15) days from its publication, or such later date as the PEM Board determines, in accordance with the WESM Manual of Procedures for Changes to the WESM Rules (WESM-RCM).	~~Upon approval of the PEM Board,~~ **The** ~~this~~ Manual ~~shall take effect fifteen (15) days from its~~ publication **and effectivity of this Market Manual shall be in accordance with Chapter 8 of the WESM Rules and corresponding Market Manual on rules change process**, ~~or such later date as the PEM Board determines, in accordance with the WESM Manual of Procedures for Changes to the WESM Rules (WESM-RCM).~~	
Appendix	11			
	A	Appendix A. LDP Methodology Sample	Appendix A. ~~LDP Methodology Sample~~ **Weather Adaptive Algorithm for Short-Term Load Forecast**	Provide details on the revised load forecasting methodologies. See Attachment 4 (Appendices)
			Appendix B. Similar Day Algorithm for Short-Term Load Forecast	
			Appendix C. Pattern Matching Algorithm for Short-Term Load Forecast	
			Appendix D. Cubic-Spline Interpolation Algorithm for Very Short-Term Load Forecast	
	B	Appendix B. List of Prospective Weather Data Providers	Appendix ~~B~~ **E**. List of Prospective Weather Data Providers	

Note: For convenience, please underline and put in bold letters the proposed changes to the WESM Manual.
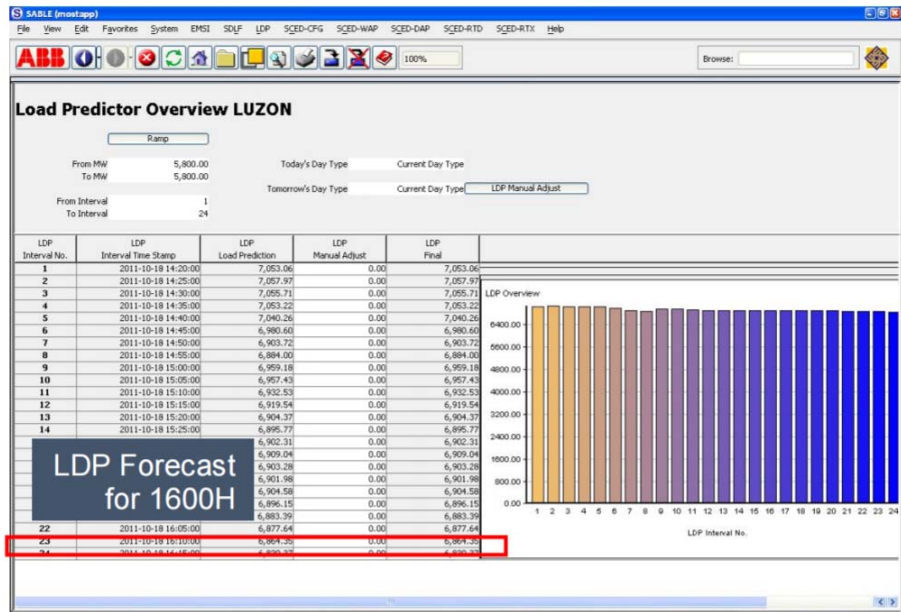
Attachment 1 – Figure in Section 4

Current	Proposed
NEW	<u>**Figure 1. Process Overview for Determining Hourly Demand Forecasts via MMS-STLF**</u>

Attachment 2 – Figures in Section 5 for deletion
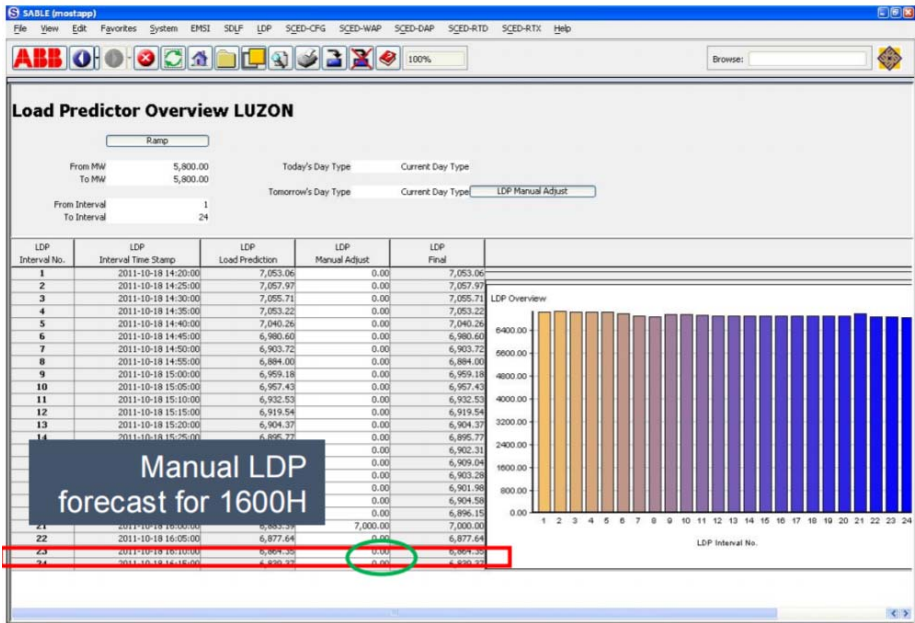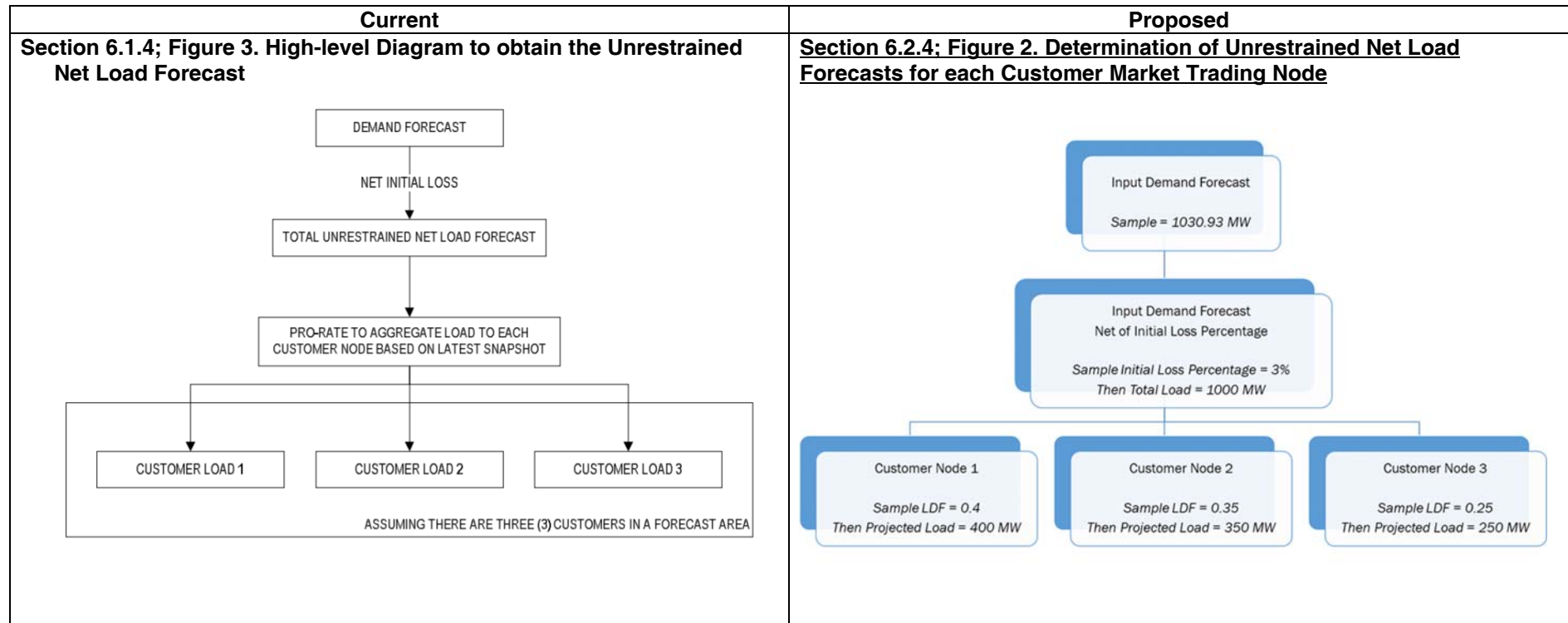

Section 5.2.3

Section 5.2.4; Figure 1. LDP Screenshot 1

Section 5.2.4; Figure 1. LDP Screenshot 2

Attachment 3 – Figures in Section 6

Current	Proposed
Section 6.1.4; Figure 3. High-level Diagram to obtain the Unrestrained Net Load Forecast	**Section 6.2.4; Figure 2. Determination of Unrestrained Net Load Forecasts for each Customer Market Trading Node**

Current (left): Flowchart — DEMAND FORECAST → NET INITIAL LOSS → TOTAL UNRESTRAINED NET LOAD FORECAST → PRO-RATE TO AGGREGATE LOAD TO EACH CUSTOMER NODE BASED ON LATEST SNAPSHOT → CUSTOMER LOAD 1, CUSTOMER LOAD 2, CUSTOMER LOAD 3. ASSUMING THERE ARE THREE (3) CUSTOMERS IN A FORECAST AREA

Proposed (right): Input Demand Forecast, Sample = 1030.93 MW → Input Demand Forecast Net of Initial Loss Percentage, Sample Initial Loss Percentage = 3%, Then Total Load = 1000 MW → Customer Node 1 (Sample LDF = 0.4, Then Projected Load = 400 MW), Customer Node 2 (Sample LDF = 0.35, Then Projected Load = 350 MW), Customer Node 3 (Sample LDF = 0.25, Then Projected Load = 250 MW)

Attachment 4 – Appendices (Proposed)

Appendix A. Weather Adaptive Algorithm for Short-Term Load Forecast

1. Input Data Specification

The following input data are necessary to calculate the load forecast for this methodology:

   a. Current load data.
   b. Current weather data.
   c. Weather forecast data provided by weather services companies.
   d. Preselected day types for forecasting period.
   e. The prediction error of the last forecast.
   f. Estimated parameter values which quantify the causal relationship among historical load data, historical weather data and day type data.

2. Weather Adaptive Using Multiple Regression Method

The Weather Adaptive Algorithm uses multiple regression analysis to create a statistical relationship between demand and weather conditions, including day types. In this methodology, the regression coefficients are estimated using equally or exponentially weighted minimum mean square error (MMSE) estimation criteria.

The regression analysis is performed with up to 3rd degree polynomial functions. The polynomial degree is adjusted for each weather influencing variable by parameter.

Regression analysis filters the different weather-dependent parts of the load for a given time, for example, time interval 8.00-9.00 a.m., as well as the influence of day type. The result of this filtering process is a set of regression coefficients (polynomial-coefficients).

To detect non-typical historical data, an adjustable data check is implemented. If load or influencing variables violate an adjustable bandwidth, they are excluded from the data analysis.

The result of the analysis is a decomposition of the time-dependent total load Y(t) into:

$$Y(t) = B(t) + a_T T(t) + a_L L(t) + \left[\sum a_W W(t) \right] + D(t) + model\_error(t)$$

Where:
B(t) refers to weather insensitive load component
a_L, L(t) refers to weather-sensitive load components
$a_T,$ T(t) refers to temperature-dependent load
a_L L(t) refers to humidity-dependent load
a_W W(t) refers to other weather-dependent load

D(t) refers to day type-specific load component

model_error (t) refers to the minimized weighted least squares estimation

The model error, is minimized using a weighted least squares technique, and this allows the user to get the forecast results in the form of an analytical expression.

Generally the regression analysis, which involves regression coefficient estimation, is activated periodically together with a subsequent forecast calculation.

3. Model analysis

Model analysis is the process used to find a new set of parameters that reduces the forecast errors for the weather adaptive algorithm. This requires using a particular set of historical load and weather history. Multiple simulations are run which imitate what the Weather Adaptive forecasting calculations would have been for that particular set of data starting at a user defined day and moving through the remaining data one day at a time. Each simulation has a different set of weather adaptive parameters. Results are summarized and may be compared, and therefore help to in analysing points that need further improvement.

4. Determination of the Weather Forecast Data

In order to get good forecast results the best available weather forecast data are necessary.

For the forecast calculation, the STLF program requires time series in the adjusted time step of each weather variable over the whole forecast period. These values are calculated automatically from the preceding inputs that are listed.

For the temperature influence, the program tracks a standardized curve through the day-specific values of minimum and maximum temperature. This standardized temperature curve is determined from the historical data at each run of the analysis program. The time points of the extreme forecast temperature are extracted from the historical data.

5. Determination of the Load Forecast

The load forecast is calculated for each adjusted time step of the forecast period using the regression coefficients and the weather variables forecast as well as type of day.

The forecast program is activated through the following different means

- Periodically at defined time steps
- After each run of the analysis program
- On user request

Appendix B. Similar Day Algorithm for Short-Term Load Forecast

Use the similar day forecast to produce a *Demand Forecast* for a day or a range of days in the forecast period.

The similar day forecast is based on recalculated *Demand* patterns. There are *Demand* increment patterns for each:

- Forecast Area *Demand*
- Month
- Hour/minute
- Day type
- Normal/average weather conditions

The similar day profiles where calculated initially using historical *Demand* data and recalculation is going to be done once a day during midnight processing. Subsequently, they can be reviewed and edited using the STLF User Interface.

Historical load profile (similar day load) has been calculated for each month, hour and day type:

$$LoadProfile_{i,j,k} = \frac{1}{n} \cdot \sum_{l=1}^{n} HistoricalLoad_{i,j,k}$$

And standard deviation for each calculated load profile has been calculated by:

$$StandardDeviation_{i,j,k} = \sqrt{\frac{\sum (HistoricalLoad_{i,j,k} - LoadProfile_{i,j,k})^2}{n}}$$

Where:
i = 1, 2, 3,…12   - month
j = 1, 2, 3,…24   - hour
k = 1, 2, 3,…8   - day type
l = 1, 2, 3,…n   - number of historical days

Forecasting applications supporting the following day types:

Day Type No.	Day Type
1	FRI
2	MON
3	SAT
4	SUN
5	WKD
6	TUE

Day Type No.	Day Type
7	WED
8	THU

The *Demand* similar day patterns are non-weather sensitive, and they provide the average *Demand* in case for normal weather condition for that time of year (defined by month, hour and day type).

The weather increment patterns defined by standard deviation are expected to change under "Hot"/"Cold" weather conditions. Positive increments indicate that load increases in hotter weather conditions than in normal weather conditions. Negative increments indicate the reverse. Under cold weather conditions, the increments are subtracted rather than added to the non-weather sensitive load pattern values.

Appendix C. Pattern Matching Algorithm for Short-Term Load Forecast

The pattern matching algorithm uses a process to filter days that can be used to determine *Demand Forecasts*. The filtering of days is based on a pre-defined set of parameters, namely the type of day and historical weather data.

Based on the values defined in the filter, such as the type of day and the high and low values of temperature, it will select days and then provide an index for its difference. From there, it will assign a weight to be applied to the *Demand* for that day.

Using the weights along with the actual *Demand* for that day, a *Demand Forecast* shall be determined.

Appendix D. Cubic-Spline Interpolation Algorithm for Very Short-Term Load Forecast

1. Cubic-Spline Interpolation Process

    The 5-minute *Demand Forecast* executes for a time-horizon of 2 hours, or for 24 5-minutes intervals.

    The 5-minute forecast-area load forecast makes use of a Cubic Spline Fitting algorithm in conjunction with the load-tracking methodology.

    The inputs to the calculation are the hourly *Demand Forecast* as well as the 5-minute historical loads as shown in the figure below.
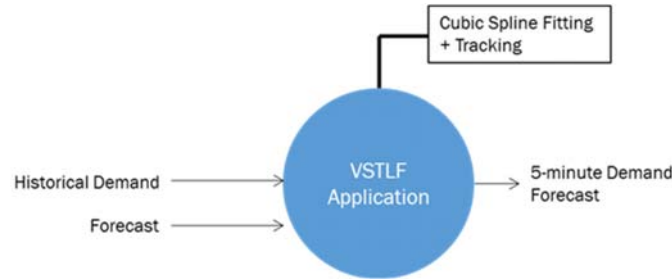

Figure 1. Cubic Spline Process Overview

    The Tracking algorithm calculates correction term to the forecast for several 5-minute forecasting period. A curve fitting algorithm is used along with actual *Demand* to calculate the 5 minute forecast.

2. 5-minute Tracking Load Forecast Function via Cubic Spline

    The tracking forecast is based on deviations between the five minute *Demand Forecasts* and the actual *Demand* every five minutes over the last hour. An average error term is used for the tracking forecast calculation. This average error term is calculated by adapting the relative errors for each time step so that values reflect the recent error trend.

$$\varepsilon_t = \frac{\left[5MinuteLoad_t^{'} - 5MinuteLoad_t\right]}{5MinuteLoad_t}$$

$$A_t = A_{t-1} + \alpha\left[\varepsilon_t - A_{t-1}\right]$$

Where:

$5MinuteLoad_t^i$ - 5 minute forecast load at time t

$5MinuteLoad_t$ - 5 minute measured load at time t

ε_t - Relative error at time t

A_t - Average (or adapted) error at time t

α_t - Adaptive parameter ($0 < \alpha_t < 1$)

The correction terms for future time steps are then be calculated as follows:

$$Y_{t+1} = (-1)5MinuteLoad_{t+1}^i\left[\beta(\varepsilon_t - A_t) + A_t\right]$$

$$Y_{t+n} = (-1)5MinuteLoad_{t+n}^i A_t$$

Where:

Y_t - Forecast correction term for time t

β - Weighting factor for the first future time step

n   - The number of the forecasting time steps (n>1)

The adaptive parameter is selected so that the error from the previous time step does not receive too much weight. The weighting factor is introduced so that the effect of the error for the previous time step may receive additional weight in determining the correction for the next time step.

Appendix E. List of Prospective Weather Data Providers

1. Department of Science and Technology – Philippine Atmospheric, Geophysical, and Astronomical Services Administration (DOST-PAGASA)

2. Accuweather

IV. **Proposed Scheme to Monitor the Effectiveness of the Proposed Changes to the WESM Manual**

V. **Referral**

MAG Date Received: ___DEC 1 6 2016___ _Jax_ 7:27 PM

Proposed Amendment: ☐ Urgent ☐ Minor ☑ General

A. **For Urgent Amendment (For the use of PEMC President only)**

Date Referred to PEMC President	☐ Yes	☐ No
Certifies as urgent	☐ Yes	☐ No
Convene the RCC within 48 hrs.		
Remarks:		

B. For Minor and General Amendment (For the use of RCC only)

Date Referred to RCC:	
Remarks:	
Action taken:	
Request for comments:	☐ Yes ☐ No
	Request written comments from: ☐ DRG ☐ MSC ☐ PA ☐ MO ☐ ECO ☐ RCC ☐ TC ☐ Other PEM Board Committees ☐ Other Interested Parties
For further review of the Technical Sub-Committee:	☐ Yes Assigned to: ☐ SO Sub-Committee ☐ MO Sub-Committee ☐ Metering Sub-Committee ☐ Billing and Settlement Sub-Committee ☐ Legal and Regulatory Sub-Committee
	☐ No
For public consultation:	☐ Yes ☐ No
RCC Resolution:	☐ Approved ☐ Disapproved
RCC Resolution No.:	
Date of Resolution:	
RCC Meeting No.	
Date of endorsement to the PEM Board:	