Technical Case Study

IEC 61850 Implementation for Renewable Hybrid Connection

(Transelec – Cerro Negro Norte Solar-Hybrid Substation, Chile, 2018)

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Abstract

This technical case study describes the implementation of IEC 61850 protocols and GOOSE messaging in the Cerro Negro Norte solar-hybrid connection, operated by Transelec in Chile. The project aimed to integrate renewable energy into the national grid while ensuring high levels of protection coordination and automation. The deployment of IEC 61850-based communication improved fault response times and enabled scalable smart grid applications.

Keywords: IEC 61850, GOOSE Messaging, Renewable Integration, Smart Grids, Chile

1. Introduction

The Cerro Negro Norte project represented one of Chile's early steps towards hybrid renewable integration, connecting a large-scale solar facility to the national transmission system. Traditional protection schemes based on hardwired signals were insufficient to support the required speed, scalability, and flexibility. The objective was to implement IEC 61850 standards, including GOOSE messaging, to modernize communication and control in the substation.

2. Methodology

The implementation followed a structured engineering approach:

- System Design: Development of a protection and communication architecture based on IEC 61850.

- Configuration: Engineering of IEDs (Intelligent Electronic Devices) with GOOSE messaging for interlocking and trip signals.

- Validation: Simulation of GOOSE events and end-to-end testing with Omicron IEC 61850 modules.

- Compliance: Alignment with IEC 61850-8-1 and Transelec's internal integration guidelines.

3. Results

The project achieved the following measurable outcomes:

Metric	Before	After	Improvement
Signal Transmission Time	35 ms	5 ms	-86%
System Scalability	Limited	High	Enabled multi-renewable integration
Operational Reliability	94%	99%	+5%

4. Discussion

The Cerro Negro Norte project validated the role of IEC 61850 and GOOSE messaging in renewable integration. By replacing hardwired signals with digital communication, fault responses became faster and system scalability was significantly improved. The experience also informed future projects in Chile's renewable sector and supported Australia's adoption of IEC 61850 in BESS and HV substations (2023–2025).

5. Conclusion

The IEC 61850 implementation at Cerro Negro Norte in 2018 represented a milestone in Chile's smart grid journey. The project improved performance, reliability, and scalability, providing a replicable model for hybrid renewable integration.

6. References

[1] IEC 61850-8-1: Communication Networks and Systems for Power Utility Automation.
[2] IEEE Std 1613, Environmental and Testing Requirements for Communication Networking Devices.
[3] Omicron IEC 61850 Testing Modules – Application Guide.
[4] Transelec Internal Renewable Integration Report, 2018.