Technical Case Study

Relay Protection and HV Testing in Industrial Substations

(Anglo American, USA, 2013)

Author: Cristopher Sanhueza, MSc – Senior Protection & Commissioning Engineer

Affiliation (2013): Camval/Thermon Inc., Chile/USA

Abstract

This technical case study presents the relay protection and high-voltage (HV) testing program conducted for Anglo American's industrial substations in the United States. The objective was to enhance operational reliability through systematic relay coordination, Omicron-based secondary testing, and adherence to IEEE/IEC standards. The outcomes demonstrated improved fault discrimination, reduced downtime, and stronger compliance with industry benchmarks.

Keywords: Relay Protection, HV Testing, Industrial Substations, Omicron, IEEE Standards

1. Introduction

Industrial substations supporting Anglo American's mining operations required a comprehensive review and upgrade of relay protection systems. Legacy systems lacked advanced coordination, increasing the risk of nuisance tripping and extended fault clearance times. The project scope involved modern relay testing, coordination studies, and validation under international standards to ensure improved reliability and safety.

2. Methodology

The engineering methodology consisted of four primary phases:

- Protection Review: Analysis of existing relay settings and fault discrimination.

- Secondary Testing: Omicron CMC-based relay injection for overcurrent, differential, and undervoltage functions.

- Coordination Studies: Development of Time-Current Coordination (TCC) curves compliant with IEEE Std C37.112.

- Validation: End-to-end system tests with simulated fault conditions ensuring redundancy and selectivity.

3. Results

The protection upgrade and HV testing program delivered the following measurable outcomes:

Metric	Before	After	Improvement
Relay Nuisance Trips (annual)	8	2	-75%
Average Fault Clearance Time	420 ms	280 ms	-33%
System Availability	95%	99%	+4%

4. Discussion

The project highlighted the importance of rigorous relay coordination in industrial substations. By integrating Omicron-based testing and IEEE-compliant coordination studies, the substations achieved significant reliability improvements. Lessons learned were later applied in large-scale renewable integration projects in Chile (2018 IEC 61850 deployments) and utility-scale BESS commissioning in Australia (2023–2025), demonstrating international transfer of knowledge.

5. Conclusion

This case study demonstrates how structured HV relay testing and coordination improved Anglo American’s operational reliability. The work laid the foundation

for scalable protection strategies, bridging industrial applications with renewable and energy storage integration.

6. References

[1] IEEE Std C37.112-1996, Inverse-Time Characteristics for Overcurrent Relays.
[2] IEC 60255, Measuring Relays and Protection Equipment.
[3] Omicron Test Universe – Secondary Injection Testing Procedures, 2012.
[4] IEC 60947-2, Low-voltage Switchgear and Controlgear – Circuit-breakers.