Roughly $60 million of the new funds sought for this year are to be transferred from the Pentagon to DOE, presumably for one or more underground tests in Nevada, beyond the two to four tests already scheduled for this fiscal year at a cost of $157.8 million. In fiscal year 1987, the underground testing account will jump to $226 million, or enough for three to five explosions. (The budget for underground testing of the weapons has exceeded that for laboratory research for several years.) In addition to the x-ray laser, a variety of nuclear-driven weapons such as particle beams, microwaves, hypervelocity pellets, and optical lasers are also under investigation and may eventually be tested.

"These nuclear power sources, if you want to consider them that way (they are explosions but they act as power sources)," may ultimately be unnecessary for a ballistic missile defense, Wagner testified. But "the first stages of the SDI program, which . . . may last decades, I believe and the Department believes will have this nuclear component, this new kind of nuclear-driven directed energy weapon as one of its very important options." ■ R. JEFFREY SMITH

Briefing:

New Shuttle Director Promises Emphasis on Safety

A new emphasis on safety will be the hallmark of the space shuttle's operations when flights resume, according to Rear Admiral Richard Truly, the new associate administrator for space flight at the National Aeronautics and Space Administration (NASA). Speaking on 25 March before an enthusiastic crowd at the Johnson Space Center in Houston, Texas, Truly outlined a series of activities that he said are "required to establish a realistic and achievable launch rate that will be safely sustainable."

Specifically, the entire budget and program management "philosophy, structure, reporting channels and decision-making process will be thoroughly reviewed," he said. All shuttle components considered vital to the safety of the orbiter and the crew will be reassessed, as will all waivers of engineering redundancy. Inspection and test requirements will be reviewed, and the booster joints, widely recognized to have been the cause of the shuttle accident in January, will be redesigned under the direction of the Marshall Space Flight Center in Huntsville, Alabama.

In addition, new launch criteria will be established at the outset, Truly said. "When it's time for the first flight, we are going to do it as safely as possible. We are going to launch in the daytime from Kennedy [Space Center in Florida], we're going to have a conservative flight design, [and] we're going to have a repeat payload, one that we have experience with." No civilians will fly during the first year, and all flights will occur in warm weather, he indicated.

Truly explained that the rules are necessary to restore the agency's credibility in the wake of the Challenger disaster (*Science*, 28 March, p.1495). The agency's present plan is to conduct roughly nine flights a year, beginning a year from now. First priority will be given to launching military satellites, as well as a tracking and communications satellite destroyed by the accident. "We cannot print enough money" to make the flights risk-free, Truly added. "But we certainly are going to correct any mistakes that we may have made in the past, and we are going to get going again just as soon as we can." ■

R. JEFFREY SMITH

Panel Sees Decline in Undergraduate Education

A National Science Board committee report says that the nation's undergraduate programs in science, mathematics, and engineering "have declined in quality and scope to such an extent that they are no longer meeting national needs." This poses a "grave, long-term threat to the nation's scientific and technical capacity, its industrial and economic competitiveness, and the strength of its national defense," the panel warns.

On the basis of evidence gathered in its inquiry, the committee pinpointed three areas that require highest priority attention.

■ Laboratory instruction was described as "often uninspired, tedious, and dull." Instrumentation and facilities were found to be obsolete and inadequate—the need for new instruments was put at $2 billion to $4 billion.

■ Faculty members in too many cases were seen as unable to maintain their teaching skills, currency in their disciplines, and command of new technology. Serious shortages of qualified faculty were noted in some disciplines.

■ Courses and curricula were described as "frequently out-of-date in content, unimaginative, poorly organized for students with different interests, and (they) fail to reflect recent advances in the understanding of teaching and learning."

According to the report, institutions of all types in all regions of the country are affected. The problems of engineering disciplines were said to be most serious.

The committee was formed last May to assess the state of undergraduate education in science, mathematics, and engineering and make recommendations on the role the National Science Foundation should take in improving it. Its chairman was Homer A. Neal, provost of the State University of New York at Stony Brook. The committee reported to the National Science Board, which is the policy-making body for the foundation.

In its recommendations, the committee said that NSF lacks the resources to solve the problems itself, but should take a leadership role in stimulating the states and the private sector to increase their investment in undergraduate science, engineering, and math education. The panel does recommend that NSF expenditures in the field be increased by $100 million a year in "leveraged" program support. Some $5.5 million for college instrumentation is the only program in undergraduate education in the NSF budget this year. NSF director Erich Bloch is charged with converting the committee recommendations into proposals to be incorporated in next year's NSF budget. ■

JOHN WALSH

Nuclear Meltdown: A Calculated (and Recalculated) Risk

For years, the nuclear industry has been trying to persuade the government to see a silver lining in the cloud that gathered over Three Mile Island. Broadly, the argument is that the 1979 nuclear accident was much less dangerous than official risk estimates would have led people to expect. Therefore, the risk studies should be rewritten. Eventually, if analysis confirms what the accident at Three Mile Island suggested, safety regulations may be adjusted to reflect a calmer view of what would happen in a meltdown.

An exercise of this kind has begun at the Nuclear Regulatory Commission (NRC), called the "source terms" review (*Science*, 5 April 1985, p. 31). The phrase refers to mathematical terms used to calculate leakage from radioactive sources. This project was inspired by the fact that radiation escaping from Three Mile Island was only a fraction of what might have been expected. Also, radioactive iodine was less volatile during the accident than many had predicted. Rather than venting to the atmosphere in a pure

form, virtually all of it combined with other chemicals and stayed in the plant.

On 26 March, NRC heard a staff report on the work done so far in the source term review. The NRC staffers said they definitely could see a glimmer in the darkness, but they could not be sure whether it was the glint of a silver lining or just another lightning bolt. Despite their uncertainty, they promised to have some new risk estimates ready for publication this fall.

Last year, the NRC released the first draft of a source term document that is meant to serve as the new scientific basis for work in the area. The report, called NUREG-0956, does not deal at all with risks. (These will be calculated in a separate document due in October, designated NUREG-1150.) Instead, the scientific document provides detailed forecasts of how radioactive chemicals might behave in 16 types of accidents and in six types of reactors. When it is complete in July, it will serve as the starting point for the risk analysis.

While the future version of this NUREG report may be sound, the present edition has been greeted with skepticism. The nuclear industry, which has sponsored its own research, calls it outdated and alarmist. The antinuclear groups see it as underplaying hazards. And a number of scientists describe it as simply unripe. In this regard, the file of public comments reveals an inherent problem that may keep the project unripe for a long time. This is a disagreement over the credibility of some computer modeling codes that are the basis for all the predictions that will come out of NUREG-0956.

There are two levels of disagreement. First, some researchers challenge the codes on a mechanical basis. The codes are so complex, tedious to review, and obscure, critics say, that they have been reviewed by almost no one except those paid to do so, that is, by NRC contractors. There may be a hidden bug in these models that no one has detected. Furthermore, it is impossible to "validate" the codes fully, for no one is going to stage nuclear accidents to see how well the numbers represent reality. For this reason, it is important that they be thoroughly vetted by independent scientists. Several commissioners stressed this point during the briefing.

Last year, a committee of the the American Physical Society (APS) reviewed some of this work, issued a report, and then disbanded—long before the game was over, it turns out. These APS members were consulted, according to the NRC staff, about the final version of NUREG-0956. But some of the APS group felt the consultation was perfunctory and fell far short of full peer review.

For example, one member of the APS committee, Fred Finlayson of the Aerospace Corporation, wrote to the NRC in January to explain why he considered the task unfinished. The codes have not been thoroughly peer-reviewed, Finlayson wrote, and their technical assumptions have not been adequately disclosed. He concluded that there were "too many uncertainties to provide a reasonable basis for revised risk analysis at this time." Nothing has changed his opinion since January.

Another, broader problem with the codes is that they distort natural phenomena by simplifying them. (The codes must be simplified to suit the computer.) Thus, knotty problems are sometimes omitted. However, these knotty ones could be important in an accident. For example, one such hard-to-model event is the scenario in which a molten core interacts with a limestone concrete floor to produce volumes of gas, heat, and a radioactive aerosol. In the right circumstances, these fumes could burst through the containment and pose a serious threat to public health.

Indeed, the codes are inadequate to cope with fuel-concrete interactions, one NRC official says, because the technical issues are unresolved. Research on this topic is now in progress in West Germany and at the Sandia National Laboratory in New Mexico. Similar uncertainties plague the issues of containment building integrity, high-pressure ejection of fuel from the reactor vessel, hydrogen production, iodine and lanthanum chemistry, and revaporization of deposited fission products. All are being researched. Citing the code's deficiencies in dealing with chemistry, R. Potter, a British official at the Atomic Energy Establishment at Winfrith, wrote of the treatment of iodine chemistry: "At best this is an oversimplification, and at worst, wrong." Unless this and other aspects were improved, he concluded that it would be "difficult to have the necessary confidence in the results."

The NRC staff, including the acting executive director Victor Stello, assured the commission that corrections and emendations of document NUREG-0956 will be finished by July. Unresolved technical issues, such as the interactions of the fuel with concrete, will be handled by setting wide uncertainty margins around relevant terms in the analysis. Work on the risk estimates themselves has already begun and will be completed within 6 months. Finally, in the bureaucratic tradition, a policy paper issued by Stello also promised that the staff would begin to propose regulatory changes right away, or, in any case, "as soon as the available information warrants such changes." ■

ELIOT MARSHALL

Insurance Drought Fosters Self-Help Plan for Biotechnology Firms

The insurance crisis that is currently affecting a host of industries has not passed up biotechnology. Faced with exorbitant premiums and in many instances the inability to obtain insurance, small biotechnology firms are turning to insuring themselves. The Association of Biotechnology Companies (ABC) plans to set up an offshore insurance venture to provide liability coverage to 20 member companies.

Warren Hyer, managing director of ABC, says that this plan hopefully will solve the member companies' immediate insurance crisis. Furthermore, it also may pave the way for the insurance industry to provide at least limited supplemental underwriting to companies for upgrading general liability coverage, protecting corporate executives and directors as individuals, bringing new products to market, or scaling up experiments for field and clinical trials.

Insurance is hard to get, says Hyer, because the insurance industry "does not know much about biotechnology. The risk right now cannot be identified." But insurers may be more willing to take on biotechnology concerns, he says, after the association's new insurance operation starts functioning. Discussions with two New York–based international brokers—Marsh & McLennan, Inc. and Johnson & Higgins—indicate that coverage on potential liability claims exceeding $1 million might be available from private insurance companies in the future, says Hyer.

ABC's tentative plan calls for each member company to be insured for liability claims up to $1 million. Each company would pay an annual premium of $100,000. The companies will review each other's research portfolios and will establish "a strong risk-prevention program" that sets out general guidelines for the conduct of research. The affiliate of the trade association is likely to be located in the Bahamas or Bermuda, Hyer indicated, to avoid U.S. tax laws that would treat a surplus in the insurance entity's trust funds as a taxable profit.

The insurance crisis extends to biotechnology's larger players, including pharmaceutical and chemical giants. "Everybody is having insurance problems," says Susan Racca, an analyst at the Industrial Biotechnology Association. Member companies of the IBA are scheduled to meet next week to discuss a self-insurance plan. The association shelved the idea several months ago but is taking it up again, says Racca, "because things have gotten so bad." ■ MARK CRAWFORD