Mumbida wind farm 132 kV connection

Submission for exemption from certain requirements of the Technical Rules

DATE: 7 May 2012

DOCUMENT PREPARED BY:

Western Power
GPO Box L921, Perth WA 6842
ABN 18 540 492 861

DM# 9331014_v1

safe reliable efficient

Table of Contents

Version Control

Version	Date	Description	Responsibility
1.0	7/05/2012	Document issued to the ERA	PS

1 Purpose of this submission

This submission seeks the Authority's approval of an exemption for Western Power from compliance with clause 2.9.4 of the Technical Rules of 23 December 2011 for connection of the Mumbida wind farm to the 132 kV network south east of Geraldton, specifically for protection clearance time for the future Mumbida - Three Springs and Mumbida – Mungarra 132 kV lines under abnormal operating conditions. This application is made in accordance with section 12.40 of the Electricity Networks Access Code 2004 (Code).

2 Context

Verve Energy has applied for a connection in mid 2012 for an 80.75 MW Mumbida wind farm (MWF). Verve Energy advised in March 2011 that the project would be in 2 stages, namely an initial output of 55 MW in August 2012 and increasing to 80.75 MW in September 2015. Under the proposed arrangement, the Mumbida Wind farm will be sharing Mungarra Power Station's existing Declared Sent Out Capacity of 112 MW.

3 Connection of the Mumbida wind farm

The Mumbida wind farm will be connected to Western Power's network by cutting in and out of the existing 132 kV Three Springs - Mungarra (TS-MGA 82) line. This would create two new transmission lines: Mumbida - Three Springs (MBA-TS 81) and Mumbida - Mungarra (MBA-MGA 81). The circuit route lengths between the Mungarra and the Mumbida substations and between the Mumbida and the Three Springs substations are approximately 28.5 km and 110.3 km respectively. The single line diagram for this arrangement is shown in Figure 1.

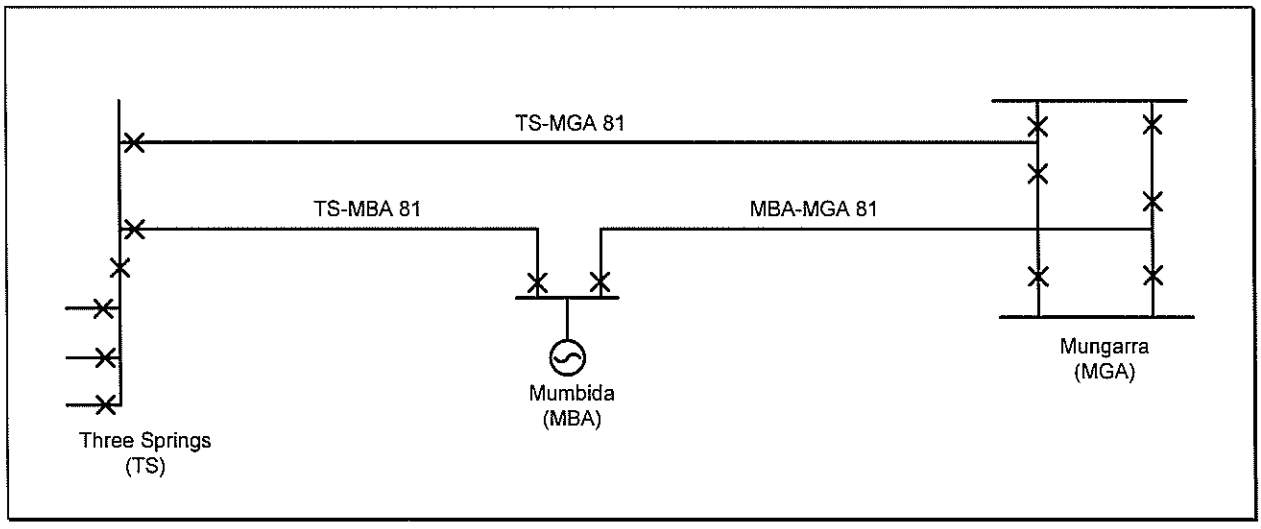

Figure 1 *– Proposed connection of the Mumbida wind farm to the Three Springs - Mungarra 132 kV line*

4 Requirements of the Technical Rules for transmission system protection

4.1 Protection clearance time

Protection schemes on transmission lines are duplicated. The specialist terminology is that 'each main protection system comprises of two protection schemes'.

Clause 2.9.4 of the Technical Rules requires that a 132 kV system fault must be locally cleared by both line protection schemes of the main protection system in a time no greater than 115ms (Tables 2.10 and 2.11).

For the Mumbida wind farm this means that the main protection systems on the Mumbida - Three Springs (MBA-TS 81) and Mumbida - Mungarra (MBA-MGA 81) lines must clear local faults within 115 ms.

For avoidance of doubt and completeness of information, Western Power will comply with the requirement to timely clear faults on the remote ends of the TS-MBA and MBA-MGA lines. Furthermore, the back-up protection system will also comply with the Technical Rules.

4.2 Two fully independent protection communication paths

For each main protection system, the two line protection schemes must use two fully independent communication bearers, as per Clause 2.9.2(a)(1) which requires '*...two fully independent protection schemes of differing principle...*'. The definition of '*two fully independent protection schemes of differing principle*' in the Glossary makes mention that '*...complete secondary equipment redundancy is required...*'. This ensures that failure of any single component cannot fail both protections.

For the Mumbida wind farm this means that two diverse protection communication paths are required for each of the 132 kV line protection (i.e Mumbida - Three Springs and Mumbida – Mungarra).

[Figure 2 deleted by Western Power]

Figure 2 – *Communication network. Compliant solution with two new radio repeater stations. Black dotted lines show two diverse protection communication paths between Mumbida and Three Springs: "PROT 1 PATH" and "PROT 2 PATH". Both paths use microwave radio as a communication bearer. Each microwave repeater station, shown as a circle, introduces a small communication delay.*

Both solutions presented here provide the required two fully independent communication paths, which are illustrated in Figure 2 and Figure 3 in the example of the Mumbida – Three Springs line.

5 The compliant and non-compliant solutions

5.1 The compliant solution - Two new radio-repeater stations

Engineering for a main protection system to achieve compliant fault clearance times would require two new microwave radio repeater stations, at an estimated cost of $1.53M. This is illustrated in Figure 2. The two new radio repeater stations would be located between the Three Springs substation and existing communication tower [redacted] at [redacted].

5.2 The proposed non-compliant solution - Power line carrier

If the 132 kV power line between Mumbida and Three Springs is used as the communication bearer, then the main protection system for that line (TS–MBA 81) could be implemented at a cost of approximately $160,000, by fitting the Power Line Carrier (PLC) communication equipment onto it, as illustrated in Figure 3.

[Figure 3 deleted by Western Power]

Figure 3 – *Communication* network. *Proposed non-compliant solution with Power Line Carrier (PLC) communication equipment fitted onto the Mumbida – Three Springs 132kV line. Red and green dotted lines show two diverse protection communication paths between Mumbida and Three Springs: "PROT 1 PATH" and "PROT 2 PATH", respectively using microwave radio and Power Line Carrier (PLC) communication bearers.*

This proposed system meets the 115 ms total clearance time under normal network configuration, with both 132 kV transmission lines to Mumbida in service (from Three Springs and Mungarra).

However, under abnormal network configuration when either of the two transmission lines to Mumbida (from Three Springs substation or Mungarra substation) is out of service and when the wind farm power output is below 11.43 MVA, then only one of the two independent protection schemes can achieve the required 115 ms clearance time. The other protection scheme on the remaining transmission line to Mumbida cannot achieve this clearance time at the Mumbida end only and thus compliance with clause 2.9.4 of the Technical Rules is not achieved.

The reason for the second protection scheme not achieving the required 115 ms clearance time at the Mumbida under these circumstances is computer processing time to run additional algorithms to reliably clear the fault.

By reliably clearing the fault, we mean that the protection system logic at the Mumbida location has to perform a few additional checks, because of the very low fault current contribution from Mumbida wind farm it sees, to verify and confirm that the fault on the remaining 132kV line really exists, before deciding to trip the circuit breaker and clear the fault.

The reasonably achievable protection maximum clearing times at the Mumbida end of the remaining line in service are 173 ms for Mumbida-Three Springs (MBA-TS 81) line and 166 ms for Mumbida-Mungarra (MBA-MGA 81) line, for which the exemption is sought.

6 Impact of non-compliance on the transmission system

Western Power has determined that these reasonably achievable protection clearance times have no adverse impact on the integrity of the network nor on power system stability, as they are shorter than the critical fault clearance time.

At this stage, there is no indication that these critical fault clearance times may change in the foreseeable future. The future adequacy of the protection scheme will be subjected to periodic review in conjunction with future network augmentation proposals.

7 Conclusion

Western Power considers that the additional cost of $1.37M to implement the compliant solution under all operating conditions cannot be justified at this time, because the cheaper non-compliant solution provides an acceptable technical outcome and better meets the Technical Rules objectives of clause 12.1 of the Code.

8 Statement of Rule Exemption

Under section 12.40 of the Electricity Networks Access Code 2004, Western Power seeks exemption from compliance with clause of 2.9.4 of the Technical Rules for one of the two 132 kV line protection schemes for local fault clearance at the Mumbida end, as follows:

> *If either the Mumbida to Mungarra (MBA-MGA 81) or the Mumbida to Three Springs (MBA-TS 81) line is out of service one and the Mumbida wind farm has an output of less than 11.43 MVA, then the maximum fault clearance time for the line which is still in service will be:*
>
> - *173 ms for the Mumbida toThree Springs (MBA-TS 81) line, and*
> - *166 ms for the Mumbida to Mungarra (MBA-MGA 81) line.*