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BHP NEWMAN TOWNSHIP ELECTRICITY SUPPLY
ANNUAL AUDIT REPORT
2021/2022

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EXECUTIVE SUMMARY

The township of Newman is located approximately 1,200 km to the north of Perth, within the Shire of East Pilbara. The electricity network is owned, governed and operated by BHP Supply Authority. The network encompasses the township of Newman, the Airport, Capricorn Roadhouse, the town water supply bore field and connections to the mining infrastructure in the adjacent areas.

In accordance with the Western Australia Electricity Industry Code 2005 (the Code), electricity supply authorities must publish a report setting out the information described in Schedule 1 of the Code for each financial year (FY). This document, known as the Annual Audit Report, is to provide a detailed report on the Network Quality & Reliability of Supply.

The Code also requires the supply authority to arrange an independent audit and subsequent report on the procedures and systems that the distributor has in place for monitoring its compliance to the Code's Part 2. APD were engaged by BHP as the independent consultant to undertake the audit process and prepare the report.

The audit interviews were undertaken on the 22nd of August 2022 via the Microsoft Teams video conferencing facility, with relevant stakeholders and resources available to APD. As a result of the audit process and interviews, the following key observations were made:

- By 30 June 2021 BHP completed the installation of (14 of 16) permanent fixed SEL735 Advanced Power Quality and Revenue Meters at selected pad-mount substations to improve the logging process by providing year-round access to power quality data including harmonics. The installation of the remaining two units was completed in 2021/22.
- Previous Audit Reports stated that there were neutral voltage integrity issues within customer supplies and that these issues were managed reactively. However, BHP has undertaken some proactive sampling of service connections to identify issues in advance. In the longer term (2 years) BHP are aiming to use the functionality of AMI smart meters to help manage this issue. Design work is in progress, and some installation work is expected in 2022/23.

The results for the 2021/2022 audit are shown in the table titled 'Audit Scorecard' (presented at the end of this Executive Summary).

The evaluation ratings remain consistent with the previous FY audit; BHP are found to be proactively undertaking continuous improvement projects to maintain adequate levels of reliability, power quality and public/personnel safety within the Newman Township. This is evident from several asset upgrade projects either already completed or currently in progress. This includes the following:

Completed in 2021/22

- Replacing aging assets 'end of useful life' - transformer T7 and pad-mount substation PS61.
- Considering the replacement of existing line interrupters with air-break switches (which have load break capability).
- Upgrading the electricity supply to the town hospital as part of the overall hospital upgrade project. This includes new network connection assets.

In progress for 2022/23 and beyond

- Closely monitor the situation with respect to HV overhead line (main road) crossings and high/oversized loads; BHP has made budgetary provision for undergrounding the relevant sections of overhead line to address this issue. Some undergrounding installation work is expected in 2022/23.
- Replacement of line interrupters with load break switches has progressed to the design stage.
- Progressing the AMI smart meter installation to (among other things) address the neutral voltage integrity issue that may arise with customer service connections.

With respects to the holistic electrical network, the recent PQ metering data indicates that Newman's electrical network has undergone noteworthy improvements to maintain its reputation as a robust and inherently good network.

The average electrical parameters of voltage, frequency and voltage total harmonic distortion were generally consistently stable and well within compliance-levels, as indicated in the notes below:

- Voltage Flicker:

Logging Period	Number of Breaches – short term	Number of Breaches – long term
2021/22	0	0
2020/21	2	2
2019/20	15	36
2018/19	17	4
2017/18	8	0

Voltage Flicker (AS61000:2001): There were no voltage flicker (short term and long term) breaches recorded during the 2021/22 logging period. This represents a significant improvement on the performance for previous years.

- RMS Voltage Magnitude:

Logging Period	Number of Breaches
2021/22	15
2020/21	3
2019/20	5
2018/19	8
2017/18	4

RMS Voltage Magnitude: There were fifteen (15) undervoltage breaches observed in the logging period for 2021/22. This is relatively higher than the number of incidents recorded in previous years. However, this seems to have occurred as a single incident across the network.

- Power System Frequency:

Logging Period	Number of Breaches
2021/22	0
2020/21	2
2019/20	4
2018/19	1
2017/18	0

Power System Frequency: No under-frequency breaches of the limits described in the Electricity Act of 1945 Section 25(1)(d) were recorded during the 2021/22 logging period. This represents an improvement in performance over the last three years.

- Voltage U-THD (Total Harmonic Distortion):

Logging Period	Number of Breaches
2021/22	0
2020/21	0
2019/20	3
2018/19	1
2017/18	0

Voltage U-THD: There were no U-THD breaches of the limits described in Part 2, Division 1, Section 7 of the Code were recorded during the 2021/22 logging period. This is an improvement in performance over the previous three years.

The recorded individual order harmonics showed a (temporary) breach on the Southtown substation feeder STS4 Start (PS111 Hilditch Avenue substation) and End (PS44 Iron Ore Parade substation). There were 53 incidents observed in which the 21st harmonic level exceeded the allowable limit. This is not considered of a practical concern at this stage but given that this issue

also arose in the same location in 2019/20, it is recommended that the situation be monitored and addressed over the coming years.

We can conclude that no major areas for continued development were identified in this audit. However, it is recommended that BHP continues its activities to support satisfactory network performance for its electricity customers.

AUDIT SCORECARD FOR 2021/22

AUDIT SCORECARD		
AUDIT DESCRIPTION	AUDIT OVERALL RATING	
	2020/2021	2021/2022
The Electricity Industry Code 2005 Part 2 Division 1 – Quality Standards Section 6: Voltage Fluctuations		
The Electricity Industry Code 2005 Part 2 Division 1 – Quality Standards Section 7: Harmonic Distortion		
The Electricity Industry Code 2005 Part 2 Division 1 – Quality Standards: Voltage Level		
The Electricity Industry Code 2005 Part 2 Division 1 – Quality Standards: Frequency		
The Electricity Industry Code 2005 Part 2 Division 2 – Standards for the interruption of supply to individual customers Section 9: General Standard of Reliability		
The Electricity Industry Code 2005 Part 2 Division 2 – Standards for the interruption of supply to individual customers Section 10: Duty to Reduce Effect of Interruption		
The Electricity Industry Code 2005 Part 2 Division 2 – Standards for the interruption of supply to individual customers Section 11: Planned Interruptions (Please refer to Note below this table).		
The Electricity Industry Code 2005 Part 2 Division 2 – Standards for the interruption of supply to individual customers Section 12: Significant Interruptions to Small Customers (Please refer to Note below this table).		
The Electricity Industry Code 2005 Part 2 Division 3 – Standards for the duration of interruption of supply in particular areas Section 13: Standard for Other Areas (Newman Township System 290 Minutes) (Please refer to Note below this table).		

Note: The “Audit Overall Ranking” for 2020/21 relevant to Part 2 Division 2 Section 11, Section 12 and Part 2 Division 3 Section 13 (the final three items in the table above) were incorrectly shown as MH (Medium High) in the Annual Audit Report for 2020/21. They should all have been H (High) as shown here for both 2020/21 and 2021/22. Note that there has been no change from 2020/21 to 2021/22. This note also accompanies Table 5 of this report.

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1. INTRODUCTION

BHP is one of the world's major suppliers of iron ore and is based in the Pilbara region of Western Australia. The township of Newman is located approximately 1,200 km to the north of Perth, within the Shire of East Pilbara. It is the main town for the Mt Whaleback iron ore mine, Mining Area C and several smaller satellite mines.

The electricity network is owned, governed and operated by BHP Supply Authority. The network encompasses the township of Newman, Newman Airport, Capricorn Roadhouse, town water supply bore field, Mt Whaleback iron ore mine and several smaller mine leases in the adjacent areas.

At present, the township of Newman has approximately 2,506 premises comprised of a mixture of residential and commercial customers.

In accordance with the Western Australia Electricity Industry Code 2005 (the Code), the electrical supply authority must publish a report setting out the information described in Schedule 1 of the Code, in respect to each year ending on 30th of June. This document, known as the Annual Audit Report, is to provide the full suite of information outlined in Schedule 1 of the Code, relating to the Network Quality and Reliability of Supply.

The Code is effectively written in four parts plus a reporting-requirements schedule; namely:

1. Part 1: Preliminary information associated with term of reference.
2. Part 2: Quality and reliability standards, which is further partitioned into 4 divisions.
3. Part 3: Payment to customers for lack of regulatory adherence.
4. Part 4: Incidental duties as a Supply Authority.
5. Schedule 1: Information to be published in this report.

As per the Code's Division 3 Section 26 Performance Reporting: BHP as distributor is required to arrange an independent audit, and subsequent report, on the operation of the systems that the distributor has in place for monitoring its compliance to the Code's Part 2.

APD were engaged by BHP to undertake the required audit and report on the current compliance monitoring processes and systems that BHP have in place to ensure compliance with the Code.

2. SCOPE OF AUDIT

The scope of audit was limited to the review of the policies, guidelines, processes, systems and procedures that BHP currently have in place to ensure that the network is complying with the following performance requirements specified in the Code:

- Part 2, Division 1 – Quality Standards, Section 6(2) – Voltage Fluctuations
- Part 2, Division 1 – Quality Standards, Section 7 – Harmonics
- Part 2, Division 1 – Quality Standards, Section 8 – Duty to disconnect if damage may result, Note (a) Voltage Levels Compliance
- Part 2, Division 1 – Quality Standards, Section 8 – Duty to disconnect if damage may result, Note (b) Frequency Levels Compliance
- Part 2, Division 1 – Quality Standards, Section 8 – Duty to disconnect if damage may result
- Part 2, Division 2 – Standards for the interruption of supply to individual customers, Section 9 – General standard of reliability
- Part 2, Division 2 – Standards for the interruption of supply to individual customers, Section 10 – Duty to reduce effect of interruption
- Part 2, Division 2 – Standards for the interruption of supply to individual customers, Section 11 – Planned interruptions
- Part 2, Division 2 – Standards for the interruption of supply to individual customers, Section 12 – Significant interruptions to small use customers
- Part 2, Division 3 – Standards for the interruption of supply to individual customers, Section 13 – Standards prescribed for particular areas.

The audit scope covered the electricity network supplying the gazetted township of Newman and the town water supply bore field. The electricity network supplying the Newman Airport, mining infrastructures at Mt Whaleback Iron Ore mine and all other mine leases in the surrounding area of the township of Newman were not required to form part of the audit.

Refer to Appendix A for the geographical map of the township of Newman.

3. AUDIT METHODOLOGY

3.1. AUDIT FLOWCHART

The methodology applied to perform the audit is as per the following flowchart:

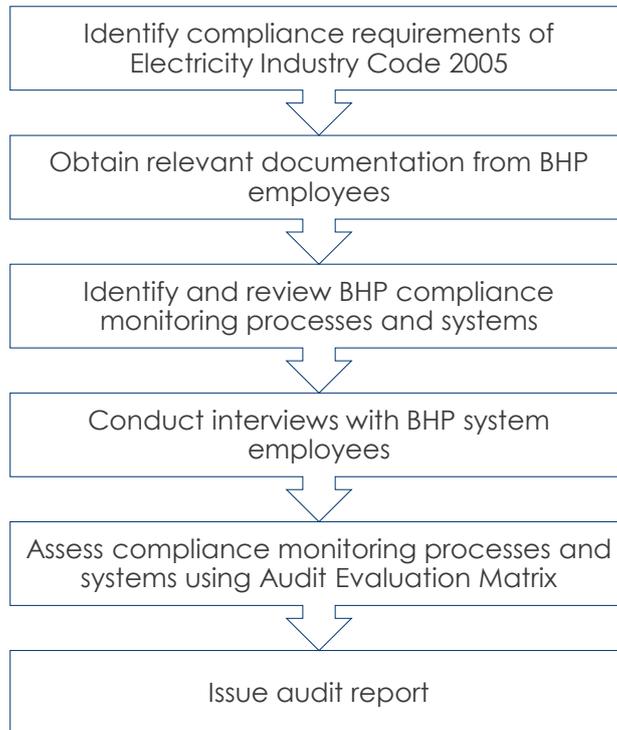


Figure 1 | Audit Methodology Flowchart

3.2. AUDIT EVALUATION MATRIX

The audit assessment was carried out as per the following procedures:

1. Review if BHP have adequate systems, documented processes and guidelines, plans, and procedures in place to ensure compliance with each of the performance provisions defined in the Code. Assess the current monitoring processes and systems using the ten criteria shown in Table 1 below. Assign a performance ranking of Low, Medium, or High to each criterion.
2. Based on the ten performance rankings assigned, determine the overall compliance rating. The overall compliance rating indicates the effectiveness of the monitoring processes and systems in achieving compliance with each of the provisions.
3. Compare all overall compliance ratings with the preceding year's results. Improvements are measured as a percentage. A 33% improvement means the overall rating has increased either from Low to Medium, or from Medium to High. An increase from Low to High is equivalent to a 66% improvement.

Table 1 | Audit of compliance management systems and processes evaluation matrix

ITEM	CATEGORY/DESCRIPTION	DESCRIPTION OF RANKING			
		LOW	MEDIUM	HIGH	
1	Process	Documented Process	Process is poorly documented and requires major development	Process is documented and shows evidence of updates/revisions	Strong process documentation in place which may comply with ISO9001
2		Process fully integrated with corporate management systems	Poorly integrated systems in place which requires development	Adequate level of integration with management and reporting systems	Comprehensive integration with IT based corporate management and reporting systems
3		Demonstration of operator understanding of the documented process	Little or no demonstration of operator training and understanding	Employee understanding of the process demonstrated	Strong employee understanding and evidence of training systems
4		Evidence that the process is followed, and records are kept as per process	Records available but not easily accessible or auditable	Adequate records available over full compliance periods	Auditable records available over full compliance periods with mandatory defined fields
5	Continuous Improvement	KPIs are in place	KPIs are not in place or are underdeveloped	KPIs are in place with some understanding by operators	Well reviewed KPIs are in place and comprehensively understood by all operators
6		Reporting system supports continuous improvement	Little or poorly detailed reporting systems in place	Reporting systems exist at some levels and shows evidence of supporting continuous improvements	High level reporting systems in place clearly showing gaps and trends of performance
7		Evidence action taken	Little or poorly detailed evidence of reactive actions taken	Evidence of reactive and requisite responses	Highly detailed and reviewed evidence that gaps and trends are proactively actioned
8	Measurement Tools	Suitability of PQ measurement devices	PQ device has partial PQ functions and not fully compliant to AS61000.4.30	PQ device has full PQ functions but not fully compliant to AS61000.4.30	PQ device has full PQ functions and fully compliant to AS61000.4.30
9		Data collection methodology of the PQ measurement devices	Data manually extracted and analysed	Data extracted automatically over communications link. Data collection only.	Data extracted automatically over communications link with data analysis at the device.
10		Method of PQ measurement devices deployment	Portable devices not permanently fixed to the network.	Devices permanently installed on the network at strategic locations	Permanently fixed and integrated into the network management control on a real time basis.
11	Overall Ranking		Refer to Table 2 for descriptions.		

4. AUDIT RESULTS

The audit assessed the performance and suitability of the compliance monitoring systems and processes that BHP have in place to ensure compliance with each of the provisions under The Code's Part 2 Divisions 1, 2 and 3.

The overall ratings are as detailed below in Table 2.

Table 2 | Overall Compliance Rating Definitions

OVERALL COMPLIANCE RATING	DESCRIPTION	
	High	High level, developed quality processes and systems
	Medium-High	Above average quality processes and systems
	Medium	Adequate quality processes and systems in place
	Low-Medium	Quality systems and processes but require further development
	Low	Quality systems and processes are not in place or require major development

4.1. PART 2, DIVISION 1: SECTION 6(2), 7 & 8(A)(B)

Sections 6(2), 7 and 8(a)(b) relate to flicker, harmonics, voltage magnitude and frequency respectfully.

The following notes relate to the Code's PQ compatibility levels:

- According to Section 6(2), the voltage fluctuation of electricity supplied must not exceed the compatibility levels of $P_{st}=1.0$ and $P_{it}=0.8$ set out in Part 3.7 clause 3 of AS/NZS 61000:2001.
- According to Section 7, the standard for the harmonic voltage distortion levels of electricity supplies is a distortion level that is less than the compatibility levels set out in a table in the same section.
- In accordance with AS/NZS 3000:2018, the voltage levels of the electrical network must be maintained at +10% and -6% of the supply voltage.
- According to Section 8, the frequency must be maintained at +/- 2.5% of 50 cycles per second.

Appropriate processes and systems are required to identify and record any breaches of the compatibility levels, and to keep track of the remedies undertaken to eliminate the breaches. Table 3 shows the evaluation matrix for BHP in relation to Part 2 Division 1 Section 6(2), 7 & 8 (a)(b) of the Code.

Table 3 | Part 2 Division 1 Section 6(2), 7 & 8(a)(b) - Evaluation Matrix

ITEM	CATEGORY/DESCRIPTION		RANKING			% CHANGE COMPARED TO 2020/2021 RESULTS	COMMENTS
			LOW	MED	HIGH		
1	Process	Processes in place and documented			✓	0%	Consistent with previous FY
2		Process fully integrated with corporate management systems			✓	0%	Consistent with previous FY
3		Demonstrated operator understanding of the process			✓	0%	Consistent with previous FY
4		Evidence that the process is followed, and records are kept as per process			✓	0%	Consistent with previous FY
5	Continuous Improvement	KPIs are in place		✓		0%	Consistent with previous FY
6		Reporting system supports continuous improvement		✓		0%	Consistent with previous FY
7		Evidence action taken - continuous improvement			✓	0%	Consistent with previous FY
8	Measurement Tools	Suitability of PQ measurement devices			✓	0%	Consistent with previous FY
9		Data collection methodology of the PQ measurement devices		✓		0%	Consistent with previous FY
10		Method of PQ measurement devices deployment		✓		3.33%	Refer to 0
11	Overall Ranking						

4.2. PART 2, DIVISION 2: SECTION 9 & 10

Sections 9 and 10 relate to General Standard of Reliability; and Duty to Reduce the Effect of Interruptions respectively.

Requirement: A transmitter or distributor must, so far as is reasonably practicable, ensure that the supply of electricity to a customer is maintained and the occurrence and duration of interruptions is kept to a minimum.

According to this provision, it is not a breach of section 9 of the Code for BHP to interrupt the supply of electricity to a customer for the purpose of maintaining or altering the network if the length of the interruption does not exceed 4 hours and BHP have given notice of the proposed interruption to the customer not less than 72 hours before the start of the interruption. If it is not reasonably practicable to provide more than 72 hours of notice; notice should be given at the earliest practicable time before the start of the interruption.

Table 4 shows the evaluation matrix for BHP in relation to Part 2 Division 2 Section 9 & 10 of the Code.

Table 4 | Part 2 Division 2 Section 9 & 10 - Evaluation Matrix

ITEM	CATEGORY/DESCRIPTION		RANKING			% CHANGE COMPARED TO 2020/2021 RESULTS	COMMENTS
			LOW	MED	HIGH		
1	Process	Processes in place and documented			✓	0%	Consistent with previous FY
2		Process fully integrated with corporate management systems			✓	0%	Consistent with previous FY
3		Demonstrated operator understanding of the process			✓	0%	Consistent with previous FY
4		Evidence that the process is followed, and records are kept as per process			✓	0%	Consistent with previous FY
5	Continuous Improvement	KPIs are in place			✓	0%	Consistent with previous FY
6		Reporting system supports continuous improvement			✓	0%	Consistent with previous FY
7		Evidence action taken - continuous improvement			✓	0%	Consistent with previous FY
8	Overall Ranking						

4.3. PART 2, DIVISION 2: SECTION 11 & 12, DIVISION 3: SECTION 13

Sections 11, 12, and Division 3 Section 13 relate to Planned Interruptions, Significant Interruptions and Standards prescribed for particular areas respectively.

An appropriate system is required to record all the scheduled outages that BHP plans to undertake in each year. An efficient process should be in place for providing notifications to each of the customers that will be affected by planned interruptions in compliance with the provision.

Table 5 shows the evaluation matrix for BHP in relation to Part 2 Division 2 Section 11, 12 & Division 3 Section 13 of the Code.

Table 5 | Part 2 Division 2 Section 11, 12 & Division 3 Section 13 - Evaluation Matrix

ITEM	CATEGORY/DESCRIPTION		RANKING			% CHANGE COMPARED TO 2020/2021 RESULTS	COMMENTS
			LOW	MED	HIGH		
1	Process	Processes in place and documented			✓	0%	Consistent with previous FY
2		Process fully integrated with corporate management systems			✓	0%	Consistent with previous FY
3		Demonstrated operator understanding of the process			✓	0%	Consistent with previous FY
4		Evidence that the process is followed, and records are kept as per process		✓		0%	Consistent with previous FY
5	Continuous Improvement	KPIs are in place			✓	0%	Consistent with previous FY
6		Reporting system supports continuous improvement			✓	0%	Consistent with previous FY
7		Evidence action taken - continuous improvement			✓	0%	Consistent with previous FY
8	Overall Ranking						

Note: The "Overall Ranking" in Table 5 was incorrectly shown as MH (Medium High) in the Annual Audit Report for 2020/21. It should have been H (High) as shown here for 2021/22. Note that there has been no change from 2020/21 to 2021/22.

5. AUDIT OBSERVATIONS & RECOMMENDATIONS

The following observations were made throughout the audit process:

- Note 1: BHP personnel that are involved in managing power quality understand the need to:
- Ensure compliance with The Code's requirements;
 - Expediently rectify network disturbances that affect the quality of supply to customers; and
 - Extend the monitoring capability of the LV network.
- Note 2: BHP demonstrated a clear understanding of their roles and responsibilities in maintaining supply reliability and minimising the duration and frequency of interruptions to the customers.
- Note 3: BHP demonstrated a clear understanding of the systems and processes involved in managing planned and unplanned outages.
- Note 4: BHP understand their obligation to provide customers with a minimum 72 hours' notice prior to a planned outage. This notification is provided in the form of a 'letter drop' at the impacted addresses.
- Note 5: Relevant BHP interviewees demonstrated a concise understanding of their responsibilities under Part 2 Division 2 Section 12 of the Electricity Code to remedy the causes of interruptions to small use customers or enter alternative arrangements if the supply has been interrupted for more than 12 hours continuously, or more than the permitted number of times.
- Note 6: BHP currently supply six customers with special health needs who rely on electricity for life support and are well aware of their responsibilities in this area, and so far as is reasonably practical, continuity of electricity supply to these houses is maintained. If supply to the premises cannot be maintained, alternatives such as temporarily relocating the resident may be considered to help maintain their well-being. From interviewee discussions, BHP are proactive in securing the welfare of special health needs customers by ensuring that prior to each planned outage these residents have sufficient resources in place for the duration of the outage as well as closely monitoring these customers during forced (unplanned) outages.
- Note 7: As evident from interviewee's discussions, BHP have portable standby generators available to cater for extended planned or unplanned interruptions. For unplanned events, these can be deployed within 3-4 hours; Generally, the deployment of the mobile generators is rare because of the high back-up capabilities of the Newman Township LV network. Although, it is rare to deploy these generators, one was used in 2021/22 on one occasion to assist in maintaining customer supplies for a transformer outage (T81).
- Note 8: In a previous reporting period, BHP purchased a 300kVA trailer mounted (mobile) transformer. This will help to reduce the impact of power outages as the mobile transformer can be deployed in less time than traditional transformers; it also removes the

need to use cranes and other high vehicles to move transformers under emergency situations. There was no network need to make use of this transformer in 2021/22.

Note 9: BHP have demonstrated a clear understanding of their responsibility to provide the residents of the Newman Township with a reliable electricity supply. As such BHP are continuing the process of migrating from their current retailing and billing contractor (Agility) to Horizon Power, with one of the key driving factors behind the migration being the installation of Advanced Metering Infrastructure (AMI) which will take place over the next two to three years. These AMI smart meters are capable of two-way communication which in-turn will provide several benefits including:

- Improved accuracy of meter readings – reducing billing errors arising due to estimation;
- Early detection of power quality issues; and
- Improved monitoring of power outages to assist maintenance crews in reducing restoration times.

In a similar arrangement to the one with the existing billing contractor (Agility), complaints made through Horizon Power will be filtered through to BHP as required.

Please note that there were no power quality related complaints received in 2021/22.

Note 10: BHP are still proactively undertaking continuous improvement projects to maintain adequate levels of reliability, power quality and public/personnel safety within the Newman Township. This is evident from several asset upgrade projects either already completed or currently in progress. This includes the following:

Completed or in progress

- Completed the work to replace transformer T7 and pad-mount substation PS61 as part of asset lifecycle ‘end of useful life’ replacement initiative.
- Continue to monitor the situation with respect to HV overhead line (main road) crossings and high/oversized loads accidentally contacting with power lines; BHP has made budgetary provision Planning for the replacement of sections of HV overhead line with HV underground cabling within the Township of Newman to address this issue. Some underground installation work is expected to be completed in 2022/23.
- Consider the replacement of existing line interrupters (which cannot be switched on load) with air-break switches (which can be switched on load). This will improve reliability of supply experience for the customers during the day-to-day operation of the network. At the time of writing, this work was at the “design” and “quotation” stages and is expected to be completed with the 2022/23 FY.
- Completed the upgrade of the electricity supply to the town hospital as part of the overall hospital upgrade project. This included new connection assets (cable, switchgear) and so the new assets are expected to provide a more reliable service compared to the older assets being replaced.

The following additional feedback and items were conveyed through the audit process:

- BHP completed (by 30 June 2021) the installation of 14 of the 16 permanent SEL735 Advanced Power Quality and Revenue Meters at selected pad-mount substations.

The installation of the remaining two units was completed in 2021/22. This will improve the logging process by providing “any time” access to power quality data including harmonics and reduce dependence on the annual power quality measurements for this data. It is worth noting that when BHP builds new Pad mounted substations in the future, they will include (as a standard) a fixed PQ meter as part of the project. This will provide a growing area of monitoring within the Newman township as the network expands.

- It was noted in previous audit reports, that there were neutral voltage integrity issues within customer supplies. Currently these issues are identified and actioned reactively from inspections by electrical contractors. As a further step, BHP has undertaken some pro-active sampling of service connections to determine if there any trends (e.g. broken or loose neutral connections) and to identify higher risk areas. In the longer term (2 years) BHP are aiming to utilise the functionality of the proposed AMI smart meters to detect neutral voltage integrity issues and action these on a more proactive and systematic basis. The work to install AMI will be completed in two parts – part 1 install service protection devices (SPDs)¹ at dwellings that do not yet have these (currently in progress), and part 2 – complete the installation of the AMI proper (estimated, over the next 1-2 years).
- BHP are conducting a risk assessment of using the auto-reclose functionality of their reclosers to reduce the impacts (duration) of outages the causes of which are temporary (intermittent) in nature, for example, lightning, falling objects, wildlife, etc. This project was put on hold for about 12 months due to a personnel issue at BHP; however, the project has recommenced, with a detailed risk assessment continuing at the time of writing this report;
- BHP is considering the replacement of existing line interrupters (which cannot be switched on load) with air-break switches (which can be switched on load). This will provide a better reliability of supply experience for the customers during the day-to-day operation of the network. At the time of writing, this work was at the “design/quotation” stage with completion date being the end of the 2022/23 FY.
- BHP carries out “sampling” of its population of service connections in the town to identify any trends and higher risk areas (e.g. broken or disconnected neutrals); this is part of an overall strategy of electric shock mitigation and is related to the neutral voltage integrity issue identified over the last year or so; ultimately, this will be addressed with the implementation of the AMI (which is expected to occur over the next two years or so).
- Maintenance strategies continue to be prepared and followed for the various type of plant (switchgear, transformers...) to ensure assets are in serviceable condition and so to provide good reliability performance for the network customers. This accords with good electricity industry practice.
- To reduce the impact of arc-flash, new kiosks (substations) will be fitted with arc-flash detection (as a standard feature);

¹ SPDs allow the isolation of a dwelling’s meter box at the meter box itself. It allows the isolation to be easily and safely carried out by an electrical contractor (and without the need for the supply authority to attend and carry out the isolation, which would otherwise be at the connecting green dome pillar box).

With respects to the holistic electrical network, the recent PQ metering data indicates that Newman's electrical network has undergone noteworthy improvements to maintain its reputation as a robust and inherently good network. The average electrical parameters of voltage, frequency and voltage total harmonic distortion were consistently stable and generally well within compliance-levels. This is supported by the fact that there were no customer complaints related to power quality in 2021/22.

However, the following comparative compliance performance was observed:

- Voltage Flicker (AS61000:2001): There were no short-term flicker nor long term flicker breaches observed during the 2021/22 logging period. A total of 2 short term and 2 long term voltage flicker fluctuations were recorded during the 2020/21 logging period. This represents an improvement from the 2 short term and 2 long term breaches in 2020/21, the 15 short term and 36 long term breaches in 2019/20, and the 17 short term and 4 long term breaches in 2018/19.
- RMS Voltage Magnitude (AS/NZS 3000:2007): In the 2021/22 logging period, the number of voltage magnitude breaches (15) represented an increase compared to the four previous logging periods 2020/21 (3), 2019/20 (5), 2018/19 (8), and 2017/18 (4). However, this seems to have been related to a single network event.
- Power System Frequency (Electricity Act of 1945 Section 25 (1)(d)): No frequency breaches were observed during the 2021/22 logging period. This compares well with 2020/21 (2 breaches), 2019/20 (4 breaches) and 2018/19 (1 breach).
- U-THD (Part 2, Division 1, Section 7 of the "Code"): There were no U-THD breaches recorded during the 2021/22 logging period. There were no U-THD breaches recorded during the 2020/21 logging period. This represents a relative improvement over the past three logging period 2020/21 (0 breaches), 2019/20 (3 breaches) and 2018/19 (1 breach).

The recorded individual order harmonics showed a (temporary) breach on Southtown substation feeder STS4 Start (PS111 Hilditch Avenue substation) and End (PS44 Iron Ore Parade substation). There were 53 incidents observed, during the 2021/22 logging period, in which the 21st harmonic level exceeded the allowable limit. This is not considered of a practical concern at this stage but given that this issue also arose in the same location in 2019/20, it is recommended that the situation be monitored and addressed over the coming years.

Reportable parameters for Newman Township Electricity Supply over the 2021/2022 FY (as outlined in 'Schedule 1' of the Code) are presented below:

- >12-hour interruptions: In 2021/2022, no network interruption which exceeded 12 hours was recorded. Temporary generators were used to supply customers during the transformer T81 outage.
- No small use customers were disconnected from the network more than the maximum number of times permitted by the Code (i.e., the limit of 16 times per year).
- No power quality and reliability-related complaints were received from customers during FY 2021/2022.

The following observations were noted in the key reliability indices:

- Customer Average Interruption Duration Index (CAIDI) of 75.38 minutes (compared to 182.82 minutes in 2020/21, and best performance of 33 minutes in 2017/18) – CAIDI is a measure of the average outage duration or average outage restoration time. [It is defined as “The sum of the durations of sustained² customer interruptions divided by the total number of sustained customer interruptions”].
- System Average Interruption Frequency Index (SAIFI) of 0.95 interruptions (compared to 1.96 interruptions in 2020/21 and best performance 0.417 interruptions in 2019/20) – SAIFI is the average number of interruptions per customer served. [It is defined as “the total number of sustained customer interruptions divided by the total number of customers served”].
- Average Service Availability Index (ASAI) of 99.986% (compared to 99.93% ASAI in 2020/21 and best performance of 99.99% in 2017/18 and 2019/20) – ASAI is the perceived availability of the network to the customers.
- System Average Interruption Duration Index (SAIDI) of 71.41 minutes (compared to 354.91 minutes in 2020/21 and best performance of 35 minutes in 2017/18) – SAIDI is the average outage duration for each customer served. [It is defined as “the sum of durations of sustained customer interruptions divided by the total number of customers served”].

Final Note:

While all reliability indices have improved since 2020/21, the 2021/22 performances (with possibly the exception of ASAI) have departed significantly from their best performance over the recent 5-year period. With this in mind it is recommended that the cause(s) of this issue is monitored with a view of seeking opportunities for improvement.

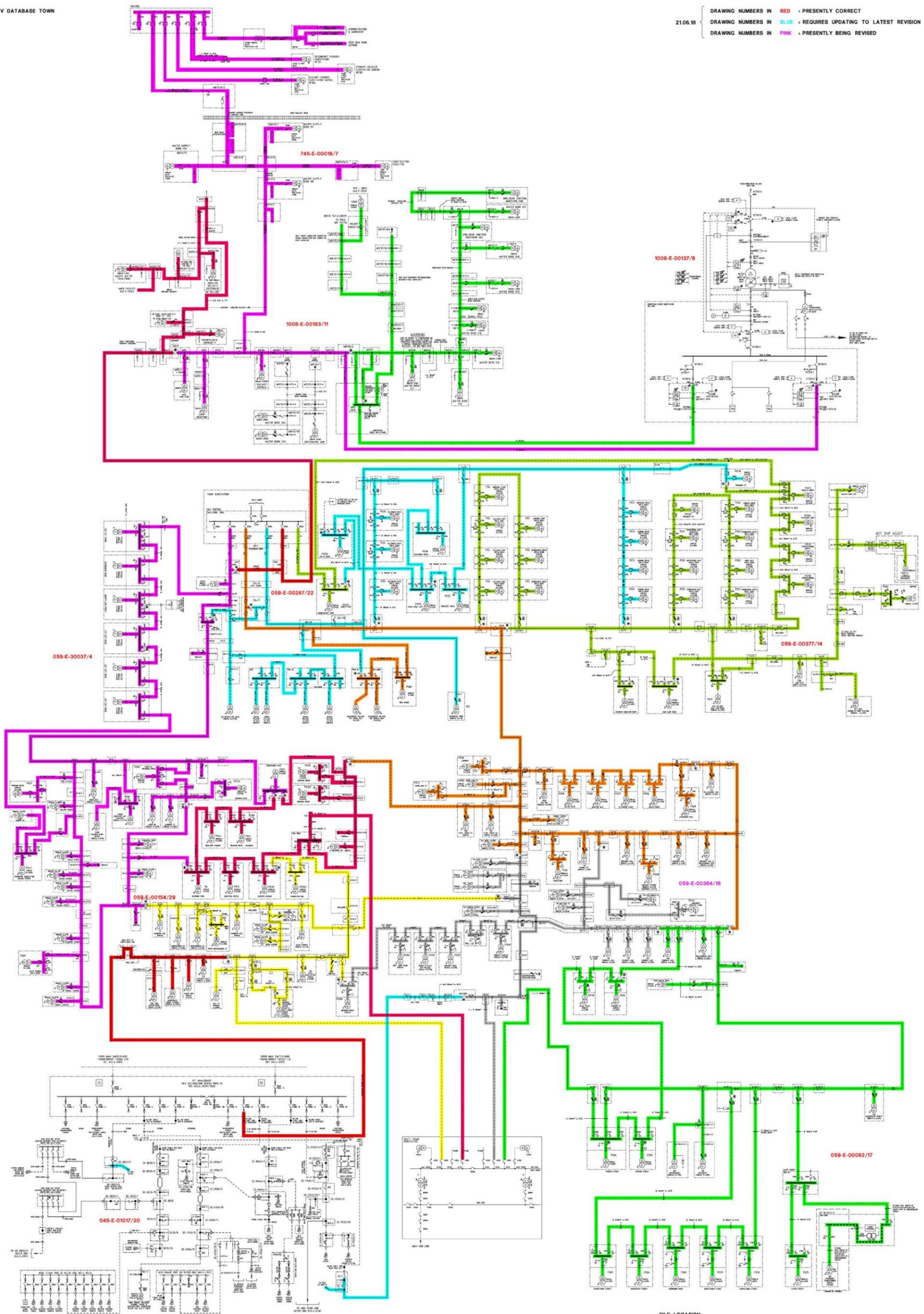
Notwithstanding this, we can conclude that no major areas for continued development were identified in this audit. However, it is recommended that BHP continues its business-as-usual (and other relevant) activities to maintain satisfactory network reliability and quality of supply performance for its electricity customers.

² By “sustained” we mean only interruptions lasting 1 minute or longer. (Momentary) Outages lasting less than 1 minute are not included in the index. Planned outages and some other types of outages are also excluded from this index. This note also applies to the SAIFI and SAIDI indices.

TKV DATABASE TOWN

21.06.18

- DRAWING NUMBERS IN RED = PRESENTLY CORRECT
- DRAWING NUMBERS IN BLUE = REQUIRES UPDATING TO LATEST REVISION
- DRAWING NUMBERS IN PINK = PRESENTLY BEING REVISED



FILE LOCATION: J:\WP\SPECIAL DRAWINGS\HV DISTRIBUTION SYSTEM\Latest Date\TKV DATABASE TOWN.dgn
 CHECK RELEVANT DRAWINGS FOR UPDATES
 045-E-01017 059-E-00082 059-E-00184 059-E-00287 059-E-00364
 059-E-00377 059-E-30037 1008-E-00137 1008-E-00183 745-E-00016

21.06.2018