



Future Energy System Outlook

Draft

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Appendix E

Zonal Network Model Overview



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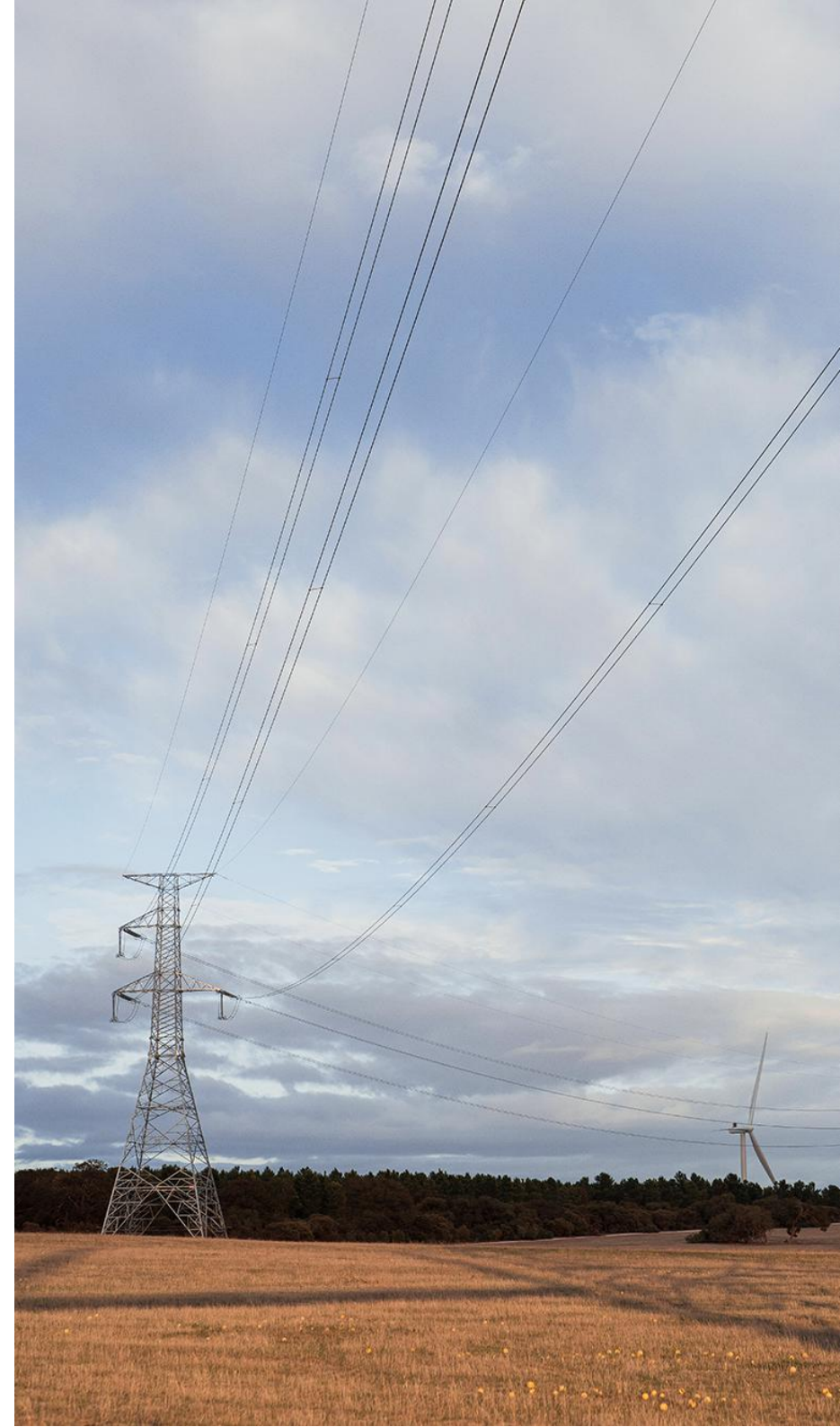
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Introduction

Western Power has developed a zonal network model for use in strategic planning studies – key benefits the zonal network model are:

- Reduced zone / node volume compared to the nodal model developed for TSP enables faster PLEXOS model run times and more complex study cases.
- Allows meshed topologies – previous zonal network models have been limited to radial network topologies.
- Zone definitions reflect likely SWIS expansion corridors to limit the number of intra-zonal constraints and investments
- Supports a hierarchical modelling methodology where a zonal model can inform a nodal model in a study to enable more effective investigation of key issues.

The zonal network model currently defines 25 zones and a range of network augmentation candidates. The network augmentations include refinements to existing augmentations that have been defined at the concept level as well as new augmentation options not previously available (e.g. offshore wind connections).

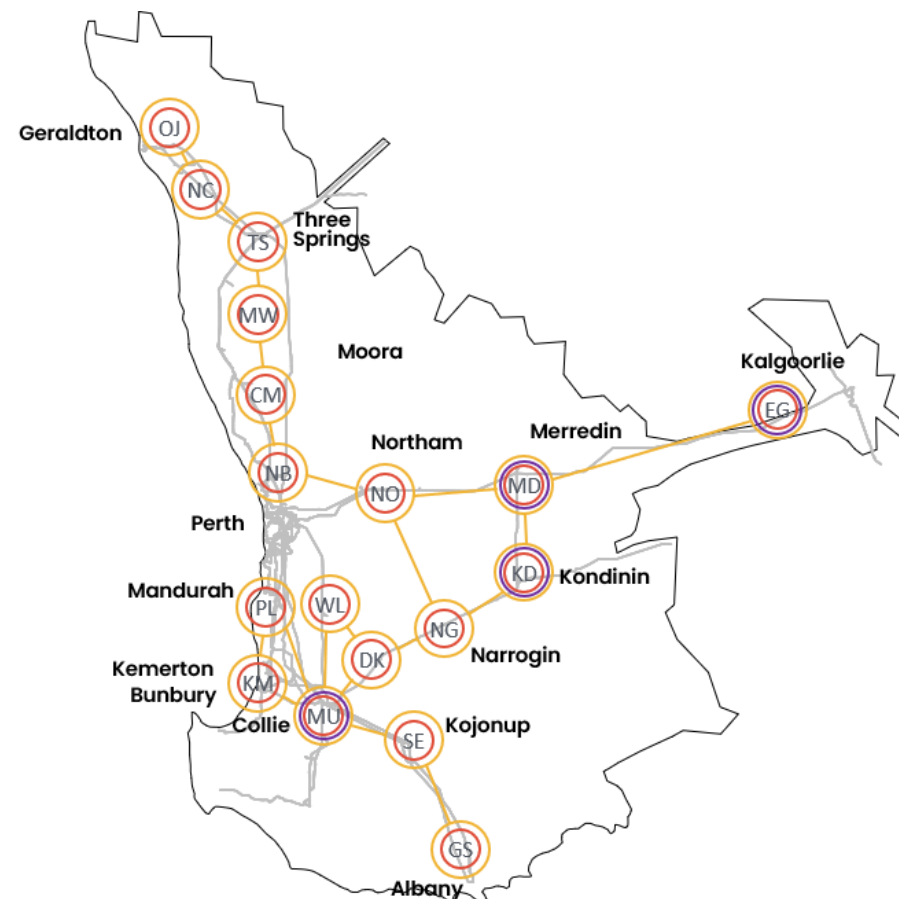


Figure 1. Zonal network model – Geographic

Zonal network model visualisation

Three zonal network model visualisations are provided in Figure 2. The base zonal network model reflects the current network topology and committed network projects e.g. CEL Phase 1. In the circuit view, each circuit between zones is represented and annotated by voltage. In the single line diagram (SLD) view multiple circuits at the same voltage are collapsed into a single line between zones.

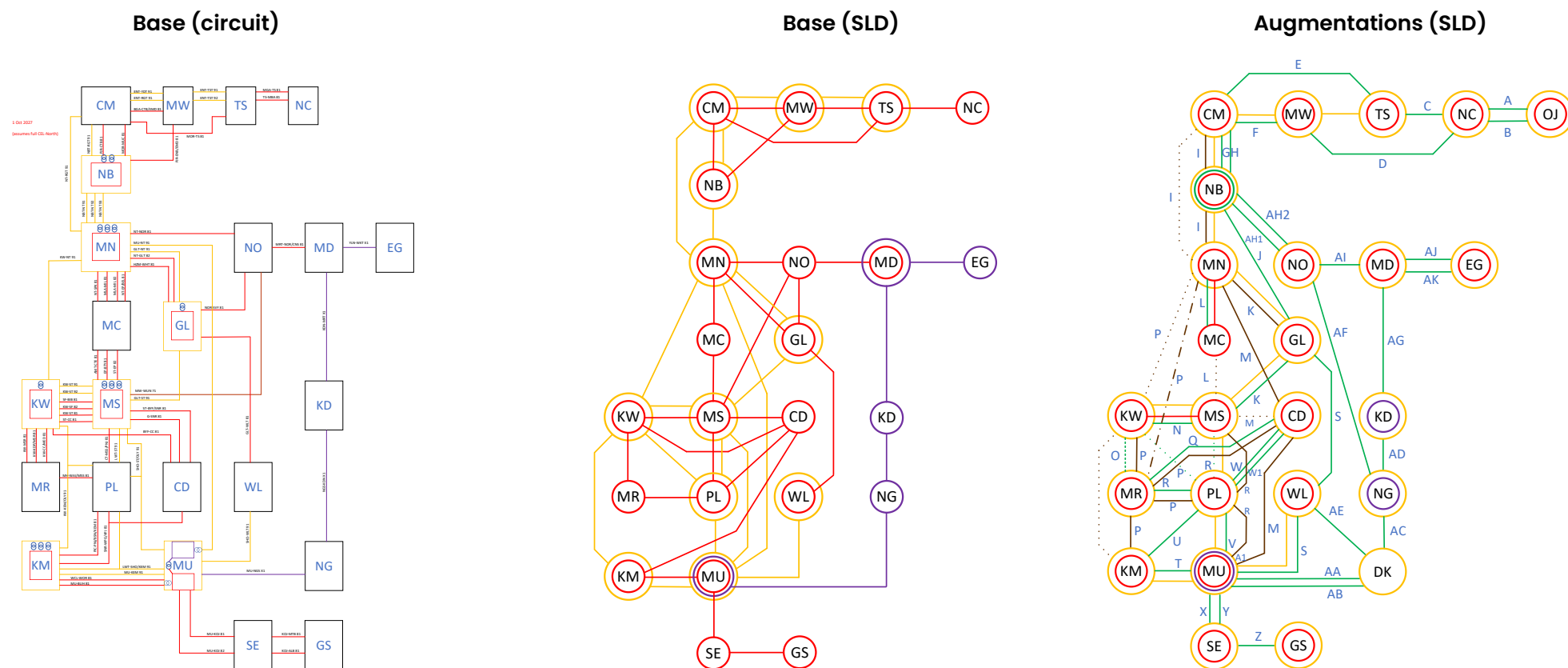


Figure 2. Zonal network model – visualisations

Network augmentations

More than 40 network augmentations (Clean Energy Links) have been developed that address:

- Expanding the SWIS into renewable generation corridors that reflect industry views on areas where renewable generation development could occur in the future.
- Improving transfer capacity across the SWIS to connect generation supply to load centres.
- Improving capacity to connect loads in key industrial development areas signalled by government and industry.

Network augmentations align with and build on those outlined for the SWIS Transmission Plan illustrated in Figure 3.

Candidate network augmentations draw on industry proposals, ongoing consultation and previous planning processes. Augmentations are aligned with the SWIS transmission architecture and costed with a model based on the AEMO Transmission Cost Database (TCD).

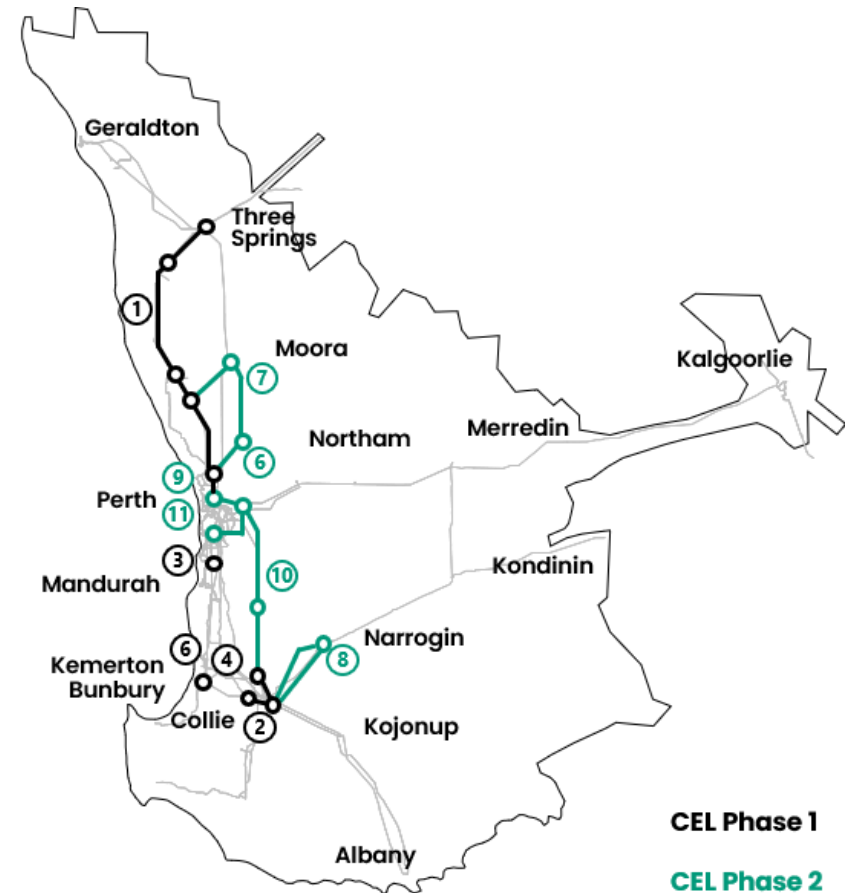


Figure 3. SWIS Transmission Plan augmentations

7 | Network augmentations

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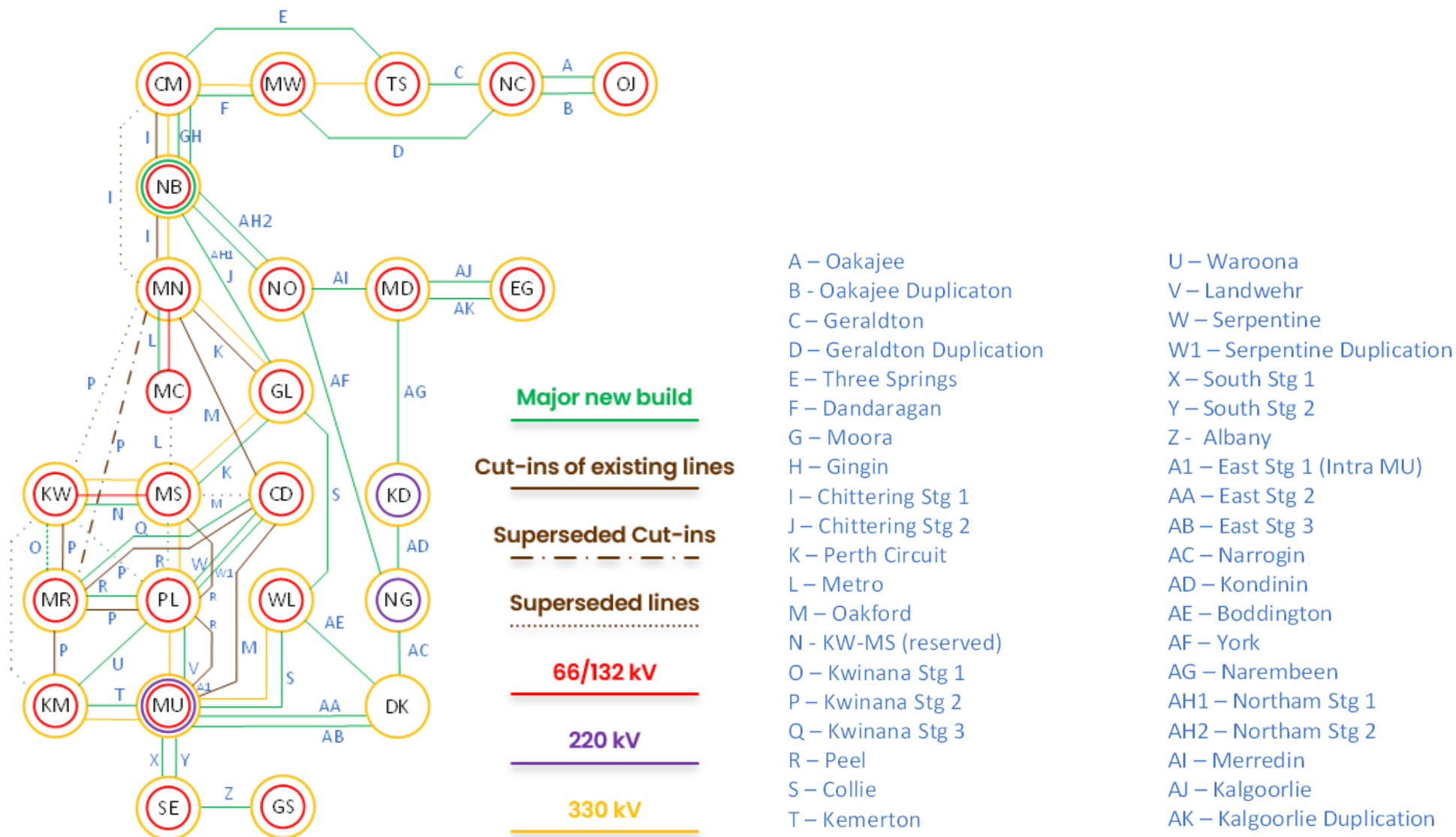


Figure 4. Network augmentations

Zonal network model development & testing

The zonal network model development has been undertaken to address expansion and congestion on the Main Interconnected Transmission System (MITS). The MITS is part of the Western Powers transmission network architecture as illustrated in Figure 5.

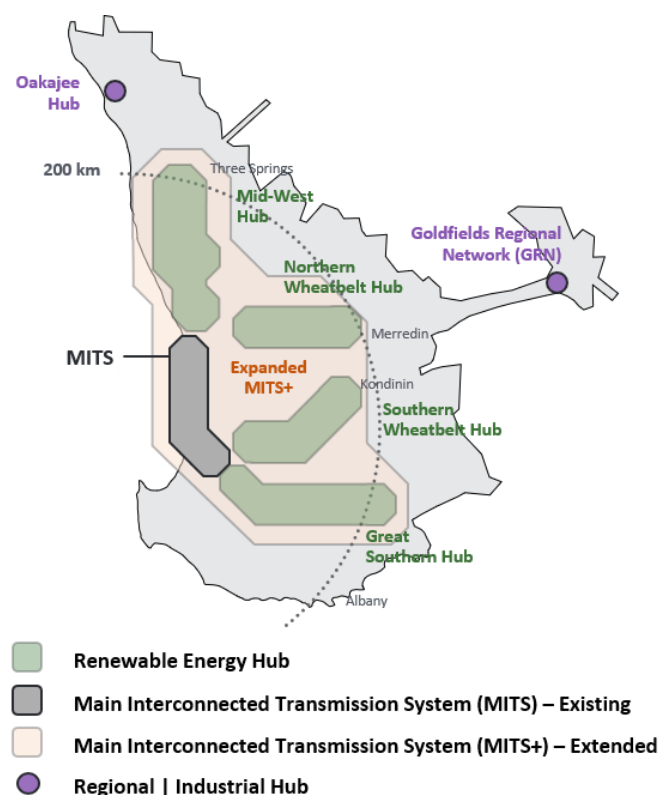


Figure 5. Transmission network architecture

Key steps in the development and testing of the zonal network model are outlined in Figure 6. A key consideration in the zonal network model development is maintaining alignment across all network models – this is important as most strategic planning studies will make use of more than one network model and internal consistency is important to ensure that study results are rigorous. Alignment across studies that use different network models is another key driver for increased focus on network model alignment.

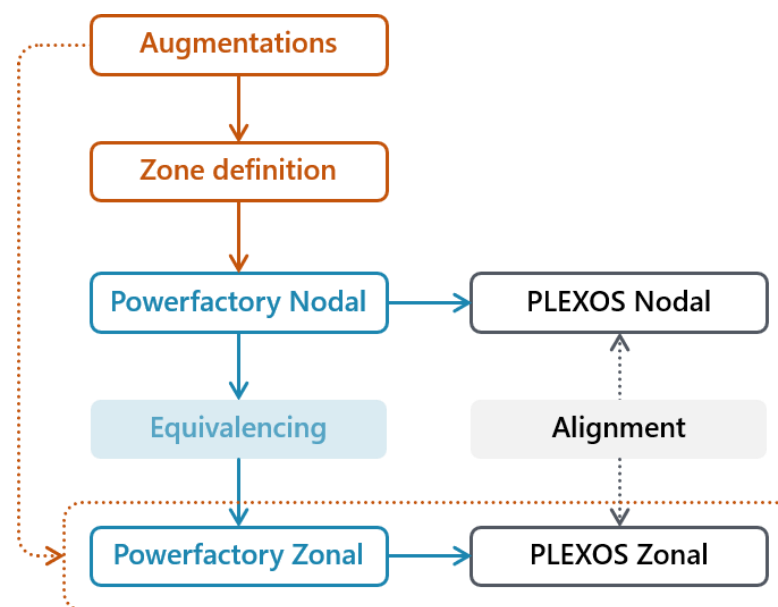


Figure 6. Zonal network model development & testing

Network augmentation development

Network augmentations are defined initially as concept projects. Only selected concept projects are progressed into pre-scoping where the project scope is more clearly defined. A strategic planning study (e.g. FESO or TSP) may provide a driver to progress a concept project into pre-scoping or to drive a project in pre-scoping into formal scoping need to develop a business case. Cost estimation is updated for augmentations as they progress from concept to scoping to detailed design.

Simple concept projects may not be built in the PowerFactory nodal model – these projects are typically built directly into the PowerFactory zonal model.

Network Zone definition

Network zones are defined to accommodate the network augmentations giving consideration to each project scope, staging and dependencies. Network zone composition is outlined in Microsoft Visio and translated into PowerFactory and PLEXOS models.

PowerFactory nodal model

The SWIS Base PowerFactory model (Steady State) provides a detailed network representation that is the basis for all other network models used to develop the zonal network model. Some network augmentations that are at concept level are not represented in the SWIS Base PowerFactory model. Network augmentations are presented as variations that can be turned on / off as required.

PowerFactory zonal model

The PowerFactory zonal model is developed by collapsing the detailed network into a zone and approximating the electrical performance of the zone. This key step is referred to as network reduction or equivalencing. To reduce the number of discrete network states that need to be considered in the PowerFactory zonal model development, network augmentations are grouped based on staging, dependencies and earliest entry year. Once defined, the DC load flow performance of the PowerFactory zonal model is compared against the PowerFactory nodal model.

PLEXOS zonal model

The PLEXOS zonal model is built directly from the PowerFactory zonal model. Cost data and other PLEXOS model parameters are applied to produce a model that can be tested for both expansion and dispatch modelling. Key model testing considerations are:

- Expansion and dispatch infeasibilities,
- Model runtimes,
- DC loadflow performance comparison to the PowerFactory zonal model, and
- Expansion and dispatch solution comparison to the PLEXOS nodal model.

Network zone boundaries

Network zone boundaries support a variety of modelling and reporting activities – the boundaries are illustrated below.

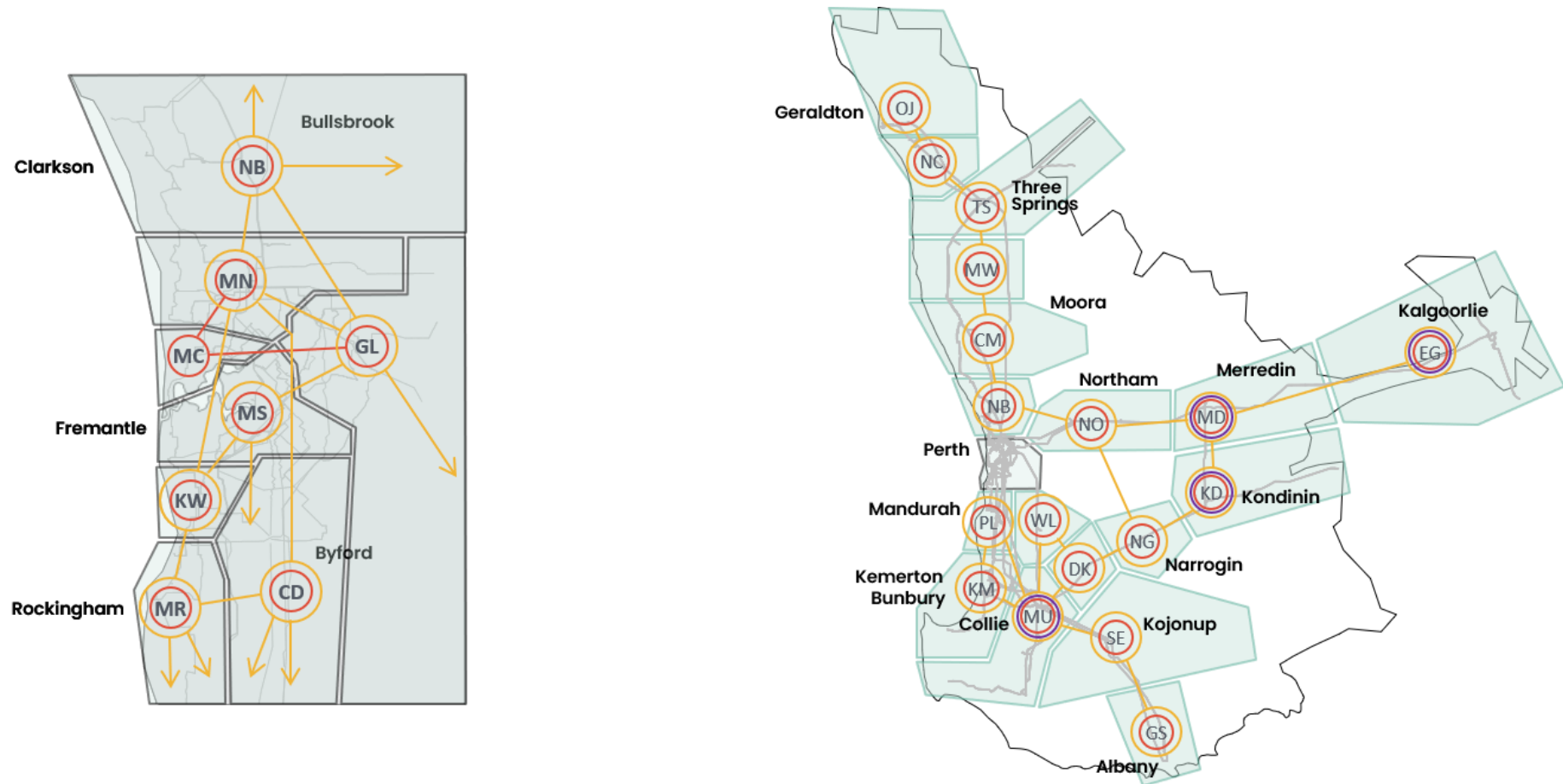


Figure 7. Zone boundaries

Further development

The following areas will be progressed to drive improvements in the zonal network model:

- Updates to the network augmentations that have progressed into pre-scoping are planned – this will involve updates to all network models.
- PLEXOS zonal model testing and performance tuning will be ongoing.

