# Report on the Independent Software Audit of the Enhancements to the NSS/NSD Tool for the 1-Hour Market and Enhanced CRSS-NSS Module for the 5-Minute Market

**NSS/NSD Calculation and Allocations based on ERC Resolutions Adopting Amendments to the Rules for the Distribution of NSS**

**OCTOBER 2020**

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

## FOREWORD

The PEM Audit Committee (PAC) supervised the independent software audit for the enhancements to the Net Settlement Surplus (NSS)/ Net Settlement Deficit (NSD) Tool for the 1-Hour Market and Central Registration Settlement System (CRSS) - NSS Module for the 5-Minute Market.

The audit was conducted in compliance to the Energy Regulatory Commission (ERC) Resolution No. 01, Series of 2019 and ERC Resolution No. 07, Series of 2019, "A Resolution Adopting Amendments to the Rules for the Distribution of Net Settlement Surplus (NSS)", which provides the mechanism for the distribution and flow back of the NSS/NSD.

This activity was handled by the Intelligent Energy System (IES), the external auditor commissioned by the PAC. After the conclusion of the audit, IES issued software certificates indicating the compliance of the enhancements with respect to the ERC Resolutions.

The PAC wishes to express its appreciation and gratitude to the management of the Philippine Electricity Market Corporation (PEMC) as well as the auditee, Independent Electricity Market Operator of the Philippines (IEMOP), for the cooperation and support they extended to the auditor for the successful completion of this audit project.


For the PEM Audit Committee,
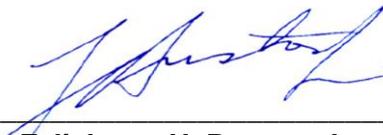



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**Felixberto U. Bustos, Jr.**
Chairperson


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**Eduardo Alejandro O. Santos**
Member
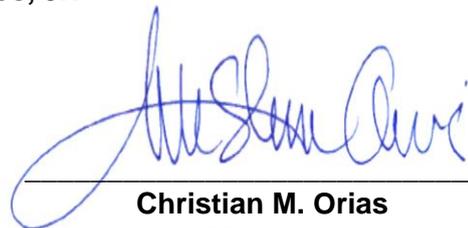
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**Christian M. Orias**
Member

# 1. ABOUT THIS REPORT

This report provides an executive summary of the results of the independent software audit of the enhancements to the NSS/NSD Tool for the 1-Hour Market and CRSS - NSS Module for the 5-Minute Market.

# 2. EXECUTIVE SUMMARY

## 2.1. Background

The Net Settlement Surplus is the surplus or deficit resulting from the locational marginal pricing design and differences between total trading amounts received and paid out in the WESM. Net surpluses are required to be passed back to applicable trading participants in accordance with the relevant WESM Rules.

On 20 February 2018, the ERC promulgated the Resolution No.1, Series of 2018 which amended the existing NSS allocation formula and redistribution of NSS, including a defined parameter that only trading participants who have actually paid for the line losses and congestion payments shall be eligible to receive NSS allocation. The revised NSS Rules became effective starting the billing month of June 2018.

The promulgation of the 2018 NSS Rules resulted in the requirement to amend the Market Rules and relevant Manuals for the distribution of NSS. This is reflected in the WESM Market Manual: Management of Net Settlement Surplus, Issue 3.0.

On 11 July 2019, PEMC/MO informed that a review of the NSS revealed an error on the implementation of the NSS formula, which affected the NSS allocation for the billing months June 2018 to May 2019. The error in the NSS Tool was corrected accordingly starting the billing month of June 2019.

Given the gross impact of the erroneous implementation of the NSS formula, the ERC revisited the NSS Rules and accordingly promulgated on 23 October 2019 the ERC Resolution No. 07, Series of 2019 "A Resolution Adopting Amendments to the Rules for the Distribution of Net Settlement Surplus (NSS)" or the 2019 NSS Rules. The said Resolution was promulgated to establish a suitable process for the equitable flow back of NSS.

In accordance with the 2019 NSS Rules, PEMC/IEMOP was directed to undertake and complete the necessary system development and enhancements including the corresponding system audit to ensure accuracy and compliance to the amended rules for the distribution of NSS/NSD.

The IEMOP then embarked on the system development and enhancements to the NSS Tool for the current 1-hour market system and the CRSS-NSS module for the 5-minute market system based on the change in formulation under the 2019 NSS Rules.

In consideration of the erroneous implementation of the formula for NSS allocation to participants with transactions in the WESM for the period 26 May 2018 to 25 May 2019, and in compliance to the ERC directive in the revised NSS Rules, the PAC/PEMC engaged the services of an external auditor to audit the corrected NSS Tool for the 1-hour market system that was implemented for the billing period starting on 26 May 2019. The objective of the audit is to confirm that the corrections made on the NSS Tool now accurately implement the NSS guidelines under the 2018 NSS Rules and 2019 NSS Rules.

The review of the corrected NSS Tool in compliance with the 2018 NSS Rules was covered in Phase 1 of the NSS Tool Audit, while the review in compliance with the 2019 NSS Rules was covered in Phase 2 of the NSS Tool Audit. The PAC likewise included in the audit the enhancements to the CRSS-NSS module for the 5-minute market system. The PEMC engaged the IES to undertake the audit of the enhancements to both market systems.

It may be noted that PEMC transferred its functions as market operator to the IEMOP, while retaining its role as the WESM governing body on 26 September 2018. After the transition, all audit projects are still supervised by PEMC through the PAC, with IEMOP now as the auditee.

2.2.    Audit Scope

The purpose of the audit of NSS Tool for 1-Hour Market (Phase 1) is to confirm that the calculations resulting from the NSS Tool are compliant with the 2018 NSS Rules and that the following updates are implemented correctly:

1.    Update to the settlement NSS Tool to modify the computations of LLCC and LLCP to implement the ERC Case No. 2017-009 RM and DOE Circular No. 2017-04-00051;

2.    Modification to the Line Rental formula of the current NSS Tool to fully implement ERC Resolution No. 1, Series of 2018; and

3.    Changes (where applicable) remain consistent with the calculations as set out in the WESM Manual: Management of Net Settlement Surplus Issue 3.0.

Meanwhile, the audit of NSS Tool for 1-Hour Market (Phase 2) and CRSS-NSS Module for 5-Minute Market aims to verify the accuracy of the calculation of NSS/NSD and its allocation in accordance with the 2019 NSS Rules. Previously, the NSS/NSD was calculated and allocated based on the combined line loss and congestion costs applicable to each trading participant. The 2019 NSS Rules revised the calculation the NSS/NSD and its allocation separately based on line loss and congestion costs.

2.3.     Conclusion

The enhancements to the NSS Tool and CRSS-NSS Module were found to be compliant with the 2018 NSS Rules and 2019 NSS Rules and business requirements documents as described in the final audit report. In view of this, IES has accordingly issued software certifications attesting to the compliance to all the requirements for the enhancements to the NSS Tool and CRSS-NSS Module. (see software certificates in Appendix A and Appendix B)

**Appendix A – Software Certificates for Audit of NSS/NSD Tool**

14 January 2020

Mr. Felixberto U. Bustos, Jr.
Chairman, PEM Audit Committee
Philippine Electricity Market Corporation
18/F Robinsons Equitable Tower
ADB Avenue, Ortigas Center
1600 Pasig City, Philippines

Dear Mr. Bustos,

## SCOPE OF THIS CERTIFICATE

The purpose of this software certificate is to confirm that the calculations resulting from the Net Settlement Surplus (NSS) Tool are compliant with ERC Resolution No.1, Series of 2018 and that the following updates are implemented correctly:

1. The update to the settlement NSS Tool to modify the computations of LLCC and LLCP to implement the ERC Case No. 2017-009 RM and DOE Circular No. 2017-04-0005[1].

2. The modification to the Line Rental formula of the current NSS Tool to fully implement ERC Resolution No. 1, Series of 2018[2].

3. The changes (where applicable) remain consistent with the calculations as set out in the WESM Manual: Management of Net Settlement Surplus Issue 3.0.

## TESTING METHODOLOGY USED FOR SOFTWARE CERTIFICATION

IES reviewed the objectives of ERC Resolution No. 1, Series of 2018 to ensure that the WESM Manual: Management of Net Settlement Surplus Issue 3.0 and related Business Requirement Documents and System Design Specification Documents were consistent and applied correctly.

The approach used to verify whether the implementation was correct and consistent with the relevant manuals and change documents was to take an entire month's worth of settlement data (input files for the billing month of September 2019), independently calculate the corresponding NSS allocations for each interval and participant and compare the outcome with the outputs produced by the NSS tool[3]. In doing this, IES also ensured values from the input files were copied into the NSS tool and/or interim calculations steps (where available) were correct.

## CERTIFICATION OF NSS TOOL WITH RESPECT TO REFERENCE DOCUMENTATION

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[1] These documents relate to the docket number for ERC's review of the NSS Rules back in 2017 which culminated in the issuance of ERC Resolution No. 1, Series of 2018.
[2] Based on treatment of Line Rental in Line Loss Congestion Charge formulation and includes checking the System Design Specifications Document and Business Requirement Document 1907-003-1907-001, dated 25 September 2019 and 16 September 2019 respectively.
[3] IES did not check the spreadsheet program or macro used to generate the NSS allocations.

Based on the independent calculations and review of ERC Resolution No. 1, Series of 2018 and the relevant manuals and documentation, we find that the current NSS Tool has correctly implemented the modification required in ERC Case No. 2019-018 MC relating to Line Rental used in the formulation of LLCC and that the remaining calculations of the NSS and Allocated Surplus remain consistent with Manual: Management of Net Settlement Surplus Issue 3.0 and correctly reflect ERC Resolution No. 1, Series of 2018.

## LIMITATION OF LIABILITY

In furnishing this certification, Intelligent Energy Systems specifically limits its liability in accordance with Clause 5.08 (b) of the Contract for External Audit Services (Independent Software audit of the New Market Management System) dated 17 February 2017. No person shall be entitled to claim against Intelligent Energy Systems any losses or damage, whether indirect, special or consequential in excess of that limitation, and PEMC shall ensure that all persons or parties who may rely on this certification are aware of this limitation of liability.

Yours sincerely

Charles Hugh Bannister
Chairman and CEO

29 July 2020

Mr. Felixberto U. Bustos, Jr.
Chairman, PEM Audit Committee
Philippine Electricity Market Corporation
18/F Robinsons Equitable Tower
ADB Avenue, Ortigas Center
1600 Pasig City, Philippines

Dear Mr. Bustos,

## SCOPE OF THIS CERTIFICATE

The purpose of this software certificate is to confirm that the calculations resulting from the Net Settlement Surplus (NSS) Tool are compliant with *ERC Resolution No.7, Series of 2019*. This also confirms that the resulting calculations are consistent with the methods and formulations outlined in the business requirement document *Development of NSS/NSD Tool in Compliance to ERC Resolution No. 07, Series 2019 for CURRENT MARKET.* [1]

## TESTING METHODOLOGY USED FOR SOFTWARE CERTIFICATION

IES reviewed the objectives of ERC Resolution No. 7, Series of 2019 to ensure that the and related Business Requirement Documents and System Design Specification Documents[2] were consistent and applied correctly. The changes as outlined in the ERC Resolution require the Net Settlement Surplus (and Deficit) to be calculated separately on the cause of the surplus (transmission loss and congestion) and allocated on this basis.

The approach used to verify whether the implementation was correct and consistent with the relevant manuals and change documents was to take settlement data from the input files used in the NSS Tool to independently calculate the NSS allocations for each interval and participant. Outcomes were then compared against the outputs produced by the NSS tool[3]. In doing this, IES also ensured values from the input files were copied into the NSS tool and/or interim calculations steps (where available) were correct.

The methodology in auditing the NSS outputs is as follows:

- Extract inputs from input files and calculate the individual BCQ amounts (this is not provided in the Settlement Values and is an interim calculation).

- Calculate the trading amounts, generator weighted average values and compare with the output values.

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[1] Record No. BRD-1911-008.1912-007, 8 July 2020.
[2] Record No. SDSD-1911-008.1912-007, 10 June 2020.
[3] IES did not check the spreadsheet program or macro used to generate the NSS allocations.

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- Calculate the spot and line rental amounts for line loss and congestion charges and compare with the outputs.

- Independently calculate the Allocated Surplus by aggregator and compare this with the final NSS outputs.

- Record any differences between the NSS output values and Settlement Values or IES calculations. This process is repeated using the Price Substitution Settlement inputs and corresponding NSS output files.

- Ensuring the test cases provided cover all variations of regional pricing conditions.

## CERTIFICATION OF NSS TOOL WITH RESPECT TO REFERENCE DOCUMENTATION

Based on the independent calculations and review of ERC Resolution No. 7, Series of 2019 and the relevant manuals and documentation, we find the current NSS Tool has correctly implemented the allocation of net settlement amounts in accordance with both the ERC Resolution No. 7, Series of 2019 and the business requirement documents.

## LIMITATION OF LIABILITY

In furnishing this certification, Intelligent Energy Systems specifically limits its liability in accordance with Clause 5.08 (b) of the Contract for External Audit Services (Independent Software audit of the New Market Management System) dated 17 February 2017. No person shall be entitled to claim against Intelligent Energy Systems any losses or damage, whether indirect, special or consequential in excess of that limitation, and PEMC shall ensure that all persons or parties who may rely on this certification are aware of this limitation of liability.


Yours sincerely

Charles Hugh Bannister
Chairman and CEO

**Appendix B – Software Certificate for Audit of CRSS-NSS Module Enhancements**

3 July April 2020

Mr. Felixberto U. Bustos, Jr.
Chairman, PEM Audit Committee
Philippine Electricity Market Corporation
18/F Robinsons Equitable Tower
ADB Avenue, Ortigas Center
1600 Pasig City, Philippines

Dear Mr. Bustos,

## SCOPE OF THIS CERTIFICATE

The purpose of this software certificate is to confirm that the NSS calculations of the CRSS NSS module has correctly implemented the change in formulation for the allocation of the NSS as outlined in the business requirement document *Enhancements to the CRSS in compliance to ERC Resolution 7 Series of 2019* and that the formulation reflects the changes made in *ERC Resolution No. 7, Series of 2019.*

## TESTING METHODOLOGY USED FOR SOFTWARE CERTIFICATION

The method used by IES to certify the logic and, where applicable, calculations of each was as follows:

- **CRSS NSS Module:** The approach taken was for IES to independently calculate settlement values based on provided inputs to compare it to the outputs from the system. This was performed for a simple test system (provided by IEMOP) which included generators and customers in all regions. The test system data included both inputs and settlement outputs of the system, and IES independently verified the calculations in accordance with the reference documents for the CRSS Settlement Module. The overall process involved the following:

    - o   IES reviewed the reference documentation to familiarise with the mathematical formulation for each settlement variable/item.

    - o   IES used the provided settlement test data to independently calculate the settlement-related items such as the distribution of NSS, VAT and line rental and compared them to the given outputs of the settlement test data.

## CERTIFICATION OF NSS TOOL WITH RESPECT TO REFERENCE DOCUMENTATION

The audit results for each NSS tool/module is as follows:

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- **CRSS NSS Module:** The audit of the CRSS NSS module shows that the settlement calculations are consistent with the formulas in the business requirement document *Enhancements to the CRSS in compliance to ERC Resolution 7 Series of 2019*, where specifically the allocation of surplus or deficit is based separately for line loss and congestion costs. The review also confirms that the formulae used in the CRSS NSS module are consistent with the amendments outlined in the *ERC Resolution No.7, Series of 2019*. The audit also confirms that other settlement related items such as the VAT are correctly calculated based on the existing documentation. IES can also confirm that under the new implementation of the CRSS NSS, the Luzon-Visayas and Mindanao settlement regions are settled separately.

## LIMITATION OF LIABILITY

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Yours sincerely

Charles Hugh Bannister
Chairman and CEO