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Report to the Chairman, House Armed
Services Committee and the Chairman,
Senate Armed Services Committee

August 1989

BIGEYE BOMB

Evaluation of Operational Tests



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**Program Evaluation and
Methodology Division**

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August 30, 1989

The Honorable Sam Nunn
Chairman, Committee on Armed Services
United States Senate

The Honorable Les Aspin
Chairman, Committee on Armed Services
House of Representatives

This letter report is an unclassified summary of our classified report (GAO/C-PEMD-89-2) that analyzes the operational testing of the Bigeye bomb and related developmental issues as required by the National Defense Authorization Act for fiscal year 1987. The classified report contains nine appendixes consisting of extensive information and analysis, much of which cannot be discussed in this unclassified version.

The Bigeye bomb is a 500-pound air-delivered binary chemical weapon that generates a persistent nerve agent (VX) from two nontoxic chemicals that mix together inside the bomb following release from an aircraft.¹ It is intended as a safer replacement for older unitary chemical weapons.

As part of our analysis, GAO personnel monitored the operational tests of the Bigeye weapon that were carried out during 1987 by the U.S. Air Force and Navy at Dugway Proving Ground (Utah). Our report also analyzes other data relevant to the Bigeye test program, including the June 1988 Navy-Air Force joint service report on the Bigeye operational test results and the August 30, 1988, interim report on the tests by the Department of Defense (DOD) office of Director, Operational Test and Evaluation.²

The joint service report, issued by the Navy's Operational Test and Evaluation Force, concluded that while the Bigeye bomb had met the criterion for agent deposition density, it had failed to meet the two other key operational criteria: accuracy and overall reliability. The Navy's test

¹VX is O,S ethyl diisopropylaminoethyl methyl phosphonothioate.

²The joint service report was issued by Operational Test and Evaluation Force and is entitled "Multiservice Operational Evaluation of the Bigeye BLU-80/B Weapon," Pub. No. 3960-12 (Norfolk, Virginia: June 24, 1988). The DOD interim report is a letter from the Director, Operational Test and Evaluation, to the chairmen of the House and Senate Armed Services and Appropriations Committees, dated August 30, 1988.

force stated that the Bigeye bomb should not undergo further operational tests until certain critical developmental issues are resolved, including determining the VX purity that results from binary reactions with initial (start) temperatures in the 140-160°F range. In addition, the test force stated that before any production decision is made, the bomb should be subjected to additional operational tests. We concur with these recommendations, which are similar to ours in earlier reports, as well as with other test force recommendations.³

In its report, DOD's office of Operational Test and Evaluation concluded that while the bomb "has demonstrated the potential to be operationally effective and suitable," it is not ready for full-rate production. The test and evaluation office also noted further Bigeye issues that remain unanswered and that require further testing. These include the fact that the bombs tested were "pre-production prototype models, not fully representative of the factory-built . . . weapon," and that a "measurable criterion for mission success (end-to-end) will be needed in order to establish the likelihood of completing a mission successfully and effectively."

DOD Request for Review of Bigeye Issues by Independent Panel

In response to a September 1988 request from the DOD Inspector General, we asked a panel of four experts to help resolve the issues outstanding between DOD and us—which are discussed both in this report and in the classified version—concerning the test and evaluation of the Bigeye bomb. The experts were Dr. John Hearne, Vice President, Resources for the Future; Dr. John Gibbons, Director, Office of Technology Assessment, U.S. Congress; Dr. Joseph Navarro, former DOD Deputy Undersecretary (Test and Evaluation) in the office of the Undersecretary of Defense, Research and Engineering; and Admiral Ernest R. Seymour (ret.), former commander of Navy Air Systems. We delayed this report so that the Congress could have the benefit of the panel's judgment, along with our own findings.

The panelists examined both operational and developmental issues affecting the Bigeye. In addition to reading our reports on Bigeye issues, the panel was briefed by DOD on January 30, 1989, with regard to DOD's response to the draft of our report on Bigeye developmental

³See *Bigeye Bomb: An Evaluation of DOD's Chemical and Developmental Tests*, C-GAO/PEMD-86-1BR (May 1986), *Bigeye Bomb: 1988 Status Report*, GAO/PEMD-88-26 (May 1988), *Bigeye Bomb: Unresolved Developmental Issues*, GAO/C-PEMD-89-1 (July 1989), and an unclassified version of the latter, *Bigeye Bomb: Unresolved Developmental Issues*, GAO/PEMD-89-27 (August 1989).

issues (GAO/C-PEMD-89-1) and subsequently reported their findings and conclusions to the Comptroller General.⁴

The panel's findings were summarized in a March 30, 1989, memorandum that was sent from the Comptroller General to the Secretary of Defense.⁵ The panelists concluded that we were correct in our evaluation that major operational and developmental issues affecting the Bigeye bomb remain unresolved and that further tests in both areas are therefore required to answer questions that critically affect the bomb's performance.

The panelists stated that DOD had not adequately formulated measures of effectiveness for the Bigeye and had not related developmental findings to operational use of the weapon. They also found that DOD's plans to conduct more operational tests without resolving developmental issues were highly questionable.

Navy Test Force Findings and Recommendations

The Navy's test force found that the Bigeye had failed to meet the operational test criteria for both accuracy and system reliability and formally recommended that the following (and other) changes be made before further operational tests are conducted:

- improve weapon reliability;
- add information to the computer weaponing program to include important missing data;
- conduct agent purity tests with start temperatures in the 140-160°F range;
- increase the maximum speed at which aircraft can deliver the weapon.

The test force recommendations were based in part on problems with the Bigeye that involve developmental issues that we had cited as potentially troublesome in our previous reports on the

⁴The previous Bigeye reports read by the panelists included Bigeye Bomb: An Evaluation of DOD's Chemical and Developmental Tests, GAO/C-PEMD-86-1BR (May 1986), and Bigeye Bomb: 1988 Status Report, GAO/PEMD-88-26 (May 1988).

⁵Letter from GAO Comptroller General to Secretary of Defense Richard B. Cheney, dated March 31, 1989.

bomb.⁶ In particular, the binary reaction inside the Bigeye bomb generates tremendous heat that can rapidly degrade VX that is the product of the reaction.

In addition, the test force stated that the F-111's computer cannot calculate weapon release points quickly enough, with the result that it tends to bunch the weapons "unpredictably." Moreover, "solutions to these computed delivery mode limitations are not envisioned." (See appendix VI of the classified version of this report.)

Air Force Recommendations

In an annex to the test force report, the Air Force stated that the current maximum delivery speed of the F-111 aircraft used for Bigeye deliveries was too slow for effective aircraft operation and therefore recommended that consideration be given to increasing the maximum delivery speed. However, increasing delivery speed will likely increase aerothermal heating, thereby increasing the start temperature of the VX binary-mixing reaction. The higher this start temperature, the more likely that VX will degrade rapidly, apparently due to heat and the by-products that are created in binary reactions.

GAO Findings and Concerns

In analyzing the results from the Bigeye 1987 operational tests, the June 1988 Navy test force report, and other relevant data, we came to some conclusions that were similar to those in the test force and office of Operational Test and Evaluation reports. We agree with the test force that the weapon failed to meet both the test plan accuracy and reliability requirements and concur with the test force recommendation that no further operational tests should be conducted until certain key developmental issues are resolved. (See appendix VI of the classified version of this report.)

However, our estimate of the Bigeye weapon reliability achieved in the operational tests is considerably lower than DOD's. The DOD estimate does not take into account whether the VX that is generated met the requirement for agent purity or equivalent biotoxicity specified by the Bigeye test plan.⁷ In contrast, we measured VX generation by examining

⁶Bigeye Bomb: An Evaluation of DOD's Chemical and Developmental Tests, GAO/C-PEMD-86-1BR (May 1986), Bigeye Bomb: 1988 Status Report, GAO/PEMD-88-26 (May 1988), Bigeye Bomb: Unresolved Developmental Issues, GAO/C-PEMD-89-1 (July 1989), and an unclassified version of the latter, Bigeye Bomb: Unresolved Developmental Issues, GAO/PEMD-89-27 (August 1989).

⁷Biotoxicity is a surrogate measure of agent purity.

laboratory test results against the test plan requirement. We found that the rate of success in generating VX at the purity level required by the test plan was considerably lower than DOD had estimated using a method that was not based on laboratory results. Our lower estimate for lethal agent generation—a major component of system reliability in our view—produced, in turn, an overall weapon reliability estimate that was also much lower than DOD's.

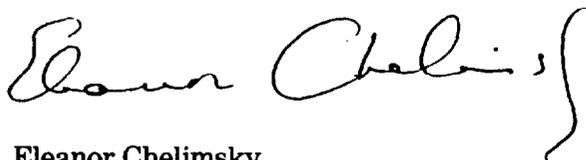
We also believe that DOD's measures of the weapon's operational effectiveness could be made more precise and realistic, as follows:

- DOD's measure of accuracy—which we evaluated as not very operationally meaningful—could be made more operationally meaningful by assessing whether agent simulant hit the hypothetical targets designated in the test plan for each test run. The amount of the target area covered should also be measured. (See appendixes V and VII of the classified report.)
- The criterion for determining whether sufficient simulant is deposited on the ground targets should be related to likely operational scenarios. The criterion for deposition density used in the first round of Bigeye operational tests, held in 1985 and 1986, was considerably higher than the level used in the 1987 operational tests. We believe that the 1985-86 level was more operationally realistic, based on information from DOD's chemical munitions manual and from tests conducted by the Army's Chemical Research Development and Engineering Center. (See appendix V of the classified report.)
- Future Bigeye tests should maximize the number of test runs and data that can be used for evaluating the weapon's performance. The Navy test force was able to use results from only 18 of 57 bombs (released in 15 test runs) to evaluate accuracy and dispersion. This meant that the results from many of the tests produced little or no usable data appropriate for determining accuracy or simulant dispersion.

Given the concerns that both the test force and office of Operational Test and Evaluation reports raise about the operational testing of the Bigeye bomb, as well as the additional problems we found, we concur with the test force recommendations cited earlier. We also agree with the requirement in the fiscal year 1989 defense authorization for Bigeye that bars the use of funds for low-rate initial production of the bomb until another round of operational tests is conducted in 1990. The bill also requires GAO certification of the test results and mandates certain standards for the new test plan and analysis of the test results, such as clear definitions of success, failure, and "no-test."

We sent a draft of the classified version of this report to the Department of Defense for their comments. In commenting on 20 findings in the classified report, DOD concurred with us on 4, partially concurred on 9, and entirely disagreed on 7. However, after careful review of DOD's comments and the relevant evidence, and after reconsidering the findings of the expert panel, we are confident that our concerns are well-founded. (DOD's comments and our response to them can be found in appendix IX of the classified report.)

Copies of this report will be sent to the Secretary of Defense and interested Members of Congress. If you have any questions, please call me or Carl E. Wisler, Director for Planning and Reporting, on (202) 275-1854. Major contributors to this report are listed in appendix I.



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