# PANEL DISCUSSION ON RECENT RECOMMENDATIONS ON DOSE LIMITATIONS

Baum: I would like to introduce the chairman of our panel discussion on Recent Recommendations on Dose Limitations, Charlie Meinhold, who is Deputy Division Head of the Radiological Sciences Division at Brookhaven National Lab, and President of the National Council on Radiation Protection and Measurement.

Meinhold: We have a very interesting topic for this morning. I note that it is stuck in the middle of an ALARA session, which seems slightly inappropriate since I think one of the aspects of dose limitation that the ICRP and NCRP have been trying to point out is that dose limits are not based on ALARA considerations, and that you chaps are doing the work to establish constraint and reference levels that we aren't able to do. We can only set boundaries, and you all have to do the work of getting those exposures down to where they should be for everything to be the way both the NCRP and ICRP want to see the situation.

Some of you also realize the NCRP and the ICRP have been up to their usual devilment. As soon as NRC adopts a new set of recommendations, they find that they are again 15 years late, because the NCRP and ICRP have a new set of recommendations. I guess that's pretty much true throughout the country and I'm sure we'll hear it from our panelists as well. Of course, both of those organizations are merely reacting to the new information that we get from the remarkable studies conducted in Japan on the survivors of the atomic bombings.

Having said that, I think we have a very interesting panel who ought to be able to address a few of these issues. Clearly those recommendations start with a reduced dose limit. I thought that Dr. Cool picked it up pretty well when he pointed out that what we are really after is a lifetime limitation of about 1 Sv or 100 rem. It almost doesn't matter in a real sense in terms of the radiobiology how you do that, although you should keep the dose rate down certainly below 5 or 10 rem per year in order not to exceed the risk estimates that led you to the 100 rem lifetime suggestion in the first place. Given that, we have to look at how that will work. The other aspect of, particularly the ICRP recommendations, is because of the "intolerability of exceeding the dose limits," ICRP has suggested a system of dose constraints. They suggest regulatory authorities should impose dose constraints on various segments of their regulated organizations. This is indeed an optimization (ALARA) step made by the federal agencies as they look at each practice. Perhaps some of our panelists can react to that to some degree.

More importantly, of course, is the idea that everyone needs to understand that the dose limits as they exist are only acceptable because of ALARA. It is the distribution of doses below the dose limit which is so important. Perhaps we need to reflect on that as we look at some of the information that some of our panelists can bring us. The panelists this morning are each going to give us a few minute discussion on these recent recommendations.

Don Cool will decide whether or not he wants to do that, already having had about a half hour of your time earlier today, but he may feel that he needs to defend himself in some way. Don Cool is, of course, the Branch Chief, Radiation Protection Health Effects Branch, Division of Regulatory Applications, the Office Nuclear Regulatory Research. I'd also point out, because I'm a bit parochial, that he's a member of ICRP's Committee 4.

Mary Measures is the Director of the Radiation and Environmental Protection Division, Atomic Energy Control Board of Canada. I suppose a lot of folks don't think Canada is a foreign country, but I'm afraid that it is. I'm sorry about that Mary, but we'll consider you giving us information from another country for this particular talk. It is interesting that, of course, we work very closely. As a matter of fact, the NCRP has often had members of the Canadian organizations on some of our panels.

Christer Viktorsson is the Head of the Department of Nuclear Power Inspections and Emergency Preparedness at the Swedish Radiation Protection Institute. Sweden has had a long history in radiation protection. Actually, the first meeting of the ICRP was held in Stockholm in 1928, and Sweden has been very much in the forefront on the whole question of reducing exposures.

John Schmitt is a Manager of the Nuclear Energy Institute. His name tag actually explains it better as NUMARC. But in the binder you will find that he's under this new name of NEI, the Nuclear Energy Institute. John has been very active at NUMARC bringing the industry people together to look at recommendations as they come, particularly from the NCRP, and the input from them has been helpful.

Jacques Lochard is with the CEPN, I guess probably the interface between the regulators and the operators is sort of an ALARA Center for Europe. Now, I will also be parochial here in that Jacques is a member of the Executive Council on the International Radiation Protection Association, of which I am the current president, and I suppose we should try to tell you that we should all try to get to Vienna, Austria, for our International Congress in 1996.

Frank Rescek is here as defender of the faith, because he's the guy who is on the floor representing the utilities, the users. I have worked with Frank. He's helped me on a committee that's been looking at whether or not it's possible to live with new dose limits, and how we would do it if we had to.

I'd like to invite each of the panelists to give a few minute presentation on behalf of the force behind the things they do, and I'll ask Don if he wants another few minutes.

Cool: You know I can't resist taking one or two, although I don't intend to try and repeat the things that I said earlier, there are several things that we need to keep in mind as we consider changes to regulatory structures changes to operating systems and the other things that go along every time someone suggests that perhaps we're not providing the appropriate level of protection. I want to emphasize "suggests that perhaps we're not providing the appropriate" because the meaning of that particular phrase is truly in the mind of the beholder, and one of the things that we are faced with these days, more than ever before, is a clash between viewpoints of groups, organizations, members of the public, in terms of what is appropriate protection, and what is the way to achieve it. Here we have been talking about ALARA, the ALARA process of reducing exposures below a limit -- the classical radiation protection approach, and Charlie has reemphasized, appropriately, that those limits are an upper boundary, a suggestion of what might just be tolerable or something, and certainly not something that we would want to have over a long period of time. At least in the United States, that philosophical approach is in direct clash with another philosophical approach, which is the establishment of a very low goal, and then seeing how close you can come to achieving it. The typical approach that is used, at least in the United States, in regulating chemicals, regulating other hazardous materials. What you discover is that you have two boundaries. You have a limit on the upper end, you have a goal on the other end, and in the middle you have a process, which is exactly the same process whether you call it by ALARA, whether you call it

achievement of goals or maximum tolerable levels above the goal. It is that same process. So one of the first things we need to consider is the philosophy and then the application of what we are really doing and what we are really about in either one of those philosophies in order to make it work. And that gets me to what I'd emphasized earlier in talking with some of you with regard to public acceptance. Because no matter what we do with the regulations, no matter what we do with our operations, if we do not have some measure of both public understanding and public acceptance of those operations, we would have really failed in the end despite all of our technological achievements. In terms of the impact of the recent recommendations, I would like to note -- I'll do a brief bit of advertising for Charlie here -- out on the table is a copy of a study that Charlie Meinhold did for the Nuclear Regulatory Commission on the "Impact of Reduced Dose Limits." In the U.S. NRC's great acronym vocabulary, it's NUREG/CR-6112. That gives you a lovely little identifier. But as a rather interesting first step in a study which we are pursuing here in the United States, an attempt to try and find out what would be the impact of changing occupational dose limits from the present 5 rem/year, the old system, 50 mSv/year value, to a variety of things, either the 20 mSv/year average, some combination of 50 and a one and/or otherwise averaging as NCRP has suggested. We found a rather disappointing response in terms of people wanting to think about it right now. I think Charlie would testify that he had a terrible time in trying to convince people that they should give him any sort of data. But we found that there is some impact out there, certainly, more with the perceived nature of *complying* with a limit, rather then the reality of being in *compliance* with a limit, and there's a world of difference there, too, between whether or not you are achieving the objective of controlling exposures within a certain criteria which I believe is already the case, clearly demonstrated from the charts that I put up earlier today, versus the feeling that I am sufficiently far below that in terms of my averages that when the NRC inspector shows up at my door that I am comfortable with the fact that he's there and that he's not going to find something and he's not then going to pick on me in some way. So those are some of the issues to start off with. Maybe we'll deal with some of the other ones later as we go through it.

Measures: I think just before I start, I'll mention that I will go through the dose limits, not ALARA. In Canada, we are of the feeling that ALARA isn't something new. It is something that's been part of the regulatory process ever since we started regulating. We maybe didn't have words for it, but it was the way to go. In Canada, it is not something that we add on as a special program, it's part of a good radiation protection program. As far as the new dose limits are concerned, I think ALARA is just part of it, just as it is part of your every day practice. Now what we did do in Canada, was in 1991 we issued a consultative document, C122, which stated the Atomic Energy Control Board's intention to follow to a large extent the recommendations of ICRP-60. One significant difference was we decided that we would probably go directly from 50 mSv/year to 20 mSv/year, without including the 5-year averaging period. However, during the consultation process, we had many comments from industry who found that this would be perhaps a bit too restrictive, not giving them the flexibility they thought they needed. From the nuclear power plants' perspective, they thought that this would be a problem, particularly for special maintenance. For example, in Canada there are problems requiring the change of pressure tubes that have to be pulled and reinserted, and also there are boiler cleaning programs going on. They felt that probably they would not exceed the limit of 20 mSv, but they would like to be able to approach it without worrying about legal consequences should they exceed it. In other words, they didn't want to unnecessarily restrict people from radioactive work. We received the same comments from the mines, because as you are aware, in Canada there are some very high grade ore uranium mines, who were also concerned about limiting to 20 mSv without the 5-year averaging. In fact, they wanted us to go directly to the lifetime limit that Charlie was mentioning before. We have not

agreed to do that, but we have agreed now that we will institute the 5-year averaging. However, that is a little bit late from the nuclear power plants' point of view because the other part of the equation is the unions, and once the unions read C122, which said we weren't going to allow the averaging, they didn't want any part of it. At one power plant utility, the union has said strictly it will not allow above 20 mSv/year. For another one, it is, in fact, part of the collective agreement, that 10 mSv/year will be the dose limit, provided that the collective dose is not increased as a result. So the unions are doing what would be part of the ALARA equation.

Another important area where we are not going to follow ICRP recommendations was for the dose limits that they recommend for pregnant workers. They recommend 2 mSv to the abdomen, plus or and--they don't really qualify if it's a plus or a combining formula--.05 annual limit of intake of any radionuclide. During our consultative process we found that the women across the country were very concerned. One, it's going to be almost impossible to measure and demonstrate compliance with those kind of limits, and especially, there is a concern about loss of employment opportunities for women, especially in nuclear medicine. So we decided in Canada to listen a bit more carefully, and we held a series of meetings across the country. We, in fact, had a series of workshops that we held at seven cities and at one mine site, to get the input from management, from workers, from unions, to see exactly what the concerns were. The overwhelming response was that women are concerned about the loss of job opportunities. They felt that their fetus would be more at risk from their losing the jobs or not getting a high paying job in the first place, then they would from any additional risks from the radiation exposures. They felt that, just as they are allowed to make an informed decision about the safety of their fetus with respect to alcohol and cigarettes, they should be given the information and allowed to make an informed decision on whether or not they would continue to work in a radioactive area. The Atomic Energy Control Board is now looking at some limit above the ICRP recommendation, by which we assume the ICRP means 1 mSv to the fetus, but below our current limit of 10 mSv. We are looking at the number of 4 mSv during the duration of a pregnancy as a dose limit to the fetus. One other topic we considered was hot particles, because of NCRP's recommendations on specific limits for skin dose from hot particles. We had a good look at the problem in Canada, and we came to the conclusion that there just aren't enough hot particle incidences for us to even bother considering that as a regulatory concern, at least not as something that we have to specify in the regulations.

The final point that I would make is with respect to doses to members of the public. We find that ICRP recommendations are a regulator's nightmare with this respect. They started with 5 mSv/year, then they added, well that's OK, provided over your lifetime you don't exceed 1 mSv/year on an average. Then they changed it to, 1 mSv, but it's OK to go up to 5 mSv sometimes. Regulating sometimes is very difficult. Right now they are saying 1 mSv, but you could have a 5-year period of 5 mSv over 5 years under special circumstances. That's not a problem with respect to nuclear power plants in Canada, but it is with respect to children and other relatives of patients in nuclear medicine. ICRP has washed their hands of that saying that's medical exposure. We think that perhaps it is true for adults who could make an informed decision. We're not sure that in the case of children that it would be true. So that's just some of the problems that we are wrestling with at the moment.

Viktorsson: First of all I would like to congratulate our U.S. colleagues for their very nice efforts we have seen this morning concerning dose reduction. I have followed very closely the work done in the United States in recent years and now I think we see the fruits that you can harvest from the very, very hard work that has been done. From the Swedish point of view, we have seen in some plants, rather dramatic increase in the last two years

concerning collective doses. This is, of course, of concern to us, and I totally agree with what Don Cool said that public acceptance is vital for this industry to survive. So we are doing our best to find the means to reduce these doses. Not all these are spelled out in regulations, but in very close discussion with the industry. As you mentioned, Mr. Chairman, we are very close to the ICRP in Sweden, and we have implemented the ICRP-60 in our new regulations from 1994, and some basic elements of those regulations are first of all the ALARA programs, we are now going to emphasize more than we have done before and one particular aspect is the commitment of management. We strongly believe that radiation protection is not an isolated process. It has to be integrated into the overall management of the power plants. We have also in the new regulations issued new dose limits. We are not going to change the annual dose limit, it will still be 50 mSv per calendar year for the individuals. However, we have introduced the ICRP concept of 100 mSv in 5 consecutive years. That will apply from the January 1, 1994. There is also in our regulations that were issued in the late 1980s a lifetime limit of 700 mSv. What we also think is rather important is a sort of ambition level or planning level on collective dose. This was already issued in the 1970s with the 2 person-Sievert per gigawatt installed electricity. In the new regulations we have emphasized this even more, but it must not be interpreted as a limit, it is a sort of planning level for the utilities. But we don't believe only in dose limitations, and as I said earlier, we believe very much in the optimization process and in the ALARA programs, and that should be the sort of focus for our dose reduction efforts.

Schmitt: A change in perspective now as we go to the licensees or the users' portion of the panel. The record of doses in the U.S. commercial nuclear power industry is that occupational workers generally receive less than 2 rem, or 20 mSv/year, a rate similar to the 10 rem in 5 years in the ICRP 60 and less than n rem lifetime where n equals age in years, which is part of the limitation system in NCRP-116. We saw this in the data that was displayed this morning and I think we will see it this morning as the panel and the workshop progresses. Therefore, the risks to workers due to their exposures to radiation in the course of their job is generally equivalent to the risks associated with the ICRP and the NCRP systems of dose limitation. The radiation protection approach in the industry which has produced this risk management is structured like this. Radiation protection programs actively practice ALARA and the programs are designed to assure that regulatory limits are not exceeded. The health physicists responsible for these programs are aware of the NCRP and ICRP recommendations on systems of dose limitation. These recommendations are generally considered in making decisions about the programs. Formal adoption of these recommended systems of limitation would be by way of regulation. In considering whether the current regulation should be changed, the potential benefits, such as risk reduction to individual workers, must be considered relative to potential impacts such as increase in collective doses for the population of workers. This consideration is best done by anticipating the performance to be achieved by programs redesigned to assure regulatory compliance with the changed regulation -- which is different than achieving the objectives without a regulatory mandate. Optimal management of the risk, via operational radiation protection programs, is the principal consideration in looking at whether formal adoption of the recommendations is more appropriate than less formalized recognition. Also, if formal adoption via regulation is selected, the transition would need to be carefully planned and managed to assure that the benefits of current radiation protection programs are preserved and the enhancements sought are fully realized.

Lochard: As Charlie said in his introduction, I am working in between regulation and operators and I will try to reflect a little bit on the topic of dose limitation from the two perspectives. From the regulatory point of view, we are in France at the moment in the middle of the

discussion about the adoption of the new Directives of the Commission of the European Community, and there are some interesting elements to mention at this level. First, there is a unanimity in France to adopt the ICRP system as it is proposed in publication 60. There is, of course, an ongoing discussion about how to apply the flexibility, in practice, with respect to the 100 mSv in 5 years. From the operational point of view there is no real technical difficulty and there is a consensus about the way to proceed. The main difficulty is related to the question of the confidentiality of the information about individual doses. A point on which we also have discussions is the problem of the role of dose constraints, specifically their regulatory status. I think there is also a majority to say that dose constraints could be a good tool to force people to think more in terms of ALARA, but also that dose constraints, if they have to be operational, should remain a matter for operators. This is the situation at the regulatory level. From the practical point of view, I think you probably know, that after a long period of hesitation, to say the least, France has jumped into the ALARA culture two years ago with the leading role of EdF. Now there are a lot of ALARA programs in power stations and we already are seeing very good results. I think this will be shown by different speakers during the week. We had an increasing trend in collective exposure per reactor over the last ten years and since the ALARA programs have been set up we now have a clear reduction. But we have also to be aware that this effort is mainly done in the nuclear industry at the moment, and that in the medical as well as in the conventional industry fields we are far from these good results. Just to finish, I'd like to come back to one point mentioned by Don Cool in his introductory paper this morning about the crucial need to pass the ALARA message to the public. Beyond the technical aspects that will be discussed the during the week, we have to be aware there is a philosophy of how to deal with residual risks in our society. I think we have to give this message to the people, especially with all the implications from the economical point of view, but also from the ethical point of view.

Rescek: I support the views and position expressed by John Schmitt. I believe that Commonwealth Edison, specifically, and the U.S. nuclear utilities, generally, are keeping individual doses ALARA and well below the regulatory limit of 5 rem/yr. Commonwealth Edison owns and operates twelve reactors (three two-unit BWR sites and three two-unit PWR sites). The 1993 year-end dose summary for all commonwealth Edison plants is shown in overhead #1. Note that there were 57 ComEd employees and 221 contractors who received greater than 2 rem last year. Furthermore, no Edison employees and only 18 contractors received greater than 3 rem. No one exceeded 4 rem in 1993. In contrast, overheads #2 and #3 show Edison employees and contractors dose summaries for the five-year periods 1989-1993 and 1984-1988. Only one Edison employee received greater than 10 rem total (average of 2 rem/year), but less than 15 rem total (average of 2.5 rem/year), in the last five-year period. Similarly, there were only 12 contractors who received greater than 10 rem total (average 2 rem/year) for the five-year periods 1989-93 at Commonwealth Edison facilities. For comparison purposes, although a fair number of Edison employees and contractors receive greater than 2 rem in 1993, only a very small number of individuals received more than 10 rem total (average 2 rem/year) over the last five years. Thus, our experience shows that having the flexibility to permit workers to receive greater than 2 rem in any one year does not hinder our ability to control individual lifetime doses. For example, ComEd plants are on 18-month refuel cycles. Consequently, one year out of three, each of our two-unit sites will have two refuel outages. during the years a site has two refuel outages, it would be very difficult to comply with a 2 rem/yr limit. Recently, ComEd reduced its administrative dose control level from 3.5 rem/yr to 3.0 rem/yr. Our analysis shows that this change would impact 33 contractor workers at a cost on the order of $200,000 to $700,000. It's important to note that this is an administrative control level and we have the flexibility to permit workers to exceed the 3 rem for critical situations with appropriate approvals. Similarly, I believe

most utilities have set administrative controls well below 5 rem/yr to keep individual doses ALARA. Finally, my last overhead shows data on transient worker doses which I obtained from INDEX. INDEX, for those of you who are not familiar with it, is the integrated nuclear data exchange program. I believe there are 18 utilities representing 33 reactor sites and 60,000 total transient employees in the INDEX data base. For 1993 there were approximately 516 individuals who received greater than 2 rem and another 1,812 who received doses between 1-2 rem. If a 2 rem/yr regulatory limit were promulgated, then the industry would establish administrative levels on the order of 1.5 rem/yr to ensure compliance. Hence, the number of people impacted based on the INDEX data would likely be in excess of 1,000. Assuming INDEX represents about one-third to one-half of the total number of transient workers in the U.S., the total number of workers impacted and the total cost would be substantial.

Meinhold: Our panelists have set the stage for a discussion on the potential impacts of these new recommendations, and since this supposed to be a panel discussion, it is open for questions and comments. Please go to the microphone and identify yourself before asking your question. While you are all thinking up your questions, perhaps I can make a few comments. Some of the data that John and Frank talked about clearly demonstrates that they are doing a good job in terms of controlling the average dose to worker, but as ICRP laid out its rationale, the problem is that the "average" person is not the person we are concerned about when we set a limit. We made that mistake in 1977 when we justified our dose limit on the basis of an average, but in the Publication 60 and in NCRP's Publication 116, we're only talking about that very rare individual for whom the dose limit is acceptable based on a comparison for people whose jobs put them at the top end of safe industry (deep sea fisherman, etc.) ICRP said that there is an upper level of risk that people will tolerate, which is about 1 death per thousand workers per year. It is this criteria which applies to Rescek's 1,812 workers. It is the distribution below the limit that is truly an ALARA issue, and I can assure you even further that neither ICRP or NCRP could have adopted their dose limits if they thought that they were going to be the basis for controlling exposure. That's not the purpose of the dose limits and I think it is important to clear up any confusion. The limits are only a boundary condition for those who might be at the highest end of that risk level and not something which drives the average. I think it's clear that the ALARA and the dose minimization programs at the power plants drive the average down and have to continue to do that. So if any of the panelists would like to react to that, I'd be happy to respond.

Rescek: The number of individuals in the nuclear industry who tend to receive annual doses near the limit can be inferred from the data shown previously in Don Cool's graph. His graph showed that for the early 1980s, approximately 700 to 800 workers received greater than 10 rem in five years. However, in the last five years, Don's graph showed that the number had fallen to only 150 workers. Clearly the industry has improved its performance in lower individual doses since the ICRP and NCRP made their recommendations on controlling lifetime dose. I believe that the number of workers who exceed 10 rem in five years will continue to be reduced without reducing the 5 rem/yr limit. Furthermore, I strongly believe that we need to protect the lifetime risk to all workers, and the best way to achieve this is by establishing a separate lifetime dose limit consistent with the NCRP recommendations, including the grandfathering criteria for people who already exceed the lifetime limit.

Meinhold: Are there any questions?

Unidentified: This is more of a comment than a question. One of the things you talk about is that there are only 150 people at this point in time that are greater than 10 in 5. However, I don't know what the rest of the utilities are doing, but in our utility we are getting into a lot of

pressure to reduce the crew sizes to perform certain tasks. By reducing the crew sizes, without reducing the dose that it takes to perform the job, you are actually increasing the exposure for each individual on that job. So with that in mind, if that is what is going on in industry, and I expect that it is with cost control measures, I think we may even see an increase in the number of people that are greater than 10 in 5. It's one other variable out there. I was reading through the NUREG report that you are talking about and what they said is that at 2 rem that is considered a safe industry, whatever that means, because even a safe industry is being redefined now as we talk about this. Safe industries are getting safer. On the upper end of the scale they say that the risk assessment is equal to that of a miner or deep-sea diver. Now in all these other safe industries, I would venture to say that they have people that work within their industry that it is publicly acceptable for them to take on riskier jobs. As a matter of fact, at the power plant, we have divers. Bringing a diver into the spent fuel pool reactor cavity is a little bit more risk that my sitting at a desk figuring out how much exposure he is receiving, but that is acceptable because of the fact that he is a diver. So one of the things that I would like to address, and this links back to Mr. Cool's comment about public education, is that it seems to me that it would be a lot more reasonable since we have a relatively small portion of people that are in the so-called high-risk category up with the deep-sea divers, that you would be better served if you would take all the money that we spent to try to get these few people less than 10 in 5, and take those resources and put them into educating the public to explain to them why it is OK to have people within the nuclear power industry have the same risk as a deep-sea diver or miner.

Measures: I would like to comment on that, especially with respect to the miners, it is an added problem where you have the miner worrying about a rock falling on his head, plus the radiation exposure. I think that when we are dealing with miners we have to add in all of these things so that we are looking at the total risk to the worker and not just one of the compartments. I think it is very important to not forget that these other risks are there.

Aldridge: I work for Westinghouse Hanford Company in Richland, Washington. I work for the DOD, I'm not in commercial nuclear power environment, but I would like to make a comment and ask you a question. In 1990 we reduced our administrative levels to 2 rem/year. We did a data search in internal dosimetry on all of the individuals that would be impacted. We also initiated at that time a 1 rem x age lifetime limit. We had 50 individuals out of roughly 1,200 employees that we had to take a serious look at their lifetime dose. We also had 3 individuals who exceeded the 2 rem/year due to old, internal deposition and exceeded, one in particular, his lifetime dose. The point I want to make is that we need to educate the public, but we also need to consider educating the worker. For years and years we have told these workers that the limits were fine, you were safe, everything was in control, they were not to worry. As health professionals we gave them this message. Then all of a sudden we impacted the workers, 50 individuals. A small amount of the total work force, but those individuals talked to other individuals and sometimes you can have problems in that area, particularly in the case of the three workers that were restricted. They can no longer work with radiation. They can no longer pursue their livelihood. One individual was only 32 years old. That is a very, very difficult situation to go through. That is my comment. I would like to ask a question of Frank Rescek. You said that you are under the legal limit right now of 2 rem/year? You are under that or you will be shortly?

Rescek: We have an administrative control level of 3 rem/year, not 2, at this time.

Aldridge: I thought I had heard you say you were going to 2 rem per year and then you were going to look at 1 and 1.5. We do currently have .5, 1 rem, 1.5 and 2 rem, and each one of those levels requires management signatures until the individual reaches two rem per year

and then they can no longer work. So I guess I misunderstood that.

Rescek: To clarify that again, we have an administrative control level of 3 rem/year at which point to exceed that you need the station manager's approval. The number of exceptions is very rare, but the approval process to go above 3 rem on a rare case-by-case basis is available, if justified.

Schmitt: As we have heard, and as you alluded to in the question and comment, how we broach the subject of ALARA and how we manage it as we talk to the public is very important, but often we think of the public as those people outside our fence. I think we've got an important public in our workers and we really need to address them. We have to carefully consider what we are doing as we look at potentially lowering the limits. If we practice the recommendations and use it to help us by our administrative means to get the doses and the risks down to individuals it is very beneficial. If we also do that via regulation, where we say now it is not longer acceptable to this government agency or anywhere in this country, or whatever, to allow people to receive doses greater than this number or these numbers, this system of numbers, the we create perceptions among whoever is affected by those limits, any public, including our workers. There are all those social perceptions and perceptions about whether or not they have been protected in the past. Have they been safe? Will they continue to be safe in the future? How about their employability? How about their expectations, their families' expectations about their health in the future, those kinds of things, as well as the potential for litigation. The people may think that because we have now discovered some new level of risk that we haven't been protecting them and maybe they ought to come at us through litigations. There are also perceptions set up which could be dangerous and damaging to the licensees who have been protecting these people in the past, but who may be perceived as not having been providing them with an adequate level of protection. I think that needs to be carefully looked at as we formalize these recommendations.

Vikorsson: This adds on to what Mr. Schmitt said. I totally agree, lowering the dose limits causes concern among workers, particularly, because they are going to ask themselves or us, have we been protected before or not? So we have had several discussions with contractors for example and they have these types of concerns. I think when you issue a new regulation they have to be accompanied with appropriate information, proper education programs, trainings, etc. Therefore, in Sweden we have asked the utilities to put more emphasis on training and on education of the workers.

Lochard: I'd like to speak on this topic because I think it's a crucial point when we discuss limits. Each time there were changes in the past with dose limits, it has been seen as a catastrophe by the industry in the beginning, just because there were these sort of considerations saying that limit is something like above the limit isn't safe and below the limit is safe. But, in fact, if you read carefully what has been written by ICRP, it has never been presented like this. What has been said all the time is that the limit is the upper bound of what is tolerable in the present vocabulary, and I think this is what we have to emphasize when we speak about education of the public or of workers. There are two different problems with radiological protection. One side is the problem of deterministic effects and in this case it is a matter of respecting some thresholds. It is safe under, it is unsafe as you go away from this threshold. As far as stochastic effects are concerned, this is just a matter of tolerability of risk and what society at a certain point in its development is able to cope with. What we have to tell people about this idea of residual risk is that we are all living every day with a set of residual risks. When we go to work every day there is a specific residual risk. Whether or not this risk is founded on scientific evidence is another business. This is the problem we have about the impact on low doses. Taking into account the doubt about the existence of a threshold for stochastic

effects, we have assumed prudently that we do as if there was no threshold, and based on this assumption, we have to educate the public on the fact that we are living with a residual risk. When this is understood, a change in limit will not be seen as a catastrophe, but a general improvement in protection because societies are getting more resources and are able to reduce further residual levels of risk. I think this is a very important point in terms of the message to the public but also for the workers and we will not be confronted anymore with this type of attitude: don't change the limit because you are going to put panic among the workers. On the contrary, if you change the limit it's a very good sign. We've made a lot of progress. It's something like ALARA I think.

Meinhold: If I let the discussion continue, we will never be able to accept another question. We'll take the next question and return to this issue if we can.

Westbrook: I am from Oak Ridge National Laboratory, and Theresa Aldridge, who just asked that question, is one of my colleagues in the DOE system, and I would kind of like to know why some rems are more equal than other rems. Notably, Department of Energy rems and NRC rems. We, like Theresa's Westinghouse Hanford, some years ago after my former boss went to the previous Brookhaven ALARA conference and got all inspired, we went to the 1 x age limitation and we instituted a series of administrative goals. We, too, have had some workers confused by what was safe and what was not, but we mostly have been able to iron that out and educate the workers on it. We still have questions raised, but we are doing OK. We thought we were being very proactive to do that but the DOE has gotten the wind up and they have instituted through the Radiological Control Manual a de facto limit for Department of Energy facilities including all contractors and subcontractors, of 2 rem/year. In order for any worker at any DOE facility to exceed the 2 rem/year, application has to be made in writing to a program secretary, of whatever DOE program it happens to be, in Washington, D.C. Can you imagine, if you people at the utilities had to apply in writing, to say, Dr. Cool over there, for permission to give a worker over 2 rem. Even 10 mrem over 2 rem, if you thought he was going to get over 2 rem, you would have to apply in writing and wait and wait until Washington got back to you on that. I would like to know why some rems are more equal than others, considering the DOE system as a whole has a much lower dose curve than the NRC, why is that Dr. Cool? And the reason I'm asking you is a lot of the time when we ask questions of the DOE, they will say things like "Well we are doing in our new 10 CFR 835, which is sort of the analog of 10 CFR 20, we have certain provisions in here," and I'll say to the DOE folks, "Why is that in there?" And they will say, "Well that's the way the NRC does it." "Well how come that's in there." "Well that's in NCRP 60." Yet they have declined to adopt 10 CFR 20 in toto. The federal agencies have all declined to adopt ICRP 60. They take a "cafeteria" approach to 10 CFR 20 and to ICRP 60. What they like, they adopt and write into law, and what they don't, they sweep under the rug. So we have this regulatory inconsistency. Perhaps you would like to comment on that since the NRC seems to be the lead regulatory protection agency.

Meinhold: I want to hear this answer, too.

Cool: So do I. I think in essence what you have identified is the heart and soul of most of the discussion that we've had around here, which is the whole problem of establishing a limit and the legalities that go along any time you draw a line anyplace. Be that at 20 mSv, be it at 50 mSv, be it at 5 years with 100 mSv -- no matter where you draw a line you have then arbitrarily, but perhaps not capriciously, but certainly arbitrarily said that anything less than that can be treated in one way, and anything greater than that can be treated in a different way. Although if we assume for the moment that we really do believe in the linear nonthreshold hypothesis for purposes of laying this out, 20 mSv vs. 20.01 mSv only changed the incremental risk to that individual by some very small 10 to the minus, some

number down there. Nevertheless, you have that problem within the regulatory schemes of things where we have decided for legal purposes, for control purposes, or whatever that might be, that there needs to be some framework laid out to provide some boundaries and that really gets to the biggest difficulty that I see in moving to things like the publication 60 or the NCRP publication 116 sorts of values, is the tradeoff between what would be a better system in terms of flexibility and perhaps a system which would more clearly recognize radiobiological realities vs. a legal system, which certainly the U.S. and the DOE and NRC live under, has gotten tremendously litigious, that we just wait for the next suit to come around the corner, we have our probability of causation tables, which are constantly changing, and how to try and provide enough flexibility so that the difference between 2 rem and 2.01 rem is recognized from its radiological standpoint perhaps separately from its legal standpoint in defining good practice. Because in the end that's really what we want to do. We want to define and carry out good practice, and ideally we would do that and we would never actually bump against the legal requirements. The short answer to your question, why are rems different? Because we had to draw a line in the sand. I don't like it either.

Meinhold: I think also one of the answers to this, of course, is that EPA has the overall responsibility for coordinating this and NRC is merely reacting to the 1987 guidance of the EPA. He doesn't like to hear that, but EPA hasn't even reviewed the ICRP or the NRCP 116 in a formal way. Now the difference between DOE and NRC is between the owner and the renter. The NRC has got licensees and all of the legal constraints that are involved in their putting more constraints on the licensees. The only interrelationship they have is the regulation. The DOE owns its facilities. It pays for the operation and can set up any rules it wants and if they react to the new data in a way that is more conservative or more up-to-date, if you like to use those words, that's something they have to understand that they are doing in terms of the additional costs and additional concern that it raises. But I think there's no inherent reason that they can't do that as anybody else. As a matter of fact the NCRP always expects individuals to look at our recommendations even more than the federal agencies because we like to have people thinking about them within 3 or 4 or 5 years after new risk information becomes available, and the federal agencies can't do it for 10 or 12. So we still think people ought to look at it and think what they should be doing now.

Cybul: I guess in listening to all the rhetoric going on, and listening to John Schmitt and his concern about expanding the normal number of people who get dose if we limit the amount of dose any one person gets, the question I have to ask the scientific community is why aren't we dealing with the total lifetime dose as the primary upper limit, the value you alluded would be 100 rem isn't the right answer. If you take 2 rem per year, and I assume most workers work 40 years in their lives, I would get 80 rem, if I take your age in rem NCRP I'll get 60 rem. So we've got three numbers here already. Why don't we come up with a reasonable risk based on a total lifetime dose and let the regulation be loose enough so that the people that have to live with them can work within a fairly good flexibility and manage their resources so that they don't exceed that total outer boundary.

Meinhold: I could react just briefly. One of the things that regulators have to worry about, and even the NCRP and ICRP, is a problem of exploitation. That is if I've just got a lifetime limit, say its a Sievert, 100 rem, how do I ensure that it's not being used by an unscrupulous person to deliver 25 rem in a year in order to get that job done faster and use him up, basically. So that's one of the reasons that there is some moderation in the way that it's delivered. The other side, of course, is that 100 rem delivered in increments at higher than 20 mSv a shot, has a different risk associated with it, about a factor of two high. We'd have to keep you below 200 mSv a year anyhow.

Cybul: My point was that we've got some reasonable regulatory limits now which address those issues. Let's just put a top cap on it and not fool around with changing any more regulations.

Meinhold: I guess you are preaching to the choir. Any comments?

Cool: You've certainly identified one of the possibilities and I will add to what Charlie Meinhold has already put out, a couple of perspectives which are probably unique to the regulator. One, of course, is the span over which you think you can exercise some sort of control. A year isn't too bad, most of us are still around next year. Five years perhaps gets a little more difficult because there's a greater turnover. As you start to expand out the time frame over which you will allow people to look at things, you begin to have a greater, uncertainty perhaps isn't the right word, but I will use it anyway, a greater uncertainty in terms of being able to keep track of it, know what has been achieved, deal with responding to changes. We are talking about a lifetime. We are talking about working 40 years or so. We're talking about looking at a sphere of control which is as long as our entire dealings in the modern area with radiation have been up until this point. And you look at the tremendous changes there and it leads you to some measure of uncertainty as to whether or not we can really do that. The other one comes to the point which Charlie had, which was simply the recording, reporting, tracking systems and the use of materials over the longer period of time where compliance gets to be extremely difficult. Up to now we have operated under a system where licensees, at least NRC licensees, had the primary responsibility for controls. We don't go to control of individuals. If you go to lifetime limits, you go to some of these averagings. That means you would have to change your sphere of control from a licensee and the focus on a licensee program to the individuals and that drastically changes, I'll suggest to you, the way in which you'll have to do business.

Meinhold: Except they use form 4 to do that now.

Measures: I'll just make a comment from a Canadian perspective. One, following the tracking isn't a problem because we have a National Dose Register, and everyone has an entry in the National Dose Registry which is one of the few times you can use the social insurance number as a linkage. So that isn't a problem, but it is a problem with some of the small licensees. The Industrial Radiographers, as Charlie was mentioning, like to dose people up and then put somebody else in, so that you have someone who quickly uses up their dose and is then unemployable. We find with the major utilities we don't expect that would be a problem because they seem to be very, very reliable and good corporate citizens. In fact, in Canada we have a much looser approach in that we don't have nearly the regulatory guides that you have in the United States. The licensee tells us how he is going to keep the doses ALARA and we review it, rather than we tell him how he has to do it, so it's a different approach.

Rescek: I believe the utility industry has good record keeping systems and can track lifetime dose. At Commonwealth Edison, we do this now and we have a separate annual administrative control level of 1 rem for Edison employees with high lifetime dose.

Borst: I work for Entergy Operations. We are the operating company for Grand Gulf, Waterford 3, River Bend, and the Arkansas Nuclear 1 Stations. We've got a fair number of employees. The question here from ANI landed on my desk last Monday, and I've been praying for this opportunity to let you all have it. And your original landed on my desk until Tuesday, so that's why it didn't get back to you. Mr. Viktorrson brought up a good point about conveying this new message to the worker about we've been protected before, what's the new limit now, why, is the lower limit safer? Where at the same time in

the U.S. we've gone to the opposite extreme by telling them that now we're going to assign you 50 rem this year but it's OK because it's not really there or now we're going to assign you 50 rem to the skin or to an extremity or something like that. So we're going through that culture shift and if we try to do another culture shift from 5 rem down to 2 rem that will be another philosophy burden on them in that aspect Mr. Rescek brought out a good point that I figured out early on that the operational flexibility is really key to what the utilities need in all of this. The utilities could live with a 2 rem limit tomorrow by simply hiring more contractors and we could go from there. He showed on the slides the number of utility workers exceeding those limits now is extremely low, and we can get below that by simply adding extra contractor workers to take up that dose. I would like to urge any contractors in here to comment on this CR 6112 through NEI because I think it's the contractors who are going to be the key to whether this whole thing works or not. So I would like the contractors to do something to get their input into here. Three questions I had and you can answer any or all of them: Does our panel have any thought or insight on whether these new limits and ALARA incorporated into 10 CFR 20 will affect litigation in the future. Up until this point I know the other countries don't have the burden of litigation that the U.S. has, up until this point the bedrock of all of our defenses in the litigation cases has been that we have kept exposures below the legal limit. Do they think this new limit would have any bearing on how that proceeds. Secondly, of the 400 and something people who exceeded 2 rem based on the 1992 0714 report, if we turn those 400 people into 400 plant special exposures, how would the NRC view that. That's a possibility. Right now, I can't speak for the entire industry but I think a lot of plants are not planning on using PSEs very much at all, but with a 2 rem limit we may need to invoke that. I'd like to know the NRC's perspective to that. Thirdly, Ms. Measures brought up an interesting point I hadn't thought about, is this reduction from 5 rem to 2 rem, is that detrimental risk of a person losing his job less important than a reduction in a potential, theoretical cancer fatality?

Meinhold: We're running late so let's have short answers.

Cool: I think he gave me all three, and I'll try to deal with those really quickly. Will the new limits affect litigation? That's a very good question that I do not have the answer for right now, of course. History in the legal system would seem to indicate that it certainly may be used as a challenge. What the courts in their infinite wisdom determine after all that has been laid out is something I don't really want to speculate on as to which way they will come out because one of the things that the courts have proven is that they are not predictable. The second one with regard to how the NRC would view taking the 400+ and turning them into PSEs -- not very well. Because we also look at those as being very limited sort of uses, and you have to be aware that ICRP took that concept back out when it published publication 60. I would hope that would not become a routine way of getting around the flexibility, that there would be other approaches that could be taken and in terms of whether the risk reduction of going from 5 to 2 is sufficient when you balance it off the risk of losing a job, that is also a real good question and brings to the front one of the trade offs we haven't talked about very much which is immediate risk vs. long-term risk, and I'm not at all convinced how that would balance out either.

Schmitt: Let me try several of those. The history has been that the legal limit is regulation generally in the court. Now this is not predictable with great certainty, but generally it has been accepted that the legal limit is what is the legal duty owed. It is what the limit is in the regulation and not ALARA. That is an important point because if the legal duty owed becomes ALARA you can have an awfully hard time defending what you've done and you're at great risk. But I think the point that goes with this question is that there is a very large difference between whether these systems of limitations recommended by the bodies, there's a very big difference on whether they remain recommendations or whether

they become the regulatory limits. A big difference -- they are both in perception, and I think when you go to the legal arena. On planned special exposures, etc., I think it's important in regulation where you've got the "you can do this" and "you can't do that" to maintain flexibility for limited situations. It's similar in my mind to the grandfathering provisions that were written into the NCRP situation. You use these under special limited circumstances in order to help better manage the overall risk situation and I think from that perspective they are beneficial. They have to be carefully used, however. On the question of whether we will increase the risk, I agree with Don, it's a needed tradeoff that needs to be carefully considered as we determine whether these should become regulation or not.

Meinhold: We are just about out of time, and I want to thank the panel very much. I thought it was a very valuable contribution.

Baum: I'd also like to thank the panel. It was very interesting.