Endeavour Energy

MOXA

A Powerhouse in Reshaping a Metropolis

Innovative Substations for Sydney's Urban Transformation



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At a Glance

Supporting the Growing Energy Needs of Greater Sydney

Endeavour Energy supplies electricity to communities across Western Sydney, the Blue Mountains, and the South Coast of New South Wales—areas experiencing significant population growth and urban development.

As the region continued to grow, it became clear that the existing electrical infrastructure needed to be strengthened. Originally built to support smaller communities, the network needed significant upgrades to provide the capacity and reliability needed for future development. A cost-effective and efficient approach was essential to delivering this outcome.

Driving Efficiency Through Innovation: Endeavour Energy's Digital Substation Initiative

As part of this broader network upgrade, Endeavour Energy began transforming the way its substations were designed and constructed. Historically, secondary system designs were developed on a case-by-case basis for individual substations. Endeavour Energy has since embraced a more standardized approach to substation design and construction, helping improve consistency and efficiency across projects.

By digitalizing operations and replacing the majority of protection and control copper wiring within substation control rooms with optic communications, the risk of contact with live electrical circuits can be significantly reduced.

Furthermore, by assembling substations off-site and transporting them to the location, on-site construction requirements are reduced. This reduces the construction and commissioning time from three years to under two years.

Addressing the Increased Complexity and Redundancy Demands of Full Digitalization

Shifting from conventional to digital substations brought significant changes to the knowledge domain and network design, adding more complexity. To ensure reliability, Endeavour Energy implemented a strong redundancy strategy, using two independent systems, each comprising equipment from different suppliers. Operational reliability was ensured by incorporating separate process bus networks for each protection scheme, effectively minimizing common points of failure. However, this made substation network design more complex.

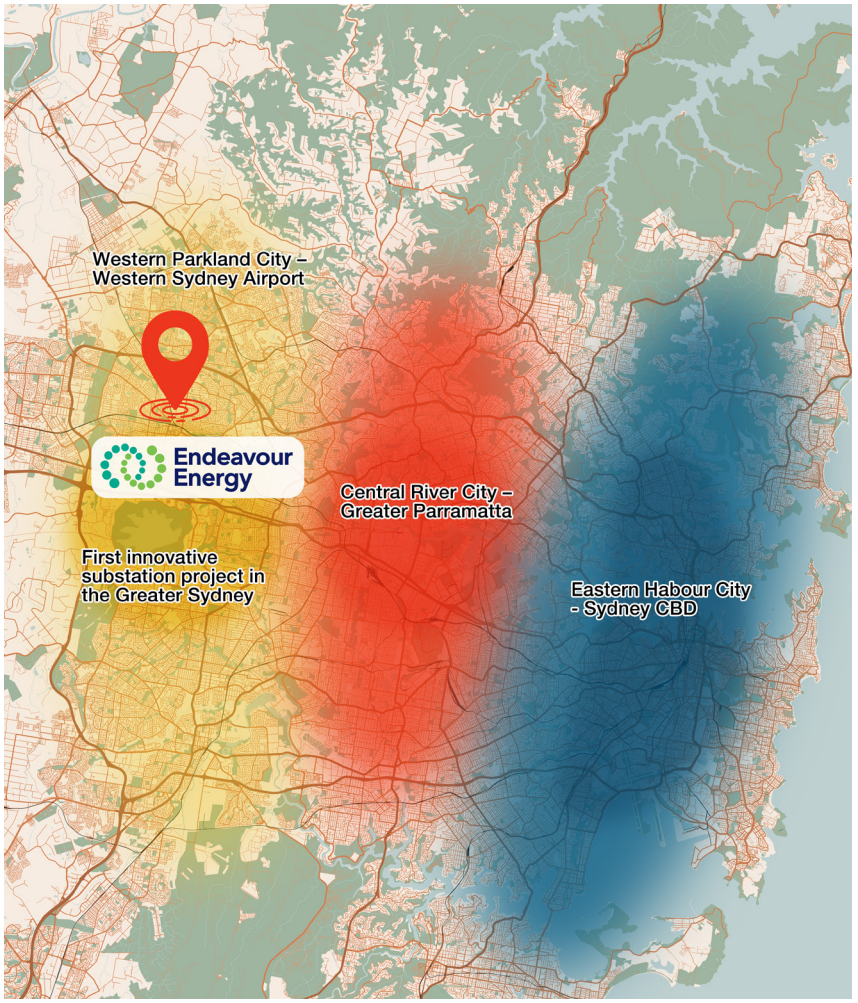


Image: The Metropolis of Three Cities Plan from the New South Wales (NSW) Government, and the location of the first Endeavour Energy new modular substation in South Erskine Park

Endeavour Energy

Endeavour Energy / Founded in : 2011
Headquarters: Sydney, Australia / Industry: Utility

Business Challenge

1 Mastering Cross-device Interoperability Challenges

Endeavour Energy's redundancy strategy involved using dual sets of merging units, intelligent electronic devices, grand master clocks, remote terminal units, and different communication functions. The diverse range of devices created an interoperability challenge because of the need to navigate through multiple protocols.

2 Achieving Millisecond-level Response Times to Safeguard Power Systems

Digitalizing the process bus was a necessary step, as this layer ensures the secure transfer of mission-critical data transmission and the execution of power protection mechanisms. Response times must be at the millisecond level, as any delays could endanger power systems, causing outages and infrastructure damage.

High-precision time synchronization and high-bandwidth communication equipment were essential for Endeavour Energy to transmit large data volumes, including sampled values (SMV) from merging units (MUs) through the process bus.

3 Streamlining Collaboration with Diverse Vendors

The redundancy strategy made it necessary to handle a greater number of vendors for different devices, which complicated vendor coordination and communication throughout the new substation R&D process.



Image: Endeavour's South Erskine Park substation is the first substation to adopt a prefabricated modular design after digitalization, but it must also address the communication management challenges that arise.

Solution

1 Guaranteeing Device Interoperability Through Rigorous Testing

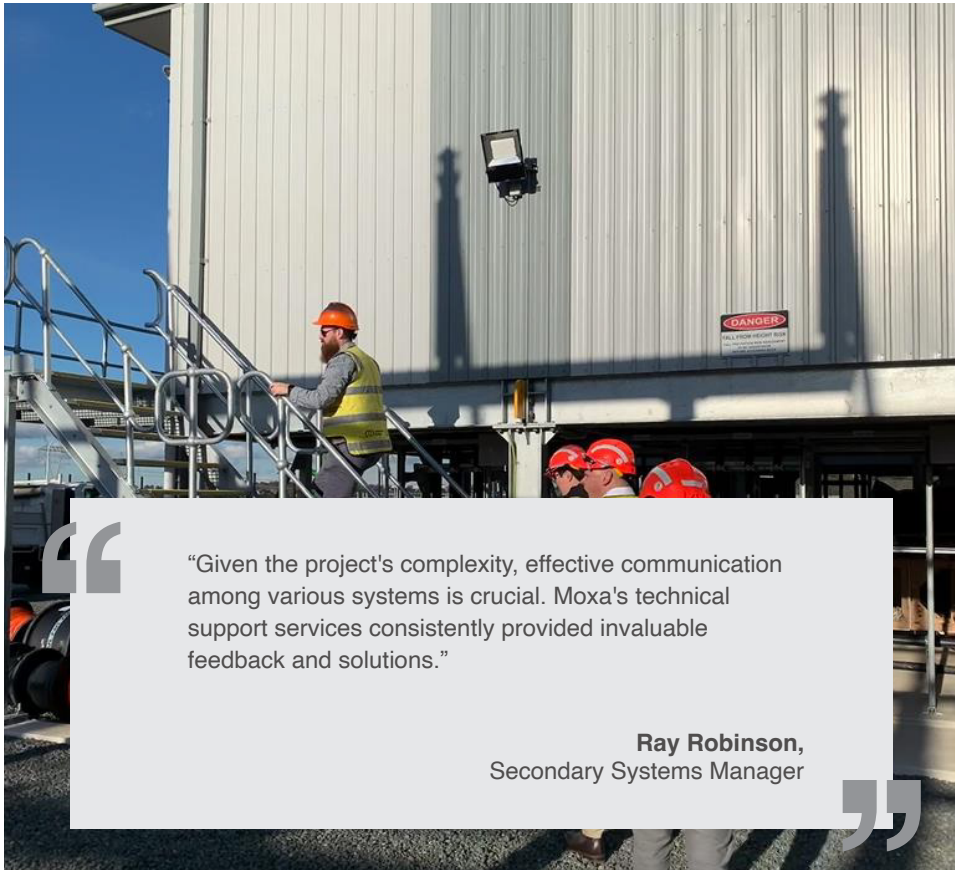
Despite the time-consuming and challenging nature of interoperability testing, Endeavour Energy prioritized ensuring cross-device interoperability. Passing the UCAIug IOP test, a biennial, world-authoritative interoperability testing conference for power equipment, was essential to confirm interoperability feasibility.

In the most recent UCAIug IOP test, only four companies passed the latest round of product testing in the network infrastructure category. Among them, Moxa's PT switches showcased their high interoperability, passing the IOP test. With Moxa's PT series switches, the substation's complex redundant device setup complied effortlessly with RSTP Ring requirements and seamlessly adapted to PRP/HSR networks. Additionally, their hot-swappable, modular design complemented Endeavour Energy's substation design, optimizing space usage and scalability.

2 Effortlessly Fulfilling Mission-critical Communication Requirements

Meeting multiple communication requirements for a process bus, including time synchronization accuracy, high bandwidth, and IEC 61850-3 standard compliance, is challenging. Endeavour Energy sought advanced communication equipment that could fulfill these requirements entirely. Moxa's Ethernet switches emerged as the solution to these demands. These switches offered high port density to connect various data sources with a gigabit transmission bandwidth. The switches not only complied with IEC-61850-3 standards but also ensured precise time synchronization with the IEEE 1588 PTP protocol, achieving substation device synchronization with an accuracy of 0.001 milliseconds. Their specifications surpassed those of other similar devices, establishing them as the top-of-the-line option.

3 Deploying Local Expertise for Advanced Network Design and Technical Services

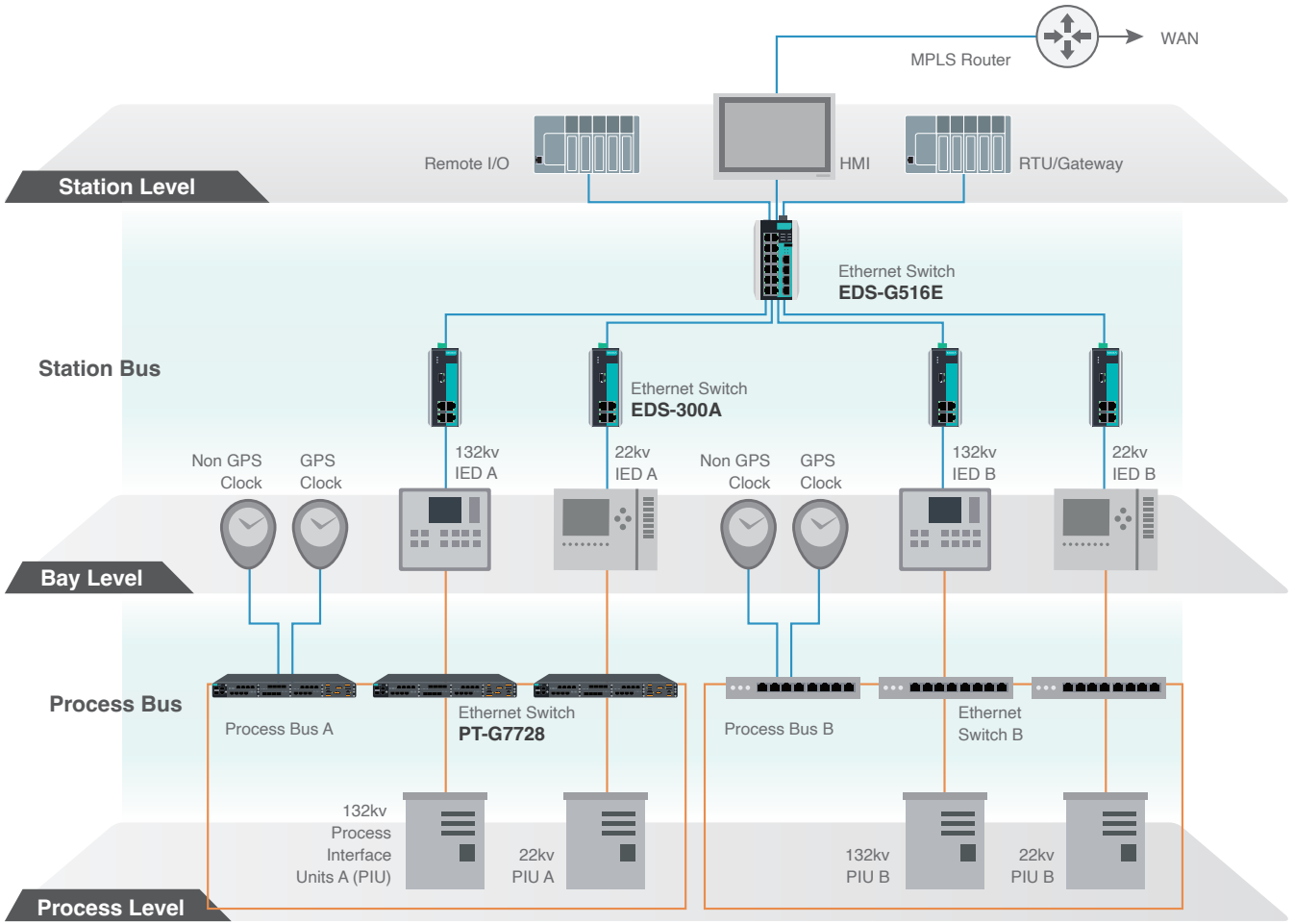


> "Given the project's complexity, effective communication among various systems is crucial. Moxa's technical support services consistently provided invaluable feedback and solutions."
>
> **Ray Robinson,**
> Secondary Systems Manager

With an energy-specialized team in Australia, Moxa assisted Endeavour Energy's new substation in network planning and deploying, ensuring timely support and communication throughout the process.

Achieving High Availability with Dual Network Systems

Endeavour Energy has rolled out two independent communication network systems, designated as A and B, to ensure exceptional availability and robust protection for the power grid. This strategic setup mandates that all communication devices achieve seamless interoperability and deliver millisecond-level response times



Network Design

- Each GOOSE and SV has a unique VLAN
- Python script can be used to update VLAN trunk tagged lists in config file for both Moxa and third-party switches
- Each switch has a mirror port for non intrusive fault finding

- Image Notes: Endeavour Energy has implemented two independent communication systems. Moxa's switches, with their interoperability, facilitate seamless communication with other devices, enabling effective communication for both the process and station bus of the substation.

- Moxa switches pass UCAIog include: PT-G503, PT-G510, PT-G7728, RKS-G4028.

Results

Bringing Tomorrow’s Innovation to Today

This innovative modular substation approach set a new benchmark in substation construction, providing unmatched flexibility and efficiency.

Embracing modularity allows substations to be easily customized, upgraded, and maintained, resulting in significant cost reductions and savings for businesses. The first South Erskine Park project has reduced expenses by approximately 22% compared to traditional substation development, and projections show that it has the potential to decrease operational costs by 58% over 25 years.

22% Capex Reduction

58% Opex Reduction

> “This substation project marks a significant milestone for Endeavour Energy, and we are delighted to have Moxa as our partner. Moving forward, our corporate strategy also prioritizes the grid of the future and facilitating the two-way flows of a modern grid. As such, opportunities to assist Endeavour Energy with the integration of renewable energy sources are also on the horizon.
>
> **Ray Robinson,**
> Secondary Systems Manager



Endeavour Energy aims to replicate its success by constructing more than 15 digital substations in the next five years, contributing to Sydney’s urban transformation.

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