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LETTERS

Guayule Development

I share the concerns expressed by some of those interviewed for William J. Broad's article on guayule commercialization (News and Comment, 27 Oct., p. 410). Had I been asked to respond to these concerns, I would have mentioned plans for a vigorous oversight and a quick transfer to the private sector as soon as needed basic feasibility and process improvement research has been done. I would also have pointed out that the funding of this program at \$30 million over 4 years is \$20 million less than the congressional budget office estimate of funding necessary to carry out the original commercialization research program.

On another point mentioned in the article, the only activity taking place in my district that may be eligible for funding is plant research, and this is subject to a competitive grant process that is, thankfully, removed from political manipulation.

GEORGE E. BROWN, JR.
*U.S. House of Representatives,
Washington, D.C. 20515*

Nuclear Power Economics

A. D. Rossin and T. A. Rieck, in their article "Economics of nuclear power" (18 Aug., p. 582), have shown that nuclear power plants installed by the Commonwealth Edison Company in the early 1970's are producing electricity at lower cost than contemporaneous fossil-fuel plants. This conclusion may be of interest to the customers of Commonwealth Edison, but it should be accorded little weight in the national debate over the merits of building *additional* power reactors.

The relative costs of Commonwealth Edison's existing nuclear and coal-fired plants are grossly unrepresentative of the costs of future U.S. plants for the following reasons.

1) Commonwealth Edison's six major nuclear units were completed in the years 1970 through 1974, and thus predate the cost escalation that has befallen nuclear plants starting in the middle 1970's. Indeed, four units (Dresden units 2 and 3 and Quad Cities units 1 and 2) were "turnkey" units subsidized by General Electric to stimulate the reactor market. Rossin and Rieck state in their table 1 that the average cost of the six units was only \$200 per kilowatt of ca-

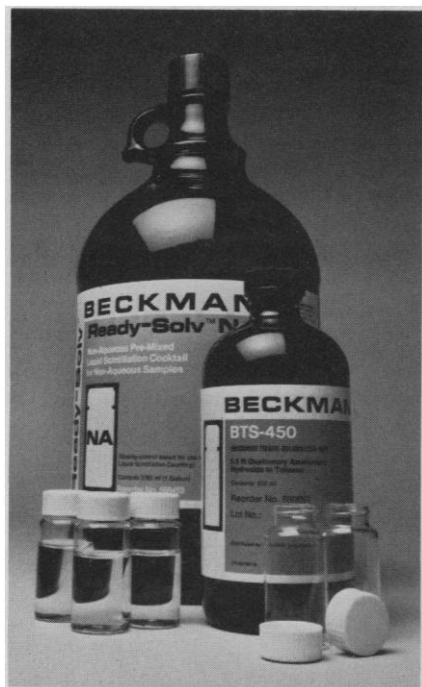
capacity. Yet nuclear plants completed in the United States during 1975 through 1977 had an average cost of roughly \$500 per kilowatt (1, table 1), indicating a 150 percent cost increase in only a 4-year period (87 percent in constant dollars). This exceeds the escalation in coal capital costs, the addition of scrubbers notwithstanding.

2) Commonwealth Edison frequently operates its coal units at reduced levels when electric demand is low, in deference to nuclear units with lower running costs. This inflates the per-kilowatt-hour fixed charges for coal units presented by Rossin and Rieck. Future coal units of other utilities are less likely to "load follow" to such an extent because of lower reserve margins, lesser percentages of nuclear capacity, and efforts to better manage loads presently under way or planned. Moreover, Commonwealth Edison's coal units are out of service more frequently than comparable units of other utilities (2), further inflating their fixed charges per kilowatt-hour.

3) Because of the several-year lead time in nuclear fuel procurement, Rossin and Rieck's fuel cost data capture little of the recent increases in the costs of uranium ore and enrichment, while reflecting nearly all of the increase in coal prices which followed the 1973-74 oil embargo.

In short, Rossin and Rieck's article is but one of many attempts to premise future energy policy on historical data that bear little relation to economic reality at the margin of selection of energy technology. A more realistic appraisal of the economics of nuclear power would have emphasized that the low capital costs once enjoyed by the nuclear industry are unavailable to new plants, largely because of the proliferation of expensive safety measures necessary to correct deficiencies revealed by operating units. Such an analysis would have acknowledged that the average cost of nuclear plants completed in 1974-77 was 73 percent greater than that of coal plants in the same period (1, p. 1) (Rossin and Rieck project future nuclear capital costs to be only 8 percent higher than those of coal, even though scrubbers add only 15 to 20 percent to coal costs while cost-increasing regulatory requirements are continuing to be added for nuclear plants).

Projection of either a 40 percent capital cost differential or a 10 percentage point capacity factor differential, both of which appear conservative based on recent data (3), eliminates the cost advantage projected for future nuclear plants



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by Rossin and Rieck, in nearly all regions. Projection of *both* differentials puts nuclear at a decided disadvantage vis-à-vis coal.

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2. —, *Power Plant Performance*, (Council on Economic Priorities, New York, 1976), pp. 88 and 98.
3. —, *Nuclear Plant Performance Update 2* (Komanoff Energy Associates, New York, June 1978), chap. 6.

Rossin and Rieck have done an excellent job presenting the economics of nuclear power.

Now if they would explain to utility customers just why those utilities which have concentrated on nuclear power command higher rates compared to those whose power is derived mainly from coal.

GEORGE A. HUHN
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The economics discussion in our article was clearly divided into two distinct parts: actual historical costs and the best estimated future investment and energy costs for nuclear or coal plants that might be ordered today.

In previous articles (1) we have criticized Komanoff's use of historical data. Commonwealth Edison's actual experience is useful; it tells us how regulations and costs are changing, as well as that capacity factors for coal and nuclear units are not likely to be vastly different.

Responding to Komanoff's points:

1) It is no secret that costs on the Dresden and Quad Cities "turnkey" (fixed-price) projects exceeded their price, and therefore the manufacturer paid a portion of the cost. Perhaps Commonwealth Edison's management in the 1960's (before we joined the company) deserves plaudits because the result has been substantial savings to our customers.

We compared the cost of our large units by correcting for inflation as if they all had been built in the same year. The result *increases* the nuclear cost *advantage* by an additional 1 mill per kilowatt-hour (2). In addition, the data we gave in the article (investment per kilowatt in table 1 and annual carrying charges in table 2) allows the reader to test the sensitivity of current energy costs to whatever price he or she wishes to hypothesize for the turnkey contracts.

2) Commonwealth Edison reduces the power output of its large coal units occasionally when the load is lighter. We have attempted to calculate the effect on coal unit capacity factors, but it is complex because the output of these units is controlled to the second by the load dispatcher's computer to minimize system generation costs. Obviously, we regulate the coal units because they are more costly to run than the nuclear units. Our figure 1 showed clearly that, even with much higher capacity factors, our coal units can hardly match the nuclear units. As we pointed out, our objective is economical electric power from a *system*, not high capacity factors per se. Actually, any future coal units Commonwealth Edison purchases will be designed for cycling service.

The extent to which certain coal units were out of service in past years reflects operating problems related to weather and the use of equipment to handle and burn coal. For our future plant cost estimates we assumed equal capacity factors for coal and for nuclear units.

3) Komanoff adds emphasis to an inherent advantage of nuclear power. Because mining and fabrication take a year and the fuel spends 3 to 7 years in the core, nuclear fuel cost increases take several years to flow through to the customer. Escalation in coal costs hits the consumer within weeks. Thus nuclear has an inherent advantage during a period of inflation. However, our assumptions for future fuel costs do not use this advantage for nuclear because our tables 7 and 8 on fuel costs are in constant 1977 dollars.

As to his last point, Komanoff is right: it would take a 40 percent increase in nuclear capital cost relative to coal (highly unlikely with scrubbers) or a net change of 10 percentage points in capacity factor difference in favor of coal (which is more likely to go the other way) to bring projected costs of coal power *down* to be equal with nuclear in our region of the country!

Huhn asks about electricity rates. We explained in our article why our customers pay less than they would be paying had Commonwealth Edison built coal-burning units instead of nuclear. (In 1977 this added cost would have been \$200 million—10 to 15 percent of each customer's bill.) This is the real question Huhn should ask: What rates would nuclear utilities have to charge had they *not* built their nuclear plants?

The report (3) Huhn may be referring to misleads the reader by considering only those rate increases granted formally by state utility commissions and omitting

the portion of the rates resulting from the fuel adjustment clause. This portion reflects fossil fuel cost increases and forms a significant part of the rates in most states.

Of real importance is the price the ratepayers actually had to pay for electric service. Over the 5-year period from 1972 through 1977, electric rates rose dramatically. The primary driving force was the sudden increase in oil prices. Increases in coal and uranium prices followed. (Those few utilities that could meet their entire needs from existing hydroelectric power stations were protected from these increases.) The average annual price increase to the electric utility consumer (per kilowatt-hour used) over this 5-year period is shown below (4).

Nuclear (%)	Average annual increase to rate payer (%)
>50	8.9
>33	10.5
>25	12.2
>15	12.4
All utilities	12.6

At rate hearings, consumers tell us that what they are most concerned about is the price they actually pay for their electricity.

A. DAVID ROSSIN
TERRANCE A. RIECK

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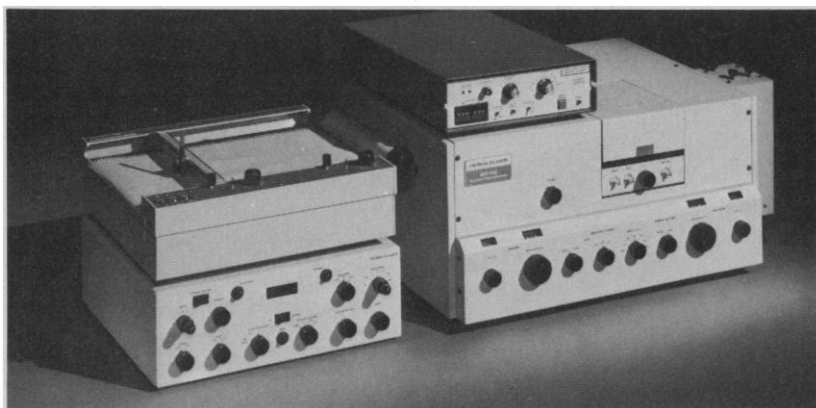
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4. F. T. Stetson (Infowire, Atomic Industrial Forum, Washington, D.C., 6 July 1978); "Comments on the report of the Critical Mass Energy Project and Environmental Action Foundation entitled 'Nuclear power and utility rate increases,'" (Edison Electric Institute, New York, 8 July 1978).

The Free-Electron Laser

I would like to comment on the article "Seeing with a new light: Synchrotron radiation" by R. E. Watson and M. L. Perlman (24 Mar., p. 1295). Although it provided an excellent review of synchrotron radiation, there was a point of

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