



WOOD & GRIEVE ENGINEERS



Comment on the Proposed Amendments to Western Power's Technical Rules

WGE Electrical, Renewable Energy & Technology Sectors

Prepared for:

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Date:
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Introduction

1. Introduction

This submission of comments has been prepared by Wood & Grieve Engineers in response to issues identified in review of the Proposed Amendments to Western Power's Technical Rules. This submission has been based on the review of the following documents:

- Submission to the Economic Regulation Authority for Amendments to the Technical Rules, Western Power, November 2015
- Modification of wording letter dated 14th December 2015 from Margaret Pyrchla of Western Power, DM# 13507648
- Modification of wording letter dated 25th February 2016 from Margaret Pyrchla of Western Power, DM# 13507648v2

Wood & Grieve Engineers

Wood & Grieve Engineers (WGE) is an engineering consultancy firm that work in the affected sectors of building services and technology including advising our clients on the connection of embedded generation. In order to adequately represent our clients' best interests it was important to prepare this submission to comment on and raise our concerns with Western Power's proposed amendments to the Technical Rules.

About us:

Wood & Grieve Engineers (WGE) is an award-winning Australian engineering consultancy built on a strong culture of exceptional client service and best-practice technical engineering solutions. We provide innovative multi-discipline engineering services to both private and government clients in land development and all sectors within the commercial property development markets.

The experience and dedication of our large engineering team is well known in the property industry and with offices throughout Australia, we have the capability and track record to deliver beyond client expectations on any project.

- We have over 500 staff and grew by over 35% in the last 3 years
- 70% of our 55 principals have been with us for more than 8 years
- 50%+ of our executive directors started as graduates at WGE

Issue 1 - DC Injection Limit

2. Issue 1 - DC Injection Limit

The ERA has invited submissions from interested parties on Western Power's proposed amendments questioning the following:

1. *Whether the proposed amendments meet the requirements of stakeholders.*
2. *Whether the proposed amendment will materially impact the safety and reliability of the Western Power network.*
3. *Whether the proposed amendment will be effective in removing barriers to entry for connection to Western Power's network.*

Wood & Grieve Engineers (WGE) provide comment on each heading in detail below and provide the following summary of comments and recommendations.

2.1 Summary

WGE recommend the clause on DC injection 3.2.1(c)(3) is removed from the Technical Rules in keeping with other Supply Authorities in Australia. This recommendation is not based on studies into the effects of DC injection on network assets but from our observations on the ability of all other authorities to operate without a limit, without apparent issue. With the present industry mass non-compliance with the current zero tolerance of DC we would expect to see the effects of DC injection first hand on the Western Power network. It is our opinion that a real issue has not been presented or demonstrated within the proposal. We are concerned that the amendments proposed by Western Power in relation to DC injection are conservative, of a theoretical nature and are impractical to implement.

Should the limit on DC injection not be removed, it is our opinion that it should be increased beyond that proposed in order to avoid the creation of barriers surrounding network access. This should include an interim exemption from compliance being made available to the electrical industry whilst further studies are carried out on an appropriate limit, if there is to be one.

Most critically, it is our opinion that the accuracy limit of 5% proposed to be imposed on the apparatus used to measure DC at a connection point is farfetched, impractical and should be revised. An appropriate study into suitably available, industry appropriate test equipment, inclusive of stakeholder engagement should be conducted to determine an appropriate equipment accuracy class.

We are also concerned with the proposed modifications of Attachment 9 & 12 of the Technical Rules - including DC injection measurements. Should a DC injection limit remain within the Technical Rules we recommend that HV connected sites are exempt from this testing as for this to be carried out at a HV connection point it would represent an unnecessary risk to electrical contractors.

Issue 1 - DC Injection Limit

2.1.1 Whether the proposed amendments meet the requirements of stakeholders

Proposed DC limit of 0.5% of the rating of the Connection Point

We note the proposed amendment to DC injection still sits within Section 3.2 of the Technical Rules, titled “Requirements for All Users”, a section applicable not just to those with embedded generation connections.

At WGE we are active in the WA electrical building services industry and work closely with electrical contractors at all levels from minor residential to high end commercial grade. It is our opinion that there is a major misconception in the industry that this requirement affects only those within the commercial solar PV industry.

Previously and at present, an LV customer can connect to the network and inject DC without any knowledge or repercussion. It is understood that most commercial facilities will inject a portion of DC through the use of common devices such as variable speed drives. This current arrangement inadvertently and unfairly renders the embedded generation industry with policing non-compliances on Western Power’s behalf. Generally speaking it is only when a customer comes to connect embedded generation that an audit on the site’s power quality is conducted.

In the below table we identify concerns, provide commentary, perspective and our industry opinion on the effect of this issue on several stakeholders.

| Stakeholder | WGE Comment |
|------------------------|--|
| LV Connected Customers | <p>These users are largely unaware of any current obligations or issues with direct current and in the majority of cases are operating outside of compliance with the Technical Rules.</p> <p>At present this non-compliance will only be brought to their attention during the consultation or early engagement phase of the proposed installation of embedded generation on their site. In our significant experience, we have not yet had a DC injection reading of zero returned by a contractor on a commercial site and thus must deduce that the majority of these customers do not comply with the current Rules.</p> |
| HV Connected Customers | <p>These users are largely unaware of any obligation or issue. It is proposed to keep limit of the level of DC injected by these customers at zero. The fundamentals of electrical engineering allow us to assert that no DC current produced by an LV connected device will pass onto the HV distribution system.</p> <p>Our concern with the zero DC limit for HV connected customers is the proposed amendment to Attachment 9 of the Technical Rules and the potential for unsafe attempts at measurements being conducted at HV. It is our opinion that HV Customers should be exempt from providing any form of test results for DC injection.</p> |
| Electrical Contractors | <p>Based on our experience, the majority of these are largely unaware of any requirement to comply with this clause or any issues in relation to DC Injection.</p> |

Issue 1 - DC Injection Limit

| | |
|---|--|
| Commercial Grade Solar PV Contractors | <p>Generally aware of the requirement as this is reviewed on application to Western Power for the connection of embedded generation of a capacity greater than 30kVA.</p> <p>When these contractors identify DC injection on site exceeding the values set out in the currently available DC Injection exemption document, (or any non-compliances with harmonics or flicker for that matter) the cost of rectification must be inadvertently added to the business case for the embedded generation. With no embedded generation the customer can continue to operate in non-compliance, without the capital expenditure for rectification works.</p> |
| Mechanical Suppliers, Contractors & Consultants | <p>Through equipment manufacture, project specifications and installations on LV connected sites, these stakeholders are responsible for the connection of numerous electrical loads and control equipment that inject DC. Based on our experience, these parties are generally not aware of the current requirements or proposed DC injection maximum levels of this amendment submission.</p> |

Measurement Accuracy Requirement

Western Power has proposed that an instrument measurement accuracy limit of 5% is imposed for DC injection at the connection point. The research quoted within the proposal states that it is difficult to achieve an uncertainty of better than 4% which in turn appears to have led to Western Power’s proposed limit of 5%. However, to quote the authors of the paper in full, *“Even with high quality lab equipment in a controlled environment it is difficult to achieve an uncertainty of better than 4%.”* (Calais et al. 2010).

It is our opinion that this research is inapplicable to the realistic measurement of DC injection at an LV connection point for the following reasons:

- An LV connection point is not a controlled environment
- The test equipment used to measure DC injection could not be realistically utilised in the scenario required by Western Power as:
 - The equipment is physically unsuitable for site based usage.
 - This is a laboratory digital multimeter, costing approximately \$10,000 based on our research.
- The test circuit set up, for which this paper was based, was constructed for the maximum rated (RMS) alternating current of the device under test (DUT), being an inverter. This is not truly reflective of the magnitude of disparity between alternating and direct current that will be found at an LV connection point.

For example, In the instance of a large commercial site connected at LV you could have in excess of 2.5kA RMS of alternating current oscillating through a conductor on a single phase at the connection point where it is proposed that the industry is to be tasked with measuring mA’s of DC at 5% accuracy.

At this juncture, Wood & Grieve Engineers are not aware of a device suitable for this application readily available on the market.

It is also our opinion that this is an unrealistic expense to put on an electrical contractor. Without conducting a detailed study into the matter, we speculate that this would fail a reasonable cost vs benefit exercise.

Issue 1 - DC Injection Limit

2.1.2 Whether the proposed amendment will materially impact the safety and reliability of the Western Power network

Based on our limited review of Australian Supply Authority requirements on the subject, DC injection limitation does not appear to feature as a requirement for the connection of users to their associated networks. WGE have not conducted a study into the effects of DC injection on network assets but we note that Western Power have engaged an external consultant to conduct this study on their behalf. This study is not publicly available so commentary on the report and the subsequent recommendations are not possible. We can however make the assumption that these recommendations are conservative based on the limited requirements outside of WA.

During their internal and external review of the Technical Rules, focused on DC Injection and NVD protection, Western Power distributed a questionnaire to the industry to both a technical and non-technical base. This questionnaire contained a number of questions that in our opinion could be considered as “leading”, specifically in relation to DC injection. Should responses to these questions have contributed to any scientific studies performed by Western Power or their external consultants, we would query the validity of the findings.

Issue 1 - DC Injection Limit



2 Have you or your organisation witnessed any of the following phenomena on the low voltage networks (i.e. 240/415V AC) that has not been explained:

| Phenomena | | Select if yes |
|---------------------------------|--|--------------------------|
| Corrosion | Cable lead sheaths | <input type="checkbox"/> |
| | Steel pipes and structures | <input type="checkbox"/> |
| | Copper pipes | <input type="checkbox"/> |
| Distribution power transformers | Harmonics rich AC output waveforms measured | <input type="checkbox"/> |
| | Localised hot spots or failures in windings | <input type="checkbox"/> |
| | Increased noise | <input type="checkbox"/> |
| | Increased reactive power consumption | <input type="checkbox"/> |
| Reactive compensation | Detuning | <input type="checkbox"/> |
| Protection | Protection maloperations (including residual current devices) | <input type="checkbox"/> |
| | Desensitisation/calibration issues with CTs/VTs | <input type="checkbox"/> |
| | Erroneous meter readings | <input type="checkbox"/> |
| Consumer issues | Customer refrigeration and air-conditioner motor saturation | <input type="checkbox"/> |
| | Distorted sound from Hi-Fi or other consumer equipment experienced by domestic customers | <input type="checkbox"/> |

Above Extract from Western Power Technical Rules Industry Questionnaire – Distributed to Technical and Non-Technical Participants via Email, 10th April 2015.

Issue 1 - DC Injection Limit

2.1.3 Whether the proposed amendment will be effective in removing barriers to entry for connection to Western Power's network

In our opinion, the proposed amendments to the Rules do not effectively remove barriers for connection to the SWIS. The zero limit had been inadvertently ignored by the industry previously until the connection of PV systems of a capacity greater than 30kVA. Although the zero limit is and always has been applicable to all users, Western Power's own comments within their submission state that "inverters below 30kVA could connect without restriction".

The DC Injection limit applies, and has previously applied to all users of the network. There appears to be a noticeable link to inverter based embedded generation in Western Power's submission. All international standards referenced within the submission are standards on inverters and their connection. No international standards or policies on DC injection at an LV connection point have been referenced. We must assume these do not exist.

The proposed modification of Attachment 9 to include DC injection measurement requirements as well as the proposed unattainable instrument accuracy class would impose a new barrier on all new facilities wishing to connect to the network at LV.

Issue 2 - AS 4777 Date Amendments

3. Issue 2 - AS 4777 Date Amendments

Wood & Grieve Engineers support Western Power's proposal to remove the year of publish from the references to AS 4777 within the Technical Rules. It would be prudent to automatically adopt new revisions to this standard in lieu of seeking amendment to the Rules at every revision of the standard. All proposed revisions to the standard have been put to public comment previously, and unnecessary delays in adoption of these standards should be avoided.

4. References

Calais, M., Ruscoe, A., Morris, C., Dymond, M., Pezeshki, H. (2010) *Transformerless PV inverters – Recent Test Results and a Discussion of DC Current Injection and Safety Issues*. Solar2010, the 48th AuSES Annual Conference



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