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Attn: Elizabeth Walters

19 July 2019

MC000229-Meadow Springs Exemption Advice – Merz response to HV/ LV currents in NCR rating

Dear Elizabeth,

This letter is to provide feedback on a response by Mr Davidson's (detailed below) to our Technical Advice on the Application to Revoke the Technical Rules Exemption Granted to Western Power for Meadow Spring Substation.

Mr Davidson's response is as follows.

Second, the ERA's consultant erroneously calculated the NCR ratings for the RRST transformers from data given in Table 4 and presented them in Table 5 RRST POWER TRANSFER CAPACITIES.

Namely, the calculation shown on top of page 7 shows the capacity of each RRST transformer was calculated by multiplying the current rating of the HV winding by its rated voltage with the correction factor for three-phase systems.

While the equation is correct, the calculation is incorrect, as the transformer power transfer capacity is determined by its LV winding – i.e. by what can be delivered to the distribution *system, 22kV in this case. The HV windings always have higher rating than the respective LV winding, because of the transformer losses, which are significant and cannot be neglected. Further, auto-transformers which are typically used in zone substations in Australia typically have the tertiary winding, which further increases the transformer losses.*

Our feedback to this response is as follows.

Normal Cyclic Rating (NCR) calculations are not undertaken on the HV winding or the LV windings independently but for a transformer as a single unit. The NCR is determined through a calculation of the top oil temperature and hot spot temperature reached within the transformer tank and core (a space that incorporates and couples both the HV and LV windings) for a given load profile. The aging of transformer insulation is also typically considered in NCR calculations.

The NCR rating (for the transformer as a whole) can be expressed as a HV current rating or an LV current rating (Western Power provided both). These ratings are provided at the nominal voltages for the transformer. To calculate the rating in MVA we need to select a reference side and use the nominal voltage for that side. We selected the 132kV side as this was the side for which we were provided a nominal voltage. Further, the LV nominal voltage of the transformer is typically higher than the nominal voltage of the distribution network to allow for voltage drop over the network therefore this is often some ambiguity of which nominal voltage is being quoted..

To demonstrate the discussion above we have repeated the capacity calculation in Table 4 of our Technical Advice for the LV side.

Western Power have confirmed that the nominal LV voltage of the T81 and T82 RRST is 23.33kV. The calculations of Table 4 of the report are repeated for both the HV and LV sides of the transformer in the Revised Table 4 below. The calculations remain based on the data in Table 3 which is provided for completeness.

Table 3: RRST NCR Ratings

Designation		NCR Summer		NCR Winter	
Equipment Name	**Voltage (kV)**	**HV (A)**	**LV (A)**	**HV (A)**	**LV (A)**
EETT81 TX	132	186	1052	216	1225
RRTT82 TX	132	187	1057	216	1225

Revised Table 4: RRST Power Transfer Capacities

Equipment Name	Voltage (kV)	MVA	Average PF	MW	0.9 MW
EETT81 TX	132	42.53	0.99	42.10	37.89
RRTT82 TX	132	42.75	0.99	42.33	38.09
EETT81 TX	23.33	42.51	0.99	42.08	37.88
RRTT82 TX	23.33	42.71	0.99	42.28	38.06

The Revised Table 4 demonstrates that the capacity calculated with reference to the HV side and the capacity calculated with reference to the LV side of the transformer are the same to 1 significant figure. Based on this, we confirm that the decision of which side of the transformer to reference in the power transfer capacity calculation has no material impact on the calculations or the conclusions in our Technical Advice.

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For any further information please contact the undersigned.

Yours sincerely,

Geoff Glazier
Principal Consultant
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