nerve agent's persistence. Several prominent chemists, including Tetsuo Fukuto, chairman of the entomology department at the University of California at Riverside, told GAO that such tests were needed. Finally, the report notes that overall bomb toxicity is determined by a complex relationship between its temperature at release and the length of time it takes to reach its target. Yet no temperature sensors have been incorporated in the bomb and scant information exists about the temperature effects of various flight profiles. "How does the pilot know when to drop the bomb?" the GAO asks. It calls this an intractable problem.

A second major theme of the report is simply that what few data exist are unclear. In particular, the GAO states, test criteria have frequently been relaxed and different results have been presented to different audiences. "Because of vague or nonexistent criteria, tests could, and were, added to and dropped from reporting of results, at the discretion of the reporter. Tests were moved from failure to success categories without explanation." Data on Bigeye reliability have been especially pliable, the report indicates, and last December, a senior program official acknowledged that they lacked statistical significance.

Chelimsky of GAO describes the Bigeye as "one of the worst" weapons research endeavors she has ever seen.

Chelimsky, a former Mitre Corporation analyst who describes the Bigeye as "one of the worst" weapons research endeavors she has ever seen, says that "most troubling of all, perhaps, with regard to the design and to the overall credibility of DOD's testing of the Bigeye, is the way in which important evaluation questions are posed at the start of a test, fail to be answered or are answered inconclusively, and then disappear from serious consideration." Even when components were redesigned, in many instances they were not retested, she adds.

Thomas Welch, the principal official in charge of the chemical weapons program, was out of town and unavailable for comment as *Science* went to press, but a special assistant in his office, Colonel Hugh Stringer, provided responses to some of the questions raised by GAO. Despite the use of venting during Bigeye pressure tests, he says, "we know what the pressure curve looks like at the worst case, and it is . . . out of the realm of interest." He calculates that the bomb would have to remain in free-flight for 5 minutes before an explosion could occur, whereas its expected free-flight time is roughly 30 seconds, a point that GAO disputes. He acknowledges that some uncertainties exist about the toxicity of the bomb in operational use, but notes that its lethality is so great that even an agent with low potency will be strong enough to meet the military requirement.

Flashing, he says, is a well-known phenomenon, whose "likelihood is virtually nil. This is a case where [the GAO has] asked virtually every question that can be asked, whether or not the answer is important." No studies have been performed of the binary nerve agent particle size and degradation rates, he acknowledges, although some may be conducted in the future. "When you've worked with a weapon as long as we have, you get to the point where you can exercise a degree of intuition about how it behaves," he says. The changes in the test protocols are routine, he adds.

At present, he says, "we have not achieved the level of system reliability that we would like to have on the Bigeye, but we are on a growth curve that indicates it will be achieved by the end of the operational testing. . . . I don't doubt that we can come up with a better bomb than Bigeye, if we spend enough time and money. We are, for example, looking at bombs that are terminally guided. But right now, we have extremely limited long-range capabilities, principally spray tanks and old iron bombs that contain nonpersistent nerve agent. The real deciding factor is: Does the Bigeye give you an operational effectiveness today that makes it worth the cost? We think it does."

Representative Fascell disagrees, of course. "Let's not spend millions of dollars on a fatally flawed weapon for use by our soldiers on the front line," he says. As if this were not enough, GAO is presently putting the final touches on another report for his committee, to be released next month, that points out numerous problems in the defensive component of the Pentagon's chemical weapon program. These include an anticipated shortfall in personnel trained and equipped to operate in a chemical environment, poor planning for medical treatment of chemical warfare victims, scant progress in the development of protective equipment, and highly unrealistic training exercises.

The report is expected to suggest that senior defense policy-makers devote additional time and effort to the defensive program. Altogether, the defensive and offensive chemical initiatives are expected to cost $15 billion to $25 billion over the next 10 years. ■ R. JEFFREY SMITH

Briefing:

OMB Floats New Indirect Cost Plan

The Office of Management and Budget (OMB) has withdrawn its controversial proposal to cut the overhead costs that are paid to universities for administering federal research grants and contracts. Instead, it has come up with a new plan that university officials apparently find equally unpalatable.

The new plan would make a big cut in a narrow area of indirect costs—reimbursement for the the time that department heads and faculty members spend on general administrative duties associated with federally sponsored research, such as service on some faculty committees. The proposal would cut payment for these activities by almost half, saving more than $100 million a year, according to OMB. In return, faculty members would no longer be required to fill out odious "effort reports," documenting how they divide their time between research, teaching, administration, and other duties.

Under the proposal, all universities would be paid an amount equal to 3% of the direct costs of a research project to cover a portion of the salaries of faculty members attributable to general research administration. Currently, the national average is between 5.5% and 6.0% of direct costs. (Salaries associated with the conduct of a particular research project are included in the direct costs of the project and are not affected by the proposal.)

The new proposal does not affect payment for overhead costs such as heating, lighting, depreciation of buildings, and part of the salaries of most nonfaculty administrators. These will be negotiated by individual universities in the same Byzantine manner as before.

The proposal was announced in a curious document released to reporters on 2 June, which outlined the highlights of the new rules. Details were supposed to be published in the *Federal Register* within a few days but had not appeared by 6 June. However, a draft of the final document was quickly circulating around Washington.

The original OMB proposal, which was put forward on 12 February and was initially scheduled to take effect on 1 April, would have capped payments for all administrative overheads—including salaries of nonfaculty members—at 26% of direct costs in fiscal year 1986. The ceiling would drop to 20% in FY 1987. Universities complained that the rules were being changed without consultation, and argued that a fixed national limit discriminates against universities

whose costs are not paid in part by state governments.

OMB claims that its new proposal is more egalitarian because there is less variation among universities in the overhead they claim for faculty salaries. It also says there have been extensive negotiations with the universities since the original rules were proposed, and argues that the new proposal is a compromise based on these talks.

University groups are not happy, however. According to Carol Scheman of the Association of American Universities, which represents the presidents of some 50 leading research universities, the new proposal was never part of the negotiations. She says the cost of the proposal will be substantially more than the $100 million claimed by OMB.

The new rules are scheduled to take effect on 1 July 1987, although there is a provision that would allow individual agencies to implement them sooner if they elect to. They would apply only to new grants. ■

COLIN NORMAN

GAO Backs Decision to Conduct X-ray Laser Test

A new report by the General Accounting Office (GAO) confirms a series of reports last fall that equipment problems have hampered tests of the x-ray laser, an important element of the ongoing "Star Wars" missile defense research program. But the report, prepared at the request of the House Armed Services Committee, diminishes the seriousness of the problems and says that scientists working on the laser were justified in conducting a controversial recent x-ray laser test.

The test, conducted at the U.S. underground nuclear test site in Nevada on 28 December with an estimated cost of $30 million to $50 million, was sharply criticized by more than 30 congressmen who claimed that the equipment problems would render it useless. Press reports indicated that some of the scientists associated with the program shared this view. Subsequently, GAO investigators visited Lawrence Livermore National Laboratory, where most of the x-ray laser work is conducted, and conferred with officials at the Los Alamos and Sandia national laboratories, the Strategic Defense Initiative Office, and the Department of Energy (DOE) headquarters in Washington. They also contacted members of JASON, a group of independent physicists who regularly advise the Pentagon on nuclear matters.

In the end, they concluded that "in our opinion, there was no need to delay the latest x-ray laser nuclear test." It is true, they added in the report on 2 June, that in several past tests, problems with diagnostic equipment were serious enough to generate false impressions of the laser's performance. "Absolute power calculation inaccuracies occurred," the GAO said, as critics alleged. But some of the equipment was "reconfigured," and "these unexpected measurement uncertainties are now much better understood."

Necessarily, the GAO report is vague about the exact nature of the diagnostic difficulties, as well as the present status of the highly classified x-ray laser program. "Essentially, we found . . . a research program with many unresolved issues," it said. But it does provide some previously undisclosed information about the manner in which the performance of the laser is assessed, and about the views of independent scientists familiar with the program.

Specifically, the report says, Livermore scientists look at five laser beam properties: time of onset, total power, color, divergence, and duration. "The measurement of these properties is a difficult task because of the nuclear environment and the high intensity, short time scale of the lasing process," the accounting office was told by DOE.

The measurements are made by a variety of high-resolution spectrometers and imaging instruments, which record such things as the temporal shape of the laser beam and "detailed atomic physics of laser materials." A difficulty is created by the fact that "the high-intensity laser pulse interacts strongly with the measuring device[s] during the time of observation," DOE said. (Specifically, oxygen impurities in the experimental apparatus lased at the same frequency as the bomb-generated weapon, sources say.)

Despite the uncertainties created by this phenomenon, all of the program's official reviewers agree "that x-ray lasing has been demonstrated," DOE added. "We know of no example where a major scientific concern was not fully considered prior to the planning or execution of an underground test or major experiment." GAO said that while their review did not cover every test, "we have no knowledge about the program that would cause us to question the accuracy of DOE's response." Some participants in the program, as well as outside peer reviewers, had offered "constructive criticism," the GAO said, and "identified problems or issues which must be addressed." But DOE has taken their advice and "overall [these] individuals generally support the current . . . program."

Finally, the GAO report notes that funding for the x-ray laser research effort has increased dramatically in the past year (*Science*, 11 April, p. 152), and reports DOE's latest justification: a need to assess the threat that such lasers might pose to space-based missile defenses "at the earliest possible date." Representative Edward Markey (D–MA), one of the program's chief critics, says that he is unhappy about the ambiguity of some of DOE's unclassified statements, but that he is now satisfied that the decision to go ahead with the December test was a legitimate scientific "judgment call." ■

R. JEFFREY SMITH

EPA Reduces Penalty Against Biotech Firm

The Environmental Protection Agency on 6 June reduced the penalty imposed on a California biotechnology company for conducting an unauthorized experiment outdoors with altered microbes designed to inhibit frost formation on plants. The agency also dropped a charge that the company had "falsified" experimental data and instead faulted the company for "inadequate reporting."

The company, Advanced Genetic Sciences in Oakland, got itself into hot water when EPA discovered in February that it had conducted an outdoor experiment with the microbes without federal approval. And, according to EPA, the company led the agency to believe that the tests had been performed in a greenhouse, which prompted the agency to charge it with falsifying data.

In the unauthorized experiment, the company injected the modified bacteria into trees on the firm's rooftop to test their potential plant pathogenicity. The company did the experiment in applying for an EPA permit to conduct a small-scale field test of the bacteria.

EPA originally proposed to fine the company a maximum penalty of $20,000, but has cut it to $13,000. The reduction of penalties is common after negotiations with a violator, according to John Neylan, director of EPA's office of compliance, which is part of the office of pesticides and toxic substances. The company did not think the test constituted a deliberate release experiment, he said in an interview. "We felt that in reviewing matters, the company didn't knowingly falsify data. It was inadvertent. That's a judgment call." He added, "We felt there was a good faith effort that the company was acting decently in trying to correct problems." The company plans to reapply to conduct the field test. ■ MARJORIE SUN