Economic Regulation Authority
Level 4, Albert Facey House
469 Wellington Street
Perth WA 6000

Attention: Elizabeth Walters

3rd June 2016

Dear Ms Elizabeth Walters,

Proposed Amendments to Western Power's Technical Rules Submitted April 2016

It seems that the proposed change to Clause 2.5.4 may not actually result in improved efficiency of investment. In this submission I present some calculations which show possible outcomes.

Of course, the capacity of a substation increases with the addition of more transformers. I provide calculations in Table 1 that show precisely how much the capacity of a given substation increases and how it differs depending on the definition of NCR (Normal Cyclic Rating) in its current form and the proposed amended form.

For simplicity, I make the assumption that each transformer (including the RRST, Rapid Response Spare Transformer) has a capacity of 33 MVA. I have included N-1 substation capacity for illustration and as a sanity check because, as I understand it, the NCR capacity should always be similar to but slightly higher than the N-1 capacity.

Table 1 – Comparison of the three criteria shows that the proposed change leads to reduced substation capacity.

	Number of Transformers	1	2	3	4	5
	Sum capacity	33.0	66.0	99.0	132.0	165.0
Assumption	Capacity of each transformer (including RRST) for simplicity of calculations	33.0	33.0	33.0	33.0	33.0
N-1 now	N-1 substation capacity	10.0	33.0	66.0	99.0	132.0
NCR now	Permissible loss of load = min (33 * 75%, RRST * 90%) = 33 * 75%	24.8	24.8	24.8	24.8	24.8
	Capacity = N-1 capacity + permissible loss	24.8	57.8	90.8	123.8	156.8
NCR proposed	Maximum power transfer is 75% of the power transfer capacity, which is the sum capacity	24.8	49.5	74.3	99.0	123.8

Note: the "N-1" case is only illustrative, the cases to be compared are "NCR now" and "NCR proposed".

Note: all values are MVA (Mega-Volt-Amperes).

Let me offer an explanation of my understanding that may clarify the way in which I have made the calculations in Table 1. Suppose that a substation comprised of homogenous transformers rated at 33 MVA were required to satisfy the N-1 criterion. The maximum capacity for a station with two transformers would be 33 MVA, the capacity of a single transformer. The maximum capacity for a station with three transformers would be 66 MVA, the capacity of two transformers, and so on.

The N-1 criterion is conservative, because it requires having what is essentially a spare transformer in each zone substation. The NCR risk criterion is less conservative, because it allows a population of zone substations of, say fifty North of the river, to share a single spare transformer (RRST). This is an enormous economic saving, given that each transformer costs say $10 million, whereas making a substation NCR requires a construction effort that is only a fraction of the cost.

According to Table 1, a substation of three transformers will have a capacity of 90.8 MVA under the current NCR definition but a capacity of only 74.3 MVA under the proposed redefinition of NCR. For a substation of four transformers, the capacities are 123.8 MVA and 99.0 MVA respectively which is a huge discrepancy.

A good definition of NCR is one which maximizes the capacity of substations in order to defer investment as long as possible. I hope that the calculations I have presented can prompt more analysis of the quantitative aspects of the proposed amendment.

Yours Sincerely,

James Davidson