Bureau of Mines

Hydraulically powered diamond core drill bores a 500-foot methane drain.

And if the industry stands by its tacit agreement to cooperate in the full-scale development of new techniques, miners may finally lose their suitability for a Dickensian novel.

The new approaches match the fruits of the research with administrative decisions much overdue.

Methane is a highly volatile, highly flammable, invisible, odorless gas formed ages ago when coal was formed; it remains trapped underground if left alone. However, as mines are tunneled through coalbeds, atmospheric pressure alters the pressure gradients which held the gas in the coal, liberating methane. In mines improperly ventilated, it accumulates, ready to be ignited by sparks from equipment or flame-producing explosives. A build-up of coal dust, which occurs if mines are not adequately sprayed with a layer of settling limestone dust, compounds the danger.

The Bureau of the Mines' five-year study project, aimed at understanding fundamental phenomena such as patterns of gas migration through coal and rates of methane liberation from coal particles, has produced basic information that will lead to more rational control. Working with a budget of about $300,000 per year, the methane program has been carried out by scientists at the Pittsburgh Mining Research Center of the bureau. For the development phase, they have asked Congress for a $1.2 million funding increase for next year and $25 million over the next five years.

"Until recently," says Interior's mine research director Thomas Howard, "there has been no scientific foundation for mining research. The crust of the earth, complex to study, has not been the focus of concentrated scientific exploration."

The Pittsburgh project, headed by Director Eugene Palowitch, laid some foundations and developed technology to investigate them. "Gas migration," Palowitch observes, "was once thought to be a mysterious process." Now, the physical laws that apply are being understood. Pressure gradients have been mapped. Problems in distinguishing methane behavior from other natural gases have been at least partially solved. "It is important to know," he says, "that natural gas in sandstone is not adsorbed into the rock. Methane is adsorbed by coal." Further, the researchers have learned that the rate at which methane is liberated is a function of particle size. The smaller the piece of coal, the faster the methane is freed. With such information, scientists can predict the quantities of gas that will accumulate in a given place in a given amount of time and take rational steps to evacuate it.

Drilling boreholes into the coalbed is one potentially efficient way of draining methane from deep mines that are highly gassy and, at the same time, difficult to ventilate. "However," Palowitch explains, "it is not as simple as just going into the mine and drilling a hole anyplace." In fact, even drilling such holes, which can cost up to $100,000 apiece, can be a problem. Previously, 150 feet had been the maximum length, and changing conditions in the rock formation have diverted drills, sending borehole tunnels to the floor or ceiling rather than straight through the mine wall. Development of a hydraulically powered diamond core drill has enabled researchers, using for a change more science than art, to drill smooth-walled holes, two inches in diameter, horizontally into coalbeds for as many as 500 feet. In addition to providing methane drainage, such boreholes can be used to determine physical properties of the coalbed and characteristics of methane flow.

New devices monitor methane-to-air ratios in mines. Even today, such readings are taken by men who hand-carry reading equipment into mine caverns to check methane levels. Modifications of currently available technology, according to Palowitch, have resulted in equipment that automatically monitors these factors around the clock and provides a continuous record.

While research and development move into the arena of scientific sophistication, Interior Department officials are pushing stringent safety demands and Congress is considering a tough, new law governing mining operations. Secretary Walter Hickel, from the mining state of Alaska, has gone so far as to declare that "unless we find ways to eliminate that intolerable cost (in human life), we must inevitably limit our mining of coal." And John E. O'Leary, whom President Nixon appointed director of the Bureau of Mines, has ordered inspectors to abandon the practice of notifying mine owners of impending safety inspections, conducting instead unannounced checks to see that current standards are being met.

BREEDERS

Ready for market

Of all the atoms of naturally occurring uranium, about 99.3 percent are U-238 atoms, unfortunately for the nuclear industry. Only about 0.7 percent are U-235 atoms, which are the fissionable ones. One way to overcome these odds is by the use of a fast breeder reactor (SN: 12/31/66, p. 563). An ordinary nuclear reactor consumes U-235 to produce energy. A fast breeder produces, or breeds, more fuel. In these nuclear furnaces, U-238 is bombarded by and captures high-speed neutrons from a starting source of U-235 or plutonium, resulting in a controlled chain reaction. Thus, the U-238 is changed into plutonium through the neutron capture process. The plutonium is then used as a nuclear fuel.

The only problem is that fast breeders, despite their relatively small size, have a high heat density. Although the heat is used to generate electricity, it also requires a special coolant that absorbs the large amounts of heat produced without slowing down or absorbing the bombarding neutrons. Industry's choice of coolant is a metal: liquid sodium.

The Atomic Energy Commission, deciding that the technology of the fast breeder reactor has progressed to the point where it is ready to be used to produce electricity as well as make nuclear fuel, has invited industry to submit proposals for the first demonstration plant.

The step is none to soon for industry.

Manufacturers of nuclear reactors such as General Electric, Westinghouse and North American Rockwell's Atomics International, have been eagerly awaiting this word since the mid 50's. They want to move now faster than AEC is willing to let them.

The AEC ultimately hopes for three plants to be completed—in 1976, 1978 and 1980—but its present plans concern only the first plant, which is to produce 300 to 500 megawatts of power.

Potential contractors will submit their proposals by July 28. The proposals will detail information about the size of the technical and economic risks involved in building the plant, possibilities of alternate sites, necessary research and development and testing, examination of codes and standards and site and safety analyses.

The AEC plans to award two or more contracts for this first evaluation study, which will take about a year. The winners then become eligible to construct the demonstration plant. Only one company will be selected to do the construction, and it must be associated with a utility company or group, which will operate and maintain the plant.

The total amount requested by the AEC for the companies to make their study is $4 million, although it has yet to be authorized and appropriated by Congress.

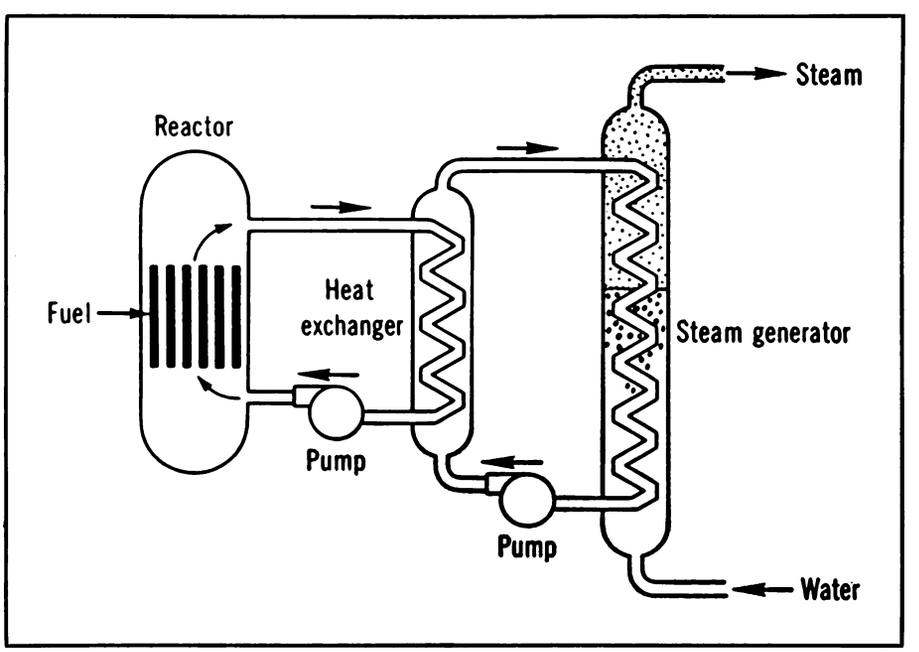
The AEC is following the usual procedure for Government-sponsored power plant construction, a gradual progression from the experimental to the small to the large. The state of the art for the breeders, bolstered by experiments at Idaho Falls and other nuclear facilities, has developed the liquid metal design to the point where the AEC has decided to leave the experimental stage and go to the demonstration plant, which will supply electric power to a community. At present, the breeders are still at the experimental stage. They are producing plutonium but none is generating electric power for consumption.

However, if the AEC has progressed in the technical area, some industry people charge it is dragging its feet in another. The accusation stems from the AEC plan to award one contract at a time for each of the three demonstration plants instead of giving out all three simultaneously. The AEC procedure means that separate proposals will have to be submitted all over again for the two other plants.

The commission defends its policy on the grounds that:

- There are not enough trained personnel on hand to design and construct all three.
- The budget does not permit simultaneous contracts. (The $4 million represents a cutback from $6 million out of a possible Government contribution of $80 million for the first plant.)
- By staggering the plants, the AEC makes it possible for each succeeding contractor to profit from the experience of his predecessor.

Daniel J. Shiller, in charge of handling the contracts for the AEC, points out that spacing the proposals will protect against duplication of effort. For example, if three companies are working simultaneously, they might all expend part of their design effort in one area, such as a heat exchanger or a coolant pump, where one team would be sufficient.



AEC

Liquid metal cools reactor by transporting heat away to change water to steam.

Shiller sees the present AEC call for the studies as a positive contribution. "Its intent," he says, "is to try to insure the success of the demonstration plant. It will give the parties a better feel for what they're getting into."

Still, not all industry people accept the AEC reasoning. John J. Flaherty, president of Atomics International, was quoted in NUCLEAR INDUSTRY magazine as saying, "We suggest that a much more logical approach would be the simultaneous construction of two or three plants. Not only will simultaneous starts be a greater spur to competition in the industry, but they should also bring the breeder to commercial status in a short time."

Dr. A. Eugene Schubert, vice president and general manager of General Electric's Nuclear Energy Division also takes exception to the choice. "General Electric has an adequate number of highly qualified technical personnel trained and available in a well-established separate organization capable of designing and constructing breeder plants," he says. He also feels that if there is more than one initial demonstration plant—and he thinks there should be—it is unlikely that the Government's contribution to each plant would be as high as $80 million.

"The present call for proposals possibly could ask industry to retrace steps it already has taken," he adds, "but that judgment will have to be deferred until a thorough study of the proposals can be made."

This invitation for proposals is the fourth of its kind since 1955. The first three invitations were for a thermal reactor-type of power plant, which employs relatively slow-moving neutrons. This fourth invitation is for a nuclear reactor employing fast neutrons, which are required for the production of plutonium from U-238.

DEMANDS OF THE POOR

Social workers move

Professionals in the field of public assistance have been held back through the years in serving the poor by red tape and lack of funds. They felt thwarted by inadequate welfare systems.

When 7,000 professionals gathered at the National Conference on Social Welfare in New York (SN: 6/7, p. 549) they intended to discuss "An Action Platform for Human Welfare." Their attempts to come to grips with the problems of social change were both challenged and spurred as welfare clients and militant civil rights advocates forcibly interrupted their meetings. And a new definition of the position of the social worker appeared to be emerging,