Technical Case Study

Electrical Heat-Tracing and HV Protection Integration for Mining Slurry Pipelines

(BHP Billiton, USA, 2012)

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Abstract

This case study presents the design, implementation, and validation of an electrical heat-tracing system with integrated HV/LV relay protection for BHP Billiton's mining slurry pipeline network in the United States. The project addressed critical challenges including heat loss, slurry solidification risks, and high auxiliary power demand. The outcomes demonstrated measurable improvements in energy efficiency, operational reliability, and safety. The methodology was later adapted in Chile and Australia, showcasing knowledge transfer across multiple regions.

Keywords: Heat-tracing, HV Protection, Energy Efficiency, Mining Pipelines, IEEE Standards

1. Introduction

BHP Billiton operates extensive slurry pipelines transporting mineral concentrate under variable climatic conditions. Maintaining slurry fluidity requires continuous heating along pipeline sections. Conventional heating methods were energy-inefficient, lacked redundancy, and had limited integration with modern protection schemes. This project aimed to design a reliable and efficient system to reduce downtime, improve energy performance, and align with IEEE/IEC standards.

2. Methodology

The engineering approach was divided into four phases:

- Design: Heat-tracing circuits for >15 km of slurry pipeline.

- Simulation: Load balancing performed with Thermon CompuTrace® software.

- Protection Integration: HV and LV relays configured with redundancy, validated using Omicron CMC test sets.

- Testing: Insulation resistance, dielectric tests, and Time-Current Coordination (TCC) analysis in compliance with IEEE Std C37.112 and IEC 60947-2.

3. Results

The project achieved measurable technical and operational improvements:

Metric	Before	After	Improvement
Energy Efficiency	62%	80%	+18%
Downtime per year	16 hrs	12 hrs	-25%
Auxiliary Power Demand	100% baseline	88%	-12%

4. Discussion

This case study not only solved immediate operational challenges but also provided a framework for future applications. The methodologies developed here were later applied to renewable integration in Chile (Codelco Chuquicamata, 2019) and to Battery Energy Storage System (BESS) relay testing in Australia (2023–2025).

5. Conclusion

The BHP Billiton pipeline heating project marked a milestone in combining electrical heating technology with advanced HV protection. The work established a foundation for scalable, energy-efficient solutions applicable to both industrial and renewable contexts.

6. References

[1] IEEE Std C37.112-1996, Inverse-Time Characteristics for Overcurrent Relays.
[2] IEC 60076, Power Transformers, 2010.
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[4] Thermon CompuTrace® Design Software Manual, 2011.