FIRE LOCATION MODEL

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ABSTRACT

A fire location computational model was developed by the U.S. Bureau of Mines. The model can determine all the possible paths in a mine that smoke can travel from a fixed fire source to a smoke detector. The associated FORTRAN computer program can be utilized to determine the minimum travel time from a source fire to a smoke detector. The difference in travel time from an isolated fire source to two or more detectors can be used to isolate those airways in which the source fire is located.

INTRODUCTION

The early detection of a fire in a mine is necessary for the informed implementation of miner evacuation. The placement of smoke detectors throughout the mine network is the obvious strategy to follow. In general, several detectors will be installed. The inherent complexity of the mine network, in the case of a metal or nonmetal mine, can pose a formidable problem for the interpretation of the signals received by several smoke detectors located throughout the mine network. The smoke from a source fire will travel with the mine ventilation, and be diluted at airway junctions. The prediction of airway ventilation in a mine network with the airflow controlled by fans and natural ventilation is amenable to computer generated solutions both for the airflow quantity and the concentration of the products of combustion that emanate from a fire source.* If the mine ventilation is known, either measured or predicted with the mine ventilation computer program,* differences in arrival times of smoke from a source fire to several detectors can be used to isolate the location of the fire. As part of its research program to develop a mine fire detection strategy, the U.S. Bureau of Mines developed a FORTRAN computer program that can be used to determine the minimum travel time from a fire source to a smoke detector. This requires an enumeration by the program of all the possible paths available to the smoke. This approach, while a significant factor in the isolation of a mine fire location, is not without limitations. The total number of possible paths increases rapidly with an increase in the number of airways. The computations presented in this report are limited to paths that individually consist of at most nine airways. However, the structure of the program permits an extension of the model to paths that are defined by any finite number of airways provided adequate computer memory is available.

The model developed in this report has applications both in the planning for the location of detectors in a mine, and in the mine emergency stage. To determine the optimum location of fire detectors, the mine network can be divided into zones, each of which is associated with a difference in calculated smoke arrival time between a pair of detectors. For