Academy Squabbles over Radwaste Report

Chairman of waste solidification panel is indignant at academy officials' decision not to publish what Handler calls a "flawed" document

In 1976 the U.S. Nuclear Regulatory Commission (NRC) asked the National Academy of Sciences for a report evaluating alternative technologies for solidifying high-level radioactive wastes. The unseemly dispute that has since arisen within the academy over this report, which was delivered to the NRC 12 months ago, offers a rare backstage view of the academy that shows that the rendering of advice on controversial issues by the high priests of science can resemble an intellectual tug of war in which all of the contestants take a fall.

The president of the academy, Philip Handler, sent the report to the NRC last July with his blessings. But Handler has now outraged the chairman of the academy's waste solidification panel, Rustum Roy of Pennsylvania State University, by partially repudiating the report as a "flawed document." The academy's Commission on Natural Resources also has expressed its reservations and decided to rescind its earlier decision approving the report for publication.

The waste management staff at the NRC, on the other hand, is pleased with the report and is preparing to print several thousand copies of it. One notable thing about the report is its recommendation with respect to glass as a material for encapsulating wastes. It does not reject glass but makes clear that no longer should glass be the "waste form" of choice and that R & D on crystalline materials such as ceramics should now receive priority.

In a letter to the Department of Energy (DOE) on 11 June, John B. Martin, director of NRC's waste management division, endorsed the report's recommendations as the way to go. But NRC staffers indicate that this endorsement speaks less to the report's overall quality than to its emphasis on the need for intensified research on crystalline materials and for a severalfold increase in funding for waste solidification R & D (now running at about $35 million a year).

Strong personalities on the solidification panel's parent body, the Radioactive Waste Management Committee, contributed to the confusion now surrounding the report by pressing hard for revisions in its early drafts. As a result, the report was weakened by a contrived statement of consensus that blurs opposing points of view about the suitability of glass as a waste form.

Gilbert F. White of the University of Colorado, the chairman of the Commission on Natural Resources, is convinced that this effort at consensus was carried too far and led to the whole embarrassing problem. But a perhaps equally important cause of difficulty seems to have been that the pro's and con's of glass and other waste forms were never clearly and coherently evaluated in terms of alternative waste disposal strategies.

Last December, at a meeting of the radwaste committee, Roy threatened to take to the streets and picket if publication of his panel's report was further delayed and changes were made in it on the strength of criticisms by a Department of Defense (DOD) contractor.

"I will have signs," Roy said. "We'll be standing out there tomorrow and Debby Shapley [a reporter for *Science*] will be out there, I assure you. And you better be ready to answer," Roy added, turning to the chairman of the radwaste committee, Ernest F. Gloyna, dean of engineering at the University of Texas, who wanted the committee to consider an evaluation of the DOE criticisms by an ad hoc group of reviewers which he had appointed. "If you don't answer, Ernie, you better be ready to defend it."

"You have done a good job of politicking this thing through," replied Gloyna.

"I have not!" Roy came back. "I could have cleared everything in 1 minute if I was given the chance to go ahead." He observed that his solidification panel, made up of experts in the materials sciences, had certified that the report was free of substantial error. He then wondered out loud whether Gloyna was going to say the panel is a "stupid bunch of idiots [and go instead with some DOE] master's degree scientists who have published three papers in their life."

Although the Roy panel's waste solidification report is narrow in focus and highly technical, its recommendations bear on matters of critical importance to the future of radioactive waste management (*Science*, 20 April). In particular, the report holds that, while glass is suitable for use in a "first demonstration" of a waste solidification and disposal system, it is generally much inferior to crystalline materials such as ceramics. Glass is characterized as highly susceptible to reaction and leaching if exposed to water and high temperatures and as thus by no means the best material for immobilizing wastes that may be placed in deep geologic repositories.

This characterization of glass as an inferior waste form is considered bad news by some leaders of the nuclear enterprise because most of the past research and development work in waste solidification in the United States and Europe has centered on glass. Indeed, a glass solidification technology similar to that employed by the French at Marcoule to solidify wastes from their nuclear weapons program has been regarded by DOE as a prime candidate to be used in the $2.8-billion military waste facility which it is ready to start building at Savannah River if Congress ever gives the go-ahead (which won't happen this year).

In the view of DOE waste management officials, alternate technologies, however attractive in the long term, have not yet been proved acceptable for operational use. (They say, however, that work on the Savannah River solidification facility could proceed without a commitment now to either glass or an alternate waste form, because 90 to 95 percent of this facility would be used to convert wastes from liquids and sludges to the dry, powder-like "calcine" that would be incorporated into whatever encapsulating solid material is finally chosen.)

During the preparation of the waste solidification report in 1977 and 1978, Roy and his panel were challenged by an unusually influential member of the radwaste committee, W. Kenneth Davis, vice president of the National Academy of Engineering and a top official of the Bechtel Power Corporation of San Francisco, an engineering and construction firm that is one of the giants of the nuclear industry.* Upon seeing the first draft, Davis took alarm. He noted that DOE's

*The respect and influence Davis enjoys in the National Academy of Engineering was manifest early last April when Courtland D. Perkins, president of the academy, asked him to prepare a brief paper summarizing for the other members his observations about the nuclear accident at Three Mile Island.

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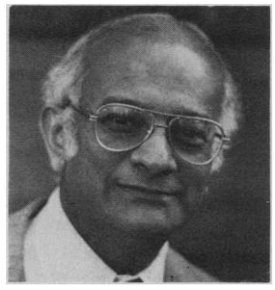
predecessor agencies, the Atomic Energy Commission and the Energy Research and Development Agency, were being severely criticized for having placed heavy emphasis on glass, almost to the exclusion of R & D on other potential waste forms. In a letter to an academy staff officer in November 1977, Davis warned that the report as then written could be interpreted as concluding that the United States would not be able to select "an appropriate . . . waste solidification process for another 10 years or more."

The report would be seized upon by opponents of nuclear power, he said, and



Rustum Roy

Photo by L. J. Carter

could have the "effect of destroying the present waste management program." Davis added that the report's "conclusions and recommendations should be changed [in the interest of] getting on with a realistic program which will enable nuclear power to move ahead expeditiously, at least to the extent that it is being held back by concern about the difficulties of radioactive waste management."

Principally as a result of these and subsequent criticisms by Davis (Gloyna also offered criticisms, but his were less substantive), parts of the panel report were rewritten several times by Roy and his colleagues. The criticism of the government's record in waste management R & D was toned down, and a summary of conclusions and recommendations was included up front which stated, albeit ambiguously, that use of glass was not to be ruled out.

". . . Because of an extensive developmental effort," the summary said, "[glass] is currently adequate for use in a first demonstration system consisting of solidification, transportation, and disposal. For the implementation of a large-scale solidification program, glass may also be adequate, but, on the basis of our analysis, *it cannot be recommended as the best choice* [emphasis in the original]. . . . In fact, a modest R & D effort may well provide alternative first or second generation solid forms whose long-term stability and ease of processing are superior to glass."

The concessions made to glass apparently were too limited and backhanded to satisfy Davis, and at least one meeting of the radwaste committee at which a new draft was discussed is said to have come perilously close to degenerating into name-calling. Certainly the notations Davis made on some of the drafts show that he did not always bother to express himself diplomatically. In one place where the status of waste solidification R & D was being discussed, Davis wrote: "I really object. Pure B.S." In another place, he put, "stupid statement."

In a letter to Gloyna in February 1978, Roy, another academician who does not shrink from plain statement and confrontation, said that his panel had gone as far as it should in trying to reconcile its differences with Davis. Davis, he suggested, should now state his opinions in a minority report. Roy said that six of the radwaste committee's eight members had already signed off on the fifth draft of the report and that Gloyna should be prepared to have the committee as a whole act on it at its meeting the next month.

Including a statement of minority views in the report was something Gloyna wanted to avoid, however, and it turned out that this was not necessary. Davis ultimately withdrew his objection to publication when assured that the appearance of the report would not imply that he concurred in everything in it.

In March 1978 the report was submitted to Gilbert White's Commission on Natural Resources and to the academy's Report Review Committee, chaired by Saunders MacLane, professor of mathematics at the University of Chicago. In light of what happened subsequently, it is clear that these review bodies did an indifferent job of looking to the report's coherence and overall quality.

The reviewers included six members of the National Academy of Sciences and even a former presidential science adviser, George Kistiakowsky. In general, their comments on the report were quite favorable. But two reviewers observed in passing that the discussion of the suitability of glass as a waste form was ambiguous. A third reviewer, Hatten S. Yoder, Jr., director of the Carnegie Institution's Geophysical Laboratory and himself an authority on the characteristics of glass, took strong exception to the fact that use of glass had been given even a limited endorsement.

Yoder's objection alone should perhaps have been enough to warn the Report Review Committee and the Commission on Natural Resources that there were major problems with the report. A central problem was that the report never came to grips with a fundamental question of strategy: Wastes can be solidified to make them easier to handle and transport and emplace in a geologic repository, with the repository intended to serve as the principal barrier between the wastes and the environment; or, alternatively, solidification can have the aim of achieving a waste form that will itself contain and immobilize the dangerous radionuclides for periods of up to 1000 years or longer, thus giving the waste disposal system a degree of redundancy.

The latter concept, of a strategy of multiple barriers, now holds sway in the NRC and among many other people who are interested in radwaste management. But the report, although containing much technical information bearing on this strategy, offers no coherent discussion comparing the characteristics of glass, ceramics, cement, and other materials in relation to it or to any other strategy.

Early last September the report, having been cleared for publication, had been sent to the printer and the presses were about to roll. But, just at this point, Captain Winfred E. Berg, the retired naval officer who serves as the top staff officer to the radwaste committee, received a telephone call from DOE informing him of detailed and damaging critiques of the report by some of its contractors, especially the Pacific Northwest Laboratory (PNL) run by Battelle.

It was late Friday afternoon, and Berg could not reach Gloyna or any of the top officials of the academy. So Captain Berg—as the officer on the bridge, so to speak—took it upon himself to call the printer and stop publication. Later, when Roy learned of this, he was furious at Berg for taking such an initiative, especially inasmuch as the prepublication draft sent to DOE and several other interested agencies had not also gone to other parties such as environmental groups and interested research scientists.

Roy believed that the PNL, which has received millions in federal research funds to develop "vitrification" technology, had a vested interest in glass. The very thought that this laboratory should be allowed to put a hex on his report struck him as an outrage. Even before this incident, Roy had been down on Berg. In his opinion, Berg had overstepped his staff role during the formal review process, as when he sent to the Commission on Natural Resources his own evaluation of the panel's responses to criticisms by reviewers.

But Handler and Gloyna felt that Berg had done the right thing in holding up printing of the report. Gloyna now set about to have the report reviewed in light of PNL's extensive comments. First he asked the waste solidification panel to look for errors of fact or omission. Then, after members of the Roy panel found nothing important amiss with their report, Gloyna appointed three members of other radwaste committee panels to look at the report independently. One of these reviewers, Thomas H. Pigford, professor of nuclear engineering at the University of California at Berkeley, took this assignment seriously and eventually prepared a lengthy critique.

Meanwhile, Roy was chaffing at the continued delay in the report's publication. In a letter to Handler last October, he observed that, for the report to be called into question by DOE contractors "who may stand to lose some business" represents a "conflict of interest . . . so gross as to be mind-boggling." (Recently, Handler, alluding to the DOE contract work done by Ray's lab at Penn State in ceramics, told a *New York Times* reporter that for Roy to be making such allegations was "like the pot calling the kettle black." But when *Science* asked him about this statement, Handler took it back, indicating that he meant merely to say that the intellectual honesty of neither Roy nor Battelle should be impugned simply because their laboratories are engaged in DOE-sponsored research.)

Roy requested that Handler rule on the propriety of the review Gloyna had initiated. Also, he suggested that a technical panel such as his might better report directly to the Commission on Natural Resources and the Report Review Committee without first having its work approved by a radwaste committee made up of people "technically nonexpert" in the particular matter at hand. The commission could then expect the "least diluted technical judgment," Roy said.

Gloyna interpreted Roy's letter to Handler as a personal attack on himself, and he wrote Roy a hot letter in reply. "Now, if you wish to politick and reorganize the structure of the academy, that is your privilege," he said. "Just keep the facts straight. Frankly, I don't care if your panel reports directly to Dr. Handler. However, if I, as chairman of the [committee], am charged with producing the best studies possible, the reports will not be ambiguous and the academy policies will be followed to the best of our committee's ability."

He added that the recent comments by the DOE contractors on the report were not instigated by him, but were entirely unsolicited. "I understand the academy always responds to comments and will accept improvements in factual data right up to the last moment," Gloyna said.

Roy has regarded the PNL comments as defensive, self-serving rubbish that reflects badly on the competence of those responsible for them. But this was not Pigford's view. Early last December, several days before the radwaste committee was to meet and bring Roy and Gloyna into heated confrontation, Pigford sent Gloyna his critique, which ran to nearly 100 pages and contained a point by point discussion of all the criticisms that had been made.

"I find that most of the DOE comments do indeed bring into question the adequacy of the data base and documentation of this report," he said, adding that "with only a few exceptions, DOE is pointing out conflicting data or lack of sufficient data, rather than arguing for different judgment and conclusions from the panel."

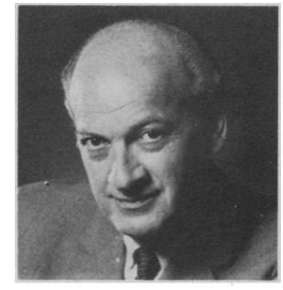
But Roy now asks, "Who is Pigford? Where did he come from? Can any ad hoc reviewer come in from off the street?" or, somewhat more charitably, he will say that "Pigford is a fine nuclear engineer" whose knowledge of waste solidification "could be written on a postage stamp."

But Handler and Gloyna together with Gilbert White and his Commission on Natural Resources, have been impressed by Pigford's criticisms, some of which clearly are justified because they call attention to obvious inconsistencies in the report. In particular, Pigford, like one of the DOE reviewers, asked how glass could be deemed acceptable by the panel for use in a full-scale demonstration of waste solidification and disposal when, elsewhere in the report, emphasis is placed on the deficiencies of glass. "In no place does the panel explain its criteria of 'adequacy' or explain why glass is 'currently adequate,' " he says. "If the panel believes in and supports its positive conclusion, then some justification should be provided. Otherwise, it is a glaring and major inconsistency within the report."

Curiously, in light of this criticism, at the radwaste committee's December meeting Roy invoked the name of Hatten Yoder, suggesting that if the committee were going to consider Pigford's evaluation of the DOE comments, how could it not also hear from this scientist who had faulted the report for its concessions to glass.

But, supported by some other committee members, and by academy member Harold L. James of the U.S. Geological Survey in particular, Roy was successful in his motion to have the committee reaffirm its earlier approval of the report without considering Pigford's critique. The vote went 12-0, with Gloyna, Davis, and two others abstaining.

But Gloyna simply passed the question as to the report's status on to the Commission on Natural Resources. The commission's decision, reached at its March meeting, was not to publish the report and to send the NRC some letters explaining its reservations about it and offering to undertake a further assessment of waste solidification technology.



Philip Handler

Photo by di Gesu

Since then Roy has continued to complain of a violation of "due process," while Handler has insisted that the guarantee against double jeopardy for common criminals at the bar should not apply to academy reports and that what matters most in their case is that they be well done. He defended Gloyna's actions and indicated that, should a similar situation arise in the future, the appointment of another ad hoc group of reviewers might be in order.

"To allow a flawed report to stand for procedural reasons will not be allowed to happen while I sit here," he told *Science*.

What object lessons are to be learned from this convoluted tale? One is that White is almost certainly correct in his judgment that much of the difficulty with the report stemmed from the failure to deal forthrightly with the conflicts in the radwaste committee by means of majority and minority reports. Another is that the report review process seems to have been entirely too casual, with the responsible bodies failing to respond even in the few instances where reviewers identified substantial problems of inconsistencies or questionable judgments.

All in all, the academy's stumbling, awkward performance in this case in which its advice was sought on an issue of critical importance was not what would be expected of a body that preens itself on its members' intellectual preeminence.—LUTHER J. CARTER