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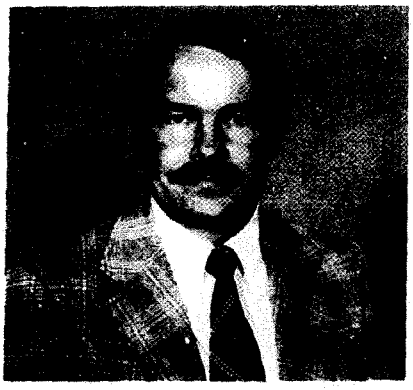

James E. Hatcher

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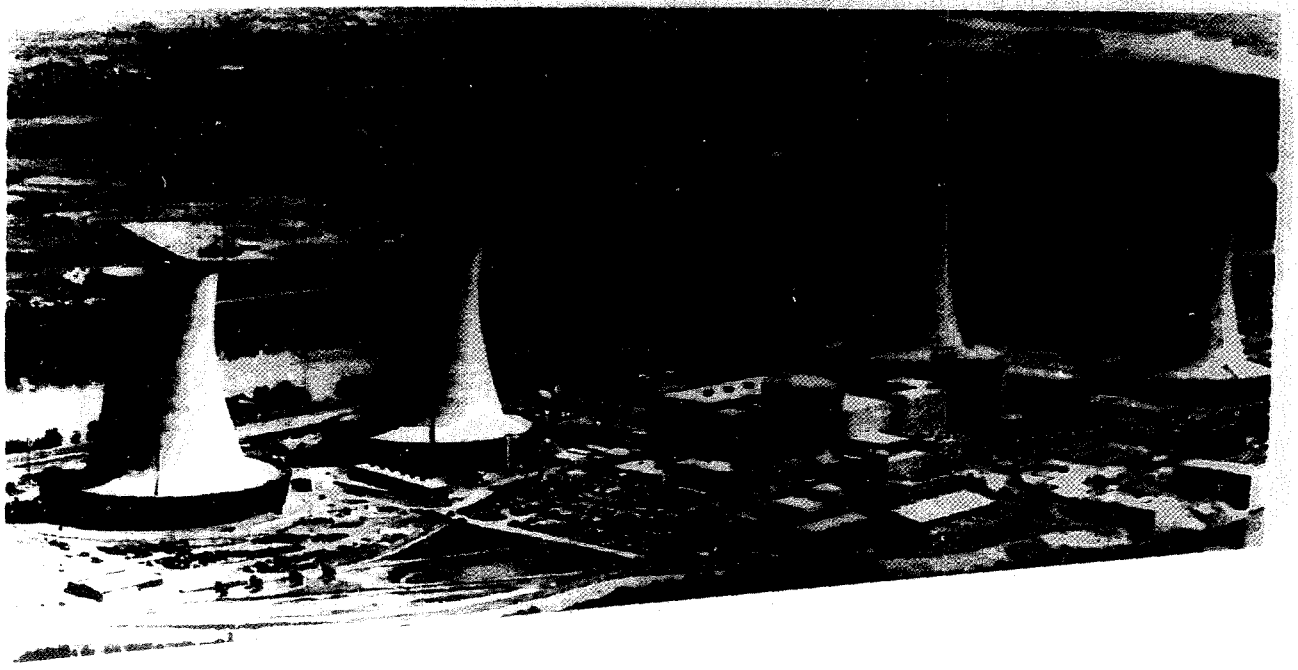
The Three Mile Island Nuclear Accident: GAO's Role

Near 4:00 a.m. on Wednesday, March 28, 1979, an event occurred which triggered the worst accident in the history of commerical nuclear power. Through a combination of equipment malfunctions and plant operator error, the core of a nuclear reactor was voided of cooling water long enough to cause serious damage. Large amounts of radioactive materials and gases escaped from the core into the reactor system and subsequently into the massive concrete containment building surrounding the reactor. Because the containment building was not immediately isolated from the rest of the plant, contaminated water was pumped into another, less secure building where unknown amounts of radioactivity escaped into the environment.

While these environmental releases were not believed to have been significant, much confusion existed at the time of the accident. It was clear that the plant operators and owners, the nuclear industry, and the State and Federal Governments did not fully understand and were not prepared to deal with the events as they happened. This has rekindled serious questions about the safety of nuclear power and has threatened to reduce further the potential of nuclear power in the energy future of the United States.

How a Reactor Operates

A nuclear reactor is, simply stated, a sophisticated machine which produces the steam used to drive a turbine and produce electricity. It is comparable to the boiler in a coal or oil-fired powerplant. The particular reactor at Three Mile Island is called a pressurized,



light-water reactor because it uses light (ordinary) water, held under extreme pressure, to remove heat from the nuclear core. The high pressures—about 2,200 pounds per square inch—permit the water to be heated to about 600° Fahrenheit without boiling. This superheated water moves from the core to a piece of equipment called a steam generator where its heat is used to boil another supply of water. The steam generated by this second supply turns the turbine and produces electricity. Two separate water supplies are used in this type of reactor because the water flowing through the nuclear core picks up some radioactivity and must be kept isolated from the environment. It is called the primary system water, while the other supply that turns the turbines is called the secondary system.

The Accident

On the morning of March 28, 1979, the reactor at Three Mile Island was running at almost full power. A malfunction stopped the flow of secondary system water to the steam generator, causing the primary cooling water and the nuclear core to overheat. Although the reactor quickly shut itself down and safety systems automatically started to function, the operators at the plant misinterpreted certain instruments and turned off some of the automated safety systems. This caused the core to be voided of cooling water and to overheat, resulting in significant damage and some melting of the core. Radioactive particles and gases ordinarily contained inside the metal tubes holding the nuclear fuel escaped into the cooling water, and finally into the large concrete and steel containment building surrounding the reactor. Before the plant operators realized what was happening to the reactor, this contaminated water was pumped to storage tanks outside the containment building. This was the source of most of the radioactive releases at the site.

During the first days of the accident, much talk centered around the hydrogen bubble that had formed inside the reactor system and of the potential for a complete core meltdown. The hydrogen had been formed from a chemical reaction of the superheated water with the zirconium metal tubes encasing the uranium fuel. It was feared that hydrogen, a very unstable element, might explode and break open the reactor system, making it impossible to cool the nuclear core. This situation could have resulted in a complete core meltdown and possibly a major release of radioactivity into the atmosphere.

The hydrogen explosion never materialized, however, and it is now thought that such an explosion was not possible. To explode, oxygen would have had to be present in the system and it is generally believed that no oxygen was present. For a period of time, however, this caused much concern and anxiety. It has been estimated that the worst conceivable release of radioactivity from a nuclear accident could involve the immediate death of 3,300 people, about 45,000 early illnesses, and several thousand square miles of contaminated land.

Response to the Accident

During the accident, all parts of the nuclear industry and the Government sent representatives to the site. Special industry "think tank" groups were established to analyze the ongoing events and offer corrective advice. The Nuclear Regulatory Commission, the Department of Energy, the Environmental Protection Agency, and others sent people and equipment to assist in the decisionmaking process and to monitor and calculate the effects of the radioactive releases.

While this response seems impressive, there were often confusion and uncoordinated efforts taking place—or it seemed that way to the public. The experts in the industry and Government did not appear to understand fully what was happening or agree on methods to deal with it. Clearly defined roles between the plant owners and operators and the Nuclear Regulatory Commission had not been previously established, and questions of jurisdiction and leadership often arose. Extensive news coverage of the accident was sometimes informative, but often misleading and alarming. It reflected the sense of confusion existing at the site. In short, this type of accident had not been anticipated and the emergency response was haphazard and uncoordinated.

What caused this situation? About 20 different groups are currently dealing with that question and have already issued, or plan to issue, reports which reveal their findings. For instance, following the accident, the nuclear industry immediately established a special organization called the "Nuclear Safety Analysis Center" to collect and analyze all information relating to Three Mile Island. The Center plans to recommend areas where the industry can take initiatives to assure such an accident does not reoccur, or if it does, that industrial capability (in terms of people and equipment) will be available to respond.

The Nuclear Regulatory Commission, which is responsible for protecting public health and safety from nuclear accidents, has diverted large segments of its staff to study the accident and identify remedial actions. The first Commission effort was through its Office of Inspection and Enforcement. During and subsequent to the accident, this office dispatched inspectors to the site to investigate the accident, determine the sequence in which it happened, and evaluate potential causes. Its report, issued in August 1979, concluded that the health effects of the accident were minimal and the safety equipment installed in the plant could have prevented any serious consequences if the equipment had been permitted to function as designed. While this study found that improvements could be made in the reactor design and in emergency procedures, it generally faulted the performance of the plant operators and the training they had received.

The Nuclear Regulatory Commission has other important studies underway. Its nuclear powerplant liscensing and inspection offices have begun to evaluate their past performances to determine if changes should be made in light of Three Mile Island. In addition, the Commission has pulled together a group of its employees to study every aspect of the accident and

critically evaluate the Commission's performance, both before and during the accident. To add credibility to this latter investigation, the Commission has segregated this staff from the rest of the organization and has hired an independent law firm to supervise and manage the effort.

Shortly after the accident, President Carter appointed a special commission to investigate the accident and recommend areas needing improvement or change. This group, with a budget of $1.5 million and a staff of 70 professionals, has been reviewing almost every phase of the accident. They are expected to issue a report in early 1980. Without the stigma of dependence on either the Nuclear Regulatory Commission or the nuclear industry to analyze its findings, this special commission has no glaring conflicts of interest and has the opportunity to interject fresh thoughts into the analysis of the Three Mile Island accident.

In addition to these investigations, many congressional committees responded sharply to the accident by scheduling hearings. Much testimony was taken on the accident, its causes, the role of the Federal Government in responding to the accident and regulating the nuclear industry. A special congressional investigation was authorized to study the accident and its causes and recommend needed congressional action. Many congressional committees and Members have requested the General Accounting Office to investigate various aspects of the Three Mile Island accident and provide our independent analysis of the events, and their implications, on the future of nuclear power in the United States.

GAO's Role

Although GAO's role in the Three Mile Island accident stems from specific congressional interest, there is little doubt that we would have gotten involved eventually, even without a request. GAO has consistently investigated and reported the important or controversial issues relating to nuclear power. In fact, several nuclear energy topics did not become issues until identified by GAO. For instance, in the past, our reports have drawn attention to

- the inadequate and inconsistently applied security requirements at nuclear powerplants which could leave them vulnerable to attack or sabotage;
- the question of financial liability for the eventual decommissioning and decontamination of nuclear powerplants—an important consideration at Three Mile Island if the disabled plant cannot be cleaned up;
- the lack of adequate training and qualifications of Nuclear Regulatory Commission licensing board members who issue licenses for nuclear powerplant construction and operation;
- the failure of the Nuclear Regulatory Commission to make independent evaluations of the quality of nuclear powerplant construction and the failure to insure the plants are adequately and safely built—a problem that has strong implications at Three Mile Island;
- the failure of the Commission to systematically evaluate nuclear powerplant accidents or events to determine if these are indications of larger, more generic problems. There have been similar accidents at other powerplants which should have alerted the Commission to the potential for accidents such as Three Mile Island;
- the failure of the Commission to insure that utilities and surrounding State and local governments had adequate emergency plans to deal with nuclear accidents; and
- the lack of progress by the Federal Government in dealing with the storage and disposal of low- and high-level nuclear wastes, a problem that, as much as Three Mile Island, threatens the future of nuclear power.

With this background, GAO was eager to get involved in the accident investigation. Three Mile Island represents the most important event in the history of commercial nuclear power and may spell either the end of nuclear energy or a renewed nuclear beginning in the United States.

As it now stands, the GAO staff has been relatively free to establish the scope of work it feels most appropriate for Three Mile Island-related reviews. In fact, at our staff's suggestion, the interested congressional chairmen agreed that GAO should not, considering the number of investigations already underway, conduct another independent review of the accident. Instead it was agreed that GAO should closely monitor the various industrial and governmental investigations and report our overview and conclusions on the adequacy of their work and analysis.

In response, a task force of 10 GAO auditors from the Energy and Minerals Division and the Philadelphia regional office has been created to handle all requests and inquiries related to Three Mile Island. While we have dealt with several special inquiries, our major effort to date has been to follow the work of the many Three Mile Island investigative groups. We have interviewed people key to these investigations, attended public hearings and staff briefing sessions, reviewed source documents and depositions, and generally tried to stay close to the investigations and understand their scope of work and activities. As each group completes its work and issues a report on its findings, we will verify major conclusions and facts in the report and use consultants to determine the reports' reasonableness and technical accuracy. Contrary to what one might expect, cooperation from these groups has been excellent. Problems with access to records and to key people have been nonexistent; the groups have been eager for GAO's involvement and, hopefully, our endorsement of their efforts.

By the time all the special investigations and inquiries are completed in early 1980, we hope to be in a position to bring together all that has been done, drawing on that information to reach conclusions on the accident, its causes, and the implications of Three Mile Island on the future growth of nuclear power.