AMERICAS COMMENTARY NUCLEAR

How to Increase Nuclear Crisis Stability

The US has a historic opportunity to enhance crisis stability by phasing out the aging land-based ICBMs.

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USS Maine test fires a Trident II ballistic missile. Photo: US Navy

Deterrence has been, and will remain, the cornerstone of US strategic nuclear policy, based on the ability to respond to any potential nuclear attack in a way that the costs will substantially exceed any gains an aggressor might hope to achieve.

The US must maintain nuclear forces capable of convincing any country contemplating an attack that there is no circumstance under which it could benefit by beginning a nuclear war at any level or duration.

Submarine-launched ballistic missiles (SLBMs) provide a unique foundation for enhancing crisis stability. Their invisibility and mobility make them ideal platforms for the strategic nuclear mission: invisibility translates into survivability and mobility into flexibility.

Because of their survivability, ballistic missile submarines are “decoupled” from an adversary’s offensive forces. The flexibility allows for effectiveness in scenarios ranging from nuclear war-fighting to assured destruction.

Phasing Out Land-Based ICBMs

The key problem during the Cold War was the instability induced by land-based intercontinental ballistic missiles. These nuclear-armed missiles could not survive a nuclear attack — even though attempts were made to ensure their survival by using hardened silos and moving command centers underground.

That meant that if the missiles were to be used, they would have to be launched on warning of an attack, before nuclear detonations actually occurred on American territory. When Navy SLBMs achieved the same or better accuracy than land-based missiles, their continued deployment became largely a matter of inter-service rivalry.

The US initiated the Ground-Based Strategic Deterrent program to begin replacing Minuteman III missiles in 2029. Replacing these missiles to maintain the land-based component of the triad would be a bad mistake since their continuation as part of the US nuclear deterrent would mean that we must continue to rely on a launch-on-warning strategic posture.

There are many things wrong with such a posture, including that the warning time for a submarine-launched ballistic missile attack may be as short as 5 to 10 minutes, forcing the president to pre-delegate authority to arm and launch silo-based forces or otherwise “wire in” the response to satellite and radar warning of an attack.

Pre-delegating authority to the military to launch nuclear forces is not unprecedented. It was done by

Presidents **Dwight D. Eisenhower** and **Lyndon Johnston**.

We now have a historic opportunity to enhance crisis stability by phasing out the aging land-based ICBMs. Eliminating the Minuteman III missiles also means they would no longer be targets, which would lead to widespread radiation from fallout over the Eastern US if attacked.

Unarmed Minuteman III intercontinental ballistic missile during an operational test in 2017 at Vandenberg Air Force Base, California. Image: US Air Force/Senior Airman Ian Dudley

Burst-Height Compensating Fuse

The US would continue to have a more than adequate capability with the ballistic missile submarines alone. The reason the US would not lose any capability as a result of eliminating the land-based Minuteman III and cancelling modernization plans is crucially dependent on what is known as the burst-height compensating fuse.

Although the accuracy of the Trident D5 submarine-launched ballistic missile is already superb, the deployment of this fuse has nonetheless had a revolutionary impact on the accuracy of its reentry vehicles, one that allows us to eliminate the dangerous launch-on-warning nuclear posture.

Consider the following: The circular error probable (CEP) of a missile is the radius of a circle around a target within which half of the warheads are expected to impact.

The cross-range CEP is unaffected by the reentry angle of the warhead into the atmosphere, but this is not true of the down-range error that increases with decreasing reentry angle.

The CEP is projected to an elliptical shape on the ground surrounding the target. The burst-height compensating fuse compensates for this elliptical shape so that the full accuracy of the missile becomes available (see more technical information in the addendum).

The down-range error becomes effectively the same as the cross-range error. This means the number of warheads assigned to a target to achieve a specified kill probability is dramatically reduced.

The burst-height compensating fuse has enormously increased the real accuracy of SLBMs beyond the CEP. Since 2009, this fuse has been incorporated into the Navy's W76-1/Mk4A (100-kT) warheads as part of a life-extension program. It is thought that all warheads deployed on US ballistic missile submarines now have this fuse. Also, SLBMs carried by submarines can each carry many more warheads than they currently do.

The US can safely eliminate the Minuteman III land-based nuclear force and not replace it without compromising US capability to destroy all current nuclear targets.

Doing so can significantly increase nuclear crisis stability, eliminate the grave fallout threat by an enemy attempt to preempt the launching of land-based missiles, and save money by doing so.

The Los Angeles-class attack submarine USS City of Corpus Christi (SSN 705). Photo: Mass Communication Specialist 2nd Class Chris Brown/US Navy

Addendum

A more detailed technical discussion of the burst height compensating fuse is given in the publicly available US patents Nos. 3,990,657 and 4,456,202 that date back to 1976 and 1984. The original assignees of these patents are The United States of America, represented by The Secretary of the Navy.

Here is a simplified description of how the fuse works: When launching a missile, one chooses a trajectory known as the Normal Trajectory that it should ideally follow. But velocity errors are unavoidably introduced during powered flight, which is one of the main reasons that different missile types have differing CEPs.

Just before the missile's reentry vehicle enters the sensible atmosphere, one can determine the position error at a given time T for each possible trajectory. Some of these trajectories will be lofted compared to the Normal Trajectory, and some will be depressed.

Because the same time interval T is measured along each trajectory, one can define the "ballistic error ellipse," the derivation of which is attributed R.H. Frick.

This ellipse is tilted in the downrange direction with respect to the Normal Trajectory, with the depressed trajectories closer to the target. Note that the CEP transverse to the Normal Trajectory is unchanged. It is just before reentry that the burst height is optimally set (to compensate for the downrange error) by the fuse after measuring its altitude.

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