Soviets unveil lessons from Chernobyl

A detailed picture of events that led to the crippling of the Chernobyl nuclear plant last April emerges in a 382-page report formally released by the Soviet government on Monday. The report, unveiled in Vienna, Austria, at the opening of an International Atomic Energy Agency five-day meeting on the accident, not only documents extensive operator error but also identifies what the Soviets are now conceding as a number of serious design flaws in the reactor – flaws that they acknowledge contributed substantially to making the Chernobyl accident so catastrophic.

According to an English translation of the report that was prepared by the U.S. government, the accident occurred when operators began a test of one of the No. 4 reactor's two turbogenerators, essentially to see if it could be used to power the reactor's emergency cooling system. To simulate the conditions under which the emergency cooling system might need the generator's backup power, the test required disengaging the system from the reactor and disconnecting the generator from external sources of electric power, according to the report. Moreover, on the off chance that the test might prove unsuccessful, the operators decided to prepare the second turbogenerator to undergo an identical test. As these tests apparently also required removing certain other automatic safety systems from the generators, both generators were vulnerable and hard to control during the accident. Leaving both generators vulnerable at the same time violated strict, written procedures.

As the reactor power was decreased in preparation for the tests, the reactor became unstable – with uneven heating occurring throughout its more than 1,600 pressure tubes, each the equivalent of a small reactor core (SN:8/16/86,p.101). In their attempt to stabilize the reactor, the operators hooked up additional cooling-water pumps. But the measure overcompensated, rapidly increasing the flow rate of cooling water through the reactor. In fact, says the report, it would have caused an automatic shutdown of the reactor if operators hadn't blocked additional emergency control systems.

To compensate again, operators began sharply reducing the water's flow rate, thereby increasing coolant temperature – a factor that can increase reactor power. When the test was finally begun, a "continuing decrease in the water flow rate through the channels of the reactor under conditions of an increase in power led to intense steam formation and then to a crisis" that included the overheating of the fuel and its disintegration. Ensuing chemical reactions helped initiate a massive steam explosion that ripped the plant apart, started at least 30 individual fires and ultimately released about 3.5 percent of the radioactive material in the reactor. The fallout may eventually cause 24,000 cancer deaths, according to calculations in the Soviet report.

If the reactor had been enclosed in a containment building, much of that radioactivity might never have been unleashed. However, the report notes, the Soviets found it difficult to manufacture these large containment structures and so instead engineered a complex series of other safety measures to compensate. At the meeting Monday, Valery A. Legasov, head of the Soviet delegation, conceded that the accident proved these measures unreliable. Moreover, the report highlights a host of additional design liabilities plaguing Chernobyl-style reactors. In preparation for a move to begin rectifying many of these, Legasov said, half of the USSR's reactors have already been shut down.

The Soviets intend to continue their aggressive development of nuclear power. Citing concern over the environmental damage now caused globally by the emission of combustion pollutants, the new report states that all future Soviet base-load electric-generating stations will be nuclear powered – not fossil-fuel fired. *– J. Raloff*

For a healthy heart

The American Heart Association this week released its latest guidelines for heart-healthy eating. New recommendations include limiting alcohol intake to 15 percent of total calories, not to exceed 50 milliliters (1.7 ounces) of ethanol per day; and restricting protein to 15 percent of total calories, primarily to hold down meat consumption. The association also beefed up some of its 1978 recommendations, advising that calories from total fat should represent less than 30 percent of all calories, with saturated fat accounting for no more than 10 percent of total calories. Cholesterol intake should be no more than 100 milligrams per 1,000 calories, not to exceed 300 mg per day. And rather than just suggesting avoidance of excessive sodium intake, the association now recommends limiting sodium to 1 gram per 1,000 calories, not to exceed 3 grams per day. Guidelines are based on a total calorie intake adequate to maintain ideal weight according to Metropolitan Life Insurance Co.'s 1959 tables. □

Fertility factor from the mouths of mice

Biology textbooks indicate that the hormones controlling the development of sperm come from two places – the testes themselves, and the pituitary and hypothalamus glands at the base of the brain. Researchers from the National Institutes of Health (NIH) have come up with a new locale, at least for mice – the submandibular gland, which lies beneath the tongue and in humans is what swells during mumps.

The submandibular gland produces a substance called epidermal growth factor (EGF), one of about a dozen known growth factors. While EGF stimulates growth of some cells in culture, until now its role in the body has been a mystery.

Osamu Tsutsumi, Hirohisa Kurachi and Takami Oka of NIH removed the submandibular glands of male mice. While the animals' testosterone levels did not fall and their behavior did not change, EGF dropped to unmeasurable levels and the number of mature sperm dropped to about half the level of mice that underwent "sham" operations, with their glands left intact. The researchers then injected the glandless mice with either EGF or another growth factor produced by the submandibular gland. Only EGF restored the sperm levels, they report in the Aug. 29 SCIENCE. EGF, they suggest, could be absorbed from the saliva into the blood via the digestive tract.

One reason for the long delay in determining EGF's action is that no known disease is marked by its absence, says Stanley Cohen of Vanderbilt University in Nashville, who discovered EGF about 30 years ago. Without a human model for what happens when EGF is not there, figuring out its function has been difficult. About the current work, Cohen says, "It is certainly interesting and warrants further experiments."

If the work pans out, EGF will be the first known substance produced outside of the traditional reproductive organ-hypothalamus axis to have a vital, hormone-like function in reproduction. In previous research, the group found EGF also plays a role in female mice. Though present at only about one-tenth the concentration found in males, in female mice the factor is involved in the development of mammary glands as well as mammary tumors. The researchers also found that an antibody to EGF can halt the growth of the tumors.

Does a substance that cuts rodent sperm development without affecting testosterone levels, and stops the growth of breast tumors, have a potential role in humans as a contraceptive or cancer treatment? "It's going to be a long time before its usefulness in humans is known," says Oka, "but it shows a way to approach the problems." *– J. Silberner*

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