



BHP NEWMAN TOWNSHIP ELECTRICITY SUPPLY ANNUAL AUDIT REPORT 2018/2019

1300 273 797

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## **REVISION HISTORY**

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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, town water supply bore field and connections to the mining infrastructure in the adjacent areas.

In accordance with WA Electricity Industry Code 2005 (the Code), the electrical 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 the 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 04<sup>th</sup> September 2019 at BHP's Newman offices, with majority of relevant stakeholders and resources available to APD. As a result of the audit process and interviews, the following key observations were made:

- BHP have continued to undergo positive developments to the structure of the division in the 2018/19 FY with the addition of a new role "Reliability Specialist" as well as an upcoming 'HV & Power Trainer' role.
- BHP are currently investigating and undertaking 'pilot project' installation of permanent SEL735 Advanced Power Quality and Revenue Meters at select pad-mount substations to improve the annual logging process and provide year round access to power quality data including harmonics.
- BHP have noted an increase in neutral voltage integrity issues within customer supplies. Currently these issues are identified and actioned reactively as a result of inspections by electrical contractors. BHP are aiming to utilise the functionality of the proposed AMI smart meters to detect neutral integrity issues and action these on a more proactive basis.

The results for 2018/2019 audit are shown in the table titled 'Audit Scorecard' (presented in the overleaf). Although the evaluation ratings remain consistent with the previous FY audit, BHP are still proactively undertaking continuous improvement projects to increase the reliability and quality of supply to the Newman Township as well as the safety to public and personnel within the Township. This is evident from the several asset upgrade projects either already completed or currently in progress. This includes the following improvement works:

- Continued and finalised works on the major equipment upgrades at the Township Substation including the replacement of the two ageing 66/11kV power transformers and neutral earth resistors.
- Upgrade of an overhead section of low voltage powerline along Mindarra Drive to an underground section to improve the safety to public within area due to lower height clearances on this section.
- Continuation of ad-hoc improvements as a result of investigations, e.g., the replacement of transformer T7 and pad-mount substation PS61 as part of asset lifecycle 'end of useful life' as well as the replacement of an aged low voltage switchboard at PS113 'Fortescue Flats'.



• Planning for the replacement of sections of HV overhead line with HV underground cabling within the Township of Newman, part of an upcoming project for the upgrade of a main road overhead crossing to prevent oversize loads accidentally connecting with the powerline.

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 well within compliance-levels, however the following compliance issues were identified:

- Voltage Flicker: An increase in the number of short-term and long-term voltage fluctuation limit breaches was recorded compared to the logging periods of previous FYs. The most onerous breaches were observed on the TC1, TC2, TC3 and TC4 feeders, with eight separate breach events recorded on the TC2 feeder in particular.
- RMS Voltage Magnitude: A relative increase in the number of voltage level breaches was observed compared to the logging periods of previous FYs. Given the temporary and random nature of the breaches, it is not deemed of a practical concern at this stage, but it is recommended that this parameter be monitored over the coming years.
- Power System Frequency: A single over-frequency breach of the limits described in the Electricity Act of 1945 Section 25(1)(d) was recorded during the logging period. As this event appears to be extremely isolated, hence not deemed of a practical concern at present.
- U-THD: A single U-THD breach of the limits was recorded during the logging period. With the exception of the single breach, the average U-THD level recorded on all feeders was consistently below the required limit.
- The recorded individual order harmonics showed a number of temporary and random breaches on all feeders that are not deemed of a practical concern at this stage. The magnitude of the breaches appears to follow a typical daily demand pattern, and it is recommended that the cause of these breaches is further investigated in coming years.

Finally, no major areas for continued development were identified in this audit, however it is recommended that BHP monitors the above-mentioned breaches and identify the root causes if the issues persist or worsen in coming years.



AUDIT SCORECARD				
	AUDIT OVERALL RATING			
AUDIT DESCRIPTION	2017/2018	2018/2019		
The Electricity Industry Code 2005 Part 2 Division 1 – Quality Standards Section 6: <b>Voltage Fluctuations</b>	мн	мн		
The Electricity Industry Code 2005 Part 2 Division 1 – Quality Standards Section 7: Harmonic Distortion	мн	мн		
The Electricity Industry Code 2005 Part 2 Division 1 – Quality Standards: Voltage Level	мн	мн		
The Electricity Industry Code 2005 Part 2 Division 1 – Quality Standards: Frequency	мн	мн		
The Electricity Industry Code 2005 Part 2 Division 2 – Standards for the interruption of supply to individual customers Section 9: <b>General Standard of Reliability</b>	Н	н		
The Electricity Industry Code 2005 Part 2 Division 2 – Standards for the interruption of supply to individual customers Section 10: <b>Duty to Reduce Effect of Interruption</b>	Н	н		
The Electricity Industry Code 2005 Part 2 Division 2 – Standards for the interruption of supply to individual customers Section 11: <b>Planned Interruptions</b>	мн	мн		
The Electricity Industry Code 2005 Part 2 Division 2 – Standards for the interruption of supply to individual customers Section 12: <b>Significant Interruptions to Small Customers</b>	мн	мн		
The Electricity Industry Code 2005 Part 2 Division 3 – Standards for the duration of interruption of supply in particular areas Section 13: <b>Standard for Other Areas</b> (Newman Township System 290 Minutes)	мн	мн		



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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 2,501 premises comprised of a mixture of residential and commercial customers.

In accordance with 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 mine and all other mine leases in the surrounding 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:

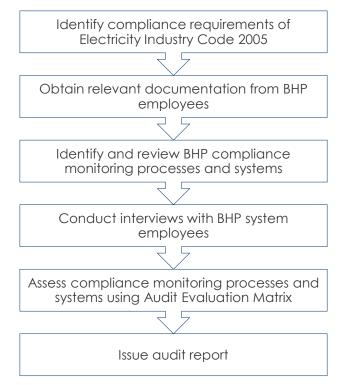


Figure 1 | Audit Methodology Flowchart

### 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

17544				DESCRIPTION OF RANKING				
ITEM		CATEGORY/DESCRIPTION	LOW	HIGH				
1		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	SSE	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 documen 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	s nt	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	Continuous Improvement	continuou proveme	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	<u> </u>	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	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	surement			Data extracted automatically over communications link. Data collection only.	Data extracted automatically over communications link with data analysis at the device.			
10	Meas	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 the 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 COM	PLIANCE RATING	DESCRIPTION			
H	High	High level, developed quality processes and systems			
мн	Medium-High	Above average quality processes and systems			
M	Medium	Adequate quality processes and systems in place			
LM	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<sub>st</sub>=1.0 and P<sub>lt</sub>=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 supplied 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 process and system 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.

			7/DESCRIPTION LOW MED HIGH		;	% CHANGE	
ITEM		CATEGORY/DESCRIPTION			COMPARED TO 2017/2018 RESULTS	COMMENTS	
1		Processes in place and documented			$\checkmark$	0%	Consistent with previous FY
2	ess	Process fully integrated with corporate management systems			$\checkmark$	0%	Consistent with previous FY
3	Process	Demonstrated operator understanding of the process			$\checkmark$	0%	Consistent with previous FY
4		Evidence that the process is followed, and records are kept as per process			$\checkmark$	0%	Consistent with previous FY
5	us ent	KPIs are in place		$\checkmark$		0%	Consistent with previous FY
6	Continuous mprovement	Reporting system supports continuous improvement		$\checkmark$		0%	Consistent with previous FY
7	Imp Co	Evidence action taken - continuous improvement			$\checkmark$	0%	Consistent with previous FY
8	ent	Suitability of PQ measurement devices			$\checkmark$	0%	Consistent with previous FY
9	Measurement Tools	Data collection methodology of the PQ measurement devices		$\checkmark$		0%	Consistent with previous FY
10	Mec	Method of PQ measurement devices deployment	$\checkmark$			10%	Refer to Note 10:
11		Overall Ranking		мн	Δ.		

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



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

Sections 9 and 10 relate to General Standard of Reliability; and Duty to Reduce Effect of Interruption 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 alter 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 interruption.

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

			RANKING		;	% CHANGE	
ITEM		CATEGORY/DESCRIPTION		MED	HIGH	COMPARED TO 2017/2018 RESULTS	COMMENTS
1		Processes in place and documented			$\checkmark$	0%	Consistent with previous FY
2	e SS	Process fully integrated with corporate management systems			$\checkmark$	0%	Consistent with previous FY
3	Process	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			$\checkmark$	0%	Consistent with previous FY
5	us ent	KPIs are in place			$\checkmark$	0%	Consistent with previous FY
6	Continuous Improvement	Reporting system supports continuous improvement			~	0%	Consistent with previous FY
7	Co Imp	Evidence action taken - continuous improvement			$\checkmark$	0%	Consistent with previous FY
8		Overall Ranking		Н	•		

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



### 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 plan to undertaken 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.

				RANKING	;	% CHANGE	
ITEM		CATEGORY/DESCRIPTION	LOW MED HIGH		HIGH	COMPARED TO 2017/2018 RESULTS	COMMENTS
1		Processes in place and documented			$\checkmark$	0%	Consistent with previous FY
2	Gess	Process fully integrated with corporate management systems			~	0%	Consistent with previous FY
3	Process	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	us ent	KPIs are in place			~	0%	Consistent with previous FY
6	Continuous Improvement	Reporting system supports continuous improvement			~	0%	Consistent with previous FY
7	Imp Co	Evidence action taken - continuous improvement			$\checkmark$	0%	Consistent with previous FY
8		Overall Ranking		мн	4		

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



## 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;
  - Expeditiously 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 at 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 into 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 four customers with special health needs who rely on electricity for life support and are aware of their responsibilities to that so far as reasonably practical, these houses are supplied with power. From interviewee discussions, BHP are proactive in regard to 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 checking in during forced outages.
- Note 7: As evident by interviewee's discussions, BHP have portable standby generators in place to cater for extended planned or unplanned interruptions. However, no temporary generation was deployed for the financial year ending June 2019. This is largely due to the extensive N-1 capabilities of the Newman Township LV network.
- Note 8: BHP have demonstrated a clear understanding of their responsibility to provide the residents of the Newman Township with a reliable network and service. 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). These AMI smart meters are capable of two-way communication which in-turn will provide a number of benefits including:
  - Improved accuracy of meter readings reducing estimated billing errors;
  - Early detection of power quality issues; and



 Improved monitoring of power outages to assist maintenance crews in reducing restoration times.

Similar to current billing contractor (Agility), Complaints made through Horizon Power will be filtered through to BHP as required. The number of power quality related complaints was nil.

- Note 9: BHP are still proactively undertaking continuous improvement projects to increase the reliability and quality of supply to the Newman Township as well as the safety to public and personnel within the Township. This is evident from the numerous asset upgrade projects either already completed or currently in progress. This includes the following improvement works:
  - Continued and finalised works on the major equipment upgrades at the Township Substation including the replacement of the two ageing 66/11kV power transformers and neutral earth resistors.
  - Proactive upgrade of an overhead section of low voltage powerline along Mindarra Drive to an underground section to improve the safety to public within area due to lower height clearances on this section.
  - Continuation of ad-hoc improvements as a result of investigations, e.g., replacement
    of ageing or defective pole top distribution transformers and pad-mount substations.
    Namely, the replacement of transformer T7 and pad-mount substation PS61 as part of
    asset lifecycle 'end of useful life' as well as the replacement of an aged low voltage
    switchboard at PS113 'Fortescue Flats'
  - Planning for the replacement of sections of HV overhead line with HV underground cabling within the Township of Newman, namely an upcoming project (previously scheduled for the 2018/19 FY period, budgeting has pushed the project to 2019/20 FY period) for the upgrade of a main road overhead crossing to prevent oversize loads accidentally connecting with the powerline.
- Note 10: The following additional feedback and items were conveyed through the audit process:
  - BHP are currently investigating and undertaking 'pilot project' installation of permanent SEL735 Advanced Power Quality and Revenue Meters at select padmount substations to improve the annual logging process and provide year round access to PQ data including harmonics.
  - BHP have continued to undergo changes to the structure of the division in the 2017/18 FY with the addition of a new role "Reliability Specialist" as well as an upcoming 'HV & Power Trainer' role.
  - BHP have noted an increase in neutral voltage integrity issues within customer supplies. Currently these issues are identified and actioned reactively as a result of inspections by electrical contractors. BHP are aiming to utilise the functionality of the AMI smart meters to detect neutral integrity issues and action these on a more proactive basis.
  - BHP are investigating the possibility of utilising auto-reclose functionality of their reclosers to reduce the effects of outages that are temporary in nature, that is those caused by external factors, i.e., lightning, fallen objects, wildlife, etc.

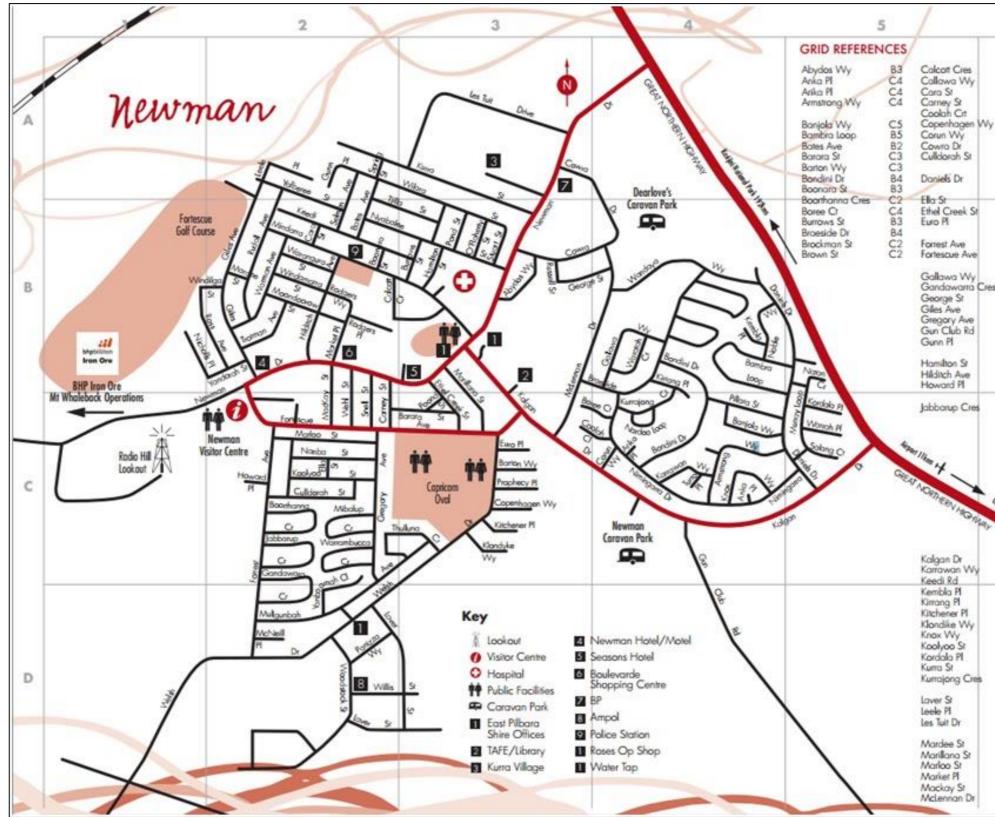


With respects to the holistic electrical network, the recent PQ metering data indicates that Newman's electrical network has undergone noteworthy improvements to maintain its reputation as a robust and inherently good network. The average electrical parameters of voltage, frequency and voltage total harmonic distortion were consistently stable and well within compliance-levels, however the following compliance issues were identified:

- Voltage Flicker: A large increase in the number of short-term and long-term voltage fluctuation limit breaches (17 short-term and four long-term breaches) described in AS61000:2001 was recorded compared to the logging periods for previous three years. The most onerous breaches were observed on the TC1, TC2, TC3 and TC4 feeders, with eight separate breach events recorded on the TC2 feeder in particular.
- RMS Voltage Magnitude: An increase in the number of voltage level breaches described in AS/NZS 3000:2007 (eight undervoltage breaches) was observed compared to the logging periods for the previous three years. Given the temporary and random nature of the breaches, it is not deemed of a practical concern at this stage, but it is recommended that this parameter be monitored over the coming years.
- Power System Frequency: A single over-frequency breach of the limits described in the Electricity Act of 1945 Section 25(1)(d) was recorded during the logging period. As this event appears to be isolated and constitutes a small fraction (less than 0.1%) of the total measurement period, it is not deemed of a practical concern at present.
- U-THD: A single U-THD breach of the limits described in Part 2, Division 1, Section 7 of the Code was recorded during the logging period. With the exception of the single breach, the average U-THD level recorded on all feeders was consistently below the required limit.
- The recorded individual order harmonics showed a number of temporary and random breaches on all feeders that are not deemed of a practical concern at this stage, note that the majority of breaches were 6<sup>th</sup>, 8<sup>th</sup> and 12<sup>th</sup> order harmonics. However, a large number of 15<sup>th</sup> and 21<sup>st</sup> order harmonic level breaches were recorded on the STS4 Feeder at PS44. The magnitude of these breaches appears to follow a typical daily demand pattern, and it is recommended that the cause of these breaches is investigated.

No major areas for continued development were identified in this audit, however it is recommended that BHP investigate the above-mentioned breaches and identify the root causes, in particular the individual harmonics at PS44. Additional PQ logging at both the transformer secondary side and downstream customer connection(s) is recommended to determine the potential source of the harmonics.

# APPENDIX A. NEWMAN TOWNSHIP MAP & SLD

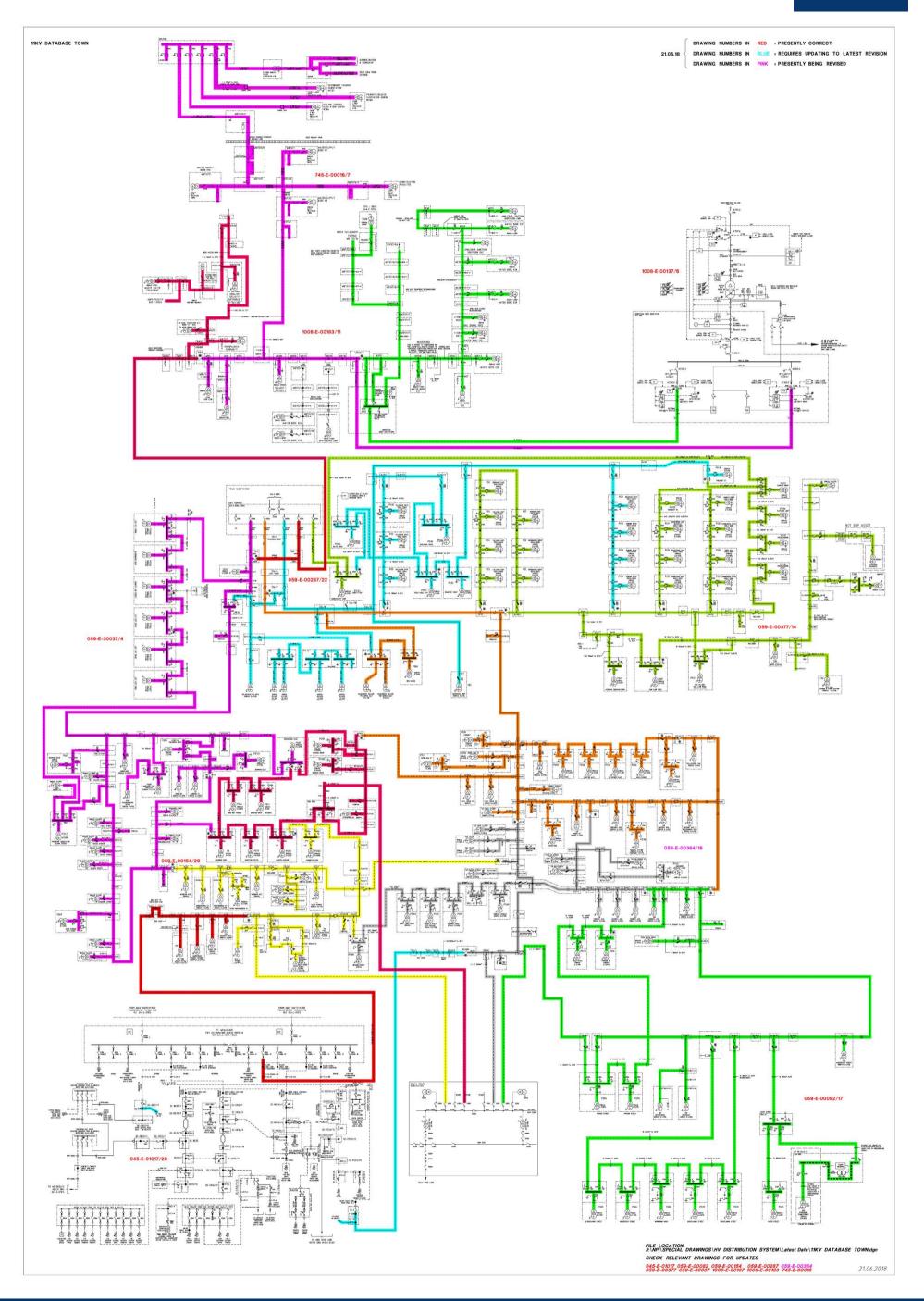




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