

# Effectiveness of Superconducting Fault Current Limiting Transformers in Power Systems

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## Research Background

Replacement of normal power transformers by SFCLT will achieve

Higher efficiency

Lower size and weight

More safety

Fault current limitation

## Research Outlines

Transformer design (100MVA)

Transformer Modelling using electromagnetic transient-type software

Integration into two test systems

Effectiveness of SFCLT

Current limitation

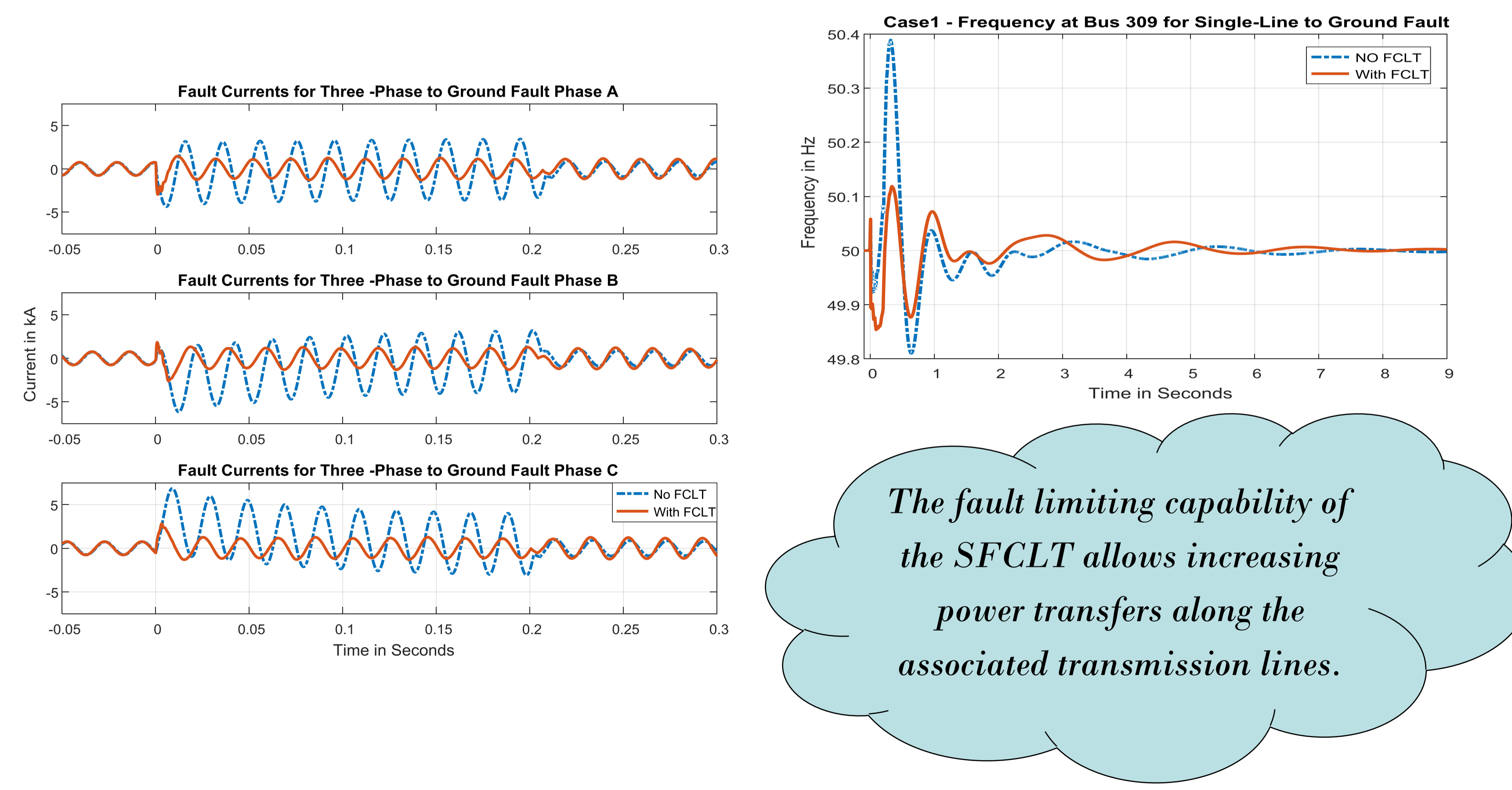
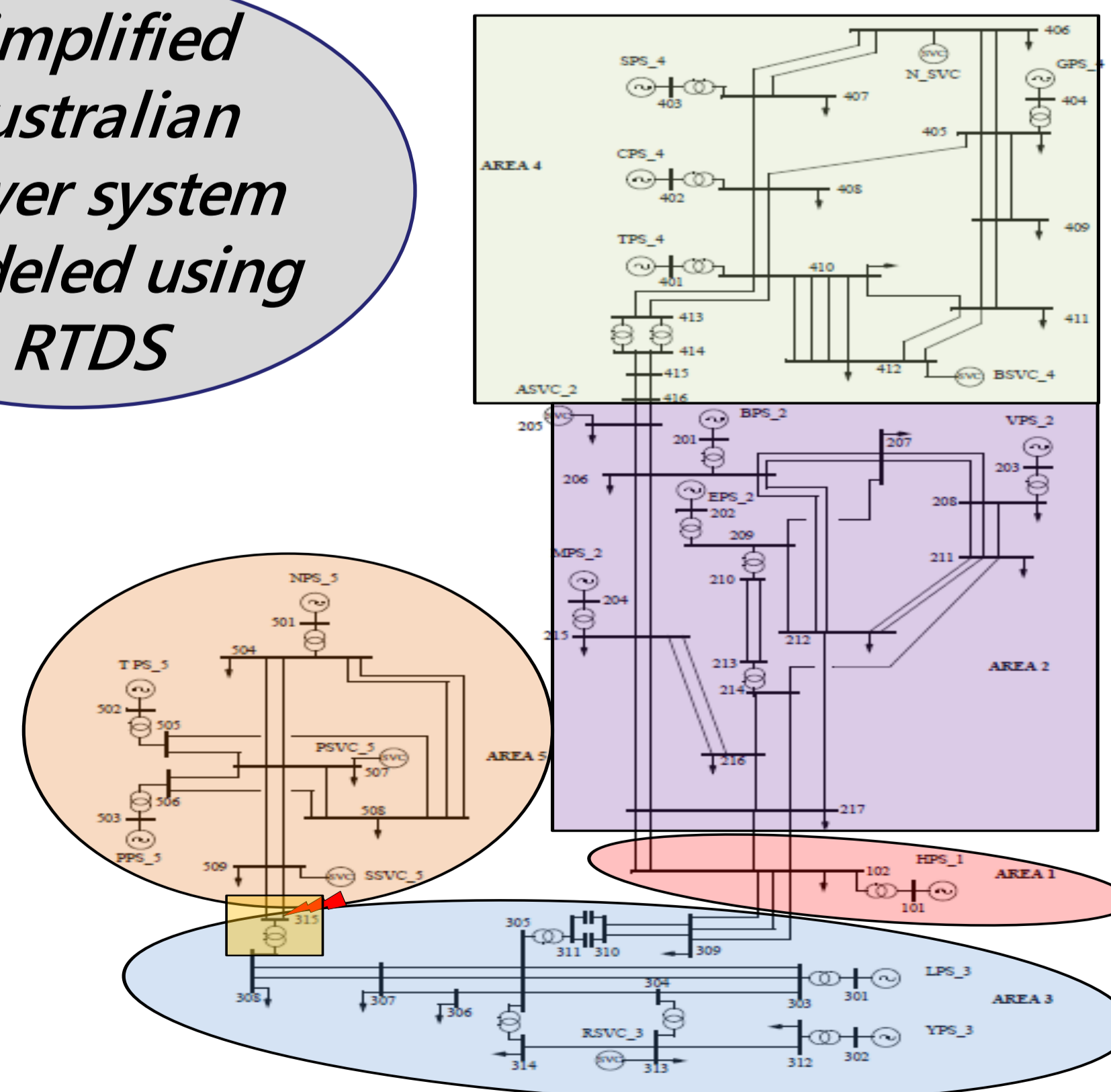
Frequency

Windings temperature

Rating	100 MVA
Type	3 phase transformer
Rated voltage	154 / 22.9 kV
Current	0.37 / 2.5 kA
Iron core	1.4 T
Frequency	50 Hz
Cooling	LN2
% Impedance	10%-15%
Estimated dimension	7.6 m × 5 m × 2.5 m
Weight	< 35 ton
HTS Property	YBCO coated conductor
Thickness	0.1mm
Width	4 mm
Stabilizer	Copper, 40μm
Hastelloy Substrate	60 μm
Critical current	50 A
Primary winding	8 tapes in parallel, 2.6 km minimum length
Secondary	50 tapes in parallel, 385 m minimum length
Total HTS length for primary	20.8 km
Total HTS length for secondary	19 km
Estimated cost for HTS windings	\$ 1.2 M

## Test system 2

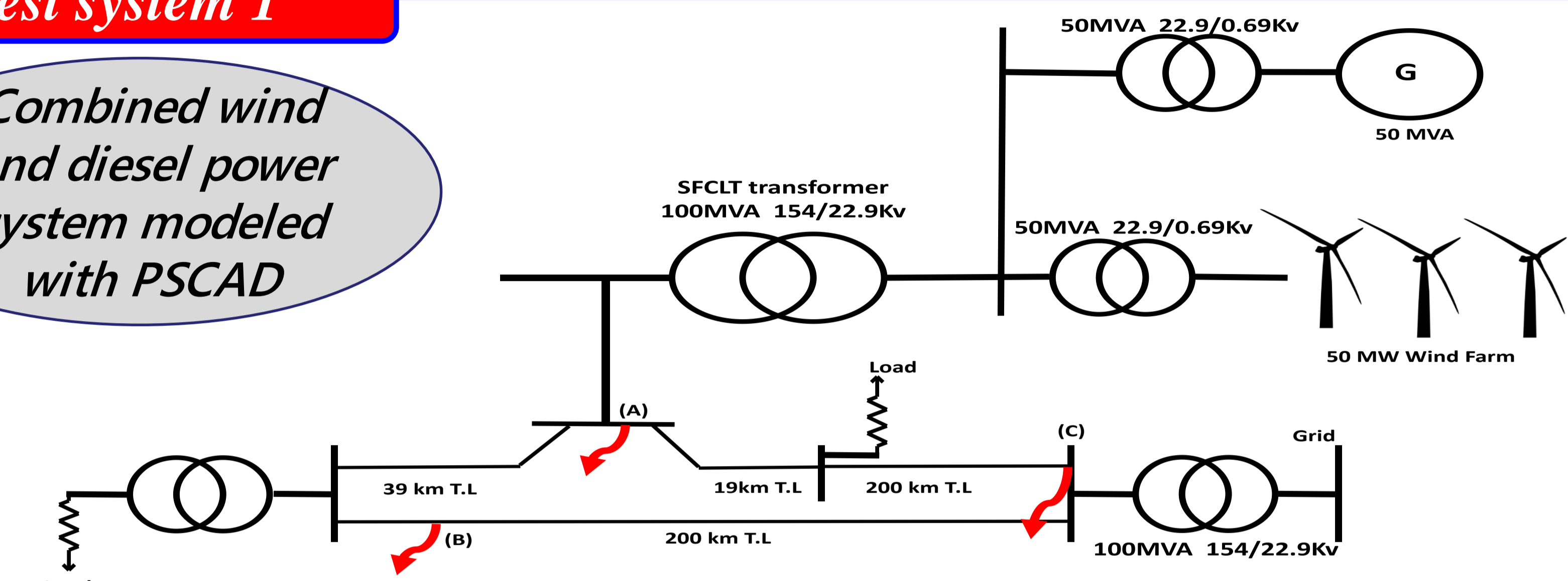
Simplified Australian power system modeled using RTDS



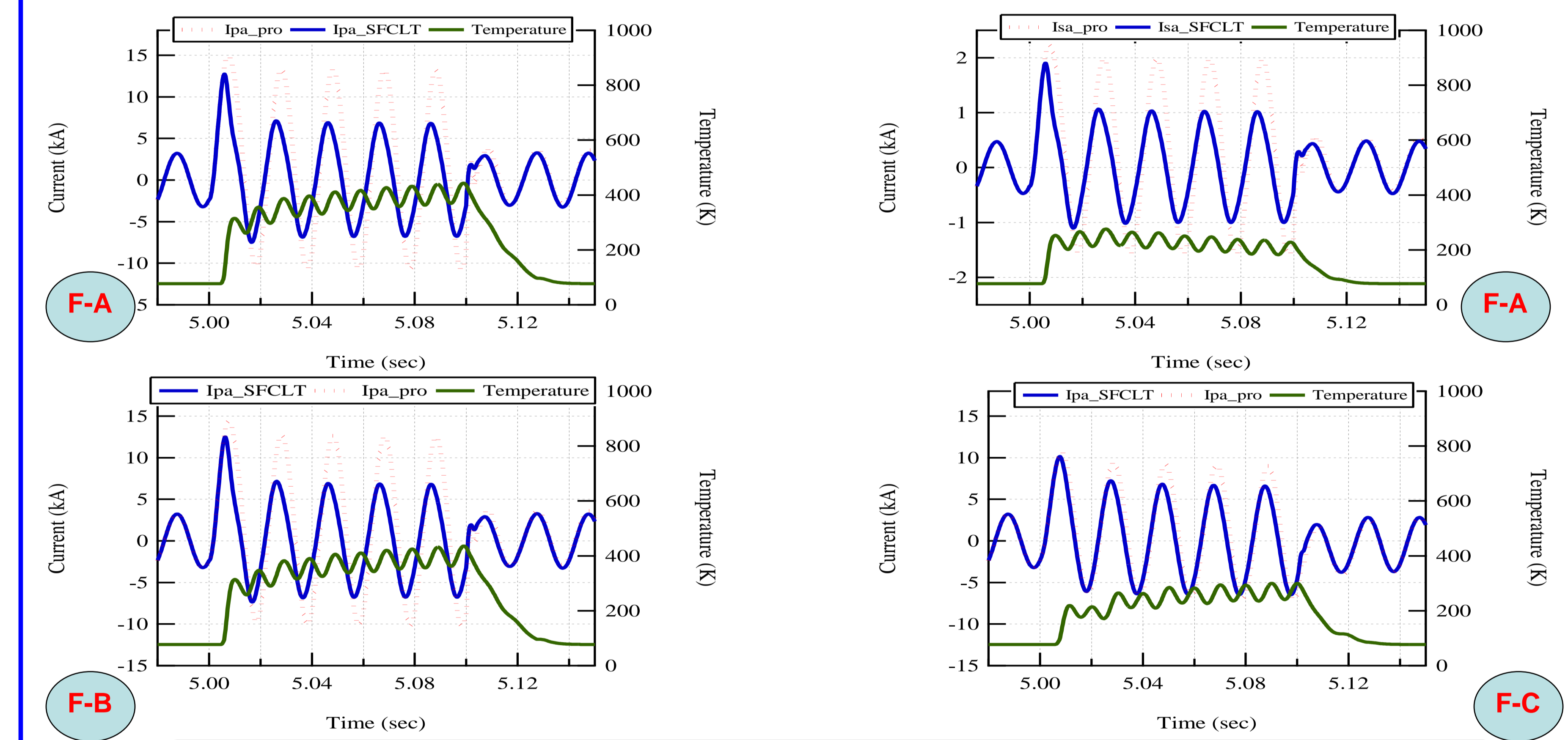
The fault limiting capability of the SFCLT allows increasing power transfers along the associated transmission lines.

## Test system 1

Combined wind and diesel power system modeled with PSCAD



Three fault locations



Currents and windings temperatures on primary and secondary sides of the transformer

## Conclusions

- The design and modelling presented herein allow to study in detail the current limiting behaviour of large superconducting fault current limiting transformers.
- Fault currents could effectively and consistently be limited to lower values within the first cycle and continue to be hold to much lower values in subsequent fault periods.
- Frequency excursions observed in the system could also be reduced using the fault current limiting transformers which helps in improving system stability .