Abstracts of Papers

EVOLVING A RATIONAL TRANSIT SAFETY PROGRAM

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The history of "fail-safe" and "brick-wall stop" design criteria is traced from the development of the track circuit in the latter part of the nineteenth century to its current application in modern transit systems. Fail-safe design in the railroad industry is essentially limited to the areas of signaling and switching, and even in such important areas high reliability but non-fail-safe components are used. The use of permissive block signaling and "keying through" tends to negate the fail-safe nature of the signaling system and place the ultimate responsibility for safety on the human operator. Other causes of rail accidents, such as derailment, platform design, and fires, do not seem to be protected against by fail-safe design. It is concluded that rail system design is based on concepts of risk management that have developed by trial and error. Fail-safe procedures represent only one way in which risks are controlled.

With this background, the system safety principles and procedures developed by the U.S. Department of Defense are discussed with regard to their applicability to transit. Possible difficulties include the cost of implementing large-scale system analysis techniques, such as fault-tree analysis, and the difficulty of obtaining reliable probability data for the various failure modes when completely new and unproven designs are considered.

Notwithstanding these difficulties, there does not seem to be any inherent conflict between Department of Defense procedures and traditional railroad practices. In fact, the former specifically recommend that historical safety data from similar applications be integrated into the safety plan and that fail-safe design procedures be used to control high-risk situations.

Two examples of how military risk management techniques can be combined with traditional rail practices are provided. The first is a preliminary hazard analysis, and the second shows how fault-tree techniques can be used to investigate whether a brick-wall stopping criterion is really necessary.

ANALYSIS OF MINIMUM SAFE HEADWAY FOR NO COLLISIONS

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The paper presents a set of expressions describing the effects of various system characteristics on minimum safe headway. None of the individual relations used in the paper are new to the transit literature; however, two of the concepts should be more heavily emphasized now that automatic transit systems carry an increasing number of passengers.

1. Minimum safe headway should be expressed in terms of the physical interrelations of all pertinent system characteristics, including wind and grade. Similarly, headway criteria should be chosen on the basis of control system capabilities and sufficient failure experience.
2. Differential velocity and differential emergency deceleration must be accounted for in minimum-safe-headway computations.

The work presented is not intended to be universally applicable and will doubtless be modified with the application of new safety assurance and control techniques. However, it does represent a rationale for expressing minimum safe headway in terms of specific hardware parameters and environmental conditions.