it and get it installed quickly enough to have an impact, in less than twenty years. For example, suppose we had all our hydroelectric dams torn down now, and started to build them over again; they generate 1 percent of the country's electricity, too. How long would it take to get all of them replaced and in operation? I suggest to you it would be hard to get them built in thirty or forty years. It takes only ten years to build a big dam anyway, and so my point is, that we can't count on new technology it is, when you're talking about energy production, say, 1 percent or 10 percent of this country's energy, you're talking about a major amount of equipment that you have to develop a whole big industry to produce and install, and you have a learning curve and a development time. So none of the new technologies are going to have a massive or substantial impact for the rest of this century. But if we work hard at it, it might begin to have an effect in the next century, and we should work on it.

The Tech: What would you say about the safety of nuclear power, taking into account the Lewis report and its criticisms of the mathematical methods used in Wash-1400? Do you still agree with your original assessment? I Wash-1400 concluded that with 100 reactors in operation the chance of a core meltdown is about 1 in 200 per year, or about 1 in 20,000 reactors per year.

Rasmussen: Yes, I think our original assessment was about right, although I do believe that the uncertainties were somewhat optimistic, partly because I would increase the numbers somewhat now from what I've learned in the four years since the report has come out. But I believe we have enough information from operating large nuclear power plants to know that the upper bounds we predicted in the Wash-1400 report can't be far off, and by that I mean not more than a factor of two or maybe four at the most. So there is not rank room for a large understatement of the uncertainty in the unsafe direction. Of course, there is uncertainty in the unsafe direction. It could be substantially safer than we said, and I suspect that they probably are. Just as Lewis himself has stated several times that he thinks that our predictions were substantially conservative because of some of the ways we've treated things. As human failures, I think that's true, and probably the answer lies significantly below where we predicted.

My folks: Your study concluded that earthquakes were a very small contribution to the overall risks of a power plant?

Rasmussen: That's correct. Do you have any comments about the recent closing of five nuclear power plants by the NRC? Was it a reasonable precaution?

Lewis: Well, if you look at what people who study earthquakes have to say about the likelihood of the very large earthquakes that we're talking about to damage the plant in this particular case, you're not talking about a little shaking, you're talking about a very big earthquake. Each plant is designed to sustain the biggest earthquake that could possibly happen at that site based on historical record. Of course, there is a possibility of getting in an even bigger one, but I think most people would agree that the probability of such a large earth-

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Second look at Brown's Ferry

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quake at these five sites per year as a probability is something like 1 in 10,000 to 1 in 100,000. Now if you ask yourself could you have said, "We'll take a month and really understand the problem, and then we'll decide whether it's serious enough," because the analysis, after all, was only done on one plant, and I assume it would show the same problem in the four others. It might have been an alternate route that the NRC could have followed, without exposing the public to a substantial risk. Now, I don't have all the facts available to me that they had available to them. With the facts I have available to me, it looks like it would not have been a big risk to say, "you have to shut down in thirty days unless you can verify or assure us that this problem is not serious. That's an alternate route that might have been used, but I don't know why they did what they did.

The Tech: Brown's Ferry was the most serious accident in the history of our commercial nuclear power plants. Do you think it was overlooked by the NRC? Many reports said it was a "near miss." Was this exaggerated, or was it that close to meltdow"?

Rasmussen: Well, we really didn't come close to melting the core, but we certainly came a lot closer than we ever had in any other system failure in a plant. It was a very serious fire and we wiped out some of the safety systems that were needed by destroying their electrical tape. What the event showed was, how very ingenious operators can be in recovering from such an event, the kind of thing we did not give credit for in Wash 1400 and in the Lewis view one of the reasons we are conservative. But so many people say, "Gee, you were lucky, you almost had a disaster," I suppose that's one way to look at it. But I look at it in a slightly different way in saying, "This was the most serious incident a plant has ever had to undergo; it was a very bad fire beyond what the plant is designed to cope with. Yet, because it was so redundant and so diverse in the ways it could stall, and you have a learning curve and a development time. So none of the new technologies are going to have a massive or substantial impact for the rest of this century. But if we work hard at it, it might begin to have an effect in the next century, and we should work on it.

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