Safety Goal Project

NUCLEAR REGULATORY COMMISSION (45 FR 71023)

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In the Matter of:

WORKSHOP ON QUANTITATIVE SAFETY GOAL

PANEL A

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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PUBLIC MEETING

WORKSHOP ON QUANTITATIVE SAFETY GOAL

PANEL A

Palo Alto Room
Rickey's Hyatt House
4219 El Camino Real
Palo Alto, California
Wednesday, 1 April 1981

The meeting was convened at 9:15 a.m., pursuant to notice, with Dr. Herbert J. C. Kouts, Panel Chairman.

PRESENT:

Messrs. Bernero, Beyea, Burstein, Joksimovic, Levine, Kato, Lewis, Lowrance, Mazur, Salisbury, Wald.

P R O C E E D I N G S

CHAIRMAN KOUTS (presiding): All right. Well, I guess we're started.

I'd like to make a few remarks at the outset. First of all, I think it's clear at this point that it's not our objective, either in this panel or in this meeting as a whole, to arrive at a safety goal for the Nuclear Regulatory Commission, or even to recommend a safety goal for the Nuclear Regulatory Commission. This is part of a process which, in time, will lead to developing such a safety goal, at least we hope so; and we hope that the output of these sessions will provide substantial input to that process of arriving at the goal.

What we do intend to do, what we hope to achieve, is to arrive at recommendations, which can be factored in to the safety goals that will be generated. Those goals will be formulated in-house by the NRC staff. And, later on, we're going to have -- there's going to be a series of meetings subsequent to the formulation of those goals at which we can actually address the technical content of them.

Now, we're starting now with a number of suggestions which have been made in a number of places and, in particular, suggestions which have been made by the Advisory Committee on Reactive Safeguards; but this is not to say that they take precedence over anyone else's suggestions on

safety goals, but it is to say that they have been addressed to the Commission, that they are very thoroughly formulated and logically structured, and they form a talking point, which we will take up first, and then we will treat other suggestions in due term.

We are not discussing just the technical content -- that is, we are not discussing the actual numbers in safety goals at this meeting. We are, instead, discussing logical structure, items which are to be contained and, in particular, in these discussion guidelines, which I'll be drawing on very heavily, and which I think you were all given copies of, these were all sent out, there is a scope statement for Panel A covering the material which it is hoped we will take up and logically develop and perhaps arrive at some recommendations on.

I'm going to be falling back, I expect, quite often on these discussion guidelines because there are a number of questions in them to which we will have to address ourselves and for which we hope to be able to develop some substantial answers.

I'd like to say one thing more relating to guidelines and how we got to this point and just to address some of the questions which came up during the plenary session earlier -- what have we been doing without safety goals up to this point in the Nuclear Regulatory Commission?

Of course, it's clear that there have been safety goals in the Nuclear Regulatory Commission ever since the process was established. These were stated in the Atomic Energy Act, which had to do with findings of the -- that the Commission had to make, which led to findings which the Commission had to make for protecting the public health and safety. And these were qualitative goals that the Commission has always addressed itself to, and qualitative determinations, which became more and more quantitative in time, were developed in order to establish that the Commission actually had met this qualitative objective.

In recent years, there's been a growing questioning of, "Isn't it time, now that we've arrived at a more quantitative view of what the safety goals of the NRC should be, haven't we learned enough to be able to restate in ways that would make it more clear when the safety goal has been achieved?" And this is precisely what -- what we're trying to do in this series of meetings. To see if we can restructure this concept of safety goals in such a way that it will become clearer to the NRC internally and clearer to the public at large that the process for protecting the public health and safety actually has been achieved.

So the safety goal that may be developed as a result of this process, we hope, will have these characteristics.

Now, I'd like to open the floor for discussion generally. I think it might be useful just to get opinions out on the table, opinions as to the structure of -- to way we're proceeding, whether or not this is a logical course, to follow. I, in particular, feel inhibited somewhat by the fact that, after all, this is supposed to be the quantitative safety goal panel and there's a qualitative safety goal panel out there, and then there's another which has a lot of miscellaneous -- social, economic, and political -- aspects to consider. And I, for one, would like to be able to say things about all these things and hear things about all these things, but -- and perhaps -- and perhaps we're going to feel quite a bit too limited by the structure, unless we take more advantage of the plenary sessions.

DR. MAZUR: Could we just more broadly interpret our mandate and loosen the constraint?

CHAIRMAN KOUTS: I think -- I think, Allan, we could probably do that if we made should that we -- that that which is expected of us is still achieved.

MR. SALISBURY: I think that may happen in the other panels, from what I was hearing.

CHAIRMAN KOUTS: I suspect that they're going to have -- they're going to have more of a tendancy to get quantitative as we are to get qualitative.

MR. BERNERO: I wonder if I speak to -- . I think

the general intention is that each panel is asked to address itself to the scope given but encouraged to -- to range freely into the area of the other panel scopes. But in an attempt to try to cover all the ground thoroughly, at least try to do something in the area that the panel was given.

I'd like to add just one remark. It's worth emphasizing. The ACRS safety goal discussion with the Commission preparing for this workshop, the status of the ACRS proposal is emphatically not "this is the Commission gospel." You know, it's up for comment. It is sort of a straw man. It is especially useful because it is about as organized and subdivided as one could make it. It's a -- it's a very natural vehicle for discussion, an excellent straw man in that regard because it -- it does take the quantitative safety goal into the very complete range of subdivision.

CHAIRMAN KOUTS: I think we'd be very much misled if we concentrated on the numbers in that document.

MR. BERNERO: Yes.

CHAIRMAN KOUTS: Those numbers, I regard, as having much less substance than the logical structure of that document, and I -- I would like very much to suppress any discussion of actual numbers as much as we can. Now, I don't think we'll be able to do that entirely. How can we be quantitative and not talk about numbers at all? But the

numbers really have much less significance than the structure.

DR. MAZUR: And, may I start, then, with a question on the logic of the argument. In reading through it, it seemed to me, to a great extent, the exercise in setting goals was to start at some arbitrary assumptions and then to go through a calculus and get to some numbers, which were called goals.

Now, since the numbers you end up with are obviously arbitrary, depending upon where you start, why not just arbitrarily set the numbers in the first place, at the end point? Why do we have to go through all the calculus?

A good example, if I may, would be -- oh, a maybe almost trivial example would be in the model of risk averseness, you have this factor, alpha, the power. Well, you know, you pick whatever alpha you want to to get to where you want and you end up, depending on where you picked alpha. Well, why even fool with alpha. Why not just arbitrarily start where you end? If you want to get a certain factor, just start there. What -- and there's a certain game feature for the whole thing, like we're playing around --

CHAIRMAN KOUTS: Well, there's certainly an arbitary character for the choice of --

DR. MAZUR: That would be an understatement.

MR. LEVINE: But there are -- there are, in fact,

ways to look at the way accidents, real accidents and projected accidents are structured; and they do have a curve of some sort that probably raises consequences of all kinds of accidents. And maybe one could make comparisons on that basis, rather than selecting an arbitrary factor. So there are ways to cope with that problem without having to say, "I think this number because of something that is undefinable.

CHAIRMAN KOUTS: There are certainly other ways to get risk aversion into the mathematics.

DR. MAZUA: Well, I didn't even want to get hung up on risk aversion. I'm -- it just seems to me it's a typical point of the discussion, and that is, we have starting assumptions here, then a calculus, then we come out with quantitative goals. These starting assumptions are arbitrary points. Once they're set, we go through the calculus that give us the firm numbers. Why do that? If it's all going to be arbitrary anyway, why don't we just start right here with the arbitrary goals. And that is, if in the end it's a judgmental thing, why apply it up indirectly from the goals; why not just focus right in on the goals? If it's an issue of setting numbers, let's just decide what are numbers that would be okay.

DR. BEYEA: Well, first of all, all argument follows that pattern that you're -- that you're stating. And, presumably, if we start -- the further back we start,

the greater concensus of agreement that we can -- that we can reach. So I have no objection to the -- to the going through that logical process, but what does bother me about the ACRS goal is that I can just -- I just cannot imagine walking into a public meeting in Harrisburg, Pennsylvania, and saying, "This is the Nuclear Regulatory Commission's safety goal," talking in terms of any quantitative number of ten to minus six, ten to minus seven, of that form. So I see -- I see the ACRS goal very interesting to me as a practitioner of risk assessment. I'd like -- I'd like this attempt to perhaps weight the higher probability or lower probability of events in a different way, but I think, as a public document, the ACRS proposal is relatively useless. I think it could, however, play a subset role in a different kind of a safety goal.

It seems to me -- well, I think I'm getting the same point you are, there's no real articulation of the logic that's going to satisfy people.

DR. JOKSIMOVIC: Why do you say it's useless?

DR. BEYEA: Well, let me explain. Because I just cannot -- I think it's too complex. I think it's too complex for most people in the public to understand the significance of that as a safety goal. Ten to minus six, ten to minus seven, what -- what's the point of that? Let me --

CHAIRMAN KOUTS: Can't -- but they understand one

in a million and one in ten million. That mean -- they mean the same thing.

DR. BEYEA: Well, again, perhaps -- we're arguing about what the public thinks, and I don't think we -- . Well, my opinion is that -- my experience with people who are concerned with nuclear power, those numbers, they just turn off. Their eyes just go out of focus and they say, "Well, why isn't it safe?" And I think -- well, let me finish.

I think there is a way to get around it, and let me try to articulate that. I think a safety goal has to be somewhat motherhood. The statement itself has to be motherhood, has to be a statement that -- that can be brought concensus on. I think, for instance, the original statement to protect the public -- what's the original statement in the Atomic Energy Act, to protect the public from undue risk?

CHAIRMAN KOUTS: "Undue risk to the health and safety of the public."

DR. BEYEA: Okay. And that's a motherhood kind of statement that at one point probably had a broad concensus, you can transfer the disagreement into carrying out that mandate.

I think what has happened, however, is that in the last ten years, that statement no longer brings concensus among the whole population. There are some people who get

very upset of there being any risk and do not accept the idea that -- they think any risk is undue. And I think what the NRC needs to do is to come up with a new motherhood goal which will reach a broader concensus. For instance, a safety goal might be that the -- it's the intent of the NRC to make the risks from nuclear power in various categories less than the risks from comparable electricity alternatives, which -- which are available in the area. With that is a motherhood type goal. Then you could begin to determine quantitatively how you would have to -- how you would have to meet that. So that the numbers that we come up in an ACRS type -- type proposal would follow a concept that the public could -- could understand.

CHAIRMAN KOUTS: That's a very -- very nice comment. It makes a lot of sense.

MR. BURSTEIN: Can I -- can I ask how you're going to define what the comparable risk is?

DR. BEYEA: Well, again, that is a problem for debate, and we may never get agreement on it, but that would be the NRC's task; and I could imagine at the end of the year there's a chart that says, "Do you understand here?" At this point, we can -- we can -- we can say that there is a -- there is a way of defining atomic risk, here we can't.

MR. BURSTEIN: We -- but we've perhaps accomplished that already and, yet, you say that is not acceptable in the

streets of Harrisburg. How do I then -- I'm not sure that you have illustrated a point that tells me you've gotten over the hurdle of convincing the public that one in a million or ten to the minus six is -- is not acceptable and, yet, the risk less than the coal plant is.

DR. BEYEA: Well, I don't think that safety goals can solve the problems of nuclear power and the public disagreements. I don't think that can happen. There's always going to be disagreements. The question, though, is whether we can get broad concensus on -- on the safety goal; and then the debate would be whether, in fact, we have -- we have met the safety goal. Maybe I haven't understood your question.

MR. BURSTEIN: Well, perhaps -- maybe this is a good point of agreement, then. We can say, and I think that we must say, that a safety goal cannot assure zero risk. There is no question that what any goal that we come up with is going to have in it something called acceptable risk. Whether it's understood by the public or not, one of the things we're defining is a level of risk which is above zero. Now, does -- the next step that I think I hear from this conversation is whether public acceptance of that level is essential. Or even its understanding and acceptance must be a criteria to be applied to the output of this development process.

MR. SALISBURY: Nobody is -- I'm sorry, Bill, you

go ahead.

DR. LOWRANCE: No. I would just ask, as one who generates electricity for a living, as I understand it, how do you feel about that? What -- how do you deal with the question of whether it's important for your consumers and your public to understand and agree to endurance of the risks associated with coal or nuclear or any kind of electricity?

MR. BURNSTEIN: Well, of course, I'm a nice guy and I'm -- I'm out there trying to convince people of that as part of my life style. It's not always easy. But like many other concerns that we have, there are times when the need to make a decision is more important than the need for universal love. And -- and I think, once we establish that standard, and this gets to perhaps another feature of this development, and that is, what do we do with it what we've established the goal, do we say that, okay, we've met it and from -- from then on there is no further debate, that it's no longer appealable, and all we're arguing about is whether we have met it or not? Or do we continue to argue, even after we've established the goal, as to whether it's the right goal. Because there will never be universal, completely universal acceptance of any quantification that might be developed.

DR. LOWRANCE: That's probably true, but it seems

to me that, in the society over recent years, we've turned to face one risk after another. I mean, for the moment, it seems to me that nuclear is being viewed a little bit more acceptingly, but that toxic wastes are more greatly feared than they were a decade ago. And after the earthquake here, we'll worry a lot more about earthquakes in California and -- and so on. And I think this is just part of the human enterprise. But at various points, it seems to me we can stop and compare the -- the risk prediction, risk abatement reduction, whatever practices of the society and at least become explicit. In fact, I think quantitative goals, making goals quantative is only part of it. I think the most valuable thing is making them explicit, saying out loud what we're trying to accomplish, and then arguing within that indefinitely about whether the number should be stricter or less strict.

But I think, as we turn now to deal with toxic waste disposal sites, and we passed the superfund, and we allocate over a billion dollars of federal funds and I don't know how much other funds, that's fine, but we'll continue in each domain; and I think more and more, we're beginning to compare different sectors of our society. And I don't think nuclear is getting undue attention. I think it's fine that we're going through this right now, and it seems to me that -- that there is reason to try to -- to at least state

what some of our goals are. I find it a very useful process, and I don't find, speaking to Mr. Beyea's comments earlier, I don't find that numbers or -- or that safety goals would be unacceptable things to pursue in Harrisburg. I don't know why you say that goals of ten to the minus six or ten to the minus seven or something of that kind, I don't think that's a very good way to state it. But I don't think discussion of safety goals that still carries some -- some finite risk with them are a bad thing or unworkable, let's say, in Harrisburg.

DR. BEYEA: I guess I'm saying that there's a way to put that in terms which are more understandable to people who don't work with numbers. Professor Mazuar just pointed out that the -- that these numbers are -- just appear to be very arbitrary, and so what I -- what I have problems with is going to a public meeting and saying, "The NRC has decided that a risk of ten to minus six is our safety goal." And somebody says, "Ten to minus risk that -- that New York City is going to be wiped out." Well, I find that to be unacceptable. And, in fact, people at public meetings spend a great deal of time talking about small risks of nuclear. Dr. Kouts here does it. Many people in this room -- room have done it. And I'd be curious as to -- as to hearing their experiences as to how successful they feel they are talking about it in pure quantitative terms.

I'm saying about doing the same thing, though. I'm saying is to put the casket into a framework which very few people can disagree with me. It seems -- it seems to me that -- that no matter how -- . Well, no, that's not the -- . Most people who are anti-nuclear would have to agree, it seems to me, that if in -- at least agree in principle -- that if one could reduce the risk in all categories for nuclear lower than all alternatives, it would be acceptable.

DR. MAZUR: Oh, I think you're totally wrong there.

DR. BEYEA: Okay.

DR. MAZUR: I think, maybe, that's the difficulty, modeling two things. Setting safety goals is one thing and assuming that, having set them, people who oppose nuclear will now favor it --

DR. BEYEA: Oh, no, no, no, no. They're going to agree with the goal because they're going to disagree with whether in fact you've accomplished the goal.

DR. MAZUR: Their opposition to nuclear may have little to do with the particular item that we're setting the safety goal on. They may avoid -- oppose nuclear for ideological reasons, they may oppose it because they think it will lead to a nuclear war within --

DR. BEYEA: Well, that would be one of the criteria, then.

DR. MAZUR: Well, no, it's not at all built into these kind of goals. What are the safety standards for a lightwater reactor is totally irrelevant.

DR. BEYEA: Well, I don't think that's true. I disagree with you. I mean, it's very relevant and it should be one of the categories.

DR. MAZUR: To the goals -- to the kinds of goals being discussed here? There's no notion of even assessing or how you would even do it. What the probability is that, proceeding with nuclear will lead to proliferation of weapons to end countries, which will enhance the chance of nuclear war. That's an issue that is --

CHAIRMAN KOUTS: That's a non-domestic issue.

DR. MAZUR: -- separate. It's not -- not involved here at all.

DR. BEYEA: It need not -- it seems to me it could be.

DR. MAZUR: Well -- but it isn't. I mean, I don't know why you --

CHAIRMAN KOUTS: That's a whole -- that's a whole issue that, really, we ought to take up separately; but that -- that's --

DR. MAZUR: No, that's not -- I'm not trying to take that issue up here. I'm simply saying that the goal -- the setting and acceptable goal for the safety of a light-

water reactor is one area of concern that is totally separate from many other areas of concern about nuclear power. Without going into those other areas, I just emphasize that, whether one accepts or doesn't accept nuclear power, or accepts or doesn't accept that particular goal, is rather separate from the NRC's task of getting on with a standard that they can use for implementation purposes.

DR. LOWRANCE: I thought I disagreed with you, but now I agree with you --

DR. MAZUR: I know you all do. I know you do.

DR. LOWRANCE: But -- but I would re-emphasize that -- it seems to me that the topic for this meeting and of this whole endeavor is to say as long as we have nuclear reactors under design, construction, operation, and so on, should we have goals for that process or not and, if so, what kinds of goals. I don't think that in any way preempts the larger question of whether we should have nuclear power at all for various other reasons, such as nuclear proliferation, aspects of international diplomacy, and so on. And I think the NRC, not to defend the agency unduly, but I think the NRC has been fair in separating its concerns over such things as terrorism, theft, sabotage, although I think that's something we ought to talk about.

Should those concerns be brought in to the quantitative reactor safeguard discussions, and I'm not sure they

can be reduced to quantitative goals, I -- it seems to me that in -- in all, that's reasonable to do; but in all of this, I think the Commission is not seeking goals with respect to whether or not we should have nuclear power. But this is not really their function at this point. That's some -- that's a question which perhaps they do have to think -- or which has to be thought about on political levels, at any rate; but the Commission is not seeking an answer to that question here. What they're seeking an answer to is, assuming that nuclear power is okay on a broad, generic basis, what kind of goals do we apply to make sure that the public is protected in individual applications of nuclear power

DR. MAZUR: This is for purposes of bureaucratic agency implementation, which is a different thing than --

CHAIRMAN KOUTS: Yeah. You go along with that, Bob?

MR. BERNERO: Yes and no. That's a narrow interpretation of a safety goal, but it is parsing the problem to the operational safety, or the accident and routine operational risks of a nuclear powerplant, prescinding from questions of the risk posed by proliferation, the risk posed by safeguards perhaps. In the broader sense, the Commission must wrestle with all of them, but I think your -- certainly, the -- the straw man that the Commission is willing to use

addresses the accident safety. It consciously and explicitly prescinds from proliferation and safeguard.

CHAIRMAN KOUTS: That -- just looking ahead, I think you'll find in this document references to sabotage, proliferation, things of this sort, and even though the numbers that -- even though the numbers that appear in this, in philosophy, don't seem to include thoughts about this, they reall do; because there's -- there is a -- there's an assumption that you cannot make probability of core melt less than a certain number. You cannot assure, at any rate, that the probability of core melt is less than a certain number because there are these very large things that cut across, like the possibility of sabotage to a nuclear power-plant, seismic questions, things of that sort, which -- which are -- which are not normally included in the probabalistic estimates.

DR. JOKSIMOVIC: To a degree, seismic are included up to the point where you decide they're small enough to be neglected. At least that's been the -- that's the way --

CHAIRMAN KOUTS: Some of the latest studies that are coming to the fore --

DR. JOKSIMOVIC: They're coming to the fore now, but in the --

MR. LEVINE: I'd like to make a comment. In trying to get organized -- organize my own thoughts for this

meeting, and to recognize that it would not be our objective to come up with numbers, I've asked myself, what are the kinds of things that this panel ought to address, and I have listed four things that I think we have to focus on to get a focus discussion and a focus trial.

One, what is the purpose of safety goals? What are these -- what use will be made of the safety goals? How will they be used? I think, unless we address these two subjects, you will flounder through a morass of ideas that cannot be ordered.

Three, what kind of velocity should you use in talking about the levels at which safety goals should be set, as was just mentioned. I think we need an overall philosophy before you set numbers.

And I think you have to talk about the kinds of things that should be in goals and should not be in goals and why. And the specificity of the goals. I think that's the kind of framework we should -- . I think that was -- we went all through the conversation this morning or the conversation around the table just now that, unless we get an ordered way of going at these ideas, that we will never get anywhere.

CHAIRMAN KOUTS: Can you -- can you say that last little bit differently?

MR. LEVINE: The last what?

CHAIRMAN KOUTS: What you just -- the last thing you said.

MR. LEVINE: Well, unless -- unless we focus on some of the elements of how one thinks about safety goals one at a time, we're not going to come to any conclusion. We will just cross -- cross the elements with the various -- the various ideas will cut across all the elements and we'll get nowhere.

CHAIRMAN KOUTS: Well, I thought that was something that Mazur was disagreeing with. He was -- he was saying earlier, why don't we just jump right to the numbers themselves and let them --

MR. LEVINE: No, I don't think --

DR. MAZUR: No, no, I didn't say it. Well, I said in -- I was --

MR. LEVINE: No. Let me say what -- I'm trying to respond to his comment. What he was saying is, there's a bunch of arbitrary discussion on this document and then there's some numbers presented with regular rationale to the numbers. I'm saying, let's develop the rationale first and not the numbers. The numbers come second. That's what I'm trying to say.

DR. MAZUR: Yeah. That's fine with me. I'm -- and maybe I confused your point or I was simply -- . If you were saying that I was suggesting, "Here, we should jump to some

numbers," then I wasn't saying that. I was trying to say in the logic of the thing, I would change the logic. The logic of making arbitrary assumptions, then a calculus, getting the final answers is compelling if it's easier to agree on the arbitrary assumptions at the first, I think, Jan, maybe is what you meant. That is to assume -- to agree on the bottom line. I don't see that in any sense. I don't see that it's easier for us to agree that alpha should be 1.2 than it is to agree on the bottom line, to the contrary, to say that it would be easier for us to come to some agreement on the bottom line than it would be to agree on what alpha should be in that particular --

MR. LEVINE: Well, I think we should discuss here today whether we need an alpha or not, not what it should be. I think that's the -- the whole second --

DR. MAZUR: Or -- or maybe we should discuss whether or not we need such models anyway --

MR. LEVINE: Yeah, that's right.

DR. MAZUR: -- rather than if we -- . Well, first of all, we could discuss whether or not we need goals, and, second of all, if we need goals, whether or not a way to get the goals is to simply say, "Okay, my concensus or vote or something, these are numbers that will be the goals," without going through a hocus-pocus set of calculations that looks like their objective.

MR. SALISBURY: It seems to me that the only -- only reason for having some kind of a model like that would be if that would allow you to more clearly compare the risks involved in nuclear with the risks in other comparable enterprises. If -- if it allows -- if the model allows you to do that, well, then, it has some validity.

DR. MAZUR: Yeah, but that would be in the goal model. I mean, that wouldn't be in the setting of goals. That might well be in the assessing of the risks from the -- to compare.

DR. WALD: Well, that brings us back to the purpose of a safety goal. I mean, if that kind of public understanding of the comparative risks of different modes of energy production is the objective, then that model should do; but I think -- I agree with Saul that, without the finding of purpose of a safety goal and having some idea in mind -- at least for me -- of a pragmatic level, if I don't have some idea in mind of what this device is going to be used for, I have a very hard time in saying how to build it. I know that committees have designed camels.

DR. JOKSIMOVIC: Well, before we forget, I'd like to address the issue of motherhood here. I really hope that the result of this effort, we're not going to end up with another motherhood statement. If we do, then I have -- I feel worse that I wasted my time. As a designer of nuclear

powerplants or a designer of any industrial complex, there's no way how we can design plants to motherhood statements. It's an absolute moving target for us, and it's an absolute mislocation of our resources. If we know what we're trying to accomplish, then we can get there. Like, you know, people managed to get to the moon because they had a goal to get there and they knew how to do it. And for us, to continue in this mode of moving targets and poor guidance, I think, is utterly disastrous and it's -- it's economically disastrous for the utilities, it's economically disastrous for the whole industry, and I think it's economically disastrous for the whole country.

MR. LEVINE: Right. I think that you're making an either/or statement, which is not an either/or situation. I think -- let me make an example. The statements which you made, which I would like to expand on a little bit, would be you want nuclear powerplant accident risks to be a small percentage of the other accident risks in society, not just electric power production, but much broader, and that's a kind of a motherhood statement and a philosophical statement.

And then the next question is, well, should it be ten percent of other risks, one percent, a tenth of a percent? And one can go about generating a rationale for that. So I think a motherhood statement is needed, in fact, to communicate people, even among ourselves, the technical people.

CHAIRMAN KOUTS: Well, would you agree that that's a motherhood statement?

DR. JOKSIMOVIC: Well, I guess -- maybe it's a matter of interpretation, what is motherhood? But I say a motherhood statement is, "I'm giving this to the public." As far as I'm concerned, that's -- that's a motherhood statement because that could be interpreted in all sorts of ways; however, if the motherhood statement is that the risks from nuclear powerplants should be less than from competing sources of electricity generation, then it isn't because then it's a tough goal.

CHAIRMAN KOUTS: Okay.

MR. LEVINE: I don't think there's any disagreement.

CHAIRMAN KOUTS: I see we have another panelist here. Al, you're supposed to sit up here.

DR. JOKSIMOVIC: You are late, as usual.

DR. LEWIS: I think I've -- this is part of yesterday's, but forgive me. I really apologize for --

CHAIRMAN KOUTS: No. Glad you made it.

MR. BERNERO: Well, again, whether we -- we need it or not, as a practical matter, it's been acknowledged by several people because the -- not to acknowledge so is unacceptable that we have safety goals. We've had them, we've implemented, we use them, and whether we define them by one label or another, the safety goal exists.

It's apparent, from what has been said, again as a practical matter, that the -- the Commission is going to quantify a safety goal and it perhaps will do so whether this assembly makes a comment or not. It may do so in spite of what this assembly provides in the way of input or assistance. So I think, in order, perhaps, to try to be constructive in this area, maybe it is not irrational to discuss some of the things that Saul Levine mentioned in terms of the purpose -- to define, again, the purpose of the goal and, perhaps more importantly, as Mr. Wald and others have suggested, the use to be made of them, the philosophy of what it is we're having to accomplish.

One of the items that might well be discussed is whether or not it is rationale, logical, necessary, desirable, a utilization of optimum resource, that nuclear power safety should be less than something else. Perhaps, it has certain advantages which indicate that, even if the price were higher, it might be justified. I don't know that we have already agreed that the level of this goal should be something less than comparative or alternative sources.

Now, that may be essential, however, to public acceptance and goes back to some of the things we've talked about before -- whether public acceptance, and the issue was raised, how do I realistically license a nuclear plant without acceptance, whether public acceptance is an essential

ingredient of a goal. And I would be then responding to a -- an emotional value as opposed to something that one can quantify more specifically mathematically.

DR. MAZUR: Would I be in order to suggest that we follow Saul's suggestions of maybe scoping things to that question, "What is the purpose of safety goals and what would they be used for," and maybe limiting ourselves to that for a bit; and if we could get something in there, maybe we can move on --

CHAIRMAN KOUTS: Fine. Let's -- let's narrow that discussion.

First, I'd like to say that I -- I'm not so sure that the old Commission statement about insuring no undue risk to the health and safety of the public is -- is a motherhood statement. I don't think it's any more of a motherhood statement than -- than the oath that you take going into government service to protect, defend -- what is it -- preserve, protect, and defend the Constitution of the United States is a motherhood statement. I think, in fact, that that has a lot of content and you -- you have to interpret that politically all through your career in government service. Certainly, the President of the United States has to make all kinds of judgments as to what constitutes protecting, defending, preserving the Constitution of the United States all through his -- his operations and --

DR. JOKSIMOVIC: But he doesn't -- he doesn't have to quantify it.

CHAIRMAN KOUTS: We are fortunate in being in a field in which quantification is possible, and that is precisely what we're doing here. We're trying to move to a position where we can take advantage of the quantification that's offered here.

Let's -- let's talk about safety goals and their application. Where would we use them? How about you, Bob? You're a good one to start off.

MR. BERNERO: Well, I would look to a quantitative safety goal, presuming, for the moment, that one has taken what some have called a motherhood statement, a general philosophical statement, and then try to translate it into a quantitative structure, that there are two fundamental uses of such a quantitative goal. One is plant specific or project specific, judging the need for change or the degree of acceptability of an individual proposed or actual application of technology. That particular powerplant is safe enough because the probability of some failure or some health effect is at or below an acceptable level.

That is one use. The other use of the goal is one that I characterize more as a retrospective or generic use, and that is that one would look at the population of reactors or the population of uranium mills or whatever, and

make judgments about the overall degree of effectiveness of safety regulation. That, given that we regulate individual reactors in a certain way, we can use a goal, a goal discussion to say that our overall regulation of 100 nuclear powerplants or 500 nuclear powerplants poses a general risk to the public of some given level and that that general characteristic risk is either acceptable or unacceptable. And such considerations can lead to the choice of alternative technology, the alternatives within their technology, and distinctions that might lead to different criteria for different reactors. We might have a different articulation of a safety goal for Indian Point than for Palos Verdes, coming from that kind of a generic consideration.

So I see two uses for safety goals. One is highly plant specific. Individual -- virtually the licensing arena, and the other is industry specific, a generic use.

CHAIRMAN KOUTS: Can you -- can you do both with the same goals?

MR. BERNERO: I think, with the same logical structure, you can set up a framework where you can use the same logical structure as the parents of both, but the translation, the specific use, this is not news to some of the people here, I think the use of -- I personally feel that the use of risk curves to the extent of probabilities of death and health effects is not useful in the case specific arena. I think

the same logical structure can lead you to case specific use of hardware goals. The probability of system failure shall be less than or equal to. The probability of severe core damage shall be less than or equal to or something, whereas, if you're looking generically, one is using the broader definition of risk. When it's not trying to tune hardware. You're just trying to look at the plants as they come out, the plants in their total, and, in fact, the plants collectively.

MR. LEVINE: I believe we should be discussing the first question first, not the second question first -- what is the purpose of safety goals, not how we should use them.

MR. BERNERO: I think we have to --

MR. LEVINE: There's a certain logical structure that follows. If you know the purpose, then you can talk about how to use them.

CHAIRMAN KOUTS: I think -- I find it hard to untie those two.

MR. LEVINE: I can untie them.

CHAIRMAN KOUTS: Why don't you untie them.

MR. LEVINE: Well, it's very simp The first thing one wants a safety goal to do is to protect the health and safety of the public. I think the second thing you want it to do, and now you have to sort of be in the field to

understand this, is you need -- you need these safety goals to make the licensing process more rationale.

As Hal Lewis said in his report, you can use PRA to make the licensing process more rationale or you can use it to only limit the degree without safety goals. If you want to use it broadly, more broadly and more powerfully, you need safety goals.

So I see the two purposes of the -- of a safety goal is to -- one, to protect the health and safety of the public or for adequate protection, however you want to say it, and, two, to make the regulatory process more rationale. Those are the two purposes I see for these goals.

DR. JOKSIMOVIC: Let me just -- I'd like to make sure that I understand Bob's point. Your second point, I call that risk budget and let me ask you if you have the same concept. Are you talking about a regional thing where, let's say, in parts of Arizona there will be some prescribed risk goals that shouldn't be violated and that they will apply to a spectrum of industrial activities?

MR. BERNERO: I don't see that the NRC can budget risk to activities it doesn't control. Now --

MR. BURSTEIN: But it's affected by them.

MR. BERNERO: Yes, it is affected. It can use them as a backdrop, as a comparison to lead to the logic on which risk would be budgeted in the nuclear cycle or in the

nuclear powerplant. I can see a regionally specific thing. We're facing one right now -- in-siting, the new siting policy. The formulation of the new siting policy, we've been directed by Congress not to foreclose the alternative in any region of the country but to have a rationale siting policy nevertheless. So we could look to the Northeastern part of the U.S. and say, "Yes, indeed, here is a safety goal-based siting policy for the Northeastern part of the U.S., and it happens to be a good enough/for one everybody else to use," or we can divide it. We can ration risk and say, "For the Northeast, considering their population, use Goal A, siting policy A, and for the rest of the country, since you've got more real estate to play with, or we can even divide the country into quarters, use safety goals and siting policies B or C accordingly."

MR. BURSTEIN: So that's what you had in mind, then?

MR. BERNERO: Yes.

DR. JOKSIMOVIC: But doesn't that beg the question of about what you mean by -- by a safety goal because you're thinking in terms of a probability of accident, but if you would descirbe the safety goal in terms of anticipated number of casualties per year, then, presumably, people in the Northeast are neither more nor less valuable than people in California. So it almost asks what the -- what the language

is and what you're going to formulate it, and that in turn depends, I agree completely, that you have to understand the objective, the purpose of the goal before you can do anything with it.

And, in a certain sense, we're here because everyone knows that not having a quantitative -- if I could take an extra moment -- not having a quantitative safety goal puts us in a terrible predictment in which the licensing process becomes irrational. If I come in off the street and say, "That damn framistand is going to break," you've got to fix it, whether or not it's relevant, and we all know that that's not a good way to do it; but when Saul says to protect the health and safety of the public, that's a copout too because the issue is how much you should protect the health and safety of the public.

DR. LEWIS: But you were --

MR. LEVINE: You'd need more questions --

DR. JOKSIMOVIC: No, I didn't.

MR. LEVINE: I'll get to that.

CHAIRMAN KOUTS: I -- I have a problem with what Bob said, which I might as well get out on the table. I don't see how you can depend more on estimates of probability of an accident than you do on the curves when the estimates of probability are the things that people view most strongly, and they're the ingredients for curves.

DR. LOWRANCE: It just seems to me that Dr. Lewis was saying that one starts with -- one could start with the probabilities of accidents and then pursue the consequences that flow from that, then look at the distribution over regions or site prospects, prospective sites, and come to some overall guidelines for -- that would apply rather universally around the country. Unstanding, too, that goals are -- that such goals may be minimum of it, that utilities or others may take all kinds of other precautions that are more strict than the NRC's overall policies.

MR. SALISBURY: They will, according to Chauncy.

DR. LOWRANCE: What did you say?

MR. SALISBURY: I said, it will, according to Chauncy.

DR. LOWRANCE: Well, at some point, we're going to have to --

MR. BURSTEIN: Well, let's add to this question of purpose. You know, so far, whether by design or other ways, members of the public have not suffered at the hands of nuclear power to the extent that the utilities' financial integrities have been damaged. To what extent might a safety goal be a guide to -- to the public who are putting their money and their futures in the -- in this energy resource from a financial perspective -- . Again, one has said that, if you protect the financial investments made in nuclear

facilities, you automatically protect the health and safety of the public, perhaps to orders of magnitude greater than current NRC requirements.

DR. BEYEA: Well, that's a very debatable statement. I don't know if we want to debate that today.

MR. BURSTEIN: Well, you may not want to debate it. It's a fact of life.

CHAIRMAN KOUTS: That's about as far as the motherhood statement -- . Let me talk about Chauncey Starr's because his are based very strongly on that. But we're not at that anyway.

DR. BEYEA: I would just like to comment on -- on Saul's first point, the purpose of safety goals, just to give my perspective as I see a safety goal. I do think I see it quite differently than many of the people here. I see a safety goal as a target, something which you would start out with and would not be reached, would not be reached at the present time. We exist -- . You know, I see a safety goal as part of an overall philosophy of dealing with risks in society, that technology brings us good things and bad things and we should be trying to reduce the risks from -- from technology. One study carried out by the NSF at Clark University indicating that about 20 percent of deaths, 15 percent of deaths, are associated with technology in some sense. Of course, obviously, technology also saves us --

extends our life expectancy a great -- a great deal of time; and so just because the technology is associated with death doesn't mean we don't want technology. But it does seem to me that one useful social goal is to try to reduce the risks from -- from technology and that's how I see --

CHAIRMAN KOUTS: That would increase the number of deaths from other causes.

MR. SALISBURY: Not necessarily.

DR. BEYEA: Okay. Then life shortening. Let me tell you about life shortening. Let me be more precise. Life shortening, the extent of which -- okay -- to extend the life -- to extend the life, that's a more precise statement.

DR. LEWIS: Is that clear?

CHAIRMAN KOUTS: That's very different, though.

DR. LEWIS: And even that isn't clear, you know, if it's a miserable height.

DR. BEYEA: Well, any qualitative -- no, no, no. They're two things. You didn't let me finish; you didn't let me finish. But I think most people would rather extend their miserable life than to cancel it, but, anyway, I think that there -- that there is a -- that -- .

Now, I would like to see goals work at the problems that technology brings to us. Now, some people feel that nuclear power has no problems and, therefore, we needn't

worry about that and, therefore, there would be a disagreement. And -- but, basically, I do think that -- that goals should be targets; and, as I stated earlier, if one cast it the function of the goal of the NRC was to reduce the risks from nuclear power and a whole range of categories compared to the alternatives, one would recognize that in, say, routine emissions, one might have already met the goal. But in terms of risk of sabotage or risk of war, one might not have met the goal and that further work should be done at reducing sabotage and so on. Okay.

MR. BURSTEIN: If I may, in meeting a goal, then, or if it's -- if it's a goal that cannot be met, if it's an objective toward which one strives but never reaches, that would make it inoperative in a licensing proceeding, in a legalistic framework, in a regulatory or rule.

DR. BEYEA: That's right.

MR. BURSTEIN: Is that correct?

CHAIRMAN KOUTS: Not necessarily. Not necessarily because the ACRS proposal has a very interesting way of dealing with that, which, I guess, would be --

MR. LEVINE: I was going to point that out that I would change the -- first of all, change the definition of goal slightly as a goal, not a target that can't be reached, but a target that may not be reached, or the place upon which you can do cross benefit analysis to decide whether --

which way to go. If you want to change the regulations to make them more restrictive, you have to justify that with a cross benefit. If your claim doesn't meet the goal, then you have to show by cross benefit that it need not meet the goal. But I think the idea of setting something that can't ever be reached is not rationale.

DR. LEWIS: Well, you know, the French have something like this. Their goal is, if I remember correctly, ten to the minus six probability of a person at the plant boundary getting ten-gram exposure from an accident -- very, very precise. And when asked how they implement it, they say, "We do our best." And there's something -- there's something to what Saul says, you know. If you can evaluate something, you do it; and if you can't, you admit honestly that you can't. But some things you can do.

MR. BURSTEIN: That I have difficulty with in the framework of the licensing procedure.

DR. LEWIS: Oh, I understand that. We may be too legalistic. That's another issue.

MR. LEVINE: I'd like to comment on that too, if I may. I'd like to talk about safety goals, not in a licensing process, but in a regulatory process.

MR. BURSTEIN: I thought one of your purposes was restoring rationale --

MR. LEVINE: Yes, and I --

MR. BURSTEIN: -- to that process.

MR. LEVINE: And when we get to talking about that, I will tell you that I would not use -- use safety goals in the licensing process, but I would use them in the generic studies to make the deterministic requirements more rationale; and then, in a way, we'd sure of being sure that if one met the deterministic requirements in the licensing process, we would, in fact, be needing a safety goal.

DR. LOWRANCE: Could I ask what you mean by deterministic requirements, partly for the public record --

MR. LEVINE: Basically -- basically, what the NRC now uses, it says, you have one of these and two of those and you have this barrier and that barrier and these are deterministic requirements that are stated probablistically. They are things you have to have. And they state the design basis for these in terms of pressures and temperatures and the like and --

DR. LEWIS: But there are a lot of rules that aren't that neat. There are a lot of rules that are very, very subject to staff judgment --

MR. LEVINE: Yes, that's right.

DR. LEWIS: -- and those are not determined --

CHAIRMAN KOUTS: Well, the design criteria -- the design criteria are certainly in that category.

DR. LEWIS: The design? Yes.

MR. LEVINE: Well, I was just trying to characterize, and you're right, I was trying to characterize them very generally to differentiate from probablistic rules as opposed to deterministic --

CHAIRMAN KOUTS: Well, William has been trying to get --

DR. JOKSIMOVIC: I have in my library a viewgraph. I have a viewgraph which says, Purpose of Quantitative Safety Goals, so can I present my views on this now?

CHAIRMAN KOUTS: Why not.

DR. MAZUR: Please. And use -- and use the machine now.

DR. JOKSIMOVIC: As a matter of fact, it is a viewgraph that hasn't changed since last July when I appeared before Professor's Altman's faculty meeting. As a part of my proposal, I give an introductory type of viewgraph, and I summarize it by saying that, what I, as a plan designer, would like to see from the point of safety goals, and I hope that I'm taking into account other aspects like postponing type of conservation, I read these books and I believe that I'm responding to that by saying that I'd like to see a specific set of safety criteria which would provide the framework for designers to work with; and, in doing so, I think that should at least minimize if not abort directly the plant requirements that we have experienced over the

last decade.

CHAIRMAN KOUTS: You're a little optimistic there, I think.

DR. JOKSIMOVIC: I am indeed. But we -- we set our goals high.

MR. LEVINE: How about reviews and setting them for us.

DR. JOKSIMOVIC: I know that's a game, but human nature, I've been told, though.

One thing that I feel very strongly about, and I've discussed with many people, is that -- that designers feel extremely constrained in what they're doing and we'd like to give you the freedom to create effective design solutions to the problems we face; and designing a nuclear powerplant to meet the safety standard is only one aspect. There are many other aspects. That plant has to operate. That plant has to have higher ability, so it's -- it's a multi-faceted objective and any and all sorts of freedom to be able to come up with a -- with a solution which is going to resolve this; and if we - we give them more flexibility and/you have more confidence in them, I think we would be able to accomplish this much easier than we have been.

And I do believe very sincerely that -- that the safety goals will protect the public better, and I also believe, and I'm addressing Sol Burnstein's point, I -- I more

than believe that they're going to be protecting -- . Also, it would enable designers to come up with a new designs, which are going to probably end in the pot. And I think if we can articulate our arguments, we should be able to communicate with the public and should complete a philosophical understanding which I think, obviously, at this point --

CHAIRMAN KOUTS: I think these are all included in your --

MR. LEVINE: I think so.

MR. SALISBURY: I have a question -- whether avoiding rationing of plant requirements is a legitimate -- I -- I don't -- . Well, it seems to me that if you get -- as you get more reactors, to go back to your generic risks, that the amount of risk you want per reactor should decrease.

DR. JOKSIMOVIC: I agree.

MR. SALISBURY: To get the overall --

DR. JOKSIMOVIC: But we should know that in advance, and it's much easier to come up with a design on the drawing board, which is up to me then, as opposed to building in the field and then you have to make specifications.

MR. LEVINE: Ratcheting means after the fact, sir.

MR. BURSTEIN: One -- one of the things that I think we alluded to before in the difference between a plant specific and perhaps a -- a retrospective or a generic issue, is, for example, to have one nuclear plant in an area.

You might be able to set a safety goal, build a plant, do all the mechanismic analyses or probablistic analyses and come out with one type of level of safety. On the other hand, if there are ten, the probabilities associated with maintaining the same risk to the public from the ten is different than it is from the one.

Do you go back to the first one and say, "I want that as safe as the tenth," because if you do, one has to design plants in the year 1980 to be part of that population of the plants in the year 2050 or 2030, depending upon how long you want them to survive. It seems to me that that kind of fact-fitting or ratcheting is very significant in terms of what you set for the specific plant application, initially.

CHAIRMAN KOUTS: I'm going to just break in and say, in the back there, we're supposed to have coffee. This is supposed to be the time at which we break for it, so why don't we do that.

(Whereupon, a short recess was taken.)

CHAIRMAN KOUTS: Shall we start again?

MR. LEVINE: Okay. The four points I made earlier were (1) what is the purpose of safety goals, (2) what use -- to what use shall they be put, (3) how should we approach setting the levels of safety goals, and (4) is hard to word simply -- I just wrote, degree of specificity, but what I

meant is what are the things that should be in the goals and what should not be in.

DR. MAZUR: Presumably, the issue of quantitative or not could be covered in number three, right? How should we approach --

MR. LEVINE: Well, I -- I put in again the point zero that I asked mentioned before. Now, the first point, why do we need quantitative safety goals? I began to hear that point coming up in the discussions.

DR. LEWIS: You don't assume that in your point one, what is the purpose of quantitative goals.

MR. LEVINE: I did not in my thinking before, but it could be.

DR. LEWIS: I see.

DR. MAZUR: But then is point one -- is there a difference between what is the purpose of quantitative safety goals and what is the purpose of safety goals? Because it seems to me --

MR. LEVINE: No, all my -- all my thinking was in terms of quantitative, and that's why I thought -- I felt I ought to add the first one, why do we need quantitative goals?

DR. MAZUR: I see. Well, I want --

MR. LEVINE: It seems to me, for the record, we should say why we need them.

DR. MAZUR: Well, then, all the comments we've been

hearing, it seems to me, would equally well apply to non-quantitative safety goals as well as quantitative goals. Is there anything specifically about any of these comments that --

DR. JOKSIMOVIC: You may have said to conclude that.

DR. MAZUR: Well, I made notes of them. I think I could -- in fact, I didn't know until just now that they were addressing specifically quantitative safety goals. They all seem meaningful just in the generic sense of why we need safety goals.

CHAIRMAN KOUTS: Meaning -- meaning these four points or --

DR. MAZUR: All of them, yeah. From -- I can read them back if you want. I think that would be tedious, but it seems to me they're all perfectly adequate answers to the question, why do we need safety goals?

MR. LEVINE: I think that these apply to any discussion of any kind of safety goals -- quantitative, qualitative, or what have you -- but in my thinking about them, I was addressing quantitative.

DR. MAZUR: Okay. Well, then, may I ask, given all these reasons for having safety goals, why must they be quantitative rather than not?

MR. LEVINE: Yeah. I think that's the question I

have heard coming.

CHAIRMAN KOUTS: Bill.

DR. LOWRANCE: I have a question to you, then, Allan. What are some examples of safety goals that are not quantitative?

DR. MAZUR: Keep things as safe as you can within the amount of money you can spend.

DR. LOWRANCE: Is that -- does not that reduce, really, to a quantitative safety goal?

DR. MAZUR: Well, I don't think it --

DR. LOWRANCE: Can one not quantitate that? If you tell me how much you're going to spend and how many, you know --

DR. MAZUR: If money is no object, we said, then, the risk goal is zero.

DR. LOWRANCE: I don't hear anybody in the society saying that very clearly.

DR. MAZUR: No, but I mean that follows --

DR. LOWRANCE: But for those -- for other than that one asking Allan, what -- what other kinds of goals are there?

DR. MAZUR: Well, it seems to me that is a non-quantitative safety goal as I've set it. I have not stated any numbers or any logic for getting the numbers. I simply stated my goal is to keep things as safe as you can manage

within the amount of money you can spend.

DR. WALD: And there's really a formalized version of that. The -- a ladder as low as reasonably achievable --

MR. LEVINE: They -- they right away quantify that with $1,000 or $100 or whatever you want --

DR. WALD: May I suggest that --

MR. LEVINE: Well, the NRC was using $1,000 per MM for awhile.

DR. WALD: But that's not part of the --

MR. BERNERO: May I suggest that that is -- that, under the framework of Sol's thing in question three, "What is the philosophy by which you would construct safety goals?" That, for instance, in here is specifically addressed by what philosophy can one generate, and that is his statement of philosophy, of cross benefit philosophy. And in here, there is, in fact, a standard proposed for dollars that are justified to be expended to avert an early death, an immediate death, or a later death so --

MR. LEVINE: I disagree with that. I think this document is deficient in terms of my number three, which is, how do we go about setting safety goals? What is the rationale for it? I think the document is grossly deficient.

MR. BERNERO: Well, I'm not trying to defend the document, Saul, I'm just trying to say that that is the rationale that can be translated into a state -- a quantita-

tive statement.

MR. LEVINE: Sure.

MR. BERNERO: A quantitative goal. The goal --

CHAIRMAN KOUTS: Saul, Saul. I'd -- let's be careful. I think -- I think your criticism is really very pertinent, more to the numbers than to the --

MR. LEVINE: I don't feel the numbers have been justified.

CHAIRMAN KOUTS: No, that's right.

MR. LEVINE: That's what I meant.

CHAIRMAN KOUTS: Okay. That's what I thought you meant.

DR. WALD: I have to make a statement. You -- you just asked Saul to state these four points.

CHAIRMAN KOUTS: Yes.

DR. WALD: What are we going to do? Are we going to discuss them in order?

CHAIRMAN KOUTS: Yes, we are. Okay. Now, as a matter of fact, we started discussing them in order earlier. Saul proposed two specific -- two specific objectives of safety goals, and then William gave some more objectives that Saul agreed were included under his objectives. I have some difficulty, as I said earlier, in just -- in disassociating objectives from -- from the uses that you put -- put the goals to because the objective is -- it can always be

stated as, I need something that I can use in this circumstance and -- and for these reasons.

But -- so this -- this means that I have -- I would have difficulty answering your number one as separate from the number two. You kind of have to answer them together.

MR. LEVINE: I think there has to be some impact in the consideration of any one of these against the others, but I think if you think about them as a whole, when you start writing about each one or trying to develop each one, there's a flow of logic that leads you to pure identification of each one.

CHAIRMAN KOUTS: Now, you -- your two objectives were to protect the public health and safety, number one, and, two, to make -- to make the -- a regulatory process more rationale.

MR. LEVINE: Exactly.

CHAIRMAN KOUTS: And I could -- I could see almost everything that Vojin put up there as some way of making the regulatory process more rationale.

MR. LEVINE: That's correct.

CHAIRMAN KOUTS: But some of these --

DR. JOKSIMOVIC: I agree with that a thousand percent.

CHAIRMAN KOUTS: I said almost every one. I -- I

didn't say every one. There were some that were not that --

DR. BEYEA: I just have a problem with what does it mean to protect the health and safety of the public?

MR. LEVINE: Well, you see, that's a statement of basic purpose. I think you'd have to expand on that as we discuss, for instance, how you go about setting the levels of safety.

DR. BEYEA: Of protection.

MR. LEVINE: Yes. So you can't -- you can't consider these as separated from one another entirely.

DR. MAZUR: It seems to me, with your wording, you have to first put the first -- the other category first and decide first to define protection of the public before you can then talk about protecting the public.

DR. BEYEA: Well, I think you have to say you want to protect the public and then you define how you do it. If you don't want to protect the public, there's no point in defining how you can do it.

CHAIRMAN KOUTS: Sounds like -- I'm sorry.

DR. MAZUR: I was just going to say, Saul, that sounds a little platitudinous, I guess. Which, maybe, it's one of those motherhood statements.

DR. BEYEA: Well, I think -- again, I think if -- you have to think of motherhood as necessary, but we don't have to be that extensive.

DR. LEWIS: I don't know if it has to be used, the term motherhood, because it's excessive.

CHAIRMAN KOUTS: We -- we've agreed on apple pie.

MR. SALISBURY: Can I raise another little question as -- is the extent to which public acceptance -- acceptability is part of a purpose of a safety goal? I don't know whether it should be or not.

DR. LEWIS: I think that's an important issue. I think it shouldn't, but it clearly is.

DR. LOWRANCE: Could you rephrase that, because that wasn't very precise. What do you mean?

MR. SALISBURY: By acceptability?

DR. LOWRANCE: Yeah. What did -- what did you mean by your point in general? Could you just say a little bit more about it?

MR. SALISBURY: Okay. Well, it seems to me the question that a lot of people are -- have been skirting around has to do with this question of whether -- of purpose, of explicit purpose of a safety goal should be, in some way, to make nuclear power more acceptable to the public or, you know, if that's possible. By setting these goals, is there some -- is there some way we can come up with a goal which will reassure people about the safety of -- of nuclear power and, therefore, make it more acceptable.

CHAIRMAN KOUTS: I think Saul is --

MR. LEVINE: Well, I -- I would say I thought about this because I considered putting that in there but deliberately did not. If -- my view of the nuclear power controversy is that there are some people who will not be satisfied with any element existing, and they will not -- you could not write a safety goal that they would find acceptable; whereas the bulk of the people in the country, a large percentage, I judge 60/40, are for nuclear power. So what we're talking about is if you want to reduce the conflict about nuclear power, you have to address the 10,000 or 100,000 or million or whatever it is people who are expressing all the discomfort, who are vocally expressing and acting their discomfort about nuclear power. And I don't think you could write something for those people, so that's why I left it out.

CHAIRMAN KOUTS: Saul, doesn't that also go the number of a level, rather than -- than the fact that public health and safety protection is a goal?

MR. LEVINE: Yeah. It would have to -- it would have to come to the number finder. I -- I'm saying that you couldn't get numbers that would satisfy.

CHAIRMAN KOUTS: Okay. Bill Lowrance.

DR. LOWRANCE: I believe that, as with debates over food and drug materials, air traffic safety, and lots of other areas, that the discussion and the attempt to develop

quantitative or semi-quantitative, explicit goals for operation of an enterprise can help foster public understanding and guidance about activities. I don't think it should be seen as an activity to sell nuclear power to the public or represent it some way that's unfair. But I think the process itself is good for all of us, whether it's people in the industry, the general public, experts like myself who are kind of on the fringe of the particular industry and regulatory process, and so on; but I think to trying to foster a much more equitable discussion is fair.

MR. SALISBURY: Let me -- could I be a little bit more specific?

DR. WALD: As -- as to what has been said, from the standpoint of public health of which, perhaps, I'm the only representative here, and thinking back to where I was two years ago today, tramping around in the mud and facing a lot of people who -- whose health was impaired, because I do include psychological stress as a detrimental health factor, defining a safety goal, I think, does protect health and safety and it's not, and I agree with you, a matter of salesmanship or simply intellectual understanding. I think it is a psychological need that can be met by this process. I wouldn't write it off as not being part of --

MR. LEVINE: You would like to include it in the purpose.

DR. WALD: Well, I think it in -- it inevitably is if you think about a lot of anxious people and a defined safety goal which is intelligible.

DR. LEWIS: Now, I think there's a very important set of issues and I think, even if -- if nuclear power were not a controversial issue, if we were not talking about a -- people who are -- who are passionate about the subject, it would still be a very important question going under your number three, how do you set the levels. Whether part of setting the levels is to achieve public acceptability. And there's this -- to use a very specific example, we know, I assume, that if you die of cancer induced by radiation, it's not particularly more or less agreeable than dying of cancer caused by something else. Yet, the general public believes that it is less agreeable, that, you know, seems to be the case. People are more afraid of radiation; therefore, if you were able, which you are not now, if you were able to set a safety goal for nuclear reactors in terms of the number of cases of cancer that might be allowed per century or something like that, would you cause more people to die of cancer induced by coal emanations simply because people find that more agreeable than dying of cancer caused by nuclear accident. A very specific tradeoff in which the population doesn't understand, and do you -- do you bend to that? I think it's a very important question to which we don't have

an answer.

DR. BEYEA: Well, I'd like to --

DR. LEWIS: I'd say don't bend.

DR. BEYEA: You were not here originally, but I think that one could propose a safety goal in which he would be directly in comparison with alternative energy technologies.

DR. LEWIS: Well, that's one criteria. That is a criteria that is comparing it with benefits. You know, there are many of them.

DR. BEYEA: What I'm saying is that would directly address the question that -- that you raised. If you set a criteria, should we make nuclear power safer in, say, four or five different categories, that would address your concern.

DR. LEWIS: Well, we'll get into this. I'm opposed in general to judging the acceptability of nuclear power in terms of other risks which we accept, because that has built into it a kind of comparison which is not a risk benefit comparison, which I would rather see. So there's an issue. There's simply not a direct trade-off between coal-generated electricity and nuclear-generated electricity. There are all kinds of issues other than the health and safety of the public involved.

DR. BEYEA: But we are --

CHAIRMAN KOUTS: There's a narrower question here

which is, should we structure a safety goal in order to make nuclear power more acceptable to the public?

DR. BEYEA: That's --

CHAIRMAN KOUTS: And I thought that was the --

DR. LEWIS: I thought that was the really narrow question you were discussing.

DR. WALD: Can I ask a related question, because I was discussing it during the coffee break, and maybe it would be useful to at least consider it. The possibility that a safety goal and, even more specifically, a quantitative safety goal may not protect health and safety; and, as an example, consider the Delaney Amendment which set as a safety goal no cancer from a substance which is taken in by the public.

MR. BERNERO: Well, that was a silly one. That's why --

CHAIRMAN KOUTS: That was an irrationale one.

DR. WALD: That was a safety goal -- that was a safety goal which has not protected the health and safety because it's removed access to agents which would indeed influence health favorably because it resolved the problem of acceptability by saying zero. Now, it's solved a lot of problems in your alpha term because it doesn't exist. And, you know, there's some real virtues to it; but what I'm really getting at is that a safety goal doesn't necessarily

protect health and safety and I think more has to come into -- into this, not in terms of use or user, which hasn't been mentioned, even more than what use -- I have trouble with a safety goal unless I know for whose use.

MR. BERNERO: Do I understand what I'm hearing from the other side of the table? Then you -- your -- some people would feel that there -- that safety goals should not try and reach any kind of social concensus on nuclear power or other energy issues, is that correct?

DR. LEWIS: No, that is not what I said. What I said is that the -- a safety goal and -- incidentally, I agree with Saul that the purpose of -- of quantitative or probablistic analysis, whichever you want to call it, is to provide a rationale for prescriptive standards because, in the end, as Burstein has -- has emphasized, the licensing process is legalistic and it's a general principle of law that somebody who comes into a legalistic proceeding has --

CHAIRMAN KOUTS: I -- I would think you would agree with him because --

DR. LEWIS: Pardon-

CHAIRMAN KOUTS: I would think you would agree with him because he cited you as the source.

DR. LEWIS: Well, you can't argue with another life.

DR. BEYEA: It wasn't a sainthood then.

DR. LEWIS: Consistency is the hobgoblin of you know what.

But -- but -- no, my view is that, as you make an analysis, what you try to do is to make it rationale and, in my view, by measuring risks against benefits. We've been given a good example of a case in which concensus has damaged the health and safety of the public. So you do your best to protect the overall human benefit as best you can, obviously. So you --

DR. BEYEA: So you're not interested in defenses, you're only interested in protecting the human health and safety as you -- as you see it.

DR. LEWIS: That is -- that's part of the objective. You want to -- you know, you want to improve the quality of life too, but you set your standards, your prescriptive standards as rationally and as well as you can. This may not be the way that achieves the best political concensus and that's tough.

DR. BEYEA: Right. I want -- I want to show that we have an -- that there are definite differences of opinion and I just want to bring those --

DR. LEWIS: Yeah. Oh, I thought you were saying that I wanted to make -- achieve this concensus.

DR. BEYEA: No, you don't want to. You don't want to.

DR. LEWIS: No, no.

DR. BEYEA: And I see the purpose --

DR. LEWIS: No. But there's a difference between saying, "I don't want it to." I don't believe that should be the primary consideration or even an important consideration in setting them up. Later, in the real world, in the political process, one gives and takes in order to accomplish things.

MR. BURSTEIN: But nothing that's going to succeed in that real world without a general public acceptance.

DR. LEWIS: Oh, I understand that perfectly well, but I'm reacting to many, many paper, documents, reports, and articles I've read that approach the question of quantitative safety goals for nuclear power and other things entirely in terms of taking public opinion polls and finding what is acceptable. Now, I'm reacting against that. I think that's just dead wrong; and when you go that route, you're -- you're really shirking your duty to the public.

MR. BURSTEIN: But the other extreme --

MR. LEVINE: You say it's a two-step process.

DR. LEWIS: Yes, I do.

MR. LEVINE: You said a rational set of goals --

DR. LEWIS: Sure.

MR. LEVINE: -- and then you expose them to the public for public acceptance - evaluation.

DR. LEWIS: Sure. And in the best of all worlds, what is rational survives.

DR. BEYEA: Yeah, but the other -- the other extreme is that you assume that you can, in fact, come up with a rational procedure, whereas, in fact, I think if you look at it, in your -- in your determination of what is of human benefit, there would be an enormous number of value judgments that will be involved in that --

DR. LEWIS: There's nothing irrational about value judgment.

DR. BEYEA: It's very personal. Your rationality is very personal --

DR. LEWIS: They are personal.

DR. BEYEA: -- as to how Lewis' personal decision as to what is human benefit.

DR. LEWIS: Absolutely. But that's the real world. We have to do things that way.

DR. BEYEA: No.

DR. LEWIS: You know, in NRC now, there a number of criteria for the licensing of plants which essen -- which are uninterpretable by the average person. They depend on satisfying the relevant staff member that you've met a requirement and, you know, sometimes -- I had an example a couple of weeks ago. I can't find out what the hell conditions the staff is using for judging a particular requirement.

MR. LEVINE: I can also tell you that there are -- in one or two instances, there are probablistic goals --

DR. LEWIS: Yeah.

MR. LEVINE: -- about specifics and the staff violates those too.

DR. LEWIS: Yeah. Well, you should -- but, you know, you have to do as well as you can.

MR. SALISBURY: It seems to me, though, that this question of public acceptability is maybe a little bit more subtle than -- than we've gone into so far. It -- well, I mean, it seems to me, certainly, there's a question of whether somebody dying of, or feels that a cancer death from nuclear or a cancer death from coal, there's a difference there, but there are also other aspects to public acceptability or public perception of risk that it seems to me might be more legitimate considerations.

For instance, there's this question of -- of risk aversion to large scale disaster. Now, does one try to take a "rational" approach in which a death is a death is a death, or do you try to take into account the fact that, somehow, people react differently to the prospect or the actuality of large-scale catastrophe. Do you -- do you make a differantiation, like the ACRS does, between the immediate death and a cancer death? It seems to me these are all hinged on -- on the value judgments that do feed back into this question of

public acceptability.

DR. LEWIS: I agree that they do. But they also feed back into the issue of what is a rational way to set about making standards, and it's not at all clear to me. I may be just not as democratic as I should be. It's not as clear to me that, if we were to resolve these very, very difficult questions around the table by saying, you should go with the size of an accident to the 1.73 power or instead of the first power, I'm not -- I don't believe that it's automatically clear that the first power is the right one. You know, that has statistician's expectation value, but it's not clear to me that's right.

But, on the other hand, if we -- if we were to come to a concensus, I'm not so sure that would be socially less desirable than asking other equally ill-informed people to come to a concensus. You do the best you can with the parameters at hand.

CHAIRMAN KOUTS: On the subject of -- on the subject of acceptability, I would not go very far beyond making it -- making things understandable. It's important that they be understandable. Take the tax laws, for instance. There are very few people you would -- you would get to make -- . It would be very difficult to make everyone agree that the tax laws are acceptable, but we would all demand that they be understandable; and I would regard safety goals in the

same category.

DR. LEWIS: It's the wrong time of year to cite the tax laws. You didn't have to translate it into reality.

CHAIRMAN KOUTS: So I would -- I would make this not a goal, not a -- . This is not one of the reasons why we have safety goals, but it's certainly a characteristic that we will demand to see.

DR. LEWIS: But, you know, you can -- you can make the acceptability hinge on performance. All these classic aircraft examples, the -- the standard for the safety factor in an airplane wing is determined by the fact that airplane wings don't come off very often, and the rate at which they come off is what is acceptable to the public, not the safety factor, which the public doesn't know anything about; and achieving social acceptability through performance is absolutely essential. This is a democracy, but it's a long way from there to determining the standards in such a way as to achieve public acceptance.

MR. BURSTEIN: Again, I think that goes to the quantification, the number, as opposed to -- to the goal, the purpose of the goal itself.

DR. LEWIS: Yeah. And no one can have specificity without quantification too.

DR. MAZUR: I wonder if I could suggest a model that might have some acceptability, and that is if we think

of the Nuclear Regulatory Commission as an agency which is not setting nuclear policy in the sense of whether we should or shouldn't have it, but is mandated with administering it, and is not trying to be promotional, and is not trying to squash public opinion, but is, presumably, a responsible acting agency, as responsible as they get, and that, from that particular perspective, safety goals ought to be what helps them proceed along in their defined tasks. And perhaps we could limit it --

DR. BEYEA: Wait a minute. The task -- the task would be what?

DR. MAZUR: The tasks being to approve particular plants and to set generic rules.

DR. BEYEA: At any level of nuclear power, then?

DR. MAZUR: I'm sorry. I --

DR. BEYEA: But that -- what level of nuclear power? 700 nuclear plants, 7,000 -- what level? How fast are they supposed to go -- to go ahead?

DR. LEWIS: That's not the decision that you're going --

DR. BEYEA: But it is safety-related, though. You assumed their task was well defined. Are you assuming their task is to promote nuclear power?

DR. MAZUR: No, no. I'm saying that is not the task of the Nuclear Regulatory Commission.

DR. LEWIS: My problem is, I have to review the law. I made that comment earlier around a similar table and somebody said, "Hal, you haven't read the law recently. They do have the task of promoting nuclear power." Now, somebody is wrong, and I don't --

MR. LEVINE: If I'm not mistaken, the Atomic Energy Commission has the task of promoting nuclear energy.

DR. LEWIS: Right. I understand, and --

MR. LEVINE: And the regulatory part has --

DR. LEWIS: I understand. That's the way I see it. Again, I made the comment --

MR. BURSTEIN: You can argue about words. Perhaps the NRC has the obligation to promote the safety of nuclear energy.

DR. LEWIS: No, I don't --

CHAIRMAN KOUTS: The issue was whether the original task -- . When the Agency was divided, when the Atomic Energy Commission was divided into two separate paths, what parts of the initial objective went in which direction?

MR. BURSTEIN: I understand.

DR. BEYEA: Let me -- . I think -- I think the mission more likely to be for the NRC to allow nuclear power to proceed at such a pace which is -- protects the public health and safety. I think that that part of the implicit mission is not simply to -- to make these plants as safe as

they need to be.

CHAIRMAN KOUTS: Bob.

MR. BURSTEIN: I -- I guess I would -- excuse me. I would disagree violently that the NRC has any jurisdiction on the number of plants. As we talked about before, it may set the safety standards to protect the -- the population in response to the generic issues raised by the numbers, but it does not have any authority, from my knowledge of the law, that that says it shall reject an application presented to it because it exceeds a certain -- a certain number.

Now, we talked about the problem of backfitting. We talked about whether new plants should have more rigid requirements than older ones because of their impact on the total population of plants.

MR. BERNERO: I just wanted to remark for clarity, it is, indeed, the old law, the Atomic Energy Act, that commission -- a commission to both promote and to regulate. The Reorganization Act in 1974 was very careful and explicit to separate that. It basically gives us what I think Allan Mazur was saying. It is the Congress, by legislation, says that there -- there is authorized nuclear power and sets up a commission to regulate it, sufficient to protect the health and safety of the public or whatever apple pie phrase you prefer, as the general objective, which any regulatory agency has -- protect the public from toxic substances or

nuclear power or whatever.

The number of nuclear powerplants, or their perspective locations, influences the safety criteria. If -- if, after all, the only nuclear powerplant anyone wanted to build would be in Arco, Idaho, you would have quite different safety criteria, potentially, than if you want to build them near load centers for electrical utilities, which --

MR. BURSTEIN: It would be cogeneration.

MR. BERNERO: Yeah. Which implicitly brings you to population centers. So the NRC does not have any authority to set a quota or, for that matter, anything else about it, except insofar as it is part of a safety regulation, a setting of adequate limitation of the risks to the public, and whether it be by limiting the overall size of the powerplant or setting standards which reflect the overall number of powerplants, either in-hand or expected, that's the -- the regulatory

MR. LEVINE: I wonder if I could assume the role of a resource person here a moment. The ins and outs of the Atomic Energy Act specifies that reactors should be licensed under the concept of minimum regulations. That's still in the law that governs the NRC.

MR. BURSTEIN: That's still in the law, but I doubt if it governs the NRC.

MR. LEVINE: The law which is supposed to govern

the NRC.

DR. LEWIS: Government is a matter of consent between the governor and the governed.

CHAIRMAN KOUTS: Bernero stated something which is -- which is right in principle but may not always be true in practice, because -- because the Commission certainly turned off the process for the generic impact statement on mixed oxide fuels, even though the industry was interested in proceeding with this, on the basis that it wanted to set a limit on the way nuclear power was implemented. Or at least it was going along with the executive branch's point of view on this for the time being. So, in practice, it goes beyond what you're saying.

MR. BURSTEIN: I think, Herb, that we must never lose sight of the -- of the pragmatic. What you have cited is indeed very true. If the administration or the commissioners appointed can divorce themselves from the politics of the world, you might -- might be able to perhaps respond to the status more precisely but, clearly, we are living in an area where these decisions, including regulations and their implementation and interpretation by licensing boards and by appeals boards and by the commissioners, are political, or have political implications and overtones.

I guess we've gotten a little bit away again from the --

CHAIRMAN KOUTS: Well, we're still dealing with what is the purpose, and we've -- we've got a little bit away from -- from the question of whether safety goals should be generated in order to be acceptable to the public; but I think we've also arrived at some sort of a concensus on this, that that really is not a primary objective of the safety goals. We're not after making --

MR. LEVINE: I think the words you said are important. You said some important words before all of that. They should have the characteristic of being understandable.

CHAIRMAN KOUTS: They should certainly have the characteristic of being understandable, and that -- that, perhaps, is as far as we can go in this meeting.

MR. LEVINE: I'd like to go back --

DR. LOWRANCE: Chairman, I have a comment on that. Sorry.

I think any set of explicit safety goals that are not just understandable but, basically, acceptable and accepted by the public won't last for very long. It's narrative process. Again, we've been through it in many areas, and so I don't think you could expect to run the industry and the agency for very long unless you start out with goals that are somewhere in the ballpark of things that people are willing to stand for. And the same is true on the benefit side. If the agency regulates so tightly the benefits the public

wants are not available, then there'll be an outcry there too.

Surely, we'll propose goals, fight over them for a year or two, revise them, change, put in some other goals, and continue this for a long time.

CHAIRMAN KOUTS: So we -- so you're -- you're certainly distinguishing -- making a very important distinction between seeking acceptability of -- of the -- of the technical goal and acceptability of the safety goal. Maybe that's not --

DR. LOWRANCE: I don't make any distinction between those.

CHAIRMAN KOUTS: Well, the technical goal is nuclear power, and the safety goal is safe nuclear power; but the -- but the acceptability of the statement of the safety goal is certainly demanded.

If the safety goal is not stated in a way such -- such that it itself is accepted by the public, it's not going to work and, therefore, you're saying that one of the objectives -- one of the characteristics of the safety goal is that it be acceptable.

DR. LOWRANCE: Yes.

CHAIRMAN KOUTS: Yeah.

DR. MAZUR: I would like to make a stab at getting to a working answer to question one so we could move on, and

I wonder if it would be okay if we basically took the -- the definitions that Bob and, I think, Saul gave toward the beginning, and that is that they were to be guides for the Agency in its specific and generic decisions and that it -- it not be construed more broadly than that so as to bring about public acceptance or promotion of nuclear power.

CHAIRMAN KOUTS: Well, now, we're moving into number two.

DR. MAZUR: No, no. That -- well, that was my attempt to provide an answer for one, what is the purpose. I was trying to say what it is and what it isn't and, hopefully, put a bound on it; and I'm suggesting the purpose of the safety goals is working answer for us, if nobody objects seriously, to provide guides for the Nuclear Regulatory Commission in deciding whether or not a particular facility is acceptable and whether or not generic judgments are proper on its part, which are the two kinds of judgments that Bob mentioned.

That's what it is, and what it is not, a specific non-purpose of it for us is to bring about the public acceptance or promotion of nuclear power.

I wonder if that might be a sufficiently acceptable answer so that we could move on to the next question.

DR. LEWIS: Well, just as a point of information, do you mean to exclude from that the use of the safety goal

at a much lower level of aggregation to decide on specific technical requirements for plants, determining how reliable a safety valve has to be under high flow conditions?

DR. MAZUR: No, I certainly wouldn't mean to exclude that.

DR. LEWIS: You mean to exclude that. I just wanted to know.

DR. MAZUR: No, I'm not. I'm not commenting on it.

DR. LEWIS: Oh, you're not.

MR. BURSTEIN: I believe again that we are getting into uses as opposed to the purpose. It seems to me that Saul Levine defined protection of public health and safety and rationalization of the regulatory procedure as part of the purpose, and when we got into the matter of specific plant licensing and generic issues, we were talking about its application, or the use to which the goal would be put.

DR. MAZUR: I guess I am having definitional problems again. What's the purpose and what's the use?

MR. BURSTEIN: I certainly feel that one can define the purpose, again in the same phrases of public health and safety protection, and in rationalization of the process, and with all of the discussion that we have had, I don't find anything that has either added or subtracted to those two items.

JBFLS
CHOY

DR. BEYEA. Can we move on to three then?

DR. JOKSIMOVIC: I don't think we are ready for that.

MR. LEVINE: I think we are ready for two.

DR. LEWIS: The suggestion is to confine the statement for the purpose to simply make the regulatory process more rational, in effect, in its protection of the public health.

MR. LEVINE: I would say, for the moment, and let's go on to two and come back and change it later.

DR. LEWIS: This is a minor thing -- making it more rational, rather than rationalization, because rationalization has a different connotation.

DR. MAZUR: So, making regulatory process more rational? But it is not to bring about public acceptance of nuclear power?

DR. LOWRANCE: I object to the word rational. I think it might make the process more orderly, more stable or other things, but I think to preempt the word rational for the engineering view or our view or something else is not quite fair.

DR. MAZUR: I guess I disagree with you. It can be orderly and consistent while being irrational.

DR. LEWIS: Absolutely.

DR. WALD: I was just going to address that same point. It may be consistent but not rational, if the trade-off, and we are not talking at all about cost benefit, and

we are not talking about alternative energy sources or any of those things, and it may be totally irrational to go the way we are going, but it will be orderly.

DR. MAZUR: But the goal is to be rational, right? Not irrational.

DR. WALD: I am not sure you can talk about nuclear safety in isolation and consider that this is rational.

DR. BEYEA: I'll go along with that. I'll interpret rational the opposite as Hal does, but I'll agree with the wording.

CHAIRMAN KOUTS: All right, number two, how do we apply it. Now Saul has proposed a modus operandi here, too. He says, we don't use the safety goals directly in licensing applications. We use the safety goals to develop the requirements that will be used in licensing applications., such as using this, say, to determine how much backup electric power you will require. Right?

MR. LEVINE: By the way, I should add that doesn't mean that one would not do a risk assessment on an individual plant or sets of individual plants, outside the licensing process that would provide you the wherewithal to make judgments about how to fix the regulations.

CHAIRMAN KOUTS: In fact, I would find it very difficult to carry through any process that uses your way of operating without doing a risk assessment on the individual

plant as well.

MR. LEVINE: In the licensing process.

CHAIRMAN KOUTS: Somewhere as part of the licensing process, but not necessarily -- I find it difficult even to say what not to do, as well as what to do, but I think in the course of reviewing for licensing, you will have to do risk analysis if you are going to depend on quantitative safety goals.

MR. LEVINE: I wouldn't.

CHAIRMAN KOUTS: Because you may not be able to determine how much backup electric power you need until you analyze the rest of the situation as well.

MR. LEVINE: May I make an example? Let's assume that there are fifty operating PWR's -- I don't know what the number is -- and let's assume that you have made a full risk assessment on twenty or thirty of them, and from those you get a set of engineering insights about what is important in those reactors. Then you compare those insights against the existing regulatory frameworks and you say, gee, I really need more reliable auxiliary feed water systems than I specify in my existing regulatory framework, and I fix that. Then I don't have to do the other twenty or thirty or the next one that comes in, as long as they meet that, because I will know that they will meet the safety goal. I don't think that you have to do it on each and every reactor. You have to do it on a

significant number of them.

DR. LOWRANCE: I don't see quite yet how the generic safety goal will then be of any use, because all that matters is how -- to me, anyway -- is how these individual plants actually perform in the long run. And I wonder if you could use an example, such as radiation release goals or something of that kind, and tell me how an overall national or regional reactor type radiation release goal could help a designer or regulator build plants or license plants.

MR. LEVINE: I think it will. I think that some of the goals proposed in here, for instance, are expected values of societal risk or individual risk. I think now you can say that if you lead to core melt how will you go, and you meet these other goals and you are acceptable, and I now have done enough risk assessments on enough individual plants to specify criteria in the licensing criteria, if implemented, it would insure that those numbers are met. I don't have to do it on every plant. That includes radioactive releases.

DR. LOWRANCE: I see what you mean. I misunderstood. I thought you were referring -- when you said generic -- I thought you meant sort of an integrated national situation.

MR. LEVINE: No, no.

DR. LOWRANCE: You didn't.

MR. LEVINE: No. I mean setting the goals for individual plants.

MR. BURSTEIN: Typical rather than generic.

MR. LEVINE: Yes.

CHAIRMAN KOUTS: You can only talk that way I think if plants are so similar that your having done a risk assessment on one or a few, allows you to carry over your reasoning to the rest.

MR. LEVINE: That's correct. I think that's true. If you can in with a fast breeder reactor tomorrow morning, you would have to look at it differently.

CHAIRMAN KOUTS: Or if you came in with a light water reactor of the German character.

MR. LEVINE: I guess I would have to say that I am talking about my viewpoint deriving from the fact that we have a limited number of vendors and we know how they build a plant and we are talking about standardizing the plants so they would be very similar.

DR. LOWRANCE: But then the question of site specificity comes up. Obviously where you put the plant makes a difference.

MR. LEVINE: That is included in the probability number for exposure to people. Population is in that number.

CHAIRMAN KOUTS: You have to do a corral calculation.

DR. JOKSIMOVIC: In my experience the form of operation is extremely important. We can do the theory studies and we have done numerous numbers of them, but when we do it

and then we subject it to the scrutiny of the plant operation we find that it doesn't fit, and hence we have to do it on a plant-specific basis, and we have to factor in the performance of each individual plant. So my particular picture is that we have to have something like a safety goal meter in every plant which is simply going, at any point in time, to describe how well that plant is performing versus what is intended.

That may be the difference between what Saul and I are saying. Because the plant operation is so dominant that it can actually obliterate any type of predictions that we can make, and until we go and scrutinize the detail of that plant operation, until we find out the whole operational history, we really cannot assess whether the plant is meeting goals or not.

MR. LEVINE: I think if you study thirty plants you will know.

DR. JOKSIMOVIC: I have yet to see two operate in a similar fashion.

CHAIRMAN KOUTS: That is certainly a whole new ball game.

MR. LEVINE: You are certainly right that the way in which the plant is operated, tested and maintained has an impact on risk. These were looked at in two different reactors of BWR and PWR. We found the risks came out much alike. You can accommodate this in the generic risk assessments you make to help you set the regulatory requirements.

MR. BURSTEIN: When it comes to operation and when it comes to design and hardware selection and low bidder versus something else, aren't you talking about the ways of achieving a goal, rather than the goal itself? You might say that we would use the goal to set a standard of performance, but we are not going to change the goal because a new crew came on to operate the facility.

CHAIRMAN KOUTS: No, he is not proposing that. He is saying that the inspection staff of NRC has the responsibility connected with safety goals as well, and once you license a plant, using safety goals in whatever way you are going to do it, the inspection staff has to go out and see if the safety goal is being met or is this plant so shoddily run that it is not achieving the objectives set out?

DR BURSTEIN: I am assuming that that gets translated not to the goals, but to the evidence of the goals that are specified in operating procedures, in limiting conditions for operation, in other kinds of hardware and software limits that are part of the unique single facility. Again I think regulators have difficulty in measuring things without a quantity to be specified for a standard.

MR. SALISBURY: Where does that lead us?

DR. BEYEA: Number three.

CHAIRMAN KOUTS: No, no. Do we follow Paul's suggestion?

DR. MAZUR: Could we hear it again?

DR. LOWRANCE: I would like to ask a question and perhaps Hal Lewis could answer it, and that is, he has had a lot of experience in dealing with probablistic assessment. If one does an assessment for a particular reactor design and ties that to overall statements on reactor goals, is it possible then to work backward to design specs? Is it possible to take overall safety goals, let's say, of the kind that are discussed in that NUREG, and work back to actual pieces of hardware and safeguards and emergency procedures, siting decisions, security, and those kinds of things? That is what I really don't know the answer to.

DR. LEWIS: My personal view is, no, you can't do that in any really definitive and quantitative way. But it's like knowing when you are on the continental divide, you really never know when you are, but when you get far from it on either sire, you know which way the hills are falling, so you can use these criteria, within their limitations, to decide whether some things are silly and whether some things are essential, and in between, in the end, you have to depend on the judgment of trained, experience and honest people. That is the way we run the world. You certainly cannot do it in any automatic way, at this time. I suppose in principle you could eventually, but I don't think so.

DR. JOKSIMOVIC: I don't know what you mean by

automatic, but we do that as a matter of routine in how we design the plant.

DR. LOWRANCE: I realize that, but if I analogize, let's say, to the aircraft industry. Suppose the country could decide that no more than five hundred deaths per year would be a goal we would try to shoot for in the United States for commercial travel at the current rate -- I don't quite see how you could take that number, and that seems to me relatively more simple to deal with, and translate that back into either landing systems or design of aircraft.

It is iterative, and I think Hal's answer would be that it is iterative. You change the aircraft some, you do modeling that is conceptual modeling and you go around and around and around so that it somehow fits within the goal.

DR. JOKSIMOVIC: It is a highly iterative process, but it works.

MR. LEVINE: I don't know if you can construct a framework from safety goals specifications, quantitative specifications on every element of the project -- it's not possible. No one knows how to do that yet.

It is possible to take the existing sets of regulations and safety guides, et cetera and relate them to the important of certain pieces and then to examine those pieces to see if there is agreement in the way they are specified of if it should be changed.

CHAIRMAN KOUTS: Again, maybe a few words would help here. It is certainly possible to do all of these things. The reliability you place in the results may come in question. You can construct a process for arriving at an answer that would have a large error margin attached to it. But we are accustomed to dealing with things like that.

DR. LEWIS: Going in the other direction, that is to say that you can ask yourself about the strength of a particular member or the redundancy of the electric power supply systems, and ask yourself whether you are overdoing it in terms of some quantitative safety goal, and do it that way. But I don't see how you can come back, because there are so many tradeoffs. If you have done a good design, there is no single tall pole in the tent anyway, so coming back to the design is not so obvious.

MR. BERNERO: I would just like to remark in here again, and I think Hal with his aircraft experience could bear out some of this --

DR. LEWIS: Hey, I lived coming up here this morning.

MR. BERNERO: The analogy to the aircraft industry is a very good one because there is a general philosophy there that it should be unlikely that any given commercial aircraft is going to kill someone. As a statement of philosophy, the FAA more or less follows that. And they try to work from that so that the expected value of killing someone should be

substantially less than one in all the flights of a Boeing 737.

MR. LEWIS: It can't be bigger than one.

MR. BERNERO: No, in any flight on any Boeing 737. But they are able, and do, in fact, have quantitative standards for those pieces of the problem that can be addressed quantitatively, the number of switches and cables, hydraulics, servomotors, and when you get to the grey-haired gentlemen who get $100,000 a year to fly the DC-10, it does not lend itself to quantitative standards, probablistic standards, but it does translate into medical standards for eyesight, vision, reflexes and what have you. The structural standards are not quite so quantitative because they are very hard to do. But one can derive some quantitative standards from a general goal, certainly.

MR. BURSTEIN: Which may be different for different applications and types of devices.

CHAIRMAN KOUTS: Jan?

DR. BEYEA: I want to comment on the aircraft analogy. I think it is very interesting. I don't think is has much connection, but the differences are important to understand why we have so much problem on nuclear power. I was thinking about that on the plane out here. We accept, or many people accept the fact that there is non-zero risk from flying in the aircraft, but we are used to it. We ride in the airplanes and I think our experience changes. After the first aircraft,

the second, third, we become a little less nervous about the process. Nuclear power process is somewhat different. My experience is that people have no familiarity with nuclear power at all. It is a concept that is very young to them, and they are concerned about it, as they might be about any new danger. And I don't think that most of the public has had enough experience with nuclear power to be willing to turn over the decisions as to what is safe and what is not safe to the experts that Dr. Lewis was mentioning. The fact that in certain areas of society we follow certain procedures in turning these things over to technicians does not necessarily mean that we can follow that procedure in all areas. I think that one of the problems with nuclear power at this time is that those people who are experts have very little credibility for a large segment of the public, and that in fact is why the Congress, of some members of the Congress, have in fact asked for a new safety goal, or at least a quantitive safety goal.

DR. JOKSIMOVIC: You are saying they asked because of the low visibility of the experts?

DR. BEYEA: That is right.

DR. JOKSIMOVIC: I haven't seen those words anywhere.

MR. BURSTEIN: I hope you're mot asking that we turn the decisions over to the non-experts. What is the choice here?

DR. BEYEA: One choice would be to rely on technology.

MR. LEVINE: I think Lewis gave a choice, for the experts to develop a role.

MR. BURSTEIN: I have no problem with this, but what we are suggesting is that the experts have no credibility and so we have to have somebody else set the goal, and I am concerned about who?

MR. LEVINE: The polls I have seen show that scientists and engineers have much higher credibility than the congress members.

DR. BEYEA: Do you think that the people, the experts in nuclear power have credibility, that is an opinion.

DR. JOKSIMOVIC: I have seen a table, as a matter of fact, and I remember that engineers were number three in the table. Clergymen were number one, and maybe medical doctors were number two.

MR. BURSTEIN: I guess I am not concerned with credibility as much as I am with capability. I think we are playing here with something that apalls me.

MR. SALISBURY: There have been some studies of experts, the predictions of experts in a number of different fields and in general they found that the predictability of experts is somewhat lower than actually, and some equal to or lower than informed laymen.

DR. BEYEA: They tend to ignore the outlyers, as

I recall.

DR. LEWIS: That is just not true in solving differential equations.

DR. BEYEA: No, but Hal, there are studies that look into this, to expert bodies making subjective judgements, technical judgments.

DR. LEWIS: Nobody is talking about expert bodies making subjective judgments. That is a red herring. We are talking about doing the best job that we can.

DR. BEYEA: That is what he is talking about, studies of experts doing the best job they can. There have been post factor analysis of their predictions, and the studies indicate that those experts tend to ignore the outlyers.

DR. LEWIS: You are not suggesting, I hope, that we have nuclear plants and airplanes designed by non-experts?

DR. BEYEA: I am saying that aircraft is not a proper analogy. Those procedures which work in designing aircraft are not appropriate to the design of nuclear power plants because there are two things that we don't have. First of all, we don't have as much experience with it, and second we don't have familiarity with it, and we don't have the credibility with it.

DR. LEWIS: Are you asking that non-experts design nuclear plants?

DR. BEYEA: Of course not.

DR. LEWIS: I think you are.

DR. BEYEA: No. I am saying that your model --

DR. LEWIS: You are saying that experts --

DR. BEYEA: I am saying that I do not think that nuclear power can or should be operated such that we must rely on decisions for safety by people who are experts, and that is why I think a safety goal must be formulated in terms which are comprehensible by the general public.

CHAIRMAN KOUTS: Let's let that stew a little bit.

DR. LOWRANCE: I think the disagreement is a little bit -- I think you are misunderstanding each other. I believe Dr. Beyea is saying that experts alone should not be deferred to for these decisions. Isn't that correct? That they should do their work --

DR. BEYEA: When large segments of the public do not think those experts are credible, do not believe them, do not trust them, they are not a viable method for making decisions in our society.

DR. LEWIS: Do you believe the public is right?

DR. BEYEA: In many cases they are correct, yes.

DR. LEWIS: I see.

DR. BEYEA: Sometimes they are not.

DR. LOWRANCE: But that is why we have meetings like this.

DR. BEYEA: In fact, the public has a lot of

experience in terms of the experts decisions that have been made. Starting out with putting the shoe boxes in stores in which x-rays were used. There is a long history of errors that have been made in this industry, as you know well. And the public has the right to evaluate experts on the basis of performance, and many people feel that the performance of the nuclear experts has been a failure.

DR. LEWIS: No question, but if you do not want the experts to design the plant, who do you want to design them?

DR. BEYEA: I don't want to trust the experts to tell me that it is safe. Let's make a distinction here.

DR. LEWIS: That is not what we are talking about.

CHAIRMAN KOUTS: It is part of the process of designing the plant. That is Hal's point.

DR. BEYEA: We have the FAA as an independent body that has some credibility going in aircraft.

DR. LEWIS: Let's not talk about the FAA.

DR. BEYEA: The public may have an incorrect perception, but the question is who are we going to rely on to tell us our nuclear power plant is safe. I get people all the time asking me, well, what is the truth? Are nuclear power plants safe?

DR. LEWIS: And I say that is a dumb question to which I will not give an answer.

DR. BEYEA: That's what I say.

DR. LEWIS: But there's no difference between us that in the end, the body politic, which means the public in a democracy, has to judge the performance of all of us. That does not mean that we ask the general public to solve differential equations.

DR. BEYEA: I agree with you.

DR. LEWIS: Okay, let's go on.

Or even to check whether I have done them right.

(Laughter)

DR. BEYEA: But the public might hire somebody else to look at your work.

DR. LEWIS: That's acceptable and even desirable.

DR. BEYEA: And that may be another way.

CHAIRMAN KOUTS: I have two dangling threads that I would like to tie up.

DR. BEYEA: How did you get it down to two?

CHAIRMAN KOUTS: We are trying to progress in a stepwise manner here. My last step, there were two dangling threads. Have we accepted Saul's proposal? Have we accepted his point of view that the way you implement safety goals in the process is to use the safety goals to settle deterministic requirements?

MR. LEVINE: To improve the regulatory process, but not to use them directly in the licensing.

CHAIRMAN KOUTS: I have not heard anyone really

disagree with this except Vojin.

MR. BURSTEIN: Then what are you going to use them for?

CHAIRMAN KOUTS: An alternative would be that licensing is based on doing a probabilistic analysis for this plant, and if it passes it and the curve falls within some other curve that you have established, then you pass the plan.

MR. SALISBURY: But then it has an effect on licensing then.

CHAIRMAN KOUTS: Yes.

MR. LEVINE: That brings you right into the licensing problem.

DR. MAZUR: But if a plant looks like it is going to violate the safety goal, you don't want to give it a license.

CHAIRMAN KOUTS: The safety goal in this case is a curve of, say, early fatalities versus probabilities --

MR. LEVINE: For one reactor?

CHAIRMAN KOUTS: One reactor.

DR. MAZUR: But, wait, that is pre-specifying that these goals will look like, and we don't know that yet.

CHAIRMAN KOUTS: That is only one way the goals could be constructed. to violate his proposal. There are other ways too.

MR. LEVINE: Bill said he doesn't understand what I am talking about.

DR. MAZUR: Nor I.

CHAIRMAN KOUTS: Give an example.

MR. LEVINE: In current regulatory criteria, there is very little specified about the reliability of systems. We talk about the single failure criteria. And there are some systems in fact in the plants that are designed mostly where it takes triple failures for portions of the system to fail. It has been known for years, thanks to the physicists who were involved in the early days of reactors, that scramming the reactor was a very important matter, and people have tried to make those systems very highly reliable. They have come out much better than the single failure criteria, in fact.

On the other hand, another system is the auxiliary feed water system which, in the PWR, is probably as important as the scram system in terms of reliability. But nobody paid any attention. In fact, it wasn't even classed as an engineer safety system, because it was in the secondary part of the plant and who cared about that? Now we know it is very important to the safety of the plant because it turns up in a number of accident sequences that are done in determining the risks and you in fact have a system of low reliability, and you find that those accident sequences will swamp the risks and make them very high. So you want an auxiliary feed water system that is quite reliable. So you can now go into -- and we know the techniques for achieving that kind of reliability, by the way,

so you can go into your deterministic process and specify that you have a number of redundant pumps, some steam driven, some electric driven, and it works with failure of AC power, and it works with failure of DC power, and that is the kind of thing that you specify in the regulations or the safety guides or whatever form they would take. And you wouldn't say the system has to have a failure probability of 10^{-4} for demand.

DR. LOWRANCE. But is that the same things as the kinds of safety goals that are outlined, for instance in this NUREG?

MR. LEVINE: Yes, they are all of the same general format.

DR. LOWRANCE: The goals that I have seen are like specific amounts of radiation release.

MR. LEVINE: You can get back from there to all of these things. Once you have a set of goals like that, in general, not that I agree with all of those, but once you have those kinds of goals, you can work your way back to these kinds of things, and you may find that some accidents may have probabilities too high and you will want to look at the lelments and make changes in the deterministic requirements to make sure that they are lowered.

DR. LOWRANCE: But then how do you say that you would rather keep this process distinct from the licensing process? It seems to me that you just described what in effect becomes

part of the licensing process.

MR.LEVINE: Part of the regulatory process. The deterministic requirements become part of the licensing process, but not the analysis. I think that if we were talking ten years from now, I would be talking quite differently. It is a kind of development that I hope to see take place. I think these techniques are new. There are troubles with the models, troubles with the data, all kinds of troubles. You have to be an expert to apply this. You have to be more expert, for instance, that to do the pipe stresses on a set of pipes. This is sort of new, formative and uncodified. So the question is how can you take advantage of these techniques without destroying the licensing process or destroying the credibility of the techniques. Practice them outside the licensing process to make the regulatory process better.

DR. MAZUR: You are saying they should be more background guides than in the forefront of considering specific plants?

MR. LEVINE: They should be used to consider specific plants, only to get background information to help you decide.

DR. WALD: Is that a general principle? Or are you talking about a transitional period?

MR. LEVINE: I think it is a transitional period until we really know how to do these things a lot better than we do now. More research information generated. There are

a lot of large uncertainties. We are talking about things that happen way beyond our experience, and we have made models. We think they are all right, but there are large uncertainties. You are familiar with it.

DR. JOKSIMOVIC: If I may, I don't know what I have said before -- but basically what I have said before is totally compatible with this document, and it is page 72 that we have all been given, and he says that the discussion of this quantification is divided into two section, a description of probabilistic safety profile, requirements for quality assurance, and a certification procedure.

What I was addressing was a point one there, which is probabilistic safety profile, and what Dave says, and I am in full agreement with him, he says, a comprehensive, detailed probabilistic risk assessment or safety profile for each particular plant and site could be a major tool for the management of risk. Then he say, analysis would be updated in accordance with experience and modified to deal with any issue that arises.

CHAIRMAN KOUTS: Okay, so that is a direct contradiction.

MR. LEVINE: It sounds to me like it is in contradiction.

DR. BEYEA: May I speak to that? I don't think it is, and I will cite an anecdote of an experience I had

yesterday where I was discussing a specific plant's probabilistic risk analysis in which my staff is engaged, with the owners of the plant. And the owners of the plant expressed a very strong desire to have the probabilistic risk analysis that comes out of this project kept alive in a continuous way, a model of the plant and how it failed, corrected from time to time to match what they have done to the plant, so that it is always descriptive of the plant.

DR. JOKSIMOVIC: A living profile.

DR. BEYEA: Yes, a living profile, and their intention is to use it as a backdrop if they discover a problem. They receive notice that a certain motor in their power plant really didn't meet some manufacturing spec, and in poring over the records someone discovered that Then they can use that model as an immediate backdrop to give them whatever sense of urgency is appropriate on that particular decision.

I didn't understand them to use it --

MR. LEVINE: Let me talk about that idea, because I am consulting on an assessment, and that is a very nich idea conceptually and I think it ought to be done if it can be done, but when you recognize what is really done, and when you throw back all but the last one hundred percent of the analysis as being not contributory to risk, then you concentrate on getting the contributors to this light, then you have an understanding of the risk. But if you want to say that you understand all

the engineering aspects of that plant in terms of all the accident sequences that could happen, you're foolish. In fact, the Ocony risk assessment is getting swamped in work trying to meet just that requirement. I don't know how to do it today. I think it is at least ten, and maybe a hundred times more work than just doing a risk assessment.

CHAIRMAN KOUTS: Right, because this really digs way down into the fault trees.

MR. LEVINE: Right, and you have to have everything just right, and the ones that you discard because they are not important -- and once you discard them, you don't do them right. You don't quantify them.

CHAIRMAN KOUTS: This happens to be the time for breaking. Thank you.

(Whereupon, at 12:03 p.m., a recess was taken until 1:30 the same day.)

AFTERNOON SESSION

CHAIRMAN KOUTS: We were going down Saul's list. Paul is not here to disagree with my interpretation, but we might as well begin again anyhow. Are we really set with a difference in attitude on how safety goals should be applied in the regulatory process? Apparently you adn Saul had some disagreement.

DR. JOKSIMOVIC: I would say that is a fair summary.

CHAIRMAN KOUTS: Does anyone wish to contribute to the disagreement?

DR. LEWIS: Could you remind us what it was?

CHAIRMAN KOUTS: Saul believes, and it has been pointed out to me that we are really sort of jumping in logic here, and we are not really talking about the application of safety goals through the licensing process, as much as talking about probabilistic risk assessment in the licensing process. We are talking about this apllication being, in Saul's view, to establish deterministic methods for viewing reactor safety. That is, methods that can be tested, specific design rules shall we say, for plants to have, which are arrived at using probabilistic risk assessment as part of the logical process for establishing a basis. I guess your view is that we should look at this only as a short run point of view, at the very best, that we should get into using probabilistic risk assessment as a real licensing tool as soon as we can.

DR. JOKSIMOVIC: Yes. However I do acknowledge that there has to be a transition period. I would like to make that position as short as possible, not the way they have from one president to another, but longer than that. But I think there has to be a transition period. I think that in doing all this we should not forget one of the main usefulness of probabilistic risk assessment, and that is to serve as a tool of compliance with whatever goals we might set. I am in one hundred percent agreement with the operant in this report where he summarizes the probabilistic safety profile on page 72. I quoted that this morning. I don't want to quote it again but is says basically that there is an aspect of compliance and it goes via the plant specific profile, which has to be a living thing, which has to be updated from feedback from the operating experience of the plant, and then we will see deviations whether the plant is meeting the goals or not meeting the goals. I think it is up to the regulator to do something if it is not meeting the goals, or to give credit if they are meeting the goals. I think it is a very powerful application of PRA in the regulatory process.

DR. BEYEA: What do you think about the idea of conservatism as another tool of setting safety goals. You wouldn't use conservatism as a philosophy?

DR. JOKSIMOVIC: I don't know what you mean by conservatism. I am for realistic assessment with adequate

assessment of uncertainties.

DR. BEYEA: How do you do that? Could you explain a little more how you would deal with uncertainties and probabilities at individual steps in the stage?

DR. JOKSIMOVIC: For instance, let's talk about Three Mile Island. The people were scared to death because of the hydrogen bubble, which wasn't real. But NRC, and I don't want to be too negative, made it real because of the assumption, and you can create an ureal and physically impossible type of situation. I don't think that is the way to go. I think if you assess the situation realistically and then you assign uncertainties or variations which can occur in various assumptions -- but you don't cover yourself with conservative assumptions which then become the bounding estimates, and you believe they are real, and when they are not real the plant simply doesn't perform that way.

DR. LEWIS: I certainly agree with that. This isn't really our subject in this meeting, but there is a lot of misunderstanding around about what the point of conservatism is, and I agree with you completely. You do your level best on a realistic basis, and then if you decide you are uncertain by a factor of two and want to be dead sure, then you increase the the strength of the girder or whatever by a factor of two. But I have been in a situation in which somebody who did a calculation that was plain wrong, because it did not conserve

momentum, said well, that was a conservative assumption, but in fact it was a wrong assumption, and being wrong is never being conservative. So there is a widespread misunderstanding. But that is not our subject today.

MR. BERNERO: I would like to be a meddlesome resource person. I think you are close to the subject and I would like to invite your attention to something. The distinction between conservatism, which is, given a model for a phenomenon to occur or not occur, I will provide a muffle or a suppresion or a beam to hold it up, whatever device, and I will add some percentage or some degree of excess to that. In the safety regulation philosophy there is a conservatism called defense in depth, where one is dealing with conservatism by relying on diverse means. I will prevent the core from being damaged or, just in case it is damaged I will have a very durable system that is not likely to melt down or, in case it does melt down I will have a very durable containment system that won't release the garbage. And I invite your attention that this is one of the logical structures that the ACRS report contained, that hazard state -- if you go to the probability of death off site, consonant with that one has a family of hazard state goals. What is the probability of significantly damaging the core, what is the probability of substantially melting the core, and given that somehow or other you got that far, what is the probability that the containment will fail when

challenged thus. Those three hazard states open up a structure where you can say, they should be internally consistent so that they all add up, one for one, to the probability of death off site, where one can consciously expand them and get overlap, and have that much more defense in depth. Of course you could carry that to a bizarre extreme if you wish.

DR. BEYEA: There seems to be a difference of opinion here. You don't see a need for that overlap in your language? Is that correct?

MR. BERNERO: The logical structure first, and then the question of should there be match or should there be overlap in the requirements in that structure.

DR. BEYEA: I guess the reason I like conservatism in your risk analysis is that you have to look at where's the probability that you've done the risk analysis wrong? To have defense in depth possibly allows you to cover your losses, to cover your bets.

DR. JOKSIMOVIC: You want an assurance.

DR. BEYEA: Extra levels of assurance.

DR. JOKSIMOVIC: I think Dave, in his document, talks about that. He talks about three subjects. One is the one I read, a safety profile of the plant. The other one is requirements for cross insurance in probabilistic analysis, and the third one is a risk certification procedure. So he is trying to take care of all these concerns that people

might have.

DR. BEYEA: But I am trying to get your ideas on how you see probabilistic risk analysis, and how it differs from Saul Levine's position. If you use probabilistic risk analysis directly, you wouldn't need defense in depth. There would be no need for defense in depth.

CHAIRMAN KOUTS: No, no.

Not at all. The probabilistic risk assessment takes into account the defense in depth. You assign probabilities to these things, too.

MR. LEVINE: You have to regard probabilistic risk assessment as not a replacement for the existing structure.

DR. BEYEA: I agree with you.

MR. LEVINE: It is just another tool.

DR. JOKSIMOVIC: I have a viewgraph on that. In my viewgraph I say that PRA better focuses the defense in depth concept.

DR. BEYEA: I would go along with that, too. It is a tool.

DR. JOKSIMOVIC: So it does not replace it. It gives a better focus what defense in depth is all about.

DR. LOWRANCE: But to clarify, as I understand it, the overall risk analysis of a plant would include all the systems, all the backup, all the redundancies, all the interactions, and in fact, would take into account the possibility

of error on the part of operators.

DR. BEYEA: I disagree to this extent. You might then go one step beyond and allow for emergency planning around reactors, for ten miles.

CHAIRMAN KOUTS: That takes that into account?

MR. LEVINE: It has already been used as a basis for the current guidelines for emergency planning by NRC. It is based on the WASH 1400 analysis.

DR. BEYEA: Isn't it the language of the emergency planning procedures that you do not expect to get such accidents in a probabilistic sense. What you have is an extra line of defense, emergency planning.

MR. LEVINE: There is an interesting question. If your took the WASH 1400 analysis, you could argue that you do not need emergency planning, because the probability of an off site release of radioacivity above a certain level is so low that it does not seem effective.

DR. BEYEA: I think it is a clost call in fact, and the decision has been made not to make that close call, but to say that you need emergency planning.

MR. LEVINE: As part of the defense in depth?

CHAIRMAN KOUTS: It is not part of the commonly stated defense in depth, but it is an additional measure.

MR LEVINE: Yes.

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CHAIRMAN KOUTS: But it is an additional layer of safety which has been added since that time. But there's nothing that prevents your including that a probable risk analysis too. And find out what the impact is.

MR. SALISBURY: What are the implications, though, of using PRA as your basic licensing criteria? Does that mean plant designers, if they can meet certain probabilistic risk figures could then do -- start doing things like forgetting about containment buildings or back up systems and so forth and so on, just on the basis of that statistical analysis?

MR. LEVINE: Well, that's not in my concept. In my concept the basic regulatory structure remains intact, and simply gets re-examined with PRA to make it more rational.

MR. SALISBURY: I just wonder what -- if --

DR. JOKSIMOVIC: Well, I go somewhat beyond what Sol said. I think that's the difference, of what I'm saying to you is that in addition to doing that, you make the PRA and it may show that the plants have not been designed in an optimal fashion. In the past. And as PRA can be used as a better plant optimization tool. And instead of having something, we should maybe take this out and put something in which we should have had in the first place, but we didn't have it for a variety of reasons.

DR. LEWIS: I wouldn't disagree with that.

CHAIRMAN KOUTS: In fact, the disagreement between you

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two seems to boil down to how long we're in some interim process.

DR. JOKSOMOVIC: Yes, I think that's well said. I think we both recognize the need for that. But I think Saul is more persnickety than I am.

MR. LEVINE: I'm speaking more from a regulatory viewpoint, and he's speaking more from a design viewpoint. But I don't sense any real inconsistency.

CHAIRMAN KOUTS: Neil?

DR. WALD: Would somebody help me by specifically relating PRA to the quantitative safety goal?

CHAIRMAN KOUTS: We haven't got there yet.

DR. WALD: Okay. I didn't just miss it then.

DR. JOKSIMOVIC: Some people would argue that's an ultimate application of PRA.

MR. BERNERO: I'd like to just draw a very simple diagram on the board that I think will facilitate this. And this applies to that ACRS graph. If you look at the probability of core melt, this is -- your initial state here and you're going to go to some public risk. Here. The probability of core melt and that's a sign -- a tentative goal of 10^{-4} per year there. And then given that you have the probability of a large release, given a core melt -- that's a conditional probability, and in that document over that I'll give a 10^{-2} per year probability, and then you must say that there's a

vc3

large release is a death. And that has 10^{-6}. Now, the logical structure is you can have a safety goal that says that no one should be threatened with death more than 10^{-6} per year if they live near a nuclear power plant. And the safety goal could be given to the designer with the construction any way you can do it-with the most reliable heat removal system in the world, and you don't need a containment building. Or you can give him that logical structure that says look at the defensive death concept I'd like to have. At least this much of it in prevention. But I won't believe anything better than that, in prevention. Of core melt. And I want a margin of protection, containment. And on top of that, I'm going to give you a separate requirement of emergency preparedness overlapping this so that the 10^{-6} per year probability of death might prevail if the person just stood there a half a mile away from the plant, and I want arrangements to haul him away before the release, as an overlap.

Now, I can choose to enlarge these to overlap them as I do with the emergency plan. That's the philosophy of defensive death. But the safety goal might be just one of them, or the whole system.

DR. LEWIS: Well, I don't understand what you mean by overlap them. That's a conditional probability, so you multiply them.

MR. BERNERO: No, not unless I deliberately say for you,

vc4

Hal Lewis, because I don't trust your analysis, I want 10^{-5} there and 10^{-3} there.

DR. LEWIS: I don't understand the word overlap.

MR. BERNERO: Well, it's overlap in that I am demanding more than a sufficiency.

DR. LEWIS: Ah, that's what you mean by overlap. It was a matter of English.

MR. BERNERO: Yes.

DR. WALD: Additional would be a better word, added on top of.

DR. LEWIS: No, I had a picture somehow of the numbers overlapping,and that I didn't understand.

MR. BERNERO: But you see, one is left with a choice in a safety goal of doing that, by that complex a logical structure, or even in that structure, an internally consistent set of requirements. Or a deliberately overstated set.

DR. LEWIS: I may have misunderstood -- if I may -- I may have misunderstood the debate here, but I thought the debate was whether, exactly as you said, that you want to give a purveyor of a plant or utility an objective, and say, any way you do it, if you can prove to us that you've done your probabilistic analysis correctly, and you get it below 10^{-6}, except for Hal Lewis, 10^{-5}, that's licensable. Or whether you use it as a regulatory tool by which both through full plant studies and generic studies, and through isolated

vc5

system studies, you ask yourself how well the deterministic regulatory system is functioning, and set yourself an objective which is an oversight objective, not a licensing objective, but an oversight objective, about how tough you ought to make the determination for a licensing system. I thought that was the issue that was being debated here, and I may have misunderstood.

CHAIRMAN KOUTS: No, I don't think so.

DR. LEWIS: I see.

CHAIRMAN KOUTS: I think it's -- let's go back to this reliability of electric power, as one of the things to analyze. You may be concerned, principally, as people are these days, about the sequence -- TMLB prime as the major thing to worry about. And as a result of your analyzing --

DR. LOWRANCE: It's the jargon. Can you explain --

CHAIRMAN KOUTS: This is complete loss of electric power at a plant, a station blackout, it's sometimes called. The loss of all capability of doing anything electrically, and inability to restore electric power in time to prevent --

MR. LEVINE: Plus the loss of normal and emergency feed water which is sometimes --

CHAIRMAN KOUTS: Which are sometimes steam driven. No feed water, so that eventually you boil the core dry, and it melts. This is the sequence TMLB prime.

And you may be convinced that the best way to avoid this

vc6

is to make sure that you're -- you have adequate backup diesel power on site. And as a result of this analysis, you go through a probabilistic analysis to determine that this really is a threat, and you need so much additional assurance of power in order to avoid this, and the best way to do this is to get better diesels, more diesels, alternates to diesels, something like this. So that you'll have a local supply of electric power.

This is the analysis you've gone through using probabilistic risk analysis. On the basis of this, you establish a requirement that local power be supplied according to this new prescription, and that prevents the TMLB prime from being a -- a big threat. Then you can divert your attention to something else.

This is the process Saul was talking about going through, and this is how he would apply probabilistic risk analysis.

The ACRS, and we will be discussing their proposal later on, has a completely different concept. They're saying for this particular plant you do a complete risk analysis, taking into account all risks, and if as a result of this, you find that you satisfy all these numerical criteria using this complete risk analysis, you're home free.

DR. JOKSIMOVIC: And then the verification comes into the picture. And one subject that I was in particular interested in, how do you verify that the goals are met?

vc7

And that's when we have to go into the operation --

MR. LEVINE: By the way, I've stated I have no problem with the ACRS proposal. I just think it's too early. Maybe in ten years from today.

CHAIRMAN KOUTS: Yes, you've said that. This is a transition period, and as a matter of fact, it may be in applying the ACRS criteria, or in applying your methodology, in practice it would work out exactly the same. You isolate -- the reason you don't meet the ACRS criteria is that TMLB prime stands out there, and drives the curves over. In which case you put on some requirements on the plant to bring it back down again. It may be what you -- once you get the process working right, using ACRS methodology, it may be it falls back to being just --

MR. LEVINE: I think I ought to point out something on this debate, and that is some people, Sandy, have looked at Okrent's criteria, to see if current plants meet them. And they meet them very handily. They then start putting the plants -- they put them at Indian Point -- they put a specific plant at Indian Point, Limmerick, Zion, they were way under the criteria. They then began to increase the population density. And they just meet the criteria with 38,000 people per square mile. And I have to point out that Manhattan is 26,000 people per square mile.

CHAIRMAN KOUTS: Now, you're talking about the specific

vc8

numbers in the criteria, and we really want --

MR. LEVINE: I think that's a very important point, though. And that is that most of the goals that people have proposed will not represent, would not be very trying for existing reactor designs to me.

CHAIRMAN KOUTS: Does that apply to the 10^{-2} also?

MR. LEVINE: That's the questionable one. Some WASH 1400 plants, per our analysis, will not meet that. Some of the newer analyses say you will meet it. I think that's a tough one.

DR. BEYEA: Depends on the steam explosion.

Depends on which kind of reactor too, doesn't it?

MR. LEVINE: Yes.

What has happened is the new analyses --

CHAIRMAN KOUTS: Yes, finish.

MR. LEVINE: The new analyses that are being done are the physical processes that occur in containment after the core melts. Which is what determines what the probability of a bad rupture is. Are being done much more carefully than we did them. There's more known than when we did them. There's new data, there's new analyses, and they're finding that the probability of a bad rupture is lower.

DR. MAZUR: Can I try some wording to an answer to our second question to see if it might be acceptable and incorporate your concerns? And excuse me that I have abbreviated

vc9

from some of the language, but in my own words it comes out like, but initially goals should provide background for judgments rather than specific licensing requirements. However, after a transition period, allowing for sophistication of goals may guide specific licensing actions. Would that incorporate your -- both of your views?

DR. JOKSIMOVIC: Could you say that again?

DR. MAZUR: Want to do that again?

DR. JOKSIMOVIC: I was trying to take notes, and it's a little tricky.

DR. MAZUR: All right. Initially, safety goals should provide background for judgments rather than specific licensing requirements. However, after a transition period of growing sophistication, the goals may guide specific licensing actions.

MR. LEVINE: The first part of your statement is too vague.

DR. MAZUR: Too vague? Okay.

DR. LOWRANCE: And the second is too short.

CHAIRMAN KOUTS: Bill, that's --

DR. LOWRANCE: Does anyone have any other comments?

DR. JOKSIMOVIC: I think you can try another inspiration.

DR. MAZUR: I will accept modification.

DR. JOKSIMOVIC: I don't think that you're far away from my standpoint.

vc10

CHAIRMAN KOUTS: Would you like to operate on this?

DR. LOWRANCE: The first part does not say -- would you read just the first part again?

DR. MAZUR: The first sentence is supposed to accomodate you. Initially, those should background for judgments rather than specific licensing requirements.

DR. LOWRANCE: Background for judging the adequacy of existing regulations?

DR. MAZUR: Background for judging -- and also for guiding the development of new regulations.

DR. LOWRANCE: Yes, right. Adequacy of existing regs and guiding development of new regulations.

DR. MAZUR: Development of new regulations. But rather than specific licensing requirements. However, -- after some transition period of growing sophistication -- this is too sharp, right?

DR. LEWIS: Well, I won't argue with it.

DR. MAZUR: The goals may guide specific licensing action.

DR. LEWIS: I agree with that.

DR. MAZUR: No, Hal --

DR. LEWIS: Well, I think it's both too sharp and too vague. That is to say, like great truths are both true and false. Guiding specific -- no, it seems to me there is actually an important point here because the objective of

vell

-- the only way I can see the objective of licensing a plant -- really in the last crunch, licensing, going into a hearing with a probabilistic objective is clearly for the NRC to be completely prescriptive about the way the probabilities are computed. That is to say to allow essentially no leeway on the part of the computer. So one just moves the prescription to a different level in which thou shalt assume that the probability of rod failure is 3.87 times 10^{-4}. Thou shalt assume and so forth down the line. And you know better than anyone how many probabilities have to be enlisted in making this kind of thing. And that strikes me as -- if it were possible -- a shade more ridiculous than other things.

MR. LEVINE: If you go that way.

DR. JCKSIMOVIC: That's not in any way what I was suggesting.

DR. LEWIS: I understand that, but let me speak to it. Because it seems to me, as I mentioned earlier, that it is a principle of American justice, that when somebody goes into ask for something, they ought to know what's required of them. And to have the probabilistic analysis done other than in a prescriptive way, different ways by different people, just puts us back into the old game of using non-quantitative means for judging the adequacy of different people's probabilistic analyses.

CHAIRMAN KOUTS: There is -- going back to Okrent's

vc12

prescription, there is a way of dealing with that too. Whether you like this particular way of doing it is another matter. But he has a risk assessment panel which is supposed to act as a supreme court.

MR. LEVINE: At which he gauged that, that's why it's called a risk assessment panel.

DR. JOKSIMOVIC: That's the certification of that.

CHAIRMAN KOUTS: This is certification of that.

DR. LEWIS: Oh, this certifies not the techniques used in the calculation, but the --

CHAIRMAN KOUTS: But the whole thing.

DR. JOKSIMOVIC: It finds out if the numbers are wrong.

CHAIRMAN KOUTS: But the whole thing. It does everything.

MR. LEVINE: I lean more towards Salisbury's version.

DR. BEYEA: How big a staff would they have?

CHAIRMAN KOUTS: Three.

MR. LEVINE: That will hold up licensing for ten years a plant while they rehash every number.

DR. LOWRANCE: I wonder if Mr. Bernero or someone else would tell us how -- I'll say this new system, understanding that there's no single one system in mind yet, would differ conceptually really -- not procedurally, but conceptually, logically, from the way things are done now.

MR. BERNERO: I'll take a crack at it. Right now

vc13

the system, in a very fuzzy piece of logic, not a highly rigorous numerical logic, approaches the regulation in a rather multifaceted way that is called defense in depth. Sometimes the scope of defense in depth is defined differently. But it says, in the first place I will make sure that the radioactivity is tied up in a fairly stable fuel form. That's my first line of defense. A risk analysis will tell you that is not really terribly important.

Secondly, I'm going to put it in a nice piece of cladding and we selected something that reacts with water. At high temperatures. Then I'll put it in a very sturdy, and not only have a significant barrier, but a very sturdy metal system, stainless steel, Monel, depending on who you are, the -- and then I will have a whole host of systems which are reliable to shut that thing off and to cool it, so that it won't get into trouble. And then I will have another layer of systems that are called accident mitigators, emergency core cooling systems that will assure it being cooled even if the pipes break. And then I will have another layer I'll call the containment system, the big building and coolers, and sprays, and things like that, that never mind how it happened, I think you are going to get in trouble and wreck the core or have the system severly damaged. And I will have this defense in depth of a confinement, a containment, and ways to cool it. And lastly, I'm even going to assume that something gets off

vc14

and I want you to organize the people around there so that they can run away from it. And so that's the logical structure.

It has crude reliability tests in it. The single failure criterion is a reliability test. And unfortunately, it's blind to some key vulnerabilities. But nevertheless, the present system, by dividing the problem in that way, consciously attempts to deal with uncertainty by overlapping the requirements, by wearing mittens over gloves, so to speak.

Now, the safety goal approach could try to be so rigorous that it would take you right to the -- the real thing is health protection. I mean, really, there's about a couple of billion dollars worth of plants at stake here, and I'm sure Saul knows about how serious a threat that is, but our business is to regulate for public health and safety. It's his business to worry about his investments.

We could go right to the public health effect, and say that's all that counts. And we want a safety goal that defines the level of threat to the public health. Or we can have a safety goal of a logic that I tried to sketch on the board that tries to segment the problem just the way the existing process does, and give the probabilistic target to each element of the overlapping set, or of the defense in depth set. And then secondly, raises the question that was addressed in the present scheme of operations, of more than sufficient -- apparently more than sufficient requirement.

vc15

Defense in depth overlapping to make up for uncertainty. I can have my objective as the 10^{-6} probability of a death, and then I can say, well, if you can assure me you've got 10^{-6} you might do it without a containment, or you might do it with a perfect containment and no cooling process.

DR. LOWRANCE: But historically, over the years in each one of these systems, whether it's a containment vessel, trapping systems, redundant cooling systems, and so on, it seems to me there must have been design goals in mind that is tied to some vision of the worst that could happen.

MR. BERNERO: But not probabilistic goals. Or reliability goals.

DR. LOWRANCE: What kind of goals were they?

MR. BERNERO: Just gut feeling, you know, yeah, that airplane is safe enough to fly.

DR. LOWRANCE: Well, you had to decide how much money to spend on the containment vessel and how strong to make it and all of these kinds of things, and everybody knows from basic design experiment experience, and experience in everyday life, that you have a whole range of possibilities in front of you, or the industry did, and you asssume some things.

MR. BERNERO: We accepted -- the regulatory process historically accepted relatively inconsistent answers. Right now if we accepted containment systems over a fairly broad spectrum that would speak to the given -- given the probability

vc16

of a large release given a core melt, we accepted things ranging from a boiling water reactor Mark I containment which is a relatively fragile containment, but -- and accepted large dry containments which are quite sturdy. And they were all accepted under a deterministic approach which was blind to those differences.

MR. LEVINE: Let me try to just amplify what you said. These decisions were made on the basis of good engineering judgment. It was, for instance, decided that a gross catastrophic rupture of the reactor vessel did not have to be considered. In the safety design of reactors. That was done on a judgment, basis judgment by a lot of people that that probability was low enough that it would not contribute to the risk.

That turned out to be true. These engineered safety features which were designed for -- towork for non-core melt accidents turned out to have enormous capabilities to handle core melt accidents, as shown in WASH 1400 and other risk assessments. So they were done on -- as are many things in this world, on the basis of the combined judgment of a lot of very smart people.

DR. LOWRANCE: But you knew that before WASH 1400. I mean, the firms that designed the reactors surely went through exercises, some of the routines of WASH 1400.

MR. LEVINE: Some of them did, and many of them didn't.

vc17

And many of those subroutines which I saw were just plain wrong, and so forth. They were in the early state of the art, and they didn't include a lot of things they should have included, and so forth.

CHAIRMAN KOUTS: Generally speaking, though, the things that were overlooked you overlooked on the conservative side.

MR. LEVINE: Yes.

CHAIRMAN KOUTS: All built into the process. What you did, if you didn't understand it, was you tried to construct an envelope which included everything you thought would take place. As soon as you decided what it is you had to take care of, then you took this approach because, after all, the engineering was defective in these cases.

MR. BERNERO: But unfortunately, the logic -- though that was the logic of the regulatory process, it was flawed because the envelope approach doesn't necessarily envelope the problem. The auxiliary feedwater system was named earlier. We found in retrospect differences of 100 times -- a factor of 100 difference in reliability from one plant to the other and the reason was, it wasn't even in the envelope. It wasn't even in the envelope. The envelope was out there worrying about emergency --

MR. LEVINE: There's another flaw in the thought process and that was in connection with thinking about relief valves as opposed to safety valves. Relief valves weren't safety

vc18

oriented so nobody paid any attention to them. And they should have been.

There are other examples of omission like that. That PRA would have brought to the fore. Now, all I'm saying is if you use PRA now, you can correct those omissions in the same process.

DR. MAZUR: The assumption seems to be that you didn't know what you were doing before, but now you know what you're doing.

MR. LEVINE: It's just another tool that helps you consider a thing more carefully and more thoroughly.

DR. MAZUR: But one wonders in ten years what will be the tool that will allow us to correct all the mistakes we're going to make now.

MR. LEVINE: Well, hopefully, we'll have it better, won't we.

MR. BURSTEIN: We will undoubtedly have more experience. And if nothing else, that's part of what goes into this.

DR. BEYEA: I've been thinking about this. I was wondering whether there really is much difference between the defense in depth philosophy and the probabilistic risk assessment. There's two ways you can handle the uncertainty. One is the defense in depth philosophy you mentioned, at each stage, where you might require conservatives. The other thing is to do it with PRA and then just add on an extra four

vc19

orders of magnitude.

MR. LEVINE: Now, wait a minute. The defense in depth philosophy does not consider failure of any system in the plant, except halfway. And it can still work if it fails halfway. And it doesn't melt the core. The defense in depth philosophy stops short of total reality.

DR. BEYEA: Well, let me change the word then. The word that -- the words that Bob was using about overlap, what's the -- what's this overlap then? One way is to require conservative overlaps, in your calculations. As a way of guarding against uncertainty. Lack of knowledge of what's going on.

The other way is just to do an assessment, a straight WASH 1400 or the equivalent, the modern equivalent of it, and then just say, well, that might be uncertain by four orders of magnitude. So we just add that at the end.

MR. LEVINE: Well, but people are trying to do the uncertainties. You can't have four orders of magnitude on the up side. We know that just on the basis of experienced success and failure.

DR. BEYEA: Well, some number. I'm not -- In other words, these are in principle. Any reason that you couldn't put the conservatism at the end rather than at each stage?

DR. JOKSIMOVIC: Not only that, but as we go through the analysis, we propagated uncertainties.

CHAIRMAN KOUTS: Let's just answer the question right

away. I see no problem with -- I think that Hal Lewis gave the answer earlier. You calculate realistically, and then you put on the safety factor later, and it's just as -- the same sort of thing you were talking about.

DR. BEYEA: So in a sense they are equivalent, if you have an extra margin for error. With the PRA, you --

CHAIRMAN KOUTS: You may feel that you want to add a defense in depth because of that uncertainty, or you may feel that you want to add it into the mathematical structure and then see if you meet the mathematical structure, you don't need a further defense in depth.

DR. BEYEA: Well, let me clarify what I mean. I'm worried about how do we take into account the fact that Brown's theory of the Three Mile Island events,which are outside the envelope, or outside the standard analysis that are being done in a particular moment in time. That's what my concern is.

DR. JOKSIMOVIC: But we account for them.

DR. BEYEA: How? It didn't account for Brown's theory. It was outside the analysis. It was not --fires were rejected in the original WASH 1400 as non-contributors to the risk.

DR. JOKSIMOVIC: But we're not rejecting it any longer.

DR. BEYEA: But you can't assume that there are no more events that are out there that are not anticipated. You can't assume that in 1981 all --

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MR. LEVINE: The question is will they be contributors to the risk.

DR. BEYEA: Well, in a post-accident analysis, WASH 1400 concluded that the ground stage fire did increase the risk by 25%.

MR. LEVINE: Which is nothing.

DR. BEYEA: But now you've considered into the risk analysis. Three Mile Island indicates that relief valves were a major contributor to certain --

MR. LEVINE: To what risk?

DR. BEYEA: To the risk --

MR. LEVINE: Not to the release of the radioactivity.

DR. BEYEA: No, no. You're saying then that all events that could lead to the release of the radioactivity are included in the current risk analysis.

MR. LEVINE: No, no, I would never say that; I have never said that. In fact, I deny that I'm just saying that. I think it's highly unlikely that there are events that will cause large releases that haven't been uncovered.

DR. BEYEA: But how do we guard against that error? In fact, that may turn out to be the dominant error.

MR. LEVINE: I don't think so.

DR. BEYEA: The dominant risk in nuclear power may be the ability of the people to -- of the risk assessors to assess risks.

vc22

DR. JOKSIMOVIC: Well, we have what you can call common cause failures, and the kind of stuff that you're talking about is an example of common cause failure. It's being a major flood, a major fire, a major earthquake that has a multiple impact on the plant.

DR. BEYEA: No, you don't understand that. In other words, the Three Mile -- what is the thread of Three Mile Island to the risk system?

MR. LEVINE: Three Mile Island fits almost right on our curve, you know.

DR. BEYEA: No, it would be on the certainty curve.

MR. LEVINE: Fits almost right on the WASH 1400 curve.

DR. BEYEA: No, I disagree with that.

What accident are you taking as the equivalency?

MR. LEVINE: Well, just look at the consequence and it fits on our curve, somewhere between 1 and 400 per year.

DR. BEYEA: Consequence in terms of what, release of radioactivity?

MR. LEVINE: Release of the radioactivity.

DR. BEYEA: That's hard to understand because if you look it as a classed non-event, it doesn't meet your curve. In fact, it's a factor of ten higher than your curve.

DR. LEWIS: I didn't know WASH 1400 did a BMW reactor.

MR. LEVINE: We didn't.

DR. BEYEA: But --

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DR. LEWIS: So what are we talking about?

MR. LEVINE: But the society has used -- the nuclear industry has used the reactor safety story to apply to all reactors in the United States.

DR. JOKSIMOVIC: That may be what is wrong.

DR. BEYEA: And therefore you -- now, wait a minute. Let me understand this.

DR. JOKSIMOVIC: Well, that's why we're getting plant specific studies now.

DR. LOWRANCE: One should not equate WASH 1400 with all probabilistic risk assessments.

DR. BEYEA: Saul just said it was on the curve, right?

DR. JOKSIMOVIC: I think what Saul had in mind was one eventry.

DR. BEYEA: I would like to understand -- you said that you don't agree with -- you agree that actually there may be event sequences out there that you might have overlooked.

MR. LEVINE: I believe we started this with the WASH 1400, that there's no way we're assuring mathematical closure on completeness of accident sequences. And there may be accident sequences not identified. And, we then said we thought that they would be not likely to be significant contributors to the risk. That means like changing it from a factor of five to ten upwards. Since we did WASH 1400 and circulated all kinds of people for comment, nobody found

vc24

an accident sequence that we had not covered in the study. There were some that occurred that we did not cover in the study, like the -- but they didn't change the risk significantly. So what has happened in the world of experience since we did the study confirms our judgment that while there surely are accident sequences out there which we did not find, they were not likely to contribute to the risk.

DR. BEYEA: To the risk of what, to the accuracy of the study?

MR. LEVINE: To the birds.

DR. BEYEA: To the two reactors you studied, or the reactor populations of the U.S.

MR. LEVINE: Well, at the time we made that study, we thought to the reactor population of the U.S. Since then, we've learned better. We've learned that the BMW reactor looks significantly different from those two reactors we looked at, and that's why the IRA program is going on now, and we are looking for other outlyers in the --

DR. BEYEA: So if you used --

MR. LEVINE: That's what the auxiliary feedwater study has done.

DR. BEYEA: But the use of WASH 1400 -- the use that was made by society -- did include events that were not anticipated in the way it was used.

MR. LEVINE: I'm not sure that I understand your question.

vc25

DR. BEYEA: Okay. I'm just amazed that somehow the Three Mile Island accident -- to me, it's very amazing that somehow that is used to confirm the WASH 1400 analysis.

MR. LEVINE: It just happened that its consequences fell on our curve. We had a sequence similar to that in WASH 1400, but it didn't fit the BMW reactor. Because we had a relief valve sticking open accident. We called it a core melt accident, with an asterisk saying we weren't sure it would melt. It had the failure of feedwater, the failure of early feedwater and the sticking open of the relief valve and BMW reactor, the relief valve opened just on loss of main feed, and not on loss of auxiliary feedwater. When that was found, that was strictly fixed, so that now that accident sequence is the same in the BMW reactor as it is in the combustion reactors. By adding this very strange sequence to the system.

DR. MAZUR: Did part of the sequence include the operator shutting off the cooler?

MR. LEVINE: No, no one knows how to model that.

MR. BERNERO: If I may interject, I think basically if you look at the probabilistic risk analysis such as WASH 1400, it portrays an intricate spectrum of accidents sequences that lead to public health consequences ranging from the very severe, virtually throwing out everything -- the entire core inventory out into the biosphere -- down to a lot of even severe accidents, core melts, or severe core damage accidents,

vc26

that don't have significant off-site effects, like the TMI 2 ones. What we have learned since WASH 1400 is that yes, indeed, it's Surrey and Peachbottom are not surrogates for the rest of the population. What you find when you look at plant specifics analyses is you find uniquely different ways of wiping up auxiliary systems can change the probability distribution. And on average, I would say that of the PWR's in this country, Surrey happens to be one of the better ones. Or at least it was one of the better ones about the time of TMI 2 accident. And what we have done is the risk -- I don't quite agree with Saul about the risk being pretty much the same -- I would say that the probability level for that spectrum of accidents is about as -- was about an order of magnitude or so higher than WASH 1400. Both out of completeness problems, you know, the missed sequences, and those reactor types that haven't been looked at, that have higher levels of probability. Than Surrey happened to have.

But nevertheless, the spectrum described is inclusive. There's not another mechanism hidden in the woodwork that can come out and throw more curies into the biosphere. You know, because we've already got the span. And what we're dealing with is variations on the probability that we're using.

CHAIRMAN KOUTS: Have we bothered this one enough?

DR. BEYEA: One last thing. How did you deal with uncertainties in probabilistic risk analysis?

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CHAIRMAN KOUTS: That's a question we will discuss in much length later.

DR. BEYEA: That's all I want.

CHAIRMAN KOUTS: I would like to move on to the next stage here which I don't really understand. Saul, would you like to tell me what your number three means?

MR. LEVINE: How do you set your safety goals?

DR. MAZUR: Clarify this -- let's leave this one unanswered, and go on to three.

CHAIRMAN KOUTS: Okay.

DR. MAZUR: I was just clarifying our status. I think we haven't gotten an answer --

CHAIRMAN KOUTS: But you had some wording which Saul --

DR. MAZUR: I think it wasn't accepted. And that's all right.

MR. LEVINE: Well, Hal objects to it, and I do too, because I think the second part of it is too foreign. I have no objection to saying it but I think it's meaningless. Because the second part of it is too far in the future, and it's probably too precise. I'm not sure we'll ever need to do that.

DR. MAZUR: Well, maybe we should just hold in abeyance this one and move on to the -- Ijust wanted to clarify it.

MR. LEVINE: If you all want to put it in, I won't --

DR. MAZUR: But we didn't reach anything like one would

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call closure on it.

CHAIRMAN KOUTS: Would you read the wording that's objected to?

DR. MAZUR: However, after a transition period of growing sophistication, the goals may guide specific licensing actions. That's what people don't agree with. We surely don't have to close. It just seemed well worth noting.

CHAIRMAN KOUTS: Well, this almost unity with you and William has disappeared.

MR. LEVINE: Well, I don't mind saying it, but I think it's pointless. I think it will be overtaken by time probably. It says may, but -- so it doesn't say will.

DR. JOKSIMOVIC: Well, let me try one -- how about trial use?

MR. LEVINE: I have no quarrel with the way it is worded now.

CHAIRMAN KOUTS: I think there is a difference in attitude and anything that is done from this point on simply papers over the difference, which I think is a bad practice. So I will try a resolution of this that will not paper over the difference and will emphasize that it exists.

MR. LEVINE: And you will report to us tomorrow morning.

CHAIRMAN KOUTS: And I will report to you, okay? And if I could have your statement?

DR. MAZUR: By all means. I will write it so that you

can read it.

CHAIRMAN KOUTS: That will help a great deal. Understandability. Readability.

Going on to number three, could you explain the question of how you set the goals?

MR. LEVINE: Well, the question is how should one approach the setting of the levels of risk in safety goals? How does one approach it, not what should they be?

DR. MAZUR: Plant information. Now I have a little bit of the same problem with meaningfulness and clarity. Now it seems to me that question presupposes we have decided that safety goals should be quantitative whereas it seems to me that to this point we have really not specified and the argument would apply as well to whether they were or weren't, and I wonder if we should --

MR. LEVINE: That's the other question, I asked, I think.

DR. MAZUR: Add a question, 2(a) or something.

About to raise the issue of should we have quantitative goals?

MR. LEVINE: I think we ought to discuss that. I think it's a pretty involved and technical discussion. But if you want to discuss it, well --

MR. SALISBURY: Well, we already have quality of goals down there.

vc30

CHAIRMAN KOUTS: I think it's central to this panel, isn't it?

MR. LEVINE: Yes, it certainly is.

DR. JOKSIMOVIC: Or it ought to be.

DR. LEWIS: There are several different issues that are kind of wound up in a simple sense. If it's a question of how you set an overall goal, you know, whether you want to set a 10^{-6} or 10^{-3} or 10^{-9}, and then there's a separate question which is that if you were to set quantitative goals on hopes of systems or you set a quantitative goal in an oversight sense, not a licensing sense. That is, if you let -- just as a conjecture, let the system run along the way it is now, as capriciously as it now runs, you set a panel consisting of the people around us -- around this table, who do the kind of review process, a nd say by and large these people aren't making reactors safe enough, and then you whip them a little, and they can do it the way they're now doing it, but a little harder.

There really are two different visions of the future. And they're both quantitatively based. And one is more practical than the other.

MR. BERNERO: May I suggest that logically it seems to me that if you go at Saul's third question, how does one -- what is the philosophical basis of a goal or an element of a goal -- I think you naturally face qualitative and quantitative

vc31

goals in an almost infinite spectrum. One that leaps to mind is that if, as a philosophical basis, you say every reactor ought to be enclosed in something, that limits the release of radioactivity if something goes wrong, what we call containment, that's a philosophical basis, that there ought to be an enclosure.

MR. LEVINE: We already got one like that.

MR. BERNERO: Now, the qualitative goal -- one can have a qualitative goal that says there should be a highly reliable containment around a reactor building, or you know, a reactor system. That is a qualitative goal. One could amplify on that and say as a measure of high reliability and there should be a highly reliable containment system, and I will give you a catalog of six challenges that it must endure successfully without failure as a measure of that high reliability, and lastly, I can do something like that up there -- I'll give you a number, the probability of a significant release defined as Okrent defines it shall be less than or equal to 10^{-2} per challenge by a given challenge. And that is a quantitative goal. Now the one in between with the catalog of challenges is a hybrid. The one that says a highly reliable goal and only practice will explain what highly reliable means, practice and judgment called, I think it's a natural evolution that a qualitative goal -- many things only lend themselves to qualitative goals, that no one really knows how to quantify it more

vc32 1 rigorously. And I think in each area the fundamental philo-
2 sophy opens the door to the use of at least a qualitative goal
3 quite logically a hybrid goal, and in some cases perhaps,
4 a quantitative goal. And I think the question is open as one
5 looks at goals generally. The structure of the goal one can
6 choose either qualitative or carry it up to the quantitative
7 and I think it's natural.
8 DR. LEWIS: Even your qualitative goal is quantitative,
9 in the sense that when you say highly reliable, somebody at
10 NRC in the end is going to give a binary decision on a plant.
11 The fact that a number is binary doesn't make it non-quantita-
12 tive.
13 MR. BERNERO: Yes, but highly reliable might merely be
14 defined -- it might be defined in a dumb way, a thick wall.
15 You know, some klutz might say a highly reliable containment
16 building is one that has a thick wall.
17 MR. LEVINE: Are we talking now about quantitative versus
18 qualitative goals?
19 DR. LEWIS: How to set levels.
20 MR. LEVINE: We're talking about how to set levels.
21 I think you set the direction of whether the goals can be
22 quantitative with a central question. Are we going to discuss
23 that later?
24 CHAIRMAN KOUTS: Yes, with question five.
25 MR. LEVINE: Well, let's talk about how one should go

vc33

about setting levels of goals, and I suggested that they should be established at levels that do not contribute to the sum of man's existing risks significantly, as a first statement of philosophy.

DR. MAZUR: What does significant mean?

MR. LEVINE: The reason I haven't done that is because you now getting involved in setting the number; it could be 10% or 1% or 1/10%?

DR. LOWRANCE: Well, that's the question.

MR. LEVINE: But we're not talking about quantifying it yet. We're talking about setting a framework. Now I'll tell you why I suggested that framework. You know, you have to think about how you're going to do this, not what's significant yet. What's significant is another step. There are a few elements that come before what's significant. So at this point you have to say significant.

So I'm talking about a comparative basis. You compare to other risks. And another question is what other risks do you compare to. And there are two ways to compare risks. One is on the basis of average values, what is called in technical terms, expected values, the areas under these crazy curves we draw. There's a sort of an average, if you have enough of them. And you have to compare that to say, average occurrences of cancer, or fatalities in other accidents which are collected statistically, or projected in the

vc34

way we project on curves.

And the other thing you have to do is to compare them to other accidents that can have a broad range of probabilities and consequences just as reactor accidents can.

So you can not compare just averages, or just accidents. You have to compare both.

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MR. LEVINE: I'm going by the comparative framework that says it should be low compared to man's other risks and it should compare both average values and --

18-1

DR. KOUTS: Do you have other kinds of decisions that you have to make, assumptions other than this particular -- comparisons of your safety goal objectives with others?

You're clearly talking now about a set of logical assumptions which are to underlie the structure of your numerical goals.

MR. LEVINE: That's correct.

MR. KOUTS: Now, one such is based on a comparison of the consequences of these goals compared to consequences of similar or other means of generating power or without power, or whatever it is.

MR. LEVINE: Well, I talked about comparing them to other averages values, which would include, for instance, the normal occurrence of cancers that -- normal background.

DR. LEWIS: But you don't confine yourself to other ways of making power?

MR. LEVINE: That's correct. I compare to all --

DR. BEYEA: This still is --

MR. LEVINE: All accidents due to technology.

DR. BEYEA: This is one way of doing it.

MR. LEVINE: That's what I've suggested.

1b-2

DR. BEYEA: Well, SL, that's --

DR. LEWIS: When I get a chance, I will object to that.

DR. BEYEA: It's a consistent philosophy, I mean it is a consistent philosophy.

DR. KOUTS: Well, it's a consistent philosophy. There are other possible things you can include. About the question of exposure of the most exposed individual.

MR. LEVINE: Well, that comes later. This is a general philosophical approach. My next category is important elements of --

DR. KOUTS: I'm just trying to find out what are in --

Well, no. I don't -- you have told me that you're going to use something which is based on integration over a curve.

MR. LEVINE: But also of the curves too. Not just the --

DR. KOUTS: How about damage to workers?

MR. LEVINE: I've just talked about problems.

DR. KOUTS: I know. So, what is your complete set of things that you're going to use to guide your criteria? This is what I'm --

MR. LEVINE: Under this philosophical approach, my next subject is the degree of specificity, that's what

1b3

it should be in and out, and that's a long list of things. That's the next question.

DR. KOUTS: So you really are -- this is your complete set of assumptions.

MR. LEVINE: This is my complete set of assumptions for this.

DR. KOUTS: Now you can object.

DR. BEYEA: Hal Lewis's assumption, Hal Lewis's formulation, which is HL, SL and HL --

DR. LEWIS: I'm going to argue that I don't like the whole idea of comparing lists because I don't believe -- you know, it's like looking for the wallet under the lamp post. It's something we all know how to do, but that doesn't make it the right thing to do.

For example, where I live in Santa Barbara, there is a risk that heavy rain will make my house slide down the hill and fall into the earthquake fault that happens to be at the bottom of my little hill, which is not a capable fault, I hasten to add.

I don't see what the risk to me of that has to do in any way with whether I think there should or should not be a Diablo Canyon power plant, a nuclear power plant 80 miles from my home.

I just don't think it's related in any way. It's related only in the way that I thought we had agreed to soft peddle or reject, which is in terms of public

1b4

acceptability of risk. That's important, and that comes later after we've done our best to assure that the risk is properly managed.

I don't think -- you know, for example, if I could build a nuclear power plant that had a risk comparable to the other risks we assume in life, but for an extra nickle I could make it ten to the minus six of the other risks we endure in life.

I would spend that nickle, because it would be worth it, even though by this standard, I wouldn't need to. I just don't see that the risk of anything we do should be compared with anything except the benefits we derive from doing.

DR. BEYEA: What is your alternative? How would you --

DR. LEWIS: The benefits we derive from doing it with an honest effort to quantify both --

DR. BEYEA: So you have a risk benefit methodology of --

DR. LEWIS: Well, not methodology, because that sanctifies a thing which is a very mysterious thing to me.

MR. LEVINE: I don't think that there is such a methodology.

DR. LEWIS: Well, yes, I didn't say methodology.

DR. BEYEA: You criticize one approach, but I

lb5

don't understand. You have to articulate more as to what you're getting at before I can understand what your alternative is.

DR. LEWIS: I believe -- I'm just repeating myself -- that the risk we assume for anything we do ought to be measured against the benefits we derive from doing it.

DR. BEYEA: In dollars?

DR. LEWIS: I didn't say that. I said quantified in the best way that we can, and if you want to make the common unit of the two dollars, feel free. I may choose to make it something else, but I think we need a societal understanding that things which are often measured in different units still often have to be compared with each other, and that the proper -- the thing against which we measure a risk which is part of a cost; whether you want to put it in dollars or not, it's part of the cost of doing something, has to be in some way measured against the joy or benefit we get from doing it. The risk -- we all know from the famous table that if I go canoing for six minutes I incur a ten to the minus six chance of drowning and I don't measure that ten to the minus six against the same risk of smoking 1.4 cigarets, according to the table, we all know, because I don't derive any joy from cigarets, and I do derive great joy from canoing.

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You know, I just think that comparing a risk of one thing with a risk for another makes only sense if they are truly alternate, identical ways of providing the same benefit, and there is no such thing in this racket.

The closest thing you could come to it, perhaps, are some perhaps similar alternate ways of providing electricity, but the much touted comparison between coal and nuclear means of producing electricity I think is quite badly misused also, because the degree of discomfort or threat or cause associated with those two technologies are just so different that to add them up in terms of what is the risk of killing the person is to misuse the threats that each provides to our society, as measured against the common benefit, which is electricity, so I would argue very strongly in favor of going risk benefit without the word methodology.

DR. BEYEA: This is good, but your alternative is helpless. I wouldn't know how then to use it as a philosophy for setting safety --

DR. LEWIS: That doesn't mean that doing something which is wrong is right. Of course it's very difficult, and I said, you quantify it as best you can, and there's some things we quantify simply by societal acceptance. That's absolutely true.

DR. MAZUR: I don't understand the difference in

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your argument. You may object to the difficulties of comparing risks from two different sources. Wouldn't you also compare the difficulties of having to bring into commensuration radically different units of risk and cost and benefit?

DR. LEWIS: I never said it would be easy, but we do it every day of our lives.

DR. MAZUR: One would make exactly the same kind of objection to both schemes or neither.

DR. LEWIS: No, no, no, no, no. One is irrational, the other is hard, and there's a big difference.

DR. MAZUR: Well, I will just reverse it. One is irrational. The other is hard, but the one you say is hard is irrational and the one -- I don't see --

DR. LEWIS: No, no, no, no. Don't you, every day of your life, in different units decide what to spend for a meal, decide what to spend for a car, decide how to use your time?

DR. MAZUR: Sure I do, and I also consider between options and --

DR. LEWIS: Sure. It's a very difficult thing sometimes to decide how to do these things, but that's the heart and soul of everyday life.

DR. KOUTS: It's very easy, but that's because we don't convene panels.

DR. LEWIS: Sometimes I convene a panel of one.

MR. BURSTEIN: Does that mean that you would not have a limit or a level of -- perhaps associated with a nuclear safety goal?

DR. LEWIS: Oh, yes, I would, but -- we're talking about item 3, how to approach setting levels. I would approach setting the levels in terms of what we're willing to pay in terms of risks and other things for the benefit of the electricity. There are people in our society who believe the electricity isn't worth a damn. You know, it's ruined our lives and we shouldn't have it. For them scratch it. We shouldn't be making electricity anyway. We need a societal judgment about the level of the benefit, and then we have to do our best to translate that into a cost.

The cost is both money and risk, and many other things. It's very hard. I'm not saying it was easy.

MR. LEVINE: I have the floor.

DR. JOKSIMOVIC: I'm sorry.

MR. LEVINE: First, Hal is exactly right intellectually.

DR. LEWIS: You will use good words to make them sound bad.

MR. LEVINE: I think you are. I have made the same argument.

DR. LEWIS: Intellectual is not a bad word.

MR. LEVINE: If I believed it were, I wouldn't

1b9

be here. I have made the same arguments before that the idealistic way to set safety goals -- to make risk benefit comparisons. My problem is I don't think anybody has the foggiest notion how to define benefits in quantitative terms. Also to compare commensurately benefits and risks and if one wants to go that way, it's a 10-year project of research.

If you want a safety goal in a year or two, I'd do it on a comparative basis, and that's why I simply want to compare --

DR. LEWIS: Well --

MR. LEVINE: I think we can probably show today that the unknowns and the inconsistencies, the uncertainties in making the comparisons are less than they would be in the benefit risk comparison.

DR. LEWIS: What I would say to that is to say that you're doing the wrong thing well doesn't make it right. I mean the evidence --

MR. LEVINE: -- better than the right thing not so well.

DR. LEWIS: No. I don't agree with that. The thing worth doing is worth doing badly. In some areas we achieve this relationship between risks and benefits simply by public consensus. That's what has happened in aviation. In aviation the risks -- airplanes can be made safer, no

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question. I know how to make them safer. We all know how to make them safer.

We don't particularly want to because we've learned how to accept the benefit, match it against the risk and live with it. Nobody has quantified the benefits in any way that is commensurate with the way in which we quantify the risks, but we've learned to live with that situation.

I think that's better than comparing it with bus travel. Buses are safer, you know.

DR. KOUTS: Allan, may I suggest a third philosophy that we could consider, and if you don't mind I will take the disciplinary prerogative of calling it a sociological approach.

DR. MAZUR: If we exclude temporarily from society those people in small groups who are adamantly on one side or the other of the controversy, then I would say that there exists in society on a given time and place notions about what kind of risks are horrendous and notions about what kind of risks are minimal and they are based on all kinds of things and they surely aren't -- preference kinds of things, but nonetheless there are such notions, and that if one is indeed set with this very difficult task of coming out with some specification of what such numbers are, rather than going through the impossible problems of

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evaluating risk versus benefit and the equally impossible ones determining equivalent risks from difficult and non-comparable alternatives, what one should do is attempt to, as individuals in society, figure out where do the sensibilities lie, and let those be the statements of what are going to be reasonable risk goals.

It is simply a matter of reading what seems to be the perception of that group of people at that time.

MR. LEVINE: How do you apply that?

DR. MAZUR: You do it by a number. For example, if the goals are to be stated in terms of risks to an individual near the plant, one gets some notion in that place and that time of what is an acceptable risk.

It is very clear that risks on the order of a one in a hundred chance in a given year that you're going to have a serious exposure is not going to be acceptable.

On the other hand, once we start talking about minutia level risks like ten to the minus seven people who aren't terribly opinionated -- I'm leaving out purposely those who will object to anything or those who will espouse anything -- are just not going to be bothered by that level of risk, assuming one can convey to them what indeed it means.

Now, obviously, there are going to be uncertainties, as in all of these things, but I would say that we

can certainly start to get an impression of what are
1b12] realistic numbers which, when presented to people in an
intelligent way and in-depth discussion, not on a question-
naire form, but where you make sure they actually have some
sense of what you're talking about, they say, "Gee, that
is not an overwhelming kind of risk." By whatever criteria
they're using.

DR. KOUTS: This is a restatement of something you said earlier.

DR. MAZUR: Well, it correlates with what I said earlier, yes. I objected to the arbitrariness of the whole thing, introducing it at the top, giving it to the bottom. It seems to me that the way to do it is go directly to the goals and let them be goals that are sensible to that society at that time.

MR. BURSTEIN: That's a public acceptance kind of thing?

DR. MAZUR: No. It's not necessarily an issue of acceptance or non-acceptance. It's more an issue of what people at the time think of a reasonable --

DR. LEWIS: When you explain the benefit to them at the same time, of course.

DR. MAZUR: Of course that will be a considera-
tion.

DR. LEWIS: I would think it would be essential.

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DR. MAZUR: Well, not necessarily. It isn't always. People aren't as all rational as we sometimes talk about them around --

DR. JOKSIMOVIC: Let me try to understand what Dr. Lewis said. I heard you and I'm interpreting that you are in favor of setting quantitative safety goals.

DR. LEWIS: Yes.

DR. JOKSIMOVIC: You're not in favor of using comparative risks studies as a basis for it.

DR. LEWIS: I hope to answer it clearly.

DR. JOKSIMOVIC: Okay. But you may be in favor of using other bases which could be some kind of a combination of professional judgment and to quote Slovic -- boot strapping and formal analysis.

These are some of the items that Paul Slovic did, but since we have the benefit of his work over here and the NRC has payed a lot of money for it and Bob can quantify it -- and more to come -- I'm using Paul Slovic's -- I expect a commission from him for this.

So if we can come up with some of his attributes like he's advocating and we can assign some percentages -- use a combination -- and we can combine all this in some fashion then, then that would be acceptable.

DR. LEWIS: If I understood what you said I would probably agree with it.

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but maybe no.

MR. LEVINE: I'm not sure I understood.

DR. JOKSIMOVIC: I'll agree that we should set --

MR. LEVINE: I understand the first part.

DR. JOKSIMOVIC: All right. He doesn't think a comparative risk study should be used. There has to be some other basis which I haven't heard him define the problem.

DR. MAZUR: The risk is justified by the amount of benefit. If the benefit is big enough you take more risk. If the benefit isn't great you take little risk.

DR. LEWIS: Absolutely.

DR. JOKSIMOVIC: But in doing so, we should exercise our judgments on that. We should exercise our experience and we should go through some formal process of making sure that the assumptions have been consistent.

DR. LEWIS: But we should do the very best we can, and that includes the way we do signs, a combination of judgment, study, experience, research, interviewing, thinking, intellectualism, the whole works, the way we do anything we want to do that is hard. This is hard. I'm not underestimating it.

MR. SALISBURY: How would you balance the benefits for the shareholders, the electric utilities versus the general public and --

DR. LEWIS: It would be very hard. Our job is the general public, as a matter of fact, so that one is actually not hard.

MR. LEVINE: You can ask Hal a hundred questions like that and he'd tell you each one is very, very hard.

lb15

DR. KOUTS: Hal, would you stop using the word "hard" and use some other word?

DR. LEWIS: Yes. Intellectually challenging.

DR. KOUTS: It may be something you could do in an afternoon. To me hard means something that really is taxing and will take a long time and a lot of effort.

MR. BERNERO: You are suggesting, Hal, doing a risk benefit or cost benefit analysis that implies a very difficult comparison of two things that serve a similar function. It's either my vacation this summer or the way I'm going to get my electricity or some other decision, and you're looking at two alternatives that are in different units, pose different threats, have different benefits or different sub-elements of benefits, and it implies that you are forced to make the choice only on that basis, no matter how difficult that basis is, and we do do this in every day life.

It seems to me Allan Mazur is suggesting that the sociological approach says is there some screening method by which you can see whether you even need to do that.

I detected, and I'd like to ask Allan to speak to it, almost a justification for what Saul is trying to do. Sol seems to say if it doesn't add significantly to the everyday risk of ordinary life and in general electricity is useful, there is no need to go do that difficult cross-benefit analysis. But a sociological test of -- it's below the threshhold of concern.

lb16

I got stuck on the witness stand one time when I was asked, "Why do you find this plant acceptable with a four millirem per year routine exposure?" There was no regulation to justify that. And I said, "I don't know what four millirem per year does to the human tissue, and I certainly don't know how the human tissue responds to it, but I know all the different ways I can get four millirim per year, and that's well below my threshhold of concern."

I just don't want to take the trouble to sort it out. I don't have to.

MR. LEVINE: In fact, that's hard to sort it out.

MR. BERNERO: It's very difficult. It's below the thresh -- that seems to be what you're saying, Al.

DR. MAZUR: That's one aspect. I mean, with the proper sociological dissertation, I could expand certainly. I would just mention that it's not surprising that Saul has made that kind of statement because he is, after all, a member of this side, and I'm sure if we start --

(Laughter in the meeting room.)

DR. MAZUR: And in fact may I make the point, and I know we're not supposed to talk about numbers in here, but if you ignore the way they got to the numbers, as I like to do because I think it's so silly, but if you look at the numbers, not surprisingly, they got to a point that's reasonable. I mean, if you look at those numbers you have to think, you know, they look all right. Who's going to really object to these kind of numbers and it's not because they got him in some convincing way, but it's because at the end they came up with numbers that, given what we know about people like us, we figured empathetically, gee, yeah, those are numbers that people just aren't going to get terribly upset about, unless they have some other reason.

For example, there is a major accident that gets all kind of exposure, then obviously you start bringing in, as both of us pointed out, you start bringing in special concerns, and these things are very time -- temporal, and what's big in one year isn't big in another year, but probably -- yes. The answer is yes.

DR. KOUTS: Hal, I think I'd prefer to look under the lamp post.

DR. LEWIS: Well, everyone prefers to look -- can I just say one thing in defense of myself, and then I'll shut up. As a conjectural world, for example, one which I --

and I know I'll be misquoted on this -- I could imagine that one might decide that the nuclear means of making electricity is infinitely preferable to any other method now known -- oil because we don't want to go to war over oil, coal because it ruins the upper atmosphere and it's dirty and it uses a lot of space when we start our strip mining, and nuclear is clean and neat and compact, and so that we'd be willing to take far more risk comparatively in order to derive the benefits of nuclear supplied electricity.

I'm not saying that that's the way it would come out, but it's not inconceivable that it would come out that way. I don't see such a conclusion coming out of anything that involves comparative risk analysis.

DR. MAZUR: Absolutely, but that's a different issue altogether. We're not making a decision whether one should or shouldn't go nuclear, because that could be tied to just such concern.

DR. LEWIS: No, I'm saying, you know, as we set -- we're talking about how to go about setting quantitative safety standards. I could imagine wanting to set them at a riskier level than a comparative risk analysis would leave you to suggest, because of the other benefits. We accept greater risks and aircraft flight than we do in bus travel because there are other benefits.

We don't do it by comparative risk analysis.

DR. MAZUR: Precisely, but the reason you will come to a specific case that demonstrates that is because you're going to come up with a risk factor that's within the range of sensibility of people.

DR. LEWIS: That we have to do only things that are within the range of sensibility, of course, I agree, but sometimes it's very difficult to determine what that range is and again coming back to the aircraft industry example I know people still who refuse to fly on airplanes, but the vast majority of society, the vast majority of people have come to accept it even though every time a hundred people get killed it's in the newspapers as a headline, although when a hundred people get killed in a mining accident in the Philippines, it's page 24 of the newspaper.

People are different about that sort of thing, but they've come to accept it without ever being polled on it or asked whether they would accept 20 per hundred million passenger miles or a hundred -- sort of vague acceptance, and I have nothing against that. That's a fine way to do things.

MR. LEVINE: A very temporal way.

DR. LEWIS: Sure it's temporal. Absolutely.

MR. LEVINE: Planes could crash in mid-air over the grand canyon.

DR. LEWIS: They changed everything.

MR. LEVINE: Changed everything. Now they're accidents and it doesn't change anything.

DR. MAZUR: -- DC 10 accident, of course, people wouldn't ride on DC 10's till --

MR. LEVINE: DC 10's. Now --

DR. BEYEA: I'd like to comment. The methodologies -- mention the one that I favor. First of all, one of the problems I have with Saul's method, take some fraction of existing risk, is that I don't think it's transferrable to all technologies in society.

If you say that you're allowed to increase the risk by one tenth, if you have 10 technologies, all of which you're allowed to fall under this category, then you've doubled your risk. If you have a hundred technologies you've multiplied your risk by 10.

DR. KOUTS: I'd like to object right away, because I'm not sure that's what he said. There are benefits. There are benefits.

MR. LEVINE: I said of the sum, the sum of all technologies.

DR. BEYEA: So each new technology you'd have to look at the previous technological risk and be allowed --

MR. LEVINE: You can add up -- we did it in WASH-1400. We added up -- half a dozen risks we studied.

Can only go higher if we study some more; it can't go lower.

DR. BEYEA: You know, I'm saying every new technology is allowed to do this. That's what I'm concerned about, but you're saying you would --

MR. LEVINE: Let's say you make it one percent. There aren't going to be a hundred new technologies.

DR. BEYEA: Chemicals, toxic chemicals. What I'm saying is we have to look at the time dependent risk. That's all.

MR. LEVINE: You know, nothing you said is immutable.

DR. BEYEA: The other problem is that comparing these existing risks involves some weighing process, which is a value judgment which has to be made, and there are some people in this society, perhaps a large number, who have a factor of alpha which is much greater than 1.2, which may be like a hundred.

DR. JOKSIMOVIC: A hundred.

DR. BEYEA: A hundred, yeah. Some people wouldn't live --

DR. JOKSIMOVIC: They wouldn't live. They wouldn't do anything --

DR. BEYEA: There are people who the fact that the accident -- the reactor accident at Indian Point

could kill 10,000 people makes nuclear power absolutely unacceptable to them.

DR. LEWIS: Most of those people don't know it's 10,000 over the course of the next 30 years.

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DR. BEYEA: Whatever they know, their perception is that that large event -- it's a selective value judgment that they make, and you may say they're nuts, but they're -- I don't know a criteria for nuthood, so -- it's a public perception that this is a value judgment.

MR. LEVINE: I think you have to first off very carefully -- it's fine, you have to take into account public perceptions, but you cannot deal with irrationality.

DR. BEYEA: How about value judgment? You value a certain --

MR. LEVINE: -- public perceptions give you value judgments. You cannot take into account irrationality in a rational analysis. Generally, you have to let that work itself out in the political process.

DR. JOKSIMOVIC: Alpha should be a finite number?

MR. LEVINE: Irrationality --

DR. BEYEA: I have different --

MR. LEVINE: -- a hundred.

DR. BEYEA: I have different risk --

MR. LEVINE: -- be impossible.

DR. BEYEA: I have different risk factors for

two technologies. They don't look the same. Which is better? Which is more rational? How do you decide which curve is more rational than the other curve.

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DR. MAZUR: There's a causal problem, and that is doesn't one's opposition depend on one's perception of risk, or does one's perception of risk depend on one's opposition?

DR. BEYEA: Both, but the main people in the middle, it seems to me, are the people we're talking about. We're not talking about the fringe.

DR. MAZUR: I would argue that, from some -- considered thought and study there are probably very, very few people who have an opinion on either side for or against nuclear power because of an evaluation of the risk factor.

DR. BEYEA: So you're saying that the people's concern over nuclear -- doesn't have to do with safety?

DR. MAZUR: Whether they are for it or against it is minimally determined by some quite -- estimation of its benefits versus its risks, which then leads -- I will be for it or against it. I would say there is probably minimal --

DR. BEYEA: My experience is just the opposite. I've talked to a lot of people opposed to nuclear power.

DR. MAZUR: Well, I know, but you got them after they are both opposed and have a risk perception, and I'm

saying --

DR. BEYEA: No. I've talked to people who are concerned about it. They are very concerned about the fact that there might be long term deaths in the future.

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DR. MAZUR: I'm sure they're concerned, and they articulate that, but what I'm saying is if you follow people like in studies and see, first of all, do they change their perception of risk and then do they become opposed, or do they become opposed first and then change their perception of risk? You don't get a clear picture that risk perception led to their opposition. To the contrary. It looks more like one's posture, which is largely dependent on things like social influence, who are your friends, what are your politics, whatnot. It determines both your alignment and your perceptions.

DR. BEYEA: If you look at the history of nuclear power, --

DR. MAZUR: I have in great detail.

DR. BEYEA: Okay. Opposition to nuclear power is very peripherally related to questions of safety then.

DR. MAZUR: No, no. It's intimately related, but I'm saying the reason the person is for or against it is not because of an assessment of safety. Most of the people who are adamantly for nuclear power are so because they've chosen a career line that puts them in, say, engineering

and work for a power company or a utility or something like that, and many of the people who are opposed have followed similar --

DR. BEYEA: Let me backtrack a little bit. Do you think that different people will judge risks with different weights?

DR. MAZUR: I'm not clear what that means.

DR. BEYEA: Do you think that different individuals in societies will weigh different kinds of risks differently? This was the same average expectation value, but different risk curves will be judged differently by different people?

DR. MAZUR: I'm not sure what that means. It's perfectly clear to me that the people who oppose nuclear power consider it much riskier than the people who favor it, and they consider the benefits much less by objective schemes than the people who favor it.

DR. BEYEA: What about the fact that people might agree? Some of here in the room might agree that the average expectation value of two technologies are the same, the average risk.

DR. MAZUR: The average risk?

DR. BEYEA: But the risk spectrum might be different. In other words, there might be an event which had the probability of ten billion people dying, which would

be everybody on earth, and that might be very small.

MR. LEVINE: More than everybody.

DR. BEYEA: What?

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MR. LEVINE: That would be more than everybody. That's all right.

DR. BEYEA: Now, my temperament -- I'd be very concerned about any accident which had that probability, no matter how low it was.

DR. LEWIS: You're not serious because there exists a probability that something will hit the earth and wipe us all out.

DR. BEYEA: No, no. If I have a technological choice to make; if I have a choice between various technologies -- I maintain that different people judge risks in different ways and have different values in --

DR. MAZUR: Certainly that's true.

DR. KOUTS: As a matter of fact, we have just such a possibility now --

MR. LEVINE: Based on --

DR. KOUTS: This is coal, because if the use of coal does lead to this take-off phenomenon that leads to a --

MR. SALISBURY: No possibility of --

DR. KOUTS: -- atmosphere.

MR. SALISBURY: -- that.

DR. LEWIS: Zero?

MR. SALISBURY: Why do you say that?

DR. LEWIS: This is really one of the big concerns.

DR. KOUTS: The biggest concern of coal burning
1b27 now is whether the carbon dioxide in the atmosphere would cause the atmosphere to heat up enough to begin to boil the carbon dioxide out of the ocean. If that's the case, we get a Venus situation on earth, and it does destroy --

DR. BEYEA: And so that's the kind of event that I would be really concerned about. Other people don't pay any attention to that. The risks are judged differently by different people. If there's a value judgment component in here which is non-scientific because you have a spectrum of risks, the risk curve, and there's no way of matching two curves up in terms of --

MR. LEVINE: But how would you do it by rational analysis?

DR. BEYEA: I say you cannot do it by rational -- you have to make a political decision as how -- eventually you have to make a political decision as to what's going to --

MR. LEVINE: So we might as well just continue this --

DR. BEYEA: No, no, no. Why is what I say of

some importance? Because the real choice, it seems to me, it not -- this factor, what's some fraction of man's total existing risk, but is the question of a choice of electricity that we make. I think this society has made the choice that electricity is something that this society wants. Not everybody, as Hal says, but most people have.

So the real choice we have to make is how do we choose to generate electricity?

DR. LEWIS: There's another choice we have to make, and that is to what extent do we want to encourage the use of electricity to displace all the other fuels? For example, there is another world people talk about, a fully electrified world in which we encourage people to get rid of the coal syndrome, get rid of the oil, heat their houses with heat pumps, powered by Wisconsin Electric Power. There is that issue too.

DR. BEYEA: That's a question of how you generate electricity.

DR. LEWIS: No, no, no. That's not a question of how you generate electricity. That's a question of whether you ought to greatly increase the amount of electricity you generate.

DR. BEYEA: Fine. That could be done by a number of different ways. If you want to do that you could do that by a number of different technologies, and the question I

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say --

DR. LEWIS: That's not clear to me, but --

DR. BEYEA: Let me go on. Just let me finish. It'll take me two more seconds to finish.

DR. KOUTS: I'd like to hold it to the subject here.

DR. BEYEA: Okay. And so I at least think that this society has made a decision that electricity is a benefit and the question is what are the choices we have to do that and it's on that basis that the level should be set.

MR. LEVINE: Well, I agree completely that -- if you want to limit it to that basis, then I think you can do a cost benefit analysis of the kind Hal would like to see done.

DR. BEYEA: I still think it's going to be a political decision because we have different areas in which you compare risks.

MR. LEVINE: It's very easy if you start weighing the use of oil and the probability of war, and the probability of contaminating the earth.

DR. BEYEA: Fine. But we can put it into an arena, and we can have a national political decision.

The method I'm proposing is the comparison of alternatives.

MR. LEVINE: That leads into whether or not you need nuclear power --

DR. KOUTS: On the cost benefit basis?

DR. BEYEA: Not on a cost benefit basis, but on a comparison of alternative ways of generating electricity. As I stated this morning, --

DR. KOUTS: Judged on what terms?

DR. BEYEA: One can set criteria, for instance, in terms of risk of war, risk of death within 30 miles, risk of death beyond 30 miles, risk of early death, risk of delayed death. I'd say 10 different categories.

One can look at the various alternative ways of generating electricity, comparing those risks and then trying -- as a goal, as I mentioned this morning which is to make nuclear power small in all those areas. As a safety goal.

DR. KOUTS: The safety goal is set by comparing nuclear with other means of generating electricity.

DR. LEWIS: I will take exception to that for just the reason I made this other point, that that assumes that it's a zero sum game, and I don't want to assume that it's a zero sum game. You're assuming that the alternatives are that we have a certain amount of electricity that we need, and that the choice is whether we generate it by coal or by oil or by nuclear or solar or what-have you.

I'm saying it is not a zero sum game. There exists a perfectly respectable body of, if you'll forgive me, intellectual activity which argues that in fact the really important thing is to stop burning fossil fuel and to electrify the world in such a way that we don't burn anything.

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There are only two alternatives there. One is solar electricity, which I wouldn't bet my country on, and the other is nuclear electricity. I don't know any others. Maybe there are.

DR. BEYEA: And? Go on.

DR. LEWIS: Well, that's a world in which you don't do a zero sum game on different ways of generating electricity.

DR. BEYEA: But you just said there were. There's solar and nuclear --

DR. LEWIS: When you compare nuclear versus coal, you're assuming that the option is whether you make electricity by nuclear power or by coal power. That presupposes a zero sum game that these are alternatives. The alternatives may be, as I would prefer to see them, whether it pays to generate more electricity, both by nuclear and coal generation, for example, or by neither. I'll accept either --

DR. JOKSIMOVIC: Rather than burning oil?

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DR. LEWIS: Rather than burning oil.

DR. BEYEA: The whole language was in terms of alternatives. You were talking alternatives --

DR. LEWIS: I'm sorry. I promise to shut up.

DR. WALD: I'm a little puzzled because I think what you're suggesting addresses the issue of a safety goal for electricity generation, and I have no quarrel with considering that if that's what you want to buy with NRC's money, but I understood that we were talking about our safety goal for nuclear power plants or for nuclear operations, and there's quite a difference. As you pointed out, the factual basis for one is quite different than the other, and the considerations have to apply to the safety of each and every process for generating electricity and that seems to be the area that you're suggesting and I suppose an artibtrary ruling is the solution. What safety goal are we discussing?

I think that one's important. I'm not at all adverse to its being given proper consideration. It has been by a number of groups already, but it's not the same as this one.

DR. KOUTS: I think we're discussing a safety goal to be used in connection with nuclear power plants. And the suggestion that's been made is that a way to arrive at that safety goal is through considering other ways of

generating electricity too, but there is objection to that also. This is one means, -- but, yes, we're considering nuclear power plants.

Well, we're just not going to arrive at any

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conclusion here. There certainly is a range of opinions on that. The philosophical basis underlying choice of numbers, and we may just have to fall back on Allan Mazur's conclusion that at some point we say yes, those are good enough.

DR. BEYEA: The consensus is we'd make them all three of the goals.

DR. MAZUR: Another way of -- maybe we might want to see if there is consensus on ways not to do it. I don't mean trivial ways, but --

DR. KOUTS: I don't think we have enough time.

DR. MAZUR: I was thinking more in terms of ways that had been advanced as real candidates that we might feel could --

MR. LEVINE: The three ways that are proposed here, four ways? Four ways.

DR. MAZUR: In fact, you're being a pessimist when you say we're not going to come to any conclusion. Actually, we've come to many conclusions.

DR. KOUTS: Yes, we have.

DR. JOKSIMOVIC: Too many.

As many as there are people.

DR. KOUTS: I think we might in fact go on to talk about -- now, what do you mean by what should they contain?

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MR. LEVINE: How much detail should be in them? A lot or a little? Why?

DR. KOUTS: Trying to answer that is something that I think we're going to be spending quite a bit of time on tomorrow, so why don't we just try not to answer that today? Because, as we go through all of these proposals of safety goals, we'll find some that have very few attributes and some that have very many, and I think we're going to have to try to settle down on some point of view as to which one of these approaches, if any, is one we would like to recognize. Okay?

MR. LEVINE: That's what I had in mind, looking at that list of thinkgs and deciding which should be in, which should be out.

DR. KOUTS: Okay. We'll be doing that. Now, let's go back to the question that we postponed, which is should we have quantitative safety goals?

MR. LEVINE: I'd like to talk about that.

DR. KOUTS: All right.

MR. LEVINE: I think -- and I can give some examples on both sides -- you know, --

DR. KOUTS: I just take it back. We'll open -- we're supposed to have a coffee break.

(Whereupon, a short recess was taken.)

MR. LEVINE: I'm going to talk about safety. And I'll say at the beginning that for a long time I didn't feel we needed them because there are a lot of things you
1b35 can do quantitatively to make the regulatory process more rational, --

DR. LEWIS: Less capricious.

MR. LEVINE: Less capricious. With quantitative risk assessment type meets without having safety goals, but then there are some things you can't do without safety goals that are quantitativ so I'm going to give some examples of both so you can see what I'm talking about.

I already mentioned the auxiliary feedwater study we made. We looked at -- while I was in the NRC. So this was done at the TM -- when the NRC suddenly noticed that the feedwater would have a profound impact on safety of plants, even though WASH-1400 had shown this some years ago before that. We looked at 25 different reactors which characterized all the operating Westinghouse and combustion engineering reactors. It was a very quick study. It was done in two weeks to look at 25 systems. It was done just looking for the obvious failure marks, and not looking for all the subtleties.

It was found in fact that there was an S-curve of -- numbers of systems versus probability of failure, you got an S-curve. Where there were some half dozen that were very, very good, had very high failure -- very low

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failure probability or some half dozen that were very, very bad, like two orders of magnitude higher failure probability, and then there was a spectrum in between, and it was clear then that that was another basis on which the WASH 1400 extrapolition from two reactors to a hundred was wrong. The slurrey system had one of the more reliable systems and the NRC promptly issued within a month orders to fix up the other systems, to make them more reliable, and that can be done without safety goals.

It involves knowing the importance of those auxiliary feedwater systems and accident sequences that are typical of most PWRs, and, you know, whatever PWR you have auxiliary feedwater has to be an important -- so that's the way to do it.

Another topic was some years ago now four NRC staff members raised 15 issues that were supposedly related to reactor safety that were not being addressed well in the regulatory process, and we were asked to analyze that by Senator Glenn, and it took us about two days to understand the issues because as you talked to the people they kept changing. Finally, we pinned down what the issues were.

Five of them had nothing to do with safety. They were procedural. The other 10 split into two categories. Accident sequences that had no significant releases of radioactivity, so they were really of not any real concern to safety, and the others were accident sequences that had a lot to do, but have large releases. But the items
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they were worried about were way down the probability chain, after the core had already melted, so they didn't affect the risk at all.

You can do those kinds of studies without quantitative safety. Just have to know what reactors look like, sort of. Another example are the so-called NRC generic safety issues There exists a list of 133 unresolved safety issues that are -- licensing process, left over from the licensing process, and again we were asked by Joe Henry to take a quick look at those and a one, one study said there were about 20 of those that were important to safety and the other hundred and some didn't matter, and so we got rid of those, except the NRC is still carrying them on the books, because it makes work for people.

DR. LEWIS: Maybe because they don't have a standard for throwing them off.

MR. LEVINE : These are three examples of the kinds of things you can do with these techniques without a safety goal. On the other hand, when you get to the

kinds of things that the NRC is now talking about, having minimum sets of engineering safety features, citing criteria which decouple population density from engineered safety features at plants, -- there's no way to consider those kinds of things unless you have a safety goal.

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You have to say here's what you're trying to meet, what are the alternatives ways of meeting them, does the addition of this add anything, or doesn't it, or where is your reactor with respect to the safety goal.

In fact, mostly you'll find the reactors that exist as currently designed are within most of the proposed safety goals, so you wouldn't have to have all these rule-makings. I'm not the only one who's said this. The American Nuclear Society said this. The American Nuclear Society has said this. One needs these things to help keep the regulatory process from being even more capricious. So I think we keep quantitative safety goals. Otherwise, the regulatory process really doesn't know where to stop. It will just keep adding things and adding things and adding things, thinking that they may be improvements in safety without even knowing them, and not knowing whether they're needed or not.

DR. KOUTS: They tell you where you draw the line.

DR. BEYEA: It depends on where you put the safety standard, doesn't it? I mean if I have a quantitative

goal which is 10 to minus 12, then it seems to me that --

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MR. LEVINE: You'll have to do something to meet it, yes. You may change the design.

DR. BEYEA: So you're assuming that you're going to set the safety level at a level --

MR. LEVINE: No. I'm not assuming anything about where I'm going to set them. I simply said that those who have proposed them, of whom two are sitting here, those were my proposals. The ACRS goal, they can all be met by most -- with a few exceptions, you know --

DR. LEWIS: But what you said is independent of whether they can all be met, because they do tell you where to stop. Where they tell you may be irrational, but they tell you w here to stop.

DR. MAZUR: Saul, given the uncertainties, is it really clear when you can stop?

MR. LEVINE: Well, you know, that's a tough question. You do these risk assessment by making your best estimates and trying to assign uncertainties to as many of parameters as you can, and propagating these uncertainties through the whole problem. So far no one has done that. We have propagated uncertainties through there; we have poured them out. After that, some people are unwilling to estimate, and so forth, but you come out at least with your best estimate and an uncertainty range.

DR. MAZUR: I understand, I think, what you're saying, but it just seems to me that the rationale you've given was a very convincing one. Still basically depends on their being a fairly unambiguous chain of inferences to say when you have in fact reached the quantitative
1b40 safety goal, and to the extent that you don't have that unambiguous chain, then it seems to me you've got the same problem. You're under pressures to go more and more to make it more and more --

MR. LEVINE: Well, by the unambiguous chain of inferences, you mean a codified way of doing the risk assessments.

DR. MAZUR: Yes, or else very limited uncertainty range.

MR. LEVINE: Well, this has been recognized and the NRC has tried to get a codified way of doing it. In fact, there is a PRA procedures guide being written to try to help codify this, but it's going to be a long time before it's codified to the same extent as the ASME code.

DR. MAZUR: But even then you're under pressure to reduce your confidence limits further and further.

DR. JOKSIMOVIC: They reflect the state of knowledge.

MR. LEVINE: You're not under pressure to reduce them because you in fact get a very useful result putting

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down your best estimate and the best estimate of the uncertainty allowance.

DR. MAZUR: I think I follow that, but I guess what I'm saying is that you can say that within your range of uncertainty you think you have proudly achieved that goal, but someone else can say, "Well, but, you know, part of your range of uncertainty lies outside that goal," so often seem to be doing more --

MR. LEVINE: The first question, of course, will be we don't consider sabotage a risk --

DR. MAZUR: No, I'm not even --

MR. LEVINE: Are you thinking about the things we do consider?

DR. MAZUR: Yes, what you do consider.

MR. LEVINE: People can argue with the analysis. They can say your best estimate is wrong or your uncertainty bounds are too narrow or what-have-you.

DR. MAZUR: Or to take this as our -- start talking --

MR. LEVINE: Yes.

DR. MAZUR: I'm sorry I can't pull out the page immediately, but there was one example where -- talked about nuclear and Canvey Island and coal and it showed that while nuclear's range had one end over the limit and the other end not -- and to the extent that that is not an

unusual occurrence it seems to me you'd be under precisely the same pressures to refine that analysis or do more to the reactor to insure that the whole range is in it. It
1b42 seems to me it's the same bind that you're concerned about.

MR. LEVINE: It could be.

DR. MAZUR: I don't see that moving quantitative would get you out of it.

MR. LEVINE: Intellectually it could be. Practically, I don't think it is that way because I think, from what I know today, the nuclear risks are very much smaller than all other accident risks and it will be accepted in fact. A competent analysis will show that you're below some safety goals.

DR. MAZUR: That's assuming, of course, that the criteria, the goals are set --

MR. LEVINE: It depends on what criteria.

MR. SALISBURY: Also PRA is so much more an arcane science. There are fewer people who could be knowledgeable enough to challenge them.

DR. MAZUR: All you need is two people to make an argument over it.

CHAIRMAN KOUTS: Well, is there anyone who wants to take the point of view that we don't need quantitative safety goals?

DR. MAZUR: May I take a third point of view?

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I would like to say that it strikes me that it is an empirical question that one can't really decide a priority as we're doing now, and that seems to me that once one decides how one gets to the goals it then becomes an issue as to whether or not they're useful, and they may be, they may not be.

It may be that using any of these methods we come across with some kind of numbers, such as are here, but in trying to implement it, either as background or as applied to this specific thing, we find again there is so much ambiguity in deciding whether the hardware is in fact in conformance with the goal. That may get bogged down and it may turn out that we're less useful than we were before.

There is after all a standard for better or worse. We have been muddling through with this other approach for all these years.

MR. LEVINE: We have stopped muddling through.

DR. MAZUR: We may well have stopped -- if we had such quantitative goals in progress in the last few years and the same events happened, we may well have stopped the same way.

I'm not sure that we've stopped because of the -- there were quantitative goals there.

MR. LEVINE: I think --

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DR. JOKSIMOVIC: But the trend is this way.

DR. MAZUR: Well, that's because it's reactive. If you've gone one way and you run into a problem, you'll go the other way.

DR. JOKSIMOVIC: No, it's not only reactors. It's the chemical industry, aircraft. You know, it's just going across the board.

MR. LEVINE: The basic problem is owners and investers can't be sure when they want to start a project, but they can deliver it on time, on cost, and with a known rate of return, and a big contributor to that is now the regulatory process. In fact, last year --

DR. JOKSIMOVIC: Overwhelming.

MR. LEVINE: -- was talking about 16 years with a total time -- when a utility decides to build a reactor, it will be operating -- financial cycles go in 10-year periods.

DR. LEWIS: Soon it will be decommissioned before it's finished.

DR. BEYEA: So how many years do you attribute to the regulatory process in terms of delay?

MR. LEVINE: I don't know how to answer a question like that. I'm just telling you that men like Sol Burstein just can't plan anything.

MR. BURSTEIN: I guess it varies from place to

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place, but certainly right here Diablo Canyon is an excellent example, or an infamous example, and I guess I'm troubled about the value or the need for quantification of safety goals in the light of the new nuclear plants that are going to be ordered and placed in service, let's say, in the next decade or two.

It seems to me that there are so many other uncertainties in this world that I know of no electric utility who is waiting on a safety goal in order to rush out and place an order for a new nuclear steam supply system.

If we are trying to validate perhaps the existing facilities and their degree of safety by some quantification then perhaps the exercise is worth it. If we're seeking to set guidelines for future nuclear plants, we may be devoting resources to something that doesn't require it.

DR. MAZUR: What happens if we set numerical goals and for some reason -- I know many of you don't consider it plausible, but just for some reason in the next 10 years it turns out the plants would be thought -- would have met those goals by experience turn out not to have met them, but yet they weren't so terrible. Might have Three Mile Island-like incidents with higher probability than anticipated beyond the goals but in fact, you know, when you really look at it they weren't all that awful in

terms of public health and whatnot.

What does that mean? Does that mean because we've exceeded those goals we have to go shut them down, or does it mean well, let's just re-do the goals --

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MR. LEVINE: No, no, neither one. It's what I said before, that you do a cost benefit analysis to determine whether it's worth fixing the plant or not.

DR. MAZUR: Maybe the goals weren't set as a cross benefit goal. Maybe --

MR. LEVINE: The goals have to include cost benefit. That's one of the elements of the goal.

DR. MAZUR: See, now. That's a specific point of view that others may not agree with.

MR. LEVINE: Excuse me. We're going to talk about what ought to be in the goals and -- or not to be.

DR. MAZUR: Well, that's certainly a principal position, I'm sure, but one could visualize an implementation of goals that didn't have a cost benefit analysis, and then again, we might be taking a loss. Whereas you see the benefit in having the specific goal, so you know when you're there, the other side of it is if you have a specific goal you know when you're not there.

That might bring about costs that are almost formalistic-like, preserving snail darters, because it is clear in the book that's an endangered species. You can't endanger

it, even though by a lot of other considerations maybe it isn't that big a deal if you do or don't endanger it.

I'm just saying that it strikes me as very difficult to know whether it's going to be useful or not. I surely don't have any objection. There's nothing that 1b47 suggests to me that it's clearly a bad idea, and if anything it seems the weight of the argument is on the other side, that it probably is a good idea to some extent, but I just think there's so much uncertainty there.

CHAIRMAN KOUTS: We have agreement with one reservation that even if you get them you may find real obstacles to applying them.

MR. SALISBURY: It seems like we're assuming that safety goal has to be either qualitative or quantitative and there's can't be elements of both.

CHAIRMAN KOUTS: I don't think that was implied. In fact, I thought we'd even agreed to -- if we have quantitative safety goals, they should be a structure under a qualitative statement.

MR. LEVINE: In fact, they will not replace the existing set of regulations, which will be qualitative --

MR. SALISBURY: I was thinking more in terms of you might have a quantative goal and you might have other kinds of qualitative -- I don't know if it's a common goal, but requirements as well. You might say, "Well, you're

going to have to have a containment. You're going to have to have so much area around the plant dedicated to, you know, without any population.

MR. BURSTEIN: Excuse me. I guess I lost something in translation. Is it the consensus that the addi-

1b48 tion of a quantitative safety goal development, that promulgation is in addition to everything else that now governs safety considerations?

MR. LEVINE: Not in the licensing process.

DR. LEWIS: We know you're asking for it, but we'll turn you down.

CHAIRMAN KOUTS: Just interject --

MR. LEVINE: I think that will be a very hard point to preserve.

MR. BURSTEIN: I think that you might reserve some time for discussing that in the future.

CHAIRMAN KOUTS: You asked a question earlier about whether -- how much time does the regulatory process add to licensing? I think we have one instance that will help, and this is Shoreham. Now, Shoreham has been on the books a long time, and the present design of Shoreham is supposed to be a twin design to Millstone 2. Millstone 2 went into operation about two years ago, I believe. Shoreham is likely to go into operation about 1985. Now, I don't know how much the regulatory process added to

Millstone, but it certainly added five years more to Shoreham than it added to Millstone.

DR. BEYEA: That could have been intervenors, not necessarily the regulatory --

CHAIRMAN KOUTS: Intervenors to some extent, but

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that's part of the regulatory process too and most of what's been added has been the result of things that have some along. You delay the process a little bit, and in that little bit of time that you add more things come along, and this is precisely what's happened at Shoreham; new seismic requirements have come along, fire requirements. They had to rip out a lot of stuff and put in more stuff. There have been the TMI add-ons. All of this has added something like five years to Shoreham.

DR. BEYEA: I thought there was a study that was done by the NRC to look into the average delay, years of delay.

CHAIRMAN KOUTS: You may be sure that it came out low.

MR. BERNERO: I was just going to say that speaking as a resource person I assure you that if we examined the sources of delay in the licensing process it ain't us.

CHAIRMAN KOUTS: Hal, just two things --

MR. BERNERO: The ACRS.

DR. LEWIS: I just want to make two things -- one

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is in response to Sol Burstein's comment about the large number of plants that would be ordered in the next decade or two. That same point came up at a recent symposium on plant standardization in which NRC took the position why worry about it because, after all, nobody's ordering any plants anyway, and these things tend to be self-fulfilling prophecies because I defer to you on your knowledge of the industry but among the people I speak to, the overriding issue is predictability, not the level, but the predictability of the process, and both plant standardization in my view and quantitative safety goals in my view are contributions to the predictability of the process which is part of a long term procedure to make it less capricious and more rational, but that shouldn't be just treated lightly just because there are not many plants coming on -- that's point one.

Let me just say point two, which is a real quickie. There's a fourth view under questions to which there was a yes or no answer should there be a quantitative safety goal. I would rather phrase it should there be a stated or an unstated quantitative safety goal, because there is now a quantitative safety goal, because decisions are made whether to license plants. It's just unstated, and it's not even agreed on among people, but in the last analysis the people who ultimately make the decisions, you

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know, have some standard in mind that's unstated.

CHAIRMAN KOUTS: -- precedent standard.

DR. LEWIS: It's better to state it.

DR. WALD: I have two questions which relate to the issue of why -- whether we need a quantitative safety goal, and, one, I'd like to ask Saul, really, because initially this morning you spoke about two purposes for the safety goals; protect health and safety and make the regulatory process more rational, and in your discussion this afternoon I think you certainly supported the second of these. I really haven't heard whether or not there will be an improvement in any way in the protection of health and safety as a result of a quantitative safety goal.

It seems to me this group would be remiss if it doesn't have some view on that subject.

MR. LEVINE: Improvement in the existing risk.

DR. WALD: An effect on the protection of health and safety.

MR. LEVINE: It's bound to have an effect that should be beneficial because we'll know better plants are meeting those goals or not. Now we have no goals. We have no idea what the probability of accidents or the consequences are in the current regulatory process. All this is outside. All the things we know about that have occurred

as a matter of research from outside the regulatory process. And ignored by the regulatory process until recently.

Now, there are other risk assessments being done by people because the regulatory process got in trouble and couldn't answer some questions, so they asked for risk assessment to be done on these high population density sites, so of course we'll know more.

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I'm not sure that the level of protection will be higher, although I can give you the example of the auxiliary feedwater systems and the example of the BMW reactor, both of which had been fixed to make the safety of the public better than it was before.

DR. WALD: But that you said was an example of --

MR. BURSTEIN: Outside of the safety goal.

DR. WALD: Something that didn't meet the safety goal, the feedwater study.

DR. JOKSIMOVIC: I think we can say that the safety is going to be improved as a result of this.

MR. BURSTEIN: Excuse me. It seems to me that something is inconsistent because I heard Saul Levine say before that practically all the plants he has looked at would fall within some of the numerical numbers of levels that he would like to see. Now, what I understand that to mean is that going through a quantified safety goal and the PRAs associated with it will give you the assurance

that you have met that target which you now perhaps do not have. But it won't change the basic level.

DR. WALD: Well, that's the issue -- that's what I'm trying to bring out for the record. Because the expectation that will go with this if we don't address this will be that there will be some sort of a change and presumably improvement in health and safety as a result of the establishment of a safety goal, and it may be rather that it is an extension of this, making the process more rational, that we'll know better what we're doing rather than that we will be able to do something better. This should be distinguished here --

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CHAIRMAN KOUTS: I think Bob has the --

MR. BERNERO: Yes. I'd like to qualify something Saul said or disagree with it, depending on whether he agrees with my qualification. Saul says that most plants would meet the goal. I would rather say that most goals proposed, such as the ones in the ACRS report and others as a general matter constitute goals that are reachable by most plants if one looked at the plants and made sure they didn't have outlyers in -- more peculiarities. And the point is that the state of the art of reactor design is capable of meeting these goals. There is excellent reason to believe that larger population of plants which haven't been scrutinized have peculiarities in them that may put

them above the goals; that is, pose greater risks, and that the improvement in public health risk will come from normalizing them. In other words, taking the state of the art and removing the bugs from it rather than the safety goal being the aegis for changing the state of the art to
1b54 a still safer level of design. What we have is a reactor design which doesn't obtain the full safety capability that's there because of peculiar -- we've had -- the auxiliary feedwater study had a major vulnerability in steam turbine driven machinery, which should be able to work without electricity.

A large pump there, steam driven and electrically power lube oil pump on it or radiator cooler. You know, a trivial dependency, and you say, "For Christ's sakes, don't do that; hook the chain on it and make it drive its own cooling water, and it's a straightforward thing to remove that, great improvement and reliability for a relatively trivial cost.

DR. WALD: So, in effect, are you saying that we'll have a more sophisticated grading system by which to assure ourselves of the absence of -- things which could be met with the current state of the art, but might not, as we don't pick them up as readily.

DR. BERNERO: Don't, in my experience.

DR. MAZUR: At the risk of being overly formal,

I would remind you that our stated purpose is not to improve health and safety, but to make the regulatory process more, quotes, "rational."

CHAIRMAN KOUTS: There's a first line to that, which is to protect the public health and safety. Unless you feel it's not safe enough. Now, here is an instance an outlyer was found.

MR. BERNERO: More than one.

DR. MAZUR: I just want to emphasize that to the extent that we formulated an answer to that first one, I was rather careful to see if I got it. It didn't make mention of improving health and safety. It didn't say improving. I think it said protect. It says in terms of rationality, which we had trouble, if you recall, agreeing on what rationality was.

CHAIRMAN KOUTS: Well, going back to the initial goals, initial goals were twofold; to protect the public health and safety and to make the regulatory process more rational.

DR. MAZUR: No, those were Saul's two goals, but if we wanted to do that we've got a whole bunch of things if we go with what each person said.

CHAIRMAN KOUTS: I thought we'd agreed on that.

DR. LEWIS: I'm completely confused. I don't see how you can make the regulatory process more rational

without improving public health and safety.

DR. WALD: That's so, I think we agree on it. I think that should be said. I gave you the example this morning of an improvement in the regulatory process that, at least to many people's view, diminishes public health and safety.

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DR. LEWIS: But I can give you examples in which, you know, in which an improvement of understanding would improve -- help the public health and safety.

An outstanding example is a place where the NRC has been devoting a great deal of effort for many, many years against the advice of many, many committees like this. I'm thinking of the ECCS, in which the public health and safety was certainly diminished by a misdirection of NRC assets away from the things that ultimately led to Three Mile Island, and if the quantitative analysis had been in place, respected and used just within NRC, it would have conceivably have prevented an accident, inevitably doing things well as to health.

MR. LEVINE: In fact, the risk assessment approach that identified the need to do more work on operator response and --

DR. LEWIS: Sure.

CHAIRMAN KOUTS: Just as an aside, I don't think this diverted any attention anywhere, because that support

of the program would never have been there except for the ECCS issues.

DR. LOWRANCE: A question of clarification addressed, perhaps, to begin with, to Mr. Bernero. You mentioned a very good example of the steam-powered plants. I wonder if we aren't letting in too much blur between quantitative establishment and pursuit of goals, and analysis, that is, good engineering analysis, hazard analysis, and so on, of a plant design. I agree that such analysis, and just basically what I would consider to be simple engineering, ethical engineering design, would try to catch those kinds of problems, and you'd use a whole series of game playing, modeling, and all those kinds of things to try to find flaws in design.

I'm not sure that that's tied. I don't see how it's tied to the establishment of overall quantitative or other safety goals. Would you speak to that, perhaps?

MR. BERNERO: Yes. I'd say it would be tied. The use of a quantitative safety goal forces you to use a product effective, rigorous analysis. I can postulate an example where the turbine-driven pump with the AC powered lube oil cooler makes sense in a power plant where the loss of electrical power is very, very, very remote, and the designer's interest is in diversity of type of pump where he's more worried about the type of pump being the problem

than the mode of power of the pump, and I think that was probably true in most plants, that the guy was more thinking of type of pump. Then it is not a stupid thing to do to have an AC powered lube oil cooler because electricity
1b58 is presumed to be available.

I think the use of a quantitative safety goal forces the analyst not to presume things, but to quantify his presumptions, his assumptions and --

DR. LOWRANCE: So it's not the existence of a goal itself that is so desirable, but that that goal has the consequence of --

DR. JOKSIMOVIC: -- tool -- that produces a disciplined, systematic construction approach.

DR. LOWRANCE: Yes, but that doesn't depend on there being a quantitative safety goal.

DR. JOKSIMOVIC: Right.

DR. LOWRANCE: You could do probalistic analysis--

MR. LEVINE: Yes, it does, and let me tell you why. In this particular accident -- most engineer safety feature systems have been analyzed, have a failure probably of one in 10 to one in a hundred thousand to turn on -- there's only one system, that's one in ten, and it's acceptable. It doesn't change the risks very much. There are one or two systems that are near one in a hundred thousand, and the bulk of them fall in the one in a hundred

to one in ten thousand, and the question is what should a particular system be designed to meet. It turns out the auxiliary feedwater system could really be designed for around ten to the minus four, not around ten to a minus two -- fantastic implication on a risk, and the safety goal will ferret that out.

The safety goal in conjunction with PRA will ferret that out.

MR. BURSTEIN: In fact I don't disagree with that, but you could still do that same analysis, I think rather effectively, without having a goal in mind.

MR. LEVINE: In fact, we did it, and the way we did it was to sort of assume that all plants ought to be about as good as WASH-1400, but that was done on a comparative basis without knowing where the --

DR. LOWRANCE: So your --

MR. LEVINE: -- could be.

DR. LOWRANCE: -- problem is in comparing different plants. It helps to have some level against which to measure the alternative design.

DR. LEWIS: Also the other point, that enforces rigor on the system. You're right. The rigor can be there without the end goal, but the goal enforces the rigor.

MR. BERNERO: I think it would be appropriate to offer further clarification from an existing case right

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now where we have a probablelistic risk analysis that demonstrates the role of a goal as against merely doing the analysis, but there is a plant for which we've done a probablelist risk analysis, and -- of the whole plant -- and in this system, auxiliary feedwater, and some corollary or related systems. We have determined that the entire plant has a probability of core melt, serious accident, of ten to the minus four per year, and it is tied up in the auxiliary feedwater system and the DC power control system and the AC power backup, you know, on-site backup system, in subtle ways.

Now, this is after the lube oil pump has been fixed that the AC dependencies of a turbine-driven pump are fixed. What we're left with is a plant for the auxiliary feedwater system that has but one motor-driven, electric motor-driven pump and one turbine-driven pump, and but one DC bus that controls the turbine-driven pump, and but one AC generator that powers the electric motor-driven pump.

The combination has a limit on it. You know, there's just, just so much you can do to that, it's just so reliable. A safety goal is needed to be able to say optimize what you have or no. Go out, Sol, and buy another pump and stick it over there. You need another pump. That's where a safety goal would come in, is to draw that

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line between making the best of what you have or, as in the case of this plant, where the system is potentially marginal to say no, that's not enough. Even the best of what you have isn't going to be enough. Click it up one more. Add a second electric motor-driven pump.

DR. LOWRANCE: Just one small question.

CHAIRMAN KOUTS: You may ask one small question.

DR. LOWRANCE: There are a lot of them in my head right now.

MR. BERNERO: No intellectual ones, though. Only small questions.

DR. LOWRANCE: Does having a safety goal in mind help you decide where the weak points are in the system? That is to identify that system that needs attention or upgrading as compared to other parts of the machine.

DR. JOKSIMOVIC: The PRA does that.

MR. LEVINE: Safety goal in conjunction with PRA will do that.

MR. BERNERO: Yes. Except that if you do the probablelistic risk analysis thoroughly you're going to get the highest threat, the second highest threat, the third highest threat, and you'll keep going down that list. Now, you have some sort of implicit goal where you stop counting, but the goal is just going to tell you where to draw the threshhold of acceptability.

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CHAIRMAN KOUTS: All right. Mr Beyea?

DR. BEYEA: Yes. I'd like to say that I think there are many things to gain from a quantative target for safety. I agree very much with what was said, that it's obviously very useful as a tool for discipline, disciplining thinking, and I think it will lead to ferreting out a number of safety problems. I think also that the idea of having a specific target will lead designers to come up with some very good safety ideas that would not have come up otherwise.

I think it would allow for better integration of safety design to -- into the plant design. Anyhow, I don't want to give the impression that I think that means that quantitative safety goals should be used so that we imply the present designs are good enough. I don't think that's true. I think that there are a number of useful, cost effective methodologies that -- a number of cost effective, useful additions to safety strategy that could be implied.

For instance, venting, passive sprays, potassium iodide. So I want to go on record to say that just because I think that a quantative safety goal is a good, useful idea, it does not mean that I agree that the levels have been set or sufficient for protecting public safety. I just want to make that clear because the statements that Saul has made implied that --

MR. LEVINE: I said I just looked at the goals of

the --

CHAIRMAN KOUTS: All right.

MR. LEVINE: That's what comes out of it.

CHAIRMAN: We're not going to discuss the question as to whether plants meet specific goals.

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DR. WALD: But the fact that -- levels require --

MR. BURSTEIN: Back to perhaps what Niel was raising before, and what Hal said, I have to -- there's no question in my own mind that I agree with the fact that uncertainty is probably the greatest factor that determines whether we are looking at additional nuclear power or not in this country today, and it is clear when we talking about applying safety goals to assure, or to perhaps improve public health and safety, that the only way we can do that with the plants that are now operating and the ones that are being built is to consider their backfitting or their retro fitting to correct some uncovered deficiency, or where the benefit of that correction is worth the activity to correct or improve, and I think that's the only way that I see us getting any different standard of public health and safety in a period of time before a new generation of plants go through the licensing and construction process, and I don't see that taking place in seriousness until the late 90's or beyond the year 2000. It will take us perhaps the rest of this decade to install the plants

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that are now being built. If we start ordering plants under a new incentive and a removal of many uncertainties they certainly will not come on line before that period I mentioned.

I have no desire to avoid bringing order or predictability to the process. I'm again concerned with the urgency of achieving that in the light of some of the other priorities we have consistent with these future needs, and if I have a perhaps analogy, we talked about looking at the big breaks instead of the real world type thing, and here we are concentrating on goals and stuff, and perhaps in deference to something that may have higher priority, because, as stated, we have a safety goal. We've licensed plants, we've met them, and we are continuing to develop improvements to those targets as experience and accident, and more sophisticated analysis allows us to do that.

DR. BEYEA: We've met the safety goals?

MR. BURSTEIN: Sure.

DR. BEYEA: How do we know that?

MR. BURSTEIN: Perhaps because of the operating history and the impact on public health and safety from all the plants have --

CHAIRMAN KOUTS: I'd say by definition you've met the safety goals because the finding has been made

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in every case that the Atomic Energy Act has been satisfied.

MR. BERNERO: This is the matter of the safety goal is a revealed standard of licensing requirements. Whether that translates into a coherent, homogeneous goal for all reactors is the question.

DR. JOKSIMOVIC: I think at this point, if I may interpret it, we set the goal very high. We may be on the way to meet them, but to have them demonstrated -- we have not.

CHAIRMAN KOUTS: Now you're talking as if different goals have been set than have been set in the past. The only goal that's been set in the past has been preserving the public health and safety of the public, and in --

MR. LEVINE: In each case, the finding --

CHAIRMAN KOUTS: In each case the finding has been made, and so --

DR. LEWIS: It's actually not putting undue risk on the public -- whatever they're due.

DR. BEYEA: We probably won't know that until we have gone through the history of nuclear error whether we have in fact met the original intent of those people who were interpreting undue risk in the agency.

CHAIRMAN KOUTS: I think we've beat this whole subject as much as we can. And we now have an injunction

given to us by the Commission to do an orderly review of safety goals that have been proposed, starting with the ACRS document. And I think we might move into doing precisely that. I think we have some very good useful background discussion, have arrived at some conclusions, which ought to be very helpful in what follows also.

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I think I would like to take up this discussion and document the first question in it related to Panel A. This is just what are the key characteristics of the approach to quantitative safety goals proposed by ACRS and see if we can agree on our understanding of what these characteristics are.

Limits are set in the ACRS scheme on three things. First is accident probability, second is individual risk, third societal risk.

In each of these cases there is a goal level and an upper limit. In addition to this there is an Alara Concept for determining when changes should be made to the plant. Now, if you look on the tables in the ACRS report, you see a footnote in each case which says the upper non-acceptance limit must be satisfied for extended operation of the new plant or for issuance of a construction permit.

Between the upper limits and the goal levels is a discretionary range for case-by-case consideration.

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If things are in between the two, you decide whether or not you need to make changes to the plant, based on some kind of risk analysis or cost benefit analysis. If the risks are below the goal level you don't have to do anything at all. You're home free, unless, of course, you can improve things more by application of the Alara Concept.

As far as I can see, this is the essence of the ACRS proposal. Is there more to it than this?

DR. JOKSIMOVIC: I would add just another point. I think the use of integrals as opposed to the limit lines is, as far as I'm concerned, not a feature.

CHAIRMAN KOUTS: That's for the societal risk.

DR. JOKSIMOVIC: No, in general.

CHAIRMAN KOUTS: No, because the individual risk is set by --

DR. JOKSIMOVIC: No. You look in Appendix A the way they calculated it, that's not the way they do it.

CHAIRMAN KOUTS: In the text, they talk about the most exposed individual, who is the --

DR. JOKSIMOVIC: Right. That may have been the intent, but that's not the way they calculate it. In Appendix A they give an example.

CHAIRMAN KOUTS: In Appendix A, -- the coal case.

DR. JOKSIMOVIC: Appendix A, nuclear.

CHAIRMAN KOUTS: Okay. On page 105 under

Individual Risk, they say the calculations presented here are not strictly for the maximum exposed individual, so they say that they really have not done it the way the --

DR. JOKSIMOVIC: Right. And then when you go and follow this, then they definitely haven't done it.

CHAIRMAN KOUTS: Well, do they mean to or do they not mean to is the question.

DR. JOKSIMOVIC: Well, I think we may have the benefit of Professor Alpern's (phonetic spelling) presence so we may ask him --

CHAIRMAN KOUTS: Maybe tomorrow.

They certainly use integrals and values of the societal risk.

DR. JOKSIMOVIC: It's a matter of -- in the approach that I have proposed, I have proposed to use the limit line which is somewhat different I suppose --

MR. SALISBURY: What is the significance of the difference?

DR. JOKSIMOVIC: Is now the time to talk about it?

CHAIRMAN KOUTS: About what?

MR. SALISBURY: Significance of the difference between the two. I don't know.

CHAIRMAN KOUTS: Well, why don't we talk about that?

DR. JOKSIMOVIC: I was going to suggest that for tomorrow.

CHAIRMAN KOUTS: I see these as the essential features, at any rate, of the ACRS proposal. Of course, a particular proposal could pass every one of these, pass, say, the first three of these, pass the first two and flunk
1b69 the third of flunk the second and pass the first and third or whatever. That is the ability to pass two of these requirements does not necessarily imply the ability to pass the third.

DR. JOKSIMOVIC: Just for sake of clarification, you mean accident probabilities, you mean hazard states?

CHAIRMAN KOUTS: Hazard states. There are three hazard states identified in the proposal. The first is one of limited fuel damage which releases up to 30 percent of the -- 30 percent of the nobles. The second is an accident which would release essentially 90 percent of the nobles and I think 10 percent of the iodines into the coolant, and the third is one which would release substantially all the bad fission products into the environment.

DR. MAZUR: Two characteristics of it which were very salient to me were one that I mentioned already that it seemed to me the methodology was highly arbitrary and, second, it seemed to be largely devoid of equity consideration.

CHAIRMAN KOUTS: There are certainly no limits placed on the dollar cost of accidents. Is that what you

mean?

DR. MAZUR: No, no. The derivation of numbers in all cases depends on whether arbitrarily stated starting points, and I think maybe Saul made the point earlier, it's very difficult to really discern the rationales for those particular numbers in any instances.

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So, I'm just using that -- my shorthand is it seemed to me that it's arbitrary. Nothing is quite arbitrary.

CHAIRMAN KOUTS: Then I'm going to ask one more, which might imply your conclusion. The first of these is realistic analysis. It's assumed that the analysis itself is -- you don't -- you presumably don't put conservatisms into the analysis itself, but --

DR. MAZUR: Number three, take three. Limits seemed arbitrary -- I mean they're derived, but the starting points are arbitrary and, number four, I was struck by the absence of equity considerations. That means there is no consideration to who is who is getting the risk versus who is getting the benefit. Does that need elaboration or not?

CHAIRMAN KOUTS: Okay. The characteristic here is an absence of a characteristic.

DR. MAZUR: Well, I think that's quite crucial, because maybe I should give you a contextural thing.

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I've been in some very similar discussions in a more philosophical group concerned with the ethics of risk benefit, and the overwhelming two objections to risk benefit kinds of analyses are, number one, the incommensurability problem and, number two, the lack of equity, because if you take risk in the aggregate and benefit in the aggregate and decide to do it because there is more benefit than risk, it says nothing about who's getting the benefits versus who's getting the risks.

CHAIRMAN KOUTS: We'll go into that in some depth when we talk about --

DR. MAZUR: Okay.

CHAIRMAN KOUTS: Where he proposes that you cut the electricity rates for people who live near a power plant.

DR. MAZUR: Yes, addresses precisely that issue, right.

DR. LEWIS: Then we ought to charge less for gas to people who live in texas and Louisiana and those who live near universities --

MR. LEVINE: My first considerations are like the environmental problem. It connects everything to everything in such a complex maze that it --

DR. LEWIS: That's essentially what I am saying. I really am not happy about raising the question of who

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gets which benefit, who gets what, which risk, because the whole society is made out of this complex of giving and taking and if we start doing it one at a time --

MR. LEVINE: If you do it on a societal basis -- go back to an individual basis, then equity is not important --

DR. MAZUR: But it isn't. That's the problem. If the premise of this workshop was to get input from people from various kinds of disciplines who thought about it, then take my word for it, there are important disciplines in philosophy and social science who have thought about these problems and overwhelmingly come up with the equity consideration as one of the major features to be considered.

DR. LOWRANCE: That's true except unfortunately, in most cases, they provided no way of dealing with it.

DR. BEYEA: There's a whole literature on this. Compensation --

DR. MAZUR: Exactly, yes.

DR. BEYEA: It's hard, it's hard, but you should do it.

DR. MAZUR: This is what I think we shouldn't do.

MR. BERNERO: As a sort of customer for the efforts of this workshop, we are indeed interested in

views such as this, and I would just add, as a personal opinion, the equity consideration is not merely postulated solutions such as cutting the electricial for the people who live near the plants. Society has long since come up with ways to deal with the equity, Tunnelship, New Jersey, being a classic example. The tax rate on the facilities such as Salem and Hope Creek nuclear power plants buys an awful lot of schools and fire engines and on and on and on.

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Society is accustomed to coping. Equity needs to be considered, and whether --

MR. BURSTEIN: I think that's important, and whether you do it by one technique or another is perhaps not as important. Unfortunately, we have gone as a society, as a general practice, to the opposite. In the State of Wisconsin and in most other states that have been the sites of very large, expensive facilities, all the ad valorum taxes are now paid tot he state, and the local population does not get very much back because otherwise it would be a windfall for a small, remote farm community because you can't site these where the customers are, and ideally an income of $5,000 per farmer from nuclear plant taxes is unheard of, when we need this to fund general purpose activities in the large populated areas, so we have almost gone the circle of providing equity to the beneficiaries of the product coming out of the facility.

They don't live near the plant.

DR. MAZUR: That's not equity.

DR. BEYEA: Inequity.

MR. BURSTEIN: That's by definition.

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CHAIRMAN KOUTS: Allan, can you tell me why you think this is part of a safety goal?

DR. MAZUR: Yes. Absolutely. I would prefer to be, if I may use the term, a resource person, and I will tell you that I am conveyor from these other very substantial discussions.

The ones I have in mind, you maybe have heard of the Hastings Center on ethics and whatever -- we've been carrying on exactly the same kind of discussions over the last two years, and this is a very, very large issue.

CHAIRMAN KOUTS: It may be an issue, but is it a safety goal?

DR. LOWRANCE: How can it be tied to safety goals?

CHAIRMAN KOUTS: Now, suppose a Company came in, asking for permission to build a power plant in some place or other, and the Commission asked have you a provision for compensating people in the neighborhood of your plant and they said no. Could the Commission therefore arrive at a conclusion that that plant is inadequately safe?

DR. MAZUR: Yeah, but the goal would be that a

small, selective segment of the population does not inordinately accept the risks from the plant. That is stated as a safety goal.

DR. LEWIS: I can think of one way of meeting that, which is to guarantee that in the event of an accident the effluent is uniformly distributed over -- that's clearly not a sensible thing to do.

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DR. MAZUR: Well, it may not be, but it's equity.

DR. LEWIS: Provide lower taxes for the people living around the plant so that we will attract a greater population to that area.

DR. MAZUR: As a safety goal, it's very clearly stated, and that is that the risk should not be unduly borne by one group of people. Should not be disproportionately borne.

CHAIRMAN KOUTS: Is no one else bothered by this being a safety goal?

MR. BURSTEIN: I don't think it's a safety goal.

DR. BEYEA: Safety goal, too, is looking at multi -- different populations actually because you have your individual risk, looking at people very close to plant. That's the risk to the mind of people you're talking about. You're saying the risk goal for those people. The latent cancer risk is looking at a larger population.

MR. BURSTEIN: Do we eliminate the risk by paying

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them something?

DR. MAZUR: That becomes an issue of acceptability which is not in itself a safety goal, obviously, but it's a way of assuaging your conscience when you haven't met that -- you accept that as a safety goal. People may not accept it as a safety goal.

MR. BERNERO: The question of equity is a legitimate question and safety goal, and it's been put down with facetious solutions. There are indeed good solutions.

Item 2 up there, individual risk, is the parameter of interest for equity, and there are indeed direct methods by which a safety goal can deal with equity; either there is a way to have some reasonable compensation to the threatened fencepost individual or the individual at the fense post will be at some de minimus risk level, or some level that clearly is acceptable even without the extra tax money, and NRC can indeed regulate that because we locate the fence post, and we can say no more 2000 foot exclusion radii. I want to see 20,000 feet exclusion radii, because we do have drastic dropoff of individual risk with distance. There are other ways in emergency planning to make up for fence post risk.

DR. LEWIS: That's the unduly concept.

MR. BERNERO: But there is indeed inequity.

DR. MAZUR: You point is well taken, because

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sure, one can structure things so that there aren't large inequities, simply by making sure that everybody is some distance.

MR. BERNERO: Yes. It's no longer an inequity if everyone is at a de minimus level, even though --

MR. BURSTEIN: Herb, the first item deals with -- you can just lower that a little bit -- accident probabilities. Is it related strictly to financial considerations?

CHAIRMAN KOUTS: No.

MR. BURSTEIN: If you have a goal that is set in terms of public health and safety on items 2 and 3, in respect to individual and societal risk, does that not include and encompass probabilities, and why is that delineated separately?

CHAIRMAN KOUTS: Two of these levels of accidents or core damage are situations that would not affect -- these are regarded by the people who put this altogehter as a precurser -- that is, these are more likely to occur than accidents which do affect the public.

MR. BURSTEIN: That's why I related this to the financial question.

CHAIRMAN KOUTS: It certainly would be a financial disaster, as it was, but if you could assure that accidents of that kind were adequately infrequent, then

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the less likely accident that would affect the public would be adequately infrequent also. This is the view we'd state.

MR. BURSTEIN: So you use these as signals to tell you that other accidents which would affect the public are or are not remotely possible.

MR. SALISBURY: Also it would seem to me that some of these accidents if you, say, imagine Three Mile Island without any release of radioactivity there still is a certain amount of social disruption. There would be, you know, fears perhaps in the minds of the surrounding public.

MR. BURSTEIN: Now you're talking about public acceptance?

MR. LEVINE: There's nothing in here about economics that I can find.

CHAIRMAN KOUTS: There's nothing in here about economics.

MR. LEVINE: They talk about a hundred years, for instance, for the severely degraded core being once in a hundred per reactor lifetime.

MR. BURSTEIN: Why? I guess this goes back again into what we just said, that much of these definitions seem arbitrary, but they do state --

CHAIRMAN KOUTS: In the brief letter which was

transmitted to the Commission, they start the discussion of hazard state, saying accidents that damage the facility represent possible forerunners of severe accidents, so therefore they want to limit the frequency of the forerunners because this would imply limitations.

1b79 MR. BURSTEIN: I guess I have trouble with that connection.

MR. BERNERO: With two hazard states, the ACRS group that put together that report subdivided the first of the hazard states, but with two hazard states it basically parses the problem as a means --

MR. BURSTEIN: I'm trying to lead back to the designer.

MR. BERNERO: What you are suggesting then is the probability of severe release, the ten to the minus six is yours, Charlie. Use it as you will.

MR. BURSTEIN: That's right. That's where I come out that the goal might properly be directed or attention to defining it in some fashion, and then you can do a number of different things to achieve that. But if you're going to put several layers or define it individually, you stand the risk of perhaps some of the discussion we had at the outset today of a different emphasis on impartial treatment to segments that make up the total of potential individual and societal risks you're trying to safeguard

MR. SALISBURY: I thought we already covered this and was inadequate state to be able to do that.

DR. JOKSIMOVIC: The issue over here is are hazard states appropriate safety goals or not? I think the ACRS report argued that they are, because they are possible forerunners of more severe accidents, partly because of public -- economic losses and because of the possible traumatic effect to the public.

MR. LEVINE: There is no analysis -- the number that is arrived at is essentially arbitrary.

CHAIRMAN KOUTS: The numbers are arbitrary.

DR. JOKSIMOVIC: I think that one can argue that these are not appropriate public safety goals. It's a matter between the utility industry and the insurance industry. It boils down to the investment risks.

CHAIRMAN KOUTS: If you set them for that reason, but if you set them because you feel that there is -- severity against probability.

DR. JOKSIMOVIC: It's a matter of -- what the public safety goal is. If it's simply to protect the people from outside the plant then individual risk -- it will suffice, and need not be supplemented.

CHAIRMAN KOUTS: Let me argue against that. Let me say that if TMI happened every 10 years -- every two years, let's say. And suppose it didn't cost the industry

anything to fix it up, but TMI happened every two years. I would be very uncomfortable about severe accidents and their probabilities.

MR. LEVINE: Because of a precurser.

CHAIRMAN KOUTS: Only the precurser question.

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DR. JOKSIMOVIC: I think that the utility industry and I think -- and the insurance industry are aware that they have to reduce their risks, and so they will do so anyway, because simply they cannot tolerate TMI's from the financial standpoint.

MR. LEVINE: I have the problem. How to calculate the probability of a severely damaged core, and I would hate to see something specific that no one knows how to calculate. Someday we may know how to calculate, but we surely don't know.

MR. BERNERO: I'd like to speak in defense of Dave Okrent and his people. He's not here to answer. I think the charge was unfairly leveled that the hazard states are pulled out of the ear. I have seen since the day I read it not an explicit explanation, but a clear relationship between the limits on individual risks and the hazard states. The limits on individual risks are what I simplified as ten to the minus six probability of death if you live near the plant, and that the hazard states which multiply together give you a probability of a significant

release, a large scale release, which I associated with the probability of death.

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DR. JOKSIMOVIC: You're saying there's a consistency there.

MR. BENERO: Yes. If you look at his Table 1, the hand-out document, if you look at Table 1 and multiply the probability of large-scale fuel melt tied with the probability of containment failure, you do indeed get ten to the minus six per year as the probability of a large release and one can argue on the surface of it at least that the probability of a large release and the probability of the fence post person dying may be taken as equivalent, and I think that's what they intended. They didn't explain it very well.

CHAIRMAN KOUTS: That just the logic that was used.

DR. JOKSIMOVIC: I have asked my analyst to verify that and he couldn't come up with that at all. As a matter of fact, they told me there was a detachment between individual and society, at one hand, and on the other end --

CHAIRMAN KOUTS: In fact, they specifically take the containment failure probability as ten to the minus two, as you say, and the probability of severe core damage is ten to the minus four and that does come out as ten

to the minus six and they just didn't say it all.

MR. LEVINE: I agree there's a relationship, but there's no basis for studying any one of them.

CHAIRMAN KOUTS: That's another matter.

MR. LEVINE: I think that's an important one. Why we are trying to set that.

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CHAIRMAN KOUTS: It's an important matter, but it's not the matter we are trying to settle here.

MR. LEVINE: I thought we were discussing that matter.

CHAIRMAN KOUTS: Not the val -- not the numbers.

DR. LOWRANCE: But how the numbers are arrived at?

CHAIRMAN KOUTS: No, even if the numbers are arbitrarily arrived at.

MR. LEVINE: Should they be in or out?

CHAIRMAN KOUTS: Any other set of arbitrarily arrived at numbers you could substitute and not change the structure of the ACRS logic. What we're dealing with is the structure of this logic, and the structure, their structure considers these as forerunners to more severe accidents and takes the point of view that if you can put limits on the rate at which forerunners have it, then you also face limits on severe accident frequency.

MR. LEVINE: I think that's fine, but I don't

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know how to calculate those forerunners.

CHAIRMAN KOUTS: Now we'll take that up. That's a very good point. Whether it makes sense to establish a limit like that -- can you really get at these accident probabilities, these hazard state analyses by probabilistic risk assessment.

MR. LEVINE: You can't identify the probabilities of that damage.

CHAIRMAN KOUTS: You cannot distinguish between severe core damage and core melt, according to modern --

MR. LEVINE: That's correct.

CHAIRMAN KOUTS: That's really a problem.

MR. BERNERO: I find it difficult to distinguish analytically between hazard state 1 and hazard state 2 in the ACRS report.

MR. LEVINE: I would say you could calculate the probability of hazard states.

CHAIRMAN KOUTS: That's right. Unless you take a sequence like TMI and you calculate the probability that someone thinks to close the block valve before you actually get very severe core damage. That's the sort of thing you can try your hand in calculating.

MR. BERNERO: But you have to do it 800 times on all the different accident sequences, and it's all tied up with predicting Charlie's reliability at turning switches.

MR. LEVINE: You have to consider not that he might reclose it, but that he might re-open it, and all that. The modeling isn't -- can't deal with those.

CHAIRMAN KOUTS: So we really can't deal with hazard state 1.

MR. LEVINE: I don't think so.

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CHAIRMAN KOUTS: That's a very solid conclusion.

Now, there is not very much difference between hazard state 2 and hazard state 3, except for the behavior or the containment.

MR. LEVINE: I think there's a lot more uncertainty predicting hazard state 3 than there is in predicting hazard state 1 -- 2.

MR. BERNERO: One slash two.

MR. LEVINE: A lot more uncertain. We made a first stab at it in WASH 300. You yourself recognized that that's where the major uncertainties in the whole risk assessment were.

CHAIRMAN KOUTS: Sure.

MR. LEVINE: They are very uncertain still. They transcend normal experience as a smidge more research than we -- know better now, but it's a very uncertain affair and I would hesitate to specify that. I'm not sure it's necessary to specify it because if you have the right numbers of the health effects, that should be sufficient.

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CHAIRMAN KOUTS: Are you going to move for striking all of this first line?

MR. LEVINE: No. I leave core melt probability.

CHAIRMAN KOUTS: That's what I say. I find difficulty in distinguishing. Why I find difficulty in distinguishing between States 2 and 3; the difference between the states 2 and 3 is failure of the containment. There is adequate core melt in sequence 2, which would essentially be sequence 3.

MR. LEVINE: I didn't follow that at all.

CHAIRMAN KOUTS: Well, Sequence 2 is large scale fuel melt, greater than 30 percent of the outside fuel become molten. I think the distinction between greater than 30 percent of the fuel becoming molten and state 3, which is subsequent release from the containment is principally whether the containment will fail.

MR. LEVINE: You'd have to calculate that probability and that's very uncertain.

CHAIRMAN KOUTS: Yes, yes, I agree. But the probability of core melt is the same for sequence 2 as for sequence 3.

MR. LEVINE: Oh, yes, and I understand.

CHAIRMAN KOUTS: So the difference between 2 and 3 is whether the containment will fail. Which is, of course, very uncertain as you say.

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MR. BERNERO: Could I attempt a restatement? Let s ignore hazard state 1 and assume it's subsumed at hazard state 2, so we don't confuse them.

Hazard state 2 is a safety goal, even though none are public health -- it's a safety goal which measures the competence of systems to prevent serious accidents and hazard state 3 is a safety goal which measures the capability of other systems to mitigate the consequences of a serious accident which has happened. There are two different things. They are measuring different parts of the plant and I find it difficult -- I hear suggestions that you can have one and not the other.

If you have the key probabilities -- of probability of death, you get there by a two-step process. Did the accident happen and what did the plant do to mitigate the accident to prevent the death and it seems to me that you can't have hazard state 2 defined as a goal without at least implicitly defining hazard state 3.

DR. JOKSIMOVIC: You're saying that it has to be a prevention goal and it has to be a mitigation goal.

MR. BERNERO: In effect, that's what they are. Hazard state 2 is the goal for prevention of core melt accident. Hazard state 3 is an index of mitigation of core melt accident and the next table, the very next page, the probability of early death or latent death is a measure of

the direct threat to the public health and safety arising from core melt accident.

DR. JOKSIMOVIC: If that is the case, then in regard to having this position of probability I think you don't have to put this condition associated with containment necessarily. You just say there should be a way to mitigate the release. Can be accomplished with a number of engineering solutions, containment being one of them. Why being so explicit about the containment integrity given core melt when you can accomplish mitigation by other means?

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MR. BERNERO: The probability of a large scale release given a large scale core melt, whether the containment failed or --

MR. LEVINE: That's a very uncertain matter. Unwise to specify it at this time.

MR. BERNERO: Well, if it's uncertain, then so is table 2 then, which is the probability of early death or latent death. It can be no less certain, or rather no more certain than the probability of containment failure.

The farther out you go in the chain the more you stack up the uncertainties.

DR. JOKSIMOVIC: So you are saying if it's not associated with the containment it's associated with simply release?

MR. BERNERO: Whatever.

MR. LEVINE: Some is uncertain. I believe that safety valves should be set without extra features in there because our first effort to try to set safety goals --

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CHAIRMAN KOUTS: Let's be careful, because they don't talk about containment failure. They simply talk about release from containment.

MR. LEVINE: They really mean containment failure.

MR. BERNERO: Mitigation systems.

CHAIRMAN KOUTS: -- may talk about the break between -- let's use their words. Such a division between accident prevention and accident mitigation is believed to be necessary, so they have the concept in here just that way.

DR. JOKSIMOVIC: -- of further confusion which we have been exposed to, I think if we clarify this point, and we seem to be in agreement on that, that would satisfy the need.

MR. BENERO: The logical structure distinction that's very important is that structure using hazard state 2 and hazard state 3 is companion pieces -- is distinctly from something Saul was suggesting, the possibility of using a ten to the minus six in offering the designer the choice of doing it all with prevention or all with

mitigation or with any combination thereof.

MR. BURSTEIN: That's right. That's a very substantial difference.

DR. JOKSIMOVIC: That is a different issue. That is an issue whether hazard states are public safety goals or not. One can argue that they are not -- primarily investment risk, right? And there is another argument which is summarized in the ACRS report. You can consider them as causes of public trauma that we have experienced at Three Mile. That is the consensus that they are a public safety --

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CHAIRMAN KOUTS: They can take the point of view also here that they are forced to this distinction, this break between prevention and mitigation, because they do not think you can do the whole job with accident prevention.

DR. JOKSIMOVIC: Yes, that's another argument.

CHAIRMAN: Could they do it all with accident mitigation?

Well, I'm simply going to ask does anyone have any -- I think it's reasonable to cut the categories from 3 to 2. Should we cut from 2 to 1? Or do we stay with 2?

DR. WALD: Release has to happen in order to get to table 2.

CHAIRMAN KOUTS: In order to get to table 2, the difference between table 1 and table 2 now becomes population

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density, exclusion distance, meteorology, things like that.

MR. LEVINE: Certain categories of containment failure, certain modes of -- certain probabilities. These are changing now very radically. People think steam explosions that will fail the containment are so small they're not going to trigger the risk -- the whole field is in a state of flux right now, right at this moment, and I think it's unwise to specify a number with a containment failure probability . That doesn't mean you don't know how to calculate and you shouldn't calculate it in the course of doing risk assessment, but it's a very changing field.

DR. JOKSIMOVIC: -- just simply position of probability -- given core melt.

MR. LEVINE: -- to release 10 percent of the core inventory of iodine and 90 percent of -- not to fail the containment in a rather gross way. Otherwise you don't get releases of that sort.

MR. SALISBURY: As a layman, though, it would seem to me given uncertainties in PRA that it would be, by breaking it down into two parts, that would present two easier problems to solve rather than one bigger one.

MR. LEVINE: A lot of uncertainty about this. There's just a whole unknown field in there.

CHAIRMAN KOUTS: What are you proposing to do?

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MR. LEVINE: Take it out.

CHAIRMAN KOUTS: Take what out?

MR. LEVINE: Number 3.

CHAIRMAN KOUTS: Hazard state 3.

MR. LEVINE: That's right.

CHAIRMAN KOUTS: And just confine yourself to core melt?

MR. LEVINE: Yes. That's what I would study.

MR. BERNERO: No other safety goals?

MR. LEVINE: Oh, yes. The health --

DR. JOKSIMOVIC: No other hazard states.

MR. SALISBURY: In other words, an ounce of prevention.

DR. MAZUR: But you still come to the consequences.

MR. BERNERO: If I could hang my hat on the ten to the minus four, but not on the ten to the minus two, how could I hang my hat on the ten to the minus six?

CHAIRMAN KOUTS: You're not. He's saying cut out the ten to the minus six.

MR. BENERO: Okay. Then there are no other safety goals?

DR. LEWIS: The point is that there will be in this proposal a safety goal assigned to the risks of people at the plant foundry that obviously contains containment failure. The question is whether there should be a specific

safety goal for hazard state 3. The argument is made that there shouldn't.

That is to say on the mechanical goals --

MR. BERNERO: You will accept implicit safety goal.

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MR. LEWIS: No, no. It's just that you don't set a standard on hazard state 3, but you set a standard on the consequences of hazard state 3 through the second group. That's the proposal. I'm not endorsing. I'm trying to interpret.

DR. BEYEA: I would have to say that there is very little confidence in going from outside the containment to individuals at the site of the risk. I'll talk about my field. That field is up in the air as well with the Benchmark study, international Benchmark study, of consequence analysis showing three orders of magnitude different of predictions at 10 miles for a PWR or BWR 1, PWR 1 vent.

That field also is in a great deal of flux and I wouldn't put much confidence at this point in the next transition.

CHAIRMAN KOUTS: I think there is a weakness there in your proposal.

MR. BERNERO: May I suggest something to consider? We spoke of the use of a safety goal in the regulatory

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process and I tried to make the point earlier on that the safety goal has two uses. One is in the plant or specific arena and the other is in the generic arena, games -- or retrospective evaluation of the industry. The probability of core melt safety goal is directly usable with -- by the designer to evaluate the plant design, to know whether or not there are enough auxiliary feedwater pumps or high pressure injection pumps or diesel generators.

The probability of large release given core melt, hazard state 3, is directly usable by the designer to know whether there are enough fan coolers in the containment building or reactor building sprays or heat pipes sticking out of the equipment hatch or whatever.

The probability off-site, the death and the category 1 accident at Ten Mile is not directly usable by the plant designer. It's usable by the emergency planner. But not by the plant designer directly.

Only indirectly. Only if he can translate it -- that into probability of large release or probability of core melt, and I think that's a very important --

DR. WALD: What is the link between three and the two that precede it. Is the limit on death probability specifically based on the other two limits or is it independent, because in verbalizing it sounds independent. The question over there sounded as if it's dependent.

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MR. BERNERO: I owe it to somebody. I owe it to myself to verify with Dave Okrent, but I have read this report all along ever since it came out as being in the simplest term a directly tied -- it you look at their table 2 probability of early death, less than one times ten to the minus six per site year, in my mind that goal translates directly into the ten to the minus two on containment and ten to the minus four on core melt.

DR. JOKSIMOVIC: No in my mind.

MR. BERNERO: It has been. I just assumed that.

DR. WALL: Which direction does the translation go? From setting the ten to the minus six and working backwards?

MR. BERNERO: Again, I'm putting words in Dave Okrent's mouth. The probability of death working uphill, because he has extensive discussion in there in the back about the British with the ten to the minus five per year probability of death and that nobody is really going to get all fired, excited about a ten to the minus six per year on death. They seem to me to justify the probability of death, and then to parse the problem, to back up and say, "What does that imply?" And the reasonable probability of core melt or core damage and containment failure and all these other -- then doesn't hold. We don't know enough to --

MR. LEVINE: You haven't heard all the factors in the argument. I think there are rational ways to set numbers. I think there are rational ways to arrive at it. All the engineer factors -- setting those numbers are less rational. There is no real rationale, no real logic presented for the selection of these numbers.

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CHAIRMAN KOUTS: We really shouldn't talk about the numbers because I think they're irrelevant --

MR. LEVINE: I'm not pointing at a number. I'm pointing at the logic of setting the number. I don't think there is a logic for setting those numbers. I think there is a logic for setting the health effects numbers, a better logic.

CHAIRMAN KOUTS: The weakness in what you just said is that if you think there is enough illogic to be able to set the probability of massive release from the containment because you don't know how the containment is going to protect you, then you cannot operationally calculate those health effects.

MR. LEVINE: I can, but with some uncertainty.

CHAIRMAN KOUTS: With as much uncertainty as there is in your calculating the integrity of the containment or whatever else is protected.

I must say we're at the point now where our schedule says we should knock off for the day, and I feel

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that's a very good plan. We certainly haven't settled the ACRS questions. I'm not sure we even fully understand the ACRS proposal yet, but it's going to take too long to get there to do it tonight. So why don't we recess?

1b97 (Whereupon, at 5:35 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: 1 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.

Michael Connolly

Official Reporter (Typed)

Michael Connolly

Official Reporter (Signature)