

**WHOLESALE ELECTRICITY SPOT MARKET  
RULES CHANGE COMMITTEE**

**RESOLUTION NO. 2014-02**

**Proposed Amendments to the Manual on Load Forecasting Methodology**

**WHEREAS**, on 06 November 2013, the Rules Change Committee (RCC) received the Philippine Electricity Market Corporation's (PEMC) Proposed Amendments to the Manual on Load Forecasting Methodology (attached as ANNEX A);

**WHEREAS**, the Proposal was finalized for submission to the RCC by the Harmonization Technical Working Group (HTWG) of PEMC, which group was created for the purpose of addressing inconsistencies between the WESM Manuals and WESM Rules, as identified by the PA Consulting Group during the 2011 Independent Operational Audit of the Systems Procedures on Market Operations;

**WHEREAS**, the Proposal is aimed at addressing specific audit findings and recommendations relative to the subject Manual, and likewise, in improving the document with regard to compliance, context, process, and governance; and to implement the new format of WESM manuals;

**WHEREAS**, the Proposal was presented by PEMC to the RCC during the 80th RCC Meeting held on 06 November 2013;

**WHEREAS**, during the same meeting, the RCC approved the posting of the proposal in the WESM Market Information Website, to solicit comments from Market Participants and other interested parties;

**WHEREAS**, the proposal was posted in the public information website on 12 November 2013, with the notification-email requesting comments from interested parties issued on the following day;

**WHEREAS**, on 13 December 2013, the RCC received comments from the SN Aboitiz Power (SNAP) in relation to the proposal (attached as ANNEX B);

**WHEREAS**, during the 82nd RCC Meeting held on 08 January 2014, the RCC deliberated on the matter, including the comments received from SNAP (attached as ANNEX C);

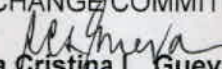
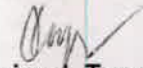


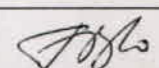
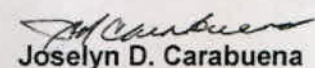

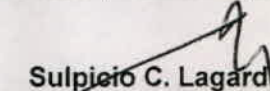
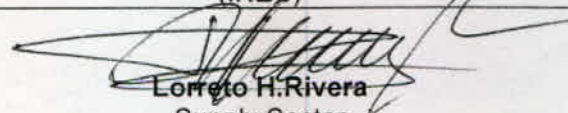
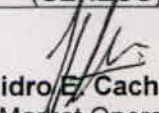
**WHEREAS**, during the same meeting and after due deliberation on the matter, the RCC passed a Resolution approving the Proposed Amendments to the Manual on Load Forecasting Methodology, as discussed and thereafter revised, and its endorsement to the PEM Board;

**NOW THEREFORE**, we, the undersigned and in behalf of the sector we represent, hereby resolve as follows:

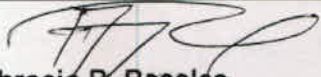
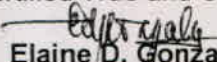
**RESOLVED**, that the Proposed Amendments to the Manual on Load Forecasting Methodology (attached as ANNEX D) are hereby adopted and approved;

**RESOLVED FURTHER**, that the attached proposed amendments on the Manual on Load Forecasting Methodology be endorsed to the PEM Board for its approval.

Done this 08 January 2014, Pasig City.

<p>Approved by:</p> <p><b>RULES CHANGE COMMITTEE</b></p> <p>  <b>Rowena Cristina L. Guevara</b>  Chairperson  University of the Philippines  (UP)</p>	
<p>Members:</p>	
<p>  <b>Concepcion J. Tanglao</b>  Independent</p>	<p>  <b>Francisco L.R. Castro, Jr.</b>  Independent  Tensaiken Consulting</p>
<p>  <b>Maila Lourdes G. de Castro</b>  Independent</p>	<p>  <b>Jose Ferlino P. Raymundo</b>  Generation Sector  SMC Global</p>
<p><b>Theo Cruz Sunico</b>  Generation Sector  1590 Energy Corporation  (1590 EC)</p>	<p>  <b>Joselyn D. Carabuena</b>  Generation Sector  Power Sector Assets and Liabilities Management  Corporation (PSALM)</p>
<p><b>Gilbert A. Pagobo</b>  Distribution Sector (PDU)  Mactan Electric Company  (MECO)</p>	<p><b>Ciprinilo C. Meneses</b>  Distribution Sector (PDU)  Manila Electric Company  (MERALCO)</p>
<p>  <b>Jose P. Santos</b>  Distribution Sector (EC)  Ilocos Norte Electric Cooperative, Inc.  (INEC)</p>	<p>  <b>Sulpicio C. Lagarde Jr.</b>  Distribution Sector (EC)  Central Negros Electric Cooperative, Inc.  (CENECO)</p>
<p>  <b>Lorreto H. Rivera</b>  Supply Sector  Team Energy</p>	<p>  <b>Isidro E. Cacho Jr.</b>  Market Operator  Philippine Electricity Market Corporation  (PEMC).</p>



 <b>Ambrocio R. Rosales</b> Transmission Sector National Grid Corporation of the Philippines (NGCP)	
	Certified True and Correct:  <b>Elaine D. Gonzales</b> RCC Secretary PEMC



**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

**I. Proposer's Information**

Name	MELINDA L. OCAMPO
Designation	President
Signature	<i>Mlocampo</i>
Company	Philippine Electricity Market Corporation
Company Address	18/F Robinsons Equitable Tower, ADB Avenue, Ortigas Center, Pasig City
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 Methodology

Nature of Request (please indicate with x)

☐ Addition ☒ Alteration ☒ Deletion ☐ Clarification ☐ Clerical Correction

III. Proposed Amendment

Title	Section	Provision	Proposed Amendment	Rationale
Please see attached revised manual and discussion paper.				

Note: For convenience, please underline and put in bold letters the proposed changes to the WESM Manual.



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

The revisions to this Manual are made to be consistent to the WESM Rules.

**V. Referral**

MAG Date Received: 06 November 2013 *[Signature]*

Proposed Amendment: ☐ Urgent ☐ Minor ☐ General

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

Date Referred to PEMC President	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Certifies as urgent	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Convene the RCC within 48 hrs.		
Remarks:		

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

Date Referred to RCC:	<u>06 November 2013</u>
Remarks:	
Action taken:	
Request for comments:	<input type="checkbox"/> Yes <input type="checkbox"/> No
	Request written comments from: <input type="checkbox"/> DRG <input type="checkbox"/> MSC <input type="checkbox"/> PA <input type="checkbox"/> MO <input type="checkbox"/> ECO <input type="checkbox"/> RCC <input type="checkbox"/> TC <input type="checkbox"/> Other PEM Board Committees <input type="checkbox"/> Other Interested Parties
For further review of the Technical Sub-Committee:	<input type="checkbox"/> Yes Assigned to: <input type="checkbox"/> SO Sub-Committee <input type="checkbox"/> MO Sub-Committee <input type="checkbox"/> Metering Sub-Committee

	<input type="checkbox"/> Billing and Settlement Sub-Committee <input type="checkbox"/> Legal and Regulatory Sub-Committee <input type="checkbox"/> No
For public consultation:	<input type="checkbox"/> Yes <input type="checkbox"/> No
RCC Resolution:	<input type="checkbox"/> Approved <input type="checkbox"/> Disapproved
RCC Resolution No.:	
Date of Resolution:	
RCC Meeting No.	
Date of endorsement to the PEM Board:	





PUBLIC

## WESM Manual

# Load Forecasting Methodology Issue 2

### Abstract

This Market Manual sets out the procedures for determining load forecast used in the relevant market runs in the Philippine Wholesale Electricity Spot Market

Document Identity:

WESM-LFM

Issue:

2

Reason for Issue:

Incorporate new processes in load forecasting and to address audit findings

Approval Date:

Publication Date:

Effective Date:

esr





### Document Change History

Issue No.	Proponent	Date of Effectivity	Reason for Amendment
0.0	MO Sub-com	2004-08-09	New Document
0.1	MO Sub-com	2004-08-17	Sub-com members comment incorporated
2	PEMC		Revised the entire document in accordance with recommendations made in the report on the operational audit of the market operator systems and processes.

### Document Approval

Issue No.	RCC Approval	RCC Resolution No.	PEM Board Approval	PEM Board Resolution No.
0			2004-08-17 (effective date)	
2				

### Reference Documents

Document ID	Document Title
	WESM Rules
	Philippine Grid Code (PGC)
WESM-DP	WESM Manual on Dispatch Protocol
WESM-PDM	Price Determination Methodology
	PA Consulting Group. <i>Philippine Electricity Market Corporation. 2012 Independent Audit Summary Report</i> (12 December 2012).



Table of Contents

SECTION 1	INTRODUCTION .....	1
1.1.	BACKGROUND .....	1
1.2.	PURPOSE .....	2
1.3.	SCOPE .....	2
SECTION 2	DEFINITIONS, REFERENCES, AND INTERPRETATION .....	3
2.1.	DEFINITIONS .....	3
2.2.	REFERENCES .....	4
2.3.	INTERPRETATION .....	4
SECTION 3	RESPONSIBILITIES .....	4
SECTION 4	DEMAND FORECAST FOR MARKET PROJECTIONS .....	5
4.1.	WEEK-AHEAD AND DAY-AHEAD DEMAND FORECASTS .....	5
4.2.	SIMILAR DAY LOAD FORECAST .....	5
SECTION 5	DEMAND FORECAST FOR THE REAL TIME DISPATCH RUNS .....	7
5.1.	HOURLY-AHEAD DEMAND FORECASTS .....	7
5.2.	LOAD PREDICTOR .....	7
SECTION 6	NET LOAD FORECASTS .....	10
6.1.	UNRESTRAINED NET LOAD FORECAST .....	10
6.2.	RESTRAINED NET LOAD FORECAST .....	11
6.3.	INITIAL LOSS PERCENTAGE .....	12
SECTION 7	CUSTOMER FORECASTS .....	13
7.1.	CUSTOMER FORECAST SUBMISSION .....	13
7.2.	CUSTOMER FORECAST VALIDATION .....	13
7.3.	SUBMISSION OF TRADING PARTICIPANT LOAD INFORMATION .....	13
SECTION 8	LOAD FORECASTING CONSIDERATIONS .....	14
8.1.	WEATHER DATA .....	14
8.2.	LOAD DEMAND .....	14
8.3.	POWER SYSTEM CONDITION .....	16
8.4.	LOAD PROFILE .....	16
8.5.	LOAD GROWTH .....	17
SECTION 9	LOAD FORECAST AUDIT AND PERFORMANCE MEASURES .....	17
SECTION 10	AMENDMENTS, PUBLICATION AND EFFECTIVITY .....	17
SECTION 11	APPENDIX .....	18

Bar





## SECTION 1 INTRODUCTION

### 1.1. BACKGROUND

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.

1.1.2. The following *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 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) direct that at the beginning of each interval, the *Market Operator* shall prepare a forecast of the *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.
- 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*.
- e) *WESM Rules* Clause 3.5.4.3 states 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*.
- f) *WESM Rules* Clause 3.5.4.4 states 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.

1.1.3. *Customers* are permitted under *WESM Rules* Clause 3.5.4.1 to submit their own load forecast that shall be used by the *Market Operator* in the preparation of *Net Load Forecast* subject to the certain conditions.

- 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 the week in accordance with the *WESM Timetable*. The *timetable* is set out in Section 5 of the *WESM Dispatch Protocol Manual*.
- 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.

## 1.2. PURPOSE

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.

## 1.3. SCOPE

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 of load forecasts to be used for the *week-ahead projections (WAP)*, *day-ahead projections (DAP)*, and *ex-ante* market runs in the *WESM*.

22/11/19





SECTION 2 DEFINITIONS, REFERENCES, AND INTERPRETATION

2.1. DEFINITIONS

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. **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.
- 2.1.2. **Demand Forecast** refers to the *Demand* projection for a particular *Forecast Area*.
- 2.1.3. **Final Demand Forecast** refers to the sum of the *Net Load Forecasts* plus the losses in a *Forecast Area*.
- 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.
- 2.1.5. **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*.
- 2.1.6. **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.
- 2.1.7. **Load Profile** or **Load Pattern** (interchangeably) refers to the time series representation of *Demand*.
- 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*.
- 2.1.9. **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.
- 2.1.10. **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.

## 2.2. REFERENCES

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)

## 2.3. INTERPRETATION

- 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.

<b>SECTION 3 RESPONSIBILITIES</b>
-----------------------------------

### 3.1. MARKET OPERATOR

- 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*.

### 3.2. SYSTEM OPERATOR

- 3.2.1. The *System Operator* shall provide the information required from them to the *Market 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*.





### 3.3. TRADING PARTICIPANTS

- 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.

## SECTION 4 DEMAND FORECAST FOR MARKET PROJECTIONS

### 4.1. 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*.
- 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)*.
- 4.1.3. The summation of the *Net Load Forecast* plus the losses computed for a *Forecast Area* after the optimization process in the relevant market run (i.e., WAP or DAP) constitutes the *Final Demand Forecast* for that *Forecast Area*.
- 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*.

### 4.2. 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.
- 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<sup>1</sup>, and then applies customer provided factors to produce the *Demand Forecasts* for each *Forecast Area*.

<sup>1</sup> Curves of best fit are identified through statistical curve fitting.



- 4.2.3. Given a daily forecasted weather data, the SDLF calculates *Demand Forecasts* based on historical demand and weather data. 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<sup>2</sup>, and then applies customer provided factors to produce the *Demand Forecasts* for each *Forecast Area*.
- 4.2.4. Procedure for Day-Ahead Forecast
- a) Through the Market Management System's *Similar Day Load Forecast* (SDLF) module, the *Market 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. boxing event)
    - 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 1.
  - 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.
- 4.2.5. 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.
- 4.2.6. Each projected load scenario shall be saved onto different cases by the Market Operator through the available forecasting facility.

<sup>2</sup> Curves of best fit are identified through statistical curve fitting.





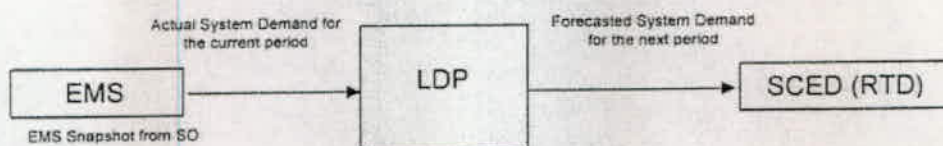
SECTION 5 DEMAND FORECAST FOR THE REAL TIME DISPATCH RUNS

5.1. 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.
- 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).
- 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.
- 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.

5.2. LOAD PREDICTOR

- 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.
- 5.2.2. 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).
- 5.2.3. 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.



- 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

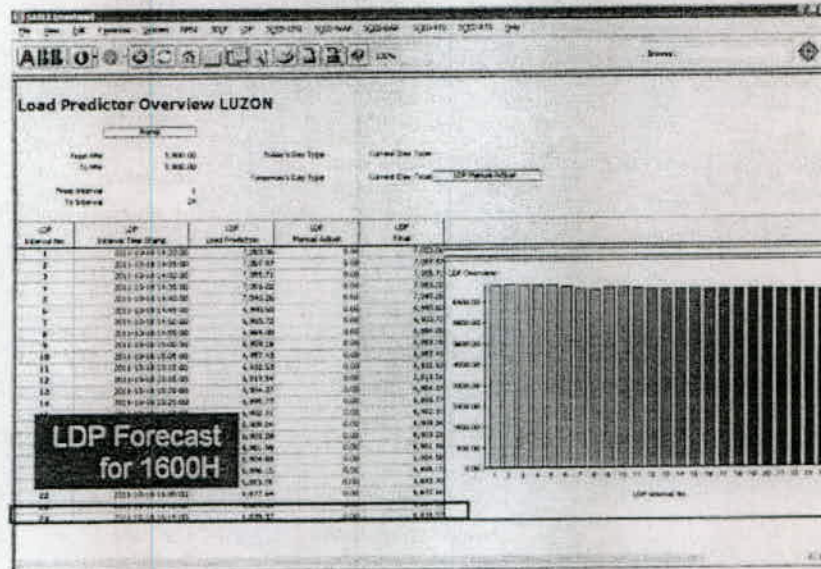
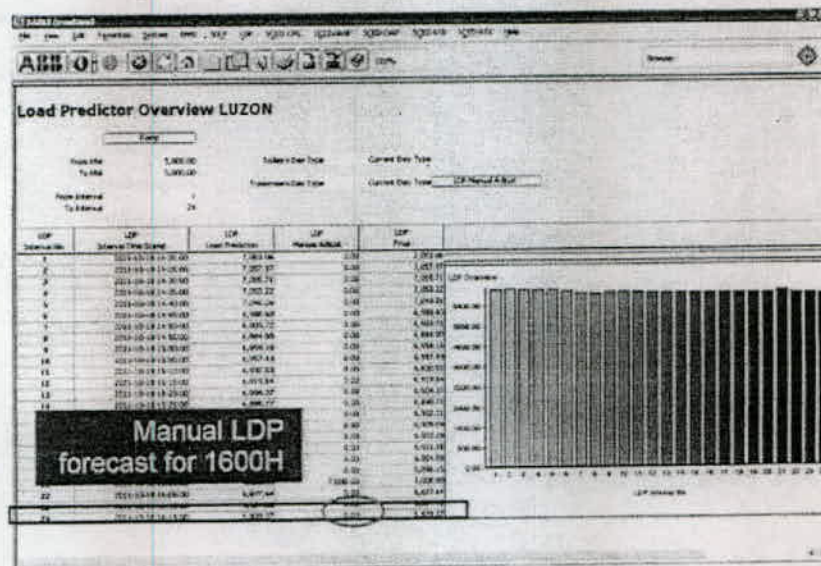


Figure 2. LDP Screenshot 2







#### 5.2.5. LDP Algorithm

- a) The following algorithm is followed by the LDP in order to forecast *Demand* for the succeeding time intervals.
  - i. Target Loads are computed for the forecast horizon
  - ii. Deviations between the target load and the current actual load are computed
  - iii. Predict the target load error for each of the intervals in the forecast horizon based on the target load error derived from the previous step
  - iv. Adjust the target load by the predicted error. The adjusted value will become the forecasted demand
- b) Target loads are derived using different load shapes. There is at least 7 load shapes in the MMS corresponding to the seven days in a week (Monday to Sunday). Other load shapes are reserved for holidays. Each load shape has a 24x12 dataset that represents 12 5-minute intervals for each of the 24 hours in a day. This dataset is comprised of 288 predicted errors or change in load values. These values are adaptively updated. The forecasted demand is computed by adding these values successively in each of the 5-minute intervals in the forecast horizon.
- c) On the other hand, new load targets are computed with the estimate of the current actual demand obtained through the second-order Kalman-Filter Formulation. The predicted error uses the Box-Jenkins Model, which is a time series forecast using an auto-regressive moving average (ARMA) model. A detailed example is shown in *Appendix A* of this *Market Manual*.

*Qmar*



SECTION 6 NET LOAD FORECASTS

Pursuant to WESM Rules Clause 3.5.4.1, the Market Operator shall prepare a *Net Load Forecast*, which are 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).

6.1. UNRESTRAINED NET LOAD FORECAST

- 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.
- 6.1.2. *Unrestrained Net Load Forecasts* shall exclude *scheduled loads*.
- 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*.
- 6.1.4. 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.

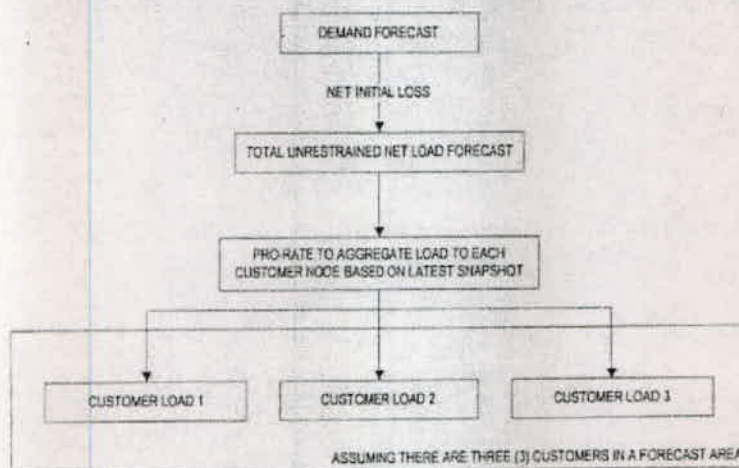


Figure 3. High-Level Diagram to obtain the *Unrestrained Net Load Forecast*





- 6.1.5. The Total *Unrestrained Net Load Forecast* can be interpreted in the following equation.

$$\text{Total UNLF} = \text{Demand Forecast} \times (1 - \text{Initial Loss Percentage}_{FA})$$

Where:

UNLF – *Unrestrained Net Load Forecast*

Initial Loss Percentage<sub>FA</sub> – Initial Loss Percentage in FA

FA – Forecast Area

- 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.

$$\text{UNLF}_i = \frac{\text{Total UNLF}}{\text{Total Actual Load}_{FA, \text{LATEST}}} \times \text{Actual Load}_{i, FA, \text{LATEST}}$$

Where:

UNLF<sub>i</sub> – *Unrestrained Net Load Forecast* of Customer Node i

Total Actual Load<sub>FA, LATEST</sub> – Sum of Actual Loads in a Forecast Area where Customer Node i belongs based on the latest system snapshot

Actual Load<sub>i, FA, LATEST</sub> – Actual Load of Customer Node i 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*.

## 6.2. **RESTRAINED NET LOAD FORECAST**

- 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).
- 6.2.2. A Customer Node's projected load will be shed should its price reach the level of the VoLL price.
- 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*.

WESM



$$RNLF_i = UNLF_i - \text{Load Shed}_i$$

Where:

$RNLF_i$ — *Restrained Net Load Forecast* of Customer Node  $i$

$UNLF_i$ — *Unrestrained Net Load Forecast* of Customer Node  $i$

$\text{Load Shed}_i$ — amount of load to be shed at Customer Node  $i$

### 6.3. 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.
- 6.3.2. 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<sup>3</sup>.

<sup>3</sup><http://www.wesm.ph>

*Emv*





SECTION 7 CUSTOMER FORECASTS

7.1. 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).
- 7.1.2. A Customer may only submit a load forecast for a Market Trading Node that is solely registered to them.
- 7.1.3. Each Customer may, at its option, submit forecasts for its respective Market Trading Node.
- 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. 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.
- 7.1.6. 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)
- 7.1.8. Customer forecasts shall be considered as the official schedule of the Real-Time Dispatch.

7.2. CUSTOMER FORECAST VALIDATION

- 7.2.1. A Customer Forecast shall only be considered in the market projections and the Real-Time Dispatch if the forecasted value is within the Customer Forecast Tolerance Range.
- 7.2.2. The **Customer Forecast Tolerance Range** shall be based on the approved percentage for determining the reserve requirement for regulation.

7.3. SUBMISSION OF TRADING PARTICIPANT LOAD INFORMATION

- 7.3.1. The *Market Operator* shall select certain Customers to provide relevant information that can serve as an input for the determination of *Demand Forecasts* and *Net Load Forecasts* for the market projections and Real-Time Dispatch.

*gar*



7.3.2. The *Market Operator* shall require the relevant Customer to provide pertinent information regarding its load profile based on an agreed timeline. Such information may include the following.

- a) Load profile representing the characteristics of the load connected to the associated market trading node; and
- b) Un-metered loads and or house loads.

## SECTION 8 LOAD FORECASTING CONSIDERATIONS

### 8.1. 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:

- a) Temperature
- b) Humidity
- c) Wind direction
- d) Wind speed
- e) Sky cover (0 = clear, 10 = maximum overcast)
- f) Precipitation

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*.

8.1.3. The *Market Operator* shall maintain a repository of the historical weather-related information.

### 8.2. 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.

8.2.2. Real-time information shall include telemetered data with provisions for state-estimation for higher reliability and accuracy. Such information shall form part of the Demand Forecast and the Net Load Forecast prepared by the Market Operator.





- 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.
- 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.
- 8.2.5. Customers shall have the option to provide their own hourly demand forecast at their own Market Trading Node to be used in the determination of market projections and real-time dispatch in accordance with WESM timetable.

a) 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.

b) Customer Load Forecast Adjustment

Load adjustment factors shall be established by the Customer and his Meter Service Provider and shall be submitted to the Market Operator. The adjustment factors shall consider site-specific losses and other factors deemed necessary to reflect accurate customer load forecast at his market trading node.

c) Default Customer Load Forecast

Should the Customer not be able to provide a forecast in accordance with the WESM timetable, or their forecast is beyond the acceptable tolerance, the Market Operator shall consider its own forecast for the customer.

d) Customer Forecast Timeline

Customers may be able to provide their own load forecast based on the Open Market Window defined in Section 4.4 of the WESM Manual on Dispatch Protocol.

22/08



### 8.3. POWER SYSTEM CONDITION

- 8.3.1. The *Market Operator* shall consider the forecasted power system condition in the preparation of net load forecast. These shall include planned maintenance (transmission, sub-transmission, and generation), large customer maintenance schedules, and other activities, including generator testing and commissioning that may have an impact on the preparation of market projections and real-time dispatch.
- 8.3.2. The *System Operator* shall ensure that all relevant information is provided to the *Market Operator* in accordance with the WESM timetable.
- 8.3.3. For unplanned power system conditions, the *System Operator* shall ensure that all relevant information is timely provided to the Market Management System through the Energy Management System or other means of communication to the *Market Operator*.
- 8.3.4. All Trading Participants shall also ensure that information regarding any unplanned activity or condition is timely provided to the *System Operator*.

### 8.4. LOAD PROFILE

- 8.4.1. For similar day load forecasts, the *Market Operator* may utilize static profiling, proxy day profiling, and estimated or deemed profiling or a combination thereof. The *Market Operator* shall use all reasonable endeavors to provide the most appropriate load profile in determining demand and net load forecasts.
- 8.4.2. The *Market Operator* may consider typical day representations for any day of the week and season combination. Static profiling shall consider day of the week profile, holidays, and special events profile. The *Market Operator* should note that static profiles do not reflect operating conditions of the day being estimated.
- 8.4.3. The *Market Operator* may consider selecting a day in history that most closely matches the day being estimated. The proxy day can be chosen based on either on weather forecast and/or system load. Actual data from the sample for the selected proxy day shall then be used to create the profile. Proxy day profiling shall consider day of the week profile, holidays and special events profile.
- 8.4.4. The *Market Operator* may obtain *Demand Forecasts* using engineering estimates, if and when necessary, for very predictable loads such as street lighting or residential area from Trading Participants.

Bar





8.5. LOAD GROWTH

The *Market Operator* shall consider the projected growth of load demand for each *Forecast Area* in the preparation of Net Load Forecasts. For consistency, the *Market Operator* shall consider information from the Department of Energy (DOE) for the load growth values.

SECTION 9 LOAD FORECAST AUDIT AND PERFORMANCE MEASURES

- 9.1. The *Market Operator* shall log all transactions performed for the determination of net load forecast including the uploading of the optional Customer's load demand forecast.
- 9.2. The *Market Operator* shall monitor the actual and forecasted load demand for each relevant market trading node.
- 9.3. The *Market Operator* shall evaluate the *Net Load Forecast Performance*.
- 9.4. The *Market Operator* shall evaluate the *Demand Forecast Performance* pursuant to the performance standards that shall be maintained pursuant to *WESM Rules* Clause 10.4.10.2.

SECTION 10 AMENDMENTS, PUBLICATION AND EFFECTIVITY

10.1. AMENDMENTS TO THIS MANUAL

Any amendment to, or revision to this Manual shall be approved by the PEM Board.

10.2. PUBLICATION AND EFFECTIVITY

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)



SECTION 11 APPENDIX

Appendix A. LDP Methodology Sample

In order to fully understand the LDP algorithm, the following example shall be used.

Assume the current forecast load for the next five-minute intervals is 1000 MW. For the first 3 5-minute interval, the following predicted errors were obtained from the corresponding load shape.

Interval	Predicted Error
1	-34
2	-15
3	5

The forecasted demand shall be obtained by using the change in load value (predicted error) in the load shape, and shall then be added to the previous forecasted demand.

$$\text{Forecast}_n = \text{Forecast}_{n-1} + \Delta\text{Load}_n$$

The following forecasted loads shall be obtained as such

Interval	Predicted Error	Computation	Forecast Load
1	-34	-- Current Forecast --	1000
2	-15	1000 - 15	985
3	5	985 + 5	990

As previously stated, the change in load values is adaptively updated. It uses a portion of the old slope, depending on the percentage share (alpha, smoothing parameter for historical slope update, as much as 1 or 100%) designated, and the remaining share is for the new slope. Once the LDP runs, the relevant change in load value in the load shape at that time will be updated. With this concept, the change in load value maintains its previous slope characteristics, and then uses the current slope's characteristics. The alpha value is configurable in the MMS.

gmo





**Appendix B. List of Prospective Weather Data Providers**

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



**Wholesale Electricity  
Spot Market**

**ANNEX A**

# **PROPOSED REVISIONS TO THE LOAD FORECASTING METHODOLOGY MANUAL**

**Philippine Electricity Market Corporation**

August 2013

*ban*



## **I. SUMMARY OF THE PROPOSED RULES CHANGE**

PEMC proposes revisions to the WESM Manual on the Load Forecasting Methodology in view of the following requirements.

1. Concrete and complete documentation of the processes involved in load forecasting, citing specific compliances to the WESM Rules as distinguished by PA Consulting during their yearly operational audit
2. New standardized documentation framework for WESM Manuals

## **II. BACKGROUND**

The WESM Manual on the Load Forecasting Methodology was developed by the Market Operator, in consultation with the System Operator, prior to the commercial operations of the spot market pursuant to the WESM Rules Clause 10.4.9. Although the initial intent was to highlight the procedures involved in determining load forecasts, the originally drafted Market Manual was unable to properly convey the processes that make it compliant to the provisions of the WESM Rules on load forecasting.

### ***Market Operations Audit***

During the 2011 Operational Audit of PA Consulting, the WESM Manual on the Load Forecasting Methodology obtained a "Red" score as it sorely lacked in the areas of "Compliance", "Context", "Process", and "Governance".

PA Consulting noted that there should be ample provisions in the Market Manual to state each of the required compliances of the Market Operator in preparing load forecasts.

In terms of "Context", clear references to other related documents should be amply provided, as well as all the responsibilities of the Market Operator in preparing load forecasts.

PA Consulting also noted that the "processes" involved are out of date, vague, and contain insufficient information.

### ***New Format for WESM Manuals***

PEMC initiated a standardized format for all WESM Manuals in view of the audit findings regarding its context and governance mechanisms.

## **III. THE PROPOSED RULES CHANGE**

*gnd*

The proposed changes on the Market Manual on the Load Forecasting Methodology are aimed to re-organize its content so that it could properly account for all the compliances required from the WESM Rules. Although the Market Operator prepares load forecasts through processes that are compliant to the specific provisions in the WESM Rules, the Market Manual was not able to amply describe such processes.

As such, the proposed changes in the Load Forecasting Market Manual intends to properly and completely document all the processes involved in load forecasting, while highlighting how such processes are compliant to the WESM Rules.

The proposed changes mainly involve the preparation of unrestrained and restrained load forecasts for the market projections (week-ahead and day-ahead projections), and for the hour-ahead forecast. The proposed revisions include specific details of the processes involved in deriving the unrestrained and restrained forecasts, particularly focusing on how nodal forecasts are derived from the regional forecasts produced by the Market Operator.

The proposed changes also include details of the parameters used in preparing load forecasts in the WESM, such as the initial loss percentage and the customer forecast tolerance range.

Should the proposed changes be not implemented, the Market Operator would still have compliance issues in terms of having an ample and appropriate documentation for load forecasting in WESM as it would still obtain a "Red" score in operational audits. Also, new details on the initial loss percentage and customer forecast tolerance range are not properly documented so that it can be amply implemented.

#### **IV. BACKGROUND AND DESCRIPTION OF THE PROPONENT**

The proponent is the Philippine Electricity Market Corporation. PEMC acts as both the market operator and governance arm of the WESM.

Top Officers:

M. L. Ocampo – President

C. C. Claudio – VP, Trading Operations

C. S. Heruela – VP, Market Assessment

R. P. Descanzo – VP, Corporate Planning & Communications

C. S. Martin-Funelas – VP, Legal

#### **V. CONCLUSIONS AND RECOMMENDATIONS**

The proposed revisions on the Market Manual on the Load Forecasting Methodology amply provide detailed documentation of the processes involved in



preparing load forecasts for the different workflows in the WESM. Hence, it is recommended that the proposed revised Market Manual be adopted.

## VI. REFERENCES

1. WESM Rules
2. PA Consulting's PEMC Procedure Review Report (2011)

## SN ABOITIZ POWER (SNAP)

Proposed Amendments  
Title

## Section

## Provision

## Proposed Amendments

## Comment

Load forecasting methodology	4.2.2 and 4.2.3	(New)	The SDLF calculates Demand Forecast....	Section 4.2.2 and 4.2.3 are nearly the same, except for a rephrasing of "Weather data used is forecasted daily". Unless purposely intended, we suggest elimination of either section or integration of the two.
	4.2.4.a	(New)	a) ....based on the following conditions:...other weather conditions	clarification, what are under 'Other Weather Conditions', suggestion include vii. Climate conditions
	4.2.4.b	(New)	b) The SDLF module shall initially prepare a set of Demand forecast by averaging the Daily Demand Profiles selected in item 1.	clarification, what is being referred to as item 1? Is it section 4.2.4.a?
	5.1.1	(New)	Demand Forecasts for the next hour in each Forecast Area shall be...	suggestion space between Area and Shall " <b>Area shall</b> "
	5.2.5.b	(New)	Target loads are derived using different load shapes. There is at least 7...	suggestion, replace "There is" with " <b>There are</b> ".
	6	(New)	Pursuant to the WESM Rules Clause 3.5.4.1 the Market Operator shall prepare a Net Load Forecast, which are either Unrestrained or Restrained.	suggestion, replace "Which are either" with " <b>which is either</b> "
	7.1.4	(New)	Each customer that intends to participate in this optional program shall require approval from the Market Operator for accounting and validation purposes.	suggestion, replace the word 'require', the word ' <b>seek</b> ' or ' <b>obtain</b> ' is deemed more appropriate.
	8.1.2	(New)	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	Missing statements/reference in " <b>listed in of this Market Manual</b> ".



## RCC Deliberation on SN Aboitiz Power's (SNAP) Comments on the Proposed Amendments to Load Forecasting

Section	Proposed Amendments	SNAP Comments	RCC Comments
4.2.2 and 4.2.3	<p>4.2.2 The SDLF calculates <i>Demand Forecasts</i> based on historical demand and weather data. Weather data used is forecasted daily. The demand profile consists of actual <i>Hourly Average Loads</i>, 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<sup>1</sup>, and then applies customer provided factors to produce the <i>Demand Forecasts</i> for each <i>Forecast Area</i>.</p> <p>4.2.3 Given a daily forecasted weather data, the SDLF calculates <i>Demand Forecasts</i> based on historical demand</p>	<p>Section 4.2.2 and 4.2.3 are nearly the same, except for a rephrasing of "Weather data used is forecasted daily". Unless purposely intended, we suggest elimination of either section or integration of the two.</p>	<p>Agreed with the comments and proposed the deletion of 4.2.3. As a result, renumbering was made on provisions affected.</p>

<sup>1</sup> Curves of best fit are identified through statistical curve fitting.

## RCC Deliberation on SN Aboitiz Power's (SNAP) Comments on the Proposed Amendments to Load Forecasting

Section	Proposed Amendments	SNAP Comments	RCC Comments
	and weather data. The demand profile consists of actual <i>Hourly Average Loads</i> , 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 <sup>2</sup> and then applies customer provided factors to produce the <i>Demand Forecasts</i> for each <i>Forecast Area</i> .		
4.2.4.a	<p>4.2.4 Procedure for Day-Ahead Forecast</p> <p>a) Through the Market Management System's <i>Similar Day Load Forecast</i> (SDLF) module, the <i>Market Operator</i> shall select a set of <i>Daily Demand Profiles</i> based on the following conditions</p>	Clarification, what are under 'Other Weather Conditions', suggestion include vii. Climate conditions	RCC did not consider the suggestion to include additional conditions such as Climate conditions deeming that weather conditions is sufficient. The RCC suggested though that instead of a boxing event as the example of a special event, the earth hour be used instead.

<sup>2</sup> Curves of best fit are identified through statistical curve fitting.



## RCC Deliberation on SN Aboitiz Power's (SNAP) Comments on the Proposed Amendments to Load Forecasting

Section	Proposed Amendments	SNAP Comments	RCC Comments
	<ul style="list-style-type: none"> <li>i. Similar Day load profile pattern (Sun, Mon, Tue-Wed-Thurs, Fri, Sat, and holiday)</li> <li>ii. Special Events, (e.g. boxing event)</li> <li>iii. Temperature</li> <li>iv. Humidity</li> <li>v. Other Weather conditions</li> <li>vi. Other Factors as deemed appropriate by the Market Operator</li> </ul>		
4.2.4.b	The SDLF module shall initially prepare a set of <i>Demand Forecasts</i> by averaging the Daily <i>Demand Profiles</i> selected in item 1.	Clarification, what is being referred to as item 1? Is it section 4.2.4.a?	PEMC clarified that what is being referred to as item 1 is item i under 4.2.4 a.
5.1.1	<i>Demand Forecasts</i> for the next hour in each <i>Forecast Area</i> shall be determined by the <i>Market Operator</i> using the <i>Load Predictor (LDP)</i> module of the <i>Market Management System</i> .	Suggestion - space between Area and Shall "Area shall"	<p>Okay. For clerical revision as suggested.</p> <p><i>Demand Forecasts</i> for the next hour in each <i>Forecast Area</i> shall be determined by the <i>Market Operator</i> using the <i>Load Predictor (LDP)</i> module of the <i>Market Management System</i>.</p>
	5.2.5 LDP Algorithm	Suggestion, replace "There is" with "There are".	Okay. For clerical revision as suggested.

## RCC Deliberation on SN Aboitiz Power's (SNAP) Comments on the Proposed Amendments to Load Forecasting

Section	Proposed Amendments	SNAP Comments	RCC Comments
5.2.5.b	<p>a) The following algorithm xxxx ..</p> <p>b) Target loads are derived using different load shapes. There is at least 7 load shapes in the MMS corresponding to the seven days in a week (Monday to Sunday). xxx</p>		<p>5.2.5 LDP Algorithm</p> <p>a) The following algorithm xxxx ..</p> <p>b) Target loads are derived using different load shapes. There <b>are is</b> at least 7 load shapes in the MMS corresponding to the seven days in a week (Monday to Sunday). xxx</p>
6	Pursuant to WESM Rules Clause 3.5.4.1, the Market Operator shall prepare a <i>Net Load Forecast</i> , which are either <i>Unrestrained</i> or <i>Restrained</i> . Both shall be provided by the Market Operator in the market projections (WAP and DAP) and the Real-Time Dispatch (RTD).	Suggestion, replace "Which are either" with "which is either"	<p>Okay. For revision as suggested.</p> <p>Pursuant to WESM Rules Clause 3.5.4.1, the Market Operator shall prepare a <i>Net Load Forecast</i>, which <b>are is</b> either <i>Unrestrained</i> or <i>Restrained</i>. Both shall be provided by the Market Operator in the market projections (WAP and DAP) and the Real-Time Dispatch (RTD).</p>
7.1.4.	Each Customer that intends to participate in this optional program shall require approval from the <i>Market Operator</i> for accounting and validation purposes.	Suggestion, replace the word 'require', the word 'seek' or 'obtain' is deemed more appropriate.	<p>Okay. For revision as suggested</p> <p>Each Customer that intends to participate in this optional program shall <b>obtain require</b> approval from the <i>Market Operator</i> for accounting and validation purposes.</p>



## RCC Deliberation on SN Aboitiz Power's (SNAP) Comments on the Proposed Amendments to Load Forecasting

Section	Proposed Amendments	SNAP Comments	RCC Comments
8.1.2	Such weather information shall be obtained from a reliable source deemed appropriate by the <i>Market Operator</i> . Prospective weather data providers are listed in of this <i>Market Manual</i> .	Missing statements/reference in "listed in of this Market Manual".	<p>Okay. For revision as suggested</p> <p>Such weather information shall be obtained from a reliable source deemed appropriate by the <i>Market Operator</i>. Prospective weather data providers are listed in <b>Appendix B</b> of this <i>Market Manual</i>.</p>



Load Forecasting Methodology

WESM-LFM-002

**PUBLIC**

## **WESM Manual**

---

# **Load Forecasting Methodology Issue 2**

---

Abstract	This Market Manual sets out the procedures for determining load forecast used in the relevant market runs in the Philippine Wholesale Electricity Spot Market
----------	---

Document Identity:

WESM-LFM

Issue:

2

Reason for Issue:

Incorporate new processes in load forecasting and to address audit findings

Approval Date:

Publication Date:

Effective Date:

*25/10/20*





## Document Change History

Issue No.	Proponent	Date of Effectivity	Reason for Amendment
0.0	MO Sub-com	2004-08-09	New Document
0.1	MO Sub-com	2004-08-17	Sub-com members comment incorporated
2	PEMC		Revised the entire document in accordance with recommendations made in the report on the operational audit of the market operator systems and processes.

## Document Approval

Issue No.	RCC Approval	RCC Resolution No.	PEM Board Approval	PEM Board Resolution No.
0			2004-08-17 (effective date)	
2				

## Reference Documents

Document ID	Document Title
	WESM Rules
	Philippine Grid Code (PGC)
WESM-DP	WESM Manual on Dispatch Protocol
WESM-PDM	Price Determination Methodology
	PA Consulting Group. <i>Philippine Electricity Market Corporation. 2012 Independent Audit Summary Report</i> (12 December 2012).



## Table of Contents

SECTION 1	INTRODUCTION.....	1
1.1.	BACKGROUND.....	1
1.2.	PURPOSE.....	2
1.3.	SCOPE.....	2
SECTION 2	DEFINITIONS, REFERENCES, AND INTERPRETATION.....	3
2.1.	DEFINITIONS.....	3
2.2.	REFERENCES.....	4
2.3.	INTERPRETATION.....	4
SECTION 3	RESPONSIBILITIES.....	4
SECTION 4	DEMAND FORECAST FOR MARKET PROJECTIONS.....	5
4.1.	WEEK-AHEAD AND DAY-AHEAD <i>DEMAND FORECASTS</i> .....	5
4.2.	<i>SIMILAR DAY LOAD FORECAST</i> .....	5
SECTION 5	DEMAND FORECAST FOR THE REAL TIME DISPATCH RUNS.....	7
5.1.	HOOR-AHEAD <i>DEMAND FORECASTS</i> .....	7
5.2.	<i>LOAD PREDICTOR</i> .....	7
SECTION 6	NET LOAD FORECASTS.....	10
6.1.	<i>UNRESTRAINED NET LOAD FORECAST</i> .....	10
6.2.	<i>RESTRAINED NET LOAD FORECAST</i> .....	11
6.3.	INITIAL LOSS PERCENTAGE.....	12
SECTION 7	CUSTOMER FORECASTS.....	13
7.1.	CUSTOMER FORECAST SUBMISSION.....	13
7.2.	CUSTOMER FORECAST VALIDATION.....	13
7.3.	SUBMISSION OF TRADING PARTICIPANT LOAD INFORMATION.....	13
SECTION 8	LOAD FORECASTING CONSIDERATIONS.....	14
8.1.	WEATHER DATA.....	14
8.2.	LOAD DEMAND.....	14
8.3.	POWER SYSTEM CONDITION.....	16
8.4.	LOAD PROFILE.....	16
8.5.	LOAD GROWTH.....	17
SECTION 9	LOAD FORECAST AUDIT AND PERFORMANCE MEASURES.....	17
SECTION 10	AMENDMENTS, PUBLICATION AND EFFECTIVITY.....	17
SECTION 11	APPENDIX.....	18

ESR



**SECTION 1 INTRODUCTION****1.1. BACKGROUND**

- 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.
- 1.1.2. The following *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 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) direct that at the beginning of each interval, the *Market Operator* shall prepare a forecast of the *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.
  - 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*.
  - e) *WESM Rules* Clause 3.5.4.3 states 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*.
  - f) *WESM Rules* Clause 3.5.4.4 states 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.

1.1.3. *Customers* are permitted under *WESM Rules* Clause 3.5.4.1 to submit their own load forecast that shall be used by the *Market Operator* in the preparation of *Net Load Forecast* subject to the certain conditions.

- 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 the week in accordance with the *WESM Timetable*. The *timetable* is set out in Section 5 of the *WESM Dispatch Protocol Manual*.
- 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.

## 1.2. PURPOSE

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.

## 1.3. SCOPE

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 of load forecasts to be used for the *week-ahead projections* (WAP), *day-ahead projections* (DAP), and *ex-ante* market runs in the *WESM*.



## SECTION 2 DEFINITIONS, REFERENCES, AND INTERPRETATION

### 2.1. DEFINITIONS

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. **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.
- 2.1.2. **Demand Forecast** refers to the *Demand* projection for a particular *Forecast Area*.
- 2.1.3. **Final Demand Forecast** refers to the sum of the *Net Load Forecasts* plus the losses in a *Forecast Area*.
- 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.
- 2.1.5. **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*.
- 2.1.6. **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.
- 2.1.7. **Load Profile** or **Load Pattern** (interchangeably) refers to the time series representation of *Demand*.
- 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*.
- 2.1.9. **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.
- 2.1.10. **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.



## 2.2. REFERENCES

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)

## 2.3. INTERPRETATION

- 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.

<b>SECTION 3 RESPONSIBILITIES</b>
-----------------------------------

### 3.1. MARKET OPERATOR

- 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*.

### 3.2. SYSTEM OPERATOR

- 3.2.1. The *System Operator* shall provide the information required from them to the *Market 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*.



**3.3. TRADING PARTICIPANTS**

- 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.

<b>SECTION 4 DEMAND FORECAST FOR MARKET PROJECTIONS</b>
---

**4.1. 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*.
- 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).
- 4.1.3. The summation of the *Net Load Forecast* plus the losses computed for a *Forecast Area* after the optimization process in the relevant market run (i.e., WAP or DAP) constitutes the *Final Demand Forecast* for that *Forecast Area*.
- 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*.

**4.2. 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.
- 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<sup>1</sup>, and then applies customer provided factors to produce the *Demand Forecasts* for each *Forecast Area*.

<sup>1</sup> Curves of best fit are identified through statistical curve fitting.

**4.2.3. Procedure for Day-Ahead Forecast**

- a) Through the Market Management System's *Similar Day Load Forecast* (SDLF) module, the *Market 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.

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.





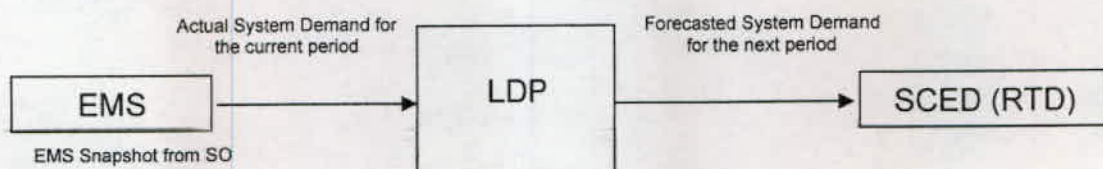
## SECTION 5 DEMAND FORECAST FOR THE REAL TIME DISPATCH RUNS

### 5.1. 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.
- 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).
- 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.
- 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.

### 5.2. LOAD PREDICTOR

- 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.
- 5.2.2. 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).
- 5.2.3. 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.



- 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.

25/10/19

Figure 1. LDP Screenshot 1

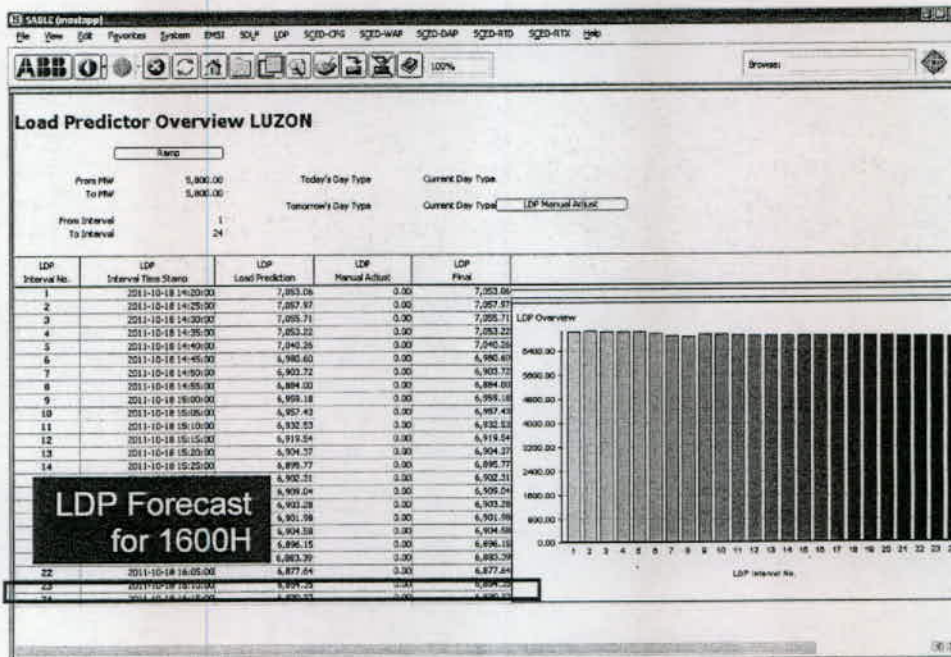
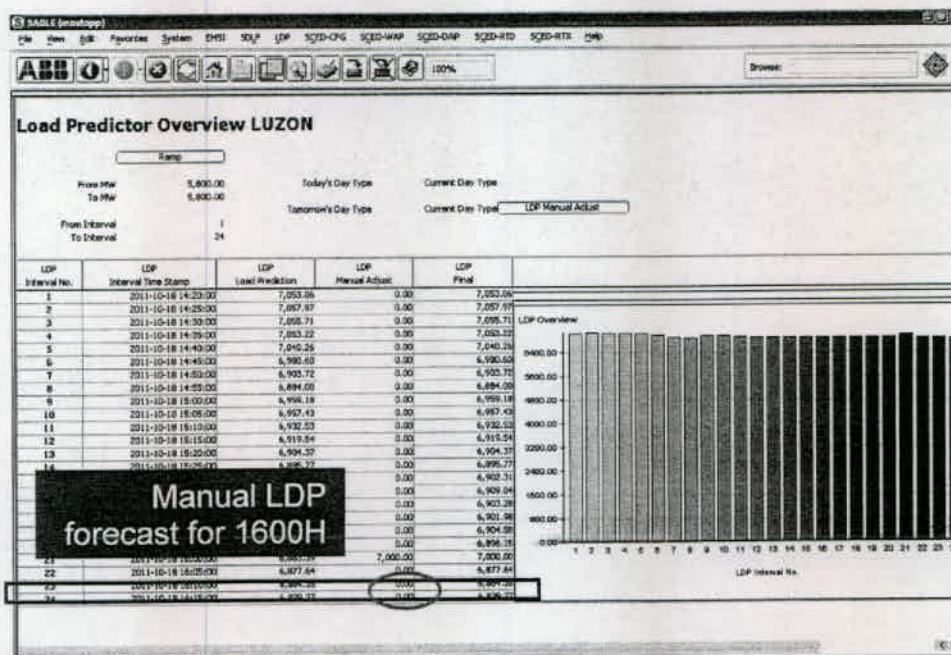


Figure 2. LDP Screenshot 2







### 5.2.5. LDP Algorithm

- a) The following algorithm is followed by the LDP in order to forecast *Demand* for the succeeding time intervals.
  - i. Target Loads are computed for the forecast horizon
  - ii. Deviations between the target load and the current actual load are computed
  - iii. Predict the target load error for each of the intervals in the forecast horizon based on the target load error derived from the previous step
  - iv. Adjust the target load by the predicted error. The adjusted value will become the forecasted demand
- b) Target loads are derived using different load shapes. There are at least 7 load shapes in the MMS corresponding to the seven days in a week (Monday to Sunday). Other load shapes are reserved for holidays. Each load shape has a 24x12 dataset that represents 12 5-minute intervals for each of the 24 hours in a day. This dataset is comprised of 288 predicted errors or change in load values. These values are adaptively updated. The forecasted demand is computed by adding these values successively in each of the 5-minute intervals in the forecast horizon.
- c) On the other hand, new load targets are computed with the estimate of the current actual demand obtained through the second-order Kalman-Filter Formulation. The predicted error uses the Box-Jenkins Model, which is a time series forecast using an auto-regressive moving average (ARMA) model. A detailed example is shown in *Appendix A* of this *Market Manual*.

## SECTION 6 NET LOAD FORECASTS

Pursuant to WESM Rules Clause 3.5.4.1, the Market Operator shall prepare a *Net Load Forecast*, which is 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).

### 6.1. UNRESTRAINED NET LOAD FORECAST

- 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.
- 6.1.2. *Unrestrained Net Load Forecasts* shall exclude *scheduled loads*.
- 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*.
- 6.1.4. 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.

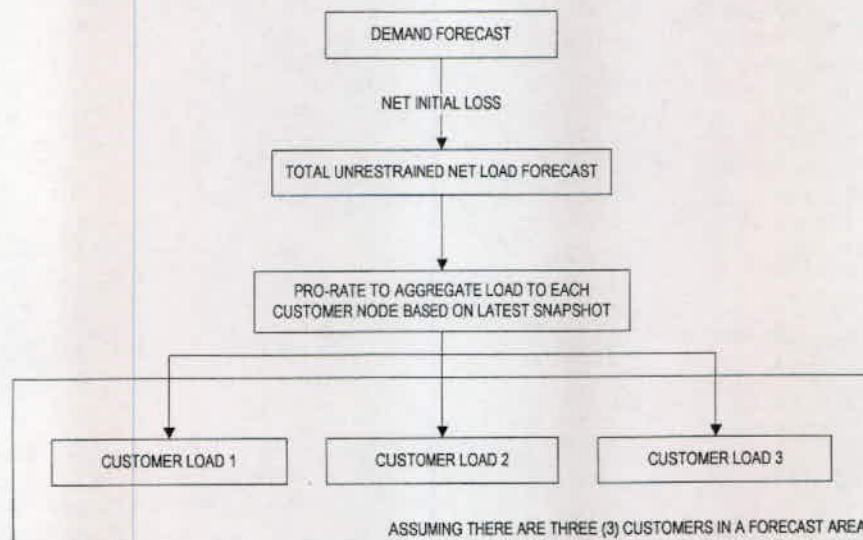


Figure 3. High-Level Diagram to obtain the *Unrestrained Net Load Forecast*





- 6.1.5. The *Total Unrestrained Net Load Forecast* can be interpreted in the following equation.

$$\text{Total UNLF} = \text{Demand Forecast} \times (1 - \text{Initial Loss Percentage}_{\text{FA}})$$

Where:

UNLF – *Unrestrained Net Load Forecast*

Initial Loss Percentage<sub>FA</sub> – Initial Loss Percentage in FA

FA – Forecast Area

- 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.

$$\text{UNLF}_i = \frac{\text{Total UNLF}}{\text{Total Actual Load}_{\text{FA, LATEST}}} \times \text{Actual Load}_{i, \text{FA, LATEST}}$$

Where:

UNLF<sub>i</sub> – *Unrestrained Net Load Forecast* of Customer Node i

Total Actual Load<sub>FA, LATEST</sub> – Sum of Actual Loads in a Forecast Area where Customer Node i belongs based on the latest system snapshot

Actual Load<sub>i, FA, LATEST</sub> – Actual Load of Customer Node i 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*.

## 6.2. RESTRAINED NET LOAD FORECAST

- 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).
- 6.2.2. A Customer Node's projected load will be shed should its price reach the level of the VoLL price.
- 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*.



$$RNLF_i = UNLF_i - \text{Load Shed}_i$$

Where:

$RNLF_i$ — *Restrained Net Load Forecast* of Customer Node  $i$

$UNLF_i$ — *Unrestrained Net Load Forecast* of Customer Node  $i$

$\text{Load Shed}_i$ — amount of load to be shed at Customer Node  $i$

### 6.3. 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.
- 6.3.2. 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<sup>3</sup>.

<sup>3</sup><http://www.wesm.ph>



**SECTION 7 CUSTOMER FORECASTS****7.1. 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).
- 7.1.2. A Customer may only submit a load forecast for a Market Trading Node that is solely registered to them.
- 7.1.3. Each Customer may, at its option, submit forecasts for its respective Market Trading Node.
- 7.1.4. Each Customer that intends to participate in this optional program shall obtain approval from the *Market Operator* for accounting and validation purposes.
- 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.
- 7.1.6. 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)
- 7.1.8. Customer forecasts shall be considered as the official schedule of the Real-Time Dispatch.

**7.2. CUSTOMER FORECAST VALIDATION**

- 7.2.1. A Customer Forecast shall only be considered in the market projections and the Real-Time Dispatch if the forecasted value is within the Customer Forecast Tolerance Range.
- 7.2.2. The **Customer Forecast Tolerance Range** shall be based on the approved percentage for determining the reserve requirement for regulation.

**7.3. SUBMISSION OF TRADING PARTICIPANT LOAD INFORMATION**

- 7.3.1. The *Market Operator* shall select certain Customers to provide relevant information that can serve as an input for the determination of *Demand Forecasts* and *Net Load Forecasts* for the market projections and Real-Time Dispatch.

7.3.2. The *Market Operator* shall require the relevant Customer to provide pertinent information regarding its load profile based on an agreed timeline. Such information may include the following.

- a) Load profile representing the characteristics of the load connected to the associated market trading node; and
- b) Un-metered loads and or house loads.

<b>SECTION 8 LOAD FORECASTING CONSIDERATIONS</b>
--

**8.1. 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:

- a) Temperature
- b) Humidity
- c) Wind direction
- d) Wind speed
- e) Sky cover (0 = clear, 10 = maximum overcast)
- f) Precipitation

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 Appendix B of this *Market Manual*.

8.1.3. The *Market Operator* shall maintain a repository of the historical weather-related information.

**8.2. 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.

8.2.2. Real-time information shall include telemetered data with provisions for state-estimation for higher reliability and accuracy. Such information shall form part of the Demand Forecast and the Net Load Forecast prepared by the Market Operator.





- 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.
- 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.
- 8.2.5. Customers shall have the option to provide their own hourly demand forecast at their own Market Trading Node to be used in the determination of market projections and real-time dispatch in accordance with WESM timetable.

a) 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.

b) Customer Load Forecast Adjustment

Load adjustment factors shall be established by the Customer and his Meter Service Provider and shall be submitted to the Market Operator. The adjustment factors shall consider site-specific losses and other factors deemed necessary to reflect accurate customer load forecast at his market trading node.

c) Default Customer Load Forecast

Should the Customer not be able to provide a forecast in accordance with the WESM timetable, or their forecast is beyond the acceptable tolerance, the Market Operator shall consider its own forecast for the customer.

d) Customer Forecast Timeline

Customers may be able to provide their own load forecast based on the Open Market Window defined in Section 4.4 of the WESM Manual on Dispatch Protocol.

*BAR*

**8.3. POWER SYSTEM CONDITION**

- 8.3.1. The *Market Operator* shall consider the forecasted power system condition in the preparation of net load forecast. These shall include planned maintenance (transmission, sub-transmission, and generation), large customer maintenance schedules, and other activities, including generator testing and commissioning that may have an impact on the preparation of market projections and real-time dispatch.
- 8.3.2. The *System Operator* shall ensure that all relevant information is provided to the *Market Operator* in accordance with the WESM timetable.
- 8.3.3. For unplanned power system conditions, the *System Operator* shall ensure that all relevant information is timely provided to the Market Management System through the Energy Management System or other means of communication to the *Market Operator*.
- 8.3.4. All Trading Participants shall also ensure that information regarding any unplanned activity or condition is timely provided to the *System Operator*.

**8.4. LOAD PROFILE**

- 8.4.1. For similar day load forecasts, the *Market Operator* may utilize static profiling, proxy day profiling, and estimated or deemed profiling or a combination thereof. The *Market Operator* shall use all reasonable endeavors to provide the most appropriate load profile in determining demand and net load forecasts.
- 8.4.2. The *Market Operator* may consider typical day representations for any day of the week and season combination. Static profiling shall consider day of the week profile, holidays, and special events profile. The *Market Operator* should note that static profiles do not reflect operating conditions of the day being estimated
- 8.4.3. The *Market Operator* may consider selecting a day in history that most closely matches the day being estimated. The proxy day can be chosen based on either on weather forecast and/or system load. Actual data from the sample for the selected proxy day shall then be used to create the profile. Proxy day profiling shall consider day of the week profile, holidays and special events profile
- 8.4.4. The *Market Operator* may obtain *Demand Forecasts* using engineering estimates, if and when necessary, for very predictable loads such as street lighting or residential area from Trading Participants.





**8.5. LOAD GROWTH**

The *Market Operator* shall consider the projected growth of load demand for each *Forecast Area* in the preparation of Net Load Forecasts. For consistency, the *Market Operator* shall consider information from the Department of Energy (DOE) for the load growth values.

<b>SECTION 9 LOAD FORECAST AUDIT AND PERFORMANCE MEASURES</b>
---

- 9.1. The *Market Operator* shall log all transactions performed for the determination of net load forecast including the uploading of the optional Customer's load demand forecast.
- 9.2. The *Market Operator* shall monitor the actual and forecasted load demand for each relevant market trading node.
- 9.3. The *Market Operator* shall evaluate the *Net Load Forecast Performance*.
- 9.4. The *Market Operator* shall evaluate the *Demand Forecast Performance* pursuant to the performance standards that shall be maintained pursuant to *WESM Rules* Clause 10.4.10.2.

<b>SECTION 10 AMENDMENTS, PUBLICATION AND EFFECTIVITY</b>
---

**10.1. AMENDMENTS TO THIS MANUAL**

Any amendment to, or revision to this Manual shall be approved by the PEM Board.

**10.2. PUBLICATION AND EFFECTIVITY**

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)

*Handwritten signature*



SECTION 11 APPENDIX

Appendix A. LDP Methodology Sample

In order to fully understand the LDP algorithm, the following example shall be used.

Assume the current forecast load for the next five-minute intervals is 1000 MW. For the first 3 5-minute interval, the following predicted errors were obtained from the corresponding load shape.

Interval	Predicted Error
1	-34
2	-15
3	5

The forecasted demand shall be obtained by using the change in load value (predicted error) in the load shape, and shall then be added to the previous forecasted demand.

$$\text{Forecast}_n = \text{Forecast}_{n-1} + \Delta\text{Load}_n$$

The following forecasted loads shall be obtained as such

Interval	Predicted Error	Computation	Forecast Load
1	-34	-- Current Forecast --	1000
2	-15	1000 - 15	985
3	5	985 + 5	990

As previously stated, the change in load values is adaptively updated. It uses a portion of the old slope, depending on the percentage share (alpha, smoothing parameter for historical slope update, as much as 1 or 100%) designated, and the remaining share is for the new slope. Once the LDP runs, the relevant change in load value in the load shape at that time will be updated. With this concept, the change in load value maintains its previous slope characteristics, and then uses the current slope's characteristics. The alpha value is configurable in the MMS.

*JSR*





**Appendix B. List of Prospective Weather Data Providers**

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

*JSW*