VOLTAGE COMPLIANCE ASSESSMENT REPORT DEC 2021 - NOV 2023

Prepared for Essential Services Commission (ESC)

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7/02/2024

GRIDWISE ENERGY SOLUTIONS

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EXECUTIVE SUMMARY

Executive Summary

Essential Services Commission (ESC) regulates the electricity distribution to customers safely and reliably in the State of Victoria.

One of the ongoing compliance requirements for electricity distributors is to ensure that the supply voltage complies with the Electricity Distribution Code of Practice (the Code). This refers to the Australian Standard AS 61000.3.100-2011. Victoria's five Distribution Network Service Providers (DNSPs) provide quarterly voltage performance data to ESC.

The Commission has engaged GridWise Energy Solutions (**GridWise**) to assess with the following objectives:

- Interpret and assess the functional compliance requirements in Appendix D of AS 61000.3.100-2011 and voltage performance following clause 20.4 of the Code.
- Provide an assessment of the voltage performance data from the electricity distributors and conclude.

The voltage compliance assessment was done based on the criteria as defined in the Code[1]: “The voltage assessment criteria are satisfied if less than 5% of the distributor’s customers experience a voltage level below 216V or above 253V.” In other words, if more than 5% of the distributor’s customers experienced a voltage level below 216V or above 253V, the distributor is considered to have potentially breached this assessment criteria.

ESC has provided the quarterly voltage performance data from different DNSPs in the standard data template from December 2021 to November 2023. This report provides the outcome of GridWise’s assessment of the voltage performance data.

Based on the weekly data provided from December 2021 to November 2023, the above-mentioned voltage assessments were performed for 104 weeks. It is observed that mainly DNSPs potentially did not comply with the over voltage (i.e., above 253V) criteria assessment. Numerically speaking, AusNet potentially breaches over 253V assessment criteria in 25 weeks, which is 24% of the total weeks; for Powercor, this percentage is 4% (4 weeks); while for United Energy, CitiPower and Jemena, this number is 0%.

Figure 1 and Figure 2 show the plots of the maximum percentage of the number of customers per month for each DNSP for the years 2022 and 2023 and are assessed against the defined assessment criteria.

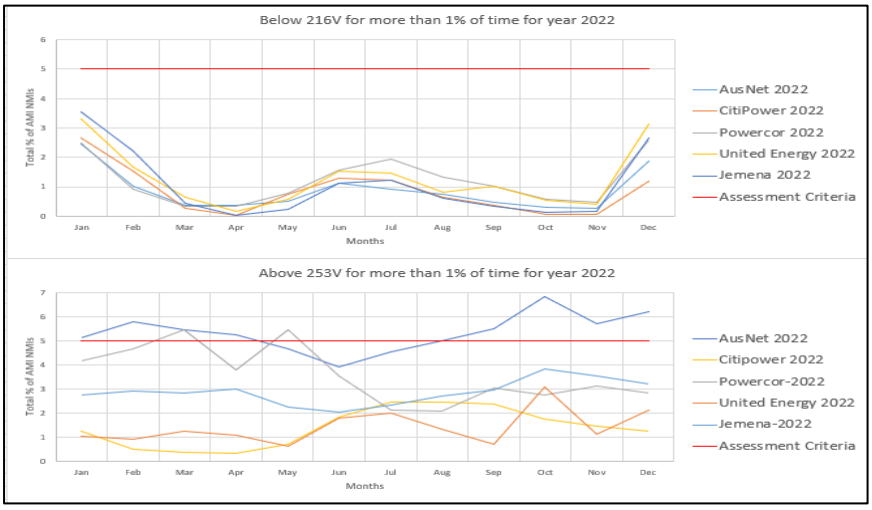

Figure 1: DNSPs assessment for the year 2022.

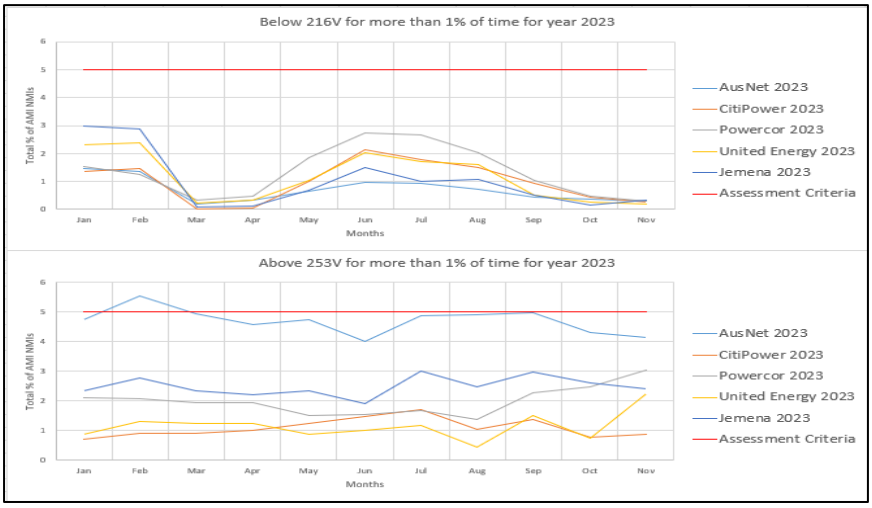

Figure 2: DNSPs assessment for the year 2023 Up to November

For 2022, all DNSPs potentially meet the assessment criteria for a voltage level below 216V; less than 5% of their customers experienced below 216V during 2022. However, for voltage levels above 253V, AusNet and Powercor have potentially breached the criteria for eight and two months of the year, respectively, whereas other DNSPs potentially met the criteria.

Similarly, for 2023 up to November, all DNSPs potentially meet the assessment criteria for a voltage level below 216V and above 253V, except AusNet, which potentially breached the criteria in February 2023.

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CONTENTS

1. INTRODUCTION

1.1. Background and Project Objectives

GridWise Energy Solutions (GridWise), on behalf of Essential Services Commission (**ESC**) (Client) Victoria, has performed an analysis on the voltage performance data each quarter starting from December 2021 to November 2023 for several Distribution Network Service Providers (**DNSP**s) in Victoria. The DNSPs are AusNet, CitiPower, Powercor, United

Energy, and Jemena. The voltage performance is measured against the Australian Standard AS 61000.3.100-2011 and with clause 20.4 of the Electricity Distribution Code of Practice[1].

The report below discusses the criteria used for the assessment, the results obtained and the conclusions drawn when comparing against the voltage performance indicators and performance criteria (or Assessment Criteria) as per clause 20.4 of the [1] and Appendix D of AS 61000.3.100-2011.

1.2. Assessment Criteria

The data received from five DNSPs will be assessed based on the assessment criteria defined below. Using Advanced Metering Infrastructure (**AMI**), data is measured every 10 minutes, obtained for each week (Sun-Sat) in the reporting period, and excluding only supply interruptions, provide:

a) The percentage of total AMI NMIs that fell below 216V for more than 1% of the time.
b) The percentage of total AMI NMIs fell above 253V for more than 1% of the time.
c) The percentage of total AMI NMIs, where each AMI NMI fell below 216V for more than 1% of the time and above 253V for more than 1% of the time.
d) The percentage of total AMI NMIs that experienced voltage values fell below 207V for two consecutive time intervals.
e) The percentage of total AMI NMIs that experienced voltage values fell above 260V for two consecutive time intervals.
f) The percentage of total AMI NMIs, where each AMI NMI fell below 207V for two consecutive time intervals and above 260V for two consecutive time intervals.

As per the AS 61000.3.100-2011, functional compliance is met when the voltages are below 253V (V99%) or above 216V (V1%) **for 95% of the distributor's customers**. Figure 3 shows the AS 61000.3.100 target range for the over and under voltage range.

Hence, from above, we considered (a) and (b) as a part of the analysis of results. The voltage assessment criteria are potentially satisfied if less than 5% of the distributor's customers experience a voltage level below 216V or above 253V.

If more than 5% of the distributor's customers experience a voltage level below 216V or above 253V, then that DNSP is considered to be potentially breaching this assessment criteria.

The results are analyzed based on this assessment criteria and explained with several plots in the following sections.

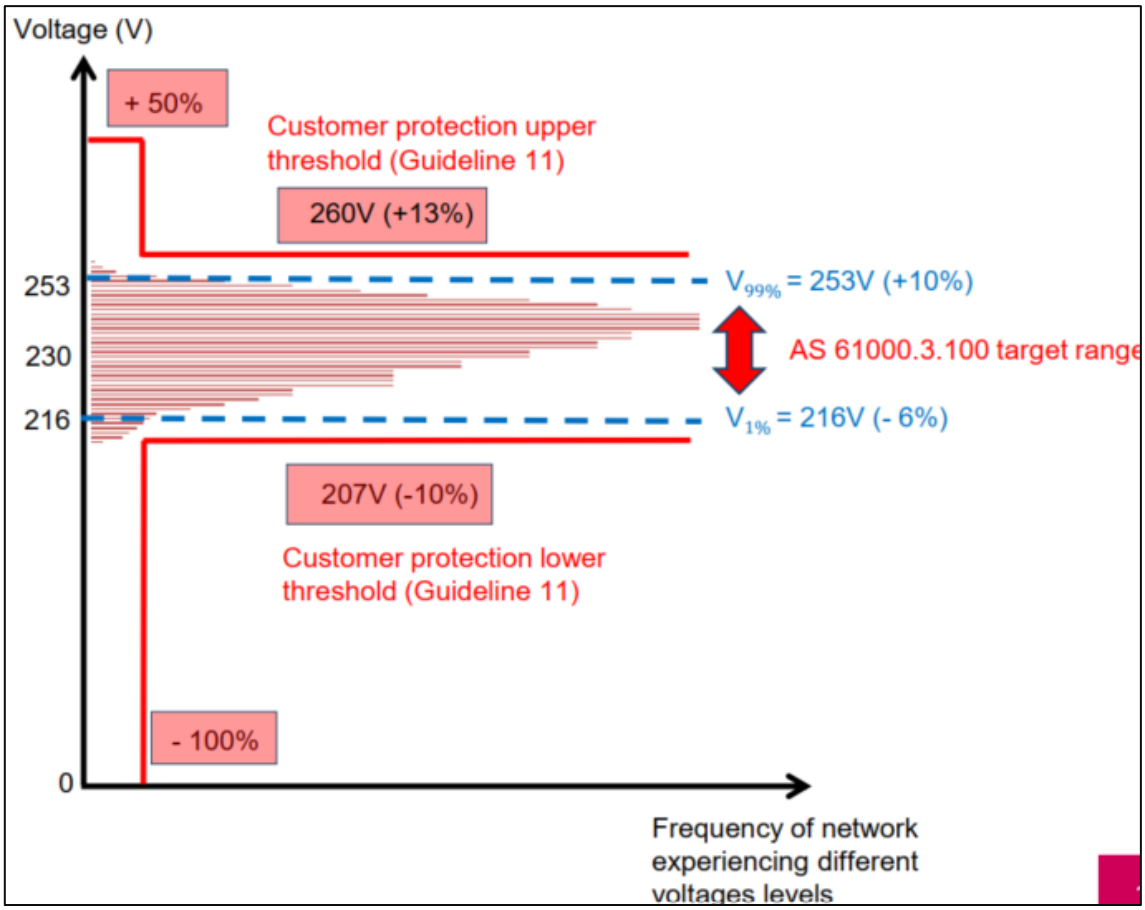

Figure 3: Australian Standard (AS 61000.3.1000) target range [1]

2. VOLTAGE ASSESSMENT RESULTS

The voltage compliance assessment for each DNSP is assessed weekly and analyzed against the assessment criteria. If more than 5% of the distributor's customers experience a voltage level below 216V or above 253V, then that DNSP is considered to be potentially breaching this assessment criteria.

This section provides a summary of the results for each DNSP. The detailed quarterly assessment plots for each DNSP are provided in APPENDIX A.

Also, in the following sections, the maximum percentage of the customers with voltages below 216V and over 253V per month are plotted separately and compared over 2022 and 2023 to represent performance for each DNSP.

2.1. AusNet Services

Figure 4 and Figure 5 below provide an example of the voltage assessment against the assessment criteria for summer 2021 for AusNet services (first quarter).

Less than 5% of AusNet customers experienced voltage lower than 216V for the summer 2021 period. However, this percentage was more than 5% for the voltage above 253V in multiple weeks of this quarter. Therefore, AusNet is potentially not compliant with the over-voltage criteria for Summer 2021.

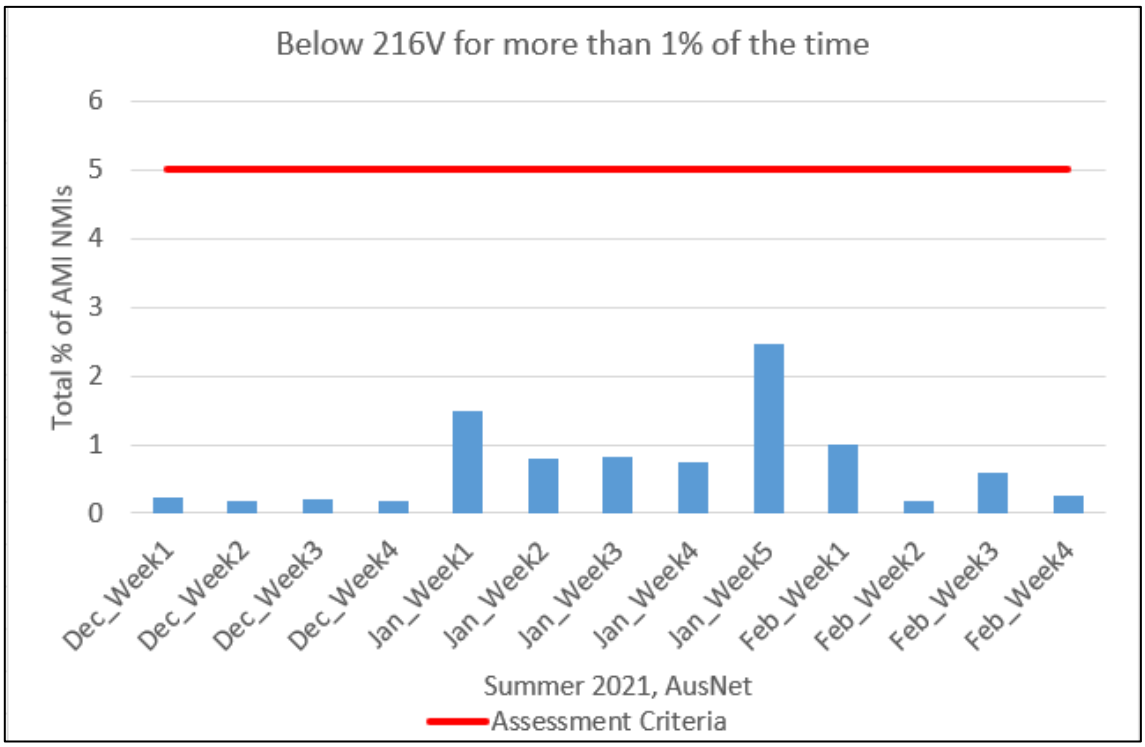

Figure 4: First Quarter AusNet Services Plot for voltage level below 216V

(28th November 2021 to 26th February 2022)

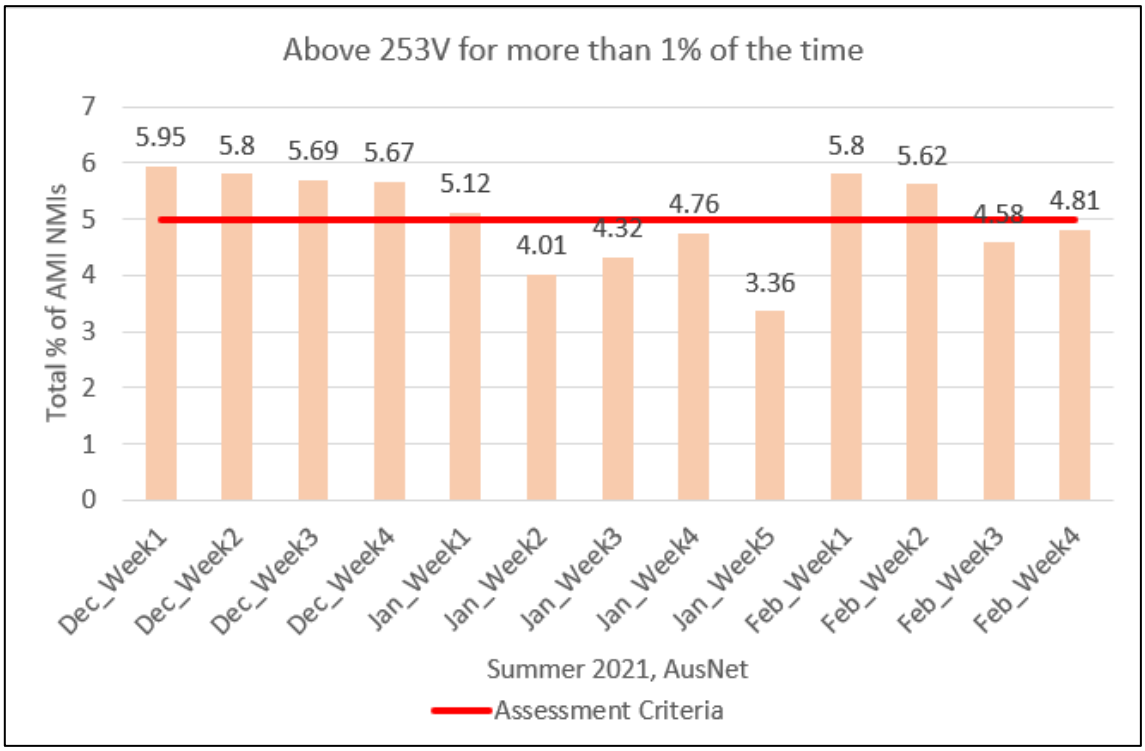

Figure 5: First Quarter AusNet Services Plot for voltage level above 253V

(28th November 2021 to 26th February 2022)

Similarly, the data for each quarter is plotted and can be inferred based on the above criteria for every other DNSP, including AusNet, CitiPower, Powercor, United Energy, and Jemena in Victoria. These results can be found in Appendix A.1, Appendix A.2, Appendix A.3, Appendix A.4, and Appendix A.5, respectively. The results can be interpreted similarly as above for each DNSP.

Figure 6 and Figure 7 below show the maximum percentage of customers with below 216V and above 253V per month, comparing AusNet's performance each year.

Figure 6 shows that the percentage of customers experiencing voltage below 216V over the assessment period is below the 5% criteria for low voltages. Hence, AusNet is potentially compliant with the low voltage assessment criteria. On the other hand, referring to Figure 7, the voltages are above 253V for more than 5% of customers for several months in 2022 and 2023 and in one month of 2021. It shows that AusNet potentially has breached the assessment criteria several times in 2021, 2022, and 2023.

More precisely, over the 104 weeks of data analyzed from December 2021 to November 2023, AusNet potentially did not comply for 25 weeks (~24%) with the over voltage (i.e. 253V) assessment criteria.

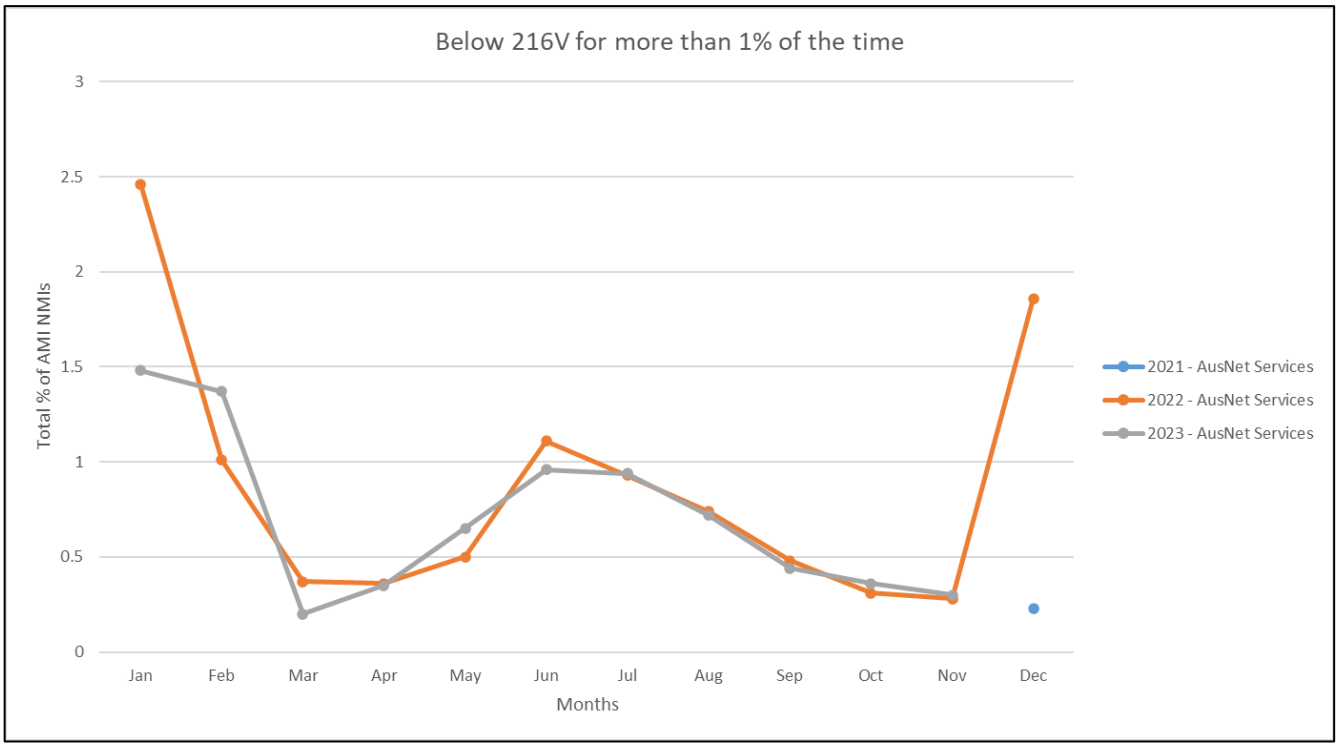

Figure 6: AusNet Services yearly comparison plot for %customers below 216V

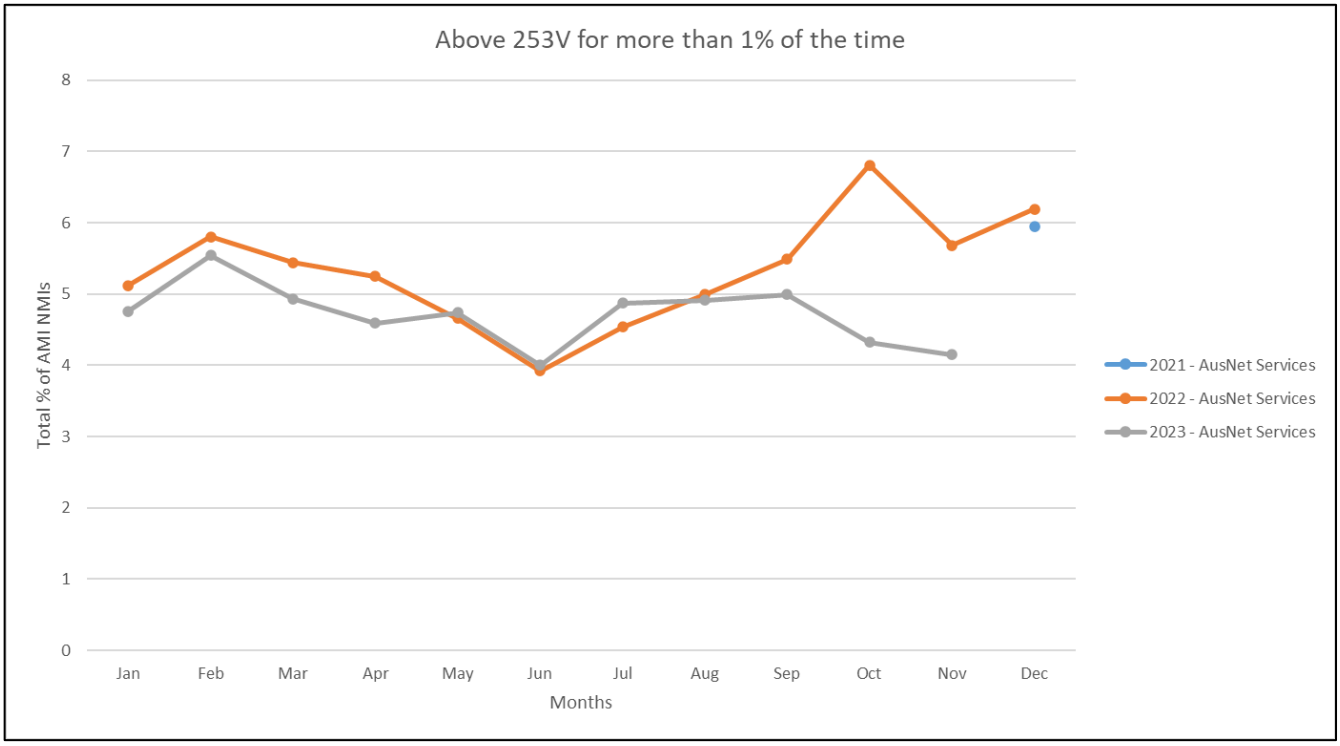

Figure 7: AusNet Services yearly comparison plot for %customers above 253V

The additional plotted trend until November 2023 in Figure 7 shows better performance for AusNet Services to reduce the percentage of customers experienced above 253V after February compared to 2022. Analyzing the additional quarter's data, it is evident that customers did not encounter overvoltage issues throughout 2023 up to November, except in February. This indicates a promising enhancement in managing customers who experienced voltages above 253V compared to the preceding year, 2022.

2.2. CitiPower

Figure 8 and Figure 9 show that the percentage of customers who experienced voltages below 216V and above 253V for the years 2021,2022, and 2023 are well below the 5% criteria. Therefore, CitiPower is potentially considered compliant with the assessment criteria for both the low and overvoltages for the assessment period.

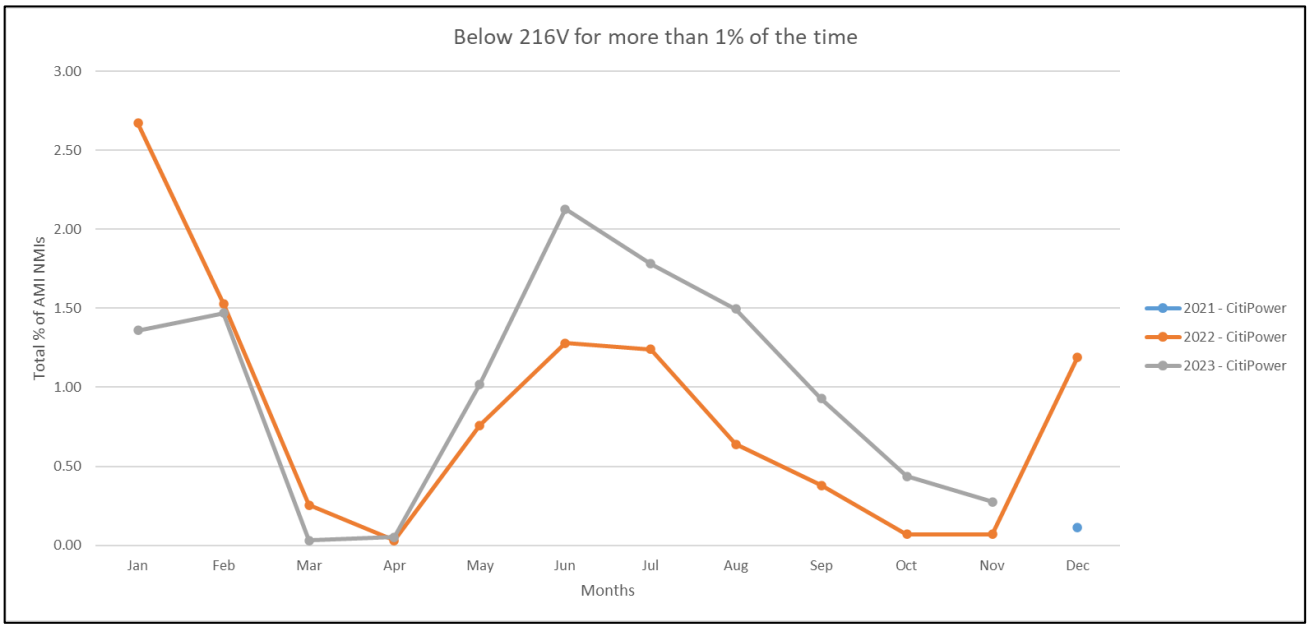

Figure 8: CitiPower yearly comparison plot for %customers below 216V

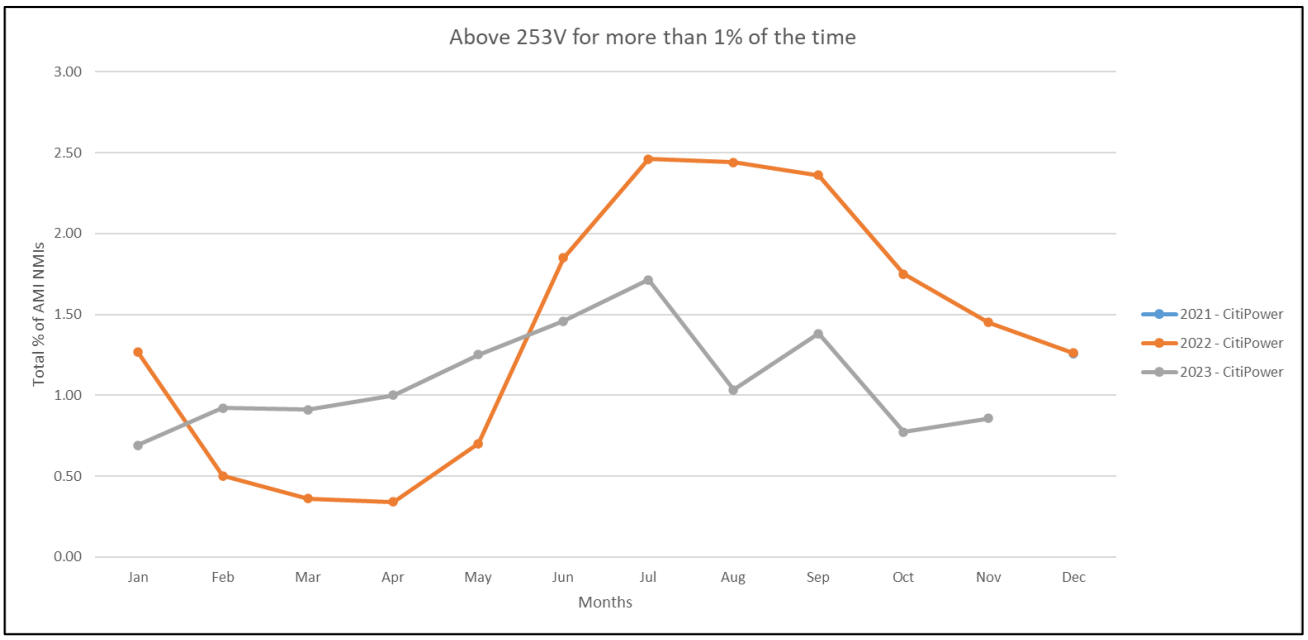

Figure 9: CitiPower yearly comparison plot for %customers above 253V

2.3. Powercor

Figure 10 shows that the percentage of customers who experienced voltages below 216V for the years 2021,2022, and 2023 are well below the 5% criteria. Therefore, Powercor potentially complies with the assessment criteria for the low voltages. However, there is a marginal rise in the percentage of customers encountering voltages below 216V from March to September 2023 when compared to the corresponding period in 2022. Although this increase remains within the accepted range of 5%, it should be acknowledged and taken into consideration by Powercor.

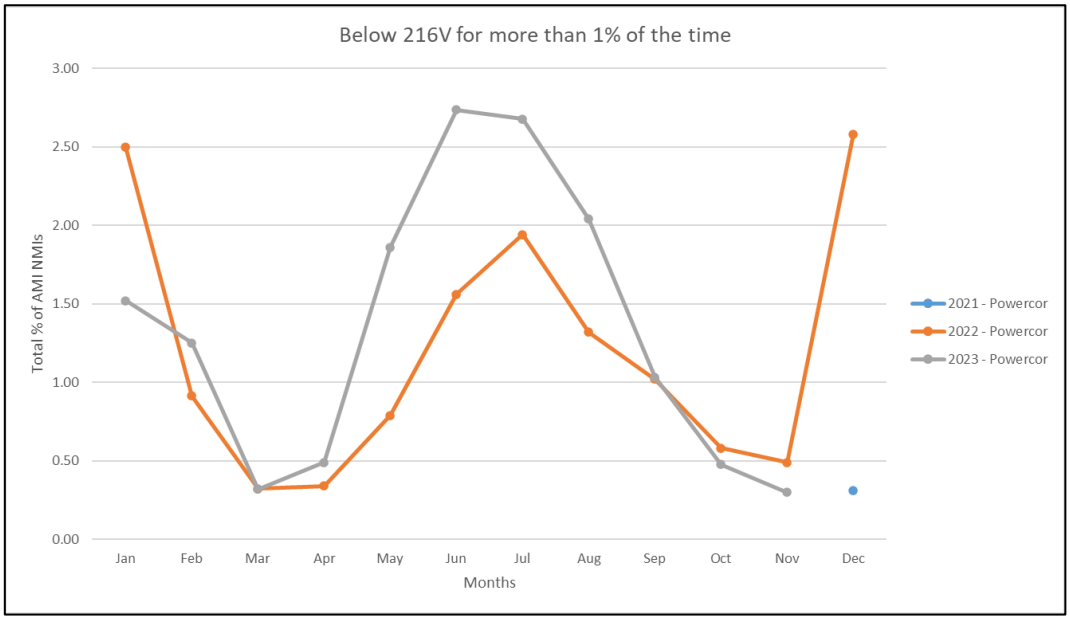

Figure 10: Powercor yearly comparison plot for %customers below 216V

Figure 11 shows that Powercor potentially breached the overvoltage assessment criteria for December 2021, March, and May 2022. However, the plot for the year 2023 shows that Powercor's performance was better and potentially compliant with the over-voltage assessment criteria. The percentage of weeks that Powercor potentially did not comply with the above 253V assessment criteria was 4% (4 weeks) of the total number of weeks (104 weeks) over the assessment period.

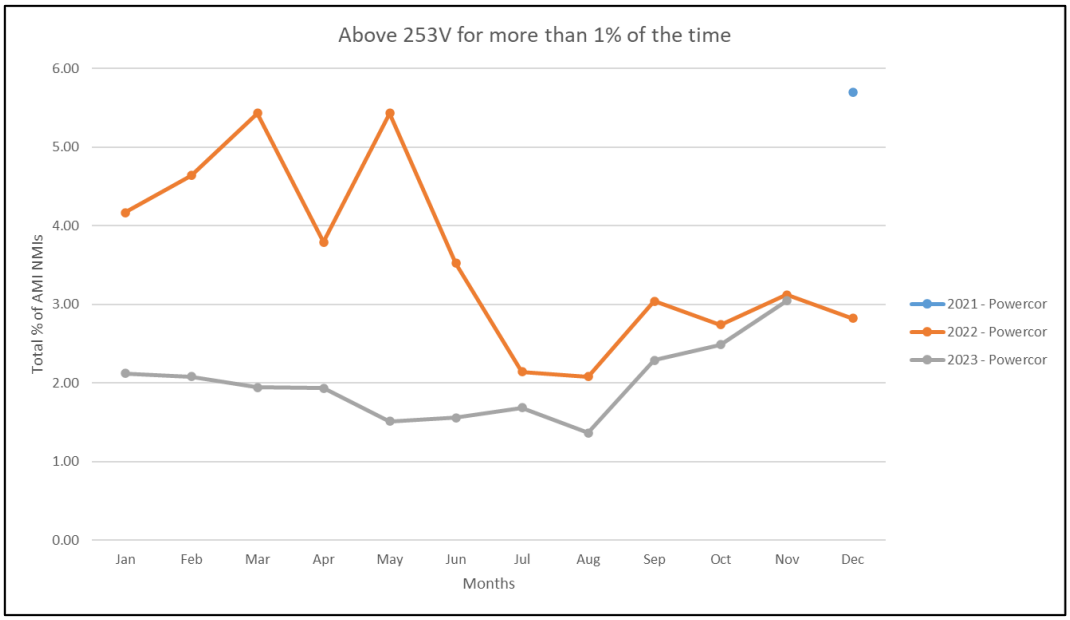

Figure 11: Powercor yearly comparison plot for %customers above 253V

2.4. United Energy

Figure 12 and Figure 13 show that the percentage of customers who experienced voltages below 216V and above 253V for the years 2021,2022, and 2023 are below the 5% criteria. Therefore, United Energy is potentially considered compliant with the assessment criteria for both the low and overvoltages for the assessment period.

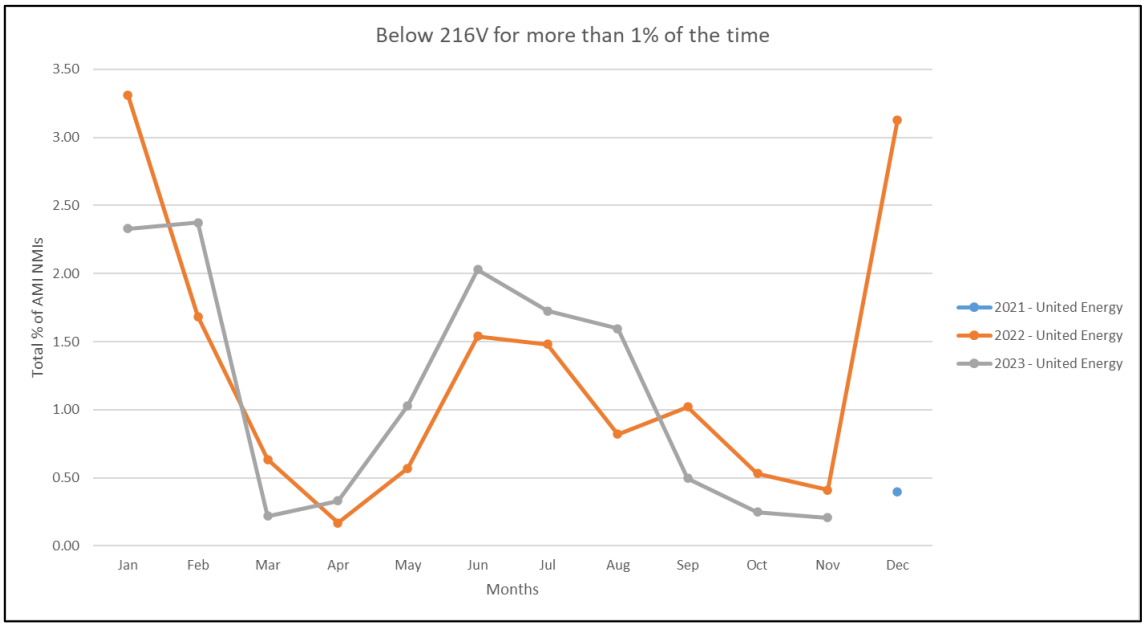

Figure 12: United Energy yearly comparison plot for %customers below 216V

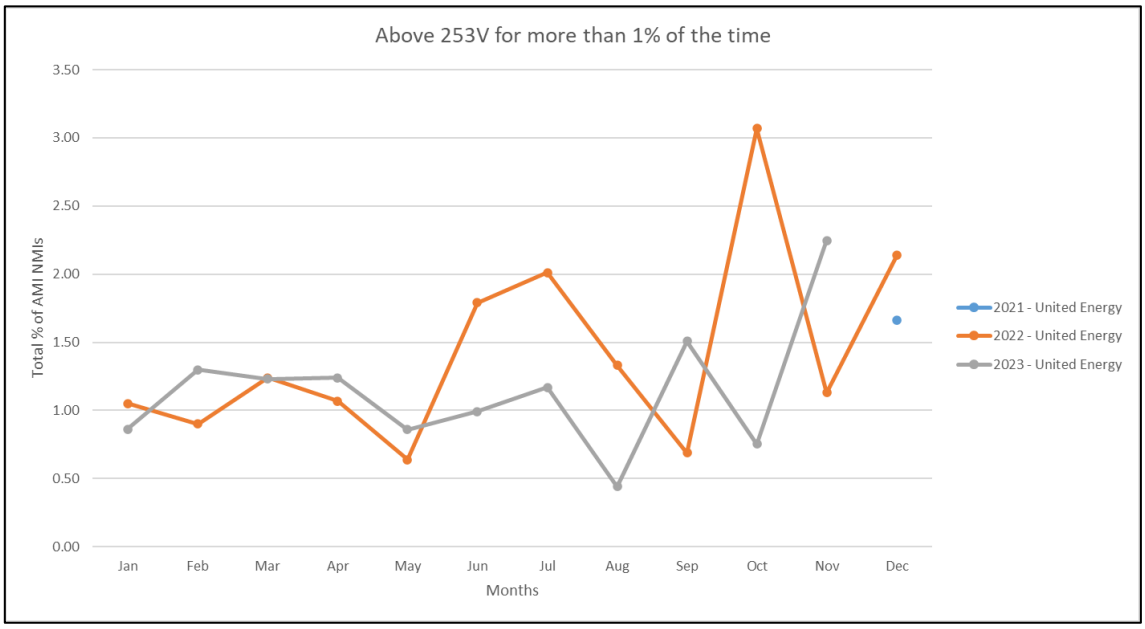

Figure 13: United Energy yearly comparison plot for %customers above 253V

2.5. Jemena

Figure 14 and Figure 15 show that the percentage of customers who experienced voltages below 216V and above 253V for the years 2021,2022, and 2023 are well below the 5% criteria. Therefore, Jemena is potentially considered compliant with the assessment criteria for both the low and overvoltages for the assessment period.

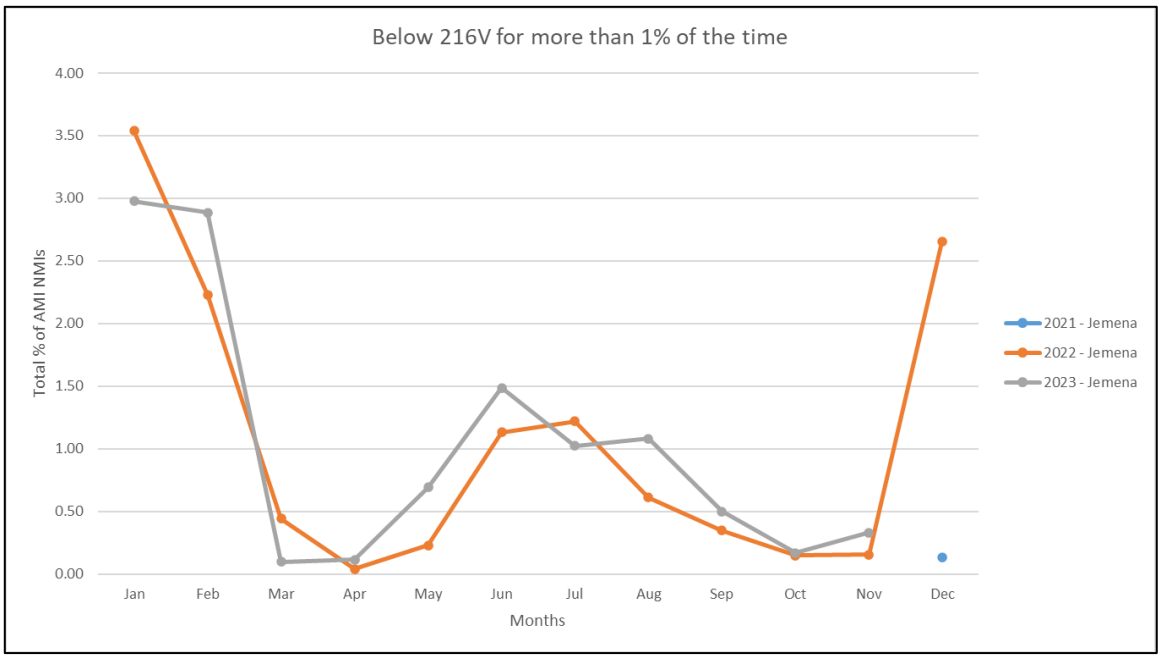

Figure 14: Jemena yearly comparison plot for %customers below 216V

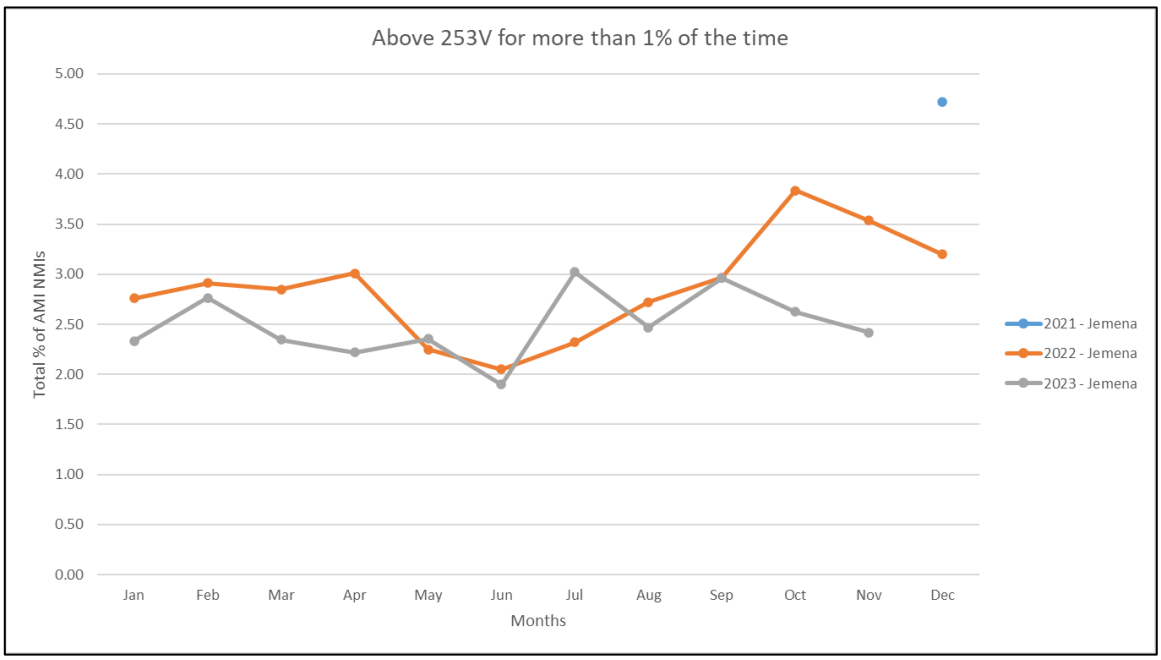

Figure 15: Jemena yearly comparison plot for %customers above 253V

3. CONCLUSION

In this report, the voltage performance data for each Victorian DNSP from December 2021 to November 2023 were assessed for the voltage assessment criteria as defined in the Electricity Distribution Code of Practice[1]. The voltage assessment criteria are satisfied if less than 5% of the distributor's customers experience a voltage level below 216V or above 253V.

Following are the key observations and conclusions from the voltage assessment for the assessment period.

- All DNSPs potentially comply with the low voltage (i.e., 216V) assessment criteria.
- Some DNSPs potentially breached the overvoltage (i.e., 253V) assessment criteria, as shown below.
    - AusNet has potentially breached the criteria for 24% of the total weeks (25 out of 104 weeks).
    - Powercor has potentially breached the criteria for 4% of the total weeks (4 out of 104 weeks).
- United Energy, CitiPower and Jemena potentially did not breach the overvoltage assessment criteria for the assessment period.
- Due to the limited amount of voltage performance data, any trends, such as seasonal trends over different years, were not apparent. Any possible trends may be visible with future voltage performance data for an extended period.
- Figure 16 and Figure 17 show the plots of the maximum percentage of the number of customers per month for each DNSP for the years 2022 and 2023 and are assessed against the defined assessment criteria.

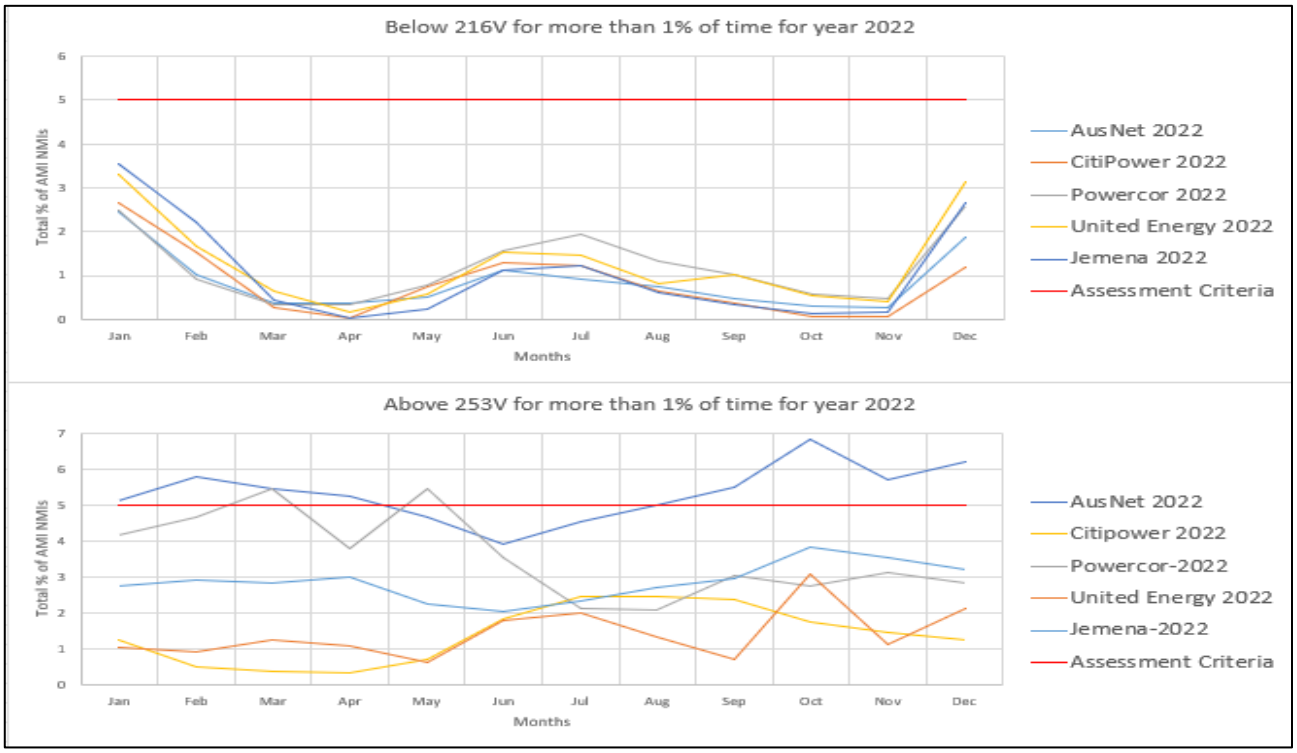

Figure 16: DNSPs assessment for the year 2022

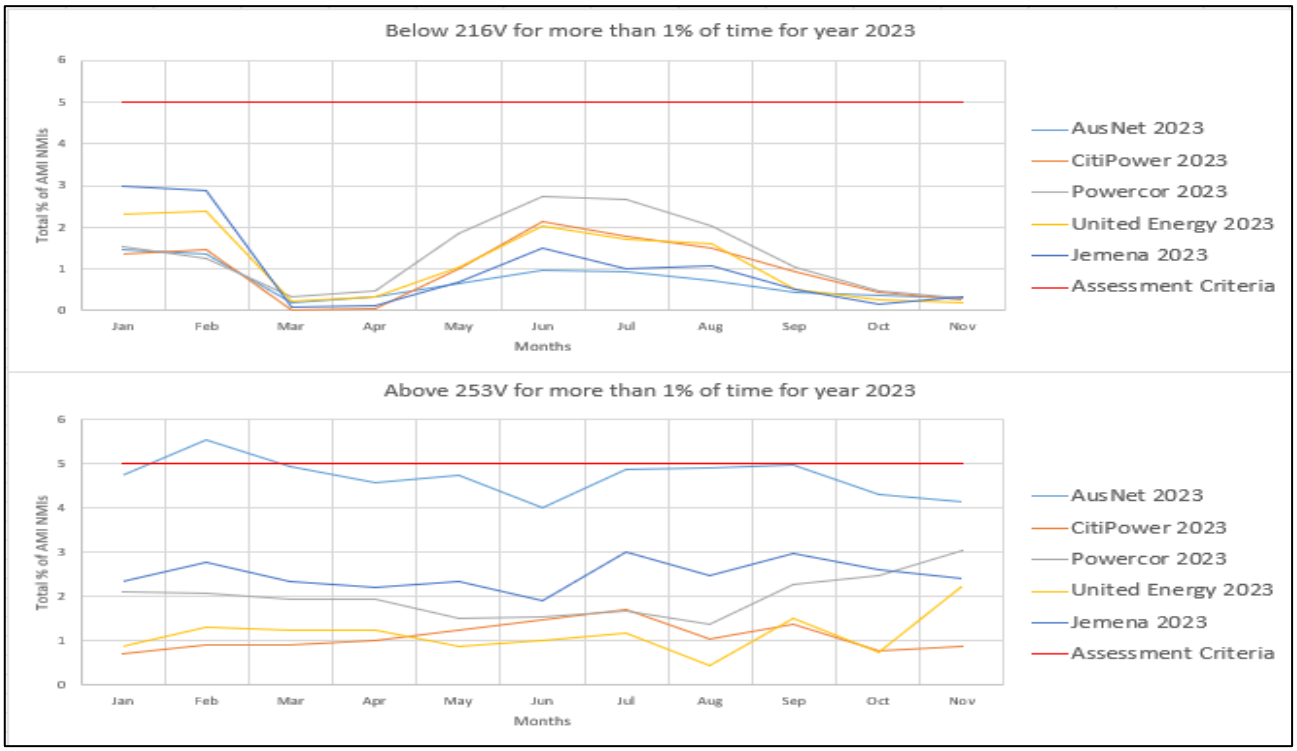

Figure 17: DNSPs assessment for the year 2023 Up to November

4. REFERENCES

[1] Essential Service Commission, “Electricity Distribution Code of Practice”, Ver 2, 2023

APPENDIX A. DNSP QUARTERLY PLOTS

Appendix A.1. AusNet Services Plots

Figure 18: AusNet Services quarterly assessment plots from December 2021 to August 2022

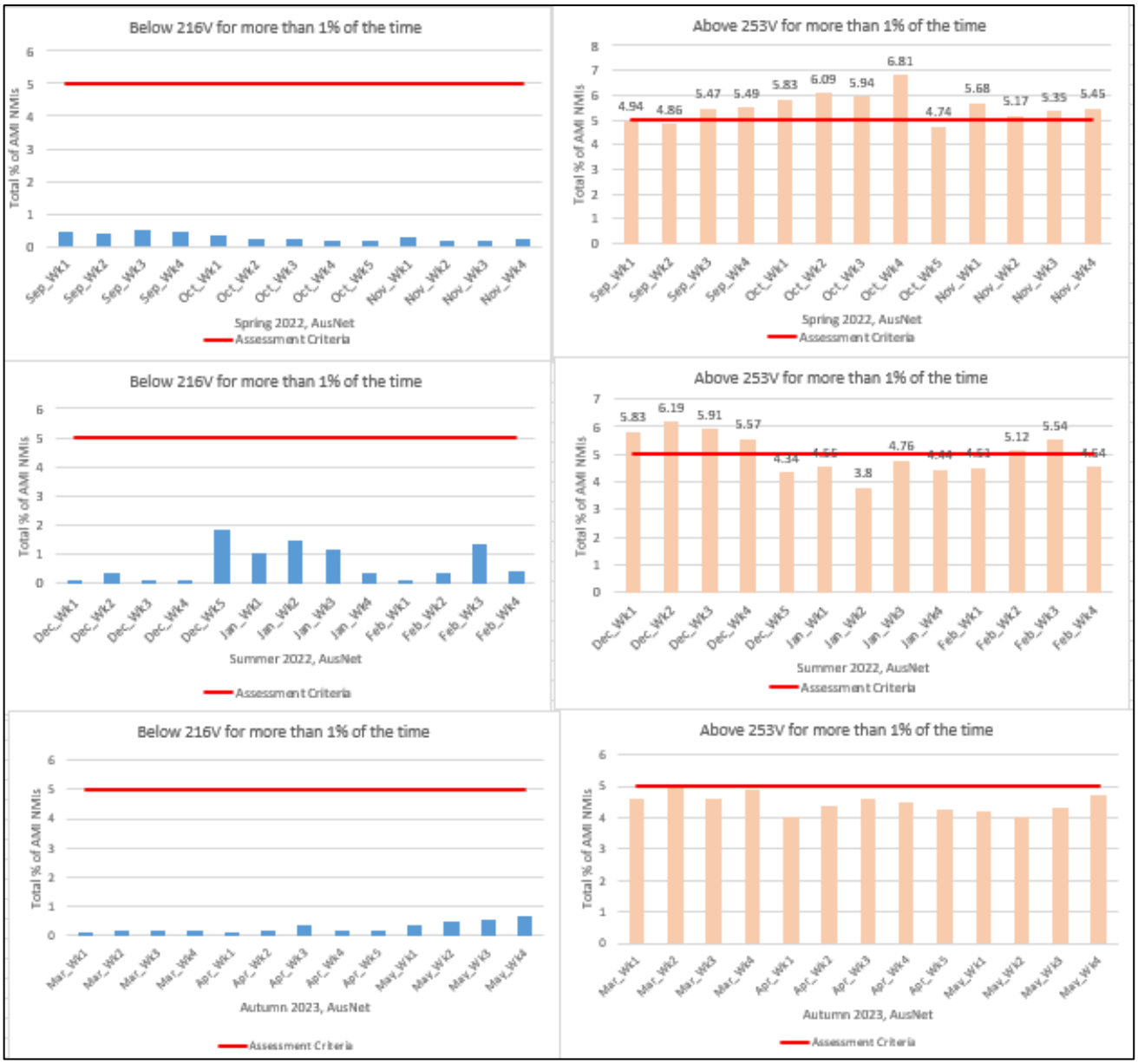

Figure 19: AusNet Services quarterly assessment plots from September 2022 to May 2023

Figure 20: AusNet Services quarterly assessment plots from June 2023 to November 2023

Appendix A.2. Citi Power Plots

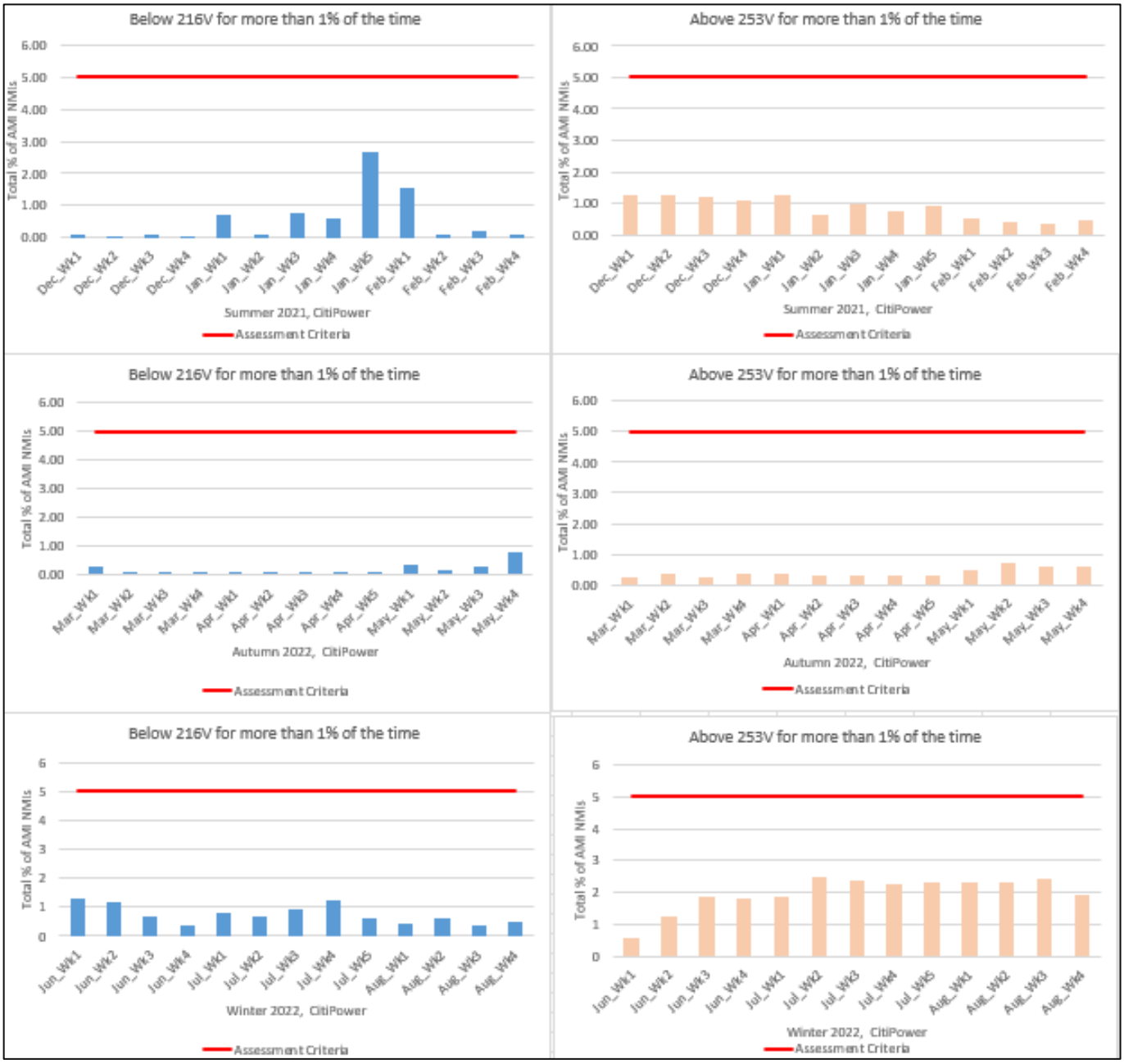

Figure 21: Citi Power quarterly assessment plots from December 2021 to August 2022

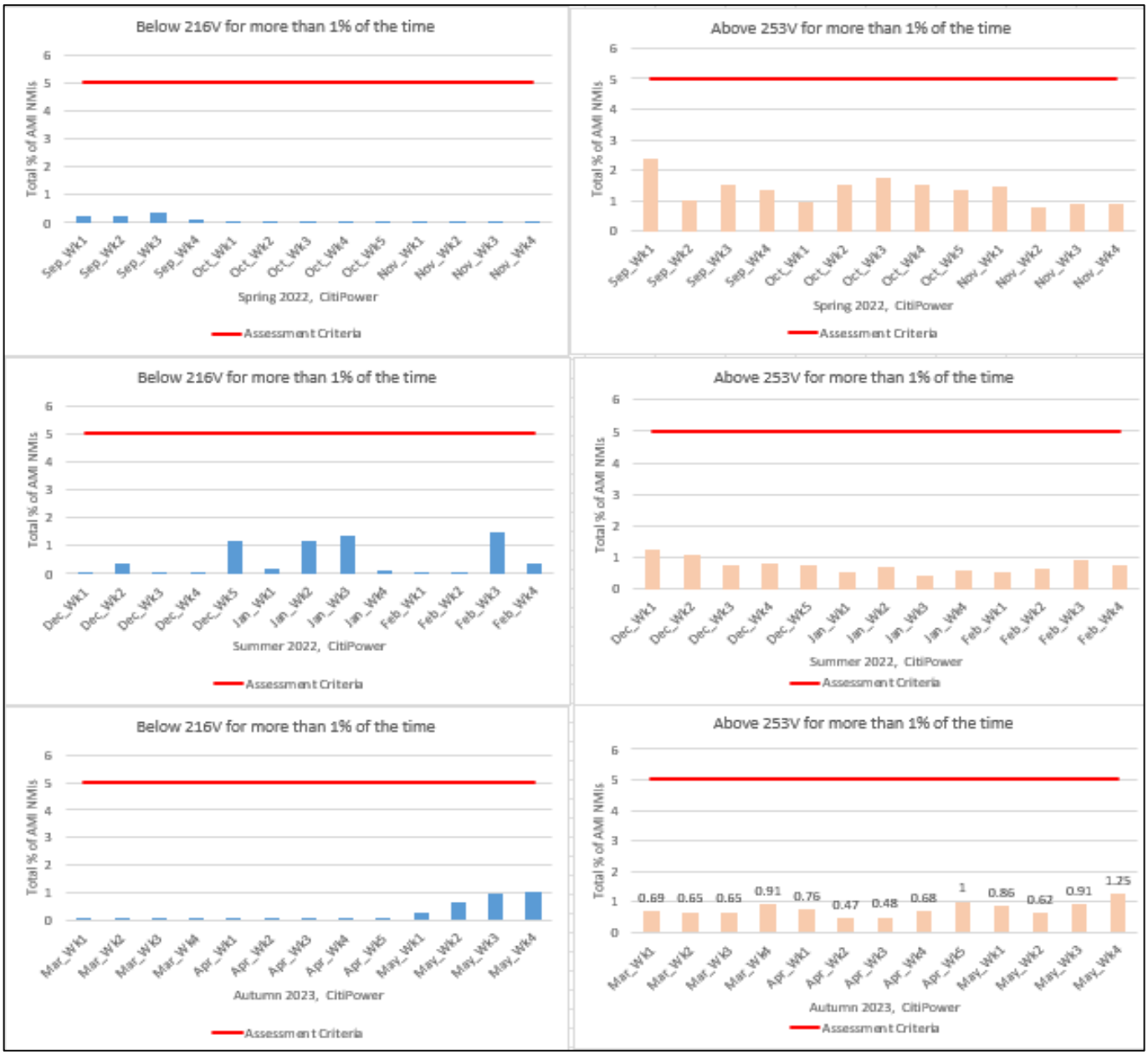

Figure 22: Citi Power quarterly assessment plots from September 2022 to May 2023

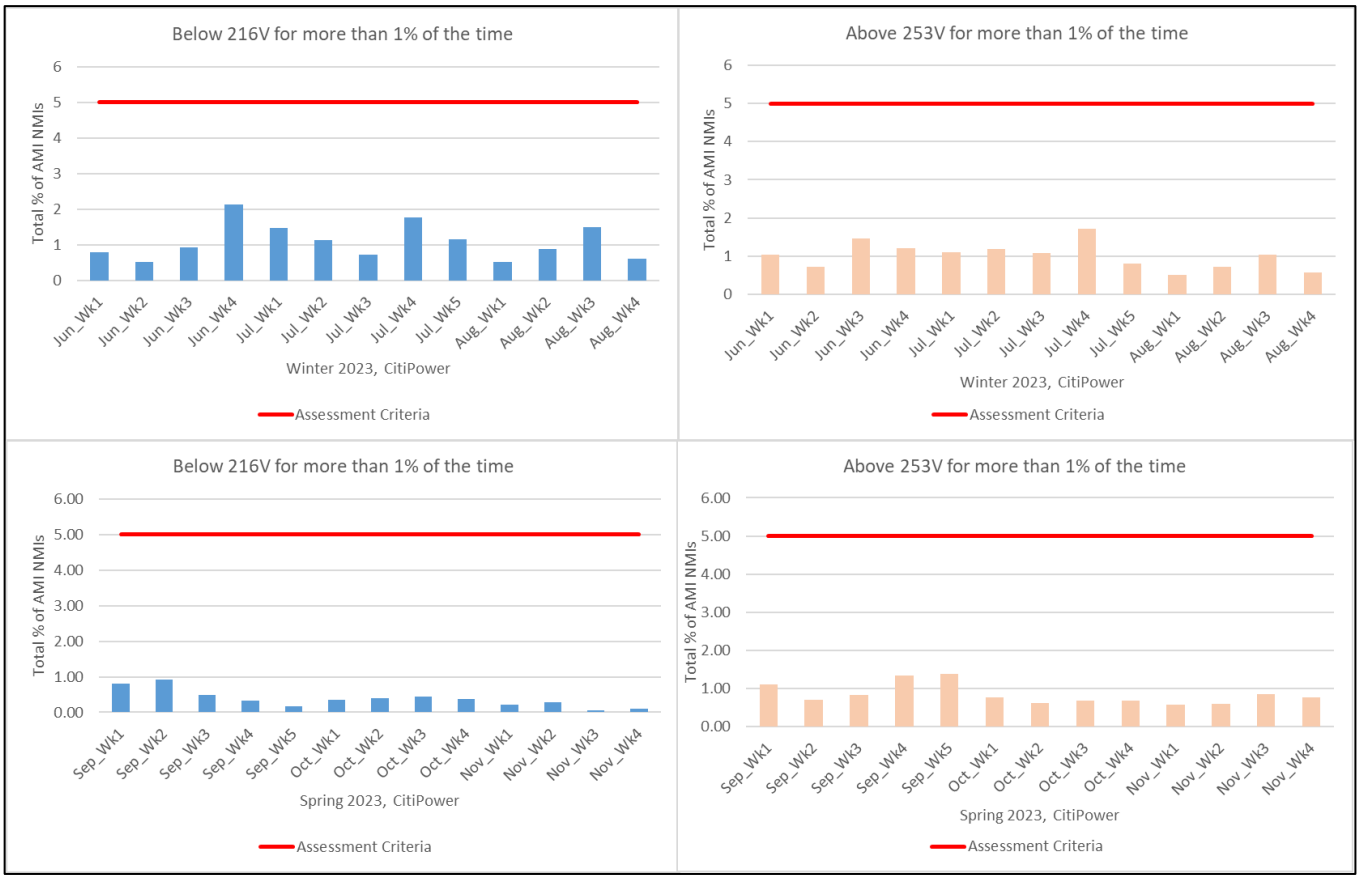

Figure 23: Citi Power quarterly assessment plots from June 2023 to November 2023

Appendix A.3. Powercor Plots

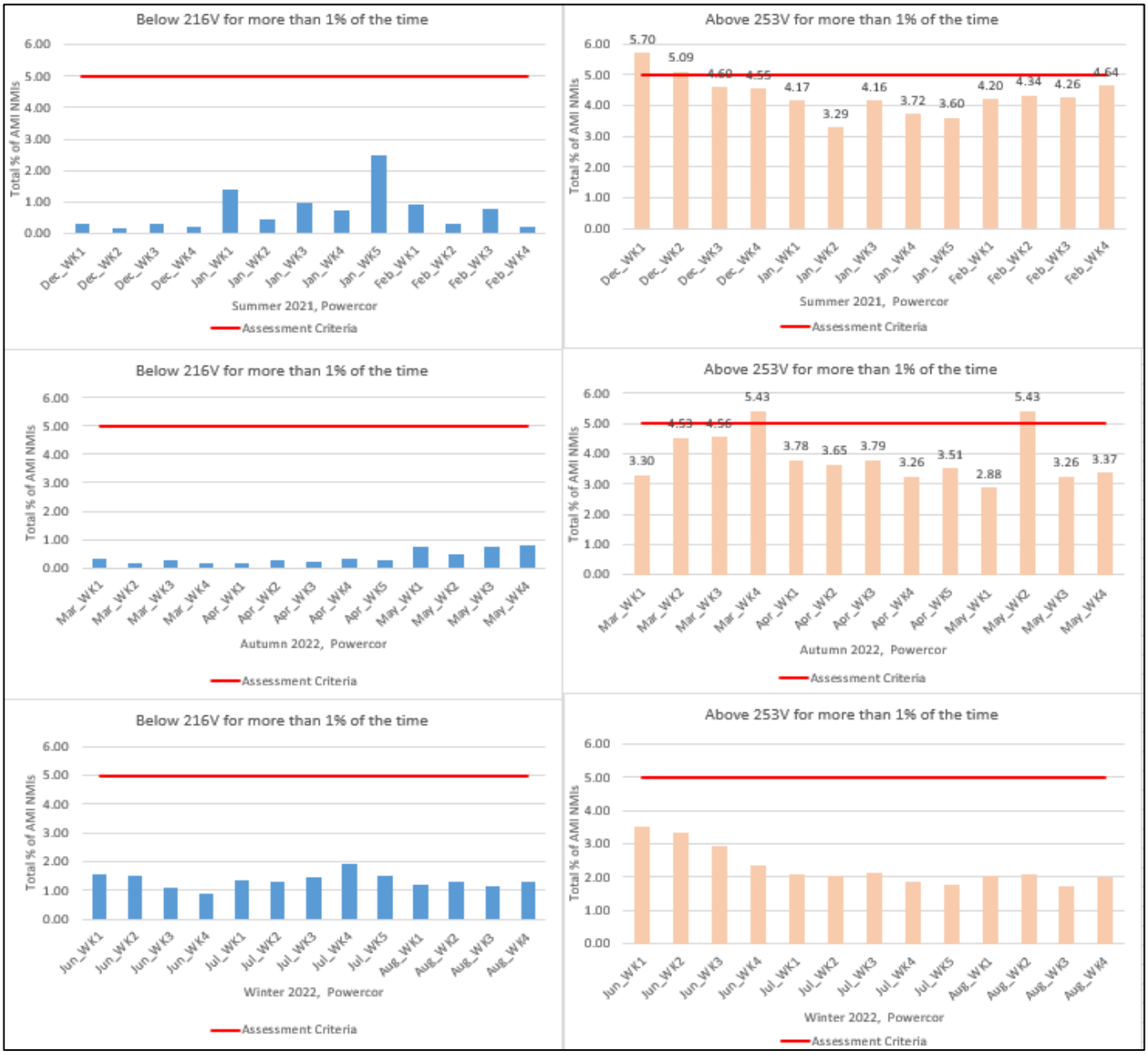

Figure 24: Powercor quarterly assessment plots from December 2021 to August 2022

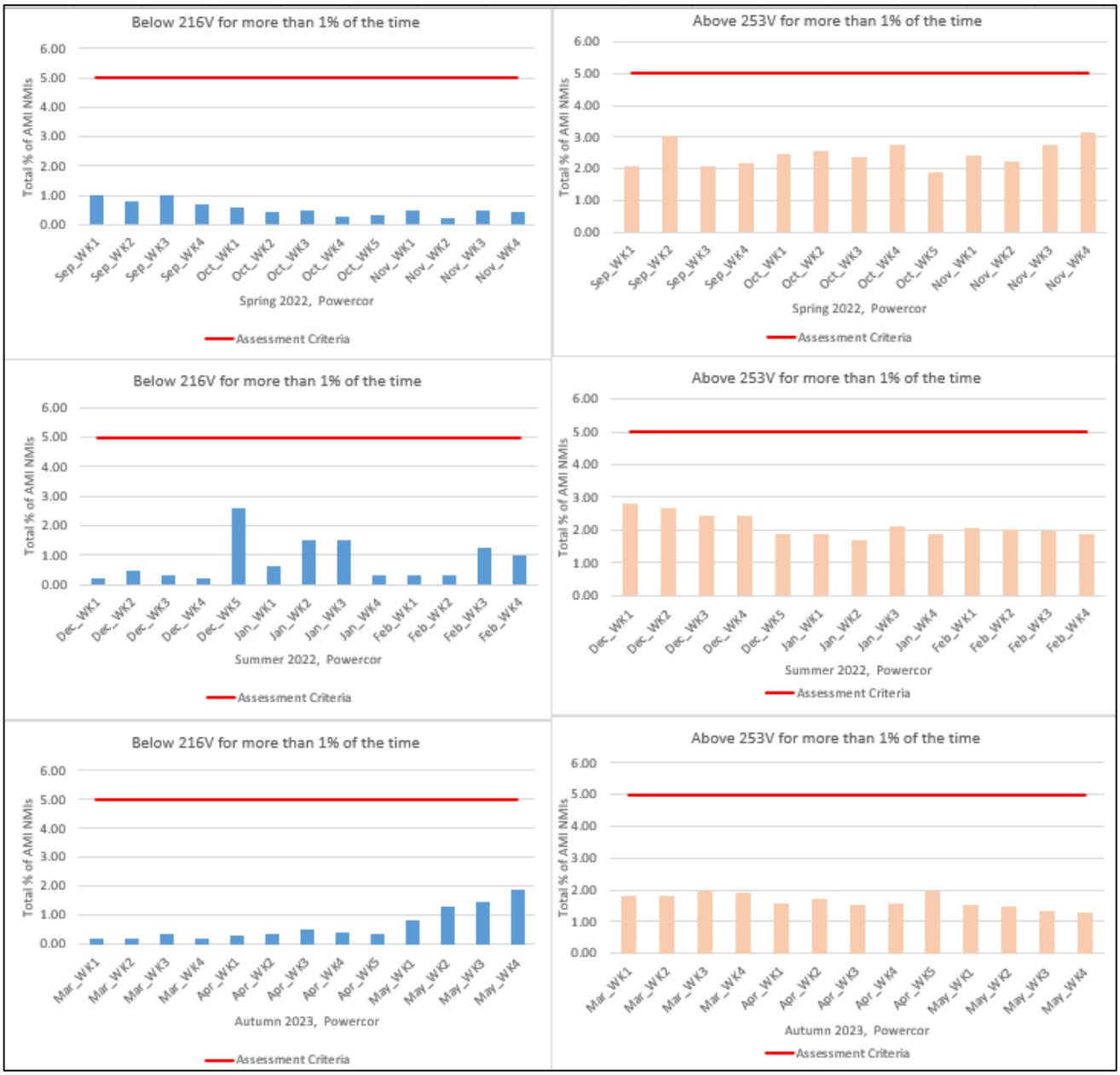

Figure 25: Powercor quarterly assessment plots from September 2022 to May 2023

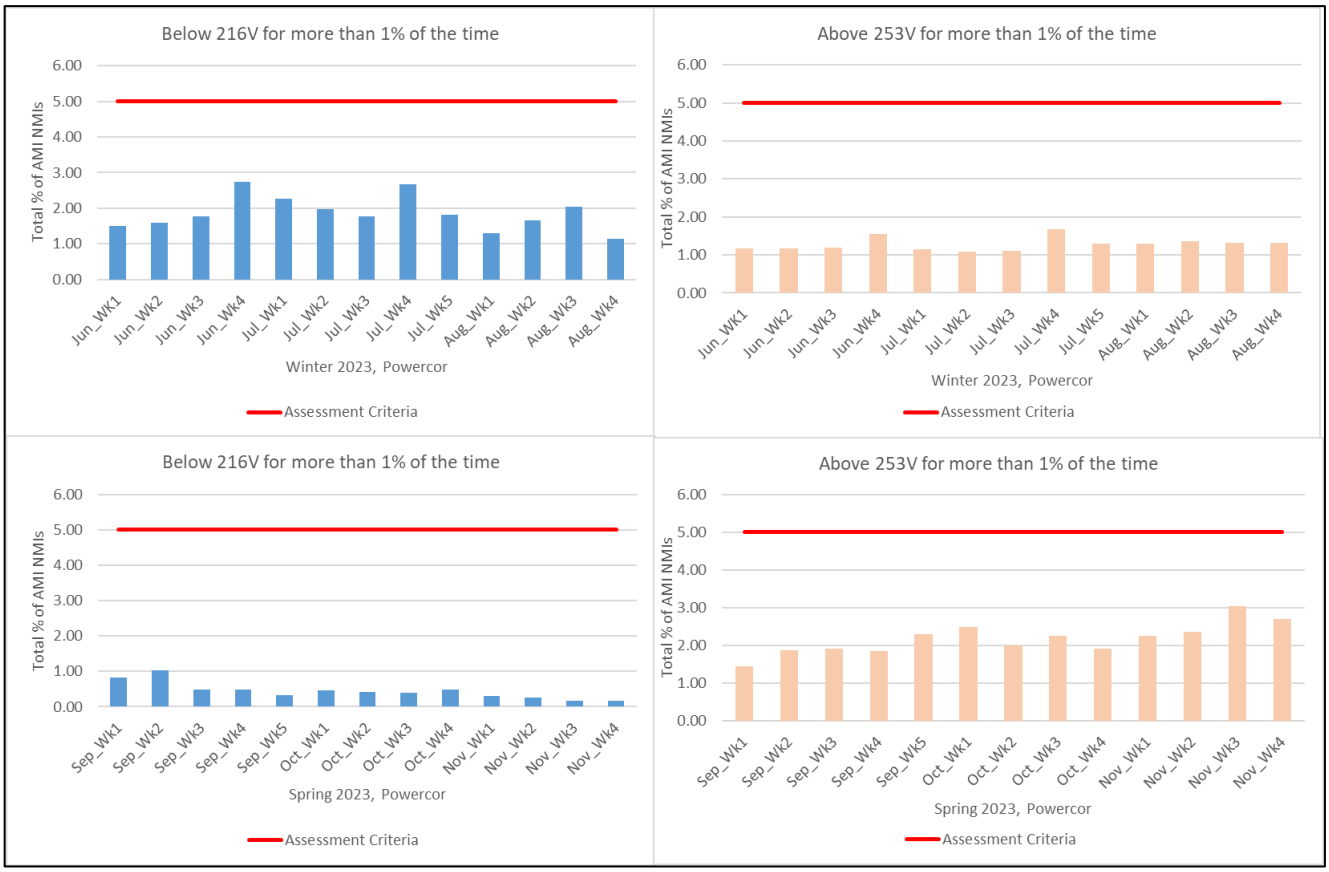

Figure 26:Powercor quarterly assessment plots from June 2023 to November 2023

Appendix A.4. United Energy Plots

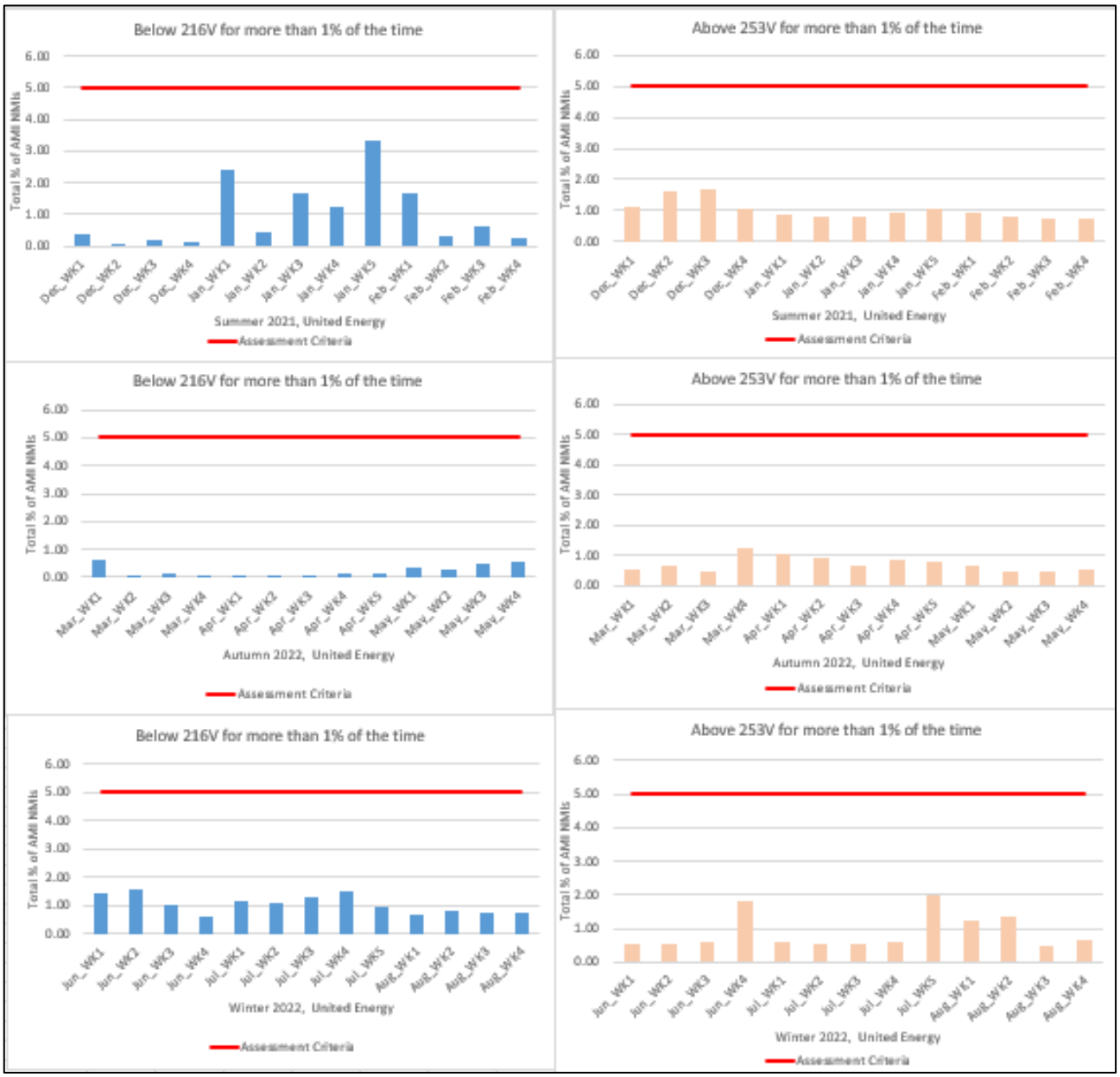

Figure 27: United Energy quarterly assessment plots from December 2021 to August 2022

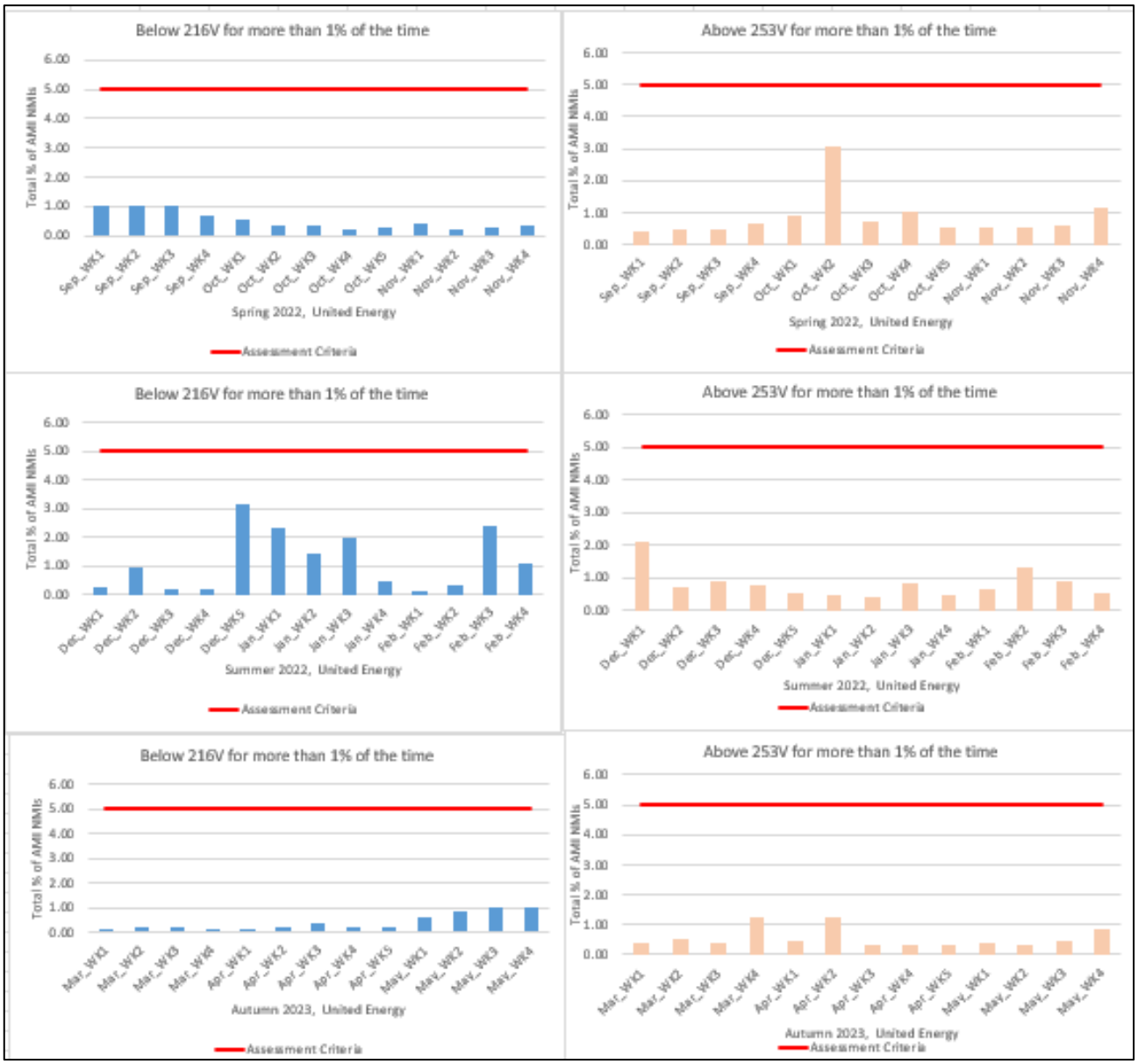

Figure 28: United Energy quarterly assessment plots from September 2022 to May 2023

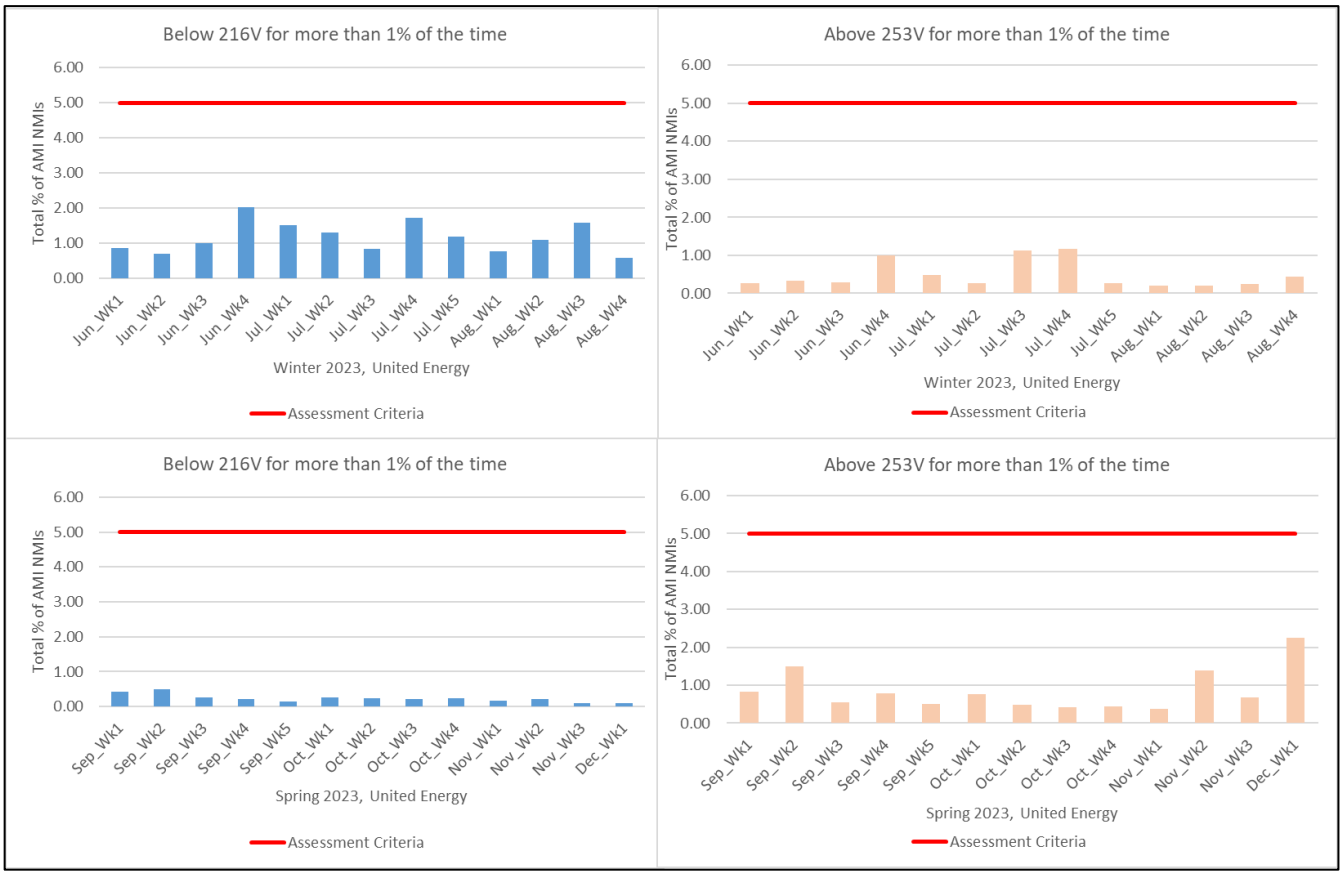

Figure 29: United Energy quarterly assessment plots from June 2023 to November 2023

Appendix A.5. Jemena Plots

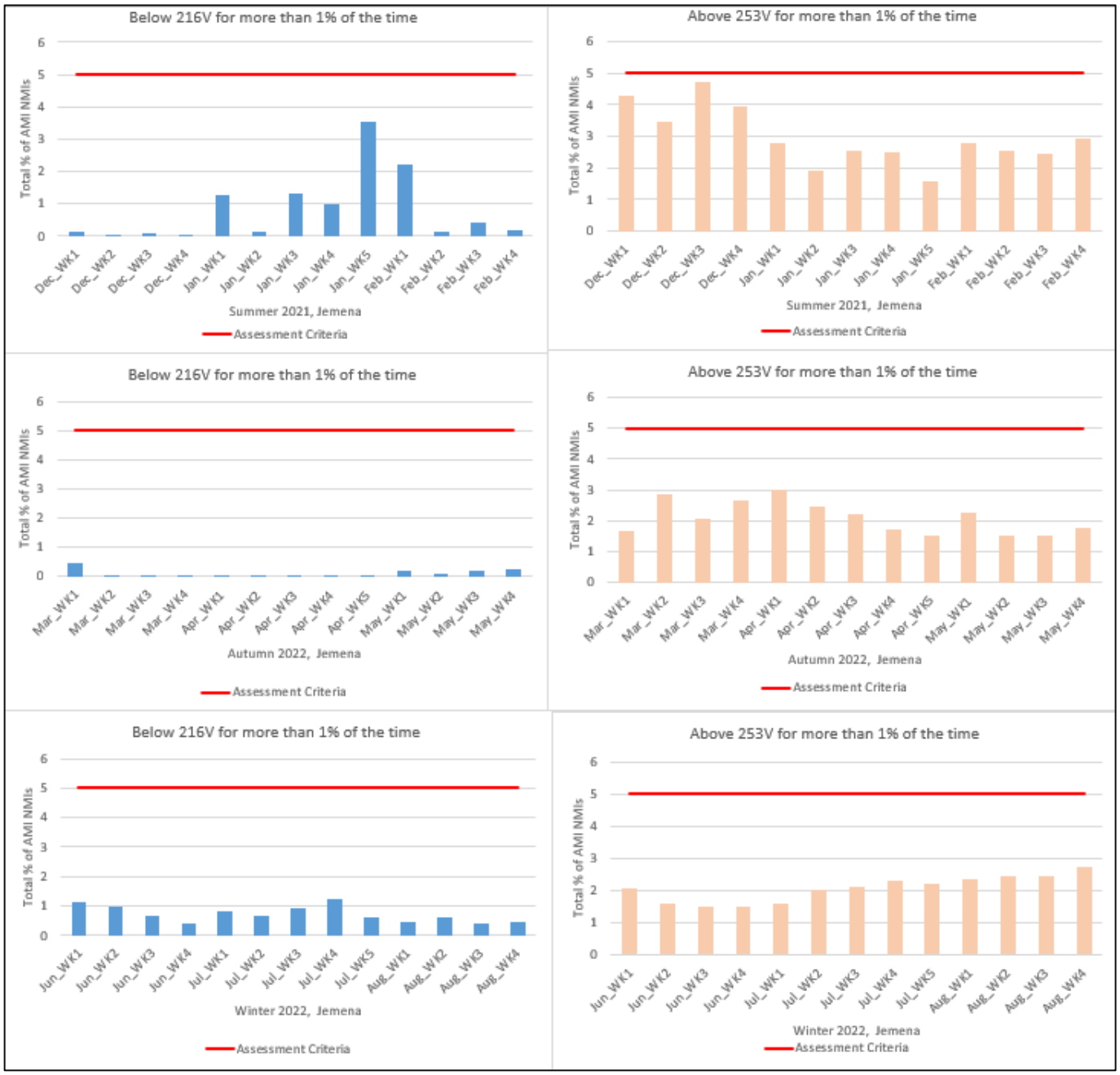

Figure 30: Jemena quarterly assessment plots from December 2021 to August 2022

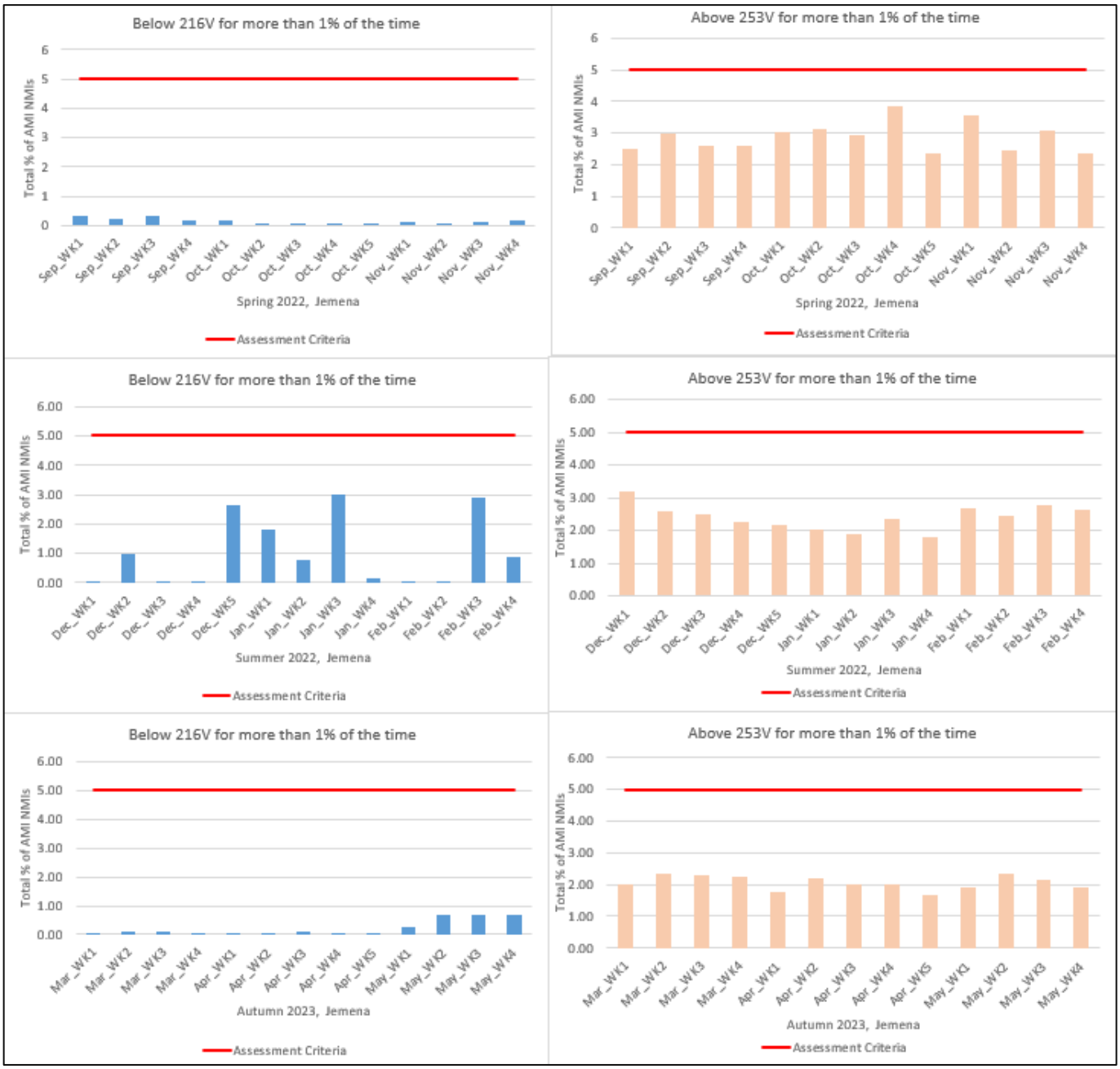

Figure 31: Jemena quarterly assessment plots from September 2022 to May 2023

Figure 32: Jemena quarterly assessment plots from June 2023 to November 2023