

Wireless System for the Detection and Mitigation of Explosions in Tunnels

Shalva Marjanishvili, DSc

Technical Director

Hinman Consulting Engineers

San Francisco, CA 94104, USA

shalva@hce.com

Mikheil Chikhradze

G. Tsulukidze Mining Institute

7 E Mindeli St, Tbilisi, Georgia

chikhradzem@yahoo.com

1 Abstract

Physical security challenges from explosions are amplified in confined spaces. The air-blast shock waves reflect and propagate throughout the confined space. This paper describes the process of designing, constructing, and validating a wireless system for identification of explosions in real time. Protection of critical infrastructure requires the creation of a reliable system which provides quick and accurate identification of the hazards and subsequent transmission of the alarm signal to response and rescue services. The proposed wireless system consists of transmitter and receiver modules spaced throughout the tunnel. The transmitter module contains sensors and a microprocessor equipped with blast identification software. The receiver module produces an alarm signal and activation signal for the operation of protecting devices. The experimental validation has been carried out at the underground experimental base of G. Tsulukidze Mining Institute, Tbilisi, Georgia. The results of the testing validated the main characteristics of the system, notably:

- No false signals were generated during the series of 20 experiments
- After a blast event, the duration for analyzing the potential threat is 2.4 msec and the duration for activating the protection device is 11 msec
- The reliable transmission distance is 150 m (492 ft) in a straight tunnel and 50 m (164 ft) in a tunnel with a 90° bend.

Keywords: Explosion detection, Explosion mitigation, Tunnels, Signal transmitter, Signal receiver