Inside This Issue

EDITOR'S NOTE

The risk of a reactor accident leading to a large radiation release has occupied the attention of safety analysts and the public for many years, It was also the risk that was raised during the accident at Three Mile Island. Several days after the accident began, the public was informed that a hydrogen bubble inside the reactor vessel might explode. The explosion never happened and the accident ended with no major radiation release, but the reactor itself is severely damaged and, as described in Boudreau's editorial, its recovery will be delayed for many years by political and economic obstacles.

The major damage and greatest danger occurred very early in the accident; however, this fact was not fully appreciated until later. At Los Alamos safety analysts watched a replay of the accident on a television screen, The replay was the product of a large and complex computer code that had taken several years to develop. It simulated the internal workings of the reactor system that had been hidden from the accident participants by numerous layers of concrete and steel. The severe situation during the early hours became clear.

During the actual accident, the operators overrode the automatic safety systems and for over three hours kept the flow of emergency cooling water to a minimum because they interpreted the abnormally high pressurizer water level shown by the control panel to mean that the reactor primary system was overfilled. Safety analysts saw something quite different on the computer-simulated replay. The pressurizer water level was high during this period because of steam in the system. Later, when the operators turned off the circulation pumps, the steam separated from the water and the water level in the reactor vessel fell below the top of the fuel rods. The uncovered rods began to overheat and soon became so hot that steam oxidized their protective cladding, This reaction produced large quantities of noncondensible hydrogen that impeded the flow of coolant for the remainder of the accident and eventually caused the concern about a hydrogen explosion. Meanwhile, at about three hours into the accident, the uncovered and damaged core was on its way to a meltdown. The meltdown never happened because some minutes later the operators turned up the flow of emergency cooling water and reflooded the core. It was a fairly close call.

In the calm of the aftermath, safety analysts were able to vary the accident scenario and watch what would have happened if the operators had allowed the automatic safety systems to operate as designed. The result would have been a minor accident that would never have made the five o'clock news.

The reactor designers and safety analysts were reassured by the final outcome, but the dramatic series of events clearly demonstrated that the human factor, largely ignored in safety analysis, can lead to more serious accidents than had been generally anticipated.

On the positive side, this fact has changed the direction of reactor safety research. Analysts will now be investigating a much broader range of problems, including the consequences of core meltdown and hydrogen production, fission product migration, and, most important, the interaction of human beings with a complex technology. Moreover, the successful computer analyses of the Three Mile Island accident have helped to convince the skeptics of the predictive capabilities of computer simulation. Advanced computer codes are no longer relegated to the domain of research. They are now being applied to very practical licensing and regulatory problems—the one of most interest to this editor being the prediction of accident signatures and the development of detailed instructions for accident management that, if used well, can reduce the risks from reactor accidents.

Most of the articles in this issue are objective descriptions of the technical achievements in code development and application, but the reader will no doubt detect an implicit pronuclear slant. Perhaps this is to be expected from the Laboratory that began the nuclear age and designed some of the very first reactors. The scientists here live and work around radioactive materials and reactor systems, and their immediate experience contradicts the public's fears. Moreover, their technical knowledge tells them that risks to the public and the environment from nuclear energy are much smaller than those from fossil fuels.

However, these technical experts are also acutely aware of the economic pressures and management realities that divide a commercial enterprise from a research project. As a government-sponsored research group kept at arm's length from industry, they retain a relative objectivity that allows them to see the problems clearly and to suggest technically sound solutions. Their influence should be welcomed by both the public and the industry.

Necia Grant Cooper