APS calls for reactor safety research

An independent study of the safety of conventional nuclear reactors, sponsored by the American Physical Society, tends to confirm official estimates that chances for a major lethal accident are small, but adds that should such an accident occur, the chances for fatalities are higher than previously thought. The study also concludes that not enough is known about how well emergency back-up systems will perform in preventing a developing accident from getting out of hand; more research is needed before confidence in these systems can be assured.

At a press conference during the annual APS meeting in Washington this week, Harold W. Lewis of the University of California at Santa Barbara, chairman of the study group, summarized the report's conclusions: "We find no reason for short-range concern about the safety of these light water reactors." The report notes that "there has been no major release of radioactivity." But Lewis urged that more safety research be performed to find ways of preventing loss of life in event of an accident and to establish quantitatively the effectiveness of various emergency systems. The study was funded by the National Science Foundation and the former Atomic Energy Commission and did not deal with breeder reactors or nonatomic energy sources.

Frank von Hippel of Princeton summarized the group's findings on the possibility of fatalities following a reactor accident in which a large quantity of radiation would leak into the atmosphere. The official AEC report (usually called the "Rasmussen report," SN: 8/24/74, p. 117) underestimated resulting deaths by a factor of 50, he said, by not adequately considering contamination of land areas under the plume of escaping radioactive material or the increase in cancers caused by the radiation, appearing perhaps only decades after the accident. The Rasmussen predictions of genetic and other nonfatal injury, especially thyroid damage, were also seriously underestimated, von Hippel said. Whereas the AEC report predicts that 300 cancer deaths could result from a serious accident, the APS study say the figure is closer to 10,000 to 20,000.

A typical accident, which could conceivably cause release of volatile radioactive material into the air, is the bursting of a major pipe carrying water to cool the reactor core. If all the water were lost, the fuel elements of the core would overheat, buckle and melt. To prevent this, an emergency core cooling system (ECCS) is provided to quickly replace the lost coolant, but in such an unstable system—with pressure rising as water changes to steam and structural braces holding the core beginning to melt—the performance of the ECCS is extremely hard to predict.

Prediction is usually tried in two ways: computer simulation and small-scale experimental testing. Unfortunately, the APS report concludes, experimental accident tests have so far been conducted on unrealistically small reactors (about one-thousandth the power capacity of commercial reactors), and computer calculations don't necessarily correspond to the results of these small tests.

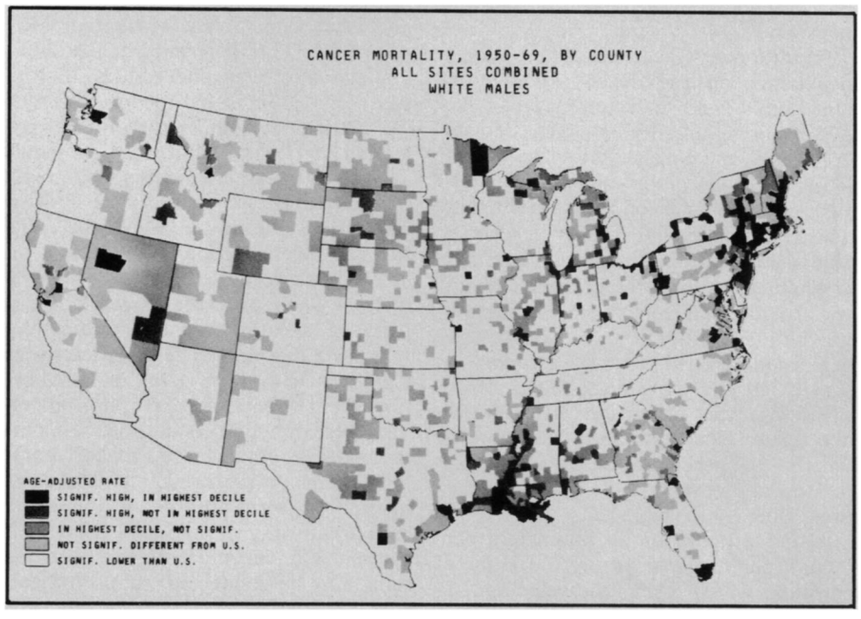
Steady-state operation of a reactor is relatively simple to program, but to deal with a rapidly changing system of melting fuel elements, turbulent coolant flow and rising steam pressure "would instantly exhaust the potential of the largest computers." The alternative is to make certain simplifying assumptions in the calculations. The results so far, concludes the report, have been "poor."

The study group also noted that delays in creating larger-sized accident-testing reactors have contributed to the problem of predicting how well the ECCS now installed in the nation's 50-odd commercial reactors would work in a real emergency. The largest test facility now planned is the LOFT (Loss of Fluid Test) reactor in Idaho, which has only one-sixtieth the power of commercial reactors, and the APS study concludes that this size is still inadequate to prove the reliability of ECCS.

Finally, the report mentions several other specific areas that need more attention: To prevent sabotage, more physical barriers should be erected around nuclear installations, rather than turning them into what one panel member called "an armed camp." Alternative siting policies should be considered, including underground construction or clustering reactors and fuel processing plants together in "nuclear parks."

Study group members refused to answer the qualitative question: Is massive deployment of nuclear reactors all right? This question, they said, would depend on a risk-benefit analysis that was beyond the scope of their study. So far, however, they found the safety of reactors "excellent," and licensing and operation procedures "conscientious." □

Cancer and chemicals: Risks mapped



Epidemiologists have just completed a study that literally puts cancer on the map. National Cancer Institute researchers analyzed cancer mortality rates by geographic areas in the United States and developed 34 maps. These maps, to be published next month, reveal previously unseen correlations between proximity to certain types of industrial activity and some types of cancer.

The maps are part of an ongoing National Cancer Institute project to amass cancer statistics and analyze them for possible underlying social, economic and geographic patterns. They, along with the compiled data they present visually, will appear in the NCI *Atlas of Cancer Mortality for U.S. Counties 1950-1969*.

Two project participants, using the maps and data, have also completed a separate study that correlates cancer mortality with an environmental factor

—residence in a U.S. county with a heavy concentration of industry. The study by Robert Hoover and Joseph F. Fraumeni Jr. reveals some possible new links between chemicals and cancer. It will appear in the April ENVIRONMENTAL RESEARCH.

The team studied U.S. counties with the highest percentages of residents employed by chemical industries. These 139 counties represent the top 10 percent of all U.S. counties with chemical-industry employed residents. They analyzed the period from 1950 to 1969, and correlated the incidence of cancer at 35 body sites with various demographic factors. They found that in the 139 chemical industry counties, the rates for bladder, lung, liver and certain other cancers exceed the expected rates for males in those counties. The correlation could not be explained by other factors, they state, such as socioeconomic class, degree of urbanization or employment in nonchemical industries.

They found strong correlations, for example, between a greater-than-expected incidence of bladder cancer and proximity to the manufacture of dyes and pigments, drugs, perfumes, cosmetics and toiletries. They found lung cancer correlated with proximity to the manufacture of industrial gases, pharmaceuticals, soaps and detergents, paints, pigments and synthetic rubber. Liver cancer was correlated with proximity to the manufacture of certain organic chemicals, synthetic rubber, soaps and detergents, cosmetics and printing ink.

In other studies not yet published, they found higher-than-expected bladder cancer levels in areas of heavy auto production and higher rates of lung cancer near copper and lead smelters.

Fraumeni warns that there are limitations to statistical analyses such as these, since unknown intervening variables, rather than the presence of a certain industry, may be responsible for the correlations. "We are not saying that the industries are creating a hazard," Fraumeni says, "just that there is a correlation and the cancer rates are higher than expected." The team suspects that the higher cancer mortality rates are due mainly to industrial exposure of workers in the industries. They are designing studies now to test this hypothesis.

One benefit of this study, Fraumeni says, is that it provides clues to chemicals that may be carcinogenic. Until their study, he says, no correlations had been seen between bladder cancer and the manufacture of industrial gases or soaps and detergents; lung cancer and the manufacturing of drugs, soaps, paints, pigments or synthetic rubber or liver cancer in those close to the manufacture of cosmetics, soaps or printing inks. □

An earlier test for cervical cancer?

Evidence has been accumulating for several years that a herpes simplex virus is associated with human cervical cancer. One characteristic of this virus is thought to be a long latent phase between infection and the appearance of a tumor in the host. A new method has been developed for finding the "fingerprints" of this virus during what may be the latent phase. This may lead to diagnostic techniques for the detection of cervical cancer even earlier than is possible with the Pap test.

Joseph L. Melnick and co-workers T. Anzai, G. R. Dreesman, R. J. Courtney and E. Adam from Baylor College of Medicine in Houston reported their work at a meeting of the American Society for Microbiology this week in New York. Their technique involves the radioimmune assay of antibodies in the human blood. These antibodies react specifically with herpesvirus proteins perhaps given off during the latent phase.

Herpesvirus can react in two ways after it reaches the cell and injects its genetic material. If the virus's complete genetic code is transcribed and translated, it directs the cell to produce more virus particles. These soon burst forth, killing the cell and infecting many new cells. If, however, the code is incomplete (in some way, as yet unknown, it can become inserted into the host cell DNA and remain there for a long period of time. During this time the host cell can start to produce certain virus enzymes called herpesvirus nonstructural proteins.

These proteins, being foreign to the host organism, function as antigens, meaning they induce the formation of antibodies. It has been found that women with cervical cancer have antibodies to "incomplete" or herpesvirus nonstructural protein (and sometimes to "complete" or herpesvirus structural protein) more often than do normal women. The new analytical technique used in Melnick's laboratory allows the team to detect the presence of tiny amounts of antibodies to the early nonstructural proteins, indicators of latent infection.

The precise relationship of these antibodies and proteins to the appearance of cancer in humans is not known, but such a sensitive method at least opens the way for finding latent herpes infections. The Pap smear, although very useful as an indicator of cervical cancer, does not register positive until altered cells are present. If a woman tested with the new technique was found to have evidences of a latent infection, she could be given Pap tests more frequently so that the chances of catching a tumor early (if one develops) would be increased along with her chances for survival.

More studies must be completed before the early detection of latent herpesvirus infections can be done clinically, Melnick says. Epidemiological studies must be done on traditionally high-risk groups to test for a correlation between the appearance of these antibodies and an eventual malignancy. Also the technique must be simplified and streamlined for use in the diagnostic laboratory. □

Skin plants: Denying them iron

If you have ever had dermatophytosis —and the chances are good that you have—you know it can be a nuisance. The disease takes lots of forms and has some lively names—athlete's foot, jock itch, jungle rot, ringworm. The itching, inflamed skin lesions associated with this disease are caused by several types of fungi. The formal name of the disease comes, appropriately, from "derma" (skin) and "phyte" (plant). Research on the disease-producing ability of these "skin plants" has yielded new information on a blood factor that is part of a little-understood mechanism of immunity and new information that may lead to more effective ways to treat and prevent disease.

If dermatophytosis is a nuisance for the average weekend athlete, it is the scourge of soldiers serving in tropical areas. Togetherness—Army style—and a hot, humid climate seem to be the ideal conditions for the growth and transmission of jungle rot. In Vietnam the problem was so serious that it caused a significant loss of manpower. It's no surprise, therefore, that an Army researcher has begun to track the problem. Dermatological microbiologist Robert D. King of the Letterman Army Institute of Research at the Presidio of San Francisco reported his work at the annual meeting of the American Society for Microbiology.

Dermatophytes, unlike most disease-producing microorganisms, are limited to the surface of the skin and only rarely are able to penetrate it and produce internal infections. Other researchers turned up evidence in 1946 that a factor in the blood was responsible for preventing fungal penetration, but the identity of the factor has been a mystery ever since. King and his co-workers decided to look for the factor—and found it. King knew from earlier research that iron added to blood serum encourages the growth of dermatophytes. In normal blood serum all the