Windscale accident: 24-year perspective

On October 10, 1957, during a routine operation, the air-cooled, plutonium-producing Windscale nuclear reactor on the west coast of England caught fire. The next day, the reactor's incandescent interior was cooled with water, sending aloft a large plume of vapor contaminated with radioactive iodine, strontium, cesium and ruthenium; carried along by the wind, it passed over millions of people in England, Belgium and other European countries along its passage northeastward.

That was more than 20 years ago, but only now have the accident's effects on people's health been formally estimated. A study by Peter J. Taylor of the Oxford-based Political Ecology Research Group (PERG) predicts that 10 to 20 persons will die of thyroid cancer in the next few decades as a consequence of their exposure in 1957 principally to radioactive iodine. (Radiation often takes decades to work its lethal mischief on people.) Among the various primary radioactive nuclides vented into the atmosphere during the accident, "iodine is generally regarded as the nuclide of principal hazard," says Gordon R. Thompson of the Union of Concerned Scientists, which commissioned the research project. Furthermore, in particular danger is the thyroid, which readily absorbs the radioactive iodine.

Taylor's theoretical prediction comes from assuming the number of thyroid cancers expected to arise in a population exposed to radioactive iodine and using that together with published values of the radioactivity levels actually measured throughout England and Wales shortly after the accident. In that one assumption, the value Taylor uses in his calculation is the same one advocated in the oft-quoted National Academy of Sciences' 1980 report on the biological effects of ionizing radiation. But in still other assumptions, Taylor "looks like he's been overly cautious so as not to offend the nuclear industry," says Carl Morgan, professor emeritus of health physics at the Georgia Institute of Technology, regarded by some as the father of the field of health physics.

Besides his theoretical analysis, Taylor searched through the health records of Wales and England from 1946 to 1977. Throughout that period of time, Thompson told SCIENCE NEWS, the national thyroid cancer death rate remained steady at about seven to nine deaths per million persons per annum. Furthermore, in Barrow, the closest big city to Windscale, there has been no increase since the reactor accident in the number of still-births or illnesses among children less than one-year-old.

The radiation accidentally released into the environment by the Three Mile Island (TMI) nuclear reactor is about one thousand times less than what it was for Windscale, according to official estimates (disputed by some, including Morgan). Consequently, Thompson told SCIENCE NEWS, the reports of significantly increased numbers of miscarriages and infant mortality among Pennsylvanians in the proximity of TMI must be looked upon with skepticism. On the other hand, he says, a major nuclear reactor accident could involve one-thousand times or more the radiation release of a Windscale-type accident, in which case the public health effects might be considerable — we still don't know for certain. □

CO_2 results fuel 'greenhouse' debate

Although the term "greenhouse effect" long ago attained headline prominence, controversies over the effects of increased atmospheric carbon dioxide (CO_2) have been fueled more by suspicion than by scientific evidence. Now, a team of atmospheric physicists from NASA's Institute for Space Studies, a branch in New York of the Goddard Space Flight Center in Greenbelt, Md., reports that since 1880, the increase in atmospheric CO_2, mainly from the combustion of fossil fuels, has caused a global warming of 0.4°C, with 0.2°C of the change occurring between the mid-1960s and the present. The findings are published in the Aug. 28 SCIENCE.

The detected warming, the scientists suggest, lends validity to the theory that the addition to the atmosphere of CO_2 causes surface temperatures to rise. As the amount of CO_2 increases, it becomes more difficult for the earth to emit infrared radiation, the main radiation sent out from the planet. If the greenhouse theory is correct, the earth's temperature will rise until the amount of radiation emitted from the planet is equal to the solar energy it absorbs.

The findings are based on a mathematical simulation that incorporates observed global temperatures over the last century as well as estimates by other scientists of the amount of volcanic dust in the atmosphere and the effects on temperature of solar variations, such as sunspots. Such mechanisms are possible causes for the 0.5°C drop in temperature in the northern hemisphere between 1940 and 1970, when CO_2 built up rapidly.

The scientists predict global warming of "unprecedented magnitude" for the next century, as concentrations of CO_2 increase from 1980 levels of about 340 parts per million to 600 parts per million. If the projections are correct, agriculture patterns and practices may be disrupted, and in North America and central Asia regions currently blessed with ample rain may become prone to drought. A 2°C increase in global temperature would result in a 5°C increase at the West Antarctic ice sheet, enough to cause the ice sheet to dislodge and melt. Twenty-five percent of Louisiana and Florida, ten percent of New Jersey, and many other lowlands would be flooded. Along the borders of the American and Eurasian continents, the Northwest and Northeast passages would open. The temperature would exceed that of the altithermal period 4,000 to 8,000 years ago and would be nearly as warm as the Mesozoic when dinosaurs flourished.

The research team, led by James Hansen, brackets its predictions within three scenarios for energy growth. Carbon dioxide-related temperature increases, the scientists predict, would range from 3°C to 4.5°C at fast growth of about three percent a year, to 2.5°C at slow growth (half the fast rate), to 1°C at zero growth. In all of the CO_2 scenarios — except total phaseout of coal use and no growth in the rate of energy use — more than 2°C warming will occur before the end of the 21st century.

Caveats in the report are many. First, the authors note, increase in CO_2 depends on an assumed energy growth rate, the proportion of energy derived from fossil fuels, and the assumption that about 50 percent of CO_2 emissions caused by humans will remain airborne. Models for complex climate systems are rudimentary, and estimates for regional climate effects are crude.

The NASA study may be disputed on several grounds. For example, measurements and effects on temperature of volcanic dust and solar radiation are controversial, and it is possible that temperature increases from other natural or man-induced causes are higher than the authors assume. Said David Rind, one of the authors, "There may be other things we don't know about that will offset the greenhouse effect, but to count on their existence would be a naive assumption."

"They have used a very provocative approach," said Wallace Broecker, a geochemist at Lamont-Doherty Geological Observatory in Palisades, N.Y. "The modeling that has been done is just too good to believe we won't see a CO_2 effect. We will probably have to wait 10 or 15 years to see the effect, but damn it, it will be there. Whether the warming will be good or bad is a more difficult question."

Robert Schware, of the National Oceanographic and Atmospheric Administration's Center for Atmospheric Research in Boulder, Colo., stresses that should warming occur, there will be "winners and losers" partly depending on the social and political infrastructure in place to help people cope with the changes. "It's important to keep in mind that the changes might not all be detrimental," he says. He described possible effects of warming, including longer growing seasons at high temperate latitudes, and, with adequate rains and growing conditions, opening of lands now marginally suitable for agriculture. □