GLOBAL POWER SYSTEM TRANSFORMATION: TOPIC 9- DER AND STABILITY

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This project was undertaken to support Topic 9: Distributed Energy Resources and Stability of the Australian Research for Global Power System Transformation (Stage 2) project administered by CSIRO through engagement with the Global Power System Transformation (G-PST) consortium.

Specifically, the work aims to undertake extensive experimental testing of modern loads when subject to various voltage, frequency and phase disturbances which were designed to replicate real life network disturbances.

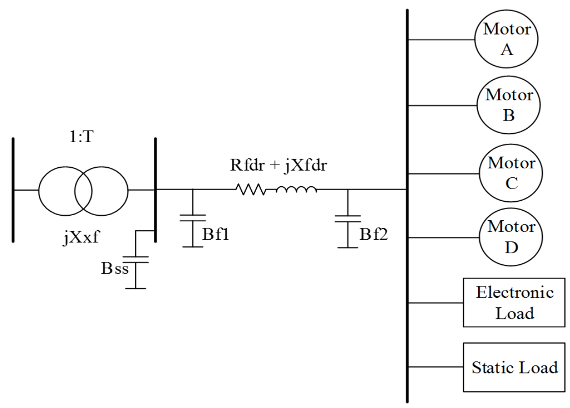
The objective was to obtain information on the response of typical loads connected to distribution networks, enabling a better comprehension of their behaviour, and facilitating the update of the parameters of the CMPLDW load models.

SUMMARY OF KEY KINDINGS

- Most of the appliances tested exhibited only temporary power cessation during disturbances before resuming normal operation once the disturbances were cleared. However, inverter based air conditioners disconnected after voltage sag events.
- Appliances with inverter-based interfaces, such as refrigerators and air conditioners, for disturbances which caused their traditional (DOL) counterparts to stall. This suggests that they should be included in the Electronic Load element of the load model instead of being represented separately.
- Electronic loads remained unaffected by frequency disturbance tests, except for the inverter-based microwave oven. The operation of most tested loads remained unaffected by phase angle jump disturbances, except for the DOL motor-based refrigerator and air conditioner.
- Similar to the DER inverter tests, testing multiple devices of the same type provides additional insights in their operation and modelling requirements. In Stage 3, attention should be given to other motor types (A, B, and C), including water pumps and commercial refrigerator systems.
- Many small residential EV chargers comprise electrical contractors, communication and control elements but lack active power electronics. The response of the EV charger to a grid disturbance will depend on the response of the EV onboard power electronics as well as any additional behaviour (e.g., internal tripping) of the EV charger itself.
- Given that the response depends on the EV fleet, a stochastic model for the behaviour of residential EV chargers could be more suitable.
- Since only one EV was available to the project during Stage 2, additional testing involving various EVs is required.
- Fast chargers (or Level 3 chargers) incorporate power electronics and mitigate the impact of individual EVs to grid disturbances. Stage 2 did not include testing on fast chargers.

LOAD MODELS

Sophisticated composite load models are now available that can capture both the dynamic and static response of loads. Composite load models consider the diverse aspects of load behaviour, such as dynamic response, sensitivity to voltage changes, and response to frequency fluctuations. To better model the response of modern power systems, the Western Electricity Coordinating Council (WECC) has developed an advanced composite load (termed CMPLDW) model with various components, including different types of motor loads, electronic/static loads as well as the inclusion of DERs.



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