Minuteman III Guidance and Propulsion Replacement Programs

The Minuteman III Intercontinental Ballistic Missile (ICBM) consists of three solid propellant stages (including rocket motors, inter-stage hardware, and ordnance), the liquid Propulsion System Rocket Engine, and the guidance set that can deliver up to three re-entry vehicles. Five hundred Minuteman III ICBMs are currently deployed at three operational bases.

The Guidance Replacement Program (GRP) is a set of hardware and software modifications designed to extend the service life of the Minuteman III while preserving its current capabilities. This program is needed to prevent a projected decline in reliability due to aging electronic components and unavailable replacement parts. GRP replaces the guidance computer, signal converters, and power distribution components while retaining the current Minuteman III inertial measurement unit.

The Propulsion Replacement Program (PRP) will extend the life of the Minuteman III operational force by replacing the solid propellant propulsion subsystems. In addition to hardware, PRP modifies two Minuteman III software elements: the Minuteman Operational Targeting Program and the Flight Program Constants Tape. These software modifications require use of the GRP-modified guidance system.

DOT&E conducted an independent assessment of the GRP program from 1996 through 1999. DOT&E determined that the GRP upgrades were operationally effective and suitable.

TEST & EVALUATION ACTIVITY

All programmed operational test activities have been completed for GRP and PRP. Both programs are currently in full-rate production.

TEST & EVALUATION ASSESSMENT

DOT&E found both GRP and PRP to be operationally effective and suitable even though accuracy performance, which is primarily attributed to the guidance system modified by GRP, fell slightly short of the operational requirement. DOT&E determined that the shortfall in accuracy is offset by the overall improvement in weapon system reliability, which makes the Minuteman III weapon system more operationally effective than Minuteman III with the current guidance and propulsion systems.

After seven flight tests with the modified guidance system, the Air Force found that accuracy results were not in agreement with expectations. Accordingly, the Air Force conducted a supplemental accuracy investigation that identified two primary sources of error in the guidance system software. One source was erroneous implementation of computational precision. In some navigation calculations, truncation was implemented where round-off was intended. In some guidance calculations, better approximations were needed to maintain adequate precision. The other primary error source was a small, undesired residual velocity bias introduced into the calculations that govern the attitude of the re-entry vehicles at deployment. The factors leading to the bias have a

The Minuteman III weapon system enhanced by GRP and PRP is more operationally effective than Minuteman III with the current guidance and propulsion systems.

complex dependence on the azimuth and trajectory. For test-flight missions from Vandenberg Air Force Base, California, to Kwajalein, the errors reinforce one another. In other trajectories, the errors might increase dispersion but not contribute significantly to the weapon delivery error. Operational trajectories would still have been less than optimum if this situation had not been discovered, so it is fortunate that the Westerly test trajectory highlighted the problem.

The Air Force initiated corrective actions though an Accuracy Upgrade Program (AUP). To date, the Air Force has conducted a total of four NS-50 flights with the AUP corrections, two in each of FY02 and FY03. The downrange biases observed previous to the AUP modifications appear to have been corrected. Additional NS-50 flights will be conducted in accordance with the FDE program. DOT&E will continue to monitor the results of this program.