UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Title: BRIEFING BY OFFICE OF TECHNOLOGY ASSESSMENT ON AGING NUCLEAR POWER PLANTS: MANAGING PLANT LIFE AND DECOMMISSIONING

Location: ROCKVILLE, MARYLAND

Date: NOVEMBER 10, 1993

Pages: 46 PAGES

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PUBLIC MEETING

Nuclear Regulatory Commission
One White Flint North
Rockville, Maryland

Wednesday, November 10, 1993

The Commission met in open session, pursuant to notice, at 10:00 a.m., Ivan Selin, Chairman, presiding.

COMMISSIONERS PRESENT:

IVAN SELIN, Chairman of the Commission
KENNETH C. ROGERS, Commissioner
FORREST J. REMICK, Commissioner
E. GAIL de PLANQUE, Commissioner

STAFF AND PRESENTER SEATED AT THE COMMISSION TABLE:

WILLIAM C. PARLER, General Counsel

DOCTOR ANDREW BATES, Office of the Secretary

DOCTOR ROBIN ROY, Project Director, Office of Technology Assessment.

P-R-O-C-E-E-D-I-N-G-S

10:00 a.m.

CHAIRMAN SELIN: Good morning, ladies and gentlemen.

We're pleased to welcome Doctor Roy of the Office of Technology Assessment to brief us on the recently issued OTA report, Aging Nuclear Power Plants: Managing Plant Life and Decommissioning. This study was performed in response to a congressional request, as we understand it, and the objective was to examine the outlook for the nation's existing nuclear power plants as they age, the prospects for decommissioning, and federal policies that could help address the economics and the safety issues for existing power plants.

This is obviously a very important and timely issue. In fact, I personally believe this is one of the most pressing and most important issues before the Commission at this point. I found your study to be very interesting. The things that I thought I knew something about you sort of confirmed and therefore -- at least I start with, therefore, a higher level of credulity as I read the parts that were new to me. We appreciate the benefit of having the study and the views of the project staff.

Doctor Roy's report brief are available at the entrance to the room.

Commissioners?

Doctor Roy, please, if you would be kind enough to proceed.

DOCTOR ROY: Well, thank you, Mr. Chairman, members of the Commission. It's a pleasure to be here. I appreciate the invitation to talk about our report on aging nuclear power plants.

Our work was, as you said, in response to House and Senate committees interested in the question of what are the prospects for plant life and decommissioning and are there unresolved issued that are yet to be addressed.

Well, our report confirmed that there are some issues, quite a few issues that are outstanding and also noted that there are a variety of activities ongoing to address many of these issues. Now, based on my observations of activities of the Commission ongoing, I don't believe our findings should hold much surprise for you. NRC activities are ongoing in a variety of areas, from thinking and rethinking the license renewal rule, reexamining the research efforts on aging and safety and finally developing the site release standards which are so important for future

decommissioning efforts.

Addressing these and all other related areas are very challenging issues, challenging issues for the Commission, for the industry and for the public too.

Now, while our findings may not hold much surprise, I hope the work is of some value to you as you face these issues in the future, particularly since it comes from such a different institutional perspective that we hold. As you face the challenges in the coming months and years, please, I hope you feel free to call on OTA if we can ever be of assistance in any way and answer some questions.

I'll outline our major conclusions. Ask questions any time. I appreciate the discussion. It will probably be more useful than some sort of lecture. I'm not appropriate for that.

I'll focus on two main issues, NRC's age and safety efforts and decommissioning.

But first let me take a moment to speak briefly about one of the most interesting issues that's facing nuclear power plants today, although it's not an issue which really falls within the main regulatory interest of the NRC. Specifically, that's many operating nuclear power plants are facing severe

economic challenges from an increasingly competitive electric utility industry. As you all know, there have been a few retirements in the last few years. Some analysts are suggesting there may be a couple dozen more early retirements in the next decade. It's pretty substantial. It's a pretty substantial force on the industry.

Now, these estimates are necessarily speculative, but what's important and the underlying issue is that increasingly the utilities and the state utility commissions that are responsible for much of the regulation are increasingly investigating the economics of continued plant operation. It's a major development.

Now, while responsibility for judging the economic attractiveness of these existing plants rests primarily with the owners and with the state utility commissions, federal activities have major implications for the economics. For example, waste disposal, issues outside of the nuclear area pretty much altogether, like addressing environmental challenges, like global climate change, the things that have substantial effects. NRC activities too, like license renewal requirements, whatever those finally will be, and other safety regulatory

activities also can have major economic impacts, as you're all aware.

In any case, accelerating federal efforts could help reduce some of the uncertainty, the substantial uncertainty that the utilities and the states face as they address the continued operation, economics of continued operation.

Well, with that, I'll turn to some of our thoughts on NRC's programs for assuring the safety of plants as they age. I'd like to focus on two, the main policy considerations we identified in our report, but there are a couple of others and I'll to them very briefly a little later.

First, accelerated aging-related safety efforts. It seems that the early license renewal efforts suggest that NRC's existing age-related safety efforts, although elaborate, could be accelerated. According to NRC staff, for example, these early license renewal activities drew needed attention to two areas that are of generic importance during the original license term of plants. These issues are well known to you all by now, the environmental qualification of electrical equipment and fatigue.

Early license renewal activities also brought additional attention to a third topic of great

important to a smaller number of plants, that of reactor pressure vessel embrittlement. This is a very useful byproduct of the license renewal effort, but it raises a question of how will a focus be raised for other issues which may not have been raised already in these early efforts.

In any case, the license renewal activities, it's not surprising at all that they brought this additional attention because the license renewal rule placed great importance on fairly elaborate integrated plant assessment activities, a very detailed look at all the systems, structures and components. It's not surprising that that identified some aging issues, even if these are aging issues that are important in the original license term. But any dependence on license renewal activities to identify aging issues that are important from the original license term really does leave unclear how and at what point focus will be brought for issues that are important to the original license term absent future license renewal applications. I know you're grappling with that now. I'm not sure what the outcome will be.

We don't have the answer to that question, but we had a couple of thoughts that you might want to pursue and they're laid out there in some detail, but

not nearly enough detail to actually be an implementation phase.

But first, it seems that NRC could accelerate and intensify the review of topics that are raised through industry and NRC-aging research programs, through application to regulatory activities. There's a lot of follow through, but it might be interesting to take a more systematic approach and look at all the research results and see what are the implications and following up on that on a regular basis very intensely. Somehow the EQ and the pressure vessel embrittlement and the fatigue issues somehow didn't get that attention, although those were all well known in -- previous to the industry and to the NRC through previous research programs. These were longstanding research topics, which has now gained greater attention.

Another approach that might be worth considering would be to base it around the maintenance rule. As utilities finalize compliance over the next few years with the maintenance rule, NRC could monitor and specifically report on whether the flexible approach that's taken in the maintenance rule adequately identifies and addresses age and degradation. In a nutshell, does this more flexible

approach work best? It may well. It's a very interesting experiment, but it's worth asking that question, I think.

In particular, in reviewing the maintenance for compliance and adequacy, you might consider whether the level of technical detail and analysis of aging issues that are provided by something like an IPA as laid out in the license renewal rule would provide a greater assurance that age and issues are addressed through the maintenance rule in a systematic fashion. Now, in no way, by no means are we suggesting that something akin to an IPA needs to be performed for the maintenance rule. Rather, what I think is more significant is raising the question in that fashion and addressing it specifically would be worthwhile as NRC and industry gain more experience with the maintenance rule.

CHAIRMAN SELIN: Now, you're not suggesting we do things differently from the way we would otherwise do them in a maintenance rule, but rather link the likely results of the maintenance rule to the prospective procedures for license renewal.

DOCTOR ROY: That's a second topic. I think you might want to do things -- you might want to look at the maintenance rule is being implemented to

see how satisfied you are with the flexible approach. It sounds like it's an interesting approach. It may be really worthwhile, but it seems like it's worth considering explicitly how has this flexible approach worked, is this working well for us, are we happy with the maintenance rule, or would something which is very detailed -- not to suggest that we should do a license renewal link it right now, but is something very detailed like the integrated plan assessment going to provide a greater assurance, something which has much less flexibility than the maintenance rule has in going through all the systems and structures and components.

It's not to say that the maintenance rule should necessarily be made more strict, but that you should consider asking the question, how well is it working for us in the next few years.

CHAIRMAN SELIN: But given the maintenance rule, is there something to learn for license renewal? Not going back and changing the maintenance rule to carry more of the weight than we otherwise see it carrying.

DOCTOR ROY: Well, that's an interesting topic too. In fact, I'll hit on that one right now, what can we learn -- what's going on with the license

renewal rule. That's of great interest to a lot of people around and NRC is rethinking a lot of the issues of the license renewal rule and its implementation. The question of whether some simplification may be warranted, greater reliance on ongoing programs, for example, as the maintenance rule will be, as it's fully implemented. I think there are great reasons for this rethinking of the license renewal rule. A principal justification for it was that for the rather elaborate requirements in there, the IPA, integrated plant assessment, as promulgated in 1991, was the need to address aging-related degradation issues that arise only in the license renewal term but not in the current licensing term. That's the concept of aging-related degradation that's unique to license renewal.

But that concept seems -- the practical distinction between aging which is unique to license renewal and aging generally is somehow hazy, somewhat artificial, it seems for most systems, structures, components. For many of them, aging management and the current license term involves revalidation of previous analyses of design margins and estimated degradation rates and such things and as more operating experience and research results are

conducted. That is that what may seem to be unique to license renewal now may not actually be in a few years, so why are we thinking of it as unique to license renewal?

For that reason, it seems like it may be better to view aging management as a more continuous process than reflected in the rule. For example, to draw more heavily on ongoing programs like the maintenance rule, provided we're satisfied that the maintenance rule and other ongoing programs really do give that level of assurance that aging is being properly addressed.

Then we're back to that first question, are we really satisfied with the maintenance rule and other activities to address aging? It's something you're going to have to grapple with. But if you are satisfied with the maintenance rule and other aging management techniques, then it seems that this more continuous process could be reflected in the license renewal rule and could be used to simplify, to justify some vocation considerably.

It's conceivable to me to -- if we really believe that the ongoing programs are adequate, to treat license renewal as a relatively simple administrative procedure like that used for recapture

of the construction period. It's possible to see it being relatively simple. That would still provide for public input and participation in the renewal process. It's still a licensing action. There are, again, the questions of what needs to be considered and what are the boundaries on what can be raised.

One can see it moving in that direction if we're really satisfied with the ongoing aging management programs. Again, to be really happy with the aging management programs, it might be interesting to think about, be more systematic about the research programs and translating the results into a sense of what more needs to be done and following up on that on a continual basis.

In any case, we --

CHAIRMAN SELIN: While you're talking about translating results, although I understand your remarks were basically procedural, that we should be on the regulatory side more aware of it and more rapid, more timely in our use of research results. Are there other areas than the equipment qualification area that you're aware of that are likely to come up and invite us that we haven't identified as being important for the management of aging on the licensing side?

DOCTOR ROY: We didn't identify particular areas we thought that were high-risk areas that needed to have additional focus drawn on. But it is more procedural, as you say.

CHAIRMAN SELIN: But you talked to a lot of people and if you came to some side conclusion along that, I'd be interested --

DOCTOR ROY: Didn't really come to the conclusion about what the particular topics would be. There are questions about containments and there are questions about support and there are questions about all sorts of areas. It's not clear which areas of the many of the huge numbers of systems, structures and components really deserve additional attention. Some of the work that comes out of the aging research program can help focus that attention. For example, with the probabilistic risk assessment, aging-related probabilistic risk assessments. They can help focus attention on those systems and structures and components which seem to have the greatest areas for improving safety. But no, we did not -- I can't tell you which three. I wish I could, but I don't think it's that simple. We certainly didn't have the staff. Here we have the staff. We did talk to a lot of folks, but we couldn't draw that kind of conclusion.

We also touched on a couple other topics on your ongoing age and safety efforts which are much more broad than just age and safety. These are topics of how to better relate the NRC safety goal policy to the age and activities and how to revise public participation procedures, provisions to simplify license renewal. One of the great benefits of license renewal for many interested members of the public is that it would be renewed attention and focus in on an opportunity for them to participate. Just what other approaches could be taken to more early gain that input and that experience, we don't have the right answer to that and I know you're aware that there's legislation before the Congress now which would allow for judicial review of the --

CHAIRMAN SELIN: 2.206.

DOCTOR ROY: The 2.206, right. That's not necessarily the right way, but it's really worth considering what other ways can we draw in more public participation earlier, as early as possible to meet these needs and to take advantage of what the public comes up with. There's really not a right answer, but it seems to be an important issue in license renewal and I think also may be a very important issue for aging management generally.

And then with the safety goal policy and how that relates to aging activities, again there's no simple way even grappling with that for awhile. How do you really translate a safety goal policy into some sort of procedures or operations? There's no simple answer. But it is interesting to note that the safety goal policy doesn't seem to show up in the statement of considerations for license renewal, doesn't show up in the maintenance rule discussion, just doesn't show up.

CHAIRMAN SELIN: Commissioner Remick has noted that several times.

COMMISSIONER REMICK: Or in the siting rule?

DOCTOR ROY: It's just a hard enough -- but even to talk about it as a base and then we have to depart because it's sort of the conceptual base for our activities.

COMMISSIONER REMICK: Incidentally, one of the comments that is certainly true is that the NRC was not able to develop objectives for a comparative risk with alternative means of generating electricity and that's true. The Commission gave serious consideration to that in developing the safety goals, but thought the NRC is not the best agency to do a

comparative risk study with coal plants. Maybe OTA should undertake such a study of comparative risks of alternative ways of generating electricity, but it would not be -- the Commission decided if NRC did it it would be self-serving or viewed as self-serving. That's why it was not done.

Also, there's a comment in there that there is no cost benefit. At one time there was a cost benefit algorithm of $1,000.00 per person rem saved and in doing that if you had a high population site, that means more people that could potentially receive dose, that you could justify larger cost to make modifications. So, at one time there was an indirect high density or a societal risk component through the cost benefit algorithm of if it costs less than a thousand dollars to prevent a man rem, you could make -- justify modifications. If you had more people, that's more man rems you might save by the modification. So, there was an indirect societal risk consideration which admittedly was taken out by the Commission.

DOCTOR ROY: This whole area of risk assessment is a tough one, and not just radioactive risk, but chemical risk too. EPA certainly is grappling with that and hasn't resolved the issue by

any means. Maybe it would be viewed as self-serving if the Commission did this type of work. The Commission is well placed to do a lot of the work, the work with PRAs and then health effects. The Commission has a great deal of knowledge and experience and research ability here and perhaps coordinating with other agencies might be the best approach.

CHAIRMAN SELIN: To be blunt about it, the problem is that if you just treated all risk as the same, you would say nuclear power plants are incredibly safe compared to the alternatives. But people -- just the fact that there is an NRC, there's not a coal regulatory commission, places like that. There clearly is a public sensitivity to nuclear risk that goes beyond some overall risk criterion.

Furthermore, when you use the safety goal you end up -- it's hard to match safety goal and defense in depth together. I guess I'd put it that way.

DOCTOR ROY: Right.

CHAIRMAN SELIN: You would end up with requirements that wouldn't -- if you used only the safety goal as opposed to Commissioner Remick's point which is you've got to take a look at it along the way

to see if you're in the ballpark or not, you would end up with requirements that would be less rigorous than those that we for other reasons think are called for. So, our doing a study of relative risk that looks at coal or oil or gas compared to nuclear, it would be hard for us to say how much tougher should be the standard for nuclear risk than the other risk. We act as if it's a much higher standard, but we've never really laid down that we have a safety goal for nuclear plants, but none for non-nuclear plants.

DOCTOR ROY: That's right.

CHAIRMAN SELIN: So, I would support Commissioner Remick's point that if this is to be an important point, and I think it is, we really do need an agency that's not identified, not so much pro or con, but we spend 90 percent of our time worrying about one of multiple sources. We really do need an agency that's got a broader scope to do such work.

DOCTOR ROY: The Department of Energy and its natural energy plan --

CHAIRMAN SELIN: Something like technology assessment is what we can --

DOCTOR ROY: Oh, it's a congressional agency. I'm so sorry. It's the other branch of government.

Okay. It is a very interesting area and it's not clear exactly where to go. You raised a point about the relative risk and how do you grapple with some of these underlying issues like trading off between ongoing low-level risks and we're sure of how many dead there will be day after day. You can name a couple of activities which have fairly predictable numbers of fatalities. It's something which is very low probability, very high consequence risk and how you trade off that. I don't know how you do that. You're right, it's not something that you'll have an easy answer to. We don't think there's an easy answer. But again it's kind of fun to think about. Not fun, but maybe useful to think about it and ground in some of your other work. I'm not sure exactly where you go with it, just that it's important. Also, it sensitizes too some public concerns that seem to review catastrophic risks in a different way, very different way.

Although it's also interesting to look at airline risks. There are low probabilities of substantial numbers of deaths from airline accidents apparently. But in any case, that's just one issue.

I'll turn to decommissioning for just a minute. Absent license renewal, I guess we're all

aware that three dozen plants will have to retire in the next 20 years. There may be some earlier ones if there are some economic retirements between now and then. There may be quite a few of those, some people think. Just about all these plants, I think probably all of these plants are much larger and much more contaminated than the plants that have been retired to date. What that means, what it seems to me to mean, is that commercial plant decommissioning is going to become a much more visible issue in the next couple of decades. I bet you're all aware of that already. I think actually working to fill in one of the big gaps that there is right now in policy towards decommissioning and that's in the site release standards. I think some people call it BRC-3 in a way, but it's --

CHAIRMAN SELIN: Not in this room.

DOCTOR ROY: Not in this room. Well, see, I'm from a different branch, like I said. I've heard a number of folks refer to it.

CHAIRMAN SELIN: I don't want to over react, but the difference between this and BRC is we're taking here a well-defined problem for which there's general belief that a solution is needed. I'm not trying to generalize to other also interesting

problems but different ones, but trying to take a particular case, which is decommissioning, decommissioning standards. Clearly when you said a standard, there will be a level below which people can act as if there's no radiation. But we're not trying to set a general standard that covers everything from consumer products to previously licensed facilities, but are tightly focused on when can licensed facilities be returned to general use.

DOCTOR ROY: Hopefully that tighter focus will make this effort more successful. It is definitely very important. These final radioactivity standards, I guess they're scheduled for 1995, is that right? 1995. They'll play a big role. They could play a big role. Well, they will play a big role in determining the ultimate scope and cost of decommissioning work, how much material we have to remove from the site and there's a lot of implications, and what's the remaining exposure to the public and the environment.

As part of this rulemaking on site review standards, it's been raised, I've seen it in a couple of the papers and it was certainly voiced at some of the public meetings that enhanced public participatory process, by the way, seemed like an excellent way to

bring in public views early on in the rulemaking process. That seems to have been a really -- to me it seems like a very interesting and useful approach before having things cast in concrete. But that's an aside.

As part of the rulemaking process, it really might be worth seriously considering developing additional options, options beyond the single goal of unrestricted use. In some cases, you're aware that clean-up to a level that's suitable for unrestricted use may neither be necessary for public health and safety nor economically desirable. If we can find a way to allow for restricted uses, it may actually be preferable to some in the states and the public by allowing them some more control or showing that you'll retain some sort of control for whatever residual radioactivity there is at the site.

This could be interesting. It's certainly not the only approach that should be taken, but it may be an additional option that's worth considering in the rulemaking. I don't know how far along that concept is going.

CHAIRMAN SELIN: Would you suggest that -- I mean this is reading more into your words than you said, but I think they are the implications, that the

role of the NRC shouldn't be both to pick an objective and set the health standards, but to identify for perhaps several different objectives what the appropriate health and safety and protection standards would be and then leave it to more the political process to decide which option is appropriate for which facility.

DOCTOR ROY: That is reading a little bit more into my words, but that's a reasonable outgrowth of some of the things we're saying. That line of thinking can be very useful, certainly in deciding whether that's the line you'd like to follow. State and regulatory interests are very important and state and local too because local governments may be playing an important role in land use restrictions and things like that. How you'd coordinate those types of activities, public interests which may really vary from site to site, those are important considerations.

Generally to expand the options and think is it really necessary to have the unrestricted site release, that could be really useful. It could be useful for all involved.

COMMISSIONER REMICK: You are aware that that is being considered in the enhanced participatory rulemaking, that very question.

DOCTOR ROY: I am aware that it was raised. I know that some of the papers have suggested this, the Commission papers. I know the public has mentioned that. It's not clear how thoroughly that approach will be investigated. I don't know. Maybe this is one that you will really pursue aggressively. You have lots of options, lots of paths you can take. This is one that might be useful to really think about seriously. It seems to us based on our hearing. If you have that under control, that's great. That's wonderful.

CHAIRMAN SELIN: No, it's not -- the fact that we've thought of something doesn't mean it's under control, but there really is a difference in philosophy between saying one of the functions of the Commission is to decide what objective is the appropriate one and then set standards for it. That would be one extreme. Another extreme would say one of the Commission functions is to be more of a technical agency, to say for each of several standards which might be set outside of our process what would be the appropriate health and safety and physical protection standards for that option.

I think that's an open question. I really do. Your comments are quite timely on that issue.

DOCTOR ROY: It will be interesting to see how that resolves itself over the next couple of years.

Along the same lines, but a little bit different, it might be interesting to think again about the entombment option. That was one that, I guess, in 1988 the Commission considered dropping entomb as an option for decommissioning, but instead decided to develop more specific guidelines on how entomb could be applied and how useful it would be. There hasn't been any -- I don't believe there's been any guidance along those lines since then. This might be a good time for it and it could fit reasonably well with the site release criteria, particularly if we're thinking about options such as restricted uses after release.

And reexamining entomb has them thinking about release generally. The benefits of minimal site work and the occupational hazards, both radiological and non-radiological, reduced waste volumes, deferred and reduced needs for low-level waste sites of entomb are going to be tough but important to balance with some of the additional costs, like deferring responsibility to future generations and regulating retired plants or sites as temporary low-level waste

sites, how exactly will they deal with that. But in any case, these are issues that might be worth considering. Entomb option may be a reasonable approach for safety and economic reasons and receive -- it depends on the site and you'd have to find this out, do some more examinations -- might receive a favorable state and public acceptance in some cases. It might be a useful option.

Well, overall, it seems that the long-term prospects for the 107 plants and the few that are retired already are unclear and much more unclear than we seem to think they were a couple years ago. A few years ago we thought they were clearer than maybe we should have been thinking. But anyway, as these plants age, the issues related to plant lives and decommissioning are sure to become much more visible and draw much more public attention. I wish you luck in grappling with these issues and again I extend my offer to have OTA to help how we can.

CHAIRMAN SELIN: But absent some request either from us or the Congress, what, if anything else, does OTA plan to do at this point?

DOCTOR ROY: On this topic? We don't plan to do anything, absent requests. A couple of papers we've been asked to write in summarizing our work and

we'll do that. We send out lots of copies, we speak at a few places. That's the end for us.

CHAIRMAN SELIN: What I heard you say today were a number of remarks about license renewal, in particular how this interpretation would be unique to license renewal aging, might be taken or not taken and a suggestion that more reliance on refurbishment and maintenance programs, be it the maintenance rule or other things that are done in the current area. Second is in the decommissioning, to perhaps not settle on a specific option and then derive standards, but look at several options, unrestricted use, restricted use, et cetera. I don't know if you suggested that we also look at the economics as well as the standards of these different pieces. That wasn't clear. You mentioned something about the economics, but it wasn't clear to me if that was part of your recommendation.

DOCTOR ROY: I'm not actually sure how NRC can grapple with economic issues like that, but certainly the economics are very important in a lot of these former -- these plant sites.

CHAIRMAN SELIN: But we would leave it to the economic regulators to --

DOCTOR ROY: Make those decisions.

CHAIRMAN SELIN: -- do the economics and in your recommendation we would provide the health and safety and security guidance that would go with these options.

DOCTOR ROY: That's right.

CHAIRMAN SELIN: And that in the aging research that -- you were pretty gracious, but it seemed to be that you were admonishing the agency to be more attentive to its own research program and move more quickly then perhaps we have in the past on drawing some conclusions of the aging research. You didn't identify anything that's missing in the research program, but you did suggest that we haven't been as fast as we might have been in seeing the implications of some of the research results and putting that into the regulatory and licensing process on aging.

DOCTOR ROY: I think we did identify one thing that's missing. It's not a particularly system or structure component, but it's a process. It's a process to do this translation. The simplest piece of evidence is this license renewal activity.

CHAIRMAN SELIN: Okay. So you're going beyond the aging research. You're using that as an example of a perceived weakness in the process that we

go from doing the research to taking advantage of that in our regulatory --

DOCTOR ROY: That's right. The license renewal rule seemed to be instrumental, take this information which was already known information in the areas of EQ and fatigue and pressure vessel embrittlement. Lots of research was being performed. But it seemed to take the license renewal effort to focus attention and to really raise this issue and move it a little bit out from the research side into thinking, "Well, what more really do we need to do?" Maybe those are the only three issues. That would be interesting, it would be wonderful if it was the case. But maybe those are not the only three issues which could have been identified if the license renewal activities, as those first two lead plants, if we'd continued along that path.

It seems -- well, first, if we do rely on the rule to raise these kinds of issues, that means we can't really simplify the rule. That's going to be very difficult to do because we're relying on the rule to address ongoing aging management issues. On the other hand, what if we do continue to rely on the rule but we don't have -- the license renewal rule, but we don't have many license renewal applications for

awhile? Then it leaves open the question of how do these types of issues make the translation.

The maintenance rule is a wonderful vehicle because it is very broad and it is taking a new approach. It's one very nice vehicle. We can see how happy we are with that, that this is being implemented, and address the question of how would a less flexible approach perform.

Also, the other side is the research. The research is translation -- we could do a little bit more and become a little bit more satisfied in the ongoing process.

CHAIRMAN SELIN: But what I heard you say about research is not that you've done an exhaustive look at even research supporting aging, but three cases should be enough to make your point. You don't need --

DOCTOR ROY: They're pretty big cases.

CHAIRMAN SELIN: You didn't need to go further to make the point. The reason you didn't go further was because they made your point, not because there might or might not be other cases.

DOCTOR ROY: Absolutely. They are big cases. They seem very important. They apply to lots of plants.

CHAIRMAN SELIN: Is that a fair summary of your major points with respect to the issues at the table, license renewal and plant aging?

DOCTOR ROY: I believe it covers most of it. There are a number of other smaller issues.

CHAIRMAN SELIN: A lot of specifics in the excellent report.

DOCTOR ROY: Yes, pages and pages of stuff here. But there's one other area that really is of interest to NRC. I'm not sure how important it is, but we had to raise it. It's on decommissioning, only because you ask. That's on the decommissioning financing. There is a question mark out there about how much it's going to cost. We don't know really low-level waste costs. We don't know how well we're going to -- how different is -- we know how to tear down big pieces of equipment. That's something that goes on. Steam generator is a great example. You take them out, you move them. But we don't know what the kinds of economies will be as we go through systematically tearing down a plant.

So, there are questions in the labor required. There are big questions in the low-level waste disposal cost. There are actually questions in the spent fuel disposal costs that are worth a couple

tens of millions of bucks per site. Big questions.

It's interesting the Commission's financial assurance provisions for decommissioning specifically consider some reasons why there may not have been adequate funds built up. For example, I think you have early retirements. You have a rule on that. There's another reason why I might not have adequate funds. That's if the costs accelerate rapidly.

Looking at the financial assurance provisions for these early retirements, that's a rule they came out with a couple of years ago, it's interesting to note that the six plants that have retired in the last four years, none of them apparently met the conditions that you were expecting and laid out in the statement of considerations. It may be a sign that there's some more work that can be done. You can do something which is more thorough. There is a question of how much do you really gain by trying to be more thorough, more all encompassing. It's not obvious what would be gained. But it does leave a question about what does this rule mean and how useful is it.

I think that is a summary of everything.

CHAIRMAN SELIN: So that's a good fourth

point, which is the decommissioning funding, not just but also for early retirements because as you know we're not happy with the situation even for plants that run full-term. There's a major review of both the estimates and also some of the components, like the handling of the spent fuel and the increased standards to green fields on that.

Thank you very much.

Commissioner Rogers?

COMMISSIONER ROGERS: Well, thank you very much. It's been an interesting report and interesting to hear from you.

I wonder if you might comment a little bit on what seems to be, I think, possibly a difference in point of view here with respect to how important research is in aging -- in identifying specific aging mechanisms because I think that our point of view with respect to current plants, current license period has been that the maintenance rule takes care of aging phenomena taking place during that first 40 years of life through inspections and replacements and things of this sort and that identifying mechanisms for aging, while perhaps very interesting, may not really be specifically as important as developing a program that anticipates the need to change a part out or to

change something out based on past performance. In other words, a kind of phenomenological approach to a plan rather than a scientific understanding of precisely how long it will take for evidence of aging to take place, to show up, but rather the development based on past history and the collection of performance data as a way of assuring that aging phenomena are adequately dealt with without actually perhaps understanding the details of all those in a way that might be intellectually satisfying.

I think that was really more or less the point of view that we've adopted. That isn't to say that we don't feel that aging phenomena shouldn't be looked at, but that we felt pretty comfortable that once a sufficiently robust database could be developed with respect to performance, that that was adequate to guide repairs, replacements and so on and so forth to avoid the demonstration of aging before it even started to appear.

But beyond the first 40 year period, there might be something else turning up and for that reason the license renewal rule really started to look at mechanisms and identified mechanisms as an important consideration because there might be something of a mechanism that would not show up in the performance

data of the first 20 years. That's really, I think in a way, what guided our development here.

But coming back to your point about research, current research being used in dealing with aging during the first 20 years period, I wonder if you discussed at all in your group the necessity for a detailed understanding of mechanisms versus an adequate database of actual performance in the field which would guide a regulatory set of requirements or a maintenance program of some sort that would just take care of those things without really understanding all of the details that might lead to some kind of aging degradation.

DOCTOR ROY: It was definitely a topic that came up. A number of people we talked to suggested that -- I think what it came down to was the type of research that was necessary depending on the type of system, structure, component. How long we expect it to live. What type of database one could have for long-lived components expected to live for the life of the plant as steam generators once were and pressure vessels still are and containments still are. It's hard to get that history, in-service history in great detail. Certainly, I guess, cabling may be an example.

We had an opportunity, perhaps, with Trojan to go through and look at what's happened with the electrical equipment at Trojan in hard to access places and you can learn a great detail from that. But the ability to get the kind of information for these long-lived components may not be great and in most cases studies of the mechanisms of degradation might be really what are called for. For short-lived components, equipment that's refurbished or replaced through some process, certainly a different approach, different type of research would be needed.

A type of research that's more useful, perhaps more useful than the mechanisms, would be research on the operating experience and just following through tracking the databases. You may not call that research, but I'd like to consider the full spectrum of activities research. The industry conducts a broad spectrum of research activities, not just on mechanisms but on how to determine what types of analysis and research to perform.

Definitely there's a need for a range of activities, but I think you see that -- you certainly see that with the NRC's research program. Included in research are such concepts, not just mechanisms of degradation, but the probabilistic risk assessments,

age-related probabilistic risk assessments. That's considered research too and that is useful for some types of questions. It depends on the question and the component that we need to address, what kind of research needs to be done.

COMMISSIONER ROGERS: Well, I appreciate your comments. I think that's very interesting.

Raising the issue of release to unrestricted use of contaminated sites, that certainly is something that is being discussed and, particularly as Commissioner Remick pointed out, has come up time and time again in the participatory rulemaking activities. I think there is an interesting dynamic in work on that question because I think some years ago there was great public concern about anything that involved releasing a contaminated site at all for any purpose. I think as time has gone on and these questions are being looked at harder and harder and debated in greater detail, I think there is more interest starting to develop now in the possibility of releasing sites for restricted use.

There is the question, of course, of the continued oversight that is necessary to see that those restrictions are not violated and that's an issue, but I think there is a dynamic process taking

place here with respect to public opinion on this issue. A few years ago, I would say, it was very difficult to find any proponents for release of a contaminated site for any purpose other than unrestricted use. Today that seems to be changing, so I think your comments are probably very timely.

DOCTOR ROY: That's interesting, the use of the word "release," because that's not really released if it's restricted, but, yes, that's true. We have to use the language that we have.

COMMISSIONER ROGERS: That's all I have.

CHAIRMAN SELIN: Commissioner Remick?

COMMISSIONER REMICK: First, I'd like to say I really thought it was an excellent report. I found it very interesting in a couple areas where I might have differed. There were things where maybe the factual statement was made, but I felt if more digging had been done an explanation could have been given, but they were not of great consequence. But in general, I thought it was an excellent report.

The one area, I guess, where I would greatly disagree with what you've said this morning is putting reactor pressure vessels in a category that only through the license renewal has this come forward. I greatly disagree with that, because a

tremendous amount of effort has been done on reactor pressure vessels going back to the '60s, continuously since then, and the pressurized thermal shock issue back a decade ago really brought the Agency's attention to develop criteria.

The thing that happened differently in license renewal in one particular plant, it was found that the assumptions -- we thought that they knew what the actual conditions of that pressure vessel were from the standpoint of materials and welding materials and so forth, and we found out it was assumed conditions not known conditions. That brought that particular issue to light in one particular plant, but the background and the research and so forth had been ongoing for years and the criteria established for how this embrittlement issue would be handled with plants. So, I don't put RPV in the same category in the same category as equipment qualification and fatigue from that standpoint. It came up as an issue in one plant, but that's because what we thought was known was only assumed to be known.

DOCTOR ROY: I can accept what you're saying, but certainly you'd agree that there's been a lot of work over time on the cables too. That's an area that we've spent -- the industry and NRC spent a

lot of time --

COMMISSIONER REMICK: No, I'm saying the only one I disagree with is reactor pressure vessel, putting it in that category that that's something that was uncovered through the license renewal process.

DOCTOR ROY: Well, that's an important area. Certainly that was not uncovered. There's a great history of interest and attention paid to RPVs. There's no doubt about it, the PTS rule. It's been going on and evolving for a long time, but there was some additional attention that was brought by this license renewal application that raised this question that you've noted about what were the actual weld materials. But this is a useful thing to have been brought up by the license renewal rule.

I don't mean in any way to say that there's been no work and that this is a surprise, that there's a surprise in the NRC or in the industry that RPVs and embrittlement are important issues. I think it was well known that you could talk to probably anybody at the Commission and anybody in industry and they would agree this is important, and any of the concerned public groups would agree too. But, it was important and it seems that the license renewal rule had an important role in bringing to light the

questions of the weld materials.

COMMISSIONER REMICK: The question of weld materials goes way back. In this case, they thought they knew what the material was.

DOCTOR ROY: The importance of the material, but it brought to light that what we were thinking wasn't quite what we should have been thinking, so it did have a useful role and it's not clear when we would have determined that the weld materials were other than we had been assuming these years absent the license renewal process.

I agree with what you're saying. There's a great history in looking at this issue and a great attention to understanding the importance. But there are some benefits that the license renewal rule brought even in this issue.

CHAIRMAN SELIN: It wasn't the rule, it was some point you made earlier, but in preparing for license renewal that's the time to review all at the same time and in the same place a lot of facts which, under the normal regulatory process, have broken up into different groups and might not get the cross cutting and the complete review that they would get in the preparation for a specific license.

DOCTOR ROY: Right. It wasn't the rule,

it was the activities that were inspired by the rule that were important for me complying with the rules.

COMMISSIONER REMICK: That's all I have. Really, I say sincerely I think it's a very interesting report and a good job in general.

DOCTOR ROY: Thank you.

CHAIRMAN SELIN: And in a step of conspicuous bravery, Commissioner de Planque will now ask --

COMMISSIONER de PLANQUE: Yes. I'm not sure how many words I can get out, but I'll try. Pardon my voice.

I enjoyed the report very much too. I think it was extremely well done.

One issue came to my mind and I don't know if you had either the time or the ability to discuss what other countries are doing in this respect, but it certainly came to my mind in the sense that we're dealing with license renewal because we deal with a given of a 40 year license. This isn't the procedure used by some of the other countries and so they don't have the equivalent

Did you at all discuss how other countries are approaching this or did you discuss the concept of a set license at all?

DOCTOR ROY: We did. Early only when we started out this work, we wanted to compare and contrast and see what we could learn from other nation's experiences and other nation's regulatory approaches and industrial approaches. We did not have the resources to do that, but we did touch on that issue a couple of places in here. One of the reasons it was very difficult and we knew we didn't have the resources for it was because the industry structures and the regulatory structures are so different and it's not simply that there's -- it's not that all the regulations are the same with the exception of the 40 year license life.

COMMISSIONER de PLANQUE: That's right.

DOCTOR ROY: There's the whole industry regulatory interaction. It seems to vary a great deal from country to country. It was hard to look in isolation at just the license renewal issues. Certainly there's a lot of interest and attention in the international community on aging issues, growing attention it seems on aging issues, a lot of experience is being gained. But there were such basic differences it was very hard to draw much more conclusion.

Also, it came up in our panel meetings, we

have these lovely advisory panels with lots of folks from different backgrounds. Some people noted, and it seemed hard for us to find a way around this, that the history that brought us to our form of regulation and industry views and public views and how those are all mixed together is different -- the history is different from the other countries and the outcome is different and so how could you really apply these lessons? Well, there are some lessons you can apply, but probably the engineering lessons are easier than the political science and the political process issues. That made it really tough for us to try to draw that conclusion, so we don't. Sorry.

COMMISSIONER de PLANQUE: Okay. Thank you.

CHAIRMAN SELIN: Thank you very much, Doctor Roy. I join my colleagues in expressing our admiration and respect for the report and thanking you for coming out here and making the presentation.

DOCTOR ROY: Thank you. Appreciate it.

(Whereupon, at 10:55 a.m., the above-entitled matter was concluded.)

CERTIFICATE OF TRANSCRIBER

This is to certify that the attached events of a meeting of the United States Nuclear Regulatory Commission entitled:

TITLE OF MEETING: BRIEFING BY OFFICE OF TECHNOLOGY ASSESSMENT ON AGING NUCLEAR POWER PLANTS
PLACE OF MEETING: ROCKVILLE, MARYLAND

DATE OF MEETING: 11-10-93

were transcribed by me. I further certify that said transcription is accurate and complete, to the best of my ability, and that the transcript is a true and accurate record of the foregoing events.

Carol Lynch

Reporter's name: PETER LYNCH

11/9/93

SCHEDULING NOTES

Title: Briefing by Office of Technology Assessment on Aging Nuclear Power Plants: Managing Plant Life and Decommissioning

Scheduled: 10:00 a.m., Wednesday, November 10, 1993 (PUBLIC)

Duration: Approx 1 hour

Participants: Office of Technology Assessment

- Robin Roy, Ph.D.

Document: OTA report "Aging Nuclear Power Plants: Managing Plant Life and Decommissioning" dated September 1993

OFFICE OF TECHNOLOGY ASSESSMENT ■ U.S. CONGRESS

REPORT *brief*

SEPTEMBER
1993

Many operating nuclear power plants face severe economic pressures

Long-term prospects for the Nation's 107 operating nuclear power plants are increasingly unclear. Proponents argue that these plants, which supply over 20 percent of the Nation's electricity, are vital to reliable, economic electricity supplies, have environmental benefits (e.g., they emit no greenhouse gases such as carbon dioxide), and reduce dependence on imported oil. Opponents, however, argue that nuclear plants bring risks of catastrophic accident, create unresolved waste disposal problems, and are often uneconomic. As these plants age, issues related to plant lives and decommissioning are likely to become much more visible and draw more public attention.

The past few years brought unexpected developments for nuclear plant lives and decommissioning. Since 1988, six nuclear power plants have been retired early, well before the expiration of the 40-year operating licenses granted by the U.S. Nuclear Regulatory Commission (NRC). Owners of several other plants are investigating the economics of early retirement as well. The owners of the first large commercial nuclear power plants slated for decommissioning anticipate costs much greater than estimates made only a few years earlier. And after a several year effort, the two lead plants in a program to demonstrate NRC's plant license renewal process halted or indefinitely deferred their plans to file an application—in one case as part of an early retirement decision. While work continues to develop and eventually demonstrate a regulatory process for license renewal, it will be several years before the first application is filed and acted on. Absent license renewal, about three dozen operating nuclear power plants will have to retire in the next 20 years.

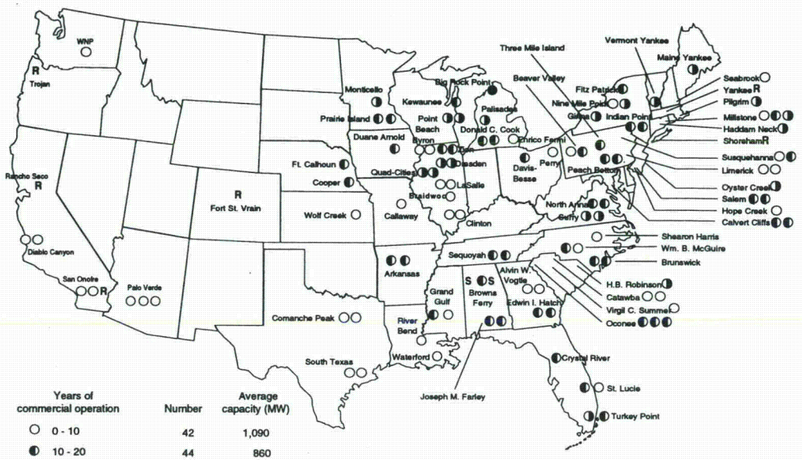
Despite these substantial challenges, there has also been good news for the U.S. nuclear industry recently. Reversing a decades-long trend of rapid increases, average nuclear power plant operating and maintenance costs have decreased in recent years. Average plant reliability and availability have improved substantially. Safety performance has also been good. There have been no core damage accidents since Three Mile Island in 1979, nor an abnormal number and severity of events that could have led to core damage, much less any actual offsite releases of large amounts of radioactivity. Average occupational radiation exposures, already well below NRC limits, have also declined substantially.

AGING AND SAFETY

After many years of intensive efforts by the NRC and the nuclear power industry, no insurmountable industry-wide safety challenges related to aging have been identified. There are some notable uncertainties for the longer term, however. While not presenting immediate challenges, some aging-related safety issues such as the extent of metal fatigue occurring over the life of a plant, degradation of cabling and other electrical equipment, and reactor pressure vessel embrittlement will have yet to be determined effects on operating lives.

Experience with and understanding of aging issues continue to grow. In total, the histories of the more than 400 nuclear plants worldwide provide several thousand reactor-years of operating experience. However, because of the industry's youth, experience with

Commercial nuclear power plants in the United States



Years of commercial operation	Number	Average capacity (MW)
○ 0 - 10	42	1,090
◐ 10 - 20	44	860
◑ 20 - 30	20	660
● Over 30	1	69
R Retired since 1988	6	620
S Shut down under review	2	1,065

nuclear power plant aging in the second half of the 40-year licensed lives is limited. This limited experience with aging can be particularly important for some major long-lived equipment such as the reactor pressure vessel, cables, and piping that are intended to function for the full life of a facility.

Current and planned nuclear power plant aging management practices are designed to identify and address challenges before they become a threat and to provide a reasonable assurance of adequate safety. These practices depend heavily on elaborate plant maintenance programs and on ongoing research. There will always remain some risk, however, and continued industry and Federal regulatory vigilance is crucial. Attention to aging issues is crucial not just in considering license renewal but in a plant's original license term as well.

The industry and NRC are working to address aging issues, but their efforts could be accelerated to determine better the long-term prospects for existing plants and to assure adequate long-term safety. For example, NRC could intensify its review of aging safety research for possible regulatory applications. Greater attention to aging safety issues during a plant's original license term could also help justify a substantial simplification of the NRC's still-undemonstrated license renewal process.

AGING ISSUES IN PLANT LIFE ECONOMICS

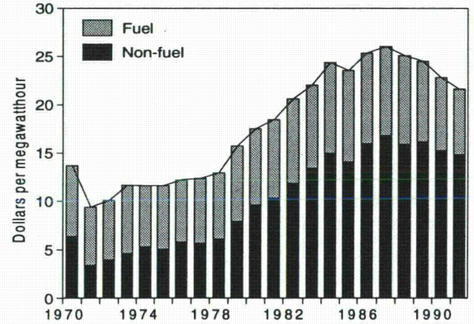
Many nuclear power plants face severe economic pressures. The six early retirements occurring between 1989 and early 1993 convey the variety of issues likely to be involved in the future, as economic life decisions are made. In several of these decisions, aging degradation and its effects on plant costs and performance played a prominent role. Other factors have also played prominent roles in determining plant lives and will continue to do so in the future. These include rising operational costs; radioactive waste disposal; public attitudes toward nuclear power; and the changing electric industry context, including increased competition and attention to environmental impacts. While future economic conditions are highly uncertain, some analysts have suggested that as many as 25 plants may be retired in the coming decade. However, the economy of most nuclear power plants appears at least moderately attractive, assuming the recent leveling of costs continues.

Any tendency to judge the industry by early retirements may give a misleadingly dim view of the remaining lives of other nuclear power plants. The great diversity among plants and plant performance, and the changing electricity market conditions across the country make the long-term prospects neither uniform nor clear. Thus, no single development is likely to affect uniformly the future of the Nation's existing nuclear power plants. Rather, the futures of the existing plants are likely to be determined individually over time, based on a host of separate decisions made by utilities, State utility commissions, and Federal regulators.

Responsibility for judging any plant's economic attractiveness lies primarily with the owning utility and State regulators. However, Federal activities in such areas as nuclear waste disposal and nuclear plant safety regulation (e.g., resolution of license renewal requirements) can have major economic impacts. Accelerating these Federal efforts could help reduce uncertainty facing utilities and State utility commissions as they make plant life decisions. Federal policies outside the nuclear arena, such as addressing global climate change and other environmental challenges, can also have major impacts on the economics of existing nuclear plants. Federal efforts are ongoing in these areas, but the outcomes remain uncertain.

DECOMMISSIONING

Several decommissioning issues remain unresolved, although work is ongoing to address them. There remains substantial uncertainty in decommissioning costs and the adequacy of decommissioning financing in cases of early retirement or rapid cost escalation. Although decommissioning costs are uncertain and large if viewed as a one-time expense, they are not large relative to lifetime plant production costs. Case studies of early retirements could be used to learn more about the prospects for decommissioning costs and performance. Perhaps of greatest importance,



U.S. nuclear power plant production costs, 1970-1991 (1991 dollars)

however, is the future disposal capacity and cost for radioactive waste. Estimated low level waste disposal costs have increased tenfold in the past decade, and there has been limited progress in developing new disposal facilities.

The nuclear plants currently in operation are generally larger and more contaminated than the plants decommissioned to date. However, experience with decommissioning small reactors and with major maintenance activities at large plants suggests that the task of decommissioning can be performed with existing technologies. Final decommissioning of all but a few very special cases will likely not be performed before early in the next century. Rather, most retired plants will go through a waiting period of between 5 years and several decades, allowing short-lived isotopes to decay.

As with many other modern societal activities, decommissioning cannot provide absolute protection of public health and safety, even if all radionuclides associated with the plant are removed from a site. For example, there will be some radiological risks associated with the waste disposal site, and nonradiological transportation and occupational risks. Background radiation from other sources will also remain. The NRC has recently undertaken a process to revise residual radioactivity requirements for terminating a license. NRC could extend this effort to examine alternatives to its current requirement of unrestricted site release. For example, because future exposures depend on land use (e.g., industrial, residential, or agricultural), NRC could investigate different radiological standards matched to restricted land uses.

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