# NRC Takes a Second Look at Reactor Design

*The Crystal River incident seems to confirm doubts about B & W reactors, raised at Three Mile Island*

As it braces for a reorganization soon to be announced by the President, the Nuclear Regulatory Commission (NRC) this month comes to grips with the most difficult technical decision it has had to face since the accident at Three Mile Island a year ago.

At issue are the safety and reliability of the reactor made by Babcock and Wilcox (B & W), the type that went out of control at Three Mile Island and which is installed in five other operable generating plants around the country. It is just possible, says Darrell Eisenhut, acting director of the NRC's division of operating reactors, that the NRC staff will find this system unstable in its present configuration.

Eisenhut's deputy, Robert Tedesco, was asked on 13 March to lead an intense 2- to 3-week review of the problems with B & W reactors and come up with some definitive conclusions based on the last 12 months of study. The review was prompted in part by the gyrations of a reactor in late February at the Crystal River plant in Florida, in which the system overheated and dumped radioactive water onto the floor of the containment building. That reactor was made by B & W.

The NRC staff must investigate this latest incident in an atmosphere of some uncertainty. The original investigation of steam system troubles in B & W reactors last year grew out of a request made by Commissioner John Ahearne, the man named by President Carter in December as the new, but temporary, chairman of the NRC. Carter has already given notice that Ahearne will not remain chairman, and he has indicated that the reshuffle of NRC authority will give Ahearne's successor greater power to direct, hire, and fire members of the staff. Will the new chairman share Ahearne's concerns? One cannot say.

Thus, with uncertain leadership in the NRC and the White House, the NRC staffers are tackling an issue whose resolution could be very important to the future of nuclear power. If the B & W system is as problem-ridden as some on the NRC staff think it is, then the public and the nuclear industry would be well served by a decision to scrap or overhaul this particular system quickly. This would be a painful decision, costly in financial terms, in lost energy production, and in lost prestige for the companies concerned. But it would be less costly to the industry than a prolonged record of stumbles and near-accidents.

Alternatively, if there is no fundamental design weakness in the B & W reactor, the NRC will have to demonstrate that the accident at Three Mile Island and the severe "transient" at Crystal River are unrelated. It will need to defend any policy that allows these reactors to continue operating without remodeling.

The trouble with the B & W system may be that it is too rambunctious. Like an overbred racehorse, it may be too jittery to settle down placidly to its task (boiling water). It likes to cavort. This is not the way the NRC describes the problem it is examining this month. The analogy is suggested by a phrase that engineers use when they talk about the unique characteristics of the B & W equipment: it is "extremely responsive," they say. Is it perhaps too responsive for ordinary control room operators to ride?

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In a sense, the question has already been answered. During normal operation the B & W reactor is run with the help of an instrumentation and control system (ICS), which uses a computer to make split-second judgments and adjustments governing the reactor. The computer is necessary, the NRC's Eisenhut explains, because a mortal operator cannot be expected to respond rapidly enough to keep up with the reactor when its delicate equilibrium is disturbed. He points out, for example, that with a loss of coolant, the B & W reactor may allow the operator a grace period of only 30 to 60 seconds before boiling dry, while other reactors typically allow 30 to 60 minutes. This unforgiving quality of the equipment poses no hazard ordinarily, but when something utterly unexpected happens, as was the case at Three Mile Island, or when the computer fails, as was the case at Crystal River, it greatly magnifies the demands placed on human capabilities. Not every operator can manage a reactor during a crisis.

Here, in brief, is how Eisenhut describes the Crystal River mishap. The plant "took off and did its own thing" when the computer in the ICS began receiving and giving out erroneous information. The trouble began when something (it is still not known what) created a short circuit in a section of the control room not related to the reactor controls. The utility, Florida Power, claims that the short circuit was caused either by a bent connecting pin in the control panel or by some maintenance work being done on an adjacent panel. The short did not knock out the entire system but did distort readings flowing through all the controls. It is important that the coolant in a B & W reactor remain within a relatively narrow band of temperatures. The computer, which is instructed to worry about such things, "thought" that the coolant was growing too cold. It thereupon began to accelerate the nuclear reaction in the core by withdrawing control rods. It simultaneously reduced the flow of coolant. The reactor overheated, drove the pressure up to the danger level, and then automatically shut down.

The befuddled computer instructed the pressure relief valve to open and remain open. This happened as the result


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of a "design defect in the electrical system." The emergency core cooling system began pumping water into the reactor. An astute operator noticed the computer's error in opening the relief valve, and several minutes later plugged the leak by switching shut a block valve. Water filled the reactor to the top and then poured out through two safety valves. One of these did not at first reseat properly. Before it was over, 43,000 gallons of radioactive water were dumped on the floor.

While this was not a major accident, it has proved a major embarrassment for the NRC. It occurred on the very day the commission announced that it would resume licensing new reactors, a procedure which had been suspended for 11 months while the Three Mile Island accident was being studied. Secondly, the Crystal River incident seemed to confirm doubts about the B & W system raised by the NRC staff last fall.

Harold Denton, director of the NRC's office of nuclear reactor regulation, wrote to owners of B & W systems on 25 October, alerting them to the NRC's investigation and asking for their help. A paper which he appended stressed a broad concern: "The staff is concerned by the inherent responsiveness of B & W OSTG [once-through steam generator] design. While some specific instances are presented in the next section of this paper, the staff concerns are also of a general nature. It is felt that good design practice and maintenance of the defense-in-depth concept require a

# INFCE: Little Progress in

What does one do with a $100-million study of nuclear proliferation which challenges the policy that created it? One does what the Carter Administration is doing with the final report of the International Fuel Cycle Evaluation (INFCE), issued on 26 February. One looks for silver linings and speaks warmly about the process of international cooperation.

Work on INFCE began with a big push from the new Carter staff in the spring of 1977. Relations between international buyers and sellers of nuclear systems were strained at the time. India secretly had built and detonated a "peace bomb" in 1974, and Canada had suspended its export agreements with the Indians in 1975. As an attempt to bring order to the market, INFCE immediately won the attention of prime ministers and presidents, according to a State Department official. Now the project seems to have receded into the shadows.

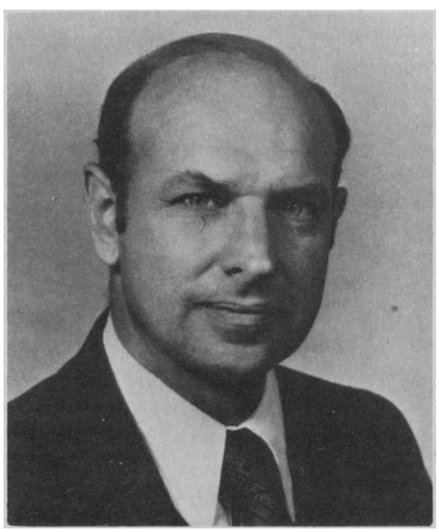
The Administration's goal was to define the technical areas in which nations might cooperate to prevent the use of commercial nuclear systems for warlike purposes. Experts from 66 countries met in Vienna and divided into eight specialized working groups. They labored for 2 years and produced 20,000 pages of documents. In the end, they showed little liking for America's purpose in launching the conference—a desire to have international controls placed on radioactive fuels and nuclear technologies that might be used to make bombs. Specifically, the Americans sought to delay indefinitely commercial development of the breeder reactor, which produces its own plutonium fuel (a weapons material). They also sought controls on plutonium shipments, the enrichment of uranium, and fuel recycling.

INFCE delegates were less than eager to endorse these proposals. On the contrary, they were quite enthusiastic about developing the breeder, which they find attractive because it helps make its owner less dependent on foreign energy suppliers. The pro-breeder sentiment came from industrial nations other than America which have invested heavily in nuclear power and are working to establish their own breeder systems. The United States has the largest breeder research program; France, Japan, West Germany, and Great Britain are determined not to be left out of the game.

While America's peers in the nuclear trade criticized the U.S. position on the breeder, the developing countries chided the big powers for trying to impose arbitrary rules on the commercial market. The nuclear "have-not" nations were chiefly interested in winning assurances that they will be able to buy any material or technology the nuclear "haves" possess. The have-nots failed to endorse any new tactics for controlling fuel cycles.

Thus the first global attempt to fashion controls for the international nuclear market was less than a stunning success. It will be followed by other talks, but none so ambitious. "If you're asking whether there will be a son of INFCE," a State Department staffer said, "the answer is no." Given that this is a sensitive issue, and given that 1980 is an election year in the United States and West Germany, he said, not much progress should be expected. "We are going into a period of quiet diplomacy." There will be private bilateral negotiations between buyers and sellers, and America will use its position as the biggest nuclear power to win cooperation with its policy of restraint. But there will be no general conferences.

American officials cite several achievements which in their view made INFCE a success. It was a major accomplishment, they say, to get so many nations with such divergent interests to agree on anything. INFCE delegates represented the haves and the have-nots as well as signers and nonsigners of the nonproliferation pact of 1968. It was important to have "a pause in what was a rather acrimonious debate," says Thomas Pickering, assistant secretary of state for oceans and international environmental and scientific affairs. He points out that INFCE was a technical proceeding, not a political agreement. He also claims that INFCE's technical report is written in such a way that it gives support to America's policy of moving slowly on the breeder. It is still too early, Pickering says, to know how the results of INFCE will affect U.S. policy on international nuclear commerce.



*Thomas Pickering*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stable well-behaved system. To a large part, meticulous operator attention and prompt manual action is used [sic] on these plants to compensate for the system sensitivity, rather than any inherent design features. The staff believes the general stability of the B & W plant control systems should be improved. . . ."

Many changes were made as a result of this study and others done by the industry. But the significance of the Crystal River foul-up is that the problem persists. The extreme "sensitivity" of B & W reactors, identified as a source of trouble at Three Mile Island, may be a fundamental flaw for which no quick technical fix is available.

Duval Holt, a spokesman for B & W, said his company is not yet prepared to comment on the transient at Crystal River or on any of the generic problems associated with B & W equipment.

Florida Power, which owns the plant at Crystal River, is "well satisfied" with the B & W equipment thus far, according to spokesman William Johnson. No damage was done to any critical equipment; the radioactive waste has been removed from the containment building and prepared for shipment to South Carolina's disposal site. It is too soon, Johnson said, to estimate the cost of this incident or to render a final judgment on the plant's performance.

The Nuclear Safety Analysis Center (NSAC), a research organization created last year by the electric utility industry, concluded a brief study of the Crystal River incident in early March. The staf-

# Controlling Nuclear Proliferation

According to the Carter Administration, INFCE was a "consciousness-raising" exercise whose most important feature may have been its "process." It persuaded delegates from 66 nations to reach a consensus on the hazards of nuclear fuels cycles. The substance of that consensus seems quite bland. There were a few hard points of agreement, however, which may lead to action in the future.

- The INFCE report adopts a lower estimate of the international demand for nuclear power than had been used previously and concludes that supplies of uranium will be adequate through the end of the century. Because there will be no difficulty in finding supplies for the current generation of thermal reactors, there is no pressing need to create a fuel recycling system or a system of self-supplying breeder reactors. This finding debunks the argument that breeders are needed to avert a fuel supply crisis.
- The report also finds that fuel recycling and enrichment facilities already planned or built will be adequate to supply the nuclear industry for at least a decade. It would be an economically risky decision to invest new capital in such facilities at the present time, INFCE concludes.
- INFCE declares that while some nations may have difficulty storing spent reactor fuel, there are safe ways to cope with this problem without investing in fuel recycling. The International Atomic Energy Agency (IAEA) has agreed to oversee a study of methods that might be used to store spent fuel. The study, it is hoped, may lead to the creation of an international spent fuel repository.
- INFCE suggests that it may be possible to develop an international program to audit and control civilian plutonium inventories. The IAEA will undertake another study to explore this possibility.
- INFCE supports work going on in the United States and Europe directed toward lowering the grade of fuel used in research reactors so as to make research materials of no use to weapons builders. The flaw in this scheme is that someone must pay for the conversion. No one has offered to put up the funds as yet.

American officials seemed disappointed by three of INFCE's decisions, or perhaps they should be called indecisions. The United States was pushing for a clear declaration that the breeder reactor is a technology of the 21st century and not one that merits commercial support at this time. It got no such declaration. Second, the U.S. representatives hoped to have INFCE rank the various nuclear fuel cycles according to the risk they might pose as a source of weapons material. If there were such a ranking, nations might agree to delay investments in the riskier technologies. No such ranking was made. Last, the Americans were disappointed with INFCE's estimates of future demand for nuclear power. According to the chief U.S. delegate, Ambassador Gerard C. Smith, American government projections of domestic nuclear power demand for the year 1995 are now 30 percent lower than those used by INFCE in computing its figures. America's use of nuclear power is about half that of the free world total, thus, INFCE's lowest estimate, based on computations made 2 years ago, probably represents what is now the high end of the range. If the demand estimates were adjusted downward, as Smith thinks they should be, the perceived need for breeder reactors and fuel recycling systems would decline.

The INFCE demand figures are "sort of an international joke," says Henry Rowen, a nonproliferation specialist at Stanford University. "Nobody I know who's looked at it seriously believes the low end of the INFCE range is going to be attained by the year 2000." And yet, "people stand up and make these solemn speeches about meeting this demand when it's almost collapsed."

Rowen served as an adviser to the Carter Administration during the INFCE talks, and he is pessimistic about the results. There is not much hope for controlling fuel technologies in the short run, he thinks. The safeguards used by the IAEA "really let people do anything they want." In rejecting the American approach to controlling plutonium, Rowen says, the INFCE delegates offered no alternative: "The problem remains, what do you do if you believe there are major dangers associated with increased access to these materials?" Rowen fears that it may take a disaster to persuade the world that there must be stricter controls on commercial nuclear technology.—ELIOT MARSHALL

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fers who worked on the project at first proposed to make recommendations for changes in specific types of equipment, but in the end they decided to offer broad, generic suggestions. As one NSAC staffer said, the operators at Crystal River were "flying blind" during the crisis because the control room instrumentation had failed. Therefore, the principal recommendation of the NSAC study is that some sort of redundancy be built into the controls that govern normal operation of the plant. This would require a redesign of electrical power supply systems.

No matter what remedy the NRC chooses, the decision will be difficult, for the commission works in a highly charged political environment today. Industry leaders are protesting loudly that the government has become too concerned with the trivial mechanical problems of nuclear plants and not enough concerned with impending energy shortages. Yet the NRC can hardly ignore the safety-related problems that its own staff and NSAC have identified. It will be interesting to see how the lessons of the Crystal River incident will be applied.

—ELIOT MARSHALL

# Navy to Close Arctic Research Lab

## *Other agencies and the state of Alaska have been asked about supporting the facility, but so far no takers*

The Naval Arctic Research Laboratory at Barrow, Alaska, which has come to serve as a national lab for arctic and polar research since its establishment 33 years ago, will begin closing down this fall despite recommendations by some prominent arctic specialists that it be kept operating.

Senator Ted Stevens (R-Alaska), who is trying to save the lab, has proposed an amendment to the pending Alaska lands legislation which calls for a 1-year study of both the need for a continuing program of arctic research and the possibility that some agency (or group of agencies) other than the Navy might assume responsibility for the facility at Barrow. At the moment, however, the likelihood is that the lab will not survive beyond this summer. The Navy feels that its need for the lab has diminished to the point that it can no longer justify bearing the substantial cost—$11.6 million in fiscal 1979—of the lab's operation.

According to Navy sources, after 3 decades of work conducted from the facility, the Navy has met many of its research needs with respect to the western part of the arctic basin and now wishes to focus more on the eastern part. In cooperation with the government of Denmark, the Navy is engaged in research conducted from Nord, a community near the northeast tip of Greenland and the East Greenland and West Spitsbergen currents. These major currents, one flowing south and the other north between Greenland and Spitsbergen, account for some 80 percent of the exchange flows between the Arctic Ocean and other oceans and are now a prime subject of arctic research interest.

*Naval Arctic Research Laboratory at Barrow, Alaska.*

In 1979 the National Oceanic and Atmospheric Administration (NOAA) and the Department of the Interior actually conducted substantially more research out of the Barrow facility than the Navy did. Nevertheless, when the White House Office of Science and Technology Policy (OSTP) and the Directorate of Defense Research and Engineering wrote NOAA, Interior, and other agencies last year to ask whether they wished to assume responsibility for the lab, the answer was no. And, according to Philip Smith of OSTP, the state of Alaska also has not come forward with an offer to take over the lab or even contribute state funds to its support.

(The state would appear to be in an excellent position to help support the lab. Alaska gets 12 percent of all the oil produced at Prudhoe Bay, and, with last year's dramatic rise in oil prices, oil revenues are piling up, with a budget surplus of $1 billion or more expected at the end of June. The University of Alaska has been managing the lab under a Navy contract.)

The study that Senator Stevens has in mind apparently would again look to the chance that a group of federal agencies will wish to join in the support of the lab.


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