President Bush's plan for a national missile defense system will face a big test in the next few weeks as Congress debates its $8.3 billion budget; after that comes the technical testing

Testing Time for Missile Defense

Delta Junction, a remote crossroads in eastern Alaska, seems an unlikely place to tackle one of the nation's most ambitious—and costly—technological challenges. But last month, when the Pentagon signed a $9 million contract for road construction to improve access to five planned missile silos in nearby Fort Greely, this economically tenuous outpost moved to the center of the expanding debate over the National Missile Defense (NMD) program.

The silos will house ground-based missiles that someday might shoot "kill vehicles" at incoming warheads a few minutes before they would strike North America. For now, military planners describe the base as an expansion of a "test-bed" for the land-based phase of the experimental program, which extends for thousands of kilometers from Alaska to the Marshall Islands in the western Pacific. It's only one of several new components that must be tested individually and then integrated into a comprehensive "battle management system." By the Pentagon's own estimate, each major test will cost about $100 million—and 100 tests will be needed for the components, one former Pentagon expert calculates. Years from now, testing of the integrated "system of systems" can begin.

The NMD debate, already loud and partisan, is likely to heat up this month as Congress returns from an August recess and examines the Administration's request for $8.3 billion in 2002, a 57% increase over the current year. Issues range from the accuracy of cost estimates to the system's affordability to its impact on the 1972 Anti-Ballistic Missile (ABM) treaty. But in their rush to score political points, politicians on both sides have paid scant attention so far to the credibility of the research program itself, including its numerous undefined components and the accelerated timetables that the military has set for developing them. The plan's increased emphasis on R&D is welcome, comments George Lewis, a physicist and weapon expert at the Massachusetts Institute of Technology (MIT). But he is skeptical of the Department of Defense's (DOD's) promise to be ready for an "emergency" deployment of the first elements of the system in 3 years. "Basically, they're saying, 'We don't know what we're going to deploy,' " but it will be developed faster than before.

The new R&D plan is beginning to draw criticism for another reason: It proposes a "layered" defense whose cost and technical capabilities are even less defined than the R&D plan (see diagram on p. 1751). Although less sweeping than former President Ronald Reagan's "Star Wars" program, it would nevertheless be a formidable undertaking. In addition to land-based missile interceptors in Alaska and a string of radar bases, this new vision includes an airborne laser carried aboard a 747-style jet, two types of interceptor rockets for deployment at sea, a space-based laser, and a concept for a space-based "kinetic kill" device that, like the ground-based interceptors, will be designed to smash warheads with brute force. Along with rockets and lasers, the Defense Department budget includes a backlog of related items, including essential tracking satellites and medium-range antimissile systems to protect troops and battle areas. Some elements are ambiguous. For example, according to a strategy outlined by President George W. Bush in May and further described by DOD officials in July, Fort Greely might switch from a research project to an operational base as early as 2004.

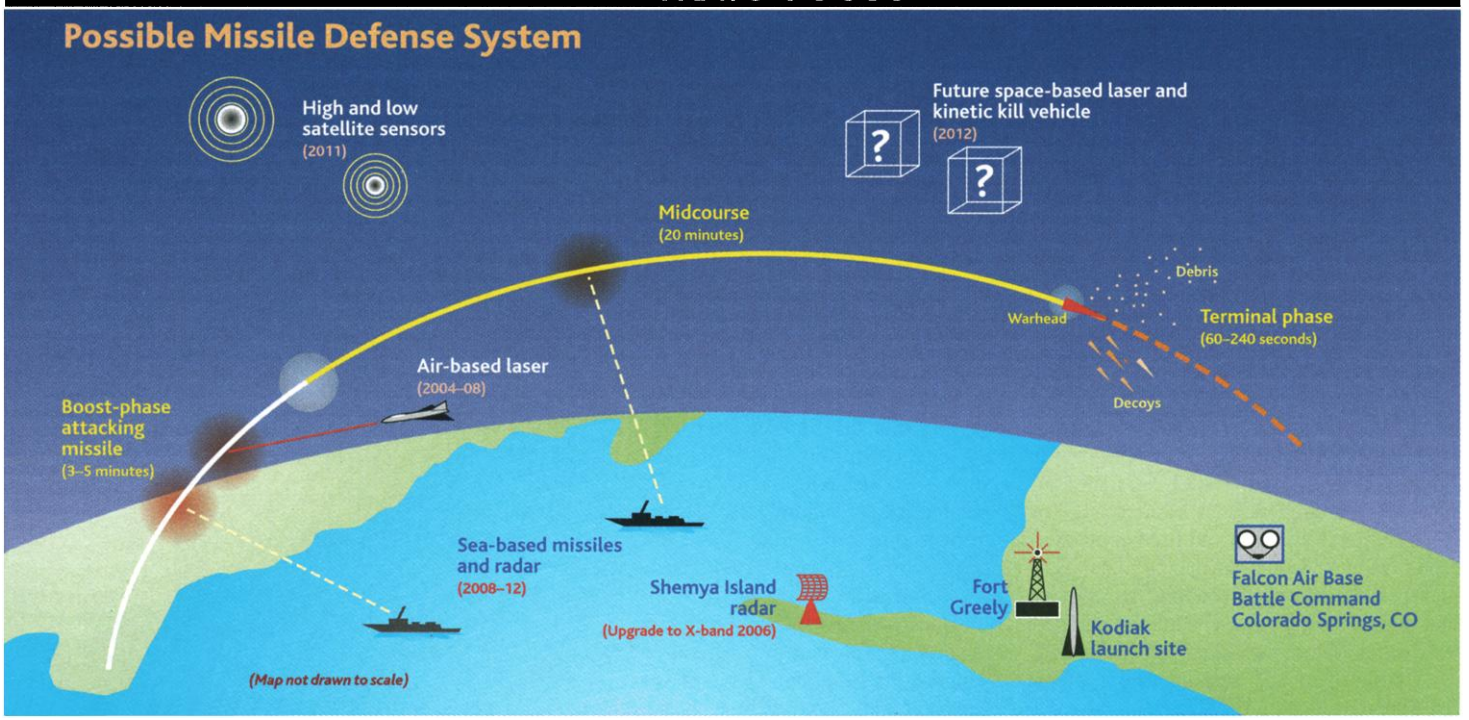
Critics like David Wright, an MIT physicist and member of the Union of Concerned Scientists in Cambridge, Massachusetts, say this ambiguity is unacceptable. Fort Greely, Wright points out, will not be used for testing, because launches from this inland site would go over populated areas. Missiles will be launched from an existing commercial site 800 kilometers away on the coast at Kodiak. This means, according to Wright, that Fort Greely would be a command center, not a test site. The Administration, he argues, is trying to start deployment now in "an end run around congressional oversight." That's where many critics want to begin the debate this fall.

Moving targets. The Pentagon seeks funding to beef up radars and expand the current Vandenberg-Kwajalein test axis to include missiles launched from Kodiak, Alaska.

ILLUSTRATION: A. STONEBRAKER

Knocking the treaty

The government hopes to clear land around Fort Greely before the winter, so that construction can begin in April. This modest activity is one of several planned for



Growth potential. The ultimate goal is a decade-long plan to build air- and space-based lasers as well as sea-based kill vehicles.

2002 that could cause the testing plan to "bump up against" the ABM treaty's restrictions on new defensive missile systems, DOD officials acknowledge. Russian President Vladimir Putin has argued that changes in the treaty should be linked to nuclear stockpile issues. But President Bush told reporters in Texas last month that "we will withdraw from the ABM treaty on our timetable at a time convenient to America." This troubles the new Democratic majority in the Senate. Senate appropriations committee chair Robert Byrd (D–WV) has said that he doesn't have "a modicum of confidence [in the] scientific effectiveness" of NMD and that "it is very unwise for Congress to lend its support." The heads of the Senate Armed Services and Foreign Relations Committees are also wary of dumping the ABM treaty.

Even if diplomats manage to paper over these contentious issues, the Pentagon is still left with the overwhelming challenge of shaping a basket of technology programs into a coherent testing program that will deliver an antimissile system. The Bush Administration has moved systems deemed to be "operational"—mainly short-range defensive weapons—out of the Ballistic Missile Defense Organization (BMDO), which is responsible for NMD and which reports directly to Defense Secretary Donald Rumsfeld. Instead, the office will focus on research and development, with reviews by the Defense Acquisition Board leading to annual stop-or-go decisions on each program. However, BMDO has not defined its tasks beyond 2002.

ILLUSTRATION: A. STONEBRAKER

Addressing the Senate Armed Services Committee on 12 July, DOD deputy secretary Paul Wolfowitz explained why BMDO's plan seems imprecise—or "murky," as *Aviation Week* called it. "We have not yet chosen a systems architecture to deploy," Wolfowitz said, "because so many promising technologies were not pursued in the past." He blamed the ABM treaty for preventing research on "air-, sea-, and space-based capabilities with enormous potential."

That explanation didn't go over too well with Senate Democrats. In a 24 July hearing, Senate Foreign Relations Committee chair Joseph Biden (D–DE) wisecracked that DOD's promise to answer questions about the system was "like the song from *West Side Story*—'Sometime, somewhere, somehow!'"

DOD officials have tried to reassure skeptics by stating what the program will *not* do. "It does not commit to a procurement program for a full, layered defense," says BMDO's director, Lt. Gen. Ronald Kadish. "It is not a rush to deploy untested systems; it is not a step back to an unfocused research program; and it is not a minor change to our previous program." He explained that the Pentagon wants to "explore multiple development paths." But Wolfowitz argued that despite the uncertainty, "missile defense is no longer a problem of invention, it is a challenge of engineering."

Hit or miss

DOD's engineering prowess will be challenged immediately by the need for a new testing agenda. Philip Coyle, former director of defense operational testing and evaluation for the Clinton Administration, who is now at the Center for Defense Information in Washington, D.C., says that one pressing need is to make antimissile tests more "realistic" and unclog the schedule. He told the Senate Armed Services Committee in July that "important parts of the program have slipped a year and a half" since 1999, and a reorganization ordered by Rumsfeld has added another 6-month delay. Environmental groups may cause another problem: Last week, the Natural Resources Defense Council and others filed suit in Washington, D.C., seeking to stop work at Fort Greely until DOD prepares a new environmental impact statement.

BMDO spokesperson Lt. Col. Richard Lehner says a revision of the master testing plan will be completed "in the fall." Lehner has said that although DOD is preparing an environmental impact statement for the launch site at Kodiak, there's no need to rewrite an earlier one for missile silos at Fort Greely. He predicted that BMDO will be able to accelerate its schedule for the ground-based interceptor because "we're getting a better handle on the producibility of the different components."

The rockets to be housed at Greely will be part of BMDO's main testing program, which since 1998 has focused on stopping an incoming warhead toward the end of the "midcourse" segment of a 20-minute ballistic missile flight. The goal, Lehner says, is to be able to block a "fairly rudimentary threat" from a so-called rogue nation. That emphasis is reflected in the NMD's budget request, which seeks a $1.2 billion increase

in 2002 that would bring spending on midcourse programs to $3.9 billion. The amount includes $3.3 billion for continued development of a ground-based interceptor missile and $656 million for conceptual studies of a new sea-based system. The budget proposal also includes roughly $500 million for sensors, $700 million for projects aimed at the early or "boost" phase of a hostile missile, and $1 billion for medium-range weapons aimed at the final seconds before impact or "terminal phase."

Most BMDO funding for a national system, $5.6 billion since 1998, has been spent on this ground-based, midcourse interceptor. There have been four experimental ground-based intercept tests in which simulated attacks were launched from Vandenberg Air Force Base in California and fired at by interceptors launched from Kwajalein in the Marshall Islands. Two produced hits, the most recent on 14 July. But the schedule has slipped, and even the successes have been questioned.

A critic of midcourse interceptors, physicist Theodore Postol of MIT, claims that the July test revealed how difficult it will be to track enemy warheads in space. High-resolution X-band radar at Kwajalein that followed the simulated attack "froze" about 64 seconds before the interceptor successfully struck its target. DOD officials initially believed the problem was data overload but later described it as a software glitch. Postol fears, however, that data processing problems will continue to plague the system, because it must analyze huge quantities of information in seconds as it seeks the real target amid a spray of debris and decoys. Even crude enemy systems, he says, can present tremendous challenges in image discrimination—for example, if tumbling warheads create electronic images that look like debris or stars.

Richard Garwin, an IBM physicist and former weapons designer, agrees that decoys and other "countermeasures" designed to trick defensive systems are "the big problem with midcourse intercept." He and Postol have advocated instead that DOD beef up R&D for attacking targets in the slow, bright boost phase. DOD's new NMD budget plan does include several boost-phase projects. But Garwin sees most of this money going to unpromising "programs that already existed," like the airborne laser, slated for $410 million. "I doubt that such a vulnerable aircraft can be maintained on station" long enough to overcome a potential threat, he says. He prefers a land-based or sea-based approach.

Because boost-phase defensive systems seem destined for more support, the American Physical Society is taking a closer look. It has impaneled a 13-member group to examine key physics issues, such as the "technical challenges involved in using airborne lasers," and the speed and size of kinetic kill vehicles required to stop a missile on ascent. The panel, headed by physicists Daniel Kleppner of MIT and Frederick Lamb of the University of Illinois, Urbana-Champaign, expects to deliver a reality check next February.

BUSH'S EXPANDING 2002 MISSILE DEFENSE BUDGET (MILLIONS OF DOLLARS)

Program	Clinton plan	Bush revision
BOOST PHASE		
Airborne laser	214	410
Space-based laser	137	165
Space and sea kill vehicles	–	110
MIDCOURSE PHASE		
Land NMD	2458	3285
Navy theater-wide	246	656
TERMINAL PHASE		
Advanced Patriot PAC-3*	534	784
MEADS air defense*	74	74
Navy area defense*	297	395
THAAD land defense	699	923
Israeli Arrow	46	66
SENSORS	383	495
TECHNOLOGY	92	113
SYSTEM DEVELOPMENT	570	821
TOTAL	**5750**	**8297**

** Proposed for transfer to military services.*

Stepping up the pace

Although BMDO has not released a formal testing schedule, its agenda calls for a faster tempo. So far, the ground-based interceptor has had seven major tests (including four intercept tests) in 3 years, with two more (one a booster test) envisioned this year. According to Kadish's testimony and briefing papers, the pace will increase from one major launch every 6 months to one almost every other month. And that's just for the ground-based system. Under the new plan, testing must soon begin for new sea-based rockets and kill vehicles.

The DOD budget proposal includes funds to begin this next phase of testing. And it proposes to extend the range of its Pacific tests by adding the new sites in Alaska. These would enable BMDO to track a mock attack over a longer distance and in a more realistic orientation. At present, targets launched from Vandenberg toward Kwajalein present a bright radar signal early in flight. Coyle, for one, says he "applauds" the proposal to reorient flights so that targets are moving toward rather than away from North American tracking systems.

The expanded range, according to Lehner, would also aid in testing new systems, such as sea-based interceptors, beginning in 2008. These would focus on the boost phase. That approach would be a significant change in the program. Beyond that, BMDO officials have said they envision starting to test a space-based kinetic kill vehicle in 2005 or 2006 and a space-based laser that could target missiles on launch by 2010. Even Lehner concedes that the space-based systems will require a bit of invention to go along with the engineering.

The most difficult challenge, Coyle and other observers say, will come when BMDO tries to coax these hugely complex but independent systems to work in concert. The first step will be computer simulation, and Lehner says that an integrated system experiment involving a live missile flight will not occur for "3 to 5 years, at the earliest."

"The scale of this effort is huge," says Coyle—with more demanding requirements for accuracy and coordination than any the military has ever attempted. The cost is also huge. Over the next few weeks, the shrinking budget surplus is likely to dominate the political rhetoric as Congress finishes putting together the 2002 budget. Democratic critics of the NMD program, especially, will be focusing on next year's $8.3 billion installment payment, arguing that the country cannot afford both of President Bush's major campaign pledges: a big tax cut and a missile defense system. Look for a reprise of the Reagan-era debates over "Star Wars."

–ELIOT MARSHALL

Big burn. Major tests, like this launch of a ground-based interceptor from Kwajalein, cost $100 million.

CREDIT: DOD