Safety Goal Project

NUCLEAR REGULATORY COMMISSION (45 FR 71023)

ORIGINAL

In the Matter of:

WORKSHOP ON ECONOMIC, ETHICAL AND SPCOPPOLITICAL CONSIDERATIONS

PANEL C

DATE: April 2, 1981 PAGES: 194 thru 391

AT: Palo Alto, California

ALDERSON REPORTING

400 Virginia Ave., S.W. Washington, D. C. 20024

Telephone: (202) 554-2345

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

- - - -

PUBLIC MEETING

WORKSHOP ON ECONOMIC, ETHICAL AND SOCIOPOLITICAL CONSIDERATIONS

PANEL C

Marsten Room
Rickey's Hyatt House
4219 El Camino Real
Palo Alto, California
Thursday, 2 April 1981

The meeting was reconvened at 9:30 a.m., pursuant to adjournment, with Dr. Paul Slovic, Panel Chairman.

PRESENT:

Messrs. Charnoff, Cochran, Ernst, LaPorte, MacLean, Bari, O'Donnell, Okrent, Page Perrow, Starr.

* * * *

PROCEEDINGS

DR. SLOVIC: I think first I would like to receive any comments about what I should have said that I didn't say, or what I didn't say that I should have said. Briefly.

DR. COCHRAN: It is not a reflection on your summary but the summary points up the need to try to be a lot more focused today, and really sharpen a few things that we agree on or don't agree on, and so forth, rather than continue the way we operate now.

DR. SLOVIC: Any other comments?

DR. PERROW: I think you could have outlined more some of the ethical issues that seem to divide us, in terms of future generations of current things, the prospect of current social chaos if we don't get more of our energy from nuclear, and the current -- the fact that we shouldn't -- some fuel that we should not take sacrifices today for the future -- we should worry about today -- those kinds of ethical issues which are in the title of our panel are not laid out and might draw some response.

DR. COCHRAN: I would like to come back to that maybe now because I think we ought to sharpen up that apsect of it. My understanding from yesterday's discussion was that while it was an interesting discussion, there are more important ethical issues that we should be identifying with respect to this sort of narrow problem of reactor safety goals

and reactor licensing or whatever. I mean, the inter-generational transfer of risk is an interesting issue, but there may be more important ethical issues for us to focus on with respect to --

DR. PERROW: Like what?

DR. COCHRAN: Well, it's --

DR. LA PORTE: Before we get to the whole procedure, in considering ethical questions, really I have two points to make. I think that for us to try to get some sort of agreement of what should be an ethical position is an interesting exercise in self-learning, but we won't get anywhere, because we will have our own feelings about these things and rather than to try to say to one another that we should change them to meet someone else's -- so first of all, I thought what various ethical positions one can take, and then the implications of having taken that position for evaluation of safety goals.

DR. COCHRAN: I think we would get more agreement on the ethical issues, but less on the empirical analysis that leads one to conclude that one is in compliance or not in compliance with an issue. If we stayed away from empirical data, I think we can get somewhere.

DR. LA PORTE: Well, I don't mind staying away from that -- what I am striving for is to try to put it in the context of having arrived at one's own personal ethical

position, does that have an implication for how you understand safety goals presented to you by others, whatever they are, or would one want, if you were a person who was primarily concerned about protecting the far future, rather then the present, and let me take what I think is an extreme position here, but you are more concerned about the future than the present, does that make a difference in the kind of safety goal that you would seek? Or evaluate others presentations of safety goals to you? What I want to try to suggest, not that we would come to some consensus on this, but to inform others about what the implications of having chosen.

DR. COCHRAN: I think the answer is yea. However I think the particular example you use is not the more important one for this area. It is more important for some waste considerations and so forth, but not for this.

MR. O'DONNELL: I thought that our discussion yesterday had reached some sort of, if not consensus, some conclusion wherein I think we were saying that these things are important considerations but can be dealt with not exclusively, but in terms of insuring that the risk levels that you end up with quantitatively are low enough such that you are in fact not only protecting the existing generations, but as a result also limiting the future generations. I agree with Tom, that to deal explicitly is waiving on the scope of what we are trying to dela with here. But I think you can inclusively

include those considerations as you can considerations such a genetics, by having an index of risk that is maybe based on present risks, but is set low enough so that you insure yourself that you have somehow covered those other apsects.

I think an important issue that we ought to try and deal with, and it has ethical and sociopolitical ramifications is the basic question that was discussed in the plenary session, that is, should the level of safety that is demanded of nuclear power be established on the basis of equity with other energy technologies, or with technologies in general, or are there reasons, and one of them could be your concerns about future generations, to somehow set a lower standard for nuclear power. I think that is an important issue, that we are to try and deal with here.

DR. PERROW: Lower?

MR. O'DONNELL: Excuse me?

DR. PAGE: Stricter, you mean?

DR. SLOVIC: I agree, I would like to discuss that. First, let's continue with the evaluation.

DR. PAGE: Critique.

DR. OKRENT: Let's see. I can't remember. Did you suggest that the new NUREG 0739 did not deal with the ethical problem? I can't recall.

DR. SLOVIC: Well, I don't know exactly what I said. I probably said something like that, that if we

neglect these issues of spatial and temporal equity -- I meant to say, and if I didn't, the point that Ed raised, about the risks being aimed at a low level so that this would be taken care of that way.

DR. OKRENT: As I think, think in fact, as I said in our discussion, in my opinion, in fact it addressed both the question of people getting risks without commensurate benefit, and the question of intertemporal risks by having in fact very low risk ot the individual, in today's family, and in fact much lower ones to the individual in future families.

DR. PAGE: Is this discussed directly or is this your interpretation of what the numbers mean?

DR. OKRENT: No, to me it is implicit.

I don't remember if --

DR. CHARNOFF: Didn't you have a discussion in there of the lowest risk group? Wasn't it in that context that you were discussing that?

DR. OKRENT: No, the point is that I think somewhere in here there is a point where you have to think about these thing. In other words, in the general discussion in part one. I'd have to go back and find where. My point is that I think it would be not correct to assume that this was neglected in the process of developing these recommendations, and we did try to indicate the kinds of things that had been considered

in some of the previous proposals to bring out how people had addressed the reviewer's admittedly incomplete --

DR. CHARNOFF: It was already too thick.

DR. PERROW: Whether it is absolutely neglecting, it's hard to say, but I don't remember any substantial discussions. I thought we had a substantial discussion yesterday which indicated the importance of that topic. I don't think that the relative importance we gave it is reflected in the others.

The other thing that you said was neglected was the discussion of genetics. I am not sure whether you were saying it was neglected or not in the panel, in 0739 or whatever;

DR. SLOVIC: I am saying that it was neglected in the ACRS.

DR. PERROW: ACRS, yes. And there may be a mention of genetics in there, but I don't find any significant study of it.

DR. OKRENT: No, in fact it says specifically that the risks of early death and delayed cancer are assumed to cover other risks such as the genetic or other health effects, and it was proposed not to set specific limits on genetic effects. Now someone might do some analysis and come up with a conclusion that this is invalid. In other words, you might have a situation where you have in fact met the levels, let's

say, suggested with regard to delayed cancer, and have an intolerable genetic effect. I would be interested in seeing that.

DR. PERROW: That is what the German study said, in effect, didn't it?

DR. OKRENT: Which German studies?

DR. PERROW: There was one on a plant that took into account long term radiation. I think that was the one that took into account strontium-90. It was dismissed by the NRC. The NRC said that they were only picking out the negative studies. They reviewed twenty years of studies. They only picked out the negative ones and didn't look at all the others and there was a flap about if the NRC would not address itself to it. Is that what you mean?

DR. O'DONNELL: The uptake of strontium-90 in vegetation?

DR. PERROW: I think that was in that and that might have been the Wisconsin study. I forget which.

DR. MAC LEAN: On this particular point, I am sympathetic with David, that you just sort of make explicit that point of view with the delayed cancer effects, and assume that this will cover the genetic aspect. I can't see how, and I don't know enough about it, but I don't know how else you could measure the genetic effects and bring them in. I think the proper place to raise that, unless you have some way of

incorporating that --

DR. COCHRAN: You've got numbers and all he is saying is that he is going to use the best estimate approach. You have a number, say 135 cancers per million man-rems of exposure, and you can get a best estimate genetic risk number, and I don't know what it is, but let's say 200 serious genetic effects per million man-rems of exposure, and all he is saying is that, you know, since it is a ratio, if you have covered one, we assume you have covered the other one. In fact, what it does is say the real risk is maybe twice what the numbers suggest because it's a per two type.

DR. MAC LEAN: And I guess if there is anything special about genetic effects, then maybe the place to consider that issue is under the question of whether the risks to nuclear power --

DR. COCHRAN: They are, but they don't particularly apply in the reactor safety area because you don't have a lot of control over the ratio of sexes that are exposed, or age groups. For example, if it was an occupational exposure you could have differential goals for people in the genetically-significant age groups, under forty-five or whatever, as opposed to older people.

DR. SLOVIC: Chick, did you say you found the study?

DR. PERROW: Yes, it is the Heidelburg study, dealt with the Lyle reactor on the Rhine. It did deal with strontium,

cesium and plutonium. The estimates by the NRC being from ten to one thousand times too low on the amounts.

DR. CHARNOFF: There has been an NRC response to that hasn't there?

DR. COCHRAN: What's your point. There's a lot of controvery there.

DR. PERROW: There have been studies about the genetic effects of low level radiation from these plants, and here is one of them.

DR. CHARNOFF: Now that is not a strictly genetic effects study. That is a study of the uptake through the food chain and so on, that has been responded to by the NRC, but that was not specifically a study in genetic effect.

DR. PERROW: There are genetic consequences of that.

DR. CHARNOFF: The real question, it seems to me, is whether or not, assuming there is even enough technical competence around this table to deal with that question, is whether or not one can use a surrogate for genetic or future generations by way of establishing a low enough level for somatic or current generation harm. If there is, the question of whether this group would have the NRC recognize that they ought to be concerned with future generations and the ethical considerations associated with that, but do so through a mechanism of the type that David has suggested. I guess that depends on whether there is enough of a technical consensus

that that is an adequate surrogate. I don't know if we have that competence in this room, but assuming it is there, the question is whether we identify the reason we are doing it and, as you indicated, at least show that we all recognize that it is being taken into account that way.

DR. CHARNOFF: Certainly establishing safety goals, that would seem to me to be a fairly reasonable priority among several others to look into.

DR. COCHRAN: Let's see if we can tighten this up. I think we can all agree and have enough expertise around here to agree that it is a proper calculational methodology. There is nothing wrong with the mathematics and the approach, and then let's see if we agree or disagree on this matter of whether one should use that approach given the confusion it is likely to generate by people like ourselves. One has to spend some time to be brought up to date that in fact it is in there as a surrogate method and so forth.

DR. CHARNOFF: What is the confusion that you anticipate?

DR. COCHRAN: I anticipate that a lot of people will do just what I did, and that is, won't read the report carefully and won't realize that it is in there but it is not explicitly stated.

DR. OKRENT: It is explicitly stated on page 65.

DR. CHARNOFF: Footnote two?

JB10

DR. OKRENT: No, it says on page 65, under 2.2.3.1, (reading): "In the case of societal health risk it is assumed that the control of both early and delayed death would adequately control other effects."

DR. PERROW: We all know the problems.

DR. OKRENT: There are not only genetic, there are teratogenic and whatever.

DR. CHARNOFF: I'm hearing, I think I'm hearing that the people around this table are saying there ought to be a more explicit recognition that this mechanism is being used for this purpose. If that is the confusion that Tom is talking about, I think it is clearly there.

DR. COCHRAN: The confusion is that people who are in a hurry will turn to the tables to look at the limits. The tables speak of cancers and the immediate question is, well, they haven't considered genetic effects. Now they have, but as you say, it's clearly stated on page sixty-something.

DR. SLOVIC: Do you feel comfortable with that assumption, or were you just doing that because you did not, at this point want to get into an analysis of genetic effects?

DR. OKRENT: In fact, my limited knowledge of the extent of genetic effects and the probability of cancer and so forth suggests to me that you will have exercised a reasonable control on genetic effects, when you have exercised reasonable control on cancer, especially using linear energy models --

not energy, the linear models of radiation and cancer, a non-threshold model -- I may be wrong but I think, in fact, this will come out. I am not, you know, opposed to some kind, at least initially -- let me discuss this -- to a consideration of some kind of a specific limit on genetic effect. But I think you have to be careful when you raise this question and say, well, I think we should impose a limit here, that you ask yourself, am I going to single out nuclear power for this kind of limit, or am I going to have some kind of a limit, impose some kind of a limit on all activities in society? On what basis am I going to do this? Suppose there is some other activity that leads primarily to genetic effects but not other things, how am I going to set that limit? I think you may find, in fact, that there are many other things going on all around you that are much more important with regard to genetic effects than nuclear power, and in fact, I don't know, to me it's not a question that one dismisses. On the other hand it is not a matter that one sets limits on without some kind of perspective.

DR. PERROW: You have brought this up at least three times now, and I just want to get this straight. Let's say I am much more fearful of atomic weapons and broken arrows, missiles that have fallen, much more fearful of that, the consequences of that, than all existing nuclear plants. And I don't think we are doing anything about it. The public

is aware of it. I think the safety technologies are sloppy and everything else. Now, that does not, however, lead me to say that because nothing is being done in there, or nothing is being done about acid rain, which could be done fairly easily and economically, that does not lead me then to say that now we are talking about nuclear power and we should pull back from this and set some limits because there are all these hazards and risks. I thought our subject was nuclear power and if we find some risks in nuclear power then we have to deal with them, we have to deal with safety, and it doesn't matter whether there cold fire plants out there that are also bad, or broken arrows or worldwide defense military command systems which are probably the most hazardous activity of mankind, we are dealing with this now. And you seem to keep saying that it makes a difference that this is not the only hazardous thing on earth.

DR. OKRENT: Yes, I think is does. I wouldn't care myself, however, to mix in military operations and their effects into a consideration of risk levels from non-military aspects of society. I think that leads to somewhat untenable decision-making processes or whatever. But I think, in fact, it would be a mistake to look at nuclear power or at coal or at any other source of energy generation and to set requirements with regard to safety without considering the alternatives that may result from the use of different things. In fact, I only

today or yesterday heard somebody, Toby Page perhaps, tell me how EPA, in the process of trying to restrict the use of pesticides that are carcinogenic, adopts regulations that have led to the use of pesticides that produce early effects. In other words, the tradeoff is not from something that produces a carcinogenic effect to something that has a zero effect. It may be a different effect and it may or may not be better.

DR. PERROW: So the EPA shouldn't do anything?

DR. OKRENT: No, I didn't say that, but I think it would be a mistake, and in fact, I will give you a better example. There was a considerable concern about children's clothing catching fire and so they put an anti-flame retardant on which then they found could or might produce cancer. To take a narrow pe-spective may in fact lead to less safety, not more safety. That is my point.

DR. PERROW: Should we try to do anything at all about these risks?

DR. OKRENT: We should try to consider the overall balance.

DR. COCHRAN: We are getting far afield of our topic. Wait just a minute. I thought the issue before us was whether we should deal more explicitly in the tables and so forth with the genetic consequences as well as the somatic. The error bars in the risk estimates of genetic effect overlap the error bars in the risk estimates of somatic effects, given the

same whole body exposure to radiation. And the means of the two are within the overlapping error bars. It is not going to make or break nuclear power to explicitly put an explicit requirement in the tables on genetic effects, just like one does the somatic effects. It may require no additional containment requirements and so forth and so on. I think we are getting very far afield in worrying about what the FDA or so forth does in these areas, and I would like to see if we can get an agreement, or whether we still have disagreement over whether it would be more appropriate if the NRC adopts this type of approach, to have a more explicit layout of the limits of genetic effects or genetic in combination with somatic effects, and the limits that are proposed.

DR. SLOVIC: I would say that it has to be considered if only because people are going to be concerned about it. They are going to want to know. This is an assumption in this document, and I think it ought to be addressed explicitly. To me, I would say that a document like this needs to attend to that issue, and to have an analysis of the genetic effects built into it.

DR. O'DONNELL: I think it probably warrants more discussion of why the single numbers proposed here is in fact as index or surrogate for these other types of risks.

DR. COCHRAN: I think we have heard that, because David wasn't very comfortable with discussing genetic effects,

he didn't know as much about it as he did somatic effects, and so forth and so on, and it is an easy way to get around the problem, and it is mathematically correct. But the question is whether you want a more explicit treatment?

DR. CHARNOFF: I think this really is the issue, because I think the debate between Dr. Perrow and David is a nice abstract proposition, but I think that my reading of the BIER Committee report and the others would suggest that what Tom said is basically right, and I think that most of those people who have written on that subject would suggest that, in effect, if you are protecting against somatic harm to some extent,you are protecting to basically that same extent against genetic harm. I guess the difference would be between where Tom has articulated, where I would come out is that I am not sure that I would need to make it explicit by way of putting a number in the table, as distinguished from having a sufficiently cogent and clear discussion that I am using that somatic index as a surrogate.

DR. COCHRAN: Let me point out a difference, though.

DR. CHARNOFF: Excuse me, let me just finish. I think that once I begin to get explicit about what the numbers ought to be in the table, I engender a whole new debate about the validity of that particular number, and I begin to raise the question that David, in effect, was raising, of how are we protecting this versus alternate technologies, and taking

JB15

that into account. I do think we ought to recognize that it can be taken into account if, in fact, so-called experts in this field have said what I think they have said to me, and what I think you have said. But I don't know that there is a need for numbers, per se, to make it explicit. I don't know what that does for anybody.

DR. COCHRAN: Let me tell you why I think the number is needed. There is disagreement in the radiation protection community over the issue of what kind of model one uses, a linear or some sort of threshold model or absolute versus relative risk and so forth. You can get some people believing that somatic risks are very low. There is no disagreement in the radiation protection community over the use of a linear, non-threshold linear model to estimate genetic effects. There is still a wide uncertainty for it. If you write your regulations solely to protect the somatic effects, you are opening yourself up to people coming in and saying, well, there are no risks with somatic effects because, you know, you are down at the 1 mr level, there is no effect below the threshold, and so in effect these things are safe. And you still have not dealt with the genetic problem properly.

DR. CHARNOFF: I don't know if you are really representing that debate quite accurately. It is certainly not my field, but it has certainly been my impression that whereas twenty years ago people were more concerned about the

JB16

genetic impact than they were about the somatic impact, that has shifted.

DR. COCHRAN: Has it shifted more than once?

DR. CHARNOFF: Well, but it has shifted. That may be and it may continue to do that. My sense is that if you are trying to get at something that is practicable and not going to be -- and I am looking at this as a lawyer, from the standpoint of how are we going to establish and litigate these things and proceedings -- it does seem to me that you have just opened up a whole new area that will take whatever period of time and controversy needed to get a number.

DR. COCHRAN: You are giving the argument for putting it in explicitly because you are stating that people's perception of the relative hazards of genetic versus somatic have shifted over time, and I think that is an argument for being more explicit about it rather then less explicit.

DR. CHARNOFF: Well, we could have a debate on the sematics, the word more or less explicit. I want a discussion of it, but I am not sure that I need a number. I think you are fighting for a number.

DR. COCHRAN: Why do you want a number for somatic?

DR. CHARNOFF: I think you need something. If you are going to go to a quantitative approach at all, and I have my own reservations on that, but if you are going to go to a quantitative approach at all, that is a way of establishing a

number, in effect, and if it is a reasonable approximation or a stand-in for some equivalent effects, I have taken care of the manner. I think what is most important is that it does not appear like it has been neglected or ignored. One can read this document except for the word "other" and wonder whether it is in there or not.

DR. OKRENT: I'm sorry about that.

DR. O'DONNELL: We are talking about how complex we are going to make the numbers, and my major criticism of this approach right now is that there are too goddam many numbers in here. We could partition the goals further. We could break it down into what types of cancers. We could have leukemia and bone marrow cancer, GI cancer -- all of these things.

DR. CHARNOFF: Which are the good ones?

DR. O'DONNELL: Yes -- and genetic effects, and we could break it down, but all of them are related to the same model in terms of health effects, that is, there is a relationship, or assumed relationship, between level of dose and these effects. And I think the use of single value as an index is the best way to have a simplified and understandable quantitative structure. But I think it does, in supporting documentation, deserve a full discussion of why this is the case, and why this goal in fact covers and insures that these other elements of risk are in fact addressed by the single number.

JB16

DR. OKRENT: Without arguing pro of con on this, and I really don't have any set opinion on the matter, if you were to try to calculate the somatic effects, the cancers, I have heard people say, well, should be calculate out to 1 r, to 10 mr, to 1 mr? Shouldn't we have some kind of a cutoff? In other words, do integrate out to the smallest dose? It is a practical question, in effect, and also I suppose over what time period will enter into this. I think just having a number here doesn't answer that. In fact, that will affect the assessment that goes into the comparison.

So that is one point, and I think the point that Tom has raised, that there are differences of opinion was to whether or not below some value in fact there is a zero effect. Some people do think there is, in principle, I suppose, a negligible effect or whatever.

So there end up being differences in these fine points. By the way, it wasn't because I was unable to specify something on genetics. We were torn between having too many things and too few. I am aware of the argument that comes from industry that there are already too many things in here, by the way. And we tried to put in what, to us, was a least number that kept constraints. For example, we were talking earlier that we tried not only to provide a risk number for the individual, but to require certain both prevention and certain mitigation features, and not let it all appear in one

JB19

area, and we also thought it was relevant, for example, to distinguish between early deaths and delayed deaths, although there are people who have a different opinion, because we thought that, while one of those might end up being limiting for nuclear reactors, if you try to compare with other technologies, at least energy technologies, the effects are not the same going from one to another, and that might be useful.

Whether that approach is correct, I don't know. Whether we had to right number in here, I am not trying to take a position on.

DR. COCHRAN: Does your most exposed individual, is it a standard man or a child? And does he possibly have emphysema?

DR. OKRENT: No, but I think --

DR. COCHRAN: Because the risks are very different.

DR. OKRENT: No, no. In fact, we in effect did give a definition. I'll find it for you if you wish, and I'm not saying it is the one that should be used, but we chose, in fact, to give a definition of the most exposed individual. I am not sure that it is important to this discussion.

DR. SLOVIC: I think we have a consensus that this needs greater attention. There is disagreement about the treatment. The is discomfort with the present treatment that is being done. The surrogate issue needs to be addressed.

DR. PAGE: Is it necessary that NRC has goals set

in terms of stone, that is, these are the goals and they are sprt of going to be there forevermore? Or is it conceivable that we could suggest that some things have more uncertainty than others? The genetic harms are considered more uncertain than the somatic harms, and apparent focus has been on what we know the most about, but this also means that we think that NRC should encourage more resolution of the uncertainty in the genetic effects. Can it be a part of NRC's goals to learn more about the genetic effects?

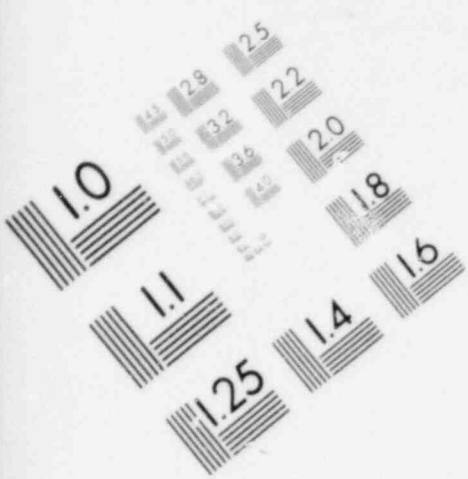
DR. CHARNOFF: The only comment I would want to make on that, I don't know if we really should do that, make that observation, withou ourselves reviewing that literature and deciding, yes, that needs more, or possibly something else.

Now in fact my general impression of the recent literature is that there is more comfort now with genetics than there was before.

DR. PAGE: My impression from reading this book was that there was nothing on genetics. I didn't know what "other" meant.

DR. OKRENT: We apologize.

DR. PAGE: That is the point. The point is that in reading this book it was all on cancer. There was none on genetics, except subsumed under this powerful word. Okay, now we know what it means. Okay? But other readers won't know what it means.



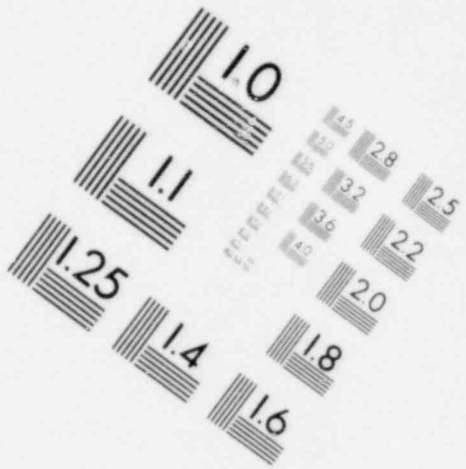
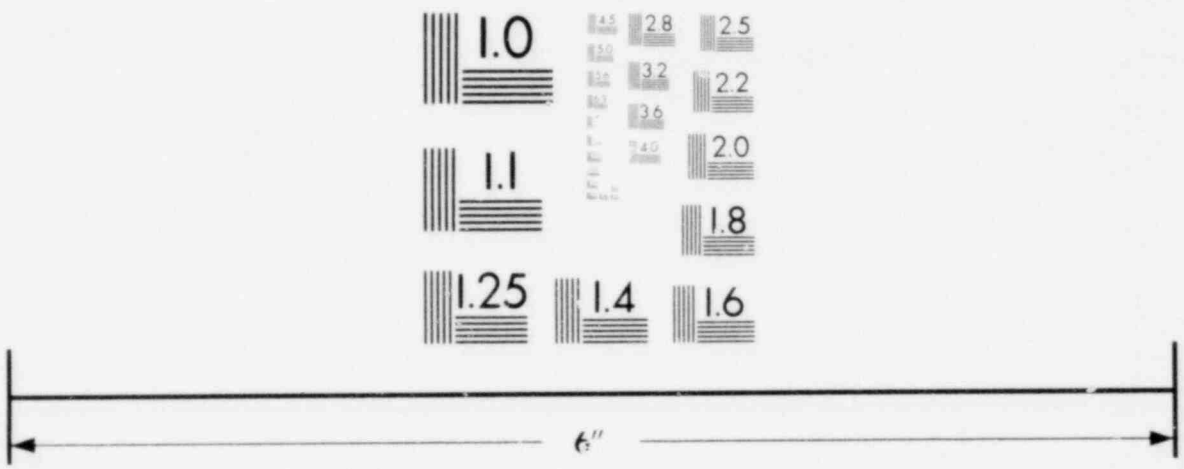
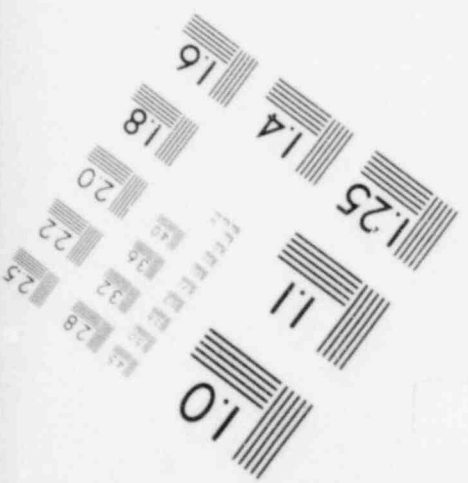
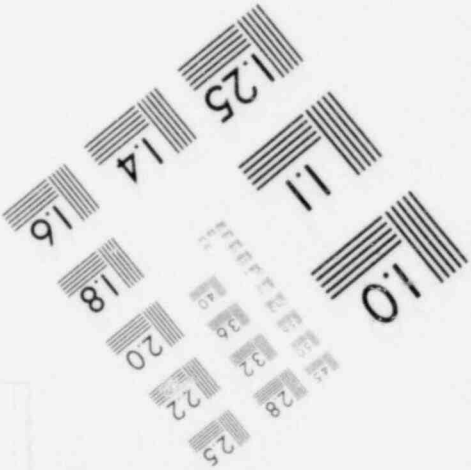
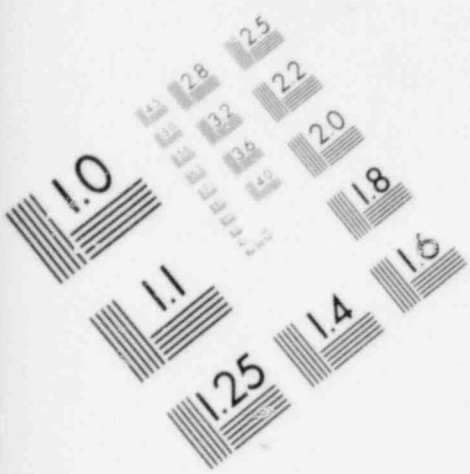


IMAGE EVALUATION TEST TARGET (MT-3)









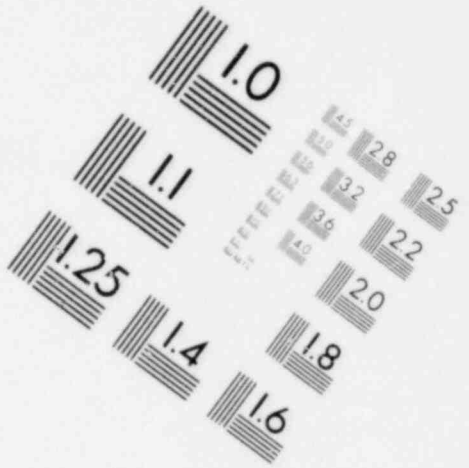
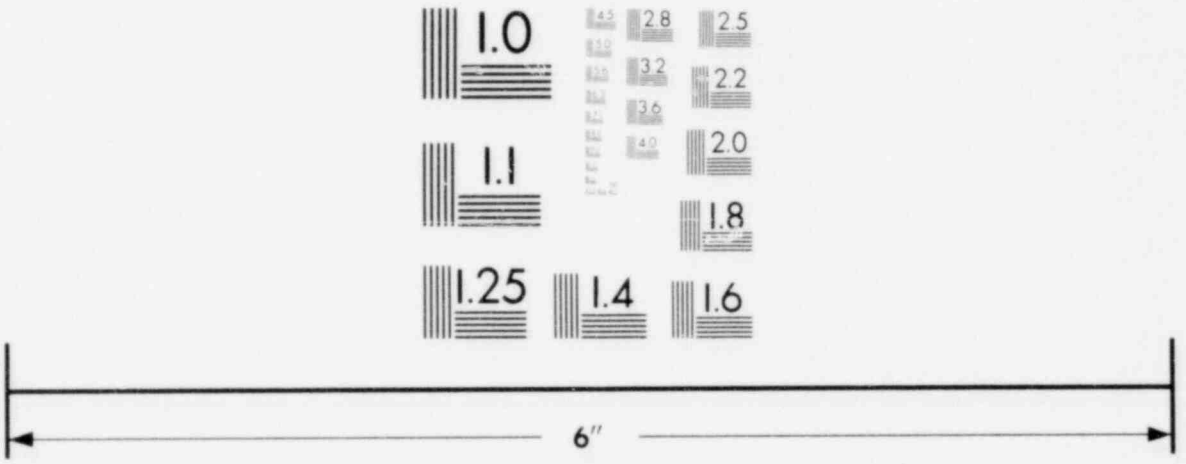
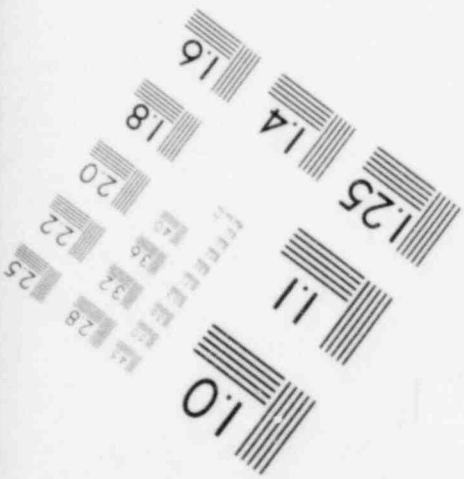
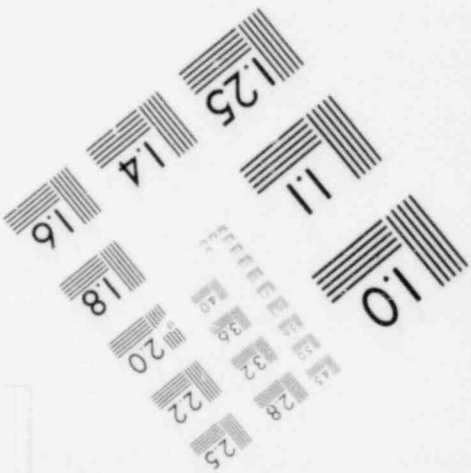


IMAGE EVALUATION TEST TARGET (MT-3)







DR. OKRENT: You are perfectly right. I absolutely accept the criticism. We should have been clearer. But there is a separate question of is it sufficient to use it as a surrogate after you have discussed it?

DR. MAC LEAN: That's what there is some division that has been expressed here. Maybe we ought to get a sense of the group.

DR. PAGE: Before we do that, we're busting to be like the other panels, where they all have neat reports and our chairman didn't, and we are all trying to help him out today.

DR. SLOVIC: Now what's the question you wanted to address?

DR. MAC LEAN: It seemed to me that there was a consensus that we don't have to discuss any more, that there should be something more explicit about genetic effects, and there was a difference about whether that discussion should take a verbal discursive form or should be included as extra numbers and tables.

DR. PERROW: Well, is it a quantitative safety goal or a qualitative one?

DR. MAC LEAN: I don't know if that's the question.

DR. COCHRAN: Whether it is surrogate methodology or explicit.

DR. CHARNOFF: The surrogate one is still a

quantitative one.

DR. COCHRAN: Yes.

DR. MAC LEAN: I was thinking that it might be worthwhile to just discover whether the group is divided or whether there is a near consensus on one or the other of these approaches.

DR. SLOVIC: Is there agreement that there should be more in depth treatment of this issue?

DR. MAC LEAN: That we all agree on.

DR. SLOVIC: I have the feeling that there are some strong differences of opinion about a fine point here of quantitative and qualitative approaches. It seems also that the surrogate issue is somewhat separate from that. That is, the surrogate you could say that you want it quantitative, but then there is the question of can something serve as a surrogate quantitatively? There are two questions.

DR. MAC LEAN: I didn't mean to get difficult. I just thought it would be more useful or more accurate to say, whether you are going to say the group was divided, that there was near consensus, all but one, or whatever.

DR. SLOVIC: I think we have two positions here. My feeling is that we are not going to get consensus on that or resolve it. I don't know quite what the balance is.

DR. COCHRAN: The chairman is pleading for a vote on what the sense of the disagreement is.

DR. SLOVIC: How many lean towards the quantitative

analysis?

DR. MAC LEAN: I'm not good at devising these questionnaires.

DR. COCHRAN: I would propose that limits on risks or goals include explicitly limits on genetic effects, and not as an alternative, to handle the genetic effects -- the somatic effects as a surrogate of the genetic effects. That is the motion. All in favor?

(There was a show of hands.)

DR. SLOVIC: Opposed?

(There was a show of hands.)

DR. SLOVIC: Undecided?

DR. LA PORTE: I want to know what we are doing here. My sense is that we are behaving as though we are panel A. That is fine, as long as we understand that is what we are doing. Though I thought we were concerned with another set of issues, and I am interested in the way we are going, because there is sort of a message here to all of us, that in this group on this topic we think that some attention to an area that has a degree of public concern, more explicitly in something that is a matter of potential official concern, is sensible, and that something -- it is recognized that in light of that social interest that if one aspect is quantitized, so should the other, that if quantification is to be used, it should be used even handedly across the effects of concern.

Now I'll stop there in terms of that point, and while I have the floor let me say that I am perfectly willing to start with the quantified safety goal as something that you would want to try for, and that what you have done is just fine for a start. I think that is what you meant it to be, and that to ask, after we get through, if we are going to take a vote on this, to change the agenda a little bit, to consider the implications of the establishment of safety goals, for how one considers the implications of choosing a quantified way.

DR. SLOVIC: I am uneasy with this voting business. It seems to me that our job is to kind of elicit ideas and points of concern. I think we have done that in this case. I think we have really laid out a general issue and some specific points that need further concern.

Then we just have to worry about --

DR. COCHRAN: (Interjecting) I would like to propose a new issue.

DR. SLOVIC: Okay. I have some, too.

DR. LA PORTE: Before we start proposing issues, I think we ought to go around and get what we would like to talk about on the table now, so that we have an idea of what we will have before us.

DR. SLOVIC: That is a good idea given the time we have.

DR. OKRENT: And allocate the time, by the way,

so that we can all identify important issues to be covered before we run out of time.

DR. LA PORTE: I would like to know what is on your minds and well as I want you to know what is on mine.

DR. COCHRAN: I am troubled by the way we left the discussion on ethical issues yesterday. It focused on the inter-generational transfer of risks and benefits, and without attention to perhaps more important ethical issues that we should focus on and try to find some consensus or points of disagreement.

DR. SLOVIC: Such as?

DR. COCHRAN: Oh, one might be related to whether you license nuclear plants in the manner that is currently being done, in face of large public opposition, or whether there is some sort of goals related to behavior of the institution that would be more appropriate in light of the widespread opposition to nuclear plants.

DR. SLOVIC: Okay, David do you have something to add to the agenda?

DR. OKRENT: I don't think we have covered socio-political and economic. I will make that observation, and I would like to come back to the point that Professor LaPorte raised about the difference between the few and many, because I would like to understand it better.

DR. SLOVIC: Okay. Ed?

JB26

DR. O'DONNELL: The issue I just raised previously that I said needs discussion I think is the concept of the safety goals for nuclear being in relationship to other technologies. I think we ought to be very clear on whether we think they should be the same or they should be different.

DR. MAC LEAN: I share Tom's sense that I didn't want to leave the ethical issues with questions od dsitribution, which I think are only a very minor part of the important issues. And I would like to see what I consider the major issues discussed. Really it covers both of these in that the way I would phrase it is that throughout this report we see acceptable and non-acceptable used all the time. And I would like to know what we mean by that.

DR. LA PORTE: I would like to talk about the scaling question and the implementation of goals as a way of evaluating the sensibility of the quantified goal, as you propose to accept it.

DR. SLOVIC: Say that again.

DR. LA PORTE: I want to talk about the requirements for implementation and as a way of getting into considering the sensibility of the quantified goal, and I'll talk about what I mean by that in a little while.

DR. OKRENT: I assume you have a note of my general request that I made before -- the risk aversion? You already have that?

JB27

DR. SLOVIC: Yes.

DR. CHARNOFF: I think there is a socio-political or an ethical imperative of dealing with standards in such a way that they put this risk in some context, and the question I would like to raise is whether there is such an ethical imperative that in establishing a standard for risk A, whether one does not owe it, somehow or another, to the public or whoever we are addressing, that this be done in the context of total life risks. Isn't there an ethical question there? If so, how do we deal with it?

DR. SLOVIC: Chick?

DR. PERROW: If I know what Todd means, I guess I am primarily concerned with whether any of this stuff is insurmountable or not. What it means -- that is still the problem I had when I was reading it before.

DR. PAGE: I am also concerned about the meaning of the term "acceptable," and the difference between developing notions of acceptable risks in terms of certain normative ideas as opposed to social engineering. We have heard several times, if only the industry could educate the misinformed public then everything could be okay. The question is essentially running the causality the other way and making the system work.

The other set of issues that I think we are beginning to touch on has to do with the use and meaning of goals in

terms of performance. I am not just thinking of verification. I am thinking of incentive structures, so that the risk assessors have an incentive to be accurate in their assessment, which means some form of keeping score and some form of rewarding the ones who are in some sense better risk assessors and punishing the ones who are worse. Also it means incentives to make the system work on the operating level so that the actual managers, operators and so on work towards the achievement of the goals. Otherwise the goals are kind of empty.

I think that those issues have to do with legitimacy. I don't think we finished our discussion on the distributional ethical issues, the intertemporal ones. So if we can clarify some of the things that came out in a rather foggy way, that would be nice. It may be hard to go further than what we did say, but I sense that some things can be said, especially in this idea that the distributional problem melts away if only the risks are low enough. This may be a practical way of dealing with the problem, but I think we need to deal with it a little more explicitly than what we have seen so far.

DR. SLOVIC: Okay. Some of my concerns have been mentioned, but one that has not explicitly been mention is a more general concern is the general level of risk incorporated in these goals, and this relates to or interacts with the question of scale, with the risk aversion question, with the question about whether nuclear power should be treated

differently. Well, we have at least half a dozen different topics that have been raised. Going back to the ethical issue, we have this level issue that I just mentioned which includes the scale problem, the meaning of acceptable risk, the question that Jerry raised about the total concept of life risks, the problems of implementation, the incentive issue, and I don't quite know how to allocate time for these things. I would like to try to cover them all, but I would like to try to look now at the question of level of risk, including some discussion of risk aversion and whether nuclear should be treated the same or differently as others. I would like to make some comments on that because that is an area where I have some special interest and concern, and I think these concerns arise out of socio-political considerations, and in particular I have the belief that, for example, the risk aversion approach used here is not a proper way to model the impacts of nuclear accidents. I think it is much too simplistic, you know, the notion that we have some sort of coefficient alpha that we can attach to the loss of life in an accident that can model the impact, I think is likely to lead to standards which could be very costly to society and to the industry. My reason for saying this is because I don't think that the impact of an accident is a function that closely of the number of people killed, the number of latent cancers, or the amount of property damage or direct clean-up costs.

JB30

DR. COCHRAN: Excuse me, are you sliding into the issue that is before us? I am not clear whether you are laying on your sense of priorities or whether you are leading us into the agenda.

DR. SLOVIC: Oh, I'm sorry if I didn't make that clear. I am taking the prerogative of the chair, and I am just putting on the table the issue of level of risk and the related issues of, say, risk aversion and the way it is treated here, and the question of should nuclear be treated differently, should we aim at a different level of risk for nuclear power than for competing technologies? That is the question I am addressing. I am approaching that from the standpoint of the risk aversion factor here, and what I am saying is that there can be accidents which are small in the sense of immediate life lost and so forth. TMI is kind of a prototype of this kind of accident. They nonetheless have immense costs to society. These are higher order costs. They are costs due to a shutdown in the industry and all the ramifications, the ripple of the stone in the pond, and these rippling effects which I think are very important. They are very difficult to model. It may be possible, maybe not. But what is being done in this approach is to use extremely simple functions as a model for the impacts of a mishap, and it seems to me that the implication of this notion that small, or so-called small accidents can have immense costs, that costs need

to be modeled in a more sophisticated way, and when we do that, if we bring in these social and political costs, it will imply a much lower acceptable level of mishap. It would also imply a shift in the balance of attention towards prevention. You know, there is some sort of balance of resources that we allocate for prevention versus mitigation, and I think taking this notion seriously implies that there may have to be more weight given to prevention of small, but frightening, accidents. Not that mitigation should be neglected, but it would be important to prevent this.

It also implies that just the events, the single events, the occurence of another TMI-like sort of mishap will have great costs, and I think this interacts with the scale issue that Todd raised yesterday because with more reactors operating, the liklihood of one such incident in the near future, or in some time period, is greater. That would also imply that one wants a stricter, lower acceptable level of risk. So that also suggests that nuclear maybe should be treated differently. I think this is really an area where I can see a major discussion on this point, but if society will react in such a costly way to a nuclear accident, more so than it would to some aspect or a mishap in another energy technology, does that not imply that the risks, the target levels should be lowered.

DR. CHARNOFF: Can we discuss the assumption that is

JB32

in that statement of concern, and quite an appropriate statement of concern. We have had the empirical situation in the airline industry where airline X had problems in the fifties with the Electras, and shut down all the Electras. Gradually over time, as I have seen it, when an airline or an airplane has had a problem, we have had less large shutdowns. It's clear to me that when we had a TMI type accident in the late fifties or early sixties, we might have had a shutdown of the total nuclear industry. In the late seventies, you had a TMI, and in effect you had an almost shutdown of all of B&W type reactors, but not all the reactors. And I have wondered about it in the context of the day when we might have a hundred and fifty reactors operating. Is there a scale question of the type you are talking about, Tom, but it runs differently. When we have many more reactors operating and many more people are accustomed to having them as neighbors, do we get the same type of regulatory or public response that we are all projecting here, that if there were another TMI, everything would shut down. I don't know what the experience is, but it seems to me that it is not inevitable that we have that particular cost, and it is only one of the costs.

DR. SLOVIC: I think that is a good point. I think that you have adaptation effects, you have increasing dependence on the technology which will lead to greater tolerance of the risks, and living with this more will lead to different

JB33

perceptions. One of the causes of the reaction, say, to the TMI is the fact that the technology is, to a great extent, viewed as an unknown sort of thing, and this is seen as providing meaningful information about the risks or their control. So you have these forces going in both directions which I think just increases the uncertainty about the impacts.

DR. LA PORTE: I would like to add to that because we have thought a lot about the air traffic control airline situation, and in thecontext of scale, it seems to me that what you've got, on the surface at least, what you have described, a kind of increased tolerance and the way we say that is with a slightly positive valence to it, sort of an okay-ness. I think what you have is a sort of ambivalence. As your dependence on technology grows, as you can't imagine not doing without it because it is there and there are so many people involved, it's sort of a technological imperative, which in a sociological sense seems to grow, that you have a -- two things happen. In the air traffic control area, you have great insistence and a considerable conflict when you can't shut it all down. So the DC-10 is a good example. At the same time you have great social investment in trying to make the damn thing work reliably. We spend two billion dollars a year on air traffic control alone. We have 25,000 air traffic controllers and 15,000 high-tech technicians in support of that system. It is very reliable and we now have a major

flap over the next generation -- if you watched Sixty Minutes last Sunday -- a big flap over the next generation of automated equipment on board aircraft, so that we are going to make an immense social investment to reduce the sense of anxiety people have about flying. I think it is because people fly in large groups rather then small groups. If you look -- one more paragraph here -- if you look at the behavior of general aviation, we kill about 1,500 people a year, just continually in general aviation. We kill a whole lot less than that in commercial. We kill them on the average of about 2.2 persons per fatal accident in general aviation. So we perceive it as being much less catastrophic activity, though it is a lot more dangerous with regard to actual numbers. So that the perceived sense of risk had to do, I think, with the notion of increasing numbers in single events.

If you put that now in the context of nuclear power, and -- you see, the probability of any kind of accident in commercial aviation is terribly low. In fact, given the amount of activity that actually goes on in the system, it is actually stunning. I don't know if it is on the order of the sorts of things you are designing, but it is really quite remarkable. But the potential catastrophe that is envisaged by people with regard to other technologies, in this case, nuclear, if it is a lot larger, I think it will have the same effect, that is, you have considerable investment, or it will seem sensible to

make the thing and the system, not just the nuclear power plants, but the whole nuclear fuel cycle, at a high level of reliability. I think that, and I guess I am arguing or coming at your conclusion from a different set of points of departure, that insofar as the technology, in this case, nuclear, then the society, by great institutional investment, to make the thing work right, as contrasted to other ones where you don't care if it works so reliably, so the investment, therefore institutional and regulatory investment is a lot lower, that this becomes special, at least in that regard, perhaps not unique, but special, and ought to be treated that way. It may not be logically, in some physiological sense, different. But it is special.

DR. O'DONNELL: The discussion on this issue of risk aversion and whether it should be treated differently, the discussion has centered mainly on the public perception reason why you might want to make it safer. That is a valid point of discussion. I would like to leave that aside for a minute and explore whether there are any technical, logical reasons aside from public perceptual concerns wherein you would want to build in risk aversion to the goals and to somehow establish a different level of safety for nuclear than non-nuclear. I, myself, can't find any that are very compelling. One would be uncertainties. That is, if in one technology the risks were more uncertain than in another, you might want to build in

a different level of safety or target, and I think that can be argued if you are looking at comparing things, and it might even possibly favor allowing a higher level of risk for nuclear, because in fact the comment has been made many times that although we are uncertain about the effects of radiation on health, we know far more about those effects than we do about other effects in terms of chemical hazards. And if uncertainty would argue for conservatism, then that would say we should be more conservative in regulating things like coal power plants than nuclear plants.

DR. LA PORTE: That is a curious way of arguing.

DR. O'DONNELL: I repeat, if uncertainty argues for conservatism, then you could make the argument that nuclear power risks are less certain than risks in many other areas.

DR. SLOVIC: That is just one aspect of uncertainty, say, the dose-response relationship.

DR. O'DONNELL: Yes, but I said you could argue with that. I am saying that I don't see any compelling reason to say that uncertainties are in fact greater in nuclear than in other fields.

The other aspect would be the large consequence low probability aspect of things, which may argue for a greater degree of safety. Again, here, I think you can even make counter-arguments, particularly if you're talking about accidents wherein you may harm ten thousand people, but

the probability is on the order of one per million years. Okay, so that would mean that on an actuarial basis you would expect less than one in a hundred per year. And I think that if you had a technology -- and this concerns the question of scale -- if you had a technology such as nuclear power fission reactors that you would say would be a thirty-year lifetime for this technology before we get it into transition to some other technology, and probably the maximum number of reactor-years we are going to have with this technology is probably ten thousand, the probability of getting this large accident therefore is, say, one in a hundred. And if you were then to compare this with a very certain risk of killing one hundred people per year with an almost certainty of one, it would somehow argue that the low probability, high consequence risk is somehow less important than the more actuarial certain levels of risk. So I think those arguments can be turned either way and I don't see, as I said, any compelling technical, logical reason for establishing either risk aversion into these levels or for treating nuclear power differently, because I think you can make arguments on either side of that, and I don't see any firm conclusion.

So I think you are left essentially with the issue of public perceptions as a basis for doing something.

DR. SLOVIC: Let me elaborate that. I think that there are those who would argue from a logical standpoint

that any nonlinearity in your function is either risk aversion or conservatism, leads to an allocation of resources such that you end up killing more people, on an expected value basis, so there is another argument for this sort of no risk aversion approach. In an expectation sense, that will maximize the number of lives saved or minimize the number of lives lost.

DR. OKRENT: In an ethical sense.

DR. SLOVIC: And that raises an ethical issue.

DR. LA PORTE: Just a point of information, what does it mean when you say risk aversion? You both use it as if we all understood what that meant, and I think you may be using it differently.

DR. SLOVIC: What I mean by it is treating an accident that takes a hundred lives as more than ten times worse than an accident that takes tenlives, sort of an exponentially-increasing function of seriousness as a function of some measure of cost.

DR. PERROW: Or losing a hundred dollars ten times.

DR. PAGE: I think we are mixing up the number of concepts here. It seems to me, first of all, the concept of risk aversion is well defined in economic literature, the Morganstern kind of stuff. It basically means that people do not accept actuarily fair gambles, depending on the structure of the probabilities. And the sort of intellectual basis of risk aversion in the economic literature is based on essentially

positive, in other owrds, descriptive ideas of how people actually value things, what their preference structures look like in fact, in terms of how they behave. It may be that when we talk about risk aversion we mix up the idea of how people actually behave towards gambles in their own lives. The evidence goes both ways here. Mix up that with notions of equity. The reason why a lot of people argue for conservatism with respect to nuclear power is because they are concerned about imposing risks on other people, and the smaller the risk and the larger the number of other people, the more the distributional consequence becomes important. The greater the irreversibility, the more you are imposing risks on other people, because you are imposing the risks further out into the future. This gets mixed up again with the economic with the economic notion of irreversibility which has to do with the use of information, where if you lock yourself into a decision today which imposes a risk now and for forty years, because you have designed a plant this way rather than that way, and then the consequence of the accident might be centuries long, whatever, that you have frozen the kind of information that you may be able to make use of later, so if you assume that you are living in an invironment where it is possible to make sequential decisions and it is possible to make use of information that comes later on, rather than now, then in an expected value sense, you will do well to preserve options over an above

what you would normally do if you did take into account the existence of the validity of information flow coming on line later. So that is a notion of risk aversion that is not real risk aversion, in the sense that it does not depart from expected value calculations. Yet it has a lot of the qualities of risk aversion in it. There is a whole literature on risk aversion of that form.

DR. O'DONNELL: I was attempting to make a partition to find out -- I recognized the public perceptions that people, if you give him choices, will choose something that will not always make what would be, let's say, mathematically or technically what you might consider to be a sound decision.

What I was trying to say, okay, we recognize that. Are there any other reasons, other than things that are mixed uo with public perception that argue for risk aversion or for treating nuclear power differently. I haven't been able to identify any, and I was just wondering if anyone else has?

DR. PAGE: Okay, it seems to me that things that I touched on are directly related.

DR. PERROW: I disagree with that.

DR. O'DONNELL: You are talking about public perception, and I recognize that.

DR.PAGE: No, I am talking about the way in which distributional considerations enter upon what operationally becomes risk aversion behavior on the part of present

JB41

decision makers, the way that irreversibility does as well, even though it is not technically risk aversion, it has the same flavor, it has the same consequence in the way we set up our decision procedures. And then there is the sort of standard version of risk aversion, which Paul and you touched upon, which is the greater salience of large njmbers that are involved in ac idents.

DR. LA PORTE: There are two kinds of risk. The first one is the first one that you talked about, it really is a concern for economic risk and economic operations in the future as contrasted to sort of behavioral response to experience.

DR. O'DONNELL: But does that favor risk aversion in the sense that it has been used in this report? That is, putting a penalty on low probability, high consequence things?

DR. PAGE: If we define risk aversion as a preference of decision makers to take -- okay, if you have two actuarially fair gambles, and one which has a lower probability of occurence and high consequence, the decision maker ranks that worse than the second one. That is sort of the standard definition of risk aversion.

DR. O'DONNELL: If he does. Is there any reason he would automatically do that?

DR. PAGE: I'll give you three reasons.

DR. LA PORTE: Well, the one that I find most

interesting about this, in terms of our conversation, is irreversibility. The degree to which, as I understand it, the consequences of losing the bet are irreversible constrain the future, reduce the number of options one can pick up in the future, as contrasted to an option that did not do that. You would take the one that maintains the future option.

DR. COCHRAN: I think you need to be careful, or we need to be careful when we throw around the word public perception when the process seems to incorporate the issues that you raise, as opposed to being quite separate. Or unless you are using the idea of public perception meaning irrationality on the part of the public.

DR. PERROW: I think Ed's use of public perception crept in. It has to creep in.

DR. O'DONNELL: I recognize that there are public perception reasons --

DR. PERROW: When youtalk about uncertainty, you, in a sense, brought in public perception, just like he was bringing it in, because you said if we don't know the consequences of something, it is worse than if we do know the consequences of something. Who is the "we"? It's got to be the public. So when he is talking about risk aversion, he is bringing in the same sense. I think your criteria is similar. It's a good point. Public perception is one thing. Let's talk about other technical kinds of things, but you cannot sever the two

JB43

completely, as you have, or I could bring back the same thing and also in your low consequence, low probability thing you have, in effect, perceptions in that. We perceive risks. We have to talk about perception. So I don't think that is part of the argument.

DR. O'DONNELL: I am saying, and maybe it is just theoretical, but if you were able to calculate these uncertainties, and these probabilities, and could then make decisions based on those mathematical models, is there something that would lead you towards the risk aversion concept?

DR. PERROW: I would disagree with your argument because that is like saying I am much more sure what is going to happen to me if I get hit by a thirty-eight caliber bullet than a twenty-two caliber bullet. Therefore I favor the thirty-eight because there is less certainty. I think ultimately that is what the argument goes to.

DR. O'DONNELL: But you could calculate what the probability is of dying from getting hit by a twenty-two or a thirty-eight.

DR. MAC LEAN: Look, I think there are some very different rationales for risk aversion being offered here. One is the types of reason Toby was giving, have to do with nature of the consequences, where the utility we want to assign to a consequence differ from the value in the expected value sense, because there is something in the nature of

various kinds of consequences that would lead us to be risk averse about those consequences. The other is where the probabilities are uncertain, and that could lead us, depending on what your philosophical commitment is to the nature of probabilities, where your degree of confidence in the probability assignment is lower, and that could lead you to become risk averse also. These are very different justifications.

Now what you are saying is where we can get better confidence about the probability assignment, should that lead us to be less risk averse? Well, yes, if the reason we were risk averse is because the probability assignment was one that we did not have confidence in, but no if the reason we were risk averse was not because of uncertainty about the probability assignment, but because of something in the nature of the consequence.

DR. COCHRAN: I want to throw in another reason that I think may be more important than the ones mentioned, although you could subsume it in the definition. That is, people are risk averse because they don't trust the technocrats who are cranking these numbers out.

DR. MAC LEAN: That is no theoretically inelegant.

DR. LA PORTE: And so true.

DR. PERROW: That's why I understood it so quickly.

DR. COCHRAN: The best example is that the public at TMI won't let them put the water into the Susquehanna

JB45

regardless of how good the cleanup is. It is irrelevant what numbers you do and it extends from, I think, a lack of trust of the utility and the regulators. It gets back, and I am weaving in my issue into yours, which was the ethical issue that has to be addressed in all this, what are you going to do about the process in terms of improving it in order to get better public trust in the process, and therefore more likely higher public acceptance if you want to continue to license these things.

DR. PERROW: I just think there can be no doubt about that. That has been made so clear, not just from TMI, but from long time.

DR. COCHRAN: It doesn't make a lot of sense to me, other than it is entertaining to sit around here and discuss what these goals are, when the Commissioners are up there on the Hill advocating speeding up licensing. I mean, it is really a sham, what is going on. We are pretending the process is working and that this is somehow an improvement over the status quo, and it is really ignoring the central issue, and if we wanted to really impact on the process we ought to be talking about goals and behavior of the institutions and the goals and behavior of the Commissioners and the choice of Commissioners, choice of ACRS members and so forth.

DR. SLOVIC: I want to avoid that question. I think it is really important but --

JB46

DR. COCHRAN: It is also more relevant to panel C.

DR. SLOVIC: But it seems to me that the discussion of risk aversion is relevant and I would like to get some sort of semblance of closure out of what we have so far.

DR. PERROW: His point about risk aversion is right on target.

DR. SLOVIC: I agree that it is relevant, but it is worth discussion at perhaps another point.

DR. COCHRAN: People won't react -- the only way they won't react is if they think they are safe.

DR. SLOVIC: That relates to my point as well. That is why they will react to a TMI because they see it as evidence of a technology that is out of control, that is mismanaged --

DR. COCHRAN: And they don't believe you.

DR. SLOVIC: -- and as a result there is a tremendous and very costly social response, and what I'm saying is that it is relevant to the target goals that you set. You want to prevent that from happening. You don't want these sorts of events.

DR. OKRENT: Can I ask Toby if he would summarize in plain English what he thinks are the important risk aversion points? And my next question will be, does he see a way of incorporating them into some kind of quantitative safety goals? Let me see if I can have you restate that, please?

JB47

DR. PAGE: Okay. I hate to sort of duck the issue completely but I was sort of interested in what Paul said, that your formulation of alpha equals 1.2 is just not going to work -- I was just interested in hearing what you were going to say.

But to respond just a little bit --

DR. OKRENT: I was going to ask him that next on the list.

DR. PAGE: Okay, but to respond just a little bit, what I wanted to say is that there are some formal reasons for this, some informal ways of thinking about risk aversion that are in the literature, that depend on different bases. One depends on the base of looking at an individual as his own decision maker and how he behaves in the gambles, and that is basically a positive theory.

DR. LA PORTE: What do you mean by that?

DR. PAGE: It is a causative theory means that it is purely descriptive. This is the way people behave. It is not the way they should behave.

Then the problem becomes harder when you worry about it the way economists worry about it, the problem becomes harder when I have to add up my personal risk aversion and your personal risk aversion. It is defined individual by individual, but then there is a big aggregation problem, and that is similar to the other interest problems that we have

to worry about that don't have to do with risk aversion, just different interests. The way that it becomes sort of deeper, that Doug would be worried about it, is it is not what people do believe and how you get institutions to incorporate what they do believe in some sort of great optimal way or potential optimal way, which means trying to make some people better off without making other people worse off, but if we start worrying about what they ought to believe, then you open this whole philosophical discussion on a very different level, and I think that what passes for a lot of discussion of risk aversion is concern over how people ought to think about imposing risks from one agent to the next, and that is why the large numbers problem is a big, important problem, and that is why the irreversibility problem is a big, important problem.

It just happens that the irreversibility problem is important in the economic literature for a totally other reason, which jas to do with the cost and use of information, and you can sort of see intuitively that if you know more about making decisions tomorrow than you do today, then you want to present a more open opportunity set tomorrow to exploit the information better. So under an expected value criterion, which we just agreed was not the criterion that defines risk aversion, it is departures from accepting actuarily clear bets that define what you mean by risk aversion. But when we take into account the use of later

JB49

information then we have another way of talking about behavior that looks like it is risk averse, but it is not risk averse in that sense.

I think what it all boils down to, and I think becomes more for the purview of this committee, the way I view it, is that the fundamental problem is not whether alpha should be 1.2 or whether we should have some other formal way of taking these numbers into account and slightly bending a bit to look at larger scale kinds of accidents, but that people behave as though they are risk averse because they don't trust the experts' judgments. I look upon it sort of the way Tom looks upon it. To the extent that we can build a performance assurance, so that people sort of make predictions and the predictions come true, and there are safety requirements and they are met, and we don't see the kind of slope we saw in Three Mile Island, I would say that one of the main reasons Three Mile Island became politically so explosive was not because of the accident, but because of the perception that people were lying, and that it was being mismanaged on that level.

DR. SLOVIC: I would like to comment on that. I think that what it boils down to is the notion that there might be an accident like Three Mile Island that comes off improving people's confidence. Again, this is a probablistic question, but my guess is that any time you have a major, low probability

but major in its import, and it is covered very closely by the media, it will come off in a way that makes the managers who were responsible look as though they weren't doing their job properly. Now that is an assertion. You may disagree with it and it is probably not always going to be the case, but the feeling of the notion that you can have a well-managed type of accident like that, I am suspicious of.

DR. MAC LEAN: I think we just had one, didn't we, a few days ago? The performance of the Secret Service was exemplary.

DR. SLOVIC: But they tried to make it -- the media tried --

DR. OKRENT: I am surprised at the statement. If anything I would say it was not exemplary in that they permitted the event.

DR. LA PORTE: But what the media tried to do is do exactly what Paul suggested, and they had an answer for it.

DR. COCHRAN: In the case of TMI, the person in the press who was identified for his exemplary performance was Harold Denton, the man responsible for allowing it to happen. And yet, after it happened, he went there and performed admirably and got an award for his great behavior and so forth, and yet he was the head of the regulatory arm.

DR. SLOVIC: I want to address David's question.

DR. OKRENT: Can I counter that. I don't see

Toby, in fact, I still don't have really a clear picture, I must confess, of how you are defining risk aversion, other than the economic one on the bet. That on I understand and in fact there is a somewhat equivalent one, I think, in the area -- it's not the same -- but on society's reaction to large events. Possibly. Certainly people don't take fear bets and they may not do the same on accidents. But at the moment I can't see how to incorporate what you are saying into some kind of approach, and so I guess I should ask the second question. Do you have something specific to recommend that NRC should be doing, either in qualitative or in quantitative safety goals, or rules or policy -- take your choice.

DR. CHARNOFF: When you open it up that way, David, then you tend to be a lot more responsive than when you say how do we do it with a numerical constant.

DR. OKRENT: No -- should they do something with regard to risk aversion? If so, what do you recommend?

DR. PAGE: Basically, the line that I am thinking towards --

DR. OKRENT: Because I am not an advocate of the 1.2. We put something in here so it would be on the table.

DR. COCHRAN: Between 1.1 and 1.2?

DR. OKRENT: No. If we had not mentioned risk aversion at all, in fact, it might never have been a point of discussion.

JB52

DR. PAGE: I think my view is that we do have a concern of risk aversion that have different bases, and it can be looked upon in terms of a purely technical problem the way I was doing originally, or it can be looked upon as a legitimization problem -- how you trust the experts. Does the system perform?

To the extent that the plants are managed in such a way, decisions are made in such a way that people can keep score and see who is doing well and who is doing badly, and the people who are doing well and doing badly get rewarded and punished, some sort of liability, and it's working, then I think this problem of risk aversion will become less important. Certainly it won't matter if alpha equals 1.1 or 1.3 in the same way that these distributional considerations become less important.

DR. SLOVIC: What are you talking about in the way of adaptaion?

DR. PAGE: You mean building performance checks?

DR. SLOVIC: Yes, which leads over time to some different view about risk aversion.

DR. COCHRAN: I like this discussion because it is leading into my issue. What it's doing is tabling the idea of trying to define a better model, a better formula, a different formula, and instead focusing on how does one create a process that instills competence and acceptance and

so forth.

DR. PAGE: Not only competence but actual performance. My view is that if nobody isscrutinizing these people who are making the risk estimates, and there is no post hoc, after the fact test of it, it is still likely to be done badly.

DR. CHARNOFF: It seems to me, just an observation first, that certainly things like remote siting are related to risk aversion. In a sense it is not quantitative, but I am curious on how you have considered, in terms of your concern with the large accident aversion, how certain things are factored into your mind in that regard with respect to the kinds of statements that Levinson and others have made with regard to the probability that perhaps the accidents are not going to be nearly as large as people postulate. How does that enter into your calculus?

DR. OKRENT: Well, let's see. If one looks --

DR. CHARNOFF: You are familiar with that statement?

DR. OKRENT: Yes, I am familiar with that. If one looks at the approach described in the NUREG, again one would calculate expected values and compare them against the goals, and if in fact people had decided that the expected value was larger or smaller, that is what they would get. So if in fact this risk certification panel or whoever it is were persuaded that the expected value was smaller because of the points raised by Levinson, Stratton and so forth, here would be such

an effect. If they were unpersuaded because in fact they thought there were other sequences that remained an important contributor in this that would change the overall total significantly, then that would be the result. So, while I am talking about this, maybe it would help to give a couple minutes of background and make a couple of points.

I believe in fact within society there is an aspect of risk aversion that relates directly to the point first raised by Paul, which is this question of aversion to big numbers, and I happen to have run across recently an article in Science and Public Policy, October 1980, by a man named Sudcliff, and he quotes in fact the provincial government of Groenigen in Holland that is adopting an interesting sliding scale, in which accidents capable of causing ten deaths thought to have a probability of not exceeding one in ten thousand, over a hundred deaths not exceeding one in one hundred thousand, and that is a linear scale so far, and of a thousand deaths, complete unacceptability. So they were unwilling, at least in this consideration, and it had to do not with reactors but with chemicals, hazardous chemicals in fact, explosions and so forth, they in fact had an expected value approach and then a cutoff, rather than some other --

DR. CHARNOFF: Is that some form of legislation?

DR. OKRENT: In fact what is at issue there is probablistic stuff showing decreasing probabilities of

JB55

increasingly large accidents, and the industry is in fact arguing that these are sufficiently small that their expected value is either small or just sufficiently low probability that you don't have to consider it, and the town council wants to have something like this. I don't think it has been resolved because in fact in the end I suspect the federal government will have to get into it. I want to point out, in fact here is one example of it being an actual issue, and that was the aspect of risk aversion that we tried to talk about. There have been papers that have been published that suggest that society acts this way, but that they do want safety to be much greater if you can have many more people killed at one time, and we have done other studies that you can arrive at sort of illogical conclusions if you go blindly down this path. For example, you take an alpha of 2.0 and you find that we would never permit certain things that we have going on in this country. There just could not be a low enough probability of the event.

DR. PERROW: What's your point?

DR. OKRENT: One point is that there is this aspect of risk aversion. That was the one that we tried to call up. Now let me indicate in fact how it relates to some of the other things we were talking about. We were talking about siting, and remote siting and so forth -- in fact if you put in some kind of a coefficient into your calculation of

JB56

societal effects, other than one, bigger than one, you slant, you provide an incentive to remote siting.

DR. PAGE: Sure.

DR. OKRENT: Okay? In fact that is one of the reasons it is in here, although it does not rule out the Commission from separately adopting a position. But this nevertheless moves the man. If he has a choice of two sites, he now has an incentive towards remote siting because of some kind of a risk aversion factor, and that is one of the principal reasons why I, for one, felt it was worth putting one in. I cannot in any way defend the 1.2. What I know is that it is no so big that it is ridiculous. That is the only way -- let me just stop at that point.

By the way, the uncertainty, the effort to cover uncertainty is picked up in the expected value. I hope you understand that. In other words, if there are big uncertainties the expected value gets larger in principle.

DR. PAGE: Is that true? Basically, we are sort of wondering how firmly held is this idea?

DR. OKRENT: If you are doing a calculation, if your best estimate is like 10^{-4}, and there is a factor of ten either way, your expected value is going to be -- suppose you assumed a uniform -- all probabilities are equally probable, then you would be weighted heavily down to the 10^{-3}.

DR. PAGE: Why wouldn't you just have this expected

JB57

value which is equivalent to the range of probability estimates, since it is a linear function? The expected value is a linear function, so whatever you have as a probability estimate, it will be translated into what you have as an expected value.

DR. OKRENT: What I am saying is I think you will find that if your uncertainty swings a factor of ten each way, and I mean a factor of ten --

DR. COCHRAN: Let's say from one to ten.

DR. OKRENT: No. In other words, if it is 10^{-4} and your --

DR. PAGE: 10^{-5} to 10^{-3}?

DR. OKRENT: Then you will find an expected value that is down to the 10^{-3} area.

DR. PAGE: Well, it will have the same range as the uncertainty estimate.

DR. LA PORTE: I guess I am really puzzled about what one does with the sort of work that David and his group have been doing. I have been listening to try to understand. It has been helpful to go through that, to hear what you have been saying, because I was puzzled about it. I am quite willing to start with your values. You have a rationale for those values. You know, your criteria, your goals. And why not? There is sort of a reasoned quality to it, but it seems to me to evaluate their utility in this process, you have to

say something more about, considerably more, than an evaluation of the logical basis from which those are derived, and the empirical material you had to do this, developing a probability statement and so forth about effects. That has to do with whether, if you had them at that level, what do they mean for implementing? Can you begin to approach them? What would it take in operational terms to -- reactor operations and so forth -- to actually approach them so that later on you could verify whether you had or not?

I mean, there is a history of forty to a hundred years before us to which these could ultimately be applied, presumably if they were to be instituted. Now I would like ask that at lunch, and it's almost that time, that we ask the question, what does it mean -- and I don't really care what number you choos, a number, and it could be varied by a factor of ten -- and that is, ask the question, well, when you try to implement them, does it turn out to be a sensible thing to try to do?

DR. SLOVIC: Okay, but that interacts with the number.

DR.LA PORTE: I know it does, but then you begin to say, well, how much could you relax the number, or would you have to relax the number, or would you have to relax the number to meet them? And did you want to do that? Because right now, we are acting as though -- and that's why I asked

those questions yesterday -- that you assume they can be done. You are not an unreasonable person. And what is back there in your head that says these can be done from an operational, from my point of view, an institutional point of view? What does that load onto society so that they will be met?

DR. SLOVIC: Ed and Doug have had their hands up for a while, but there was a question that David raised to Toby which I don't think was answered, and I would like to comment on it. It has to do with what is the implication of this? First of all, several of us have been critiquing this notion of risk aversion, and I think it is unresolved. Where does this lead? What is the implication for this document? I don't pretend to have the answer for it, but I have one sort of rough answer. My view is that this notion that you were referring to this other study where your criteria varies with the number of deaths, that to get at the modeling issue, it is somewhat analagous to the view of what we were talking about with genetic effects and the surrogate issue. Here you are using this very simple functional relationship as a model for what I see as a very complex impact process, that has really significant costs to it. And I feel that the costs cannot be predicted very well by the kinds of expected things, by this model. For example, you would never predict the impact of Three Mile Island on the basis of this alpha of 1.2. Three Mile Island may be equivalent to an alpha of 10 or

something, and of course you point out that if you had alpha of 10, it would lead to a lot of other things that we feel are absurd. So it seems to be like a paradox here, and I guess I am saying that I don't think the Three Mile Island response -- I think it is understandable in light of the very specific qualities of nuclear power in this day and age. The trust problem, the uncertainties and so forth. This is likely to be a changing thing over time, as has been pointed out. It is not likely that you will get the same response if we have another Three Mile Island today. It may or may not lead to the same response. If you had another one next week maybe there would be a damping out of it. But what I am saying is that the process is very complicated, there is a lot of uncertainy to it and yet I think it is relevant to the kinds of goals that are set.

Finally, just one handle on it might be to say that if there is a high enough probability that these so-called small accidents will have social costs of tens or hundreds of billions of dollars, you might want to adopt as a criterion the kind of thing that we set standards such that there will not be another TMI-like event in this century. The cost to the industry and to society would be so great that those sorts of economics would argue to have that as a goal.

MR. COCHRAN: That is a more understandable one.

DR. PAGE: Isn't that sort of what Kemeny was trying

JB61

to say in his report?

DR. OKRENT: I don't know what it means to say there will not be another one.

DR. SLOVIC: You can couch it in terms of return frequencies which are functions of probability.

DR. OKRENT: Because as I think I mentioned around here, the dikes were designed for the five hundred year flood and it occurred sooner.

DR. SLOVIC: It would have to be on a probability basis.

DR. MAC LEAN: I would like to make two comments on David's question, and I hope they respond to David's question to Toby. The first is sort of contentious. If you think -- when you pointed out, with the large number problem, that if you build an increasing degree of risk aversion you might get the problem where, if the numbers are large enough, there is no probability small enough, and then you have some formal problems for a model. If you don't have that, you have formal problems, too. You get real formal paradoxes if you just have expected value and no degree of risk aversion. These have been known since the last century, but that is the contentious comment.

DR. OKRENT: I accept that. We didn't know what was a good model for risk aversion. We chose not to neglect it. Okay?

JB62

DR. MAC LEAN: But the other thing, when you asked Toby the types of different kinds of consequences that you want to assign risk aversion to, how can you build that into the model, I, myself, am very pessimistic that you could ever do that in anything other than a totally ad hoc way. That might be what you want to resort to. And that is because the consequences that seem to trigger risk aversion in people, so far as I can see, differ, are identified in purely qualitative ways. Some risks people just don't think are worth taking, in ways that vary independently from the amount of the risk. Hell's Angels will ride around without their motorcycles, but you don't --

DR. COCHRAN: Hats.

DR. MAC LEAN: Without their hats on, but you don't see them driving down to Three Mile Island to breathe the air. It is just some risks people don't think worth taking, and I feel you have to pick those out, and I don't see anything other than a qualitative way to pick those out. Then you might assign a risk aversion number to each one you can identify. That is one of the real problems. You are going to have to resort to this ad hocery, especially in this area.

DR. O'DONNELL: I think the point Tom raised, that people are risk averse probably because they don't trust the experts. Putting a factor of 1.2 -- an equation does not change that. It is irrelevant.

DR. OKRENT: I said what I think it does. One thing it does is provide some incentive for moving away from --

DR. LA PORTE: Well, for whatever reduces the number.

DR. OKRENT: Or from resouces that would be very expensive, or so forth. It gives some incentive.

DR. CHARNOFF: But it is almost like what I think Tom mentioned yesterday, the concept of defense in depth might be something people understand, just as remote siting or so... other qualitative statement to deal with that big risk is something that is far more understandable. And acceptable.

DR. OKRENT: Not to me, unfortunately. I know what is in the defense in depth thing and in fact it does not serve the purpose.

DR. COCHRAN: Separate the methodology from the empirical application.

DR. O'DONNELL: You have illuminated the reasoning behind the 1.2 --

DR. OKRENT: Well, it's one reason.

DR. O'DONNELL: You indicated it was really to get to a determinative, that is, remote siting.

DR. OKRENT: No, I said this provides an incentive. By the way, it is not easy to put incentives in here. Also, and I have said this earlier, I think, in fact, society does tend to be risk averse in the same way the Dutch aldermen, or whatever they are, are and in fact they would prefer not to

have these large accidents even though they give the same expected value. They would prefer to see their frequency reduced. So I think in fact it is reasonable to build in what I call modest risk aversion in some way, to large events. In fact this is not to say that there is not a very big penalty currently associated with events that are very expensive to clean up, but may not have posed any substantive public risk. I don't think it is an either/or situation. I think you have to decide in your mind, do you do something with regard to events which might have large consequences. There is a separate question: what do you do about events that we would call our first hazard state. Our first hazard state -- I think if I followed Paul's logic I would make the probability of that first hazard state smaller by a factor of a hundred or something like this. But it would not necessarily change what I did with regard to limiting large events. I would have to address that question separately.

DR. SLOVIC: I would like to close the session and invite you back at one-thirty.

DR. CHARNOFF: I was going to suggest that we have a little experiment this afternoon to deal with Tom's concern about trust. I was going to suggest that we go out on the street and bring twenty people in to sit here this afternoon and listen to this discussion and decide whether they have more or less confidence in the process.

DR. SLOVIC: I think the NRC is going to do something like that in a month or two, so I would rather leave it to them.

DR. LA PORTE: Now we could leave right now, but I am interested in the fact that the thing that you chose to say were at risk was essentially the public health and safety, and the social impact, did not include the risks to institutions. It didn't really say, what if we wreck our institutions? Could we say that some technologies put them at risk? I'll say some more about that after lunch.

DR. COCHRAN: What do you mean about institutions?

DR. LA PORTE: Confidence in the process.

DR. OKRENT: In the family?

DR. LA PORTE: No, I didn't mean that really, I meant in terms of governmental influence.

DR. OKRENT: That is certainly not in here.

DR. LA PORTE: No, it's not. If it turns out in this area that the major safety goals should be to enhance the public confidence in the institutions involved, it would be quite important.

DR. SLOVIC: Let's talk about this after lunch.

(Whereupon, at 12:05 p.m., a recess was taken until 1:00 p.m. the same day.)

L1

A F T E R N O O N S E S S I O N

CHAIRMAN SLOVIC (presiding): I'd like to begin again. I don't really want to linger on this risk aversion thing, but I'd like to just mention another facet of the issue that came up during lunch in a discussion with David, and that is, it seems to be tied into what one sees as the responsibility, say, of an agency like the NRC, that is, sort of a definition of what it is to protect the health and safety of the public. How broad is that mandate? What is included in that? If you take a relatively narrow view and start looking at the traditional types of health effects and health consequences, maybe some of these concerns about risk aversion aren't as serious and maybe this approach is more reasonable. If you take a broader view, looking at the secondary and higher order of costs and those sorts of things, then I think there's alot of concerns that can be raised, so perhaps there is a fairly important issue to be decided that is relevant to these goals as to what is the mandate of the Agency?

DR. COCHRAN: Let me see if I can reframe that. Are you suggesting that, on the one hand, the Commission should look at itself as sort of fat prima donas who have been told by the dictator that they are responsible for insuring public safety as opposed to the five commissioners seeing themselves as acting "in the public's interest on behalf of the public to insure --"

L2

CHAIRMAN SLOVIC: No, let's say acting in the public's interest to insure the public health and safety.

DR. COCHRAN: What are meaning the public?

CHAIRMAN SLOVIC: Well, how broadly do you construe health and safety? To what extent to you bring in higher economic costs into that? Obviously those things will impact health and safety at some level.

DR. PAGE: Well, why would you argue on principle?

CHAIRMAN SLOVIC: Well, maybe David can rephrase this.

DR. OKRENT: Well, all right. Let me put it in a different way and maybe in a specific way. Paul was suggesting that in considering risk aversion one should think about the large costs due, not only to direct effect, but secondary effects as a accident, like Three Mile Island, and one should therefore -- if, in fact, this was part of your concern, arrive at a conclusion that such an accident needed to have a very low probability because of these large economic effects. These were not health effects. These were economic effects. You can translate them into health effects if you wish by saying that if we spend money here, we can't spend money elsewhere and --

DR. COCHRAN: Opportunity costs.

DR. OKRENT: Opportunity costs, but they're not direct health effects, so, in effect, you could say the NRC would be trying to protect the industry's economic investment; prevent them from going broke because they have a very expensive

L3

economic accident which, in fact, didn't have any important, not zero, but any important effect on the public health and safety meaning that there are large numbers of people who were either directly, or on some statistical evaluation, might have been killed or injured.

Well, is it the NRC's role to protect the industry against itself, that way? That's another way of phrasing his question, as I understand it, because I was questioning at lunch whether, in fact, it was the legislative mandate that the NRC should provide adequate protection of the public health and safety to provide that kind of protection and I was suggesting, myself, that it wasn't clear to me that it was. I said, in fact, in our Alara criterion against accidents, since economic costs were in it, if, in fact, this were really judged to be a big cost when you did it, you would pick it up presumeably as something that was an incentive to improve the reliability of plants to prevent it. I think the industry already has this incentive, but through another mechanism, but there is a question, I think Paul was trying to bring out, is that one of the roles of the NRC? If it is, then you might reflect it in your approach to quantitative safety goals. Is that okay? Did I state it right?

CHAIRMAN SLOVIC: Yes.

DR. PAGE: Well, let me slightly change it. A standard economic analysis of the problem would be to interpret

L4

Alara as essentially a cost benefit analysis and then all the costs and all the benefits would be in there and all the indirect costs would be in there as well as the direct ones. The only problem would be one of double counting so essentially you'd worry about everything.

DR. OKRENT: But it would be in Alara, as it's proposed here and he was suggesting that it might be in a limit earlier on saying the probability of the TMI event occurring has to be very small. In fact, that's the conclusion he was drawing as a possible one.

DR. PAGE: But that seems a very indirect way of phrasing the problem. What you're saying is because we're excluding certain costs from the safety standard because it's just based on health effects, then we're going to insist upon a lower probability of these health effects occurring in order to somehow capture the idea that we've left something out.

DR. COCHRAN: No, no. What he's saying -- well, I think that that interpretation of what's demanded or required under the Act, and so forth, is wrong. I think a fair reading of the Act is that you've got members of Congress representing the public saying you can license certain types of commercial activities, but you've got to insure the health and safety of the public, period. It's got to be safe. Now, the question is, under who's definition? Is it under the Commissioner's, under the Congress or whatever. I would say that my interpretation

L5

of the way that should be interpreted is that the Commission are representatives of the public. I mean, they're public servants and they should be doing the public's will and somehow if the public doesn't think they are safe enough, they've got to go back and do a little more -- add on a little containment, or change the process or whatever, and I think that what we are witnessing is, at least with respect to some large, but undefined percentage of the public, thinks they're doing a lousy job; thinks these things are not safe, and I don't think you can operate under that mode. I think if you're going to run an industrial activity, you've got to have more than 60% confidence that the machinery is operating safely and so forth, and what you're saying is that the public is demanding a good bit more, and I don't think you should interpret the rule to suggest that you go out and pick five technocrats and they decide what they think is safe.

CHAIRMAN SLOVIC: So are you implying that if the public feels that these higher-order costs are part of the whole picture of safety that --

DR. COCHRAN: I don't think the public gives a damn about the higher order of costs in shuting down the industry. I mean, I think there's some, but the public sentiment, in large measure, is that the plants aren't safe, period, and they're not internalizing alot of costs to shut down the nuclear industry or anything like that.

L6

MR. CHARNOFF: We do have some law on the subject as to the higher order of costs, at least as far as the Atomic Energy Act is concerned. It has been interpreted by the courts for example, in 1963 or 9, to include consideration of thermal effects, okay? The courts have clearly held that as far as the Atomic Energy Act is concerned, the jurisdiction of that permission is limited to radiation health effects, and it couldn't go into it - is not permitted to go into thermal effects. Certainly under that context, it can't go into economic effects.

Now, of course, subsequent to that, there's legislation. The National Ground and Policy Act talks about evaluation, at least, of these, and maybe there's some jurisdiction under that Act, to look at these questions, but if we're flying under the standard of protecting the public health and safety, the so-called higher order of effects that you are concerned about from an economic effect, just is a matter of law and not within the Atomic Energy Commission or the Nuclear Regulatory Commission's jurisdiction.

That doesn't mean that I disagree, Tom, with you, but can we have an industry that can supply when 40% of the public opposes it, and holding apart from the Nuclear Regulatory Commission, I think it's pretty clear that the private utility industry, and no private industry, whatever the nature of it, is going to be able to force a technology upon an unwilling

L7

public. That's a different question and we have a different kind of charter or problem to deal with in that context, but in terms of the question that you two were discussing, I think David is clearly right and I think the law has already been decided on.

MR. O'DONNELL: Yeah, my understanding of the law is also that the NRC doesn't have the authority to worry about economic considerations such as the health of the nuclear industry.

DR. COCHRAN: The NRC doesn't. NEPA does not, under the atomonic industry.

MR. CHARNOFF: Well, it's a different question.

MR. O'DONNELL: Well, my feeling is that the cost benefit is really where you pick up those economic effects, but to turn to the specific formula or model that's set forth in this document, I think it goes one beyond that in that when you do a cost benefit, normally you would consider the economic impact of an accident on a cost side of the equasion, that is, if you had an event that had a probability of 10 to the minus 6 and it could essentially destroy the plant, well, then the economic consequences of that would be a billion dollars, let's say, of an expected rate of one in a million, so that would be, let's say, $1,000 per year, which would be, if you were to fix that accident sequence, would be a cost savings involved, and that would show up in balancing the costs against the

L8

benefit meaning the radiation or risk reduction. What this does here, in this ACRS document, is add a third term, though, that is strictly a balancing of economic costs and economic benefits, which is this third term in here which is the two divided by Delta E, sub r, 1,and that would seem to indicate that if you had a particular accident sequence that had essentially very little radiological consequences, okay, in terms of manram exposure, and the other terms essentially being zero, you would still somehow be requred to fix up that sequence because it has some economic exposure, so I think that although the economic consequences of radiation exposure or accidents is picked up, and should be picked up, in the cost benefit on the cost side of things, I think the particular model that's proposed here, does something in addition to that and it puts an additional term in that's related strictly to balancing economic interests and I think that is -- that's not really an appropriate conclusion in this cost benefit equasion in the context of a safety goal.

DR. OKRENT: Let me just make one comment on that. In that economic part of the proposed Alara criterion, there might be three different contributors to the economics. One could be all side effects. My own opinion is that those unequivocally should be in this. They're as important as health effects when you're trying to consider the merit of some possible new feature. A second one could be damage to the plant, which, in

fact, is covered by insurance or within the capability of the company to withstand without going to the rate payers. I prefer to say within the insurance because if it's beyond the insurance eventually they'll be ending up going to the rate payers, so if it's within the insurance, I think you could say it should be excluded.

MR. O'DONNELL: Well, not necessarily. They have zero costs.

DR. OKRENT: Yeah, but they've already paid for it, so if that occurs, you shouldn't buck. If there is an economic cost to the plant that is not covered by the insurance, whatever the form of the insurance is, in the end this reflects back to society. It's as costly to clean up some cesium that got outside the plant, and so I think that should be in the formula, so, to repeat, if I were going to say what I would include in the economic costs and what I would exclude - but covered by insurance -- that part of the cost I think should not be in that formula. I would put the rest in. The factor of two we put in is pulled out of thin air and I'm not going to try to defend that in any way.

MR. CHARNOFF: Well, whether it's insured or not, it's a cost. If it's appropriate to consider costs when you're cost benefitting the Alara, the fact that it's within or without insurance is immaterial.

DR. OKRENT: Well, all right. You might even say

L10

then it should be in because who pays insurance, but in the end it's the rate payers. Well, all right. I would end up, then, with all in, not out.

MR. O'DONNELL: Well, I think it should be in, but I think the way it's put in here is not appropriate. It should be in the cost when you do the cost estimate of some accident sequence that comes in on the cost side of the equasion.

DR. OKRENT: But again, see, that's -- you've got a plant that's designed, and it, in fact, meets all of the other criteria, but in the other criteria there were no other economic cost effects at all, right?

MR. O'DONNELL: Right.

DR. OKRENT: Now somebody comes along with a new valve, which if he puts in instead of the old valve, he can reduce both the expected value of early deaths and latent effects genetic and sematic, and he can also reduce economic losses on site and off site. Okay, and what that says is that you sum those all, putting some kind of dollar value in there - some trial values there which are pretty large, and if, in fact, the reduction, let's say, in costs is less than it would cost you for this new valve and if he didn't show any discount factor and I'm not going to try to argue pro or con on that because you might -- but it costs less for the new valve than what you calculate, then the valve is worth putting in on that Alara criterion. Now, I don't see the question. Isn't that a trade

L11

off of cost against benefits?

MR. O'DONNELL: Yeah, but what you have here is a trade off of costs against cost.

DR. OKRENT: Well, the benefit is the reduction in this expectant, --

MR. O'DONNELL: Well, then that cost comes into the cost, though, of the item, that is - maybe we're getting into detail that we can discuss later, but --

MR. ERNST: You have two other costs that hadn't been identified, though. One, for example, is the cost of the policemic power and the secondary, the ripple effect on the industry.

DR. OKRENT: Well, again, when I was talking with PaulI said in principle, those costs could be included in this. I don't know, after hearning Mr. Charnoff, what the legalities would be for the NRC to include this -- a ripple effect, but I agree -- those are costs of the accident.

MR. ERNST: Perhaps we should bring Marty in here because I have a different perception, lately anyway, of the legal position with the NRC of whether or not the cost should be -- could Marty step in?

CHAIRMAN SLOVIC: Yeah, I think so.

DR. PAGE: What's the reason for the two here?

DR. OKRENT: There were two reasons and neither of them very good. One was we had a feeling the way people had

L12

estimated costs in the past, they had underestimated it for things like Paul has mentioned and other things -- other reasons, and in fact, Wash 1400, in fact, could be only on site costs and not off site costs, if I remember correctly, so that was one thing. The second thing was we say, well, let's provide an incentive to prevent these events instead of a direct quid pro quo. I repeat, I will not defend the factor of two.

DR. PAGE: So you'd be willing to interpret this criterion as a straight cost-benefit criterion?

DR. OKRENT: I wouldn't really -- if, in fact, the costs were done well, I would be able to remove the factor of two, but I think you would want to do them adequately, you know.

CHAIRMAN SLOVIC: Let's move on to one of the half dozen other topics.

DR. LA PORTE: I'd like to get mine in here before I forget my little feature. What I wanted to do is go from the proposed quantitative safety goals, such as David provided us, and run through a logic that talks about the things you want to consider with regard to accepting them. It's very different from what we've been talking about now, but it summarizes some of the things that we've --

DR. COCHRAN: Well, let me stop and ask -- you're basically tabeling the next issue and I think the Chairman was about to propose the next issue. I'm not sure his proposal is

L13

the same as the one you're talking about.

DR. LA PORTE: I thought I was being called on, but that's okay. Go ahead.

CHAIRMAN SLOVIC: Well, you were being called on because I thought you had a point relevant to the last question.

DR. LA PORTE: Oh, I misread --

CHAIRMAN SLOVIC: No, I was going to move on to a new issue. I don't have a strong preference. We have alot of loose ends from yesterday that people want to try to tie up on the ethical side - the questions of the scale issue, the questions about implementation, and then this concern about acceptable -- frankly I think they're all important, and I'd like to cover them all this afternoon. I don't have a strong preference for order as long as we really try to cover them.

DR. LA PORTE: Well, we just spent 30 minutes on yours or whatever.

MR. O'DONNELL: Did we cover the question of nuclear versus --

CHAIRMAN SLOVIC: That's right. I don't think we did really treat very adequately the differential versus equal coverage or the overall level of risk. Now, let's just hold off on this other just to see what the feeling is in the group about those issues. I mean, are they important? Do we have anything to say on them?

DR. MAC LEAN: My own feeling is that they are very

L14

important issues but that they are very closely related to denotion of acceptability and I think that perhaps maybe we can make a point of discussing those in conjunction --

DR. COCHRAN: The acceptability is very much related to implementation. Maybe we ought to just kind of mush all of those together and talk about those.

MR. O'DONNELL: I'm not sure what we mean by implementation, but it seems to me that one of the most basic questions, and befcre you can even look at the numbers, is to decide -- if you say, well, nuclear should be as safe as other technology - it gives you some frame of reference and gives you a way to start taking cut at numbers and things. If you say it has to be safer, then you have the problem of how much safer, which is a question all unto itself. If you cross that first hurdle and say, well, it should be as safe, but not necessarily safer than other technologies, I think you've provided an anchor, at least for alot of the other discussion.

CHAIRMAN SLOVIC: Well, I think that's really important issue to address here. We touched on it this morning, some reasons why -- over the last few days -- reasons why nuclear we might want to have it safer, and questions of maybe uncertainties are, perhaps, larger, than with other technologies - at least some aspects of the uncertainties. The ethical or distributional considerations may be different. I think all of these are debatable, though. There are two sides to that, so I

L15

don't know quite where to --

DR. LA PORTE: What would it mean if nuclear weren't safer than coal? What would that mean? It already is safer than coal, but what would it mean, I guess, in terms of every day operations? What would it mean if it weren't safer than coal? It seems to me that the way of posing it that way is not very helpful.

MR. CHARNOFF: Well, let's try and answer to your question. If you're saying that it's already safer than coal, but it ought not to be required to be safer than coal then it is wasted means that you're not to make the present safety criteria any more strigent.

DR. LA PORTE: Well, what would it mean in operational terms? How would you know?

MR. O'DONNELL: You can take what Gerry is saying. You may say, well we've already reached that level of safety. I think it should be a regulatory premise that --

DR. COCHRAN: Black coal one at --

MR. CHARNOFF: Whatever it is, I mean, it would have an impact in that context.

DR. COCHRAN: How about a social disease? I mean, is that a better refence?

MR. CHARNOFF: Well, I don't know. Is there something simpleitic about nuclear power?

DR. COCHRAN: No, I'm just wondering why you pick out

L16

other things that are not very --

MR. O DONNELL: Well, if you're going to start looking at alternatives, I think the first place to look would be the alternative means of doing what nuclear power is intended to do and that's generate electricity. You can go on from there, if you can, but I think that's a very good --

DR. LA PORTE: If we're going to do this, we're going to have to open up the question of the whole nuclear fuel site because if -- it seems to me that as you've run -- if you go from safety of power plant, talking about operation, to is nuclear safer than, or something else, you're going to -- the whole nuclear fuel site will have to be taken into account, just like you take the whole coal cycle into account and do we want to do that or not. It seems to me that on a power plant operation, itself, that nuclear power plants should be -- I don't know what it means to be safer than a coal fired power plant, because of the potential catastrophic effect, though rare - low probability of something going wrong and that just on its face, the facility itself is not comprable, the nuclear facility is not comprable with any other entity -- any other power generation facility. I'm not sure that's true, but I think, as a layman, it seems --

MR. CHARNOFF: How about dam?

DR. COCHRAN: There is another approach. You could say we want to make the reactor safe and we could go out and

L17

sort of get a sense of the potential people that live around these things as to what that means. I mean, that's a messy problem, but we could go out and try to identify how safe is safe enough, independent of all these other things. Now, once you've made - set some standards for safety of the reactor, then you can come back and presumeably you do this in other areas - then you could come back and do this - the waiting, or whatever, and the licensing of this alternative versus another which you might want to bring in the whole baggage to decide which one of the alternatives is cheaper and which is better and so forth, but I don't think you have to carry all that baggage along just to decide how safe you want to make the containment system of the reactor. I think people that live around the reactor want a safe reactor. I don't think they want you out there comparing it to rock quarine or whatever.

DR. STARR: The point that's been raised, what would you do, first, if nuclear power were expected to be more costly - visibly more costly than, say coal? What you would do then is you would build one or two demonstration plants and you wouldn't build any central station plants on a network basis because you would build those plants to get enough experience to see whether, either by technology, or by verification of performance, you could reduce the uncertainty so you would either try to reduce the risk factors, or you would reduce the uncertainties to the point where your perceptionof

L18

the total cost of nuclear power brought into a competitive range, so in effect, you would not expend power. You would build demonstration plants and that's about it. That's about -- for example, if fusion develops -- you know, there's a series of papers. They wrote some and I notice Mr. Holdren has written some too and so forth, pointing out that fusion reactors have a risk equal to or greater than that of fission reactors, and what will happen, if that ever gets into the engineering stage, which is decades of late, if ever, is that there will probably be some experiments done on demonstration plants to begin to pin that point down and there won't be any big expansion until the total economics as far as society's concerned, appears acceptable.

Now, let's assume now that it is acceptable and you've raised a second question. If you're going to look at it, why don't you include the whole fuel site. Now I, as an individual, do not object to this at all, but there's a reason why, in effect, it's been pushed aside in all the discussions. There are actually several reasons.

One is that one chemical reprossing plant will handle about 50 nuclear stations. Second is that the risks associated with public risks from operating a chemical reprocessing plant are not anything like the magnitude of risks which are potentially hypothesized for nuclear plants. The energy content is very low. The ability to spread public radiation is

L19

extremely low in comparison, potentially, and so noone really has word of that to a great extent, that the public risk associated with one chemical plant is of national significance or even of much regional significance.

The waste disclosal issue - you know, the professionals in the field, feel the waste disclosal issue is from the public risk point of view, actually diminimus, and that, in fact, there is not any reason at all for there to be any public concern about - over any length of time over the high level waste disposal - the amount that has been proposed, and the result is therefore, that there's an implicit assumption in dealing with the nuclear plant alone, that this is the one area where, in fact, the risk may be high, potentially, and where we may not know enough about it or anticipate it enough to have sort of protected ourselves against every element of public risk. That's where they use the word litigation, as well as --

CHAIRMAN SLOVIC: Let's address, again, this question about the comparison with something like a dam which has, at least you can sort of plot a curve of probability by magnitude of consequences. It might look somewhat similar to a nuclear reactor, and then the question arises, would one want to set some different target levels of safety for a reactor as opposed to a dam. Why would one want to do so? Some reasons that come to my mind are the, perhaps, greater uncertainties where this

L20

curve lies for the reactor and some of the distributional effects that - the effects of radiation as opposed to flowing water and this sort of thing. Are those legitimate reasons to have a different standard or are there additions to those? What are your feelings about that?

DR. LA PORTE: Well, the standards for dams, while there is a probability, if I understand this right, they have recently, within the last couple of years tried to develop the breakage - the dam breakage figures and prior to that they didn't consider --

CHAIRMAN SLOVIC: I'm not sure there are such standards for --

DR. LA PORTE: The standard for dam was no break. There was supposed to be no risk and they've been surprised that there is a more or less orderly --

MR. CHARNOFF: I can't believe that any dam engineer has ever articulated that there is no risk.

CHAIRMAN SLOVIC: No, but it wasn't a probable --

DR. LA PORTE: It was so low that they never got any kind of cost benefit to the consequences of downstream of the growth---

DR. STARR: I don't think it was the fact it was so low. I think it was the fact that the nature of the dam accident consequences were publicly accepted. It was publicly acceptable to have a sudden catastrophy which might require

L21

evacuation or might kill hundreds of people, but that was it. It occurred very infrequently and everybody forgot about it and I think it was the nature of the acceptance of the public of the consequences.

MR. CHARNOFF: Can I tell you a little anecdote on that? The words first nuclear intervenor was a fellow named Adolph Ackerman, who was an engineer who designed hydro projects and he intervened in a case in Minnesota in the mid-sixties, and what he demanded to know from norther states power, which was proposing to build the Montecello plant, was who is the hydro engineer on this project and I asked him what he meant by that and he said, "Well, when there was a dam - I don't know whether it was Brazil or Argentina - that failed and so many people got killed that fellow commited suicide." I want to know who that is here. That was the standard that they used.

DR. OKRENT: In fact, dams are not designed with very high safety standards. Most of them, in the United States - the majority of them are designed for a hundred year flood and, in fact, there's been a deprogram to fix that up. The majority of them did not have seismic design considerations in them at all and so forth. I think, in fact, the uncertainty in our knowledge about the risk from dams is equal to that to nuclear, except I think for most dams I could move it in a direction such that there was not such a large overlap. In other words, they

L22

wouldn't sit in the same space, because the risk for many of the dams would have a higher probability for the same consequence. Again, saying that, I still think, and I said nuclear should be designed to be safer than other enery technogies. In other words, not for the reasons you've suggested.

DR. COCHRAN: I think the whole slew of reasons of why people's conception of the risk of dams, the fact that the corps of engineers was the one that made the decisions. There's no licensing process. They're building all kinds of uneconomical projects and so forth - many of these things built years ago are very different from what it is today and it's no - when you look at all of these reasons, it's hard for me to say that we should take that historical context and set that as a standard for a new technology when people have long since decided that they want a new standard today, for a very different situation, and I think you'll make a standard for nuclear plants and pretty soon you're going to have a very different standard for toxic water pumps --

CHAIRMAN SLOVIC: I agree with you but you're looking at what was, but supposing you're starting across the board now to consider a variety of, say, energy producing technologies and you started from scratch and you want to set some goals for these technologies. Then you should differentiate.

DR. COCHRAN: Let's make these reactors safe so that the public at random is convinced they're safe and they're

L23

operating safely and then when we come to coal, we ought to have people insuring that the mining of coal and these people don't take these crazy risks when they mine coal, and clearly - because of the nature of the political process and so forth and leverage, they're going to be these vast disparities in these numbers.

DR. STARR: Can I pick up your thought because I'm agreeing with your general thought but I would carry it one step further. You may not like the extra step. The one step further is that I would agree that the argument that alternative energy sources are less safe than nuclear power, in an analytical sense, is not sufficient because that doesn't justify the deep lower safety of the alternative, but if you then follow this and say, well, they should all be from a public evaluation point of view, or social evaluation point of view, whatever it is, equally safe, and they should all be made safer. Safety requires a social investment, so there has to be a socal decision as to how much you want to invest to reduce these areas of this versus other social investments that do other things, so a society like the United States would have to decide in some complicated fashion, roughly how much it invests overall in the safety and energy sources. There is a cap. There is something that says that even though you equalize these things, you don't necessarily continue to press every one down because there's a point of diminishing returns from the

L24

point of your social investment, so that extra step has to be applied and one of the arguments that has to be considered, and where we don't know where the point is, is how far, if you set nuclear as a standard for everybody else, how much are you doing in the way of the allocation of national resources to make energy sources safe and is that the wisest allocation?

DR. COCHRAN: I appreciate that point and I, frankly, think it may be a little bit of a red herring in terms of the reactor's safety. I think it doesn't require that you necessarily vary these plants underground and so forth. I mean, the problem can be solved without pricing nuclear out of line with coal and the kinds of problems you worry about, I see, more or less being taken care of in a not very satisfactory way and when one does the trade offs in picking amongst the alternatives. I think that's very political and it's a sham operation but the process, in theroy, is there for handling that type of tradeoff. You cannot, because of ethical considerations - there's people that sit around these power plants, trade those risks against some coal mining fatalities and say we're not going to put a containment on there because we've got so many people dying in the coal mines. I mean, I think that you've got to protect the public health and --

DR. STARR: That's a distortion of the argument. I can take the same coal data and say that that is a measure of the level of investments that society wants to make in energy

L25

source --

DR. COCHRAN: I would say that's a level that society has tolerated for a whole host of reasons and I want to make a very different distinction between what people think is acceptable and what people have to tolerate for all sorts of reasons and I think the safety goal shouldn't be what people will tolerate. It should be what's generally acceptable. I mean, there's going to be some out liers in all of these things, but --

MR. O'DONNELL: The ACRS has gone on record as saying that they believe the nuclear power should be safer than other technologies and I guess you would endorse that. I'm interested in knowing the reasoning behind that statement or that position. I'm not sure what it means.

DR. OKRENT: It originally was found in an ACRS letter back around 1960. In fact, it was in a letter on citing, if I remember correctly, in which they said that it has been projected that the level of safety for nuclear should be that which is being attained in other existing technologies. In fact, at that time they said they wouldn't accept it. One of the reasons, but not the only one, was that, in fact, we didn't know that much about nuclear, so they said, in fact, because of the uncertainty in what the actual level of safety for nuclear was, they should be trying to make it safer and I guess maybe, although they didn't say it explicitely, they might have

L26

said well, something along the lines, I was not a member at that time. They may not have been saying what is happening today elsewhere is necessarily acceptable, as the point has just been made. I think the ACRS has generally, since then, I don't know of any situation where it has said it didn't favor trying to make a nuclear safety -- if there was the occasion. Now, if you want my own opinion, I think in part, it relates to the public acceptability. I think, in fact, it is relevant to have a greater degree of public acceptability for a thing like this although I am not trying to meet what I consider to be misinformation which might derive from talks which suggest that there could be large health effects from what was actually released from Three Mile Island. In other words, I'm not trying to get that kind of public acceptability where I want to be - get an acceptance to a position really based on what I'll call just misinformation. I think, in fact, it is relevant. I think the Congress has indicated a concern about the safety. They have, in fact, said that they would like to have a higher level of safety. We spoke to Governor Babitt - the head of the President's Nuclear Safety Oversight Committee - the Chairman, and we asked him about comments on how safe is safe enough in nuclear. He said -- the one statement he was willing to make was he thought they should be safer than other sources of energy. That was, I think, an official, responsible elected official - a knowledgeable official --

L27

DR. LA PORTE: Well, it's a political intimacy.

DR. OKRENT: -- this sort of thing. Now, furthermore, I think they can be made safer and I've said, if, in fact, there's way of doing which is not necessarily more expensive. In fact some of the time when you're making it safer, you're actually making it cheaper either because it's more reliable or whatever, but not everything to make it safer makes it more reliable, and I'm willing to spend somewhat more money. By the way, I have published elsewhere along the lines that Starr has -- I think society has to think about -- where you spend your money to reduce risks, and I think that is an important consideration, and nevertheless, I'm still --

DR. STARR: It isn't just a matter of acceptability. It's political penetration. Whenever you try to market something new, it's got to be better than its competitor or it isn't going to penetrate the market and safety and health and so forth is a big political market, if you wish, and in order to -- for him to take that market as a politician, he's got to -- if he's going to back something up, it's got to be better than what is already on the market and I think that the politician automatically thinks in those terms and I think it's a correct answer, that if you want, on a political level, to get something new in, it's got to be better in the issues that the public is concerned about, than what already exists.

CHAIRMAN SLOVIC: So you're then implying that

L23

partialling out concerns that are due to misinformation, there are other legitimate concerns about nuclear that should be accounted for --

DR. OKRENT: I think I've indicated --

MR. O'DONNELL: Related to public acceptance.

DR. OKRENT: I'm using the terms -- Governor Babitt is a member of my public, okay? Congressman Udoll is a member of my public. I think they're important members of my public.

MR. CHARNOFF: Well, in terms of Governor Babitt and Udoll --

DR. OKRENT: And Chauncey Starr to form another triad.

MR. CHARNOFF: In terms of that, when one says that nuclear ought to be better or safer, and I think I buy that same description, by the way, do we say that it ought to be better than that which exists or in the context of the discussion we had around ten minutes ago, should it better than that standard we would now impose on coal and hydro were we to establish a new standard. I think we ought to be clear about that.

DR. OKRENT: All right. In my opinion, if we're building a new nuclear, we should compare it to what we would be doing on a new hydro.

MR. CHARNOFF: And in that context, should it be safer than the standard for --

That's not clear to me. It's perfectly

L29

clear to me that we ought to ought to be safer than whatever the existing acceptable technology standards.

DR. OKRENT: Well, I think you have a good question. It's not an easy one to answer because, in fact, we don't know what the safety of a new hydro plant would be since we don't really know very well what the old one is. By the way, one point of information, my knowledge is that no no dam that the corps of engineers has built has failed. That's about over 7,000 dam years of operation, but that's not to say thatother dams have not, as you know damn well that they haven't.

It may be, at some level, of safety for others. You may say they're all safe enough and, in fact, I would say myself, you could in fact, define some kind of a level of safety if you thought it was met with a sufficient degree of assurance, you would now no longer try to match it against whatever the dam was doing and say "Now we have to go a factor of tenths or better." There is a level that's low enough, in my opinion, that you now would do cost -- so you then go to the Alara criterion and not try to compare.

DR. PERROW: Who built Teton?

DR. OKRENT: It's not Whoppers.

DR. STARR: I could answer your question in a somewhat different way. You build a plant because somebody decides that they want to have another electricity source. Let's take the practical situation - a 100,000 megawatt station. Except for

L30

the hydroelectric capabilities, which are very limited and regional, your alternative to nuclear would be coal, so at the time that you build the plant you either decide on a nuclear plant or a coal plant. At the time that you make that decision, you want that nuclear plant to have the total integrated public safety leval lower than that of the total integrated public safety, however you measure it, of the coal plant. Now, ten years from now when the coal plant presumably a new coal plant going on line can be improved, then that target may be lower than the target was when you made the decision today. There is a moving target if you want to use the issue of a comparative list. If you want to take a level of risk that's sufficiently low that it's going to take decades for the alternative like coal to meet it, you know -- my people in our enviornmental groups say coal and alot of other people say coal, and it's about 100 times more risky to the public in terms of public health than nuclear, and in that case, if I set a level for nuclear plants at -- let's say the level which Dave suggests, it may be 20, 30 or 50 years before coal catches up, so the moving target aspect, that being really irrelevant, but assuming they were very close --

MR. CHARNOFF: Are you saying that the same time - if I'm advocating the coal unit, come up with a standard that says my coal unit ought to be safer than your new nuclear unit -

DR. STARR: No. We're talking about the capability

L31

of the technology at the time you made the decision. That's all. Right now if we build a coal plant now that meets all the quality control requirements, as far as our own internal, environment calculations show, we're for coal plants too. I mean, you know, we've got a big group of people to fight for this too. From a public health point of view, that integrated coal plant looks to us like it's about 100 times riskier than the nuclear plants.

DR. COCHRAN: Let's stay away from what is rather than what should be.

MR. CHARNOFF: I don't want to get in an argument with you over that issue or your statement that reprocessing is such a great idea when --

DR. STARR: No, I'm reporting the opinions of the people in the industry. I'm not arguing that the facts are correct.

DR. PERROW: We're not giving consent such as waste disposal is no problem.

CHAIRMAN SLOVIC: Somehow I have the feeling that we're not closing in on anything here with regard to this - what seems to be a pretty fundamental question as to whether, if we're setting, say, new standards now for energy technology, shouldn't we have some special factor of safety that we tack onto nuclear standards for some reason. Does everyone agree that there should be?

L32

MR. O'DONNELL: I didn't hear the proposition again?

CHAIRMAN SLOVIC: Well, if we're setting new standards, say, for coal and nuclear, that we should tack on some special requirements, more stricter requirements for nuclear --

DR. STARR: What we should discuss is whether nuclear ought to be safer than the other alternatives. It may already be.

MR. CHARNOFF: That's the difference with the way you formulate it.

DR. STARR: The question of whether it is or isn't safer is a separate question, but the general agreement that nuclear power ought to be safer than --

MR. CHARNOFF: The way to ascertain that is should the NRC safety goal reflect a requirement that it be safer than alternatives, and --

DR. COCHRAN: I agree.

MR. O'DONNELL: I disagree.

DR. STARR: I think, Ed, you ought to explain.

MR. O'DONNELL: Unless we say why -- if we say, well, that should be because of issues of public acceptance, that's one thing. If we say that that should be that way because of some technical, basic, reason, I would have to disagree with that. If we're going to say, well, we feel that the NRC should establish a level -- should require nuclear plants to be

L33

safer than alternatives because that's presumably what the public wants --

DR. COCHRAN: What do you think the standard ought to be and why?

MR. O'DONNELL: I think the standard should be set on a basis of equity and --

DR. PERROW: The same as all alternatives. All standards should be the same.

MR. O'DONNELL: Right. It would be such that the level of risk to the public is a very small fraction of the level of risks they already have, which I think is the case.

DR. COCHRAN: How do you provide an incentive --

MR. O'DONNELL: Through the cost benefit aspect. That is -- and this gets back to the allocation of resources that if, in fact, you could take your money from one area of society and invest it in reducing public risk at some optimum level, you ought to do that. The incentives are in the cost benefit aspect.

MR. CHARNOFF: Are you excluding the Alara concept?

MR. O'DONNELL: When I say cost benefit, that's concerning the Alara. I accept the Alara, yes.

DR. PERROW: But the Alara is fairly meaningless.

MR. O'DONNELL: No, no. On a specific cost benefit, but Alara, to me, is too vague a term when we're really talking about cost benefit.

L34

DR. PAGE: It seems to me that we've already talked to some extent of the several reasons why we might want to treat nuclear power as different from other energy sources and one, Chauncey Starr says because it's a new technology, it bears the burden of market penetration which means that the newcomer has to bear special advantages over the existing alternatives. The second one is the political one we discussed yesterday which is basically, if you kill a number of people sort of on a very diffuse basis because of existing coal technology, you're not likely to shut down the coal industry but if we have another Three Mile Island and it's a more severe accident, then there may be alot more severe consequences even though they expect the number of deaths as equivalent and we sort of touched upon that --

CHAIRMAN SLOVIC: We sort of ruled that out except inasmuch as it may come into the Alara principle.

DR. PAGE: I'm not sure -- have we ruled it out? It seems to me that the concensue, except for Mr. O'Donnell is that we may want to agree with Dan's position --

DR. COCHRAN: They're two separate ways of managing risk reduction. Some people are trying to distinguish one as setting a level of what constitutes "acceptable" in terms of safety and maybe that has to apply to another technology and another is how far below that you go through some sort of benefit cost Alara --

L35

DR. PAGE: Let me try to respond to that. It seems to me that where these -- in my understanding you have two approaches. One is sort of an absolute risk concept which are supposed to be so low in risk that we side step questions of intertemporal equity - so low in risks so we essentially don't have to work about any severe consequences of shutting down the industry because --

DR. OKRENT: I don't want to say that. It's low enough that I think you don't have to look at questions of whether the person getting the risk gets a direct benefit. In other words, the person living nearest the plant may get --

DR. PAGE: So you're saying that you've tried to choose these numbers such that the distributional considerations both intertemporal are --

DR. STARR: Right.

DR. PAGE: It seems to me that those are proper considerations and if we can argue that the distributional considerations are more important for nuclear power than they are for, say, hydroelectric, then that's an argument that says that these absolute numbers - these tens to the minus fives should reflect the differences.

DR. STARR: I think that's right.

DR. OKRENT: But I don't think they are from the point of view of the people living today. In other words, there are lots of people --

L36

DR. PAGE: No, I think they are both in terms of --

DR. COCHRAN: No, what I'm gettin to is that I think there are people living below dams who get no benefit from the dams and get much more risk than the people - than what we're proposing here.

DR. PAGE: But I think that's part of the point, that people are more willing to --

DR. OKRENT: You get inundated in a place that would never be under water after the dam is there.

DR. STARR: Toby raised a point which is a sophisticated way of talking about the difference in the kind of deaths and injuries that come out of a major nuclear accident, not out of a dam burst. A dam burst is like an airplace accident or an earthquake. The effects are sudden, they're fast, the living population in the environment gets immediately affected but future generation effects are of a sociological rather than a physical nature. The -- one of the big concerns - one of the reasons of the public imagery, if you wish, and difficulty of evaluation, is that except for the very minimal probability of acute deaths from nuclear exposure, almost everything is latent and there are fears of mutagenic and genetic effects down the road, whether they're right or wrong. The costs are paid in an intergenerational fashion and --

DR. COCHRAN: There's alot of uncertainty in dosages.

DR. STARR: Right, exactly. All of these things are

L37

uncertain and so there is a difference in the nature of the public health risk --

DR. OKRENT: Excuse me, Chauncey. I just want to make one point. In fact, people have not looked to see whether there are not the long terms effects from dams, but I have little doubt that I can find sites where dam failure will lead to the dispersal of chemicals which will lead to these same long term effects, and I can probably calculate larger ones than from a nuclear accident.

MR. CHARNOFF: But beyond that, I think the public is concerned with a nuclear accident. I think the public concern with a nuclear accident is really -- it takes two forms. One is what you might call the informed public, but I will wager that the typical public reaction to the nuclear accident is it scares them and it does not distinguish between near term and latent effects. They see it in terms of the mushroom and the immediate effects.

DR. PAGE: Well, I think that's being unfair to -- I mean, if you told me, you know, there are two gambles, one of which is 1% chance of getting killed by a dam breaking and the other you have a 1% chance of getting cancer, I would have no trouble at all deciding which risk I'd want to live under. No trouble at all and I think --

DR. OKRENT: Excuse me -- which would be your answer?

DR. PAGE: I'd far rather get killed by the dam than

L38

have cancer.

DR. OKRENT: Well, let me pose a question. Suppose you knew it was the dam this year or cancer 20 years from now? In other words, the accident with of them would occur next year. What would your decision be?

DR. PAGE: Well, that's harder.

DR. MAC LEAN: That's not the question.

DR. PAGE: No, that's not the question because I think we've carefully finessed this this whole time. I keep pressing the question about -- they think the number's low enough and so it doesn't matter. Okay, if we made the numbers low enough, then it doesn't matter, okay? I mean, either we accept your point of view or we don't. Let me also respond to the question about the dam and the toxic wastes of the chemicals. It's perfectly clear to me that when people are concerned about long term genetic failure, reproductive failure, neurological disorders and cancer, people are very upset and I think people have real concerns about their way of dying and this is a proper concern. In other words, I don't think it makes sense to simply add up number of deaths and that's it. Some deaths are worse than other deaths and it has alot to do with why nuclear power is viewed the way it is. It's not just the mushroom clouds. It's cancer.

MR. O'DONNELL: If we've reached this point where we're saying, okay the standard should be a different standard,

L39

which I thought I heard a concensus forming here - we're making the judgement that we do, in fact, that these temporal intergenerational things, or whatever they are - that we know enough about the problems, both on the nuclear side and the non nuclear side to arrive at this judgement and I think we're pretending that we know what the problem is. We think we can reach that conclusion, I think we're kidding ourselves.

DR. COCHRAN: Let's relax the statement so that maybe we can get a concensus rather than saying should they be the same. Let's have the negative of there's no basis for them being -- in our view, there's no basis that nuclear risk should be the same as --

MR. O'DONNELL: There is no basis for my opinion of saying they should be different.

DR. STARR: Well, what Dave has said and what I think is the generalopinion of the nuclear industry, and again, I don't want to get in an argument over the numbers - I'm talking about the thought behind the numbers - the thought behind the numbers - the number sufficiently allows it so that the areas of uncertainty about intergenerational effects are supressed in that number. That is, if this number is achieved, then it covers the uncertainties of the intergenerational effects. It isn't that you know enough about the intergenerational effect even if you take upper limits. It's unimportant if this number is taken, and I think this is what you were referring to before

L40

and if you stop looking at that area of ignorance, as Dave pointed out, there's an air of ignorance on many other areas, too. It's the uncertaintites of these areas, and by getting a number low enough, you can push that aside as a secondary issue and I think -- am I reflecting the thought behind the numbers you're proposing?

DR. OKRENT: Well --

DR. COCHRAN: I agree with Chauncey. I think the industry believes that the numbers that the -- the goals are low enough that you meet the goals without undue economic harm to the industry and therefore they find the goals acceptable and can be pushed low enough to dismiss alot of these other problems. That's their argument. I think alot of people that would probably accept the goals but would never accept the view of the industry that they're anywhere close to approaching the goal.

DR. STARR: But that's a different argument.

DR. LA PORTE: But it's a relevant one in terms of safety goals.

MR. O'DONNELL: I think we've come at it at that way in saying that these numbers are such that these effects are minor but in answer -- to say that nuclear should be safer than other things would seem to say for other things we could have a higher level of risk and I just don't think that we're at the point where we know enough about these other risks to go that

L41

far.

DR. STARR: I disagree with you, Ed. First, criteria like this are good for what? 10, 20 years? There's going to be other committees sitting 20 years from now reacting about numbers and changing things. The point is that we have more experience - maybe not all the fine detail knowledge, but we have more experience with those technologies that have been around for 20,30,50, 100 years and based upon those experiences we're much less likely to be surprised and it's the uncertainty in the nuclear areas because it's new and the surprises are apt to be greater, and for thatreason, there is a difference, even though there are uncertain things about coal and the long range effects on health and so on. The total integrated uncertainties are less. If you put a statistical distribution of our knowledge on coal, it's going to be a sharper curve than that on nuclear.

CHAIRMAN SLOVIC: We're going back and forth now on something that we've -- there are a number of issues here that I think we need to attend to and I'd like to call on Todd now to get back to what he wanted to raise earlier.

DR. LA PORTE: Thank you. Now, there are sources of uncertainty on the one hand, in thinking about moving from the proposal of quantitative safety goals to thinking about the implementation and let me suggest some logic here and then we can talk about it if you choose to. Establishing quantitative

L42

safety goals is based, or can be, based on the assumption that if they are attained -- if the health and safety of the public would be assured now and in the future - if you have uncertainty as taken into account after what you've heard. In using these goals as a basis for evaluating programs - safety programs in reactor operations, it's assumed that reactors can be designed and operated to attain the desired performance, or they can be determined not to and shut down or at least limited in their deployment. Otherwise the goals would be harmful rather than helpful. Well, taking this as a point of departure to understand the implications for agreeing on the proposed goal, or perhaps for changing it. I think the three aspects, four, associated with attaining the desired performance require attention in the context of safety programs generally and the requirements - they're the requirements that cost and probability of realizing them in four different areas. Let me just list tham, and what I want to do is finish with stating what my preferences would be for safety goals in addition to the quantified ones. They're the requirements for the following - developing and operating power plants as their numbers grow from, say, 150 to 500, over their four to six-year lifetimes. That is, can we assure - what are the requirements necessary to operate at a higher level of the liability plan says they go in number over the next number of years.

Secondly, to develop and operate an adequate State

L43

Federal regulatory system in parallel to the reactor fuel cycle growth implied by the numbers I spoke of before.

DR. MAC CLEAN: Will you repeat that again?

DR. LA PORTE: Development and operation of an adequate State and Federal regulatory system in parallel to the growth of reactors.

Thirdly, to develop and maintain an adequate plant/community emergency response readiness capacity - to get the hell out if you have to if your other things don't work, and

Finally, to provide the resources necessary to redress of the consequences of major errors and breakdowns were they to occur. That's the mitigation costs and cleanup costs, etc. Those four things.

DR. OKRENT: Could you restate that first one again?

DR. LA PORTE: Sure. Just the operation.

DR. OKRENT: What about the operation?

DR. LA PORTE: Whatever you have to do to operate plants at the level that maintains the operational requirements that are necessary to meet the --

DR. OKRENT: To meet these same goals.

DR. LA PORTE: Yes, yes. All I'm talking about that they have to do that assure that the qualified levels of performance released and so forth, are obtained --

DR. OKRENT: Are still being met with large numbers.

DR. LA PORTE: Yeah, with large numbers and --

L44

DR. OKRENT: Not a change in goals, but --

DR. LA PORTE: No, not a change in goals.

DR. OKRENT: But you want to be sure that they are being met.

DR. LA PORTE: Yeah. The reason I'm stating it this way is that, I appreciate, as I said before, the logic underlying the -- the analysis underlying the specifications of a quantified - or the quantifications - what my concerns are are really not only that we could agree on that logic, but that if they are applied to an extending number of plants, along with the regulatory appartus that's necessary and the emergence response capabilities that are also now necessary, along with -- that if something screws up, actually does happen, you have resources available to take care of the problem.

MR. CHARNOFF: Resources other than emergency --

DR. LA PORTE: Yeah. I mean like the in -- it's a TMI kind of a thing but that's the only thing I can imagine. Now, what the answer to these questions are - you may discover -- I don't know what the analytical answers are to these but I want to know them to know whether the goals that you specified -- what the implication the society would be for trying to -- for attending to meet them, and --

DR. STARR: That would be the same no matter what. I mean if you're going to list, it would be exactly the same no

L45

matter what the number was.

DR. LA PORTE: That's true. It wouldn't make a bit of difference. Now, it's possible that when you went through this against the goal, you say, that's not what you had in mind. Let's see what we have to do in terms of goal structure, I mean, goal specification, to see whether the efforts to achieve them could be realized on the level of socially --

CHAIRMAN SLOVIC: Could you be a little bit more concrete about where we might be surprised and feel that somehow -

DR. LA PORTE: Well, let me just specify what my intuition is that as you move past 100 power plants -- we have 70 or 65 or something like that now, up to -- upwards past 150 to 200, that the problems of assuring the kind of personnel attention and so forth would be much more difficult to attain. You have to do more things to keep people - all those people operating at the level of a reliability -- you know, we talked about that.

DR. STARR: Is that an example or a parallel to show that that's true? I mean, you're just guessing that. What examples do you have that as the numbers go up the operational attention and care goes down? You're making an assumption and I want to know what leads you to that assumption.

DR. LA PORTE: Well, the stores that we're hearing out of the submarine --- it may be difficult for them to now maintain the quality of personnel that they seek and you have

L46

the same thing in -- what I'm saying is that it's not that you can't do it. You go to more efforts to maintain the level of --

DR. STARR: Well, would you say the airplane pilots today are less competent airplane pilots?

DR. LA PORTE: No, you're not hearing what I'm saying. I said the efforts to assure level of reliability and competence - you have to --

DR. STARR: I misunderstood. I thought you were implying that the -- you're making a basic assumption that if the numbers go up --

DR. LA PORTE: You didn't hear what I said. I said what are the requirements and their costs of probability of realizing the requirements as - for doing four things, as you increase the number of power plants, in the system.

DR. COCHRAN: As I understand, when you had one or two airplanes, they only had sort of a compass and a stick and so forth and with what we've got today, they're alot more complicated --

DR. LA PORTE: You have to work harder to --

MR. CHARNOFF: That's not necessarily as a result of higher numbers.

DR. LA PORTE: That's right. The other example you asked for of what I meant by that - I think the other one is well, the regulatory we can talk about in a little while, but there's a third point and that is developing and maintaining

L47

adequate community emergency response readiness. I think that that's going to be - if we really believe that's necessary, that's going to be really hard to effect over the lifetimes and over the numbers of communities that would be involved. Putting it the other way around, what you have to do to assure that readiness on the parts of those communities.

DR. STARR: Well, you're confusing your objective with where the objective can be reached and the objectives, it seems to me, are already the traditional objectives of the NRC and the industry generally of many other regulated areas which- are similar to these. Your perception of the objectives are going to be difficult to reach. I don't follow that.

DR. LA PORT: Well, I guess I wouldn't put it that way. I'm saying that it's not -- well, let me tell you the way I put this for the third time,that my intuition tells me that it is not obvious that the increase in the number of power plants, going from what we now know with 60, can transfer without change to 500. That there are no differences in regulatory effort or personnel requirements.

DR. STARR: Yeah, but I was saying -- I don't believe you're listening to what I was saying.

MR. CHARNOFF: Yeah but his question is how does that impact on the standard?

DR. LA PORTE: If you have - if your standard can be usefully applied and then be attained for ten power plants,

L48

where if you apply the same standard to 500 it couldn't You couldn't maintain the --

MR. CHARNOFF: If the naswer to any of your four questions is no, it couldn't be done then --

DR. LA PORTE: Or it would be so costly that you can't imagine doing it. I mean, there's a number of ways you could --

DR. PERROW: Why did the cost of community scram go up unreasonably, if you had 150 plants instead of 70?

DR. LA PORTE: Well, I'm not sure that I want to put it in terms of from -- that as you spread the requirement for maintaining community readiness to leave, you have two kinds of problems. One of them is that you have the plans - but to maintain the social readiness to effect them over the time frames involved -- that is, where nothing happens for 50 years kind of problem -- simply to maintain -- I think the social standards may very well be.

DR. COCHRAN: Let's take a hypothetical example, which is not really required, but suppose everybody were required to maintain the stock of iodine tablets for emergency purposes, I would find it difficult to insure the implementation of that on a 50-year basis.

DR. LA PORT: I think that if you have 500 plants that the incidents of accidents would be more frequent per unit of time.

L49

DR. STARR: The objectives here written down, I think, are reasonable and implicit in many of the things the regulatory agencies are already doing and I do think that one has to consider how one affects the civil systems, if you will, and regulatory systems as the number of plants go up. I don't think there's much argument about that, but your next step was to carry an implication that this is going to be too difficult to achieve, and therefore --

DR. LA PORTE: Well, my own intuition is that we'll be surprised of the level of effort that will be required to --

DR. STARR: On the contrary, my intuition says just the opposite.

DR. LA PORTE: Then we should reexamine it, shouldn't we?

MR. O'DONNELL: The four principles, I think, are something that I certainly can endorse. I don't know how they relate to the safety --

CHAIRMAN SLOVIC: It seems to me that we're lacking a knowledge based on which to evaluate this. I mean, I think that there's a feeling that your concerns are legitimate, but there's no consensus about the direction --

DR. STARR: Well, we have some knowledge of this. Operations evacuated on an emergency basis with no prior preparation at all and have been done very expeditiously and any society which has some internal structure can focus in some

L50

of these problems when it has to and this is not the only problem. There's a whole mix of these in our society and so society has to have some level of organization for emergency responses. This is just one of many things.

DR. COCHRAN: Well, let me give you an example on the second one, develop and operate a state and federal regulatory system where I think we're experiencing now is something of a failure and that is after the TMI accident we withdrew all of the staff off of the new licenses and applied them to the lessons learned, and so forth, and now you get a little pressure from Congress to crank the licensing up and you abandon the TMI leesons learned and go back to licensing plants until you cannot - you don't have an adequate system --

DR. STARR: Is that even now?

DR. COCHRAN: Now, at 70 plants.

DR. STARR: No, what I'm saying is that by the time we get to 500, we're going to have to have worked that problem out.

DR. LA PORTE: You misunderstand the point I'm making. I'm wanting to know if we were to approach something more than we have, what would be the loading on society to work them out? What would it take? How much pressure on local and state regulatory capacities would have to then be - and I don't know what the answer to that is but --

MR. CHARNOFF: Do you think we grow different than

L51

linearly with the growth of the plants?

DR. LA PORTE: I expect so. There's two hypothesis about that --

DR. PAGE: Can we focus just a little more on sort of the problem at hand and it seems to me that first of all, there's a large empirical literature on scale problems and industry cost control and that sort of thing. Nasa projects have been studied, and --

DR. LA PORTE: That doesn't tell you very much.

DR. PAGE: Well, I think it tells you alot of what you're worried about is that quality control becomes harder when you scale up and you have routinized procedures and when you go away from hand tooling and that sort of stuff. This is a well studied problem, I think, and the point is, if I may interpret you, is that the emphasis is almost entirely upon safety for one plant and there is an obvious thing - an evolutionary dynamic problem, which I think we all agree. At least I think we agree, that there is, and it's addressing one set of problems and if it's put in the context of what the industry's going to look like as it changes over time, then somewhere along the line someone's going to have to address these questions that you bring up.

MR. CHARNOFF: We agreed with Todd yesterday when he made that point that if we're talking about 1,000 reactor universe, it could well be that these standards would be

L52

different and ought to be made more stricter.

CHAIRMAN SLOVIC: If we don't have anything further on that --

MR. O'DONNELL: I'd be willing to reconvene at this time - the same group, when the 301st application comes into the NRC. We can readjust these safety laws.

DR. COCHRAN: Are you implying that if no more met them it wouldn't --

DR. LA PORTE: I'm sure you were being facetious and I'm sure it's time for a break, but my own sense of this is that what gets placed and put employees over the next decade with regard to these safety goals. If there are, we'll have a very long life and that they'll be pressure to maintain them for some of the reasons you raised in the morning, that is, to maintain expections of the industry --

DR. COCHRAN: They'll be pressured to utilize them the way, like --

MR. O'DONNELL: From the industry viewpoint, we, in fact recommended, since noone's really attempted to do this before, that whatever goals are established be on an interim basis or some trial period of only three years or so. I think there's got to be -- the application of this has to go through some trial period. I think we're fooling ourselves if we think we're going to establish goals that are going to stand for 50 years.

L53

DR. LA PORTE: My point's a different one, and that is that what I would -- if I were to ask myself the question, what's the implicit error that --

DR. STARR: Omission.

DR. LA PORTE: Well, it's the surprise. What is is that by starting out - by using something like this and range of other sort of apparent solutions to the nuclear materials handed in the problem, which has a very long time into the social future, that we get committed to arranging things thinking it's going to be adequate for the very large scale, etting the very large scale and discovering that it's not very adequate at all and then we're stuck.

DR. STARR: If you're proposing that these topics be studied on the scale up time at advanced basis, I would agree. I think it's worth doing system studies on these and on the operation of the institutions, the structures and the likely and the options, but for accomplishing -- well, for example, one of the things that the industry suggests is standardization to simplify some of these problems. One of the objections of standardization is it tends to freeze engineering into a fixed format so the fact that that ought to be studied and argued about and options developed for it, I would agree and I think that's your recommendation. Is that it?

DR. LA PORTE: Yeah. Well, it's not -- sure. I would say that I'm agreeing, but I'm also suggesting that

L54

the - that we be informed about the results of these studies, in regards to the cost in dollars and in institutional change implied by these questions to reach the goal if we were to accept the goal. I can imagine a time -- I can imagine a situation of saying, well that's the goal we want and if that's what it takes to do it, we don't want to do it because --

DR. PERROW: I think there are at least three things involved in here that haven't been studied and I think it's not just a case, Chauncey, that you agree that they should be studied. I think he's making a stronger case. They are, to some degree, counter intuitive. They are not obvious and there - to some degree they may be rather explosive when examined, so they haven't been particularly examined. There are three things. One is, when you -- it's just sheer resource. It's like availability of manpower or regulators. You just can't make the NRC any bigger and expect it to be at all efficient. I think there's a problem there. Then, there's another kind of problem, scale effect which you were referring to which is a different thing than sheer resources. What happens when something gets bigger in size, volume, time and so forth, and then there's a third one which we call in social science methdology contextual effects.

DR. COCHRAN: Why are you complaining about the people's big words?

MR. PERROW: I'm trying to explain it because- well, I

L55

try and explain words when I use them and I prefaced it by saying something we call in social science as contextual effects. This is the difference between an individual being -- an individual characteristic and a situational characteristic, so for example, you can have, in group dynamics you can have a tipping balance of 25% level where you put in a little bit more and you just cover the whole group with the change of attitude - group pressures and other things come on which make you -- makes the group behave quite differently than it would, with a very little small increase or change, deviation in attitude. It depends upon the context in which it takes effect.

Now, what Todd was referring to was one of these would be the nuclear accidents that you're going to get every year when you have 1,000 plants, if you have -- at the proper probability affix figure. That's going to be totally different, and I can readily see, from one every 100 years with 100 fewer plants. That would be the kind of a contextual effect. There's probably alot of others that we haven't thought of, because we are just not used to this kind of long range planning with highly toxic kinds of substances and so it's saying you may be in for some real surprises, which the yellow book would not contemplate.

CHAIRMAN SLOVIC: How can you address that in the context of goals? Can you build in an extra conservatism for that factor or what --

L56

DR. LA PORTE: Well, let me -- while you tackle that. It says qualitative goals. I don't know what they mean. I don't know much about - what I'm saying here with regard to exemplications for plant design are operations but it's something like the following and follow the first three points here, that the plant design, facility scale and operational requirements, that it is on the plans to minimize the need for extraordinarily organizational behavior and the cost of remedying serious accidents. I don't know what minimize means here. It doesn't mean zero but it means probably a large number. You work to minimize those kinds of things. You work to minimize the regulatory loading on states and the federal level. As you design the operation to not require regulatory oversight or monitoring or watching at the state and the federal level. Parenthetically, let me just suggest that in this country, unlike France, perhaps, and certainly in the Soviet Union, the requirement of a technology to be watched or regulated has some real political, ideological cost to them. We don't like regulation generically, as part of our political culture and one of the things that's hard to factor into technological or any kind of policy cost benefit analysis is the political cost of having to do some things that you don't like politically, ideologically, so that you can have the benefits of the other technology, and I think that when you have alot of nuclear materials floating around for instance, if

L57

society wants to have watched - doesn't trust the operators, that that's going to have your contextual effect, at some point. I don't know when it is, but as you grow with the number of watchers that you have to have to be assured that the operators are doing it the way you want to have them do it - that's a real political cost because it makes us feel bad about our government. Not really us, but, as you see the regulatory activities increasing, and that's only a trivial requirement. Clearly it's designed to meet the needs/costs of the community, in order to maintain emergency response readiness -- well, I don't know what that means exactly because I -- but as a design goal, that's flows from the uncertainties of knowing what those answers are --

DR. STARR: As I understand the root of your comment, it's not to make a decision today based upon a limited quantitative analysis, such as presented here without trying to make an estimate of the future trend, which that decision leads to.

DR. PAGE: And the impacts of those trends.

DR. LA PORTE: If you were to accept that as what we were trying to meet in the face of whatever system you envisage here --

DR. STARR: That's right. Your worry is that decisions are going to be made today on fairly limited criteria which the future consequences of which may be alot greater than is now

L58

perceived.

DR. LA PORTE: Yeah, it's another way of saying - addressing that thing of -- you coulin't really address them if you don't know how to do it and that is what's the other costs in your social costs section.

DR. COCHRAN: Maybe an example of this is the Desmo process where the standard or the determination was the no hazards consideration in loading the Big Rock plant, but ultimately they were forced to address wide scale use of plutonium before they startel in at that step.

DR. STARR: Sure, and I think that's an example of that issue, but then I think, if you're willing to do that with the nuclear case, then coming back to where we were before, you want to do that with the alternative option, if you don't go nuclear, one is the same question for the alternatives.

DR. LA PORTE: Yeah, I agree with that in the main. I think, however, and this is my response to the question of comparing different energy systems and risks -- I think I understand the general point and I agree with it, but I think that we really can't ask NRC to do that.

DR. STARR: Well, that's a difficult question.

DR. LA PORT: We keep asking as though that were a part of our concerns for NRC's role.

DR. COCHRAN: I'd like to plead to the Chairman for equal time on some of these other issues.

L59

CHAIRMAN SLOVIC: Okay. I think we really have gone through this as much as we need to. I think there is an appreciation of the points that Todd is making and feel that it needs to be studied and considered although just how that might be done is not clear. The direct implications are not clear, but I think the point is very important.

DR. LA PORTE: I think the direct implications are that in terms of specification and quantitative goals at this time, that the uncertainties in regard to its meaning for implementation and the consequences of seeking to implement then is very determined. You've got to ask these kinds of questions. It's all intuition.

DR. STARR: I would hate to see that go in as a conclusion because the decision the NRC is facing is really two steps: one, that they set a quantitative goal and the other is what should it be and the alternative of not setting a quantitative goal is to proceed without a quantitative goal, and your issues are just as relevant if you proceed without a quantitative goal. The act of setting the quantitative goal doesn't change the relevancy of your issues.

DR. PERROW: It will decrease their visibility.

CHAIRMAN SLOVIC: It affects the level of safety.

DR. OKRENT: Which could affect the level?

CHAIRMAN SLOVIC: This indeterminacy.

DR. OKRENT: Which indeterminacy? I think there may

L60

be more indeterminacy without these goals than with them and, in fact, you may have a harder regulatory problem without them. It isn't clear to me that there's a connection between the concern and whether or not the NRC goes quantitative, qualitative, or stays with exactly what it now has. It's related -- if it's real and I don't want to ascribe the same reality or liklihood of importance to each of those, I don't think, in fact, it's related to this yellow --

DR. COCHRAN: We've spent a day and a half within a narrow definition of what these goals are, namely some quantitative stuff like in the yellow book and without addressing of whether the goals which the Commission should be considering, should really address the implementation process of whatever ends up in the yellow book and that, I think, is a much more important issue that we should have been discussing yesterday instead of -- well, I hope we get that on the table before --

CHAIRMAN SLOVIC: Okay, well, I think rather than start that, we'll break in eight minutes. I think we should take our break now.

DR. OKRENT: Why don't we take a short break? Do we need a long break?

CHAIRMAN SLOVIC: Let's reconvene at 3:30.

(recess.)

CHAIRMAN SLOVIC: We've covered quite a number of the issues that were raised even though we didn't read into

L61

them formally, we somehow touched upon them and at some point we may want to take stock again.

George Sege inquired about -- I guess he took my comment seriously about another day and don't get worried. I was just wondering if you want to decide that now, or see how it goes or if there's some people who definitely have to leave at 5:30.

DR. MACLEAN: I wouldn't mind deciding now that if we don't get through with the agenda that we either extend or reconvent. I'd be in favor of reconvening, myself.

CHAIRMAN SLOVIC: Tom, do you want to --

DR. COCHRAN: Well, I don't have any great speech or any good ideas but I think the process that the NRC and the institution is operating under right now, is wrong and should be addressed in terms of safety goals. I think arguably, the issue's an ethical one of whether one is forcing the license process through in what I consider a biased manner and enforcing these plants on the public, a large segment of which doesn't want them. I think there are things that could be done to increase the process. They could be formulated in goals. I haven't any nice typed suggestions, but certainly the idea of the Commission being up on the hill at the moment, the proposal which everybody refers to as efforts to speed up licensing, and I think the rhetoric speaks for itself that I'm talkinn about streamlining the process and making the

L62

process more fair. Everybody knows what the issue is. There are a bunch of plants that have been built and people want to get them operating and the name of the game is how do we get them licensed, not how do we decide whether we're going to meet the safety requirements, or should we license them, so I think the whole process has always been and certainly now is not a fair one and I think we should -- some of the goals should be addressed to improving that process.

DR. PERROW: I thought you were going to bring up the other issue that I'm really insterested in, that you did just before the break. Supposing this here is all agreed on and so forth. How is --

DR. COCHRAN: How is it implemented? That's what I'm bring up. I mean, there should be goals addressing how one implements other goals, standards, or whatever --

DR. STARR: Well, Tom, I both agree and disagree with you. I agree that the NRC process ought to be reexamined. I agree with you that the objective ought to be public safety.

DR. COCHRAN: How about public acceptance?

DR. STARR: Well, that was going to be my next point. I don't there's anything in the NRC charter or anything in the congressional setting up of the NRC or any obvious roles for the NRC that it should be responsible for public acceptance or unacceptance of the - of any technology that it's regulated, that the issue of public acceptance is a political issue which

L63

Congress ought to be dealing with.

DR. COCHRAN: Well, I just gave you an example of why I think -- why I would argue the other side of that. Congress has told the agency that it must make a determination of undue risk compensation to the public. Now, to sort of make a -- to overstate that issue, one way to do that is to go out and get some technicraft or a group of technicraft and all together and make that decision on the basis of expected value risk, all right, without ever consulting the public and they may come to a conclusion that won't be accepted by 10 of the public, and I would say that's not the intent of the law because the intent of the law is to set standards that meets an undue risk --

DR. STARR: I think you can make the point, but you're not getting back to what the intent of Congress in setting up the licensing of the NRC. I completely disagree with you on your interpretation. That doesn't mean that there shouldn't be a reinterpretation, but I don't see what that has to do with setting this criteria because you may not like the way this criteria has been arrived at in a political sense, but in an analytical sense do you have any criticism of it?

DR. COCHRAN: No, that wasn't my issue. My issue was that there ought to be other goals aside from what's in the yellow book. It goes to the issue of how does one implement? What sort of process does one have of implementing what's in

L64

the yellow book and I think those are legitimate goals. I think they address ethical issues. One of those ethical issues is should we be operating in the way we're doing to ram these things down people's throats when they don't want them.

DR. STARR: Well, your discussion of ramming people down their throats, as far as I can tell, the NRC has been a great interference in successful development of nuclear power and a great interference in enhancing public safety. I don't think public safety has been approved one iota by the intervenors or by the NRC, but that's a separate matter. That has to do with the institutional structure and what function and the very issues of who plays the role in it, but completely aside from that, the issue of whether the evaluations of what amount to the basis on which decisions are being made in the present NRC structure -- the issue of whether you have a quantitative objective or not and whether this kind of approach which opened, that is, colleagues have suggested - whether that is a good approach, is, I think, the issue that's being faced now. Your issue is a valid one but completely I think --

DR. COCHRAN: You just want to define the problem --

DR. STARR: No, I just want to say that this is not the place to discuss it.

DR. MACLEAN: I think that this has to be the place to discuss that throughout this report and I don't think you could ever come up with any kind of quantitative or other report

L65

that didn't - that wasn't like this in this respect. You see the word acceptable throughout and at some point it's important to examine what we mean by acceptable. I mean, and he's got to raise the question of when you define a level as acceptable, to you mean acceptable to the public or not?

DR. STARR: All right. I agree with that.

DR. MAC LEAN: I mean, that seems to be --

DR. COCHRAN: To these technographs or to the public?

DR. OKRENT: But I need to understand -- I don't understand what Tom's question is in view of his last comment. I thought he had said that these goals, if in fact, they were met and if he was satisfied by the process by which they were met, might, in fact, be okay, but --

DR. COCHRAN: If the public were satisfied by the process, they might find those goals acceptable.

DR. OKRENT: But I think he earlier said he disagreed, I think it was with Starr, that thecurrent licensing process, in fact, is achieving this and he's also, I guess, not convinced that the current directions make it come closer to this. He's possessing the fact that they're going to speed up licensing in a way that might, in fact, go the other way. If I understand the implication of --

DR. COCHRAN: Well, I'm willing to segregate two issues. One issue is whether, in fact, the process is working in a manner that some group, like the ACRS, some body would

L66

conclude that the goals are indeed to be met. I want to separate that question from the question of whether the public accepts that conclusion and I think Charles here also wants to make that distinguish --

DR. STARR: They are completely different vantage points.

DR. COCHRAN: He says it's irrelevant in terms of what's being asked to this body and to this group whether or not the public accepts these as long as we can find, as long as ACRS or EPRI and the AIF agree, then it's quite proper, but if there's some rag tag folks dancing at TMI that don't accept in, that's irrelevant because they are uninformed.

DR. STARR: Well, that's an extreme way of putting it, but you're on the right track. The analysis and the evaluation of a highly complex technical matter ought to be done by professionals. Now, your issue is a good one. Don't spoil it. Your issue is, and I think you clarified it -- the question of what is publicly acceptable in the sense -- and you define that as acceptable to the public, rather than what someone else thinks what the public ought to accept - that difference - that distinction isn't clearly made and there isn't a good mechanism from your point of view, to determine what the public is willing to accept, versus what, say, a group like the ACRS says this is what the puglic ought to accept.

DR. OKRENT: But again, I want to make sure I

L67

understand the point. My understanding is that one might have a set of goals like this and in fact, both of the industry and in fact, the rag tag people dancing at Three Mile Island, might say "These goals would be okay if we believed they were being met." Now, what -- if I understand what Tom is saying further, --

DR. COCHRAN: So we don't have to argue with the goal issue but the number issue.

DR. OKRENT: Right, but he's not satisfied in the first place, it would be enough for either the commissioners or some designated group to say, "Yes, these goals have been met," if, in fact, the public, whoever that is, and I'm going to ask him in a minute to tell me, how - by what criterion do I decide that the public is satisfied. He says there is a need for some other agreement, if you will and now I'll put the question to you. How does one get them the measure that the public, in fact, also agrees, assuming that in the future there is some set of goals and nine good men look at it and they say, "Yup, this proposed reactor meets the goal." What is the criterion when one decides that the public does it? Does every member of the public have to agree? Does 99%, 95%, 51%? I would assume there would have to be, you know --

DR. COCHRAN: I think you're trying to measure something that's not measurable. I think it's not quantifiable and it's not - it may not even be the real thing you ought to be focusing on.

L68

DR. OKRENT: I think one can make qualitative statements about public acceptance of this technology versus some other system.

DR. STARR: How do you get that sense?

DR. COCHRAN: Well, I think the public finds kite flying to be sort of, not a risky operation even though Ben Franklin may have taken some risks. There are technologies that people have confidence in, the regulatory aspects and so forth. Rather than try and run out and measure that on a Harris poll, we ought to be looking at goals. If measures address in the process and so forth, the institution recommendations so that we will get better public acceptance.

DR. STARR: Well, there were recommendations made to improve the NRC's internal function, but not necessarily to markedly change the ability of the public to communicate. It was just to streamline the operation, which was the word you used before, to make the NRC more effective in what it was doing. Those were the recommendations that came out of the Kennedy commission. They didn't say anywhere that the public wasn't being consulted.

DR. COCHRAN: I don't have the --

DR. STARR: Well, I read the report and they didn't make that point. They made alot of the other points.

DR. COCHRAN: They made points such as the process was -- I don't think they used the word sham, but it wasn't a

L69

fair process.

DR. STARR: I don't know whether they used the- word fair, but they criticized the process.

DR. COCHRAN: That's right. And I think it's a proper goal, qualitative goal if not quantitative, to be addressed by this group to address that issue of how one goes about implementing --

DR. STARR: Yeah, but your answer to Dave was that if the process were satisfactory, you would have no quarrel with the --

DR. COCHRAN: I'm trying to set aside an argument for the moment that we already directed as whether the level in the yellow book is proper, and it raised the issue in that it is also quite proper to set goals on procedure that addressed procedure in an implementation and so forth, that it really go to the heart of public acceptance or whether people think it an undue risk to them by citing a power plant.

DR. STARR: I thought you were talking about public confidence.

DR. MAC LEAN: You're not talking about something separate from what is in here, I mean, you're talking about something that's essential to these. I mean, you've got various numbers and we don't want to dispute these numbers any more, and the dispute of various aspects of them, but you raise the question, are these numbers acceptable? Now, is this an

L70

acceptable level? Now, what do you mean? I mean, there is a problem when you say acceptable to the public. How are you going to decide that, but there's no problem. I mean, let's not raise that question right away. I see acceptable all over here and I don't know what that means. When you ask --now, it seems to me that putting away certain disputes about various minutia at some of the things we were talking about this morning on the quantitative level, it seems that Cochran is saying that perhaps given the right procedures and some qualitative requirements, that these numbers might be acceptable and that this might be an acceptable qualitative goal. Suppose we could all agree on that? What would that mean? I don't think it would mean that then, any time you regulated down to that number you've obtained an acceptable goal. It means only if you've done it in the right way. The right way would have to be determined.

One of the qualitative standards, I would think, one of the things that would count as processing, would be things that would have to include things the putlic could accept and I'm prepared to try to take a stab at defining what was acceptable. I think -- I mean, let me just throw something out for a suggestion. I'm not deeply committed to this because I haven't thought about it hard enough, but it has to be some sort of combination of empirical measure of public acceptance and normative criteria of what we think that a reasonable

L71

informed, rational person ought to accept, and that means that, I think in a very sophisticated technology, you're going to have to rely very heavily on expert opinions and not just go out and promulgate something like this to a nontechnical audience in bits and measure, but there are ways, I think, of achieving this.

DR. STARR: Isn't that the Congressional process?

DR. MACLEAN: Well, I don't know if it's the Congressional -- that's one way to look at it. I mean, that may be one way to talk about it, but in something like this, I mean, you've got a very particular situation here where you've got a number of expert groups and they're divided on certain issues. Now, I would think that any kind of safety standards that would be found okay that the NRC would pass around to EPRI, to the Atomonic Industrial Forum, to the NRDC and Union of Concern scientists, would get approval by all four of those groups, I'd be prepared to say there's a sufficient measure of public acceptability.

DR. PERROW: I just find this whole debate kind of bizzare. I think issues are being confused. I thought you were going to raise the quetion, Tom, of implementation, and now you're talking about public acceptability, presumeably the numbers, but I thought that public -- how is the public going to get involved in acceptability implementation or do it in a way that the public would accept. I think there's a much more

L72

serious, serious, issue here. Look at -- we have Kennedy Commission, we got all those warnings, all those things in the industries. Looking at the accident statistics doesn't seem to make a damn bit of difference on the industry. They're still doing the same things. You're going to put in new regulations here and set up these chapters and nothing's going to happen. That's what I think is the important thing. Do these things mean anything? How is that going to change one width the behavior of any utility, any operator, any of those things sitting out there? That's what I would like to know and I think the issue of whether the public gets involved in this is really beside the point right now. It's whether anybody gets involved in it.

DR. STARR: Well, the industry has responded and they have maintained that both collasal organizations - they don't do it overnight but there are alot of substantial things in both organizations. The effort to set up this particular exercise is one of the evidences of that. Now, we may not like it and from my point of view, the NRC has only- done a fraction of whatothers do, but it isn't that they're not moving, and these things do have an effect. It's just that they move very slowly and they don't move in composite ways the way the town would like to see, or I would like to see for different reasons. Both the industry and the NRC are relatively inofficially organized to respond, and they'll gradually shift as time goes

L73

on and they're doing it. I'm not going to give you alot of instances, but within the utilities, for example, as a result of the TMI thing and the pressure to reorganize almost every nuclear utility and set up a nuclear division instead of rolling into their possible plant division. They've recognized that this is a special problem. That was victory number one. The NRC, I think, messed up its response, but it responded to alot of things. It stopped the license involved and it put people on TMI and then it put people on something else, and so forth, so it's been trying to respond. It isn't that they don't have an effect. Whether the efficiency of the response of direction is a good one, that's a different question. I would agree with you that there have been alot of imperfections in both, but I don't think it's a wasted effort. Let me put it that way.

DR. PERROW: All right, but what's going to happen with this? What impact is this going to have?

DR. OKRENT: If you want to talk about impact, I'll let you --

DR. STARR: This would have a real impact inside the NRC and inside the industry and being that it would have to be, even though somebody might not like it, a professional review group like the ACRS Supreme Court of a technical nature, which would have to believe that based upon the foreseeable technical sequences which might occur as a result of various events, that

L74

the plants design have a plausible probability of meeting this target and --

DR. PERROW: I'm not impressed.

DR. STARR: You may not be impressed, but I'm impressed because that's never been done before to that degree. It begins now to rationalize the design and engineering decision making that affects both design and machines. The two elements of your three-element picture. Now, that kind of organized analytical structure doesn't exist and this would create it, and I think it would have a very big effect inside the defenders and inside the utilities -- inside as to what's important and what isn't, and to the decision-making process, to which the ACRS plays a significant role.

DR. PERROW: What's going to happen to Indian Point? Nothing. Is this only for new plants?

DR. STARR: Well, are you asking me what I would do if I were running the - if I were dictator of NRC? I don't know what the NRC's going to do.

MR. O'DONNELL: This should be applying to Indian Point, sure.

DR. PERROW: Okay, now, what's going to happen to Indian Point?

DR. STARR: How do I know.

MR. O'DONNELL: Well, right now Indian Point is going through and doing a big risk study to hopefully access the level

L75

of risk posed by those units on that site. Now, this is going to be now submitted to the NRC and the ACRS, I'm sure, is going to get a chance to review it and they're all going to be looking at all these numbers and this risk assessment and somehow are going to be expected to make some judgements as to whether or not that's good enough.

DR. COCHRAN: If it has an effect, at least it would be indirect if we believe the statement that this is only applicable in tight water reactors and may be more stringent than these existing plants.

MR. O'DONNELL: That's what this says and that may be very well what the NRP does, but you know, the use of risk assessment techniques and safety goals to me is a mechanism for rationalizing and improving upon the way we do things now and in putting the attention on the things that are really important from --

DR. COCHRAN: Would you include process in that?

MR. O'DONNELL: Well, you know,the deterministic requirements are such that you look at things that everybody thought was the worse case, the double ended break of the largest pipe in the cooling system. There's an area of design in analysis that the industry has spent a great deal of time and effort on.

DR. COCHRAN: Three Mile Island was not from that kind of accident. It was a valve that stuck open and created

L76

in effect, a two inch break. The reason that people didn't concentrate on those things was because the deterministic requirements were geared towards this other event and it was pointed out by the Kennedy Commission and the Regovin Commission that the Rasmussen Study, in effect, indicated that these smaller type breaks were bigger contributors, so if these techniques can be used to really focus in on the things that really appear to be more likely and greater contributors for risk. I think that is the rational way to use it.

MR. O'DONNELL: What's the basis for your assumption that that's a greater contribution to risk than simply to overall behavior of the NRC as an institution which grew out of an AEC that was promoting the technology and --

DR. COCHRAN: I'm talking about -- I'm trying to graps it from the design standpoint. How do you get a Federal design?

DR. STARR: They even fool around with other people's lives, I'm sure. To finish Indian Point, I would agree with Ed that this process ought to be brought to a point and if the numbers come out radically different in terms of probability distributions and therefore effects -- then I think the NRC is faced with a policy decision, which involves other factors than just this alone, and it might very well be that if the analysis indicates that the NRC -- what this process makes visible is the probable sequence of events which might lead to

L77

accidents and if Indian Point then comes out badly in a case like this, the NRC might decide to take whatever's appropriate action to shut it down or whatever.

If it turns out that it approaches this answer and special operating characteristics are -- increase staffing like bringing it into this range, they might decide to set special requirements on operation. The grandfathering of something like this does not mean that you should not go through the process for all the plants.

DR. PERROW: I must be extremely dense, but I do not see how either Shoreham or Indian Point - how you take this and operate with this. This sets an overall goal that says we should have an overall thing like this. It doesn't tell me anything about what anybody is going to say about backup systems, emergency systems. Should we have three emergency or four of them?

DR. STARR: On new or existing designs?

DR. PERROW: On new or on existing. It doesn't -- I find this so abstract.

DR. STARR: It's not abstract to me. There's another whole technical piece that goes with this here and that's a probablistic risk analysis, which is a highly technical thing that uses as best as you can, engineering data -- engineering judgements. It goes through all of the analysis to sort of try to figure out what the risks are on the things that we know

L78

might fail and that ends up with a kind of a guiding number that says based on this particular design configuration, there's a certain probability of certain events happening. That, then, gets compared with the target. This just sets a target and that process is a very revealing process. It tells you a hell of a lot more about what's going on in a plant, where it's weak points are and what you ought to do to remove the weak points.

DR. PERROW: That isn't what I understand about it. That kind of an analysis has enormous problems with it. We have a long ways to go before we can get any --

MR. O'DONNELL: I think that's why we're saying you shouldn't throw out what we've got - an institute that's in its place. I keep coming back to this as a means of improving what we have, not replacing what we have.

DR. LA PORTE: Let me ask a question in a different way. From you guys in the industry, what would you find -- sort of take yourselves out of your official position for just a minute and just as persons knowing about this, what would you say are the four things that would really impress you with industry's response to cleaning up its act. What would really impress you? At the outer reaches of what's possible, what makes you think, now that's what should be happening?

DR. STARR: Well, now, I was responsible for laying out the industry's plans and we got into actions and some of the things I had recommended, but not all of them. The Nuclear

L79

Safety Analysis Center, which we set up which works very closely with the NRC's staff, was something that was an attempt to cure the feedback of experience which had become very sluggish. The learning process in actualoperations had become sort of constipated.

DR. LA PORTE: Okay, that's one.

DR. STARR: And so we set up a system that works very closely with the NRC staff which now gives almost minute to minute information to everybody in the industry, not only of what's happening, but what you do about it, so we've shortened down to matters of hours and days the operational technical response time to new information.

The other thing was the fact that we felt that there was a great disparity in the quality of operation and the quality of personnel in the operating side and the kind of stuff that has been written about and talked about and I think is right on track and we set up an institution which has yet to sort of cut its teeth, in its early stages. That's the Institute of Nuclear Power Operations which is all supported by the industry and which has been trying to set up for uniform views on a management basis of a hierarch inside each operating facility to set up criteria for the operators, for the technical staff and so on and to try to improve the quality and understanding of safety and reliability in the operations. That's to raise the quality of the operations at all nuclear

L30

stations to that of the best of the stations and that's just beginning to operate.

There's a third thing that we tried to get and that's the item of standardization and that one we still are having grave difficulty in and that's because it involves the vendors and the industry and the great tradition of individualism by the vendors in the industry so that the - what the NRC is faced with is with new designs all the time and always cite specific so that they have an endless chain of small problems, all of which have a big effect. We think that has to be cured eventually. We have not solved that problem.

The other thing that I felt very strongly about, the Kennedy Commission recommended over and over agin, was the fact that I think the whole objective of the NRC is philosophically wrong. It works on the basis of policing rather than the basis of removing the problem and it's like the police force versus the crime problem. I don't think that putting people in jail and fining them is any way to get safe operation. I think what you have to have is an agency that works cooperatively with the industry to improve the safety of designs and the safety of operations. That philosophy doesn't exist so what you have is an adversary system rather than a cooperative system, and I have to tell you, that hasn't happened.

DR. COCHRAN: Time is precious. Now, I'm willing to stipulate that you've done alot of things and you're improving

L81

safety, and I don't think we have to waste alot of time going through those. I'm willing to stipulate that and move on to something else. Now, you've taken care of some problems that address utility confidence. They address safety problems directly, but there are other problems.

Let's take intervenor finding so that intervenors would have confidence in the process, so that -- I wish I could cite it, but I can't -- these statements by commissioners and intervenors are very helpful in identifying problems and so forth. Now, there's another -- could be a goal to improve the safety of the plants. It could be a safety goal and it could insure confidence in the process and so forth and could we get agreement or do we have disagreement on whether that is a proper goal or of whether goals of that nature -- not intervenor findings but goals that address process or appropriate to add to these strict, numerical numbers of the types of David's generation.

DR. STARR: I would agree, Tom, that a self appointed technical elite should not have 100% control of all decisions and I recognize that there can be merit in having professionals outside of, say, the routine functionof groups playing a role in reviewing and commenting and critiquing and trying to improve the basis for decision making, so I don't object to eithr the concept of outside critical reviewing, which you call intervenors -- I hate that word, but I don't object to outside

L32

critical review. I do object to outside critical review on a self -- on a completely random basis, where regardless of degree of knowledge or expertise, an individual decides that he's going to come in and play a role and it's the randomness of the intervention that we have now which I --

DR. COCHRAN: Let's talk about how we can set up or recommend a goal.

DR. STARR: Well, I've answered your question.

DR. COCHRAN: Let's recommend a goal that resolves your randomness process which still permits technically competent people to represent public concerns and --

DR. STARR: We have a precedent, Tom, and the National Academy is bemused by Congress as a kind of critiquing group.

DR. COCHRAN: That's just like the ACRS.

DR. STARR: But the Congress at least goes to a third body for critiquing. Certainly any mechanism for us getting a professional quality group outside of the industry itself to review critical items, I wouldn't object to at all.

DR. OKRENT: Actually, Tom, you're I think, not correct when you say the National Academy appoints its own members because when they appoint panels, in fact, most of the members of the panels are from outside of the Academy and they're not even members of the committees forming the panels.

DR. COCHRAN: In some cases that's even worse.

DR. OKRENT: Well, I was merely correcting a

L83

statement of fact. I'd like to get to your major point. We did not ignore it in this document and we did not ignore it in our thinking and if you would turn to page 74, you didn't give it alot of space and it's there and this is probably the time to point that out. If you look at the second paragraph, on page 74, it says -- three lines instead of one word -- it says, "It is proposed that the NRC has the responsibility for evaluating methodologies and results provided by the reactor owner and also to arrange for a third party review of the probablistic risk assessment." Now, our thinking was, in fact, that there was some kind of a need,not only for the reasons that you've raised, but for the reasons that I have mentioned, that, in fact, I don't think this is the kind of thing where there is only one answer. It's not only -- even if people have absolutely no bias, they'll not get the same answer, and the people will come in with biases, so it was our feeling, in fact, that for multiple reasons, including the one that you've mentioned, and I've had that one in mind in proposing it, that there was, in fact both a merit and a need for a third party review and it says, in fact, that this risk certification panel when then acted, would have the benefit of this third party review before they acted.

DR. COCHREN: Well, why didn't you propose the license codes so that people could interven -- the people who have sort of been left out on this appointment process, which is going to

L34

be, if it's like others, the politics would be such that biases seeped in and you don't have a process where an outsider could feel like he got a fair shot at --

DR. OKRENT: Well, let me give you an opinion. I think, in fact, partly, in fact, to give the additional public confidence, I would have this certification panel presidential appointees. In other words --

DR. COCHRAN: Do you mean like Babitt and Lewis and --

DR. OKRENT: Well, they could equally well be --

DR. STARR: John Deutsch and something like that?

DR. OKRENT: No, but they could be Cochran and --

DR. STARR: But they wouldn't be.

DR. COCHRAN: There's more than one pro nuclear, now, come on.

DR. OKRENT: Now, just a minute. I don't know of any way of getting representative people appointed to do jobs like that that's better than the way the Supreme Court is picked. Now, if you know a better way, you'll have to tell me what it is. Now, at the moment, as far as I'm concerned, the present practice for taking Supreme Court justices is as good a way - - not that I agree with all nuclear decisions, nor am I happy about all the people that have been appointed, but it's not clear to me that if you took that one away, what would take its place would be better. It seems to me that the President, in fact, is elected by the people. The Congress is

L35

elected by the people and there is a process here.

MR. O'DONNELL: I have problems with this risk sort of thing.

DR. OKRENT: Yeah. I didn't think he'd like it.

MR. O'DONNELL: I would say that if risk assessment were the only thing you had and you're going to make your decision solely on the basis of that, this thing might be a good idea, but I keep getting back to the idea that we have the whole body of regulations in existing requirements that we must meet and it does require us to do very sophisticated calculations and seismic design and analysis which we don't submit to a seismic analysis certification panel. I mean, these things are reviewed --

DR. OKRENT: It would all, in fact, enter into the judgement of this group. If you would have done seismic analysis, this third party would have looked at seismic analysis, and if they thought there were weaknesses for one reason or another, their information would reflect this.

MR. O'DONNELL: Well, we have a Nuclear Regulatory Commission who's charged into the law with making those reviews and those decisions and you're proposing that we have another regulatory group.

DR. OKRENT: No, it's not a regulatory group. Again, --

DR. LA PORTE: It's like a science court only --

DR. OKRENT: I originally had the terms like science

L35

court but that's very controversial. and people who are supposed to be very well thought of have their reputations on the line. They may not commit suicide, but --

DR. STARR: On this point, Tom, you said something a moment ago, which I think characterizes the problem. You said look at those people on the Babbitt Committee. They're pro nuclear. That's just my point. Anybody who works in this area and has this job has to be pro nuclear because the function of this is not to decide whether nuclear power goes ahead or not. It goes to decide the level of safety .

DR. COCHRAN: The Kennedy Commission,if I'm paraphrasing and remember another statement that was made, says you're not going to get nuclear safety until the attitudes of the regulators changes and I don't see any goal in here that would insure the absolute of the nuclear regulators changes.

DR. STARR: I talked with Kennedy about this. What he talked about was waht I said before. He wanted an NRC that was interested in safety rather than in regulation and that the but anybody on the NRC who goes on, has a responsibility to get nuclear power moving safely. It isn't his responsibility to stop nuclear power.

DR. COCHRAN: He doesn't have a responsibility to get nuclear power moving safely. He has the responsibility to insure that nuclear power is not amenicable to the common defense and security or an undue risk in the health and safety

L36

of the public. It says nothing about moving swiftly or safely. In fact, the Commission, right now, is acting to get nuclear power moving to get on with the licensing and is not moving to insure undue risks of the health and safety of the public. I think we ought to look to goals which solve the other part of that problem.

DR. MAC LEAN: There really is something amiss here. Chauncey has said both that acceptables should be determined by the experts and that those who regulate should not be confrontational with the industry. They should be working together with the industry to promote common goals, and thirdly that you can't have anybody that's anti nuclear playing an important part in --

DR. STARR: That a person who has a philosophical desire to stop nuclear power, should not be given a job of essentially establishing a level of safety.

DR. MACLEAN: I think that if this is how we understand the process involved in establishing and impelenting these goals, then we ought to be explicit about it, at least to the extent of calling them things that are neutral with regard to public acceptance - calling them triggering goals -- you know, goals that will trigger licensing or something like that, but there's constantly misleading statements and it starts out on the first page when we talk about costs to society arising from conflict over accepting technological risks and it really

L87

suggests, on the first page of this, and in some of your articles, which I enjoyed very much, that when we talk about acceptance, we're talking about something about society coming to terms with technological risk and acceptingthem, but it turns out, as we explore the details of this, that we want to move society out of it and move it over to the experts, and I think we ought to get rid of the words acceptance and other things. and --

DR. STARR: I think you're absolutely right and I think that this is a semantic confusion in the way these things are --

DR. LA PORTE: I don't think it's confusion at all. I think it's a preference in terms of the relationship between the experts and the public. It's not a confusion. It's very, very, straightforward.

DR. STARR: But it's not clear. When I have used the term public acceptance, and in this document, what's meant here is what we, as experts from our point of view, think the public ought to accept. That is different than what the public wants to accept and I thought that was the point that Tom was making before.

DR. LA PORTE: The combination of what you just said and what you said about who should be on the Nuclear Regulator Commission - you put those two together and anybody who is an observer who wonders about the public credibility or

L88

the credibility of public bodies, with regard to monitoring the behavior of a particularly risky industry, there's no way on earth that anyone who listens to that hould thi-nk that the NRC is anything more than a promoter and should be trustful or trustworthy of being able to say no to the industry if, in fact, they have a real question about the -- it's just -- it runs exactly away from the problem we've got now of an enormously distrustful group of observers of which Tom is one and all those people who are very articulate and smart, are very about what they are seeing and what I am hearing from you is that the industry is behaving in all sorts of ways which would say, we're going to get our act together so that we can continue to do what we've been doing and it's not revealing, essentially, the kinds of uncertainties that you all know exist and I feel, if the goals for safety -- one of the goals for safety and operationof nuclear power plants ought to be increasing the confidence of the public in the industry and in the regulatroy process itself. We're paying enormous costs for this stuff.

DR. STARR: You know, you're making a point and I don't disagree with the point, but you're interpreting what I had said against that point and I have not addressed thatpoint. I said it yesterday and I've said it today several times that we have not addressed in any of these things, the problem of how you establish public confidance or how you communicate with

L39

the public or how the public communicates back to the industry. We haven't discussed that at all.

DR. LA PORTE: I just did.

DR. STARR: I know. All I'm saying is what we've been talking about, or I've been talking about, has left that out, and I agree I've left that out, but there's something else that I want to point out. You would not consider putting at the head of the Federal Drug Administration, somebody who's philosophy was that no drug should be used for any medical purposes and there are such people and you say, well, that's ridiculous, that's assinine because the job of the Federal Drug Administration is to see that the drugs that are issued are safe for the public. The fact that the guy who heads it believes in the use of drugs doesn't mean that the public can't have confidence on his judgement on the safety.

DR. PERROW: I believe the administration was doing that right and left.

DR. COCHRAN: Well, Chauncey, will you support a goal of intervenor funding if the Licensing Board makes a decision of whether the funding is merited?

DR. STARR: No. I'd have to have a much greater definition of who the people are that are going to be funded.

DR. COCHRAN: That would be determined by the Licensing Board after the hearing, whether or not they contributed --

L90

DR. STARR: I'd have to know alot more about it, but I wouldn't object to an outside body of professionals not directly related to the industry as such in terms of either the people who had done the proper work --

DR. COCHRAN: Why would you have to have more information than to have some feeling of a general nature of whether a licensing board could make a reasonable determination of whether the funding is justified or whether they made a --

DR. STARR: I'd have to know who that funding goes to, that's all.

DR. COCHRAN: It goes to the participant in the licensing --

DR. STARR: Look, I said what I believe in and now you're asking the question of how do you choose and how the third party grew, and I'd have to know alot more about the optional ways of doing that and how this would work and --

DR. OKRENT: Tom, I guess it's not clear to me that the narrow issue of intervenor funding is one that this panel has to focus on. I think we ought to move away from it.

DR. COCHRAN: Look, we've addressed 16 of your bonafied goals and --

DR. OKRENT: No, all I'm saying is that you're discussing process, but I think you're trying to --

DR. COCHRAN: I'm trying to pick some examples.

DR. OKRENT: But there are many different aspects of

L91

process and I think this is an oar that you're trying to row or something.

DR. PERROW: Give us an example. It's a concrete example of a basic problem.

DR. COCHRAN: Scratching for examples. I mean, if that is one, I'll take one of yours.

DR. OKRENT: If that is the only example that you have --

DR. COCHRAN: All right, the selection of the ACRS membership. Right now ACR's members are, for all practical purposes, chosen by the standing body and in fact, there has been alot of criticism of that. You get no, through the historical precedence, you get no people like from MHB or Bob Pollard on the ACRS --

MR. O'DONNELL: You also get no industry people.

DR. OKRENT: I consider myself, by the way, as much a member of the public as you consider yourself.

DR. COCHREN: I'll stipulate to that.

DR. OKRENT: In fact, I find myself as much ostrasized by th-e industry, but I think there is a question of who is the public and how is the public represented. Again, I tried to indicate that, in fact, I think process is important and in this particular document we tried to pose something specific that we thought w ould help assuming down the road that they were going to go this way. I'm not trying to say that

L92

process is unimportant and in fact that there is a need for the public to be confident and in fact, the regulators are doing what they said they were trying to do.

DR. COCHRAN: Do you agree that we should look for at least qualitative goals that address process as part of this --

DR. OKRENT: I'm supporting the general discussion of the area. I'm trying not to go --

DR. PERROW: No, that's the one that ended because you didn't like the example of funding.

DR. COCHRAN: I want to find out whether you agree with the issues.

DR. OKRENT: I think it is important that there be a process, wheth-er it be for this or whatever other way it is done, that, in fact, provides some suitable degree of confidence. I am unable to define whether that means a 40% or 20% or 5% of the people who --

CHAIRMAN SLOVIC: Would that be part of the offer?

DR. OKRENT: No.

DR. LA PORTE: It's not usually talked about in terms of percents of persons and let me say what I think Tom means, at least in part, and that is that in the case of the -- the word process is now being used in terms of the sequence of events to which outsiders can come and with the kind of time and resources and availability of background documents that were used by the two, to feel that he had, as he put it, a fair shot

L93

in understanding what the intellectual, analytical basis for decisions or whatever of the proposals had been so he could comment on them and that's one of the problems that outsiders have had is that they don't have resources to spend the kind of time anything like the sort of time that the persons who's developed analysis have had and they can pay for it and they're there for the job. Am I talking about some of the things that you're referring to?

DR. COCHRAN: Well, the Commission is proposing to the Congress that in some circumstances in the licensing review that discovery not be allowed and staffed by an outside party. It seems to me that undermines people, undermines public participation and so forth and undermines the credibility, "acceptability", whatever -- I think a goal should be - a safety goal should be the reverse. That political process that's going on right now on the hill -- tell the Commission that they're headed in the wrong direction.

DR. STARR: Well, Tom, first, you know when a government agency gives the National Academy or any equivalent body a task of appointing a committee to keep doing third party review, it funds that, so in fact, the principle of having funds for outside review is not new. That's an old principle. There is a prescedent for paying outside people for critical review.

DR. COCHRAN: Well, the NRC has consultants.

DR. STARR: So the issue really is who the outside

L94

people are and how they're selected and I think that's putting a blanket on it of saying that anyone who wants to call himself an intervenor gets funded is too wide a scope.

DR. COCHRAN: I didn't say that. I said if you allowed the licensed employees --

DR. STARR: And I said I'd have to know more about the mechanism -- let's go back to the matter of discovery. What are the complaints of the NRC that its staff is badgered to hell. It's harassed by having to answer questions from the outside, all of which require time and energy and everything else and there's an harassment issue, and the question is how do you put a bound on this?

DR. COCHRAN: You have a Licensing Board and if it's harassment and the discovery process, the council for the NRC can go to the Licensing Board and object to the questions as being irrelevant and the Licensing Board, if it agrees with the account with the staff that they're not relevant, they'll be thrown out. If the Licensing Board believes the questions are relevant, they'd have to be answered. I mean, it's like any other legal proceeding where you have some --

DR. PERROW: You don't handle the problem by not allowing the discovery.

DR. STARR: Yeah, I'm not running the NRC and I didn't make the NRC regulations and all I'm saying is that before you sound righteous on one side, you have to recognize

L95

the problem on the other.

DR. PERROW: That's clear, but it's pretty extreme remedy, and given the pressure for licensing --

DR. STARR: I think the NRC will have to answer for itself on those matters.

DR. PERROW: Well, the question is whether that beongs in here.

DR. LA PORTE: It doesn't belong in the yellow book. That's not what the yellow book is for but it might belong in something for safety proceedings.

DR. OKRENT: But what is the -- what is it, now, that is being suggested because -- in other words, as I've indicated, I think in fact there is merit to trying to provide a process that not only, in fact, will have the potential for enhancing safety but in fact will have the potential for giving the public a better basis for judging, if you will, whether the particular commission is doing their job the way they said they were. My simplistic, perhaps, approach in regard to this is to say that there be a third party independent review in this case. In my opinion, in fact, it is practical to constitute such a group which, in fact, includes people needed from the NRC or from the industry --

DR. COCHRAN: You have that already.

DR. OKRENT: No, I'm sorry. The ACRS does not do the kind of peer review that this is talking about and in fact

L96

there exists somewhat similar things to this, in fact, in Germany they have something called the TUV or there's a group of experts who are paid - they're sort of government employees but for all their services the companies and utilities, or whatever it is, are being affected and audited and so they supply the money to cover the cost of the government, as it were and it's their responsibility, let's say -- if it's welding that you're worried about, to be satisfied that the welding was done adequately. This doesn't let the owner off the hook from having his own quality assurance role, but they have a third party - an independent -- and these guys are looked upon usually the way somebody was describing these building guys that they wanted to audit the various groups to find -- I mean, in other words, in principle, they're supposed to be somewhat mean.

DR. LA PORTE: Well, one of the ways of putting it - I'm not sure of the language here, but one of the ways of putting it would be -- one of the goals in the development of safety programs should be to provide a process or have a process which provides access to responsible intervenors with -- through the medium of, and you give some examples. In discovery and adequate time to review background documents and resources to do so and if you wanted to put in another example -- take Tom's notion -- I really don't understand it but it seems, from the base of its principle to have those persons who would

L97

receive some resources, could this be approved by the License Agent Board and -- or something of an equivalent sort. Now, I don't know whether that -- I don't know enough about NRC's proceedings to know whether that's unusual for what they do now or not. You've given us to udnerstand that it's not the case now and it's hard to get the sense that you have a -- you and others who are technically competent to get a sense that they really have a chance to get themselves heard in a serious way.

DR. COCHRAN: It's a little more complicated. There is a process which anybody can -- I think that's a party to licensing proceeding to participate in that, and the question is, is that fair? Is the staff really operating as an agent for the licensee at the time of the hearing or is the staff acting as an agent in the "public interest". Is the -- does ACRS which has a quasi judicial role in the licensing process - is it what might be required under the Federal Advisory Committee Act reasonably representative of the interests involved or sort of heavily weighted and the process is fairly complicated and there's lots of room for the Commission through its power over the process to really bias it, and I'm not familiar with the other agencies, but I'm sure that that's probably -- There are all kinds of issues like that and proposals to change the laws and the Atomic Energy Act and "streamline-" the process which might be --

L98

DR. LA PORTE: Tom, let me ask you a different way. I'm sympathetic in sort of a general way, to your - to what you're describing, not so much with NRC but the way the relationships are of the public interest groups and government bodies which are closely tied to industry, but besides a statement that would come from a group like this or some other group that simply says open up the system so that more people can participate in a more meaningful fashion, which I suspect that the people who were there knew that's what they were doing more or less -- what can you say to give more detail about? I mean, you've tried it with regard to the licensing -- you know, providing sources for outsiders which is a matter of some controversy but it may very well occur beside that.

DR. COCHRAN: I think you have to have a process whereby parties in the process feel that regardless of whether they won or lost on the issue, they had a fair shot.

DR. LA PORTE: Well, what do you mean by process?

DR. COCHRAN: Well, in this case it's a question of are these quantitative goals.

DR. LA PORTE: By process do you mean a set of what? What do you have in your head when you say that?

DR. PERROW: Do you want a forum?

DR. COCHRAN: No. I'm talking -- well, I mean there's a whole series of things. I mean there's the procedures in about which an individual or individuals participate in the

L99

licensing process.

DR. LA PORTE: Licensing here.

DR. COCHRAN: In licensing here. Is the staff, because if you look at historically how appointments are made to senior staff level --

DR. LA PORTE: That's not processing. That's the quality of personnel involved.

DR. PAGE: Well, appointments are certainly part of the process.

DR. LA PORTE: Well, are you talking about how the staff gets appointed then?

DR. COCHRAN: Yes. Do they all get appointed or 93 or 90% of them coming from the nuclear industry and therefore saw the staff has this sort of built-in bias to sort of get the thing licensed rather than to look after the interest.

DR. LA PORTE: Well, you're talking about alot more than just a formal process.

DR. COCHRAN: Do the whistle blowers get shoved out the door or put on --

DR. STARR: What Tom is describing are the generic problems of any large judgemental body. In other words, the judicial system or regulatory agency for the NRC -- they exist in all of them in various degrees and Tom's unhappy with the NRC for his reasons. I'm unhappy for a different set of reasons, but there's -- this is a complicated issue of how you

you establish a balance --

DR. COCHRAN: This stuff is complicated too, but that doesn't mean we shouldn't --

DR. STARR: No, but I think it's almost a separate subject. I thought your key point and the point that was raised before was that you can't just treat this in the absence of recognizing the structure under which this goes and I think that the form has been made and I agree, but this document doesn't treat with the structure.

DR. COCHRAN: That is a separate form and that is this entire two days, so far, of activity in these three buildings, as acted as if safety goals means should we or shouldn't we adopt something like this and should we juggle the numbers around a little bit and the other issue I have is no safety goels doesn't mean just that. It means much more.

DR. LA PORTE: I think I find myself as slightly bemused by Tom's coming back at this, as the rest of you because I don't understand the situation very well, but I think that what he's saying and the kinds of responses that the NRC and the government and industry - particularly industry's attitudes towards legitimating his concerns that my response is that the industry doesn't legitimate those concerns and they respond -- you two have responded that way, both in your words and in your -- in the looks on your faces. These are irritants that are legitimate in terms of the ways between NRC industry

L101

and the public in contact. As long as that persists, you're going to have a degree of mistrust justified, I think, by the kind of response that the persons who are wanting in and feel affected will have, and as- long as that mistrust remains, you're going to have conflict of a sort from here to -- it's going to seem to be obstructionist and it will be in lots of ways almost because it has to be.

MR. O'DONNELL: You're misreading my face, whatever my face was saying.

MR. LA PORTE: Well, I'd like very much to believe that.

MR. O'DONNELL: These concerns that Tom is raising, are in my opinion, legitimate concerns and ones that should be discussed and the questions of intervenor funding and how staff is selected and things like that are very legitimate concerns. It doesn't necessarily mean that I agree with giving money to intervenors, but I think, again, the problem is we're somehow thinking that this document and the safety goal is going to be the answer to everything. It's not. It's a part of the total picture.

MR. LA PORTE: Well, that side steps the issue here.

MR. O'DONNELL: I think we have to side step the issue here. I don't think we can deal with this -- the subject of process and funding of intervenors, I think, is a subject for some other forum.

L102

DR. LA PORTE: Why?

MR. O'DONNELL: Because I don't think we can deal with that.

DR. LA PORTE: What's the goal of this form?

MR. O'DONNELL: My understanding of the goal of this form was to come to grips with the question of quantitative safety

DR. PAGE: I think you can't find a better form than this one. We're tlaking about, not only how you set numerical goal but also how do you work to promote the liklihood of its achievement and that means that you have to worry about the process and how the process works.

MR. O'DONNELL: I'm perfectly willing to sit here and discuss tgese things. I just didn't think that was --

CHAIRMAN SLOVIC: My understanding is that this is a very legitimate issue.

DR. STARR: This is the structure of th-e NRC and how --

DR. MACLEAN: This whole workshop is not entitled toward a quantitative safety goal. It was entitled toward a safety goal and the three panels run quantitative, aualitative, and this is the economic, ethical and social, political issues so I really do think that these are the questions that we have to address.

DR. PERROW: I think I may have misled by this

L103

is what you know, for good or bad, is what we have as an example and it's likely to come out.

This is exactly what I would predict would come out and this is what worries me, so we're dealing with that.

DR. MAC LEAN: Right, and we've dealt for a long time with alot of the sort of internal workings of this and I don't think that was exactly what this panel is going to do, but I'm glad we did it because I've learned alot, but I think our fundamental responsibility here is to ask, so what do we make of something like this supposing we can agree on all of the numbers, and how does this fit in towards achieving a safety goal.

Now, I think that, I mean, if I can go back to acceptance a little bit, I mean, I want to say a few things about accepting risks. I mean, all of these things work from the assumption in sophisticated modern technologies, we can't have them without risks. We also know that alot of these technologies have to be implemanted as a result of centralized decision making, so what you have is you've got some centralized body making decisions that are imposing risks on other people and the fundamental ethical question is when is it justified to do that - to impose any risk at all, and then we can debate what level of risk is okay for certain justified procedures, and we have a pretty good answer in cases where the decisions don't have to be made in a centralized way.

L104

When a decision doesn't have to be made in a centralized way, say, a doctor is going to do something to imposes a very small risk with no risk on a patient, he has to get the prior consent of that patient.

One of the problems with decisions that have to be made in centralized ways is that you can't get the consent that way. You can't go around and ask everybody if they accept the standard and have them say yes. If you could, that's what you shoud do. Now, if you can't do that, what do you do? Well there are other notions of consent and I wouldn't want to give up this idea that consent, rather than something else, is what we need to appeal. Where you can't get consent of one level of risk is alright or not, then the way that philosophers usually appeal to when talking about it in establishing social and political institutions, is you agree to some sort of consent on the procedures that will be established and now, that's exactly wnere I think we are here and the question of what procedures -- that really raises the issue of where, in the process, are we going to bring in the experts and the expert opinion making and rely on the expert judgements. Th-at's something that I think the general public has to agree to. We all know that we can't do without expert judgements here and the question has to be what's the role of them,wherever they're going to fit in.

Now, it seems to me that sociologically it's absurd to

L105

think that you can sort of snowball over the public opposition in nuclear power, and especially the expert opposition to nuclear power and come up with anything that can make any kind of plausible claim to be socially acceptable, so one of the things in determining the processes, is to try to establish -- by the way, we're dealing with an adversary siatuation here and that's just a fact of the game and unless we recognize it and try to build in a way that responsible opposition and make a case, I don't see how you're ever going to get this technology socially acceptable.

I also think that it would be very easy to achieve some sort of social concensus and some sort of degree of social acceptability because it would be very easy to get opposing groups to work together, but that rests on the assumption that people who raised opposition to the way certain things have operated in nuclear power were not all intent on shoving down or opposing the way certain things are happening. You may not agree with that. I don't know enough about it.

MR. ERNST: I think we've started to get back to from the -- the verification that I made is extremely important and I would appreciate the focusing on that particular problem. What you're going to have, like Indian Point, you're going to have 3,000 pages or something or a very complex analysis, which is strongly dependent on assumptions and perceptions of how plants work and assumptions on economo failures and things of

L106

that sort. What I'm saying is that there's going to be a large band of uncertainty that has to be addressed and I do agree, I think, that the public, whatever that means, has to have some understanding of what's going on in this process. The science court idea, I think is a good one for the technical expertise side, but there has to be some mechanism, I think -- a credibility of that court, that speaks to the public and also speaks to me as the person responsible for making the staff evaluation, because it is complex. It's not something that is easy to understand, but more importantly, I think, several times I've gotten the sense that the group is not addressing full on the question that I think EI's hit several times, and that is the role of this so-called quantitative approach as compared to the role of the past practices of the NRC, and I would appreciate it if the panel would express some judgement. I think there's a consensus, but I'm not exactly sure just whether or not this risk approach,quantitative, is supposed to supplant, supplement, or what. What is the role?

DR. COCHRAN: We're all in consensus that it would supplement it.

DR. OKRENT: Well, the word supplement is an ill defined word in itself. You may get everyone around here to agree with that, but if they had to write what this meant, it would look different. Let me just breath a word of caution in that regard.

L107

DR. COCHRAN: And I would add, under some procedures, it's irrelevant.

DR. STARR: Can we come back to this question of the process just for a moment? I'd like to comment on the presentation we made because I agree with it completely. I have to tell you that in the history of the business, however, when the AEC had the so-called licensing operating within its own contract, all these issues that you have just now raised were raised as a criticism of the fact that the AEC had in both promotional and licensing responsibilities and therefore was biased in its decisions, and a group was set out separately called the Nuclear Regulatory Commission to -- and by the consent of whatever process we had, which is a congressional action, a procedure was set up. An institution was set up to make those decisions on the public's behalf. Now, what's happening is that there's a group of people who don't like the decisions and who --

DR. LA PORTE: Well, now wait a minute.

DR. STARR: Let me finish my comment and then you can say anything you want about it. What actually happened was that there was a group of people that didn't like the decision and my belief is that the inherent distrust that these people had of the nuclear power, per se, motivated them to try to intervene in the process which the NRC had established, and they did this by pulling the NRC into the Federal courts, and getting

L108

the Federal courts, not Congress, to interpret what the NRC's actions should be -- what its process should be, and they took it out of the mechanism of the Congress and put in into the Federal court and posed a series of its procedures on the NRC and the NRC has now - and that's been followed through. Tom is smiling because he knows that's what happened, and in fact, the NRC now - its administrative procedures and policies have been heavily interweaved with those imposed upon it by legal interpretations of the Federal process.

Now, I think the process has gotten messed up and ought to be cleaned up for alot of reasons. I don't disagree with the objectives. I just want to point out that what you're saying is correct, but not new. That's exactly what Congress tried to do. It just hasn't been effective.

DR. MAC LEAN: What's new is that -- I mean, from my vague understanding of this, I think that I agree with you almost all the way, that when the NRC was established, it was established as just the right kind of thing to meet all the procedural requirements to make decisions that are acceptable and that what happened, for whatever reason, is they lost a large amount of their credibility in the public's eye and so you really have to -- there's not a universal distrust of experts or regulators. This technology has very special problems and one of the very special problems it has is that the regulatory agency has lost a large part of its credibility

L109

and it has to be regained somehow, right?

MR. ERNST: We would agree on that.

DR. PERROW: Maybe we ought to tell the story a little different. I haven't often done this to you and I always want to rewrite you because it's extraordinary how you view the world. I think that you've got to start out that first they set up the NRC and staffed it with all AEC nuclear power proponents and I think that's been very well established so you had the old AEC in there.

DR. STARR: I agree with that.

DR. PERROW: And then, the first intervenors were not dead set against nuclear power, as you said. The first ones came in and said, "Just don't put it over this earthquake fault." The next one came in and said -- with another specific kind of thing, that said something about containment or air claims, or something like that. They were not anti nuclear. They said, "You're not doing a good job." Then the NRC came back and tried to block these efforts and then the people had to go to Federal court in order to get some protection so they could carry through what was supposed to be -- and they forced the NRC to do what was supposed to be its function, so that's a slightly different script from that. I don't think anybody started out anti nuclear power per se. It took a long time to get there because we didn't even know about alot of these things. We worried about fish in warm water, and then there was

L110

earthquakes. It took a long time to get to the point where so much distrust of the NRC and of the industry turned people to say, "I don't want any part of nuclear power. I'll never trust this."

DR. COCHRAN:That's kind of water under the bridge and I think we can stipulate that there are all these categories of people but they ought to all have a fair shake in the process and they all ought to be able -- the ones that are anti nuclear that want to intervene -- I mean there's some that are going to try to slow things down and there are going to be some that think they could win if the process were only fair and it's very costly to slow things down and we ought to have processes that allow us to do it very quickly. There's some that are only interested in their issues and there's a whole spectrum, but I can tell you one thing. The vast majority of that group of people think sthe process is not a fair one.

CHAIRMAN SLOVIC: I'm hearing the same things over and over again now.

We don't have alot of time left. I'm wondering if there's some other things we ought to look at before we adjourn.

DR. LA PORTE: How are we doing on that list?

DR. COCHRAN: Well, can we have a consensus that at least the Commission, in addressing this issue, should take a more careful look at this and - - I don't know. Somebody else

L111

may be able --

MR. O'DONNELL: I think the process by which decisions are made --

DR. STARR: I think Ernst hit those points and I think that setting such a goal ought to raise the considerationof the process of verification and the process of credibility that all these are associated with the goal and that this is not by itself, going to be sufficient.

DR. LA PORTE: That doesn't get at what you were saying.

DR. COCHRAN: You're still trying to classify or make the goals that they're seeking be inclusive process.

DR. STARR: You're not going to ask the NRC to act to destroy itself and start afresh. Someone else is going to have to do that.

MR. ERNST: There's certainly a narrow issue of process which has to do with the verification process for all the studies that come in ahich I think, at least --

DR. COCHRAN: And which I haven't seen any of this write up. I mean, to me, this is Sege and family have ignored this issue and maybe all I'm looking for is a statement, at best, since I'll never get agreement out of Chauncey, that they've got to spend alot of time on this issue, otherwise this is kind of irrelevant.

MR. ERNST: I think it's extremely important because

L112

we'll spend the rest of our lives debating whether or not the goals have been met, because they are complex goals to prove on verification and if we establish a goal and do not have a verification process that makes sense, is understandable and reasonably simple, then we're all wasting our time here considering quantitative goals.

DR. PAGE: I'd like to turn it over to -- it seems to me that one of the great problems that we face here is that the NRC is in the position of making what amounts to large numbers of predictions of various kinds of failure - not just mechanical failure, but how operators fail and how designers fail and we are reaching a way of seeing how well we're doing. When Harold Lewis came to Cal Tech last year, he sort of chuckled and laughed at the Rasumssen Report. He told these stories about going through the code and not being able to make heads or tails of the documentation to see whether or not you were on the tree or off the tree.

Now, my point is that it's virtually useless to set up a formal procedure of risk assessment which can't be checked and I think it's a high priority thing to recast the way in which we do our risk assessment such as we define interim predictions, interim events, interim indicators essentially that allow us to know if we're doing a good job or a bad job. I think you can see this, where it works that the two cases where people say that risk assessment really works well are

L113

one, weather forecasters, and two, people who handicap forces. The reasons for why it works, I think, are obvious. There's alot of feedback and specific predictions and numerical estimates of what the event's going to be and then you see what's going on. Now, granted, it's alot harder in this field because we're faced with trying to figure out what's a common mode of failure and what's not a common mode of failure. We're faced with ultimate events that we'd like to know something about that have a very low probability and intermediate events that we have a very hard time defining in such a way that we can get a frequency interpretation calibrator estimate. It seems to me that we must be able to do better than before, and to the extent that we do better than before and we're open about it, we begin to see what the performance is, and that's a road towards increasing this distrusted distrusted credibility, and I think that's a very important one. So that's one point I wanted to make.

The second one is closely related, which is, another reasons why the weather forecasters and the handicapters do well in the sense of making probable predictions, is that they get rewarded and punished based upon their performance and it's visible and it's a little bit like these air traffic controllers that we've been talking about all weekend, where if a plane goes down, you know it and you're in trouble and that's what keeps these people on their toes.

L114

If you look at the Kennedy report and the aftermath of it, you've sort of got a world of difference between the way operators work in a nuclear plant, you know, sort of recruited off the street, trained a little bit, shown the switches and the way, say, NASA pilots are trained where they do lots of simulations. It's a high level of professionalism and you say, well what are the major differences. Well, one of the major differences is when things go well in a nuclear plant you become sleepy. There's nothing to do.

DR. OKRENT: We probably have more reactors than they have space shuttles but they have had more engineers killed in inertial compartments than we have had reactors that -- you have to look at NASA and after you've finished praising them you can still find things that they've missed. I'm talking about three recent incidents. I'm just saying --

DR. PAGE: I'm not -- I don't want to say --

DR. LA PORTE: He's not seeking --

DR. OKRENT: I'm just saying what has --

DR. STARR: Only a quick fact. The operators all go through about two years of training, licensing by Nuclear Regulatory Commission and continuous simulation exercises, so the fact that they're not adequate for the total situation is still true, but don't exaggerate they're incompetence.

DR. OKRENT: Look, I think the NRC needs to do better, but I don't think NASA and the FAA are perfect. That's the only

L115

point I'd like to make.

DR. PAGE: Okay. Well, these are in part, clerical questions. The basic point is you're not going to have a very good system of predicting risks and managing risks and finding design failure and so on, unless you have an open system of performance where you can tell if you're doing well or badly and two, a system of incentive so that those people who make predictions, who flip the switches and get the training, and so on, have their ass on the line a little bit. If it's varied, it's pretty obvious why we get into the kinds of management problems like Three Mile Island, and design and institutional problems and decision-making problems like we've seen -- it seems to me that these things are visible after the fact. Nobody's saying that these accidents have been managed real well and the question is what do we do to make them work before the fact, and I'm just saying that these are the two ways that I see.

DR. PERROW: He's brought up a point that I keep harping on and I'll just mention it again. When you take these goals and you start putting them down by the technical specifications and so forth, you're going to come up against the fact that I've just been looking at four, recent, -- not unusual -- they were almost randomly picked LER's and nuclear prints and all of them had multiple failures of the kind that could not be conceived by, I think, the kind of predictions

L116

that would to into making this an operative, safe -- incredible things that happened and they're all very different -- the range of possibilities that can happen in these plants is enormous. The complexities are enormous. I'm considering design - what I call -- it's not three, it's five the depot system design, operators, procedures, equipment and environment, so you look at those four accidents and they would be off scale for any risk prediction system that we have now and anything that would come to back up this and that's just an enormous problem.

DR. COCHRAN: Chauncey, is it possible to devise a system -- I mean there's a system of sanctions now - finds of their guys that don't report things and so forth. Is it possible to take that fund and turn it into rewards or to make it bigger. I mean, tax the 35 plants and hand it over to the -

MR. O'DONNELL: I thought you were going to say hand it over to the intervenors.

DR. STARR: No, Tom, that's a serious suggestion and, in fact, it is possible because there are fairly accurate records, both on maintenance and operation. The LER's is just one source and there are other sources and one could tag crews and individuals and crews in terms of their relative performance on maintenance, their relative performance on operation, the number of LER's that occur that are due to the human operation characteristics and provide reward -- you don't have to provide punishment. You could provide rewards and

L117

bonuses for those individual groups that perform better.

DR. OKRENT: Or who report the fewest LER's.

DR. ERNST: You have to watch out because --

DR. STARR: Well, yes. You sort of take my next comment. You have to be very careful that you don't set up a system, incidentally, that's true with the FAA. You have to be very careful that you don't set up a system that inhibits your flow of information.

DR. PERROW: But you've got safeguards there.

DR. STARR: There are all kinds of information, but you have to be -- it's a point that can be handled. It's not simple. It gets complicated and --

DR. LA PORTE: You mean by what? Complicated in what sense?

DR. STARR: Any system you set up that's going to blanket the operations of all kinds of institutions and hundreds, and hundreds of people, raises all the issues of equity and process and all that.

MR. O'DONNELL: I think, you know, Three Mile Island has had a great effect on providing incentives to the industry as a whole. It very clearly demonstrated that each utility is affected by how the other utilities perform and it's apparent that there are, among the various utilities, a spectrum of confidence - levels of confidence in operating staff and management.

L11

DR. PERROW: Some of them haven't got that message yet.

MR. O'DONNELL: I think INPO is one illustration of how the industry is recognizing this synergistic interaction between themselves and in fact, is supposed to be setting up standards of excellence and self policing mechanisms for the industry.

DR. LA PORTE: Well, the jury isn't in on that one yet.

MR. O'DONNELL: Yeah but what I'm saying is that there is an economic incentive that's been recognized by all the utilities.

DR. PAGE: Well, maybe we should make an economic incentive a little more clear cut. It appears that the behavior of MedEd after the accident is very much like the behavior of people who live in flood banks after a flood. You know, first you live in the flood line, and you don't find the insurance, even though it's heavily subsidized and then when the flood happens, you say, "Help us. We're victims. Give us special treatment." Now, it may be that we should have our incentive structure work right beforehand so that people exhibit precautionary behavior as opposed to strategic, after-the-fact behavior.

DR. STARR: And, of course, the industry recognized that too, so the industry has set up an additional insurance

L119

fund which is not covered by the regular insurance which covers things like the purchase power cost and so forth, and has inquired that all the nuclear utilities to join this and has told them that if they don't follow the criteria set by them, they're not going to be eligible for this insurance and it gets to be a fairly big economic, incentive to essentially try to improve their operations. You're right about this, but this was all after TMI and GPU was not --

DR. COCHRAN: I don't know. I mean, maybe it could be an incentive, but that type of insurance is also a disincentive because it lowers the risk of the individual utilities. I would say, if you wanted to increase the incentive vis a vis TMI we should get rid of Price Anderson.

DR. STARR: Do you go around setting fires to houses because you carry fire insurance.

DR. PAGE: Some people do.

DR. COCHRAN: Well, I might say, well I don't have to worry about licensing the plant of this size because after all, in terms of populations --

DR. LA PORTE: All of this is very heartening. I'd be equally impressed, however, if the industry said, "Yeah, that's right. By God, those outside experts, who aren't employed by us, or by the University, who are smart and want to participate in this certainly have a hard time doing that. They're important and what we should do is set up a blind trust

L120 . so that we provide for equal money with the NRC to fund outside experts to do a good job and be part of the pay review." I'd be impressed with that because it would seem to me that what that says is that there's a recognition inside the industry and inside the NRC that they've got to do something in the next decade to recover the sense -- to establish -- realize the legitimacy of the requirements and then we also realize the difficulty in meeting it in the common interest, and that would be impressive. It wouldn't take alot of money but it would send all kinds of signals.

DR. STARR: It's an interesting suggestion and it's not out of order at all. The only difficulty is that you assume an outcome for which alot of people, including myself, would raise a big doubt. Do you think the public confidence would go out by some order of magnitude because the industry had set up a fund to take care of outside experts? You see, that's your assumption.

DR. COCHRAN: I think the public confidence would go up dependant upon if the people felt like their representatives our there, experts, had a fair shake in the process.

DR. PAGE: And also if the decisions begin to get better because they're being better thought out.

DR. STARR: But who knows that the decision is better except the experts?

DR. PAGE: The analogy is with criminal law where, and

L121

after the case of Gidian, it was decided that the indigents should have a bigger representation. I think that most people feel that jury trials just do not work well unless defendants have lawyers. After he got in people felt, well maybe the system will work a little better.

MR. O'DONNELL: Does the same thing apply in civil cases?

DR. PAGE: No.

DR. COCHRAN: There's no reason you coulin't have a licensing branch in the NRC, or more than one, sort of to be the technical experts for the intervenors or something. I mean that set up some sort of mechanism --

DR. PAGE: The parallel in civil cases is sort of interesting. I mean, the reason why we tolerate lawyers that take 30% contingency fees is precisely that's the only way that they can get -- that people -- that accidents can get represented and so we do have these mechanisms.

DR. LA PORTE: I'm a little surprised. You responded almost exactly the same way to every suggestion that the industry recognize the legitimacy of external review and the difficulty of external reviewers of discharging that function of the society by saying, oh, it probably won't work.

DR. STARR: I didn't say that.

DR. LA PORTE: Well you came very close to that.

DR. STARR: You're interpreting everything I'm saying

L122

one way.

DR. PERROW: Well, you questioned whether it would have any effect.

DR. STARR: I didn't say any effect. I said the suggestion has value if one accepts the presumed outsome, namely that public confidence would be restored by this.

DR. LA PORTE: The tone of your voice suggested that you didn't accept the liklihood of a desired outcome. Let me turn it around and say that it seems to me that instead of the industry, and I'm probably unfairly representing, suggesting the industry really, rather than waiting for someone else to solve that problem for them, pick it up directly and try to be creative about how to solve it itself, because the NRC isn't likely to. It's not really in a position to do that. Without the cooperation and the encouragement of the industry, it's not likely, and I think it's very much of a symbiotic relationship there in the solution of these things and it's unfortunate, but that's the way it is.

DR. STARR: Well, I want to come back to one point, which I don't know the answer to, but I'll phrase the question. I think the chief problem in all of this is not so much whether the industry would or would not consider either through the government or directly making funds available to outside groups for critical review. The key problem is not the funds or even the principle. The key problem is how those groups get selected

L123

and I would want to hear a much better --

DR. LA PORTE: You solve the problem. Make the proposal rather than to ask someone else to do it for you and then say no.

DR. STARR: I'll tell you what our experience has been as a generalization. You can find exceptions, but the generalization is that the people who are critical, but who are not expert, but who are participating one way or another -- I'll give you an example -- the NOW organization - the National Organization for Women taking an anti-nuclear posture and makes no pretense about being a nuclear expert. Those people who have some ideological base for being anti nuclear, would not be happy with an outside group that gave a cent. Now, there may be an intermediate public which is not committed one way or the other that might have alot more competence than an outside group but how that group gets elected is the key.

DR. LA PORTE: Do you have some suggestions on how to do it?

DR. COCHRAN: You set up a system where the licensing board, the judicial body makes the judgement as to the - whether the intervention has merit or if it's useful in sharpening the decision or useful to the licensing board in making a decision and they can [illegible] the decision on the issue of need, whether the people got so much money they didn't need this money or whatever -- I mean --

L124

DR. LA PORTE: You guys must be problem solvers.

DR. STARR: I thought this was --

DR. MACLEAN: Even in the nuclear industry we've seen how opposing groups can work together in some areas with considerable success.

DR. PERROW: There's precedence for this with the UCS and Krypton.

DR. MACLEAN: That's exactly what I was thinking. The UCS said that it was so safe to vent it, even after they said that, people living around Three Mile Island said they didn't want it vented, but you didn't see -- I mean, there was very little sympathy, I think, across the country, then, that Krypton shouldn't be vented. I mean, I know it was because Kendall came out and made the announcement. Instant credibility.

DR. PERROW: They were invited in on that issue because of their critical status.

DR. MACLEAN: I think another instance, without trying to rule on the merits of this particular case, but the way the IRG proceeded in setting up their recommendations that eventually led to the Carter policy and you didn't see any groups that studied the issue and made recommendations which were adopted almost to the letter as -- you didn't see any big opposition of the policy.

DR. STARR: The IRG was not considered a third party either, was it?

L125

DR. MACLEAN: No, it wasn't, but these -- here are two instances where the problem that you keep on claiming is really essential is how are you ever going to set up and identify people on the other side in a responsible way. That seems to be solved. I mean, that's been solved in the past. It's not such an impossible --

DR. STARR: I didn't say it couldn't be solved. All I said was I wanted to see --

DR. LA PORTE: You keep wanting to see things. Why not make some proposals because the wanting to see response and always, no, that won't work, sounds like --

DR. COCHRAN: If it were the industry proposal which was, in effect, accepted or endorsed by your critics, I mean, you get all sorts of acceptability out of that.

DR. STARR: Why is it the problem of the NRC? The NRC has to have, as you pointed out before, it's a body created by Congress that was supposed to represent public opinion or public judgement. If it's not doing this properly, why shouldn't it establish the mechanism by which third party reviews?

DR. COCHRAN: You know, it recommended intervenor funding but that was to the Congress and that didn't pass and intervenor funding was not supported. There are examples of good alternatives. I mean they set up a Citizen's Advisory Committee on clean up at TMI which turned around and came in and recommended things like relax your standards on solidification

L126

of the resins so you can get 'em off and shipping - they recommended getting on with cleaning up the war.

DR. PERROW: I think the NRC should try to do it, but the industry should too because neither of you have credibility. If you want to get credibility for the industry, then you've got to take some profits --

DR. MACLEAN: There are a number of issues that I think that come up - safety issues in that regard to regulating the operation of plants and the disposing of the wastes where the issue should we have nuclear power or not doesn't get raised directly, where that one can be shelved and people from different perspectives can work together. Frankly I don't see why the industry itself, just doesn't, out of their pocket, fund opposing views. I mean, it would seem to be such a more efficient way to reach agreement on the number of issues.

MR. O'DONNELL: I think these two examples are very good examples of competent interaction between industry and public interest groups. The Kendall thing on the venting, I think, was a very positive step as well as the Citizens Panel.

DR. LA PORTE: Well, why is it that industry has to be -- this is a long time since all of this conflict has been going on and in the industry, if we can think of it in a --

MR. O'DONNELL: The industry has as much mistrust of the intervenor groups as the intervenor groups have of the industry.

L127

DR. LA PORTE: Yeah, but the industry -- there's lots of resources there and they're not -- I mean, you guys aren't below average intelligence to go on and try to be essentially pro active or reactive in these things. I know the idea that we can sit around here and think up a couple of examples that sound good - we should be in parallel to this, responding to an industry draft that gives us you know, five different alternatives for us to try to think through a social science and that way the outcome can be as the industry social scientists -- I mean, that's the sort of thing you'd like to see happening. I don't understand it. I can think up some reasons.

DR. STARR: That doesn't mean the industry wouldn't consider things.

DR. LA PORTE: Don't just consider things. Do It!!

DR. STARR: Well, because there are also negative outcomes which are possible.

DR. LA PORTE: Well, of course!!

DR. STARR: Well, the point is that the industry's experience with the history of the intervenors has been that when they got outside funding, not from the industry and not from the NRC and not from the government, when they got outside funding, they became a destructive group. At least that's the way the industry interprets it, so the industry, in effect, felt that feeding the monster was no way to get rid of it.

L123

Now, you have to understand that there are two types of outcomes and that if you set up a really workable situation, you resolve a conflict. You also could set up a situation when all you do is strengthen the opposition without ever resolving the conflict and because of the two outcomes, the industry is very suspicious of doing anything.

DR. MAC LEAN: As in all these other risk situations you have to consider the alternatives. The alternative might be to try to foreplay and run the opposition, and I think you've got to do a good risk assessment on what the best --

CHAIRMAN SLOVIC: I am getting a sense that it is time to adjourn this meeting and personally I'm glad it's going to be -- there's going to be a transfer vote because I think it's really been a remarkable, actually, two-day session in terms of the issues. Alot of these readings, I found this really sort of unusual in the depth and frankness of the approach to some pretty complicated issues. Maybe something will even come of it!

Let me just mention something about kind of what I know of what happens next on this. There's a session tomorrow and you will have an opportunity, I'm sure, to add your comment on my comments and at a later point, I believe the transcript of the plenary comments will be sent to you for your own additions or whatever or anything further, so you'll have further opportunities to look at the record here. I would just

L129 like to thank everyone. I think we all worked pretty hard and seriously. Personally, I'm tired, but pleased and thank you.

(Thereupon, at 5:40 p.m., the hearing was adjourned.)

This is to certify that the attached proceedings before the

Nuclear Regulatory Commission

in the matter of:

Date of Proceeding: 2 April 1981

Docket Number: Safety Goal Workshop

Place of Proceeding: Palo Alto, California

were held as herein appears, and that this is the original transcript thereof for the file of the Commission.

Tom Parker

Official Reporter (Typed)

Official Reporter (Signature)