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 The nuclear industry, which has sponsored its own research, calls it outdated and alarmist.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