

state & society

NRC panel commends and criticizes Rasmussen report

In 1974 the Atomic Energy Commission released a draft version of the Reactor Safety Study (WASH-1400), which employed an event-tree/fault-tree analysis in an attempt to establish a quantitative measure of the probability of nuclear power-plant accidents and to model the consequences of such accidents. Event-tree and fault-tree analyses attempt to work forward and backward, respectively, along causal chains of events to determine the consequences or causes of a particular event.

Even before the AEC study, headed by Norman Rasmussen of MIT, was released in its final form it had come under severe criticism, both from inside and outside the AEC. Since then the merits of WASH-1400 have been argued everywhere from public debates to Congressional hearings.

New Lewis report. Last year the NRC brought together a widely disparate group of physicists to produce a review of the Reactor Safety Study and to study the present state of risk-assessment methodology. Three of the members of that group also served on the 1975 American Physical Society Study Group on Light-Water Reactor Safety. Harold W. Lewis of the University of California at Santa Barbara headed both the APS and the NRC study groups. The report of the NRC group was recently made available by the Commission.



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Although the Lewis group commended the Reactor Safety Study for pioneering the use of event-tree/fault-tree methodology, it faulted its application of that methodology. Specifically, they found that the error bounds on the estimates of absolute probabilities of accident sequences were "greatly understated," that the Rasmussen group's determination that the effects of fires, earthquakes and human accident initiation are negligible may be incorrect, that the statistical analysis in WASH-1400 "leaves much to

be desired," that the peer-review process was inadequate, that the report is written and organized in such a way as to make any serious reading of it next to impossible, and that the Executive Summary to WASH-1400, which is by far the most widely read part of the report among the public and policy makers, does not adequately represent the rest of the report.

Despite this lengthy list of criticisms, the Lewis group declared that WASH-1400 "provides at this time the most complete single picture of accident probabilities associated with nuclear reactors." Lewis explained the apparent contradiction by saying that if one can use event-tree/fault-tree analysis, "it can enable us to know better where the weak points of a plant are and where the places are to put our finite resources (in regulation, inspection, etc.), and we strongly recommend that that be done. On the other hand, what WASH-1400 tried to do was go beyond that and to carry it through to an actual calculation of the probability of an accident and the consequences of an accident . . . They didn't carry it off very well."

The comments come as no surprise to many observers; they echo other reviews, especially that of the APS committee, in which the study group expressed a lack of confidence in the absolute probabilities assigned by the Rasmussen group for risks

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AIP Corporate Associates discuss science policy

Science policy was a major topic discussed at the annual meeting of the AIP Corporate Associates, held late in September at Battelle Memorial Institute in Columbus, Ohio. The meeting brought together Corporate Associates representatives, physics-department chairmen, the AIP governing board and government officials; 177 persons attended.

Sherwood Fawcett, president of Battelle, said that no true national energy policy has emerged because various interest groups have sought out "experts" who will tell them what they want to hear about energy. He likened such groups to obese smokers who look for a fat doctor

who smokes. Fawcett called for those who provide a link between science and business to provide leadership and help the Nation define its energy problems.

Hans Mark, a physicist who is now undersecretary of the Air Force, discussed long-range planning in the government. He believes the key elements of a successful long-range plan are: It should be in accordance with long-term demographic and resource or political trends, consistent with available technology or capable of using technology just being developed, and an immediate political event should occur that allows the plan to be executed. Mark gave as successful

examples the establishment of the land-grant colleges by the Morrill Act of 1862, the development of US sea power (which was triggered by the Spanish-American War) and the development of satellites (advocated in 1946 by Francis Clauser, David Griggs and Louis Ridenour at the Rand Corporation); in this case the trigger was the orbiting of Sputnik in 1957. Unsuccessful examples he cited were: development of lighter-than-air craft by the Navy and the adoption of nuclear power on a wide scale. The missing ingredient for wide-scale adoption of nuclear power, he said, is a near-term political situation. He believes the impetus



At the AIP Corporate Associates meeting, Ernest Ambler (left), director of the National Bureau of Standards, chats with Sherwood Fawcett, president of Battelle Memorial Institute, the host.

for development of new energy supplies may come in two to four years by a cut-off in the oil supply from the Middle East.

Thomas J. Davis Jr heads a venture-capital firm called the Mayfield Fund, which starts up high-technology companies. Over a ten-year period the firm invested over \$15 million in companies such as Scientific Data Systems, Tele-dyne, Qume and Tandem Computers. Then a flight from venture capital occurred—the capital-gains tax was increased and salary taxes were lowered, discouraging young entrepreneurs. Over the past 18 months, however, venture capital has again become popular, he said. Davis started a new partnership, Mayfield II, with a fund of \$8 million. The partnership is scheduled to end in seven years. Davis believes that a small venture-capital firm such as his is ideal because a hierarchy is not needed. In choosing a nascent company to support, he looks for a group of effective managers of advanced technology, rather than the best inventors. The products must be market-oriented and the management of the new firm should have a “piece of the action.” The minimum needed to start up a company is \$1–1.5 million, he said, although Mayfield II itself only puts up about 0.5 million.

Werner Menden, counselor for scientific and technological affairs at the Embassy of the Federal Republic of Germany, discussed funding of science abroad. Over the period 1970–77, he said (using data from OECD), the US continuously spent more than 2% of its Gross Domestic Product on science research and development, in absolute figures, far more than the other nations studied. Next in magnitude were France, Germany and the United Kingdom. He then compared government funding of R&D by objective. About half the US and UK support went for defense-oriented R&D; France spent slightly less in this area. On space the US

spent a much larger fraction than other nations; Italy spent a surprisingly high proportion. In basic science (including support for universities), the leaders were Italy and Germany, each with 51% of their budgets. For health and environment, the US led, but Canada was also strong. For energy, all the countries considered spent 10% or more.

Arthur Findeis of the NSF described the new NSF program to support regional instrumentation facilities. NSF received 113 proposals for equipment costing \$165 million. Shortly after the meeting, the recipients of the NSF grants were announced. In the question period, R. A. Young (Georgia Tech) remarked that sophisticated x-ray equipment, neutron facilities and electron optical instruments including microscopes are being developed abroad. If the US doesn't develop its own instrumentation, Young said, we are headed for trouble. Findeis replied that NSF currently gives money to develop new instruments as part of its research program.

In a panel discussion on fellowships in industry, Joan Lurie (Rider College) described her APS Industrial Postdoctoral Fellowship at the Colgate-Palmolive Company. Coming from a background as a solid-state theorist, she spent most of her time applying image-analysis techniques to study the feasibility of obtaining quantitative evaluation of chapped hands. Werner Wolf (Yale University) outlined a proposal for an APS Graduate Internship Program for summer jobs in industry for students, which still needs approval from the APS Council.

The meeting included a tour of Battelle's Columbus Laboratories, which does \$80 million of contract research per year, 70% for government and 30% for industry. The labs have a staff of 2600 working on 1800 projects.

Other speakers included Richard A. Muller (Lawrence Berkeley Laboratory)

on radioisotope dating with accelerators, Robert D. Maurer (Corning Glass Works) on optical waveguide technology, Gordon Little (NOAA) on ground-based remote sensing of the atmosphere, Brown F. Williams (RCA Corp) on amorphous silicon, Melvin B. Gottlieb (Princeton) on tokamaks and Abdus Salam (Imperial College and International Centre for Theoretical Physics, Trieste) on the electro-weak force. At the banquet, Edwin C. Krupp (Griffith Observatory) was awarded the AIP-US Steel Foundation Science-Writing Award (PHYSICS TODAY, September 1978, page 87) and Abdus Salam was awarded the John T. Tate International Medal for Distinguished Service to the Profession of Physics (same issue of PHYSICS TODAY). The after-dinner talk was by Brendan P. Loughnan (Geosource Inc), who spoke on seismology in the search for energy.

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of nuclear power-plant accidents. The APS group did see such analysis as being of value in comparative studies of different sequences of reactor behavior, however, and in highlighting the relative strengths and weaknesses of reactor systems.

Rep. Morris Udall (D-Ariz.), chairman of the House Interior and Insular Affairs Committee, one of the NRC oversight committees, sent a letter to Joseph Hendrie, NRC Chairman, asking what the Commission intends to do with the findings and recommendations of the review group, which was formed largely at Udall's instigation.

NRC response. Hendrie told us that the plan to be followed by the NRC in the immediate future will probably include the following four-point strategy:

- ▶ Review Commission responses to Congressional correspondence to see if there is anything they have said officially in the past that “might appropriately be qualified or said differently in the light of the Lewis report recommendations.”

- ▶ Review past licensing actions to determine if any decisions were made that “hang critically” on those features of WASH-1400 on which the Lewis report commented negatively. How the Commission will define a critical link and how it will deal with implicated licensing actions are unclear, although the staff's initial assessment, according to Hendrie, is that “there will not be a great number of such cases” because, in general, the staff has always carried out its licensing decision-making on a “deterministic” basis. “Nevertheless,” he said, “there are probably some places where the staff has anchored a decision critically in a WASH-1400 result, and those ought to be examined.”

- ▶ Determine to what extent, if any, the