



Report on the Audit of Market Systems Enhancements and Tool to Implement the Co-optimized Energy and Reserve Market

**Software Certification of Enhancements to the
Market Management System – Changes to Merit Order Table (MOT)**

November 2024

This Report is prepared by the
Philippine Electricity Market Corporation –
Market Assessment Group for the
PEM Audit Committee

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FOREWORD

This report provides the objectives, scope and results of the Audit of Market Systems Enhancements and Tool to Implement the Co-optimized Energy and Reserve Market. The Philippine Electricity Market Corporation (PEMC) has engaged an Independent Auditor, Intelligent Energy Systems Pty Ltd (IES), to conduct the Audit under the supervision of the PEM Audit Committee (PAC).

The Audit was conducted to assess compliance of the market systems enhancements and tool against DOE Department Circular DC2019-12-0018¹ and DC2021-03-00092², Market Rules and Manuals, Request for Changes (RFC), and any associated Business Requirement Document (BRD) for the following components:

1. Central Registration and Settlement System Enhancements
2. Market Management System (MMS) Enhancements
3. External Tool to Generate Merit Order Table (MOT)
4. Software Change Management Review

This report presents the audit results for one of the enhancements to the Market Management System, specifically for Changes to Merit Order Table. The audit results for the other enhancements covered in components 1 to 4 have already been previously reported and published³.

Upon completing the audit, IES issued the corresponding software certificate (see Appendix) confirming that the MMS enhancements with regard to changes to MOT considering reserve capacities scheduled is consistent with the provisions of the Wholesale Electricity Spot Market (WESM) Rules and Manuals. The certification is for one (1) of the three (3) MMS enhancements and specifically relates to ensure the changes to the MOT in the MMS, implemented by the MMS vendor, correctly reflect the exclusion of reserve market capacities from the MOT list for use by the System Operator (SO) in its re-dispatch process.

The PAC wishes to convey its appreciation and gratitude to the PEMC management and the IEMOP management for their continuous cooperation and support. This support was invaluable in ensuring the successful completion of the audit.

For the PEM Audit Committee,



FRANCISCO LEODEGARIO R. CASTRO, JR.

Chairperson



CONCEPCION I. TANGLAO
Member

ROSSANO C. LUGA
Member

¹ Adopting a General Framework Governing the Provision and Utilization of Ancillary Services in the Grid.

² Adopting A General Framework Governing the Operationalization of the Reserve Market in the Wholesale Electricity Spot Market and Providing further Policies to Supplement DC2019-12-0018

³ [PAC Audit Report on the Audit of Market Systems Enhancements and Tool to Implement the Co-optimized Energy and Reserve Market](#)

1. ABOUT THIS REPORT

This report is prepared in accordance with Section 3.3.2 of the PEM Audit Manual. It contains the objectives, scope, audit approach, as well as audit results for the enhancements to the Market Management System, specifically for Changes to Merit Order Table.

2. AUDIT HIGHLIGHTS

2.1. BACKGROUND

The PEM Audit Manual Section 5.3 provides the requirements for the audit of the software of the Market Operator (MO) including enhancements or modifications thereto.

The audit of Market Management System enhancements relates to the changes to the Market Participant Interface (MPI), Merit Order Table (MOT) and Market Dispatch Optimization Model (MDOM), as listed in Table 1.

Table 1: Test Areas: MMS Enhancements

Test Area	Testing Objective
MPI Testing on Inclusion of Control Modes	Testing of inputs and bid/offer validation rules involving the inclusion of control modes in the submission of offers
Changes to MOT	Ensure the changes to the MOT in the MMS (implemented by the MMS vendor) correctly reflect how the reserve market capacities are not in the MOT list for use of SO in its re-dispatch.
Changes to CSV Files sent to SO	Ensure changes to CSV files sent to SO are correctly reflecting reserve capacities, energy dispatch, and the control mode information submitted by market participants through the MPI
Constraints for Providing Multiple Reserves	Ensure that the results of the MDOM pre-processing to determine constraints on reserves have been correctly reflected in MDOM to ensure configuration of providing multiple reserve services
Scheduling Pre-requisites	Ensure that the results of pre-requisites for reserves provision are properly reflected in MDOM for the conditions to allow a generator to be scheduled for a specific type of reserve
Regulation Limit	Ensure that a generating unit should operate within a defined operating range when providing regulation and other energy or reserve services if the minimum regulation limit is specified.

Except for the audit results of Changes to MOT, the results of audit of the other test areas have been previously reported and published⁴.

⁴ [PAC Audit Report on the Audit of Market Systems Enhancements and Tool to Implement the Co-optimized Energy and Reserve Market](#)

2.2. OBJECTIVES AND SCOPE

The audit objective of MMS enhancements is for the Independent Auditor to conduct an audit to assess compliance against the requirements specified in WESM Dispatch Protocol Manual, Issue 20. The WESM Dispatch Protocol Manual governs the construction of MOT as follows:

10.1.2 The WESM MOT (WMOT) is generated by stacking in an unconstrained manner of scheduled and unscheduled capacities, excluding negative quantities, reserve schedules, and generators on outage through the market offers submitted for the real-time dispatch runs. Energy offer blocks submitted by generator Trading Participants for a particular dispatch interval are arranged from lowest to the highest priced offer block, without considering any constraints. The WMOT stacks energy offers into two, namely, the energy offers that were scheduled (or “Offers Dispatched”) and energy offers that were not scheduled (or “Offers Not Dispatched”).

10.4.1 The WMOT shall be prepared using the real-time dispatch schedules, and the offers, excluding the negative quantities, reserve schedules, and generators on outage of each generating system for which offers were submitted for the relevant dispatch interval.

2.3. METHODOLOGY

The general approach for testing of the MOT is for the Independent Auditor to recreate the MOT from the Real-Time Dispatch (RTD) information (i.e., inputs and outputs) and compare it to the MOT implemented by the MMS vendor. Below are the key steps to independently determine the MOTs for all the given RTD intervals and compare it with the MOTs implemented by the MMS vendor:

1. Check for the MW accuracy of the MOT

- Calculate the entries of the MOT for all the resources in each dispatch interval using the same logic used in MMS vendor implementation.
- Generators on outage were considered to have 0 MW for both “Dispatched” and “Not Dispatched” entries in the MOT, and thus, were not included in the MOT.
- Generators not part of the “Offers” or “Nominations” lists (i.e., those that do not have offer prices) but were present in the MOT, were facilities scheduled through overriding constraints, or security limit, from the System Operator.

2. Check for accuracy of high-level order and price order of the MOT

- Check the high-level order of MOT and the price order of the offered capacity
- The ordering of the resource / MW blocks was based on their resource names in descending order if they are of the same dispatch priority type (security limit, must dispatch, priority dispatch, and non-scheduled) or offer price.

3. Evaluation of Results

- If both items 1 and 2 are a PASS, the audit result for that time interval is labelled as a PASS. Otherwise, it is assessed as a FAIL.

The Independent Auditor was provided with 10 dispatch intervals of data (each time interval as a test case) to carry out the review. The assortment of test cases covers different periods of days and a range of generators providing combinations of energy and reserve categories and can be considered a good enough sample size.

2.4. FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

The testing conducted on the Changes to MOT passed all test runs on the data files. As such, the Independent Auditor assessed the testing of Changes to MOT to be a “Pass” overall. There were no recommendations on the testing that was carried out.

Table 2: List of Sample Periods for MOT Test Cases of MOT (implemented by MMS vendor)

Test Case	Time Interval	Test Result
1	26/09/2024 9:25:00 AM	PASS
2	26/09/2024 9:30:00 AM	PASS
3	26/09/2024 10:10:00 AM	PASS
4	26/09/2024 11:10:00 AM	PASS
5	26/09/2024 11:45:00 AM	PASS
6	26/09/2024 12:55:00 PM	PASS
7	26/09/2024 1:15:00 PM	PASS
8	26/09/2024 1:35:00 PM	PASS
9	26/09/2024 2:05:00 PM	PASS
10	26/09/2024 2:20:00 PM	PASS

Appendix: SOFTWARE CERTIFICATE

- Software Certificate for enhancements to the Market Management System for Changes to MOT

8 October 2024

Mr. Francisco L. R. Castro, Jr.
Chairperson, PEM Audit Committee
Philippine Electricity Market Corporation
18th Floor Robinsons Equitable Tower,
ADB Avenue, Ortigas Center
1600 Pasig City, Philippines

Dear Mr. Castro,

SCOPE OF THIS CERTIFICATE

The certification testing verifies that the Market Management System (MMS) enhancements with regards to changes to Merit Order Table (MOT) considering reserve capacities scheduled is consistent with the provisions of the Wholesale Electricity Spot Market (WESM) Rules and Manuals. This certification is for one (1) of the three MMS enhancements and specifically relates to ensure the changes to the MOT in the MMS (implemented by the MMS vendor) correctly reflect how the reserve market capacities are not in the MOT list for the use of SO in its re-dispatch process.

CERTIFICATION TESTING METHODOLOGY

A list of validation rules was provided to Intelligent Energy Systems Pty. Ltd (IES) against which compliance requirements were determined:

- Department of Energy (DOE) Department Circulars:
 - DC-2021-03-0009 “Adopting a General Framework Governing the Operationalization of the Reserve Market in the Wholesale Electricity Spot Market and Providing Further Policies to Supplement DC2019-12-0018”, and
 - DC-2019-12-0018 “Adopting a General Framework Governing the Provision and Utilization of Ancillary Services in the Grid”.
- RFC-2302-005 “Reserve Market Enhancements for the Market Management System (MMS)”.
- Rules Change Committee (RCC) Resolution No. 2021-21 “Proposed Amendments to WESM Rules and Various WESM Manuals on Implementation of Reserve Market”, ANNEX A.E, proposed Amendments to WESM Manual on Dispatch Protocol, Issue 20.0.
- Highlights of 49th IT Change Advisory Committee (ITCAC) Meeting, Page 1.

The testing of enhancements to MMS (MMS-2: Changes to MOT) was to confirm that the MOT generated using the MMS-2 is accurate in terms of MW and price order and is compliant with the logic set out in WESM Dispatch Protocol Manual, Issue 20.0.



To test the compliance, IEMOP provided IES with 10 dispatch intervals of data files used to create the MOT for each dispatch. IES independently recreated the MOT using the inputs – offers, nominations, energy schedules, reserve schedules, generator outage information, and self-scheduled generators information provided by IEMOP and compared it to the MOT implemented by the MMS-2. If the two MOTs agree, then the test case is given a result of PASS.

IES views the 10 dispatch intervals to be a sufficient size to test the functionality as it covers a range of different periods randomly selected from 1 day and covers the full range of registered generators in the WESM providing a wide range of combinations of energy and reserve categories.

CERTIFICATION OF MMS WITH RESPECT TO CHANGES TO MERIT ORDER TABLE

The following is our certification of the MMS-2 for the implementation of MOT files, ensuring they are correctly reflecting the MOT:

“The testing conducted on the MOT files provided to IES for assessment passed all tests run on the data files. As such IES assesses the enhancements to MMS for implementation of MOT to be a pass overall.”

LIMITATION OF LIABILITY

In furnishing this certification, Intelligent Energy Systems specifically will not be liable for any indirect, incidental, or consequential damages, and that no person shall be entitled to claim against IES, any losses or damage whether indirect, special, or consequential, in excess of that limitation, and the Philippine Electricity Market Corporation (PEMC) shall ensure that all persons or parties who may rely on this certification are aware of this limitation of liability.

Yours sincerely



Michelle Bannister

Chief Executive Officer

Intelligent Energy Systems Pty Ltd.