Deployed U.S. weapons systems are rated equal or superior to those of the Soviet Union in 25 of 31 areas, roughly the same as last year. No comparison is made in two of the areas—ballistic missile defense and surface-to-air missiles—where the United States has chosen not to deploy any weapons system, and the imminent deployment of a superior U.S. antisatellite weapon will eliminate an existing Soviet lead. Artillery and mines are thus the sole areas in which the United States is clearly inferior.

The report again notes that the Soviets have assigned more personnel and a far greater portion of their gross national product to defense than the United States, to little avail. One problem is that "Soviet capital investment has not kept pace . . . advanced equipment has not been provided, automated support systems are not available, and as a result productivity may be lower. Moreover, the nature of Soviet society tends to stifle innovative and imaginative thinking—key elements in the pursuit of research," the report states. It optimistically predicts that the Soviets will have trouble closing existing technology gaps and that "new ones are likely to emerge." ■

R. JEFFREY SMITH

Thiokol Had Three Concerns About Shuttle Launch

Officials of the National Aeronautics and Space Administration (NASA) had three sound reasons to postpone the ill-fated launch of the space shuttle Challenger, according to engineers and officials of Morton Thiokol, Inc. One was a warning about potential leaks in the joints of the shuttle's booster rockets due to low temperatures. As *Science* reported last week, Thiokol engineers explicitly warned of such leaks on the evening before the launch, but senior NASA and Thiokol officials chose to disregard the warnings.

A second reason, which was considered more of a budget concern than a safety hazard, was the existence of unusually rough seas offshore, which might have jeopardized recovery of the boosters after launch. Several ships in the recovery area reported 26-foot waves on the day before the launch, several Thiokol engineers say, and some equipment needed to reel in the booster parachutes had fallen overboard.

At the moment that Thiokol first learned about these conditions, the ships were moving out of the recovery area into calmer waters. Had they been unable to recover the boosters after their splashdown, it would have cost the government an extra $40 million to replace them.

A third potential reason to postpone the launch, according to Thiokol officials, was the presence of ice in a network of water troughs used to suppress acoustic reverberations from the boosters at lift-off. According to a Thiokol engineer, "there were substantial uncertainties" about how well the ice-filled troughs could protect the shuttle orbiter, as well as the struts supporting various fuel tanks, from acoustic shock.

Fourteen Thiokol engineers gathered in a conference room in Brigham City, Utah, to discuss these concerns shortly after 1 p.m. on 27 January when they learned of the weather forecast for the launch. "We fought like hell all day to get permission for a presentation to NASA," a senior engineer told *Science*. By the time it was made, the engineers had done an analysis predicting that rubber gaskets used to seal the booster joints would probably be between 27 and 29° F. Since the coldest temperature that the gaskets had ever been tested was 47° F., in a static firing in Utah, the engineers could not predict exactly how they would perform in such a cold environment.

During a teleconference that evening, NASA officials and engineers, including Larry Mulloy, the manager of booster programs at the Marshall Space Flight Center, asked Thiokol to quantify how much and how quickly gasket performance might be degraded. "Although we had no data, we knew their performance was going from good to bad as the temperature dropped, and we were afraid that it was worse than ever before. There was not one positive statement in an engineering sense to support a launch that night," a Thiokol engineer said. All 14 engineers, as well as four others from Thiokol, supported a recommendation that the launch be postponed. Included in this group were Robert Ebeling, the manager of solid rocket assembly; Arnold Thompson, supervisor of the booster structures section; and Allan McDonald, the solid rocket motor program manager.

Mulloy and others challenged Thiokol's presentation, claiming that it was insufficient to support a conclusion that gasket performance would sharply decline at low temperatures. Apparently, no direct pressure was applied to Thiokol to reverse its judgment. Instead, aspersions were cast on the soundness of the company's technical judgment, and a request was made that its engineers reexamine their data. "It was a pro-launch meeting, and this tone was recognized by our management," one engineer told *Science*.

After a heated internal debate, and consultations with other corporate officials, Thiokol's Joseph Kilminster, the vice president of space booster programs, decided to reverse the initial recommendation for a postponement. In a document transmitted to Marshall and the Kennedy Space Center at 11:45 p.m. (EST), he took the agency's viewpoint and called the data "not conclusive on predicting primary O-ring blow-by [gasket failure]." Although the cold would clearly slow the movement of the gaskets into the joints, a backup would operate even if the primary fails, he said. Moreover, it would do so before pressures from the booster begin to force the joint apart, a phenomenon first discovered in 1982.

The presidential commission investigating the shuttle accident has reported that details of these disputes were never reported up the line to senior NASA officials, including Jesse Moore, who was then the agency's associate administrator for space flight. (Moore has since been replaced by Rear Admiral Richard Truly, the former head of the Naval Space Command and twice a shuttle pilot.) "Over time, we have found them to be one of the most conservative groups in the world," a Thiokol official says. "But on the night before that launch, they had a lapse of corporate memory." ■

R. JEFFREY SMITH

CERN Agrees to Independent Review Committee

The governing council of the European Laboratory for Particle Physics (CERN) in Geneva has accepted a proposal from the British government to set up an independent review committee to look at the implications of "alternative levels of funding" from its present budget.

This proposal had been made by Britain's minister responsible for science and higher education, George Walden, following last year's report by a separate committee chaired by Sir John Kendrew, which suggested that Britain should reduce its contribution to CERN by 25 percent in order to free up funds for other areas of research (*Science*, 17 January, p. 216).

The CERN review will be carried out by a group of five to seven members, to be appointed by council president Wolfgang Kummer after consultation with its 14 member states. The committee has been asked to report its findings and recommendations within a year.

A resolution passed unanimously by the council last week stated that the members

"might include scientists, engineers and industrialists" who would be chosen for their "breadth of experience," although the council rejected an amendment which would have stipulated that one member should be "a broadly-based physicist."

The terms of reference to be given to the committee ask it to advise on how CERN's human and material resources "might be developed to operate with maximum cost-effectiveness and value for money at alternative levels of funding by present member states and to assess the consequences for the CERN program and services to member states."

Although no figures were included in the text of the resolution, the British government insisted that a footnote should be added noting its request that the alternative funding levels whose implications are to be examined should include a 25 percent reduction in all members' contributions over the next 5 to 7 years.

Following the publication of the Kendrew report, Britain's Science and Engineering Research Council is already planning to make such a reduction in its own contribution.

The resolution also asks the committee "to assess the possibilities for engaging and enlarging other sources of funds and resources," a reference to the suggestion that CERN should try to increase the support it receives from nonmember states such as Canada, Japan, and the United States. ■

DAVID DICKSON

Monsanto Opens Files on Genetic Release Test

In an about-face, the Monsanto Company has decided to make public a lot more information about a genetically engineered microbe that it wants to test outdoors as a pesticide. The company wants to analyze bacteria that have been altered to protect corn plants against black cutworm.

Monsanto's decision comes on the heels of community opposition in California to a genetic engineering experiment by another company, Advanced Genetic Sciences (*Science*, 14 February, p. 667). The experiments planned by the two companies would constitute the first field tests of genetically modified organisms, and have generated considerable interest concerning their potential ecological impact and the adequacy of the federal regulatory process to assess the safety of these types of experiments. The Environmental Protection Agency and an outside panel of experts formed by EPA are still in the midst of reviewing the Monsanto application.

Nearly a year ago, Monsanto sought approval from EPA to conduct its experiment and, in the process, submitted a hefty pile of data concerning the modified bacteria and the test. But when EPA said it wanted to release a bit more information about the experiment, the company adamantly opposed the idea, claiming the information was proprietary. Since then the agency and the company have been at an impasse.

Now Monsanto has agreed to make public virtually all the information it has submitted to the agency. Although Monsanto described the experiment in general at a press conference last year in Washington, DC, its application provides more details. Only a few pages out of 7 inches of documents submitted have been expurgated. The papers include a description of the experimental protocol, information about the genetic stability of the microbe, and the methods and results of toxicity tests conducted on several plant and animal species.

Up until now, all the company has said about the experiment is that scientists have isolated a gene from *Bacillus thuringiensis* that codes for the production of toxin lethal to cutworm. The gene has been spliced into *Pseudomonas fluorescens*, a microbe commonly found on the roots of corn plants. When cutworm attacks corn roots, it eats the bacteria and dies.

In its application, the company describes the genetic engineering methods it used to alter the soil microbes and the technique it used to ensure that the toxin gene is not transferred to another microbial species. Specifically, the company inactivated the transposase to prevent the movement of the transposon, which carries the toxin gene. The company conducted toxicity assays on several species, including fish, aquatic insects, mosquitoes, laboratory mice, earthworms, and quail, and found no untoward effects. About the only information that was struck from the documents concerns the company's method of coating the *P. fluorescens* to the corn seed.

Although the company originally asked to perform the experiment at locations in Texas, Illinois, and Missouri, it now has limited its request to test only at its Missouri farm in St. Charles. The company proposes to plant 26,000 corn seeds on a 1-acre plot.

Monsanto spokesman Gerard Ingenthron said that the company's willingness to disclose information about this experiment does not establish a corporate precedent. "But because this is one of the first experiments of its kind and we were asked by EPA to reconsider, we decided to release the information," he said. Ingenthron said that the local furor over the experiment by Advanced Genetic Sciences was not a main reason for the company's change of heart. "We would have arrived at the same decision without the AGS situation," he said.

William Schneider of EPA, who is overseeing the review of the application, says he is pleased that Monsanto is willing to release the information. "If we can't show the public how we're conducting our risk assessments [on these kinds of experiments], confidence is not going to be as great," Schneider said.

The company documents will be available in microfiche form by 3 March, according to EPA officials.* The agency is seeking public comment on the application by 21 March. ■ MARJORIE SUN

*The documents can be read at EPA's docket office or can be obtained in microfiche form by writing EPA's Freedom of Information Office, Office of Pesticide Programs, 401 M St., SW, Washington, DC 20460.

Comings and Goings

Charles R. Schuster, a psychologist and psychopharmacologist who directs the University of Chicago's Drug Abuse Research Center, has been named the new director of

the National Institute on Drug Abuse. NIDA's intramural research director **Jerome Jaffe** has been filling the post, which was vacated last year by **Herbert Pollin**.

Robert G. Niven resigned in January from the directorship of the National Institute on Alcohol Abuse and Alcoholism. Deputy director **Loran D. Archer** is now acting director.