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Lessons Learned from Hybrid Microgrids

Integration of renewable power sources into existing systems –
A short discussion on design considerations.

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Acknowledgement of Country

We wish to acknowledge the traditional custodians of the land we are meeting on, the Whadjuk (Perth region) people. We pay our respects to the Elders both past, present and future for they hold the memories, the traditions, the culture and hope of their people.

Mining is a leader in the energy transition

Some of the drivers for change include environmental responsibility and cost of traditional fuels.

As a result, there is greater ambition to advance projects.

But what can go wrong?

What can we learn from the Rhombus of Regret?

- Lack of transmission system capacity
- Lack of system strength

How does this relate to hybrid microgrids and mining?

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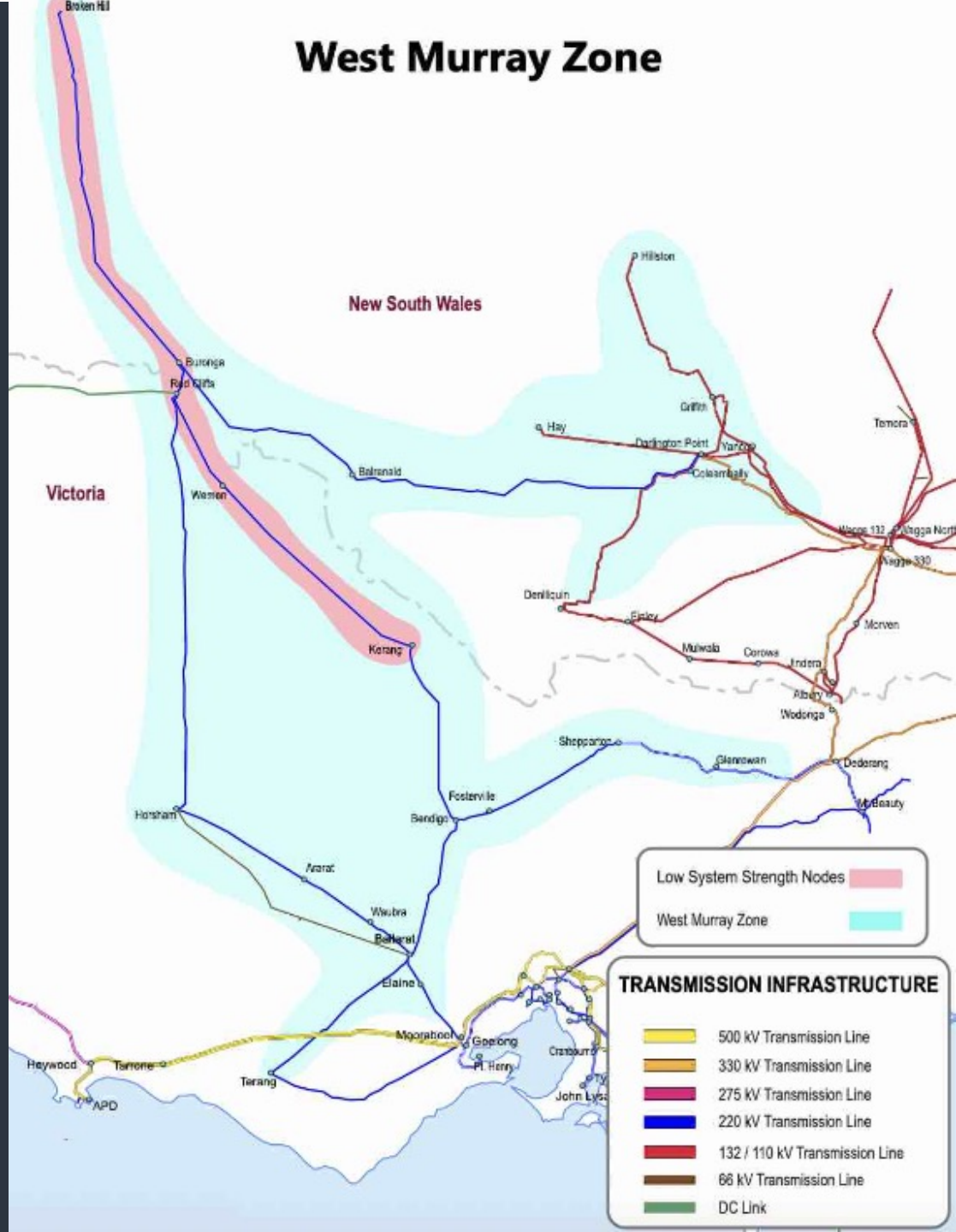


The Short Circuit Ratio

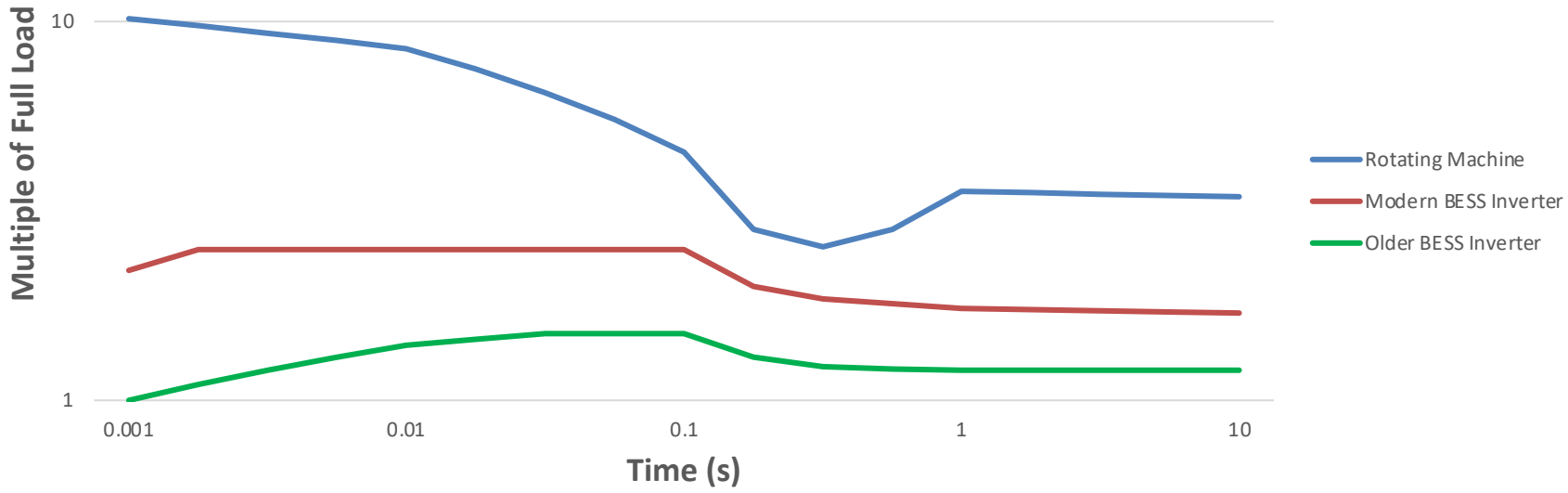
The measurement of system strength

In a power system, the Short Circuit Ratio (SCR) is the ratio between the system full load current and the current that appears during the first 50 or so milliseconds of a 3 phase short circuit (the subtransient period) before the current starts to decay.

Systems with high SCR are typically better able to clear faults, provide more stable voltage and frequency regulation and are less impacted by system noise and harmonic interference.

Systems with high SCR are better able to facilitate stable operation from grid following inverter systems.

The Short Circuit Ratio



	Grid Forming Systems		Grid Following Systems
	Traditional Rotating Generator Sets	Battery Inverter Systems	Solar and Wind Farms
Current Equipment	SCR is typically 8 to 10 times full load	SCR is typically 2 to 3 times full load.	Typically a system requirement for 1.5 to 2 times full load
Older Equipment	SCR is typically 8 to 10 times full load	SCR is typically 1.1 to 1.2 times full load.	Typically a system requirement for at least 3 times full load

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A simple example - 10MW (at 1pf) is to be drawn from a small solar farm

Case	Solar Farm Inverter Rating (MVA)	Solar Farm Inverter Required System Fault Level	Required BESS Inverter Size	Comment
Modern BESS System (Assume SCR = 2.5)	10	2x 10 = 20MVA	8MVA BESS x 2.5 = 20MVA (ok)	• BESS inverter is a reasonable size for the application
Less Recent BESS System (Assume SCR = 1.2)	10	3x 10 = 30MVA	25MVA BESS x 1.2 = 30MVA (possibly ok)	• BESS inverter is very large for the given application • Too expensive
Less Recent BESS System (Assume SCR = 1.2)	10	3x 10 = 30MVA	8MVA BESS (very little transient reliance) Syncon 4x 8 = 32MVA (ok)	• System is too small and would likely require a generator or SynCon to operate correctly • Still Expensive

In summary – you don’t want to end up in the Rhombus Club…

Grid forming inverter systems have improved remarkably in the last couple of years, and for most well-designed applications rotating inertia shouldn’t be needed.

- Pay attention primary equipment ratings
- Ensure that BESS systems are adequately sizes for the application
- Enlist some engineering assistance

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Thank you!