Reactor Safety: Congress Hears Critics of Rasmussen Report

The federal government's *Reactor Safety Study*—headed by Norman C. Rasmussen, professor of nuclear engineering at the Massachusetts Institute of Technology—came under sharp criticism from experts testifying at a congressional hearing on 11 June. But there was no indication that the critics had landed a disabling blow against the study that provides the chief documentation to claims that nuclear reactors are extraordinarily safe.

The study—commonly called the Rasmussen report—was first published in draft form in 1974. It was then subjected to written comments from some 90 organizations and individuals, and was issued in final form, including a summary, a main report, and eleven appendices, on 30 October. The study estimates the probabilities of various nuclear accidents and the damage that those accidents would cause. Many of its charts and tables suggest that the risk of a reactor catastrophe is comparatively small. Thus the chance that an individual would be killed in a reactor accident if there were 100 plants in operation is described as 1 in 5 billion, compared to a 1 in 2 million chance of being killed by lightning.

Unfortunately, although the Rasmussen report has become a cornerstone of the nuclear debate, it has not been subjected to sustained and searching scrutiny by a significant number of competent outsiders. Although the first draft was subjected to such outside criticism, the final version has attracted only scattered written and oral commentary, partly because many nuclear critics lack the manpower and resources to analyze a report that is now essentially a fait accompli. The 11 June hearing before the House subcommittee on energy and the environment—a unit of the Committee on Interior and Insular Affairs—provided the first major forum for critics of the report to air their complaints before members of Congress.

One of the most eminent of the critics was Wolfgang K. H. Panofsky, director of the Stanford Linear Accelerator Center, who had served as chairman of the review panel for an American Physical Society group that issued one of the most detailed critiques of the original draft of the Rasmussen report. Panofsky noted that the American Physical Society had had no chance to review the final Rasmussen report and that he was testifying as an individual. In the guarded language of an administrator whose laboratory depends on federal support, Panofsky characterized the Rasmussen report as "a useful but far from definitive input into the overall question of reactor safety." He complained that "it is almost impossible to make an overall thorough critical review of the report for a number of reasons: one is the sheer length of the report and the second is that the method of presentation in the report leaves much to be desired in terms of clarity and exact statement as to origin of data and procedures actually used."

Panofsky's central conclusion was that the Rasmussen report exaggerates the degree of confidence one can place in its estimates. "The probabilities of accidents of major degrees of severity calculated in the report are subject to considerably larger uncertainties than those stated," he said. Panofsky stressed that "my critical remarks do not imply that reactors are in fact less safe than the Rasmussen report asserts them to be. Rather my conclusion is that the Rasmussen report has very greatly overstated the certainty of its conclusions; for this reason and because of the intractability of much of the reasoning used in the report its findings should not be used as a definitive basis in the formulation of policy."

But Panofsky waffled a bit when it came to explaining what implications his comments might have for further development of nuclear power. His prepared testimony suggested that coal production might impose a larger health and environmental burden than does nuclear energy; the prepared text also said his criticisms in themselves "do not constitute a valid reason for retarding the rate of evolution of a light water reactor industry *below that controlled by economic forces* [emphasis added], provided an intensified safety research and actual safety improvement program is pursued." That left many listeners confused about where Panofsky stood, since economic constraints have lately proved a massive roadblock to nuclear development. When pressed by the congressmen, Panofsky said, "I would be more concerned about this if the reactor industry was evolving extremely rapidly."

Another member of the American Physical Society's review group—Frank von Hippel, of Princeton University's Center for Environmental Studies—was equally critical. Von Hippel claimed the Rasmussen report is "highly misleading" and "deceptive" in its comparison of reactor accident hazards with other hazards to which we are exposed, such as meteors, earthquakes, fires, and explosions. The key graphs which compare fatalities from these various hazards, he noted, depict only the *early* deaths that would occur within a short time after the accident while ignoring delayed fatalities such as deaths caused by cancer in the area downwind of a reactor accident. Using data "almost buried" in the appendices, von Hippel calculated that a reactor accident that would cause only 10 early fatalities would also cause 7,000 cancer deaths, 4,000 genetic defects, 60,000 thyroid tumor cases, 3,000 square miles of land contamination, and enough strontium-90 released into local waters to contaminate the Ohio River above maximum permissible drinking standards for more than a year. Such long-term consequences would far exceed the likely delayed effects of a meteor impact which caused 10 short-term fatalities, von Hippel said. Yet just last month, he noted, the chairman of the Nuclear Regulatory Commission, which sponsored the Rasmussen report, stated that "the risks from potential nuclear accidents would be comparable to those from meteorites."

Panofsky had also complained about the "highly misleading manner" in which the data on delayed effects had been handled; he found it hard to take a "benign view" of the matter. But Rasmussen, who also testified at the hearing, denied that the delayed effects were "buried" since they were mentioned in the executive summary and the main report as well as in the appendices. The delayed effects were not put into the graphs comparing various hazards, he explained, because there were no good data available for the delayed effects of nonnuclear hazards. Still, as Representative Jonathan B. Bingham (D–N.Y.), who chaired the hearing, noted, pictures have "power" and the printed description of long-term hazards "simply doesn't catch up to the impact of the graphs."

Von Hippel, who described himself as an agnostic on nuclear power, cited a number of alleged weaknesses in the Rasmussen report, all of which led him to suggest that a substantial peer review of the report be completed and that a new study be commissioned to put the Ras-

mussen report results "into a form appropriate for policy-making purposes."

A third critic of the report—Henry Kendall, a Massachusetts Institute of Technology physicist and head of the Union of Concerned Scientists—was the only witness to reach a conclusion that was clearly adverse to nuclear power. Whereas Panofsky had simply argued that the Rasmussen estimates are subject to great uncertainty which could encompass either under- or overestimation, Kendall concluded that "the risks in a large reactor program are almost certainly substantially understated" by the Rasmussen study. He also expressed greater concern over the uncertainties, calling them "very large—large enough to accommodate risks that are entirely unacceptable."

The most substantial review of the final Rasmussen report so far seems to have been conducted by the Environmental Protection Agency (EPA) and one of its contractors, Intermountain Technologies, Inc., of Idaho Falls, Idaho. William D. Rowe, EPA's deputy assistant administrator for radiation programs, told the hearing his agency has identified "several significant areas" in which the report is either "deficient" or contains "unjustified assumptions."

The most significant was that it failed "to address fully the health effects expected after an accident." The EPA contends that the Rasmussen group should have calculated the delayed somatic health effects from reactor accidents in accord with an approach used by the National Academy of Sciences Committee on the Biological Effects of Ionizing Radiation in 1972. The Rasmussen group used a different approach that had the effect of reducing the estimated cancer fatalities by a factor of from 2 to 10, according to EPA. (The Rasmussen group says the factor is only 4, and it claims to have good support for the approach it uses.) The EPA also took issue with the Rasmussen report's assumptions concerning the protection that could be provided by evacuating people from the vicinity of an accident, and it disputed the estimates of the probabilities of radiation releases. But what it all added up to was unclear. Rowe told the congressmen that EPA believes Rasmussen has understated the overall risk by a factor ranging from 1 to "several hundred." If the figure lies at the upper end of that range, some nuclear critics believe the underestimate is significant. But Rowe seemed to back down a bit by adding that EPA, on the basis of information that was not in the Rasmussen report but has since been provided by the Nuclear Regulatory Commission, now believes "the most likely value lies in the lower part of this range."

Various critics also contended that the report ignored or downplayed such problems as sabotage, human error, aging of reactor components, hazards in densely populated areas, floating nuclear plants, and the possibility of a "real lemon" among reactors.

Supporters of the Rasmussen report tended to regard the criticisms as nitpicking and trivial. And even EPA's Rowe, after calling for corrections in the Rasmussen risk estimates, concluded that "it is not possible at this time" to assess what difference such corrections might make in judging the acceptability of nuclear power. At many points in the hearing, participants seemed to be haggling over numbers whose significance was not fully understood. Yet the haggling is important because, in the absence of substantial operating experience with reactors, risk assessment must be based on theory and judgment.

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Glomar Explorer: CIA's Salvage Ship a Giant Leap in Ocean Engineering

New information about the CIA's deep sea recovery vessel, the *Glomar Explorer*, makes it possible for the first time to envisage roughly how the ship and its associated systems were designed to operate in their technologically unprecedented mission. According to accounts that appeared in March and April last year, the recovery system was designed to salvage a Russian submarine that sank in 17,000 feet of water some 750 miles northwest of Oahu, Hawaii.

The new facts, made available as part of the government's effort to lease the ship, are at variance with many details of the descriptions reported in the national press last year. They also are hard to reconcile with the leading version of what the mission accomplished, according to which the submarine was raised in one piece, but during the ascent two thirds of it broke away and plunged back to the ocean floor, never to be recovered. Yet neither the *Glomar Explorer*'s interior well, nor its associated barge, the HMB-1, were designed to accommodate a full length submarine.

The CIA's deep sea recovery system, despite its unique capabilities, has now been broken up. The submersible barge has been given to the Energy Research and Development Administration for an ocean heat experiment. ERDA also has custody of the "strongback," which was the main frame of a crucial and still secret component of the system, the grappling machine that enveloped the submarine wreckage. The strongback, reputedly the largest single piece of steel ever made, was recently saved from the cutter's torch at 24 hours' notice.

The *Glomar Explorer* itself is moored at Long Beach, California. No government agency has an immediate use for it. Unless a civilian user can be found in the next few months the ship, which cost about $250 million to build, will probably go to the scrapyard.

Yet the National Advisory Committee on Oceans and Atmosphere described the vessel in a recent letter to the White House as a "great national asset." William A. Nierenberg, director of the Scripps Institution of Oceanography and a consultant to the National Security Agency, has compared the achievement of constructing the *Glomar Explorer* with that of the Manhattan project. And Admiral J. Edward Snyder, until recently the Oceanographer of the Navy, told *Science* that the system "is probably the greatest technical achievement in ocean engineering in my lifetime."

The chief reason for these plaudits is the considerable leap by which the *Glomar Explorer* exceeds the best existing technology. Hitherto the deep sea weight-lifting record has been held by the *Alcoa Seaprobe*, which can raise 50 tons from 18,000 feet. According to a Global Marine Corporation brochure, the *Glomar Explorer* can handle "payloads in excess of 1500 tons" to about 17,000 feet, an increase of more than 30-fold.

The advantage seems to have been gained by skillful use of existing techniques rather than any dramatic break-