

Our ref: DM#12933390

12 May 2015

Elizabeth Walters
Assistant Director Electricity
Economic Regulation Authority
Level 4, 469 Wellington Street
PERTH WA 6000

Dear Elizabeth

EXEMPTION REQUEST – WAGIN SUBSTATION WEAK-IN FEED

In accordance with clause 1.9.2 of the Technical Rules, Western Power requests the Economic Regulation Authority grant Western Power an exemption from complying with clause 2.9.4 (maximum fault clearance time) of the Technical Rules. The request relates to a proposal to connect 885 kVA non-exporting Private Parallel Generator to the Western Power network received from Morton Seed & Grain.

Details of the proposed connection and the exemption justification are contained in the exemption request document.

If you have any queries with regards to the exemption request, please do not hesitate to contact Lindsay Offer on (08) 9326 6303.

Yours sincerely,

Margaret Pyrchla
Regulatory Compliance Manager

Enclosed: Submission for exemption from compliance with clause 2.9.4 of the Technical Rules

Submission for exemption from compliance with clause 2.9.4 of the Technical Rules (Maximum Fault Clearance Time) - Wagin substation weak in-feed

12-May-2015

Regulatory Compliance
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Glossary of terms

Acronym / term	Meaning
Authority	Economic Regulation Authority
AQP	Applications and Queuing Policy
CAG	Competing Applications Group
Code	Electricity Networks Access Code 2004
DSOC	Declared send out capacity
kVA	Kilo Volt Amperes (Apparent power)
MVA	Mega Volts Amperes (Apparent power)
MW	Mega Watts (Real power)
PPG	Private Parallel Generator
RIS	Required in service (date)
Technical Rules	Technical Rules 2011
SWIN	Southwest interconnected network
WPN	Western Power network

1. Executive Summary

This submission requests the Economic Regulation Authority (Authority) grant Western Power an exemption from complying with clause 2.9.4 (maximum fault clearance time) of the Technical Rules. The exemption request relates to Morton Seed & Grain (the Applicant) proposal to connect 885 kVA non-exporting Private Parallel Generator (PPG) to the Western Power Network (WPN).

The Applicant's connection site is located approximately 7 km from Western Power Wagin substation at 31 Stewart Rd, Wagin 6315. The PPG consists of a single generator of 885 kVA, which will not be exporting power into the WPN.

The proposal is to connect the PPG to Wagin substation via the existing 22 kV WAG510 feeder. Due to the age of the substation, both transformers at Wagin substation have only HV fuses installed instead of the circuit breakers, which is the current standard. However, the substation is deemed to comply with the Technical Rules under clause 1.9.4, as it existed prior to 2007. As a result, this connection causes a risk of a weak in-feed on Western Power 66 kV network.

In order for Western Power to connect the Applicant's PPG and remain compliant with the Technical Rules, a substantial upgrade would be required at the Wagin substation. This would include the installation of new 66 kV and 22 kV circuit breakers, current transformers and associated protection equipment. The upgrade has an estimated cost of \$2m, plus costs for additional communication and SCADA upgrades.

Taking into account the Applicant's connection requirements and current network considerations, Western Power proposes to connect the PPG without requiring the whole substation to comply with clause 2.9.4 in the Technical Rules. This will enable the PPG to connect and operate without the need for significant network augmentation. Western Power's intention is that Wagin substation will return to compliance as part of the network development planning process because the substation assets are aging and approaching the end of their life.

In order to reduce the risk exposure, Western Power is proposing that a SCADA style intertrip arrangement is put in place as an integral part of the connection. This is to ensure that the disconnection of the PPG occurs at times when 66 kV transmission lines supplying Wagin substation are out of service for planned or unplanned outages.

The Applicant has expressed their acceptance of the proposed connection arrangement and the associated operational constraints, as shown in the attached letter of support (Attachment 1).

Western Power considers that the proposed connection arrangement permits the Applicant to obtain a covered service to the extent reasonably practicable, in accordance with good electricity practice, while efficiently minimising any cost associated with network augmentation. The proposed connection arrangement has no additional impact on the existing level of safety and reliability to other network users.

In summary, Western Power considers that in this case, the advantages of operating with the exemption outweigh the disadvantages of requiring full compliance.

2. Introduction

The proposed PPG connection will be at the Applicant's existing site currently supplied via the Wagin distribution network, approximately 7km from the Wagin zone substation. The locality and connection route for the PPG is shown in Figure 3 included (Attachment 3) and is proposed to be connected to the Western Power 22kV network through Wagin substation on feeder WAG510 Dumbleyung. Attachments 2, 3 and 4 show diagrams depicting various aspects of the proposed connection.

The PPG is a grain husk fuelled bioenergy cogeneration system. The husks are burnt in a steam boiler plant, with the steam used to create vapour which in turn drives an Organic Rankine cycle (ORC¹) turbine that turns an induction generator.

The Applicant is requesting to connect the PPG which utilises organic waste material to generate electricity on site, thus reducing site energy consumption from the grid.

2.1 Connection Details

The PPG is a single generator of 885kVA and is designed to reduce the Applicant's maximum demand and will not be exporting electricity into the WPN.

The proposed connection details are as shown in Table 1 below.

Table 1: Connection point details

Item	Description
Point of connection	Morton Seed & Grain connection 1
Connection point	LV side of distribution transformer DU61/3/1 (Pick ID: N4477678)
Generator type and energy source	Induction, Biomass
Generator size and voltage	885 kVA, 415V
Rated kW (sent out)	770 kW
Declared Sent Out Capacity (DSOC)	0kW (non-exporting)
Purpose of connection	Demand management
Expected operating life	20 years
Plant operation	Continuous parallel operation
Requested in-service date (RIS)	RIS date July 2015
Technical Rules	The Applicant's assets to comply with the requirements of the Technical Rules

¹ Organic Rankine cycle (ORC) uses an organic, high molecular mass fluid and this allows Rankine cycle heat recovery from lower temperature sources such as biomass combustion, industrial waste heat etc.

This PPG project is non-competing with other applications pursuant to Clause 24.1 of the Applications and Queuing Policy (AQP). As a result, this PPG project will not be required to participate in any Competing Applications Group (CAG) solutions.

3. Technical Rules Requirement

The requirements of the Technical Rules for transmission system protection under consideration are listed in clause 2.9.4 below:

2.9.4 Maximum Total Fault Clearance Times

(d) For primary equipment operating at 132 kV and 66 kV:

- (1) One of the *protection schemes* of the *main protection system* must operate to achieve a *total fault clearance time* no greater than the "No CB Fail" time given in Table 2.10. The other *protection scheme* of the *main protection system* must operate to achieve a *total fault clearance time* no greater than the "No CB Fail" time in Table 2.11. The *backup protection system* must achieve a *total fault clearance time* no greater than the "CB Fail" time in Table 2.10, except that the second *protection scheme* that protects against *small zone faults* must achieve a *total fault clearance time* no greater than 400 msec.
- (2) on 132 kV lines longer than 40 km, all main and back-up protection schemes must operate to achieve the relevant maximum total fault clearance time given in Table 2.11; and
- (3) on 66 kV lines longer than 40 km, one protection scheme of the main *protection system* must operate to achieve the *total fault clearance times* specified for 132 kV in Table 2.11 (rather than the times specified in Table 2.10). The other *protection scheme* of the main *protection system* must operate to achieve the maximum *total fault clearance times* specified for 66 kV in Table 2.11.

3.1 Network constraints for this connection

The proposal is to connect the PPG to Wagin substation via the existing 22 kV WAG510 feeder. Due to the age of the substation, both transformers only have HV fuses installed, instead of HV and LV circuit breakers, as per the current design standards and practice. The Wagin substation was built prior to the establishment of the Technical Rules in 2007, therefore it is deemed to comply with the Technical Rules, as per clause 1.9.4.

Pursuant to clause 1.9.4 (b), any subsequent work at the substation would require Western Power to bring the substation to be fully compliant with the Technical Rules. As a result, new 66 kV and 22 kV circuit breakers, current transformers and associated protection equipment would have to be installed at significant costs.

Assuming the PPG is connected, in the event of a fault the fuses on the transformer HV side would not be able to back up WAG507 for a phase to earth fault. Issues with detecting and clearing the fault contribution from the generator for a fault on the 66 kV busbar within the specified Technical Rules clearing times would also arise.

In considering the Applicant's connection request, two options were investigated in detail. Option 1 proposed full compliance with all relevant Technical Rules. Option 2 proposed an alternative solution, with an exemption required for clause 2.9.4 (maximum fault clearance time) of the Technical Rules. These options are outlined in detail below:

Option 1 - Fully Technical Rules compliant

This option would require the following network augmentation activities:

- Install a 66kV circuit breaker and current transformer on both transformers
- Install a 22kV circuit breaker and current transformer on both transformers
- Install protection 1 and protection 2, 66kV bus zone protection, which also trips the transformer's 22kV circuit breakers.
- Install protection 1 and protection 2 for the transformers
- Install transformer LV protection on both transformers
- Install any associated secondary equipment
- Associated design and labour costs

Western Power estimates the total cost of the required network augmentation to achieve compliance under Option 1 would be in the order of \$2m excluding costs for additional communication and SCADA upgrades.

Option 2 - Technical Rules exemption approach

This option involves a solution that is non-compliant with the Technical Rules. However, the non-compliance, and any potential impact on the transmission network, would be minimised by the following:

- The risk of a busbar fault is extremely low.
- The PPG will disconnect from the system within one second.
- The generator is an induction machine and has reverse power protection installed. The protection settings will be set to 1 second at the PPG's connection point to ensure that the transmission network is protected from faults.

This option includes the proposed intertrip arrangement (Attachment4), which will ensure that the disconnection of the PPG is possible at times when System Management determines the potential occurrence of a high risk event. This includes times of both planned and unplanned outages, which will result in 66 kVA transmission lines supplying Wagin being out of service.

An exemption from clause 2.9.4 of the Technical Rules would be required in order for Western Power to pursue option 2. All other Technical Rules requirements will be met under this option.

Taking into account the Applicant's requirements and current network considerations, Western Power is proposing to connect the PPG without upgrading the substation.

Details of non-compliance

The system under consideration is a 66 kV transmission line that is longer than 40 kms. Clause 2.9.4(d).3 of the Technical Rules would be breached under Option 2 with the protection clearance time exceeding those listed in Table 2.

Table 2: Alternative maximum *total fault clearance times* (msec) for 132 kV and 66 kV lines.

		Existing Equipment No CB Fail	Existing Equipment CB Fail	New Equipment No CB Fail	New Equipment CB Fail
132 kV	Local end	150	400	115	310
	Remote end	400	650	400	565
66 kV	Local end	1000	Not defined	115	310
	Remote end	Not defined	Not defined	400	565

In the event of a supply interruption following a single transmission fault, the total clearance time would exceed the limit specified in the Technical Rules. To minimise this issue, the PPG's reverse power protection will be set to operate within 1 second after detecting a fault.

The connection of the PPG would cause a risk of a weak in-feed on Western Power 66 kV network. The risk would arise when either KOJ-WAG or KAT-WAG 66 kV line is out of service and a line fault occurs. There is a risk that the PPG could feed the fault from the load side. In this situation, the small current from the PPG feeding the fault would be too low for Western Power protection to operate (on the transmission 66 kV level).

According to Technical Rules clause 2.9, Western Power is obligated to clear faults (even small fault current) within 150ms for local faults and 400ms for remote faults at 66 kV. Under these 'weak in-feed' conditions, the PPG would clear the fault by the operation of its reverse power protection within a maximum of 1 second (compared to the 150 ms required in normal circumstances).

4. Exemption Justification

4.1 Service Standards in consultation with the Applicant

A fully compliant option (Option 1) has been priced at approximately \$2m plus costs for additional communication and SCADA upgrades. A risk-based approach option with a Technical Rules exemption (Option 2) would avoid this significant augmentation cost with no adverse impact on the existing level of safety and reliability of the network.

Western Power recommends Option 2 as it is deemed to be more economically viable for this particular PPG connection.

Based on efficiently balancing the Applicant's requirements with current network considerations, Western Power is proposing to connect the plant without requiring the whole substation to be fully Technical Rules compliant.

Following consultation with the Applicant, it was confirmed that the proposed option was preferable to any other option, subject to Western Power gaining a Technical Rules exemption. The Applicant has accepted the proposed service standard and understands and acknowledges the potential financial impact of this connection.

The Applicant has provided a letter confirming their understanding of the nature of the proposed connection arrangement, and the impact on the PPG operations. This letter further supports Western Power's submission and acknowledges the consultation that has taken place. Refer to Attachment 1.

4.2 Impact on other existing network users

Western Power's assessment of the proposed connection arrangement shows no adverse impact on the existing level of safety and reliability to the other network users.

As with other induction generators, this type of plant can be considered unlikely to form an island and back feed the network – as induction generators require network connected power to energise field windings so that they can generate their output power.

4.3 Justification for granting this exemption

Western Power considers the following grounds as reasonable and prudent to granting the Technical Rules exemption request:

- Western Power's assessment of the proposed connection arrangement shows no adverse impact on the existing level of safety and reliability to the other network users.
- Western Power considers that the proposed connection arrangement permits the Applicant to obtain a covered service to the extent reasonably practicable in accordance with good electricity practice while efficiently minimising any cost associated with network augmentation.
- The Applicant has agreed to the proposed connection arrangement, and any associated minor potential impacts on the PPG operations.
- Granting the exemption request will enable the Applicant's PPG to become operational in the shortest possible time frame in accordance with the Applicant's connection application and proposed operational time lines.

In summary, Western Power considers the advantages of operating with the exemption sought outweigh the disadvantages of requiring full compliance.

5. Exemption Risk assessment

5.1 Introduction

A degree of inherent risk already exists for all aspects of connections of this type. The pre-existing known risks are mitigated by the application of Australian Standards, Technical Rules and safety regulations. The additional risk assessment for the proposed 800kVA PPG connection out of Wagin Substation has been carried out. The results are presented in Table 3 below.

Table: 3 Risk assessment and description of expected impacts.

Risk category	Description
Users/other customers impact	Western Power considers that the proposed connection non-exporting PPG arrangement will not change the existing supply and power quality levels. Thus, no material impact is expected on the existing level of safety and reliability to other network users.
Network arrangement and compliance	There is a possibility of a Technical Rules fault breach with the present network arrangement to which this generator will be connected. However, this risk is already present for the existing connections (due to the grandfathering provision). Thus, no additional issues are to be expected from an asset performance and power quality perspective when there is a 66kV bus fault whilst the PPG is generating. This is because, from a distribution plant point of view, a loss of grid supply would initiate a trip of the PPG within 1 second. This means the LV distribution voltage will drop below limits for no more than 1 second. Compliance requirements are such that the network supply voltage has to be within compliance limits derived from a 10 minute average. In addition, if this PPG is there for the purpose of peak load lopping, it would only be generating if there is sufficient load present. Therefore, if a fault was to occur on the 66kV bus at that same time, the PPG is more likely to feed the load rather than to export to the grid.
Earth potential rise and low frequency induction voltage levels	This connection can be expected to have little impact on existing network earth potential rise (EPR) and low frequency induction (LFI) voltage levels. Due to the location of Wagin, the population density of the region is low. This helps with the risk of EPR/LFI voltage levels, as the chances of someone being in a place with touch or step potential issues are reduced.

An assessment of the proposed connection out of Wagin Substation (once the inter-trip is in place) from the network and protection engineering viewpoints has determined that the proposed connection arrangement presents a low risk.

The decision not to upgrade Wagin is acceptable from a risk perspective given the cost of the upgrade to the Applicant and the expected remaining life of the equipment within the substation. The reduction of the trip time of the protection at the generator from 2 to 1 second provides additional risk reduction.

Based on the above risk table, granting the exemption to the Applicant would not result in significant change to the existing risks to Western Power, the network, or the public.

6. Statement of Technical Rules exemption

Pursuant to clause 12.40 of the Access Code, Western Power as the Service Provider for the WPN hereby applies to the Authority for exemption from a specific requirement of the Technical Rules, as follows:

Western Power is exempted from complying with the requirements of Clause 2.9.4 of the Technical Rules with respect to the connection of the Morton Seed and Grain (885 kVA non-exporting generator). This exemption enables Western Power to:

- (1) provide a constrained connection without upgrading Wagin substation; and
- (2) comply with a revised maximum clearance time that does not exceed 1 second.

The exemption will apply until the Wagin substation is upgraded as part of a WPN capacity project, or unless otherwise revoked under the provisions of the Access Code 2004.

7. Conclusion

Western Power considers that the additional cost, in the order of \$2m plus costs for additional communication and SCADA upgrades, to implement the compliant solution in Wagin substation under all operating conditions cannot be justified at this time.

Although non-compliant, Option 2 is the least costly solution which provides an acceptable technical outcome and risk profile.

The disadvantages of requiring full compliance include:

- There would be a significant cost impact on the Applicant which would likely see the project become not viable.
- The refusal to connect may be seen as an unnecessary barrier to connection because the connection will not be adding significantly to present risks, and with the proposed intertrip (as shown in Figure 4) any additional risk is lowered.
- There is a possible equity issue – the solar PV systems already connected to the feeder present similar risks. Therefore, it could be argued that their contribution above the existing risk is small.

Based on the above, Western Power considers that this exemption request meets the requirements of section 12.41 of the Access Code, as assessed:

- by a reasonable and prudent person,
- on both technical and operation grounds, and
- will have minimal effect on the network and its other users.

Therefore, Western Power believes, in this set of unique circumstances, that the exemption should be granted.

Attachment 1: Morton Seed & Grain letter of acknowledgement

9th October 2014
Mr Paul Italiano
Chief Executive Officer
Western Power
363 Wellington St
Perth WA 6000



Dear Mr Italiano

**Western Power Submission for Morton Seed and Grain Bioenergy Cogeneration Facility (Wagin)
Technical Rules Exemption**

Morton Seed and Grain is one of Australia's largest manufacturers and exporters of oats for human consumption. Morton Seed and Grain's Wagin operation is a key part of the regional economy in Wagin and the surrounding area.

To increase the international competitiveness of their operation, Morton Seed and Grain is in the process of installing a bioenergy cogeneration facility powered by oat husks (a by-product of the milling process). This project has received funding from the West Australian State government (LEED fund) and the Federal government (Clean Technology Food and Foundries Investment Program – CTFIP).

Morton Seed and Grain has been working with Western Power for over 1 ½ years to achieve an acceptable solution for the non-exporting, non-contestable generator in Wagin. In this investigation Western Power has advised Morton Seed and Grain that non-standard protection tripping times will prevail upon installation of the generator due to the non-compliant status of the Wagin substation.

The necessary network augmentation to comply with the technical rules would render the bioenergy cogeneration project at Wagin commercially unviable. Morton Seed and Grain have reviewed Western Power's proposal that non-standard tripping times are acceptable in this situation and fully support their application for a derogation to the technical rules. If you wish to discuss this matter further, please contact Karne de Boer on 0406 771 053.

Yours sincerely

.....
Jonnie Morton
Managing Director
Morton Seed and Grain

Morton Seed and Grain
96 Hope Valley Rd
Hope Valley WA 6165,
08 9410 5800

Attachment 2: Morton Seed and Grain PPG connection

The network interconnections for Western Power's Wagin substation are shown in Figure 1.

Wagin Substation is connected to the rest of the SWIN by the following lines:

- a 66 kV transmission line from Kojonup to Wagin (KOJ-WAG 71);
- a 66 kV transmission line from Katanning to Wagin (KAT-WAG 71)
- a normally open point 66 kV transmission teed between Wagin, Narrogin South and Narrogin Substations (NGS-WAG/NGN 71)

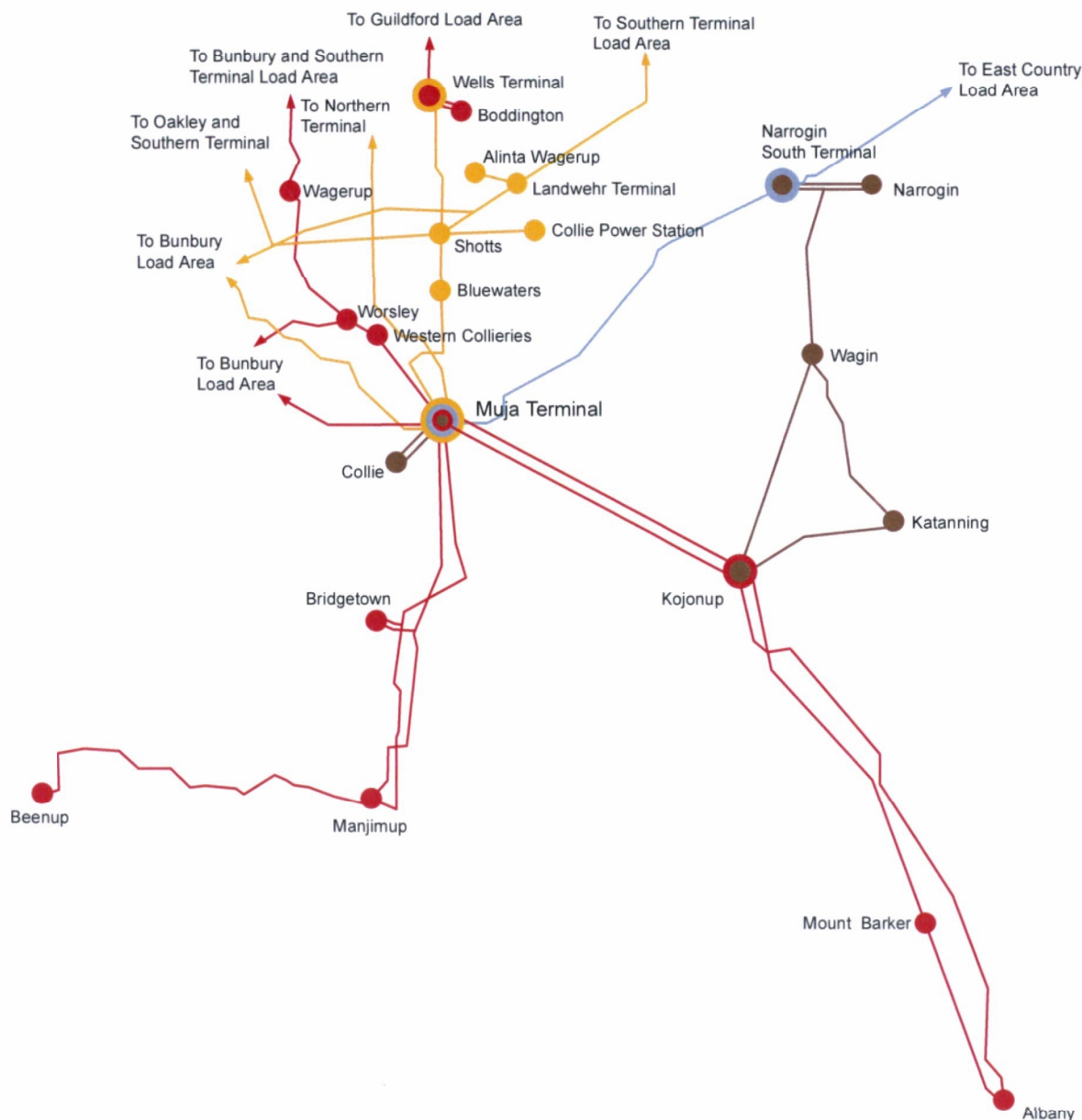


Figure 1: Transmission Network – Muja Load Area

Wagin substation has two 66/22 kV transformers with a total installed NCR transformer capacity of 10 MVA. The proposed generator location is shown in Figure 2.

Attachment 3: Morton Seed and Grain PPG location

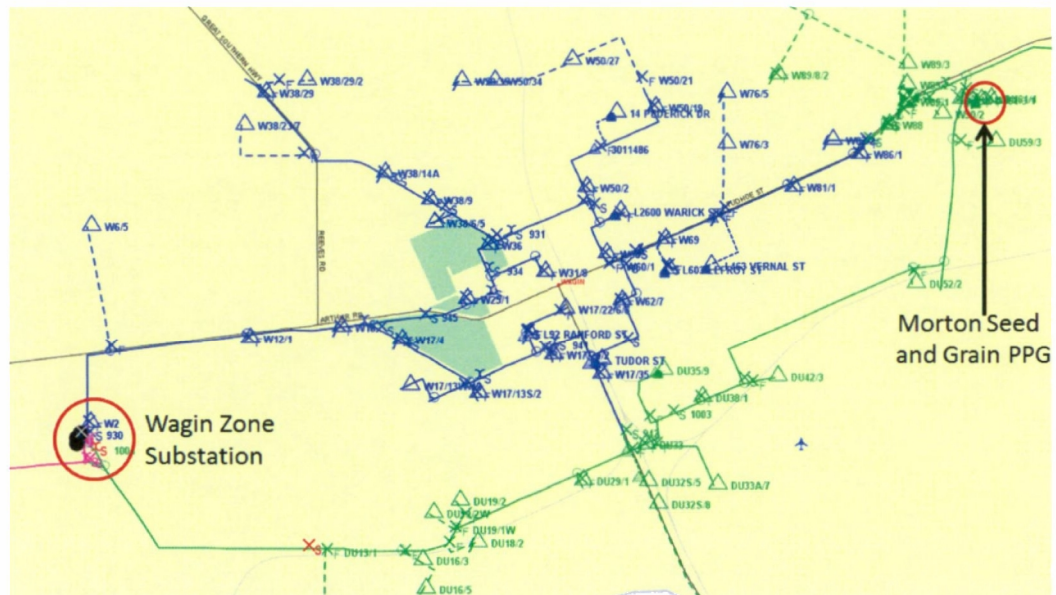


Figure 3: Location of Morton Seed & Grain PPG

Attachment 4: Proposed Morton Grain and Seed PPG SCADA/Comms solution

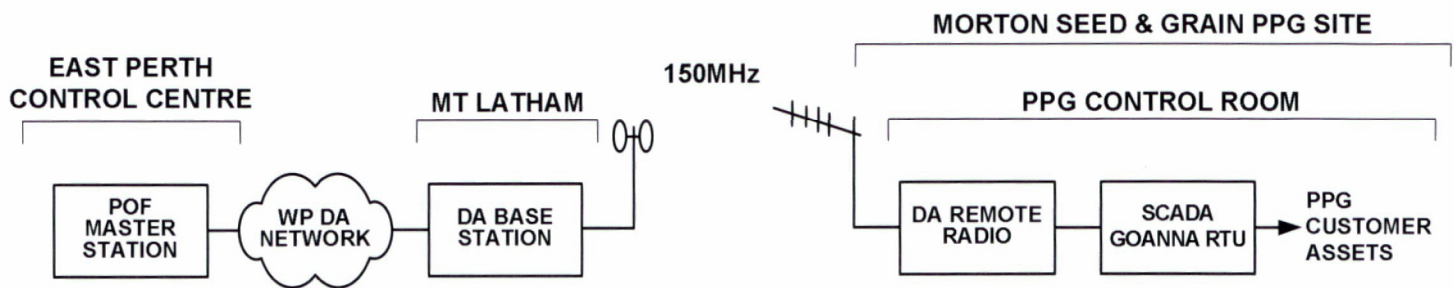


Figure 4: Proposed intertrip to disconnect PPG