

Framework on Modernization and Extension of Useful Life of Transmission/Distribution

CIGRE Technical Brochure 985, developed by Working Group C5.37, highlights the importance of considering asset life extension, refurbishment, modernisation and replacement within an appropriate regulatory framework. For Australia, this question is becoming particularly important because the future role of an existing asset may be very different from the role for which it was originally designed. The Australian members of the Working Group were Bilal Qadar and Alaa Jaralla.

Australia's electricity networks face two major investment challenges at the same time. Transmission and distribution networks must manage ageing infrastructure while also expanding and modernising rapidly to support the energy transition. This raises an increasingly important question: how can Australia obtain greater value from existing network assets without constraining the technical capability required from the future power system?

AEMO's 2026 Integrated System Plan anticipates a power system increasingly supplied by renewable generation, supported by storage and substantially expanded transmission. At the same time, Network Service Providers are managing ageing transformers, transmission lines, switchgear and secondary systems. Australian planning frameworks already recognise that asset condition, risk, reliability and economic assessment should inform replacement decisions rather than age alone.

However, increasing penetration of inverter-based resources (IBR) adds another dimension to the definition of useful asset life.

As synchronous generation retires and more wind, solar, BESS and grid-forming technologies connect, networks must manage changing requirements for system strength, voltage control, fault levels, protection performance, power quality and dynamic stability. An existing asset may therefore remain physically serviceable while becoming technically inadequate for the future operating environment.

The same challenge is emerging on the demand side.

Large inverter-based loads (IBL), particularly hyperscale data centres, are becoming material participants in network planning. Their scale and power-electronic characteristics mean future networks will increasingly need to consider not only how much load can be supplied, but how that load behaves during disturbances and interacts dynamically with the power system.

This changes the asset-management question. Rather than asking simply, "Can this asset safely operate for another ten years?", planners may increasingly need to ask, "Can this asset safely and economically perform the function the power system will require from it over the next ten years?"

For some assets, condition-based life extension may remain the most efficient outcome. For others, refurbishment may provide additional capability. In other circumstances, replacement, uprating, digitalisation, dynamic equipment or non-network solutions may deliver greater whole-of-system value.

Australia's regulatory framework should therefore continue evolving toward technology-neutral, risk-based and whole-of-life decision making. Regulatory investment processes should enable meaningful comparison between maintenance, life extension, refurbishment, replacement, augmentation and credible non-network alternatives, while recognising future system-security and connection requirements.

The objective should not be to maximise the physical life of every network asset, nor to replace assets simply because they have reached a predetermined age. The objective should be to maximise the value obtained from Australia's existing network while ensuring that each asset remains fit for the electrical system it will actually need to support.

As Australia connects increasing levels of both IBR generation and IBL demand, that distinction between an asset being physically serviceable and being technically fit for the future grid will become increasingly important.