

RESEARCH NOTE

Mathematical analysis of the MPS MX missile system

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A model for the cost-optimization analysis of the multiple protective shelter (MPS) MX missile system is developed. Because many of the components of the system have never been built before and an enemy's capabilities are hard to predict, parametric analysis has been carried out to understand more about the system design.

Key words: mathematical models, missile systems, cost optimization, parametric analysis

Recently, the development of a new land-based intercontinental ballistic missile (ICBM) system that could survive nuclear attack has been investigated by the US.¹⁻⁴ This new missile system was to be called 'MX' for missile experimental. Since the MX system was proposed, several basing modes have been considered. Some of these systems include: deep underground basing, continuous airborne basing, mobile missile systems, launch and/or attack systems, small subsurface basing, surface ship basing, closely spaced basing and multiple protective shelter (MPS) basing. Of these options the MPS basing system has been seriously considered for possible future development. This paper analyses this MPS MX missile system mathematically. A model is developed which determines the cost-optimal design of the system under varying conditions. In light of the fact that many components of this system have never been built before and the enemy's capabilities are hard to predict, parametric analysis is carried out to understand more about the system design.

System description and problem definition

The MPS MX missile system has several major features: the missiles would be deployed in protective shelters, hard enough to protect them from attacks on adjacent shelters, the shelters would be spaced in a linear grid pattern and positioned to form the vertices of a hexagon (Figure 1). This hexagonal array is the pattern that would maximize land area, while maximizing the number of warheads that need to be expended to destroy the shelters. The shelters would be constructed together in connected groups called 'clusters'. Figure 2 shows two such clusters arranged linearly and each containing 27 shelters. Only one shelter chosen randomly within a cluster would house the actual missile, while the remaining shelters would house decoys, engineered to be undistinguishable from the actual MX missile.

As a further precaution to ensure that the likelihood of the actual missile remaining undetected, a specially designed transporter would shuttle the missiles and decoys periodically about the shelters within a cluster. The mobile transporter is an extremely large manned vehicle weighing approximately 20000 lb, and when fully loaded it would have weighed 7.5 million lb. The shelter within a cluster would be connected by heavy duty roads capable of supporting the weight of the transporter. Each cluster would have one outside transporter and one mobile maintenance facility for the exclusive use of that cluster. Physical means would be considered between clusters to ensure that additional missiles could not be brought into the cluster, primarily due to enemy considerations. Viewing posts would be installed on the shelters' radars for satellite observations. Hence, if the MX system were designed to be verifiable, it was thought that an opponent would be very likely to build an interceptable missile system.

The MX missile designed for the MPS system is the most accurate and powerful in use that the United States has ever built. The MX is a MIRV (Multiple Independently-targeted Reentry Vehicle) missile with a 70 separate 3000 lbm warhead each with plans to increase the warhead yield to 8 megaton each. The unclassified NATO Treaty specifies that 10 warheads are the maximum number of MIRV warheads a missile can carry.

The objective of the system is for the equivalent of approximately 1000 nuclear warheads to survive a hypothetical nuclear attack; it is the US Government's estimate that about 1000 warheads would be needed to destroy nuclear force capacity.^{5,6} Also it is assumed that a warhead strength of 2500 warheads would be assigned at the MX system.

The proposed MPS MX missile system would have been an extremely big job. The entire system was conservatively projected to cost approximately 240 billion (1980 dollars).

Misguided Expenditures An Analysis Of The Proposed Mx Missile System

David Gold, Christopher Paine, Gail Shields



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